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THE OXFAM/WORLD NEIGHBORS HOUSING RECONSTRUCTION PROGRAM:

GUATEMALA

1976 - 1977

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(A review by the staff and consultants of the program, made possible by a grant from OXFAM-America)

The following material is a compilation of the key volumes of a report regarding the activities of the OXFAM/World Neighbors Housing Reconstruction Program in Guatemala following the earthquakes of February 1976.

PART I: Report on the OXFAM/World Neighbors Housing Reconstruction Program Following the Earthquakes of February 1976 in Guatemala

PART II: Evaluation of the Activities of the OXFAM/World Neighbors Post-Disaster Housing Program, Guatemala: February 1976 - March 1977

PART III: Training Aids Developed by the Education Office of Programa Kuchuba'l

INTERTECT
P.O. Box 10502
Dallas, Texas 75207

OXFAM-America
302 Columbus Avenue
Boston, Massachusetts 02116

REPORT ON THE OXFAM/WORLD NEIGHBORS HOUSING RECONSTRUCTION PROGRAM FOLLOWING THE EARTHQUAKES OF FEBRUARY 1976 IN GUATEMALA

INTRODUCTION

The following report is a detailed discussion of the OXFAM/World Neighbors housing reconstruction program in Guatemala which began immediately following the earthquakes of February, 1976, and which is scheduled to continue in operation until mid-1978. The purpose of this report is to provide extensive information as to the objectives, goals, and priorities of the program, set against the background of the situation immediately following the disaster and the context of the reconstruction program as part of the development process which OXFAM and World Neighbors are trying to encourage in the Central Highlands region of Guatemala.

It is important that this program, especially, be documented among the many others in Guatemala, as it has had wide-ranging effects on many of the other programs of the voluntary agencies and of the government itself. In many respects, the OXFAM/World Neighbors housing program has been a pace-setter, a program which has led the way in the development of materials, the introduction of new housing concepts, and the presentation of a major alternative to the traditional types of aid usually provided by external agencies. The program is also unique in that it not only concentrates its efforts on having an impact on the people within its assigned area, but also concentrates on trying to influence other voluntary agencies working within the country and the government. It has been estimated that no fewer than twenty different relief organizations have attended special classes set up by Program Kuchuba'l; no fewer than fourteen agencies have used its training materials in their programs; and no fewer than seven agencies have adopted one or more components of the OXFAM/World Neighbors program to copy, virtually as is, in their own area.

Programa Kuchuba'l has drawn widespread acclaim and not a few criticisms in the course of its one year of operation. The purpose of this report is to document each of the various aspects of the program, tell why it was developed, how it evolved, to estimate the end result and its impact on the people for whom it was intended.

The report is divided into four volumes. The first is a description of the program as it was originally set out with commentaries added by the staff and consultants on how things actually worked out. Every part of the program is mentioned to show the reader the wide range of activities, programs, and schemes that can come into play when a voluntary agency puts together a housing program after a disaster.

The second volume is a study commissioned by the consultant to evaluate the performance of the program after one year of activities. It is included in its entirety without comment.

The third and fourth volumes are supporting data about, or produced by, Programa Kuchuba'l. Volume III, which presents the training aids produced by the Education Office, will be of special interest.

Volume V is a study conducted in March and April of 1976 of the housing reconstruction program of other agencies operating in Guatemala after the earthquake. It summarizes the activities and goals of each and includes an early description of Programa Kuchuba'l. The authors of this volume also conducted the evaluation in Volume II.

INTRODUCTION

The following report is a detailed discussion of the OXFAM/World Neighbors housing reconstruction program in Guatemala which [illegible] immediately following the earthquake of February, 1976, and which is scheduled to [illegible] until mid 1978. The purpose of this report is to provide interesting information as to the objectives, goals and activities of the program, and to examine the background of the situation immediately following the disaster and the [illegible] of the reconstruction program [illegible] in the [illegible] Altiplano region of Guatemala.

It is important that this program, especially, be documented among the many efforts in Guatemala, as it has had wide-ranging effects on many of the other programs of the voluntary agencies and of the government. Certainly in many respects, the OXFAM/World Neighbors housing program has been a pioneer, a program which has led the way in the development of new methods, the introduction of new housing concepts, and the presentation of a major alternative to the [illegible] provided by [illegible] agencies. The program is also unique in that it has not only [illegible] to make an impact on the people [illegible] but in trying to influence other voluntary agencies operating within the country and the government. It can also be indicated that [illegible] housing programs [illegible] by Programa Kuchuba'l; no fewer than four other agencies have used its training materials in their programs; and no fewer than seven agencies have adopted the main components of the OXFAM/World Neighbors program as their own, virtually [illegible] in their own area.

Programa Kuchuba'l has drawn widespread praise and not a few criticisms in the course of its two years of operation. The purpose of this report is to document some of the various aspects of the program, tell how it was developed, how it evolved, [illegible] and its impact on the people for whom it was intended.

The report is divided into four volumes. The first is a description of the program's evolution [illegible] with commentaries [illegible] how things actually worked out. Every part of the program is mentioned to show the [illegible] that can come into play when a voluntary agency gets involved in a housing program after a disaster.

The second volume is a study commissioned by the consultant to evaluate the performance of the [illegible] year of activities. It is [illegible] in its entirety with [illegible] changes.

The third and fourth volumes [illegible] as produced by Programa Kuchuba'l. Volume III, which presents the training [illegible] by the Education Division, will be of special interest.

Volume V is a survey conducted in March and April of 1978 of the housing reconstruction programs of other agencies operating in Guatemala after the earthquake. It summarizes the activities and goals of each and includes an early description of Programa Kuchuba'l. The authors of this volume also conducted the evaluation in Volume II.

I. DESCRIPTION OF THE PROGRAM

A. Background

Description of the Area:

The earthquakes of February 4, 1976, covered a wide area of Guatemala. The area in which the destruction was greatest was in the upper highlands region of the central portion of Guatemala. The hardest hit area was bounded by Guatemala City, Rabinal, Joyabaj, and Tecpán. In the center of this area lie the municipios (municipal districts) of San Martín Jilotepeque, Santa Apolonia, Chimaltenango, Tecpán, and San José Poaquil. Within these municipios, the government estimates that approximately 90% of the structures were either totally destroyed or substantially damaged.

The population of this area is predominantly made up of Cakchiquel-speaking Indians who live in both the towns (pueblos)or in the rural villages known generally as aldeas. The area is very heavily populated for a rural area in Central America; it has been estimated that this region is one of the densest in all of Latin America.

The farmers in the area have led a marginal existence, with many of the people leaving annually to go to the coast to help harvest coffees, cotton, sugar cane, and other major cash crops on the large estates (fincas) which lie on the coastal plains south of the mountains. The main crops in the area are corn and wheat, and only recently have improvements in the agricultural system been introduced which have allowed the farmers to realize greater returns and a gradual improvement in the standard of living. Even with these changes, however, it is still a marginal existence; and before the earthquake, a delicate balance between gradual economic improvement and possible economic disaster was only slowly tilting in favor of the former.

Principal Organizations and their Interrelationships:

Prior to the earthquake, there were a limited number of organizations working actively in this area, mainly in the field of economic and agricultural development. One of these organizations, World Neighbors, has been working for thirteen years, helping to strengthen cooperatives and training local extensionists to work with the farmers and their families to bring improvements to the agriculture of the area, and teaching better nutrition and health practices in the villages. At the time of the earthquake, World Neighbors was admistering two development programs in the area. One covered the municipio of San Martín Jilotepeque (with thirteen paid staff and about fifty volunteer extensionists), and the other centered in Tecpán and covered the municipios of Tecpán, Santa Apolonia, and San José Poaquil (with a paid staff of six and twenty-five volunteer extension workers). World Neighbors was also assisting the El Quetzal Agricultural Co-op and the Kato-Ki Savings and Loan Co-op. The Kato-Ki Savings and Loan Co-op that World Neighbors had helped to establish had offices in most of the pueblos of the area and members in almost all of the aldeas in the region. Recent improvements in agriculture enabled many of the members to begin small savings accounts with the co-op. The World Neighbors programs encouraged this saving as a means of self-reliance and as "insurance" against a future possible disaster, although at the time, it was considered that an economic disaster (such as a crop failure or an illness or death in the family) would be far more likely than the earthquake.

Some of World Neighbors' activities in the Department of Chimaltenango at the time of the earthquake were supported by OXFAM, which is a British organization with independent affiliates in Canada, Belgium, and the United States. OXFAM is not an "operational" agency; rather, it funds projects in the development field. Unlike World Neighbors, however, they have been active in numerous relief operations in many developing countries, including recent operations in Managua and Brazil. The Field Director, Reggie Norton, had served as a Field Representative in Managua following the earthquake there in December of 1972. OXFAM's role in Guatemala prior to the earthquake had, however, been strictly one of funding projects submitted by organizations such as World Neighbors.

To summarize, the interrelationship of the organizations at the time of the earthquake was as follows: The Quetzal and the Kato-Ki Cooperatives were principally supported by the members of the co-ops themselves, plus organizational, technical, and funding assistance from World Neighbors. World Neighbors was administering two integrated development projects, one of which, the San Martin Project, received its funding from OXFAM.

B. Immediate Post-Disaster Activities of OXFAM/World Neighbors

It is important to note that, despite the fact that the housing program became the largest component of the OXFAM/World Neighbors post-disaster response, it was by no means the first (or an original priority) activity of the organizations. Immediately following the earthquake, the co-ops became the very first of the local organizations to respond to the people's needs. The members worked to help rescue other villagers, establish communications, conduct damage surveys; and they met with as many people as possible to determine what the initial priorities were. These were transmitted to the staff of World Neighbors who, in turn, passed them on to OXFAM. An emergency distribution program of blankets and medical aid was initiated. (It is interesting to note that this program set the tone for many of the future activities, in that none of the aid was imported; everything was purchased within the country of Guatemala.) The major activities of the first few days revolved around the need to set up a distribution system. The organizations who could best handle this were the World Neighbors projects which were already back in operation. The initial success of the distribution program proved to the supporting organizations (OXFAM and World Neighbors) that it was possible to carry on larger distribution and marketing schemes of construction materials when the question arose in the following weeks.

By the end of the first week, the major leaders of the cooperatives and World Neighbors programs had had time to meet with people in the various villages and had begun to collect a list of priorities. During the second week following the quake, they met with the Field Representatives of the OXFAM/World Neighbors team and presented a list of requests for assistance. At the meeting, the requests made by the co-ops and extensionists were discussed and debated. Many of the items requested by the co-op were rejected immediately (such as a request for six heavy-duty agricultural tractors) as being impractical or not related to immediate relief, as opposed to reconstruction or development, needs. Finally, three main priority areas were delineated:

1. <u>A request for financial assistance to obtain small silos to protect the grains which had been left exposed by the earthquake.</u> In Guatemala, farmers traditionally stored their corn and wheat in one room of their house. When the house was destroyed by the quake, it left much of the crop covered by the rubble and large portions of it exposed to the elements. Therefore, they wanted a place to store the corn and protect it.

2. <u>The re-establishment of the markets.</u> The farmers knew that whatever aid was coming from the outside would not be enough to provide all the needed money for reconstruction. They knew that they must rely on their own resources, and this meant having a market in which they could sell their grains. To complicate the problem of reestablishing the markets, many major international organizations (such as CARE, CARITAS, etc.) were importing large amounts of food and flooding the market with large distribution programs at no cost to the recipients. The farmers felt that if these programs continued indefinitely, there would be no market in which to sell their own crops. Therefore, they suggested that some sort of price stabilization program for basic grain supplies be established.[1]

3. Reconstruction assistance in rebuilding housing. The number one priority of the people in this field was clearly lamina (corrugated iron sheeting which has been laminated with a zinc coating). Before the earthquake, people with sufficient resources were buying lamina, and it had a high level of prestige and cultural acceptance. Lamina can be erected with great speed, does not use a great deal of wood for support compared with alternative materials, and is relatively safe. It can be used for provisional shelter and then reused for permanent housing. When reconstruction began, the people in the rural areas were primarily concerned with roofing for two reasons:

   a. It was clear that the heavy tiles which were often used prior to the quake had killed many people, as they fell through the roof-supporting structure during the tremors. In looking at the damage, it was easy to see that the houses which had lamina had withstood the earthquake in much greater numbers than those with tile roofs;

   b. It was only 2 1/2 months until the beginning of the rainy season, and people wanted some sort of roofing material which would last out the rainy season and then could be incorporated into a permanent structure as they continued the reconstruction process.

During the meeting, a World Neighbors representative encouraged discussion of alternate roofing materials such as traditional straw-thatched roofs. Straw houses had withstood the quake well and are reasonably inexpensive. But there were several things which the people pointed out as being drawbacks to returning to the use of grass for roofs. First, due to rapid population growth within the region, the area of the farms which had traditionally been allotted to the growing of roofing grass had been converted to more intensive agriculture. Therefore, the grasses which formerly were abundant were no longer available in sufficient quantities to be used for the massive reroofing which was necessary. Second, in the last few years, both tile and lamina had become more readily available due to increases in agricultural production. Many people in the region had only recently switched from grass roofs to tile or to lamina, and as it was a status symbol, they refused to return to the former type of roofing as it would indicate a step back to poverty. It was felt that the people with tile roofs would switch to lamina but would not go back to grass. Third, grass takes a good deal of time to prepare and erect, and at the time, the farmers had to devote their efforts to planting.

Other types of materials which were locally available, such as the tejalita (asbestos cement) and other snythetic materials, were either too expensive, too fragile, or not available in sufficient quantities. The people at the meeting also felt that if OXFAM did not act quickly to purchase large amounts of lamina, there would be no resources available locally for purchase, and that with demand at an all-time high, prices would skyrocket, denying access to the rural people. After considering all the options, OXFAM was encouraged to initiate a major purchasing plan for lamina.

Several other important issues were discussed at the meeting which bear mentioning. First was the discussion of the area to be served by the OXFAM/World Neighbors program. The co-ops wanted OXFAM to work through the co-ops in the lamina distribution program but wanted to serve only their own membership. They felt that if they served everyone, there would be no incentive for people to join the co-op, and they wanted to use the disaster programs to help strengthen the co-op. Furthermore, the leadership of the co-op felt that if they agreed to a general distribution without consulting the members, the members would resent it.

OXFAM countered by saying that the co-op should serve everyone in the area, thereby demonstrating that it was an institution committed to helping everyone and demonstrating the value of the people having their own organizations in an emergency. This would increase popularity and thus, membership. OXFAM also pointed out that the co-op could not distribute all the resources which would be available within its limited membership and indicated that other means would have to be set up to serve the general population. Co-op leaders felt that if OXFAM were to start an independent program, it could eventually supercede the co-ops in importance, thereby reducing their effectiveness.

Finally, the co-op did agree to serve all the people in the area. Later, when OXFAM signed its commitment with the government to provide reconstruction assistance to the rural areas of San Martín, Tecpán, San José Poaquil, and the town and rural areas of Santa Apolonia, OXFAM further agreed to extend services to co-op members who resided outside the area.

Several other matters were also discussed. Whether or not a housing specialist should be employed was hotly debated as were the areas which should receive assistance. No agreement could be reached on the hiring of the consultant, but it was decided that the joint OXFAM/World Neighbors program would be limited to the areas in which World Neighbors was already active, and that OXFAM's assistance to groups in Guatemala City would be a separate program.

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1. A description of the stabilization program and the silo storage project is found in the personal termination report, "Project: OXFAM Emergency Disaster Relief Program", by Jo Froman, Bob Gersony, and Tony Jackson, March 12, 1976; and in a report by Paul and Mary McKay, Roland Bunch, and Bill Ruddell on the impact of imported disaster relief foods on the local markets.

C. Description of Housing Before the Earthquake

An understanding of the housing cycle and housing types before the earthquake is necessary in order to understand the reasons why different elements of the program came into being. There were several factors which indicated items that had to be included in the proposed housing program. First, housing in the area failed not because of the materials used, but because of the manner in which they were used. For example, the adobe in the area is some of the finest and strongest in Latin America; however, the manner in which it was incorporated into the structures violates almost every principle of earthquake resistant construction. Houses had high walls, heavy roofs, were unbalanced, and all the walls were load-bearing. An analysis of the damage after the earthquake showed that in only a very few cases did the adobe itself fail; rather, the houses came down because they were not built according to earthquake resistant principles. The implication of this is that, if a self-help housing program were to be undertaken, the emphasis would have to be on the teaching of better construction methods rather than on how to make, or convert to, better materials.

Adobe houses were not the only type of construction in the project area. In several of the villages, a type of construction known as <u>bajareque</u> was used. <u>Bajareque</u> closely resembles the wattle-and-daub method of construction. Posts are placed vertically in the ground, and pieces of bamboo or small sticks are placed in horizontal rows on either side and attached by special vines (traditional) or wire and nails, more common now. The <u>bajareque</u>-type structure is a true indigenous type of architecture in the area; this method of building dates back to the Pre-Colombian period and is an adaptation of the building process which, while it is not entirely earthquake resistant, certainly would not be lethal in an earthquake so long as the house had a lightweight roof of grass or <u>lamina</u>. In fact, a survey of casualties following the quake by INCAP showed no confirmed fatalities in <u>bajareque</u> houses with lightweight roofs.

<u>Bajareque</u> houses can be quite formal structures, and some of the older homes in the highland cities such as Antigua had been built using this process. However, over the years as adobe has replaced <u>bajareque</u>, this type of construction has lost its desirability. In fact, in the Oxford English-Spanish dictionary, a "<u>bajareque</u> house" is defined as "a shack, a hovel, a poor man's house". Therefore, any type of housing program which advocated a return to the traditional type of architecture faced the problem of overcoming this cultural stigma.

Another factor to consider when examining the housing before the earthquake is of utmost importance in understanding some of the main reasons why the particular approach was adopted. In the project area, people traditionally build evolutionary structures; that is, the house begins with one room being built as a kitchen and sleeping area for the entire family. In following years, a ceremonial-sleeping room is added; in the next few years, another room. By the time the structure attains its final form, it has undergone a number of changes. In terms of the mechanics of how the house will withstand an earthquake, the house has often evolved from a small square structure into a long, rectangular structure, and then, especially in the <u>pueblos</u>, into an L-shaped structure. With each addition, the balance of the house changes, and its ability to resist an earthquake is lessened.

Studies of adobe housing in other post-earthquake reconstruction programs have indicated that the houses built after disasters in other Latin American countries have also followed this evolutionary process. Immediately following an earthquake, the people turn from traditional building materials such as adobe, and rebuild with lighter materials which have only a limited lifespan. However, as time passes, the people forget the earthquake and begin slowly returning to the traditional heavier (and warmer) materials. In ten to fifteen years (usually a shorter period of time in cold climates such as in Guatemala), the housing is the virtually identical to the types of houses destroyed previously. This underscores the need for construction of a strong, earthquake resistant frame from the very beginning. Any structure which is built immediately following an earthquake cannot be considered as the final end product. Even temporary shelters or intermediate housing will, in fact, become the basis or core for an evolutionary house. While people can be expected to use lightweight materials which offer less insulation will be replaced gradually with adobe. Within a few years, houses will be completely rebuilt with adobe, and unless the frames are built strong at the outset to allow the incorporation of the adobe, the adobe walls may be weaker than the old ones and the stage set for the next disaster.

D. Setting up the Program

Setting the Policies:

OXFAM and, especially, World Neighbors had both hoped that after the immediate relief operation was over, they would not have to "go operational" and get involved in a massive housing program. However, at that time, there was a tremendous increase of activity in the housing sector, and many foreign-based organizations (such as CARE, the Salvation Army, Mennonite Central Committee, and others) began to plan housing programs. Most of these groups had not operated in the area before and, if they had, had not been involved in the housing field. Furthermore, the programs which these groups were proposing were either heavily subsidized or provided free housing to a small number of people. In other words, these groups were going to provide housing for people - a short-term goal - rather than work with people to adapt the local skills already in the community to the process of reconstruction, and thereby have a permanent effect on the housing process (a long-term goal). Hence, during the second week after the quake, it was decided that a housing committee would be set up to begin work on the development of a housing reconstruction program.

The housing committee was made up of one representative from OXFAM, one representative from World Neighbors, and incorporated for the first time an outside planning consultant from INTERTECT. As soon as the committee met, it began to map out a formal strategy for the conduct of the program and to review possible options.

The first step in this process was the establishment of the overall policy under which the program would operate. Briefly stated, the policies were as follows:

1. The program was to be controlled by the local people;
2. The program must use and be supportive of the local organizations, as well as the natural coping mechanisms of the society;
3. The structures which would be built must use indigenous materials, skills, and techniques found in the normal, local housing process;
4. The structures must be built at a cost affordable to local people;
5. The choice of whether or not to build, or even to use the earthquake-resistant principles, must be left up to the individual.

It is important to note that the OXFAM/World Neighbors program was the only program in Guatemala that placed the burden for decision-making entirely on the shoulders of the local people. Thus, it became a matter not of whether or not a man had an earthquake resistant house, but rather of the process by which he obtained an earthquake resistant house. There has been much criticism from other organizations because the OXFAM/World Neighbors program did not use its resources to build houses for people, or because the program did not find ways of forcing people to incorporate earthquake resistant building techniques into the houses which were eventually built. When other organizations moved into the area with construction programs which organized local people to follow pre-set plans, developed by the organizations without the participation of the people in the design process, there was even extensive criticism from the people themselves for not building them houses as the other organizations were doing. While it will be years before the end result is seen, the staff of the OXFAM/World Neighbors program maintains that, in the growing reality of the worldwide housing shortage and the necessary reliance in the future on self-help housing programs, this was the best approach; if in the future the organizations were to be confronted again with the same circumstances, they would not hesitate to use this approach.

Area Inspection:

The next step in setting up the program was to carry out an extensive inspection of the project area to determine what the problems in building would be, the availability of materials, and to identify specific problems which might arise in conducting the program. As the team went through the project area, they had extensive talks with local masons and carpenters, as well as people who were already beginning to rebuild their homes. Primary areas of interest were the availability of materials; determination of people's attitudes towards reconstruction; and determination of the extent to which people understood the reasons why their structures fell down. In each area, the technical consultant also examined the structures and the damage to them, in order to verify or reject the people's contention that it was the fault of the adobes.

By the end of the inspection tour, it was obvious that several problems would confront the team. First, there was a lack of indigenous, lightweight roofing materials. As mentioned earlier, there was simply not enough grass or wood to go around. Lamina was still available on the local market (other than that supplied through World Neighbors) but was expensive, and rumors were rife that it was being purchased in large quantities by speculators for resale at a later date. In fact, prices for all building materials were climbing at an alarming rate, despite the fact that the government had instituted strict price control measures. The only building material which did not climb dramatically was cement, which is produced by only one government-sanctioned monopoly (although the price of transportation did climb to some extent).

The second problem was that few people had a real, functional understanding of why the buildings had come down. Talking with the builders, they emphasized that the best way to build an earthquake resistant structure was to build a thicker wall -- a practice which is diametrically opposed to fact. Although many people understood that the heavy tile roofs had been lethal, they did not understand the role these roofs had played in knocking out the end walls of the houses and bringing the entire structure down.

The third major problem was the fact that many valuable resources of building materials were being bulldozed. In the haste to re-open the towns, bulldozing teams were removing or destroying wood, adobe, iron, cable, and nails which would be invaluable in rebuilding the houses. Those in charge of the bulldozing crews did not seem to realize that when all these materials were shoveled into the back of a truck, and dumped down the side of a barranca, the people would have to go out and pay someone to dig it up again and bring it all back to the town. Especially disturbing was the fact that so much wood was being wasted. There is an on-going shortage of good construction timber in Guatemala, especially timber which is resistant to termites and rot. Many of the houses which were destroyed had extensive wooden structures to support the roof; these had been made out of cypress at a time when that wood was much more plentiful. (Some houses which were destroyed were found to have been tied together with leather, a practice which dates back to the time of the conquest.) These large wooden beams could be invaluable in reconstructing the frames for earthquake resistant houses. By removing them, the bulldozing authorities would be forcing the people to use a variety of pine which is susceptible to rot and insect infestation, and which would have to be replaced probably every five to ten years.

The fourth problem encountered - and one which was of the greatest concern - was that many voluntary agencies were proceeding with housing programs which were viewed as paternalistic by the OXFAM/World Neighbors team; many were already generating much resentment on the part of the local people. This factor underscored the necessity of providing, as quickly as possible, a widespread alternative approach to housing.

On the plus side, the inspection tour revealed several key factors which would assist in the proposed housing program. First, local groups appeared to be functioning well, especially the co-op organizations supported by World Neighbors. Not only were the formal organizations such as the co-ops functioning well, but informal organizations such as the extended family and _ad hoc_ groups of people were beginning to get together to discuss alternative plans for the reconstruction. Several committees had even been formed to protest the various housing programs proposed by the voluntary agencies. The housing committee was especially impressed with the way local leaders, trained by the World Neighbors programs, had responded to a wide variety of pressures and demands from the other voluntary agencies, and from the communities in which they worked, as well as from the _lamina_ distribution program which was just beginning operation. It also became obvious during the tour that many people not associated with the co-op had begun turning to the co-op, as they perceived it as a place where their ideas and needs would get a fair hearing. There was an influx of savings immediately after the earthquake.

Also on the plus side was the fact that the local builders were anxious to learn how to build earthquake resistant houses. Many of the master builders _(maestros de obra)_ had already gotten together to discuss how they would confront the problem of rebuilding. Many state that they knew they had to rebuild with adobe, but they knew they did not understand the proper techniques of how to build an earthquake resistant house. They were seeking education materials which they could understand, which would demonstrate the techniques they needed to incorporate into the building process.

The team noted, however, that there was a wide spectrum of illiteracy within the community of builders. Some of the masons could read or write Spanish fairly well and could even interpret technical drawings. At the other end of the scale were men who had no formal education whatsoever, who had learned their building skills through years of apprenticeship and on-the-job training. Thus, any approach which stressed training the people how to build earthquake-resistant housing would have to confront the problem of developing new methods of communicating these ideas to people who were at vastly different levels of literacy.

Goals and Objectives:

After the tour of the project area, the next step was to develop a set of goals and objectives for the program and to develop a methodology which would enable these objectives to be met. The initial program thus evolved as follows:

1. An extensive program would be undertaken to ensure that the greatest possible number of structures within the program area would be built to resist the next earthquake. The education program would consist of four parts:

   a. Training of the local builders;

   b. Training new extensionists and <u>promotores</u> in the housing skills;

   c. Training existing staff in the housing skills;

   d. Training, as time permitted, of other interested groups, concentrating on the voluntary agencies working in the area.

   The primary emphasis of the training program was to be on training local <u>albañiles</u> (masons) and <u>carpenteros</u> (carpenters). These are the people already respected in the community as builders, who in the long run would be asked for advice and whose recommendations and actions would be followed. The advantage of concentrating on using <u>albañiles</u> is that they already knew how to build a house; thus, all they would need in training would be how to build using earthquake-resistant principles. Also, by concentrating on the <u>albañiles</u>, the project would be supportive of the local building cycle, as it would be improving the skills in the community and supporting the builders in the eyes of their peers. At all key levels of the organization chart which evolved, <u>albañiles</u> and <u>carpenteros</u> were placed into positions of importance; and in all cases, they were regarded as the final authority in the training and building programs. <u>Albañiles</u> were selected to serve as instructors and builders of the model homes, and were expected to train others in both building techniques and how to teach the building principles to others.

   Secondary emphasis was placed on the training of extensionists. There were two groups, one in San Martín and one centered in Tecpán, who had already been trained by World Neighbors. These extensionists were to receive additional training in how to build earthquake-resistant houses and how to teach earthquake resistant principles to people in the rural communities. As they were not builders, it was also necessary that they receive some instruction in how to build.

   Included among the extensionists already trained by World Neighbors were some women who had been teaching such skills as nutrition and family planning. It was decided that special courses would be developed for these women extensionists so that they could pass on some of the more important points to the women in the villages. It was felt that, since women spend the most time in the houses, they should be fully familiar with the more important anti-seismic building principles and of all the possible safety features which could be incorporated into a structure. As the children spend many years with their mothers in the houses, women would also be able to pass on to the children a basic understanding of the importance of the various structural members and supports.

In addition, there are various things the women can do in the houses which will help prolong the life of some of the wooden components in the frame and in the roof, and the special classes would address these points.

2. A limited construction program of building model structures throughout the program area would be undertaken, with the following priorities, to provide:

   a. On-the-job training for builders and extensionists so that they could learn anti-seismic construction techniques;

   b. Model houses showing the earthquake-resistant principles and demonstrating that local materials could be used safely;

   c. Limited housing for persons within the program area who were unable to reconstruct their own dwellings, e.g. widows, elderly, injured, etc. (considered for a time but rejected as a poor idea);

   d. Housing for the staff of the program and other local organizations participating in the program;

   e. Community building built in the same manner but of a larger size which would demonstrate that any size structure should embody the anti-seismic principles, and filling a need expressed by many of the villagers for a common meeting hall.

The fourth and fifth items listed above merit special attention. The question of whether or not to provide staff housing became an early issue in the housing program. The point that it might appear to people outside the organization as if the staff were taking advantage of the program to better their own interests was overruled by the feeling that the people who were working with the program were true leaders in the community; if these people were to reside in houses which embodied most of the new construction techniques, thereby indicating that they trusted these new ideas, it would encourage their neighbors to follow suit and use some of these principles in their own reconstruction. It was also felt that since some of these people were putting in very long hours working with the reconstruction and housing programs, they did not have the time to devote to their own rebuilding needs, and therefore it would be a nice gesture to assist in providing some help in rebuilding. A stipulation of assistance, however, was that the person receiving the house would provide or pay for the materials, while the program would provide the labor.

In regard to the construction of community centers in the various villages, quite a bit of discussion ensued before this item was added. The consultant felt from his experience that, unless a structure is actually lived in, it is not regarded as a house by the local people; therefore, since the program's objective was to encourage better building practices in housing, all the demonstration structures should, in fact, be houses. The other members of the committee, and the representatives of the communities, argued that community centers were vitally needed in each of the villages in order to serve as a focal point for community organization, and that it was an activity in which the whole village would participate. Furthermore, since many people would be using it constantly, a greater number of people would be exposed to the ideas and, unlike a house, they could always go to examine the structure inside and out to get ideas to incorporate into their own buildings. The villagers paid for the materials (with the exception of the lamina roofing material), and the program paid for the albañil.

3. A program of technical assistance would be provided to the villagers and albañiles, the objectives of which were:
   a. To work out problems arising from the use of local materials with the new construction techniques;
   b. To work out problems arising from the introduction of new building materials;
   c. To introduce new materials and the related tools, machines and/or equipment (the introduction of new items such as block machines was reviewed by the technical assistance program to see that it was consistent with the policy of using or building upon local skills, materials, and personnel).

4. A program to advise local groups on proper salvage techniques and to demonstrate proper techniques of inspection, recovery, storage, and repair of materials salvaged from the ruins was instituted. Where possible, model salvage projects were to be carried out to demonstrate these techniques.

5. The final component of the housing program was to be a continuation of the materials distribution program which had already been started. It was foreseen that additional materials such as wood preservatives, nails, and other types of materials to assist in the construction process could also be provided through the materials distribution network. Eventually, more than two dozen different items would be distributed, although at the time it was only foreseen that a few items would be provided in this fashion.

Most of the items distributed through the materials distribution program were provided at a subsidized price. Wood was sold at cost; everything else was sold at one-half of the wholesale price.

E. Testing the Approach

Once the housing committee had completed their outline of project activities, the next thing to do was to verify whether or not these would be feasible. Immediately, several small pilot projects were set in motion.

The first of these was to conduct several small classes with the builders to find out how receptive they would be to classes on earthquake resistant construction techniques. On February the housing committee met with a group of seven albañiles from the pueblo of Tecpán and began by giving them the first class in earthquake resistant construction. The class, which had originally been scheduled for two hours, took five hours, and the builders seemed very enthusiastic about the material which was presented. Following the class, they requested a chance to walk through the town of Tecpán to look at the damage and to determine among themselves why the various structures had fallen down and why others had remained standing. On completion of this tour, they requested that some sort of model house be built so that they could learn how to incorporate these principles and apply them in building.

This, then, became the initial approach: First, the conducting of a class giving the theory of building earthquake resistant houses; second, a walk through the rubble to look at the damage, and then to discuss the reasons why housing had survived or fallen; and third, the construction of a model house. A number of other classes were given throughout the project area to verify that this approach was the most acceptable and, in fact, it turned out to be perfectly matched to the immediate needs.

The second demonstration project was the conducting of a model salvage project also in the town of Tecpán. A number of builders were hired to begin salvaging materials at two sites to show how much material could be saved, and to organize resistance to the bulldozing activities of other agencies. The salvage project was organized by finding people in the community who were willing to let the program do the salvage in return for a portion of the materials. (It was planned to use these materials in the construction of the first model houses.) Unfortunately, the salvage program was too good. When the people began to see how much material they could save, they reneged on their original agreement and wanted to keep all the materials for themselves. The program finally bought one building which had been destroyed, cleared the site, and used the materials for the first model house.

The model salvage project, however, had only a limited effect. In the towns, the bulldozers moved whatever they wanted, and in the rural areas the people pretty well knew what to salvage anyway.

F. Organization of the Program

While the housing committee was setting up the various objectives and components of the housing reconstruction program, several events occurred which had a great influence on the final structure of the table of organization.

On the afternoon of 18 February, OXFAM representatives met for the first time with the new National Emergency Committee. OXFAM outlined their efforts to that date and discussed future plans. The NEC suggested that OXFAM be given official responsibility for the areas they were already working in.[2,3] Thus, on the morning of the 20th, OXFAM submitted a proposed plan of action which outlined the subsidized lamina sales program and the areas which would be covered. That afternoon, the proposal was accepted by the NEC, and the NEC drew up an official acta designating OXFAM as the responsible authority for relief and reconstruction in:

1. The aldeas and rural areas of San Martín;
2. The aldeas and rural areas of the municipio of Tecpán;
3. The aldeas and rural areas of the municipio of San José Poaquil;
4. The pueblo, aldeas, and rural areas of the municipio of Santa Apolonia.

As these areas had been formally agreed on between World Neighbors, OXFAM and the government of Guatemala, it was felt that the organization of the program must reflect a specific project in each one of the areas, to be able to demonstrate to the government on paper that the commitment was being carried out. However, the Kato-Ki Co-op and the El Quetzal Co-op had been working in areas other than those covered by the agreement. Therefore, it was decided that a special branch of the program would have to be set up for these members. The co-ops said they wouldn't participate in the program unless they were allowed to sell lamina to co-op members who resided outside the assigned areas.

By this time, some of the early classes and other activities in the distribution program and salvage program were already underway. The program had already begun to generate much interest from other organizations, and there had been a large number of requests for assistance to these other programs in the provision of information on earthquake-resistant construction, possible approaches that were available, and information on how to use indigenous materials. It was felt that a special program was needed as an addition to the overall program structure which would enable these other requests to be met.

During this period of planning and setting up the housing program, there had been essentially two different staffs. One staff was headquartered in Guatemala City and was working to establish agreements with the government, make contact with other voluntary agencies, and procure the materials necessary to carry out the distribution program. The second staff revolved around the housing committee and was located in the field. Generally, the staff in the City consisted of the people from OXFAM, those in the field from World Neighbors. Due to problems of communication and differences in ideas, each began going off in different directions. It became more and more difficult to coordinate the activities and operations of the entire project. By the end of the fourth week, a number of disagreements as to program emphasis and organization had arisen, and it was necessary to establish a coordinating body to provide leadership and direction to the whole program and to resolve the disputes.

On March 6, a meeting of all the key program people was held in Guatemala City. A formal table of organization was adopted and a board, made up of the key project personnel plus representatives from the local people, was established. The new program -- called Programa Kuchuba'l (Cakchiquel for "working together") - was to be a joint effort of OXFAM and a union of W.N. programs and cooperatives for reconstruction. Many of the personnel in the pre-earthquake programs would be incorporated into various components of Programa Kuchuba'l and would be expected to carry out dual roles; but as the reconstruction activities waned, they would return to their normal activities in the cooperatives and other World Neighbors programs. In terms of the operation of the program, this meant that materials distribution would be carried out via the cooperatives, and the education program for the housing reconstruction would be carried out by the pre-earthquake World Neighbors programs assisted by a new housing education office in charge of coordination, production of educational materials, technical innovations, and the training of albañiles.

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2. The policy of assigning specific areas to a relief agency was not unique to the NEC - OXFAM agreement. The National Emergency Committee encouraged all the voluntary agencies to undertake the reconstruction of one particular area in the country, instead of duplicating efforts throughout the affected region. (At this time, it is still not clear precisely how the idea originated, but such a procedure is suggested in USAID's Disaster Preparedness Training Program which several members of the NEC had attended prior to the earthquake.)

The head of the NEC has stated that the purposes were:

1. To avoid overlapping of resources.
2. To help distribute aid to all regions.
3. To assist the voluntary agencies in raising money, as it would allow each organization to be able to present a project area to its donors, giving them a personal attachment to the particular region and thereby helping them to see the results of their contributions.

Whatever the source of the suggestion, or the intent, the way in which it was finally carried out by the government of Guatemala had far-reaching implications. First, not all the relief organizations were made subject to the same type of agreement. CARE had been asked to work in the eastern part of Guatemala, but refused, then demanded and received a letter of authorization to work in the entire country - a letter which the CARE director interpreted as virtually having veto power over other agencies working in Guatemala. The issue caused much strain between CARE and many of the other voluntary agencies.

Second, the government made no effort to check out the capabilities of the organizations undertaking the commitment to rebuild various towns. For example, Chimaltenango, which is a major town of 35,000 people, was assigned to the Wings of Mercy organization based in California. Wings of Mercy is only a small group of businessmen who were involved in relief primarily as a tax incentive; it had no capability of carrying out any type of reconstruction program or even of raising a substantial amount of money for assistance. In fact, when these businessmen committed themselves to rebuild Chimaltenango, they did not even know where the city was located.

It is possible that this approach might have had some benefits had there been proper control and forethought given to the division and assignment of voluntary agencies throughout the country. However, this policy usually generates more negative results than positive. Among the problems are:

1. The system creates inequities in the distribution of relief and reconstruction aid. The level of assistance that is given in each area is different, and many agencies distribute aid under different requirements and under different policies. For example, some agencies sold lamina at subsidized prices, some gave it away free, and some instituted so-called lamina-for-work programs.
2. The system fostered resentment against certain programs due to the inequalities mentioned above. The CARE program of free distribution in particular caused many problems for other agencies.
3. The system is responsive to needs of donors but not to the needs of victims or the government. The most important image for a government after a disaster is that of fairness to all. By developing a system that encouraged inequities, the government's image ultimately will take a beating.
4. The system encouraged the images of the government not being able to handle the situation by itself, and the people not being able to cope without foreign assistance. These images are incorrect.
5. The letter of commitment that was signed by the various organizations left the impression that they were given sole responsibility for the reconstruction effort in each one of these damaged villages, and many agencies took this pledge quite literally. One organization, in fact, issued an order in its assigned village that all local reconstruction activities should stop immediately until the new sponsors had time to figure out what they were going to do.

There is one way in which the system could have been improved. Had the NEC, and later the NRC, established uniform reconstruction policies (for example, setting a standard policy for sales of lamina), it would have removed many of the inequities of the system.

3. The fact that most relief organizations know little of the culture to which they provide aid is underscored when looking at the areas in which they committed themselves to work. Most chose only urban areas and not the surrounding rural areas, which demonstrates a complete lack of understanding as to the administrative and social make-up of Guatemala. It is virtually impossible to work in any of those areas - urban or rural - without working in both. The pueblos are much more than administrative centers for the municipios; they are tied to the rural areas by a strong social and economic network. Success in any program would entail addressing whole municipios as one unit. Again, the issue of inequities of distribution arises.

Figure 1

INITIAL TABLE OF ORGANIZATION FOR THE
KUCHUBA'L HOUSING PROGRAM

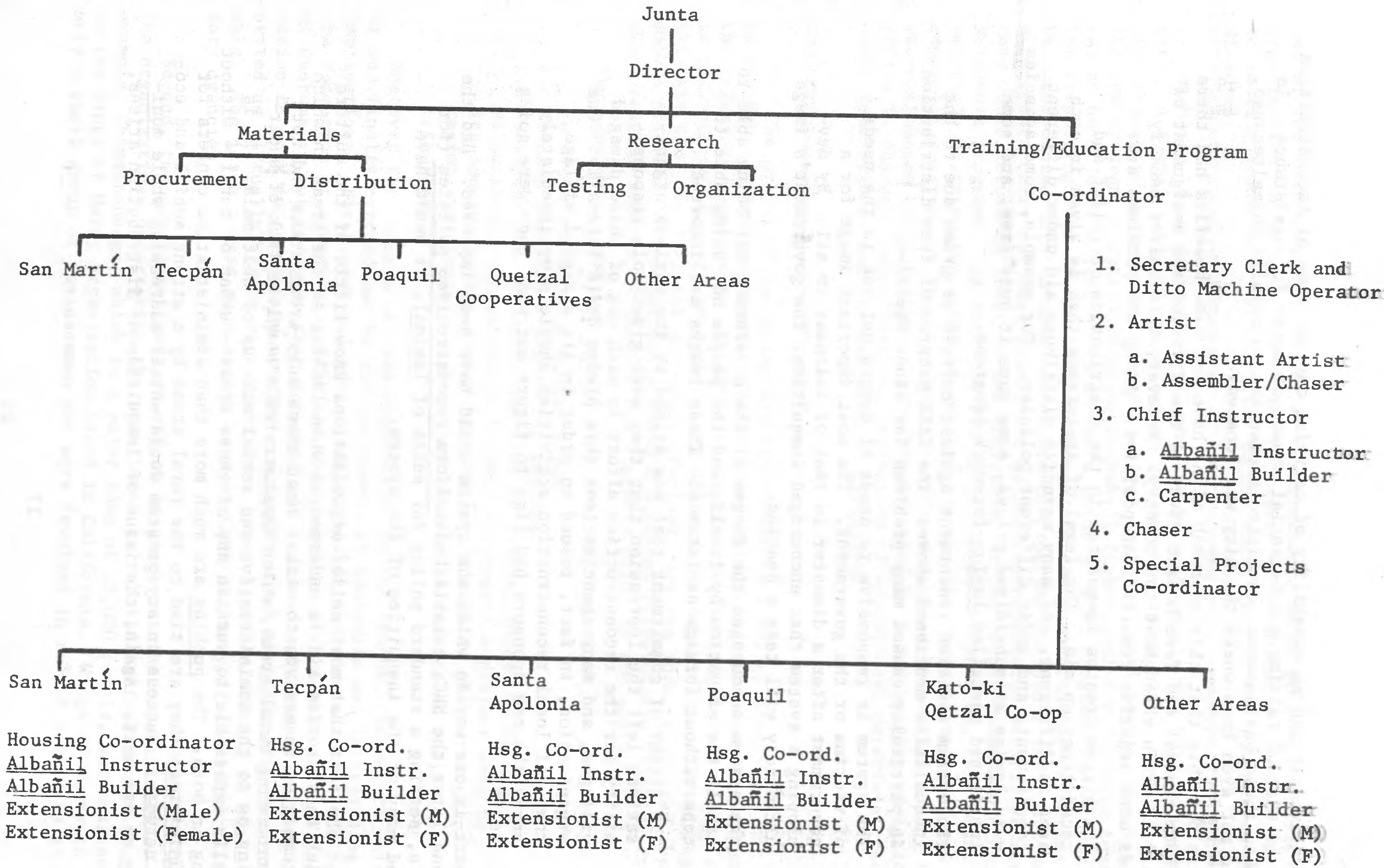
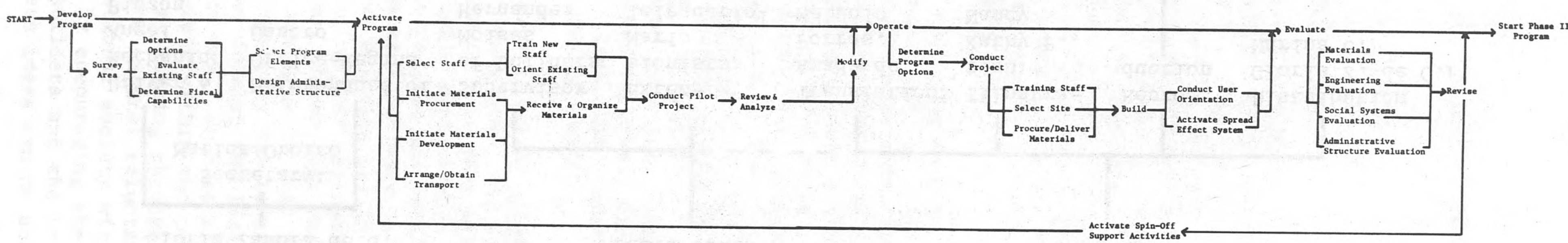


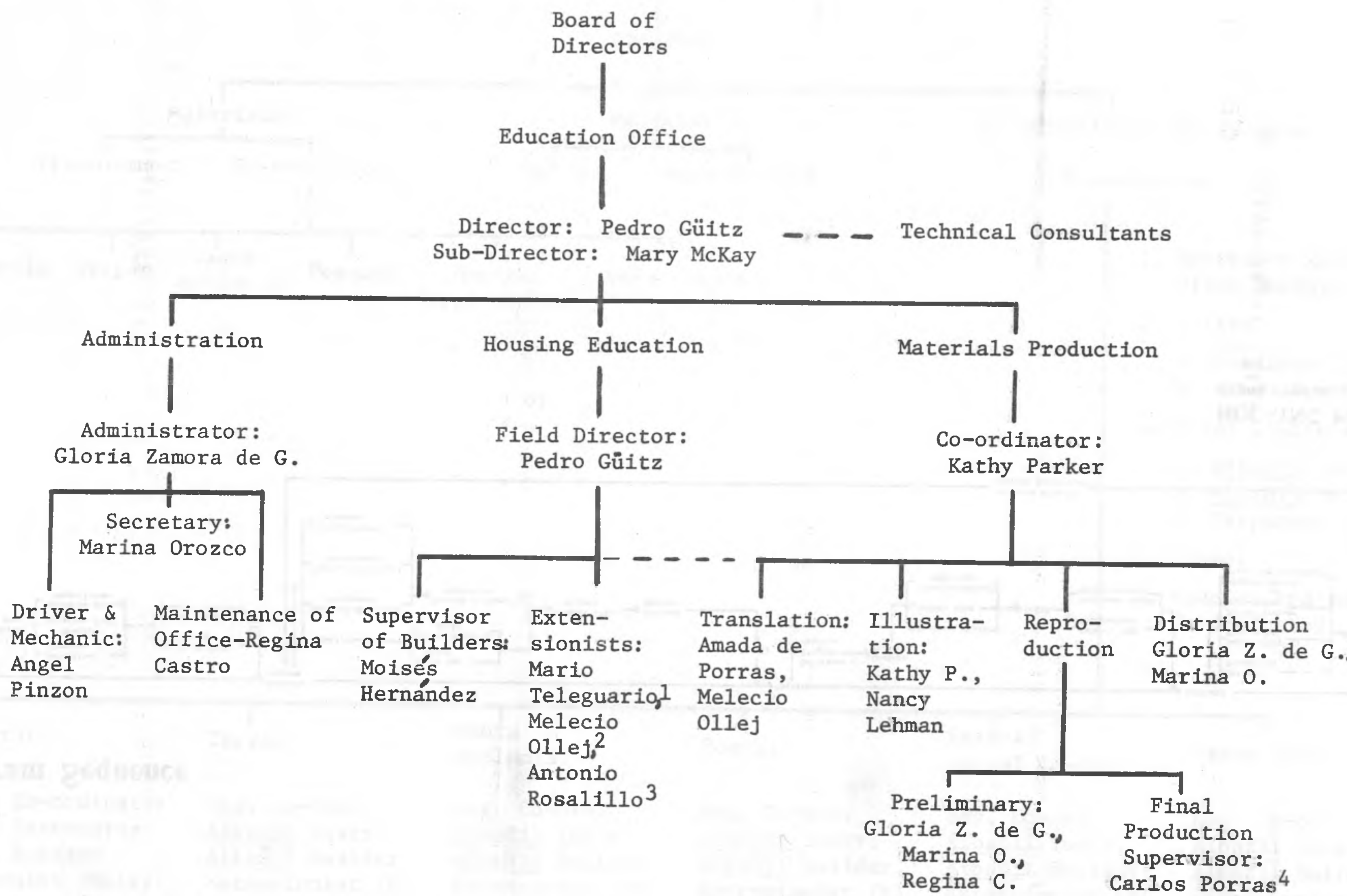
Figure 2

Program Sequence



HOUSING PROGRAM
OXFAM / VECINOS MUNDIALES

Figure 3 INTERNAL STRUCTURE OF THE KUCHUBA'L EDUCATION OFFICE



[1]Reconstruction Extensionist of the Co-ops, attached to Kuchuba'l
[2]Kuchuba'l Extensionist/Cakchiquel Translator
[3]Kuchuba'l "Roving Builder", with one assistant, for out-of-program requests
[4]Also is Architect/Consultant to the Co-op

II. PROGRAM ELEMENTS

A. Education Program Description

1. Training Programs:

a. Albañiles Training Program: In the first part of Programa Kuchuba'l, the albañiles training program received the top priority of the education staff. The original concept had been that a small number of builders would be trained in both the theoretical and practical aspects of building earthquake resistant structures, and they in turn would initiate classes to train other builders. The original group would supervise the training of the next group, select the best two or three instructors, and work to train them as instructors also. These, in turn, would begin the same process over again. In this manner, it was hoped that a pyramidal training structure would evolve which would be able to train and educate the majority of builders in the program area.

By the beginning of the rainy season, however, it was obvious that this approach would not work. It was difficult to maintain quality control of the instruction process; the quality of the instructors, and the quality of the information which they passed on began to decline. Also as all good albañiles began working full time at the highest wages in history, they stopped being interested in either giving or receiving classes. Hence, the emphasis changed from trying to train using the pyramid approach to one of concentrating on hiring a number of well-qualified albañiles to do the training themselves and to setting up a school wherein albañiles could be trained and be given advanced instruction. In addition, the request for information from non-albañiles increased to a point where it was decided that the instruction staff should be giving classes to both albañiles and non-albañiles alike. Thus, the classes were restructured to a slight extent to reach the general public.

Although the emphasis on training albañiles has to some extent been lessened during the past months, the program still feels it to be a top priority to ensure that as many albañiles as possible receive instruction in how to build anti-seismic buildings. If anything, the experience of the program has verified the original assumption that it is of the utmost importance to work through the existing building system and improve building skills within the community. Several other advantages to using this approach became obvious during the conduct of the program. First, the builders are important people in the community and are usually well respected. For a man to become a master builder, he not only has to develop the skills necessary for construction, but also develop the leadership skills necessary to run a team of construction men. He must also develop the respect of his community, so that people within the community will come to him for advice in building. By working through these men, the program was able to overcome much of the natural reluctance to try and use the new ideas presented. Any traditional society will be hesitant to use new construction techniques; but by encouraging the builders to use them, and by working through the builders and the traditional building system, much of the opposition to these ideas can be sharply reduced. In communities where builders were not actively brought into the program by the instructors or by the extensionists, they almost always stood in opposition to the program and tried to find ways in which to discredit the technical ideas. In those communities, it was much more difficult to get people to use the building principles in the reconstruction of their homes.

Another advantage to using the builders in the training program as instructors was that it eased the teaching burden. It was far easier to teach builders how to build with the earthquake-resistant principles than it was to teach non-builders how to use them. First, you had to teach the non-builders how to build a structure, and then teach them how to incorporate the principles.

All this is not to say that it was easy to get the builders to be instructors; in fact, it was quite to the contrary. After working in Programa Kuchuba'l for a short time, many of the instructors found that they could make much more money working on commercial and residential building in the capital. Many of the reconstruction programs in the area also offered more money than did Programa Kuchuba'l, and many of the builders who were trained left the program soon after their training to seek higher paid employment in other areas. The core instructors, however, stayed on; and it is a credit to their dedication that the program has been carried on so successfully.

<u>Organization of the course for instructors:</u> The basic course for the instructors consisted of three parts and used the following format:

Part I Theory of Earthquake Resistant Construction

- A. Discussion of Earthquakes
- B. How Earthquakes Destroy a House
- C. Safety Tips

Part II Inspection Tour (In the first few months after the earthquake, each theoretical session ended with a tour through the damaged area to look at structures which had fallen down to point out reasons why the houses had failed. As the debris was cleared and new structures began going up, the purpose of the tour changed to that of inspecting new houses to see if they incorporated anti-seismic principles.)

Part III Construction of a Model Building (Originally, all the buildings were intended to be model houses. Later, village meeting halls were also built.)

In addition to the above training, the builders in each community were encouraged to set up a schedule of permanent meetings wherein the instructor could bring new materials produced by the education office, and provide more detailed training, and therein the problems which faced the builders could be discussed with someone from the training staff. The materials used during the advanced training were the Technical Detail Series, and new manuals which were produced in response to the builders' requests. (A description of how the materials are produced is found later in this section.)

It soon became obvious that the instructors and the <u>albañiles</u> would require more technical information than that which was provided in the normal program for the public at large. Therefore, several instructor's manuals were prepared to provide more detailed information as background for the instructors and for the builders. These included an intructor's manual on how to build housing using and incorporating the earthquake-resistant building principles; an instructor's pamphlet on earhtquakes, how they originate and the effects they have on structures; a booklet on how to build strong cement block houses; and a booklet on wood preservation.

The booklet on earthquakes, their origin and effects, turned out to be one of the most important. Throughout the program, the instructors staff was called on to dispell the myths of earthquakes, and there was intense interest on the part of the people as to precisely what earthquakes were and what caused them. In order to convince people to use the principles, it was necessary to point out how an earthquake affects a building, and it was mandatory that the instructors be able to respond to a wide range of questions regarding earthquakes before they could begin to teach anti-seismic construction principles.

Incentives: At the very beginning of the education program, a decision was made by the staff to pay the albañiles who were attending the classes for the time that they were working on the model structures. The reason for this decision was two-fold. First, the staff felt that it was only fair that they assume an obligation to see that the loss of these people was not too great; we were taking people away from their work during a critical period when they desperately needed money for reconstruction. The loss of a full day's pay might prevent many of the builders from participating in the program. Second, the program wanted to develop a series of incentives in order to encourage the builders' participation in the program. It was felt that there would be no better incentive than the chance to learn (and possibly to work on the model structures) and be paid for the time spent. However, pay for the time in class was dropped after the first few classes, as they were only several hours long.

Another type of incentive was also explored. Latin America is a society in which great value is placed on diplomas and certificates. The albañiles had little formal schooling and none had gained any type of formal recognition in their communities. Therefore, it was proposed that a series of diplomas be issued to the graduates of the education program. Originally, the plan called for a certificate of participation to be issued to each builder who both completed the theoretical courses and participated in construction of the model structures. A certificate of participation would be essentially a second-class certificate. The builder could, however, upgrade his certificate to a first-class certificate designating him as a master builder, qualified in building an earthquake resistant house, once he had come back to the program staff and demonstrated that he had built an earthquake resistant house without supervision.

In the end, only the first certificate was produced and issued to the builders and participants in the program. It is difficult to tell how well it has worked as an incentive, although in the beginning, there was considerable interest in the certificates, and they did seem to serve as a stimulus to bringing new participants into the program.

b. Use of Extensionists in the Housing Education Program: The World Neighbors Rural Development Programs, which had been in operation before the earthquake, relied on the use of a network of extensionists and promotores to train local people in agricultural, family planning, nutrition and health ideas and methods. The success that World Neighbors achieved in the area was due in large part to the quality of the instructors and their ability to effectively communicate new ideas to the rural people. It was only natural, therefore, that World Neighbors would want to train these extensionists in how to build earthquake resistant housing and, in turn, use their extension network to train people in the rural areas. In the San Martín municipio, especially, the extensionists were well-established and many were leaders in their own communities.

When Programa Kuchuba'l began organizing the housing program in the San Martín municipio, the extensionists decided among themselves that they would prefer not to use the local builders (the primary media for getting information on anti-seismic building into the communities), but would prefer to use the existing extension staff. Over the objections of the consultant, it was decided to go ahead and try to use the extensionists rather than emphasizing the teaching of builders.

Despite some early drawbacks, the use of extensionists has proven a limited success. During the first phase of Programa Kuchuba'l, before the rainy season began and while housing was a high priority in many of the rural areas, the extensionsists worked fairly well. They were able to organize classes and, once they had been trained, to teach them fairly well.

There were a number of problems, however. To begin with, many extensionists did not know the correct procedures for building a house, much less an earthquake resistant house. Therefore, they had to be trained in not only how to build using the anti-seismic principles, but also in such basics as how to lay out a foundation, how to plan a house, and how to lay each course of adobe to make sure that it was in plumb.

Another problem with the use of extensionists rather than builders was that many of the builders opposed new concepts introduced by non-albañiles. Most of the opposition, however, was not in the rural areas but in the pueblo of San Martín where the builders insisted that the only way to build an earthquake resistant house was to build with concrete block, a process that they were familiar with. Some of the opposition may have been because they felt that the new techniques were somehow a threat to their work, but whatever the reason, they consistantly downgraded their importance.

One final problem which occurred bears more consideration in the future. The extensionists had other training responsibilities, and after the initial demand for building terminated with the onset of the rainy season, many of them quit teaching the housing courses and returned to teaching agriculture. The problem is not so much the use of extensionists versus the use of builders, but rather a question of to what extent the housing reconstruction program can rely on the use of existing personnel. As long as housing is a priority, it can be justified when they are diverted from other activities; but once that priority has been reduced or eliminated, the staff must return to its normal duties. In Guatemala, the advent of the rainy season was viewed by the education staff as a chance to bring the instructors in for extensive recurrent training and to prepare them for the second building surge which would begin as soon as the rainy season ended. However, the extensionists returned to their normal duties at this time and housing became a low priority, so it was very difficult to use the opportunity to expand their capabilities.

Several other housing programs in Guatemala (most notably the Save the Children Alliance program in Joyabaj) used the same teaching methods as Programa Kuchuba'l, yet they decided to form a completely new staff which would teach only housing. A comparison with the Alianza staff, which is made up of both builders and housing promotores who have been trained by SCF, indicates that the Alianza instruction team is much better qualified in housing than the extensionists in the San Martín program area. It is too early to tell, however, whether the extensionists of San Martín will have a greater impact than the new staff of the Alianza program.

On balance, the question of whether to train builders to be extensionists or extensionists to be builders seems to be moot; each has its own advantages and disadvantages. The best approach does seem to be the one developed by the SCF Alianza, that is, the use of both in a team. The team approach allows the advantage of working through, and supporting, local builders while being able to rely on the teaching skills of an extensionist. Teams can be loosely structured allowing each member of the team to choose the parts of the course and training program that each feels most qualified to teach or to demonstrate. Alianza has used this approach, and results seem to be very promising. While the costs are greater, the benefits seem to point out that the approach is cost effective.

c. Schools Program: One of the main objectives of Programa Kuchuba'l has been to try and affect the entire process by which housing is constructed in the rural areas in Guatemala. The program seeks to find many new and innovative ways to carry the concepts to the people. It was felt that, in order to have a complete effect and impact on the community at large, it was necessary to present the earthquake resistant building principles not only to the adult populations of the villages, but also to the children.

In April 1976, a Peace Corps volunteer, working with the Department of Education in Quiché, approached Kuchuba'l with a proposal to utilize the education materials produced by the program in the schools in the Chichicastenango area. The volunteer also proposed to develop a curriculum for teaching teachers and students how to build earthquake resistant houses.

When the school system was approached with the idea, they were very enthusiastic. The schools have few books or other educational materials, and they were very happy to receive the booklets provided by Kuchuba'l. The materials which had been designed for adults who had only a fundamental understanding of Spanish, used simple, easy-to-understand drawings, and therefore were easy for the children in the schools to comprehend. The parents of the students were very receptive to the introduction of the materials in the classes because they felt that a more functional education should be offered in the schools and they were pleased that the children were learning something which they could apply later in life.

The program was instituted in May of 1976. At this point it is too early to see the results clearly. However, the program instituted in Quiché by the Peace Corps volunteer did not work out well because the volunteer lost interest in the project. Kuchuba'l continued the program in its own area, and the SCF Alianza started a similar approach using the OXFAM/World Neighbors-produced materials but developed their own curriculum for teaching the instructors and the children. The outcome of the program and an analysis of its impact will be conducted at the end of Programa Kuchuba'l. The staff feels, however, that more emphasis should have been dedicated to the project at the very beginning.

d. Special Classes for Relief Agency Personnel: Interest in the OXFAM/World Neighbors reconstruction project was intense from the moment it was presented to the government and to the other voluntary agencies. Numerous requests developed immediately for assistance in designing earthquake resistant buildings for use by other programs, for advice on strategy and policy, and for provision of technical assistance to help other agencies work out special construction problems. The staff realized that most of the agencies working in Guatemala had had no prior housing experience; and many of the people, especially at the field level, were completely lost and did not have any idea of what to do. Therefore, it was decided to institute a special training program in order to try and provide technical information to other agencies and to institute a forum wherein common technical problems could be aired and the field staff of all the agencies could coordinate their programs. It was also felt that this would be an excellent opportunity to try to influence other agencies to adopt reasonable programs, and to encourage them to incorporate at least some elements of the OXFAM/World Neighbors approach.

The program to assist other agencies consisted of three parts. First, weekly meetings were initiated at OXFAM House in Antigua. These meetings were divided into two parts. The first was a class which was given in English or in Spanish (on alternating weeks) which presented the basic, introductory earthquake resistant course used by the program, but which was designed to provide more detailed information for the agencies. While this class was being conducted, an open meeting was held in an adjacent room. The purpose of this meeting was to discuss common technical problems and possible approaches which could be used to eliminate or reduce the problems. Topics covered included not only those problems directly related to building, but also more general discussions of policy and approaches to reconstruction. The field staffs were encouraged to develop common approaches and to try to convince the administrators of their programs to allow all policies to originate from the field.

The second part of the program was the development of a technical library on housing and housing problems which was housed in a central location for all agencies to use. The library included the reference materials which OXFAM and World Neighbors used in preparing the educational materials for Programa Kuchuba'l, as well as references on such topics as wood preservation, use of concrete block, and numerous books on earthquakes and house repair.

The third part of the program was to develop an information exchange center whereby each agency working in housing would provide information concerning their programs, their progress, and problems for the other agencies to compare and use.

The results of this special program were wide-ranging. Programa Kuchuba'l was able to affect the policies and procedures of many different agencies in Guatemala, and was able to convince many to adopt portions, if not all, of the Programa Kuchuba'l approach. In the early stages, the open meetings (which were the most important part of this project) were effective as a means of coordinating activities at the field level. There is always a bit of rivalry between programs in a reconstruction operation and Guatemala was no exception. Some of the rivalries grew into hostilities at the administrative levels, but the field staffs (in a large part, because of the meetings at OXFAM House) were able to continue to coordinate throughout the reconstruction period.

It has been said, with some truth, that the greatest effect which Programa Kuchuba'l had was not so much on the people in its own project area, but on the other agencies operating in Guatemala. The staff feels that this program of providing technical information and assistance to the other relief agencies was one of its most cost-effective and beneficial programs.

e. Albañiles School: Early in the program, it was realized that there would be a tremendous demand on the staff to provide training not only to our own area, but also to many persons and agencies wanting the training who lived in other regions of the country. The consultant to the project suggested that a special school be set up to train albañiles from other parts of the country, and that it be headquartered in the project area. The staff, however, felt that the project would be too time-consuming and that the first obligation of the program was to carry out its promises in its own project area. Therefore, the project was temporarily shelved.

In the summer of 1976, however, the demand for assistance still ran high, and many of the staff members had been sent to various parts of the surrounding countryside to give individual classes to other programs, agencies, and villages requesting these. The additional activities were putting a tremendous strain on the teaching staff. At the same time, there was a growing awareness that there was an increasing need for well-trained albañiles in Guatemala and that the demand would continue throughout the years of reconstruction. Many people who had worked as albañiles, or as albañiles' helpers, had come to Programa Kuchuba'l requesting additional information (especially more technical information) in order to improve their skills. Therefore, in July, 1976, it was decided to begin a school for albañiles. The initial objectives were:

1. To provide training for young men who wished to become albañiles;
2. To provide advanced training for those who were already albañiles.

In addition, the schools allowed men from outside the area to attend.

The curriculum for the schools included the following courses and topics:

1. Basic Construction Knowledge:
   a. Principles of earthquake resistant construction.
   b. How to take measurements and the use of a tape measure.
   c. How wood is measured.
   d. Designing the plans for simple houses in the countryside.
   e. What is meant by "scale" in housing plans.
   f. Technical names of the parts of a house.
   g. How to lay out the foundation.
   h. Building foundations.
   i. Placement of uprights.
   j. Wood-preserving treatments.
   k. Balancing the walls; placement of doors and windows.
   l. The frame: ring beams, diagonal braces, trusses, etc.
   m. How to make X-braces with wood and with wire.
   n. Leveling masonry.
   o. How to build earthquake resistant porches.
   p. Correct placement of lamina (corrugated zinc roofing sheets).
   q. Drainage.
   r. Cement floors and tile floors.
2. The Construction of Various Types of Wall:
   a. Bajareque (traditional local construction using bamboo and adobe mud).
   b. Adobe de canto (adobe set on its side).
   c. Half-and-half adobe (bottom half of the wall is of adobe de soga

laid flat, top of adobe de canto).

d. How to make the iron armature for cement block houses.
e. How to make moulds for concrete and how to pour columns and ring beams.
f. Proportions for the cement used in pouring columns, for mortar, for plaster, etc.
g. Laying cement blocks and bricks.
h. Stucco and plaster.
i. How to remove old wooden uprights and cross braces and replace them with new ones.

3. Special Advanced Courses:

a. Installation of various types of windows.
b. Installation of bathrooms.
c. Wiring for electricity.
d. Plumbing.
e. Wood-burning stoves with chimneys.
f. Heating the home.
g. Ceilings.

During the courses, the schools try to find projects in the community to work on to provide the students with actual construction experience with the new techniques they are taught in the classes. Projects they have worked on include:

1. Private houses.
2. Community meeting halls.
3. Buildings and offices for the co-ops.
4. Buildings of the World Neighbors program staff.

2. Training Aids

Background

The materials in Vol. II were prepared by Programa Kuchuba'l as training aids for use in teaching the improved housing construction methods. These training aids are used as part of a comprehensive training program which encompasses specific courses designed for specific groups of people, including local builders, and extensionists, as well as the general population of the fected area. All the materials were produced on-site, using artists who have had extensive experience in the preparation of training aids, with text developed and written by the albañiles and office staff.

The vast majority of the people for whom these training aids are intended are non-literates or semi-literates -- rural people who speak Spanish only as a second language. Thus, the language which accompanies the drawings is presented in the local form, i.e., basic, non-formal, idiomatic Spanish.

These materials represent the end-result of a long and time-consuming process of field testing, revision, field testing again, and more revisions, finally coming to the end product. Throughout the process of developing the aids, the materials were constantly checked by the extensionists and builders. All comments made by the people receiving the materials in class were especially taken into account. Figure 4 shows the procedures used for developing the training aids.

The materials explain the fundamental earthquake resistant building principles, how to use these principles in actual construction, and the sequence of building a structure using these principles. In addition to these materials, a number of other training aids were developed for both the instructors and the general public which clarify many of the specific questions people have. For instance, one of the major problems encountered was how to build an adobe wall using the cross-bracing which is recommended for building an earthquake resistant structure. Instructors are shown how to use aids on-site which may include a model, a series of drawings, or an actual demonstration house which incorporates these principles.

The materials are used in a completely balanced training program. The presentation of the program includes both classroom and practical training. The classroom portion consists of a broad discussion of how an earthquake affects buildings and why they fall down during an earthquake, an explanation of the principles of earthquake resistant construction, and finally, how the principles can be incorporated into an actual building. It is stressed throughout that it is not the selection of materials that makes a house safe -- it is the way in which the materials are used, in other words, the incorporation of as many of the building principles as possible in each and every structure.

Many of the principles and practices which are illustrated in the materials are simply an extension of building practices already in use in the community. Some building principles or techniques which have been used elsewhere, such as the use of buttresses, were dropped due to the fact that, for one reason or another, they were not acceptable to the local people. Hence, the principles which are presented in these materials represent the maximum number of building principles acceptable to the local community, and not the maximum number of earthquake resistant principles which could be used.

Types of Education Materials:

Depending on the subject and the audience for which it is destined, a decision is made in conjunction with the field staff as to what type of educational materials are necessary.

The materials produced fall into one of the following general categories, although, in many cases, a single product may serve more than one function:

a. Information for the instructor: This is developed to acqaint the instructor with unfamiliar subjects, such as geological information, construction techniques, etc. Since the average instructor is more accustomed to written materials, these productions can be more detailed, with more reliance on text and with more sophisticated drawings. Example: Instructor's Manual.

b. Course outlines: These are brief unillustrated outlines to help the instructor organize his class in such a way that the main points are covered in a class; it is a teaching aid. The field staff is also shown how to make the outline themselves. The experienced extensionists who already know how to plan a class can then become more independent and tailor classes to meet their own specific needs. It is essentially a kind of safeguard to help ensure all the main points are covered when presenting a large group of instructors with new information. Example: Course outline for "How to Build a Safe House" course.

c. Pamphlets and handouts: These are designed to be intelligible to nonreaders, with a heavy emphasis on illustrations and minimum text. They are to be given out after a class to those attending so they may take it home with them to reinforce the new information they have just learned. These can also double as instructor's materials when the subject matter is straightforward. These are the most common type of educational materials produced and usually the pilot materials for each new subject. Example: Pamphlet, "How to Build a Safe House".

d. Visual aids for use in classes: Several aids have been developed to graphically present new information which class members would otherwise have trouble visualizing. They also serve to maintain the interest level in a lengthy class with adults unaccustomed to a classroom situation. They are useful for the instructor also, serving to keep him on the right track and remind him of the points he should be covering. A good visual aid makes a strong impact on the same drawings so that people will be reminded of what they learn in the class. Example: Flipcharts, "How to Build a Safe House". Other visual aids include the model village meeting halls themselves and miniature scale-models (with such features as detachable X-braces to demonstrate the instability of a structure without them).

Figure 4

PROYECTO KUCHUBA'L

DEVELOPMENT OF EDUCATIONAL MATERIALS

Flow Chart:

1 Consultation w/Field Staff Needs and Priorities → 2 Technical Information and Research → 3 Development of Text (-Translation, -Reworking - Rural Comprehensibility) / Advice from Field Staff / Illustration (-Rough Drafts, -Selection, -Final Drawing) → 4 Preliminary Production, Usually Mimeo'd → 5 Field Testing and Feedback → 6 Revision (Repeat until Satisfactory, back to 5) → 7 Final Production → 8 Distribution and Use

Collaboration:

Field Staff or "Educational" Staff

- -Director
- -Sub-Director
- -Supervisor of Builders
- -Extensionists & Instructors

"Technical" Staff

- -Technical Advisor
- -Artists (2)
- -Translators (2)
- -Production Supervisor/Architect
- -Sub-Director

B. Technical Assistance Program

1. Design Assistance:

Throughout the program, persons living within the program area who had particular problems in designing or laying out their house were invited to seek technical assistance from the program staff. Initially, the consultants to the program provided this service; however, in later portions of the program, the chief instructor and other members of the permanent staff were deemed technically qualified to offer this assistance. As the technical consultants withdrew from active participation in the day-to-day operations of Programa Kuchuba'l, an architectural student from the University of San Carlos in Guatemala City (who indicated a strong interest in working in the rural areas) joined the program and, after several weeks, began supplementing the staff in providing specific advice on design issues.

By the end of the first month, a number of people had requested a simple design for them to follow in order to construct an earthquake resistant house. INTERTECT therefore prepared a series of drawings which could be used as simple plans for people to follow (these plans are found in Appendix C). The number of people requesting these plans decreased when the comic book, Como Hacer Una Casa Mas Segura, was produced, as it gave a step-by-step explanation of how to build a house which people found easier to follow and read.

Analysis:

The use of technical drawings such as the ones developed by Kuchuba'l prior to the circulation of the comic book is only of limited value. The only persons who can read and interpret the drawings are those who have had extensive experience in building and in reading technical drawings. However, they can be useful as interim documents in establishing the first model houses of a construction program similar to that of Kuchuba'l.

2. <u>Cement and Pumice Block Program:</u>

As a result of the earthquake, many people indicated a desire to abandon the use of adobes in the construction of housing and switch to cement block. There were several reasons for this. First, the people believed that the adobes had failed, and that this was the primary reason for the collapse of the houses. They knew that many of the houses made of cement block had survived the earthquake with only minimum damage and, without knowing the principles behind why the houses had remained standing, they decided that it would be better to rebuild with cement blocks because they were safer than adobe. Second, houses made of cement block look very similar to those made of adobe, especially when they are covered with stucco on inside and out. Furthermore, the skill required for the construction of a cement block house is similar to that for constructing an adobe structure; therefore, most people felt that they would be able to build their own homes without too much difficulty.

Cement block houses are generally too costly for low income families to afford. After the earthquake, however, there was speculation that many low interest loans would be available from the co-op and the government, which would enable those families who had established credit to obtain loans in order to build cement block housing. At the time, there was also considerable discussion as to whether or not the government would encourage the use of cement block for houses in the <u>pueblos</u> through enforcement of a new housing and building code which was being developed. Therefore, the Kuchuba'l staff decided that a program would be undertaken by the co-op to produce cement blocks in quantities sufficient for the co-op members and the people in the assigned area to purchase at low cost.

Over the past few years, OXFAM has been working with a church group in Brazil to develop an automatic block machine capable of producing low-cost cement blocks in large numbers. As soon as discussion of a cement block program arose, the OXFAM Field Director decided that one of the machines should be brought up from Brazil for a test program. The consultant to the project argued that a low technology solution, such as producing the blocks with wooden moulds similar to those used in making adobes or using special wooden moulds in which individual families could pre-fabricate the blocks themselves, would constitute a better approach. It was decided, therefore, to run a test program using the different production methods to determine which would be best for use in the program.

At the end of the fourth week, the first of the demonstration projects took place in Tecpán. Mr. Henry Duval (a soil stabilization specialist from the firm of Trident Engineering) had been working in Guatemala for several years, trying to promote a gradual change-over from the use of adobe blocks to blocks made of stabilized pumice. Pumice is a volcanic material produced by the eruptions of the volcanoes, and it is the material of which most of the mountains in Guatemala are made. It is very similar to sand; in fact, it is essentially aerated glass and is extremely lightweight (pumice rock is lighter than water, and many of the streams and lakes in Guatemala are, therefore, covered with floating rocks). Pumice is already used in Guatemala for the production of concrete blocks; but most of the firms which make the blocks use pumice as a "cheater" to cut the proportion of sand which is used. In fact, the use of pumice actually makes the blocks stonger, because pumice and cement are one of the best bonding combinations known. It is even feasible to use nothing but pumice and cement to produce a very lightweight block. Pumice cures better than ordinary sand and in the same period of time will become almost twice as hard.

The initial test program was to construct blocks similar to adobe blocks, using the same mould and the same basic techniques, yet fabricating them from pumice stabilized with cement. An adobe mould was obtained, and a number of test blocks using various types of pumice sand and different percentages of cement were made at Tecpán. The most impressive part of the field test was the minimum amount of water that was necessary to mix the material (approximately one Coke bottle full). Normally, a gallon of water is necessary to produce one adobe block made of mud and clay. Thus, the total amount of water necessary for a family to carry to their construction site would be cut by as much as 80%.

The advantages of using this type of block were projected as follows:

a. The procedure for making the blocks and the skills required were identical to those for making adobes;

b. The tools and moulds used in making the blocks were identical to those used for adobes;

c. Large amounts of water would not have to be carried to the site;

d. If the people produced their own blocks, as they did with adobe, the only material which would have to be purchased would be cement. Distribution of cement would be much easier than trying to distribute completed blocks because most of the people have to hand-carry the material from the point of purchase to their villages, often many miles into the mountains.

It was quickly obvious, however, that this approach to constructing lightweig blocks would not be successful; Guatemalan staff who participated in the project showed no interest in the new blocks. Despite the fact that the blocks were appro imately 25% to 35% lighter, the staff felt that the local people would not use the blocks in construction. The reasons given were:

a. The cost of the new blocks was comparable to that of buying manufactured concrete blocks on the open market; the manufactured blocks would be even lighter and were considered more desirable because they indicated upward economic mobility.

b. The people felt that the blocks were not as strong as the tests indicated because there had not been enough water, river sand or cement used in the construction of the blocks. They simply did not believe that the blocks would hold up for any length of time.

c. The curing process for the pumice blocks was slightly different from that of adobe, and it was felt that if people used the adobe moulds and the same general procedures for making adobes, they would attempt to cure the blocks in the same manner, thereby making them weaker.

It was also pointed out that, while less water was necessary to fabricate these blocks, more water was necessary to cure the blocks; thus, the amount of labor necessary to produce the blocks was approximately the same.

The second type of handmade block operation which was proposed at that time was a process developed by the Novella Cement Company. The blocks which were produced resembled the blocks made in the block factories in Guatemala. A two-piece mould was made of wood, and portions of it covered with metal strips. The pumice and sand mixture, which was the same as the mixture for the blocks described above, was poured into the mould and tamped down with a wooden ram. The finished block was then placed aside to cure, and the moulds were removed. The entire procedure is described in Appendix

The advantage to this type of mould was that less material was necessary to construct a block, thereby reducing the overall cost. However, the blocks produced by the mould were fairly large; and although they were lightweight in relation to the total area and volume that they would take up in a wall, compared to a corresponding area and volume in an adobe wall, they were eventually rejected as being too large to work with. The advantage of using this type of mould would have been the ease of fabricating the moulds at various centers scattered throughout the project area, then providing them to families to take home and use, thereby making the distribution process much simpler than trying to distribute finished blocks. It was also felt that blocks made by this method would be cheaper than comparable blocks of the same size, because there would be no labor charge. Interest in the program waned, however, when Irmão Urbano, the inventor of the OXFAM block machine, arrived to begin work on the first test program with his machine.

Urbano arrived almost a month before his machine showed up. During the time he was waiting, he continued work with the field staff, trying to develop a simple block production method for the program. He had brought with him a simple hand mould which he had invented which was far superior to the moulds offered by the Novella factory. It produced a smaller, simpler block -- one which would be easier to use in an earthquake resistant lightweight wall. Because the mould was smaller, however, it required the use of a finer grain of sand and the addition of lime to help strengthen the thin walls of the block immediately after it was ejected from the mould. The disadvantage to Urbano's hand mould was that it was all metal and would have to be fabricated in a metal shop, rather than by carpenters or by the people themselves.

While Urbano was able to carry out several successful experiments relating to composition of the mixture to be used in the mould, and to produce a number of blocks in different locations using the mould which were well received by the people, the use of the hand mould was abandoned when the automatic block machine arrived in April 1976.

The OXFAM block machine is a simple vibrating platform which is electrically driven and which can produce three blocks at a time, each block measuring 3x6x10. If electricity is not available, the machine can be powered by an auxiliary diesel generator. Once the materials are at the site and mixed, the number of blocks that can be fabricated per hour represents a sizable increase over the number that can be produced by hand. As the machine produces three blocks at a time, and is quite simple to operate and maintain, a work crew of six can produce between 1,500 and 2,000 blocks per day. (A full description of the OXFAM block machine and its sequence of operation is found in the supporting volume to this study.)

The overall advantages of using the OXFAM block machine include:

a. If properly organized, more blocks per day can be produced than by hand or by other types of machine;

b. The blocks produced by the machine are lightweight and strong, and are excellent for use in earthquake resistant construction;

c. The skills and techniques used in building with normal commercial blocks and adobes are identical to those required in order to build a house with blocks produced by this machine.

The disadvantages of both the machine and the blocks are:

a. The cost of importing the machines is very high;

b. The block machine is heavy and difficult to transport; therefore, a central fabrication center must be set up and, thus, problems of distribution occur because people have to carry the blocks to their villages by hand;

c. The overall cost of the block is not substantially less than that of the blocks offered on the commercial martket. If the total cost of importing the machine and the cost of bring expatriate staff to set it up and train the teams necessary to operate it is added to the cost of operating the machine and buying the materials, the total cost could be more than buying blocks on the commercial market.

The initial tests using this block machine proved that the material which was being used was ideal for fabricating the blocks, and several other machines were then imported. The machines are only used, however, in urbanized areas where people have only a short distance to carry the blocks to their building sites. Eventually, most of the machines were installed in Guatemala City, but one block machine was set up in El Tejar for use by a branch of the co-op which made blocks before the earthquake. This machine was intended to be operated as a money-making venture for the cooperative rather than for providing large numbers of blocks to people in the project area. In fact, most of the blocks have been sold to persons living outside the area of both Programa Kuchuba'l and the co-op.

The ultimate economics of using the block machines is unclear, as the availability of cement has drastically decreased since the earthquake; and the price of cement has escalated to a point where it is no longer economically feasible to produce the blocks unless the cost of cement is subsidized by either OXFAM or the government. In a comparison of the use of the machine in El Tejar with its use in Guatemala City, it is clear that the choice of using them in the City was best.

(The initial installation of the block machine touched off a debate as to how the machine should properly be used. The inventor of the machine, Urbano, had indicated that he wished the machines to be used in a program wherein the machine was provided to a group of families. They would produce their own blocks plus 50% more for sale at a cost comparable to market value. The sale of these blocks would subsidize or substantially reduce the cost of producing their own blocks, thus enabling them to build a house for much less money. Urbano stressed that the blocks should remain in the control of the local people and the machines should be passed from family to family. His experience with cooperatives in Brazil, where they are controlled by the government, had convinced him that if the machines were not controlled by the local people, then the co-op would raise the price to a point where local people could not afford them, thus providing blocks only for the wealthier families.

(The Kuchuba'l staff argued that the situation was different and the Kato-Ki Savings and Loan Co-op assisted by World Neighbors was responsive to the needs of the poor. While the co-op would be making a profit off the sales to all persons who purchased the blocks, the profits would be poured back into the savings and loan fund of the co-op, and therefore would benefit all the members.

The consultants to the project argued that not only should the block machines be provided to the co-op, but also the plans should be provided so that the co-op could make more machines and sell them to whomever wanted to purchase them, because the blocks were by far the safest building material in Guatemala. Urbano objected to this idea because he felt the machines would be purchased by block-making companies who would produce the blocks and charge a greater price in order to make a commercial profit. The consultant countered that the poor would always be able to get the blocks from the co-op operated machines, and the fact that they kept the price low would mean that the operators of any commercial machines would also have to keep the price down in order to compete in sales. Urbano finally agreed that the overriding consideration was one of safety for people in earthquakes, and therefore consented to provide the drawings and instructions on how to make the machines to anyone who requested them. A payment for the drawings based on a sliding scale according to the purchasers' incomes was set up with all funds from the purchases to be returned to OXFAM for the housing program.)

Analysis:

The use of concrete, cement or pumice blocks to build a house in an earthquake area is highly recommended. Blocks substantially reduce the weight of a wall, and therefore of the entire house, making the house more resistant by this very feature. However, a block house must have concrete and steel reinforcing in order to be safe. Block itself, despite its lightweight properties, is only slightly safer than adobe unless it is reinforced. For poor people, the disadvantages to using blocks far outweigh the advantages, especially in rural areas.

The first disadvantage which must be considered is the overall cost of the finished block, as well as the cost of building with blocks when the use of concrete columns and ring beams reinforced with steel is added. No matter how cheaply an agency can produce the blocks, it will not be cheaper than self-made adobe, as the fabrication of adobe requires no materials which need to be purchased.

The second disadvantage is that few of the processes for making concrete blocks are that much faster than the process for making adobes. If one examines the total number of steps which are necessary to fabricate an adobe block (which include digging up the material, transporting it to the site for fabrication, mixing it with water which has been carried to the site, placing it in the mould, setting the mould and the adobe out to dry, and curing the adobe), it is easy to see that the same procedure must be followed in fabricating blocks, even with a machine. Unless the machine produces several blocks at a time, there is rarely an increase in the output nor a decrease in the total amount of labor necessary to produce a given quantity of blocks or adobes per day.

Even if the blocks can be produced efficiently and cheaply, there still remains the problem of distribution. It takes approximately 350 to 500 blocks to produce a very small, one-room house of the size used in Guatemala. If the blocks are produced on the building site, the purchasing of materials and transporting them to the site would require approximately three trips on foot. If the blocks are produced off-site, and if a man could carry five blocks at a time, it would require between 70 and 100 trips to carry the finished blocks to his building site. Thus, an agency contemplating the use of a block machine in a rural area would also have to provide trucks in order to facilitate distribution. The number of trucks necessary would probably make the program too costly.

The final problem to be considered is that of quality control. Even if the machines are easy to operate, the quality of the blocks is dependent not on the machine so much as it is on the quality of materials used, the proper mixture of the materials going into the machine, and proper curing techniques. In order to properly cure cement blocks, they must be moistened and kept under cover for a number of days before they can be set out in the sun to dry. This necessitates supplying the fabrica with adequate material to cover large numbers of blocks while they are in the initial stages of curing. Proper mixing and curing were the greatest single problems encountered in the OXFAM/World Neighbors block programs.

3. Wood Preservation:

Early in Programa Kuchuba'l, it became obvious that there would be a need to devote extensive effort in the education program to teaching local builders better ways of preserving the wood used in the construction of houses. Of the many different methods of strengthening houses which were introduced, most of them required the use of wooden posts and other wooden components. (In fact, there was an overall reduction of the wood requirements for a house, due to the fact that the roofs were being converted from tile to lamina, which requires less wood for support. However, the wood which was used in the frame was critical.) In houses of adobe de canto and bajareque, for instance, the wood was in the walls, covered up, and therefore more susceptible to damage from subterranean termites. The type of wood most available in Guatemala is a light pine which rots very quickly and is susceptible to termite infestation. It is available because it grows nearby, and, after cutting, the people do not have to carry it very far.

Another reason for stressing the use of wood preservatives is that deforestation in Guatemala is quite extensive. It means that there will be less wood available in the future, and that, therefore, the cost of replacing the wood will be much higher. Thus, it is necessary to ensure that the wood is treated to last as long as possible in order to reduce long-term maintenance costs.

Information regarding the best wood preservatives for the area was difficult to find and, when it could be found, was very confusing. Local builders have long used a combination of crankcase oil with a measure of Aldrin or Dieldrin mixed into it to coat the wood, a treatment which they feel is adequate for most needs. Several publications by the government of Guatemala emphasized that this treatment was inadequate; when it was only painted on or applied in an immersion process, it offered no protection whatsoever. The government recommendations stated that pressure treating the wood was the only way in which pine could be made to last.

After much discussion with the local builders, it was decided that Kuchuba'l would adopt an approach of teaching all the various methods which were available and recommending what should be selected according to the user's financial capability. Courses were developed which taught each process, in a progression of complexity and cost, starting with a simple treatment of burning the wood to char its outside, then lining the hole in the ground in which it is to be placed with bits of charcoal. The courses presented each method in an upward progression of cost. For the most expensive processes, the course showed how groups of families could get together and build small treatment plants out of discarded oil drums, to treat the wood with a somewhat sophisticated immersion process. (An outline of the course on wood treatment is enclosed in the supporting volume to this report.)

A number of demonstrations of each of the processes were carried out for the benefit of the instructors. They were encouraged to demonstrate these practices in the aldeas. A series of pamphlets was also developed to demonstrate the correct procedures for treating wood with the various processes. (The training aids developed for the wood treatment courses are enclosed in the supporting volume to this report.)

The second part of the wood preservation program was to provide creosote at a subsidized price so that people could afford to treat the wood with a preservative which the staff felt was the best that was available at a reasonable cost. The creosote was mixed with a carrier (in most cases, diesel or gasoline) and an insecticide was added. These were then poured into half-gallon jars which were sold by the cooperatives as part of the materials distribution program.

The third component of the wood preservation program was to explore ways in which the houses could be constructed without having to use wood at all. Where the wood requirements for a structure could be reduced, several approaches were explored, including:

1. Interlocking adobes;
2. Buttresses;
3. Construction of concrete-reinforced columns.

Each of these approaches, however, proved impractical or culturally unacceptable; and as there is plenty of wood available now, the people were more willing to utilize the wood columns and braces in the houses rather than try other recommended methods. The first two methods - the use of interlocking adobes and buttresses - were never even field tested. CARE tried a program wherein concrete columns were mass-produced, but the program had limited impact on the region in which it was tried; therefore, Kuchuba'l decided to continue to emphasize wood treatment rather than finding a substitute for wood.

Several problems were encountered in the realm of wood preservation. First, there was the initial lack of adequate information as to the best type of preservative to use and the best procedure for applying it. Al the materials developed by the government were recommendations for highly technological processes which were beyond the capability of local people to afford, even if they had been able to get their wood to the treatment centers. The extension agents, provided by the government to help the co-ops develop treatment procedures, only served to confuse the matter by recommending chemicals which were not available in the country, and a process which the program felt (and later verified) was more harmful to the wood than beneficial.

Several problems in the distribution of creosote were also encountered. The distribution itself was somewhat late due to the fact that many of the people had already installed untreated wood in their houses by the time the creosote became available. Furthermore, many of the people had purchased the lamina and other materials offered in the distribution program, and they did not come back to get the wood preservative before they began reconstruction. The program, therefore, asked the instructors and the extensionists to pass the word that the creosote was available; eventually, the amount being requested increased significantly.

Once the creosote was being used on a wider basis, other problems arose, the first being to convince people to wait after they had treated the poles with the creosote and allow them to dry properly before inserting the poles into the ground. The common practice was to paint poles in the morning and use them in the afternoon. The most widely used method of treatment was brushing the creosote onto the wood, and rarely was more than one coat of creosote applied.

It was also difficult to get the people to apply the creosote anywhere but on the portion of the post being placed into the ground. Though they complained about the smell of the creosote, cost was the major consideration, and they would only use the preservative to cover those portions which they knew would be completely covered by earth or by the wall. Several techniques were attemped to reduce the smell, and numerous attempts were made to show people that, once the poles were in the wall, they could be covered with a stucco and would not give off a bad odor. Even so, the average family used the creosote only on that portion of the wood which was actually in the ground.

C. Construction Program

1. Model Structures:

The main part of the construction component of Programa Kuchuba'l consisted of the erection of numerous model structures throughout the program area to demonstrate the earthquake resistant building principles and to serve as a means of providing on-the-job training to the builders. By establishing this component, it was felt that the following concepts could be effectively employed:

a. The best way to teach is to offer not only theoretical but also practical instruction. The learning-by-working concept was viewed as the most important part of the education program.

b. By putting a model structure in each community (and more than one in some communities), people who were rebuilding their own houses would be provided a model they could visit to check on how particular details of the structure were made. As the whole concept of Programa Kuchuba'l was essentially a self-help housing program, the models were indispensable as self-help housing teaching tools.

c. By using indigenous materials, the program was able to demonstrate that local materials could be used safely in reconstructing housing.

d. By using local people and local builders to erect the model structures, the program was able to demonstrate that all the skills necessary to build an anti-seismic house were already in the community.

e. Most importantly, by showing that local people could get together to build an earthquake resistant house, the program was able to show them that they could do something themselves without having to wait for outside help.

Priorities were developed to ensure that the persons or villages which needed the model structures first would receive them on a priority basis.

The requirements for participation in the model structure program were:

a. Generally a person or a village put up the materials; the program would pay the labor.

b. The model structure had to be placed on a site which would be visible to a large number of people. If the structure was going to be a house, the recipient of the house had to be willing to agree to let people come into the house occasionally to examine the various building details. The preferred sites were roads or paths traveled by large numbers of people on their way to market.

c. The structure had to be built with materials available in the village. The type of construction chosen had to represent a method which was cost effective and appropriate to the economic level of the village. (To begin with, all the model structures had to be built from materials which had been salvaged from the ruins; but within several weeks, this requirement was dropped.)

Most of the model structures to date have been constructed utilizing the following materials:

a. Adobe de canto: This is the process wherein the existing adobes are used by turning them up on edge in the wall. They are supported in the wall by framing them with wooden columns and either wood or wire cross-braces. Many adobe de canto houses are covered with a stucco on the inside and outside, once the building is completed.

b. Bajareque: This is a process similar to wattle-and-daub. Posts are placed in the ground at approximately three-meter intervals, and bamboo or small straight sticks are placed on both sides of the posts, horizontally, at approximately 18-inch intervals. Wooden cross-braces are placed between the columns; then the entire area between the columns is filled with mud, stabilized with straw or pine needles. Bajareque structures are an original indigenous form of architecture and building in Guatemala, and the use of bajareque structures is the most economic form of building in Guatemala today.

c. Half-and-half adobe: This process is used in building larger structures. Adobe is built in the usual manner to a height of approximately one meter, and then adobe de canto is used to finish the remainder of the wall. This lightens the overall weight of the wall and keeps the weight and center of gravity of the house fairly low. When used with a lightweight roof and vertical columns, as well as cross-braces and ring beams made of wood or barbed wire, this type of construction is not only economical but also very strong and earthquake-resistant.

d. Adobe and wood: In the very beginning of the program, many of the people were still hesitant to use adobe for the entire structure. Hence, a number of houses were built which used adobe only to a height of approximately one meter, and the remainder of the wall was constructed of wood. This was very similar to the types of houses being built by the people themselves at the time Programa Kuchuba'l started, and therefore, it was a logical place to begin in teaching the new techniques.

The bajareque and adobe de canto houses were, by far, the most popular of all the model structures. Both could be built within a price that most people could afford. Many people were surprised to find how well a bajareque structure could be made and how strong it could be, using some of the new techniques. A bajareque house using a lamina roof is by far the safest method of building in Guatemala. Unfortunately, in the last few years, the bajareque method of construction has been generally scorned by the general public; in fact, the Oxford English/Spanish dictionary refers to bajareque as "a shack, a hovel, a poor man's house". In encouraging people to return to the use of bajareque structures, the program not only had to overcome this stigma, but often had to reteach the skill of how to build this type of house. Much of the stigma was overcome when one of the instructors pointed out that many of the houses which had survived the earthquake had been made of bajareque, and a field trip was arranged to visit a school in San Antonio Aquas Caliente made of bajareque which had received only superficial damage. On the field trip, the builders noticed that the difference between the houses in the towns and those in the rural areas was that the ones in the pueblos were covered with stucco inside and out. Without chipping away the stucco, it was impossible to tell whether or not the house had been made of bajareque or adobe. Therefore, a person could build a bajareque house, and it would look just as if it were made of a more expensive building material, a point which was not lost on the builders. The addition of the stucco cover has been the most important innovation in changing the image of bajareque.

In addition to the houses mentioned above, several test structures were erected to attempt to introduce new building methods. One of these used "California" stucco. Two of these structures were built in the Tecpán region and, although popular with the occupants, they did not catch on, and no more were built.

A number of houses to be made of cement block (both of the normal blocks which were available commercially and of the blocks produced by the OXFAM block machine) were scheduled to be built in the program area. However, many problems arose including the sudden rise in the price of cement and lime, and the construction of the models was postponed indefinitely. In Guatemala City, where OXFAM (alone and not with World Neighbors) was conducting a housing program in the marginal areas, a number of model cement block houses were built. Despite requests from some of the builders who were interested in learning how to build a cement block house, however, none were erected by Programa Kuchuba'l in the project area. The program staff felt that cement blocks were beyond the capability of the rural people to afford, and therefore, this received a low priority.

When the first plans were made to erect model structures, it was proposed that a number of models be built with cane walls and thatched roofs. This idea was discarded because CARE was conducting a large shelter program which provided free lamina, providing that the people built a wooden frame with cross-braces. The main type of material that people were putting on the outside was cane; and the Programa Kuchuba'l staff felt that this was ample demonstration of how to build a cane-walled house. It was also felt that most people in houses with cane walls would want to change them as soon as possible; therefore unless proper techniques for construction with the heavier materials was demonstrated, many would go back to using the old construction methods, ending up in unsafe dwellings.

The Kuchuba'l staff felt that a number of demonstrations should be made showing that indigenous materials such as grass could be used for roofing. However, most of the people in the project area had lived in houses with tile roofs before the earthquake. Tile roofs had become a status symbol and one which had taken many people years to attain. Lamina also was a status symbol in the community and people were willing to switch from tile roofs to lamina, but were not willing to switch from tile back to thatch, as this was viewed as a step backward in status. Despite numerous attempts by the staff to encourage the local builders to erect houses with grass or cane roofing material, all the villages and individuals building model structures opted for the use of lamina for the roof.

2. Model Village Meeting Halls:

By far the largest number of model structures built by Programa Kuchuba'l were the model village meeting halls (or community centers) which were erected in the vast majority of aldeas of the municipios of the program area. In a report to the Lilly Foundation in November 1976 (the mid-point of the program), the staff described the program as follows:

The benefits of the model village meeting hall program can be divided into two categories. The first concerns the communication of earthquake resistant building techniques; the second concerns community organization.

a. Results relating to the communication of earthquake resistant building techniques:

1) In 48 villages, there is now a model demonstrating anti-sismic construction. These are centrally located in the village so that those wishing to copy this type of construction when building their own houses will conveniently be able to do so.

2) Since the village is responsible for providing the majority of materials, which must be indigenous to the area, we are demonstrating that local materials can be used safely to build earthquake resistant houses.

3) Each one of these models represents the practical on-the-site training of the local builder who was in charge of the construction. In each case, he was from the village where the model village meeting hall was constructed. Therefore, 48 locally recognized builders have thus far been trained in 48 widely scattered villages.

4) The labor for the construction of each model meeting hall is provided by the villagers. Thus, many men in each community also received actual construction experience using earthquake resistant principles.

5) The planning, construction and inauguration of the meeting halls provide several very good opportunities to give additional instruction on safe house construction. The extensionists give an introduction to earthquake resistant building techniques when introducing the idea of a model meeting hall to village leaders. A formal class is given the day the building is laid out (somewhat like a ground-breaking ceremony), and at the inauguration. Pamphlets on how to build a safe house are given out to all attending.

b. Results relating to community organization:

1) We feel that the presence of a community hall within the village will greatly stimulate and facilitate community meetings. In many of these villages, this is the first time that the village mayor has had a special place where he can meet with the other town leaders to discuss matters of interest to the community. In addition, many halls are already serving for agricultural classes, health and nutrition classes, literacy classes, and for road work meetings.

2) Just to build the village meeting hall requires a degree of community organization. All decisions concerning the meeting hall, such as the organization for supplying materials and labor, were the responsibility of the village. Since the village is providing the major portion of the materials for the construction, the village also decides what size and shape of building they are willing to undertake.

The program pays for the roofing materials (lamina) and any materials which need to be purchased (such as nails and barbed wire) outside the community. The upper limit on roofing material supplied by the program is 30 sheets of 9-foot corrugated galvanized roofing. The majority of the villages want to make as large a building as possible, although some prefer to use part of the roofing material to make a corredor.

The program also pays the salary of the mason selected by the village to be in charge of the construction, since no villager is in the position at this time to donate a full month of work without pay. The rest of the labor is donated by the village.

Since the village provides the materials for the walls, the community must analyze what they have and decide what type of wall construction they will build. The majority of the village halls have been made of adobe de canto or bajareque.

3. Model Church Construction Project

Background :

One of the first construction projects to develop after OXFAM and World Neighbors signed the letter of commitment with the government was a project with the parish priest in Santa Apolonia to build a series of model structures throughout the Santa Apolonia municipio, which could be used as community meeting halls as well as small parish churches.

Santa Apolonia is a small town approximately 5 kilometers from Tecpán. Although it is only one-tenth the size of Tecpán, it still has its own municipio (municipal district). Santa Apolonia is the only pueblo that OXFAM and World Neighbors agreed to assist in a reconstruction program. The agencies had agreed to work there because they had had extensive activities in the rural areas surrounding Santa Apolonia and because the parish priest (an American expatriate) was a close personal friend of the World Neighbors staff. The priest was on the local reconstruction committee, and the leaders of the church had a history of involvement in social projects. Thus, it was felt they would be a good resource in conducting the program.

The church at Santa Apolonia had been entirely destroyed during the earthquake. (It had just been rededicated after a three-year reconstruction program in which the building was remodeled and upgraded.) In addition, in the aldeas of Santa Apolonia, there were numerous small churches which had been destroyed. These churcheswere a part of the parish of Santa Apolonia. The central parish church wanted to help the villages rebuild their chapels and was planning on providing certain financial help to build the structures if the villagers would donate salvaged adobe, newly-cut wood and other materials and provide the labor. The priest asked Programa Kuchuba'l to help design and supervise the construction of the chapels so that they would be anti-seismic. Programa Kuchuba'l saw this as an opportunity to have a demonstration earthquake resistant structure in each one of the villages and, therefore, agreed to assist.

The final agreement was as follows:

a. Programa Kuchuba'l and the parish would build one large temporary church, made of materials salvaged from the damaged church at Santa Apolonia. This would be used as both an interim church and a community center. The parish would provide all of the materials. Programa Kuchuba'l would provide one albañil whom they had trained in earthquake resistant building techniques, and the people of the parish would donate the labor. The construction of this building would train local builders who would then return to their willages to construct smaller churches, incorporating these building techniques.

b. The small chapels in each of the aldeas would be built under the supervision of Programa Kuchuba'l-trained albañiles. These chapels would also be used as community centers for the aldeas. The villagers themselves would provide the materials, except for lamina and other materials which had to be purchased, which would be provided by the parish. The villagers would donate all of the labor. Programa Kuchuba'l would train the local builders, provide trained albañiles to supervise the construction, and give classes in each of the aldeas in earthquake resistant building principles.

Results of the program:

Only the first part of the agreement was carried out. The large, temporary church was completed at Santa Apolonia just before Easter (mid-April), but it had taken two months to build. Because of the time involved, there had been many problems, especially in continuing to get volunteers from the parish to work on the structure. (No builders came and many people who were requested to help sent their teenaged sons who didn't have any building experience.) The albañil who had been trained by Programa Kuchuba'l, who was to supervise the other albañiles and train them, quit after the construction of the church at Santa Apolonia. Due to all the associated problems, the church lost interest in working on the smaller chapels, and the program ended upon the completion of the church at Santa Apolonia. Programa Kuchuba'l later began construction of village meeting halls in many of these same aldeas and used the same formula for participation as in other program areas.

Analysis:

Several lessons were learned from the proposed program which bear mentioning. The construction of the church did have a small effect on construction practices in rural aldeas. Several aldeas later organized to build model structures. Some of the builders assigned to their construction journeyed to Santa Apolonia to look at the church and get ideas on how to build their own model structures. Several of the builders said that the large, outsized structure was very helpful because it clearly showed the details of how to join things together and was thus easy to study. As a model for large groups of people, however, the concept of building a centralized model for many people to see proved not to be valid. People who wished to copy it would have to leave their villages and go into the town in order to study it, a practice few people undertook. In retrospect, the approach of building many small models in the aldeas themselves was far better.

As far as the concept of building one large church first and then working in the other areas was concerned, this type of undertaking would probably have had a negative effect had it worked as originally planned. Had a number of albañiles come to Santa Apolonia as planned to build the church, they would have been taken out of the aldeas at a key time to work on a structure which would have only limited benefit to their own area. Furthermore, it is doubtful that builders would have learned much only working on a piecemeal basis of a week or two at a time on a project that took a total of two months.

D. Salvage Program

Background:

By the end of the second week, every major town in the highlands area had been assigned a crew of bulldozers to begin removing the rubble. The teams were made up of crews from the Department of Roads, from private contractors, from construction firms owned by the larger families, and a large contingent from the Mexican Government's Department of Works. The first task of the bulldozing crews was to open the roads in each of the towns; and during the first two weeks, they concentrated primarily on this aspect. By the end of the second week, however, they began to clear the debris, block by block, from both commercial and residential sites.

The staff of OXFAM/World Neighbors became alarmed at the extensiveness of the bulldozing, which seemed to stop for no one and respect no one's property rights. In theory, the bulldozers were only to clear individual homesites at the owner's request. But as many of the owners were not present during the day, the bulldozers moved through the area sweeping up the debris, depositing it in trucks, taking it some distance out of town, and dumping it down the barrancas. Most of the people in the town did not resist these bulldozing activities. The OXFAM/World Neighbors staff, alarmed at the way the operation was being handled, tried several times to intervene with the bulldozing crews in order to slow down the bulldozing, but these efforts were generally unsuccessful. As the staff knew that the villagers had to have access to these materials in order to reduce their reconstruction costs, it was decided to attempt a model salvage project.

Project Activities:

The proposed program was divided into two parts. The first was to conduct a series of demonstration salvage projects to illustrate to the people what and how much could be salvaged from a damaged house. The second part was to encourage the co-ops to start a program to buy salvagable materials, especially those from larger commercial and residential buildings which were certain to be rebuilt from entirely new materials. The co-op would hold the salvaged materials and then resell them when reconstruction activities got into full swing at a price slightly above what they had paid for them. In this way, it would be possible to reduce the cost of new materials to the lower income families. In addition, the purchase of salvaged materials would have several added benefits. First, it would provide needed money for immediate needs for a certain number of people, both by allowing them to sell their materials and by creating jobs for people working on salvage teams. Second, it would make sure that there was a cheap source of materials, especially wood, for low income people in the future. Third, it would demonstrate to the people that there was a value to the material in the rubble, and would encourage them to save the material rather than allowing it to be bulldozed.

Results:

Only one model salvage program was actually carried out, in Tecpán. There were many problems, including the fact that it was too successful. The way in which the program was conducted originally was that Programa Kuchuba'l would offer to supply a team to salvage the materials, and in return for the labor, Kuchuba'l would receive one-half of the materials. (These materials were to be utilized in the building of model structures throughout the town.) Unfortunately, when the owners saw how much material was being salvaged, and realized the value of the material, they backed out of their agreements. Finally, Kuchuba'l had to acquire its own site to conduct the demonstration project.

There were other problems, also. First of all, the co-op did not like the idea of paying for the salvaged materials, because they felt that it would increa the looting. Several co-op leaders had already been hit hard by the looters and did not want to see their building materials carried off.

In the towns, the bulldozers were difficult to stop anyway. There seemed to be an increasing frenzy building up around the bulldozing. The more they worked, the harder they worked; and despite many efforts to try to control them, they generally bulldozed anything they felt like doing. (It was an interesting pheno-menon to watch the egos of the bulldozing crews build up over the two or three month period in which they worked in these towns. Eventually everyone came to despise the crews, which only seemed to make the situation worse.)

In the rural areas, the people did not have a bulldozing problem, as the onl bulldozers that came in their direction were mainly to open the roads. Thus, the people had time to salvage whatever materials they wanted, and there was no dange of the materials being thrown away as it would have taken too much effort to move the debris any distance. Thus, the emphasis of the salvage program changed from demonstrating to people what to salvage to teaching, in the education program, how to tell if it was possible to re-use materials such as adobe or wood which had been reclaimed from the rubble.

E. Materials Distribution Program

Soon after the earthquake, the materials distribution program got underway. The first purchase of 2,000 sheets of lamina, which was to become the central material of the distribution program, was made on 10 February on the speculation of the OXFAM staff in Guatemala City. At the meeting of the 14th, the decisions relative to the initial purchasing and distribution network were made. Because the co-ops were not yet back in operation (as well as an unsettled policy of eligibility), the distribution was started by the World Neighbors staff in Tecpán and San Martín. Two weeks later, the Kato-Ki co-op took over distribution in Tecpán and, on 15 March, took over in San Martín.

Following the meeting on the 14th, OXFAM moved to purchase substantial amounts of lamina, both locally and in neighboring countries. These moves were for the following reasons:

1. Lamina was the number one priority of the people for reconstruction. Even before the earthquake, people with sufficient resources were buying lamina, and it had a high level of prestige and cultural acceptance.

2. Due to the earthquake, demand for existing supplies in Guatemala was more than could be met with the supplies on hand. The distributors' market in Guatemala City was chaotic. Distributors made sales of small quantities of lamina, required cash in advance, and then did not deliver. The OAS made a donation of US$500,000 to the National Emergency Committee for a purchase of about 100,000 sheets of lamina, virtually the entire production of the only national source, Galvanizadora Centroamericana (GALCASA), a subsidiary of a U.S. corporation. This transaction ruled out Guatemala as a viable source of supply for other agencies.

   Pre-earthquake Central American stocks of lamina were also inadequate to supply the needs in Guatemala. However, El Salvador did have a processing plant, and if supplies could be produced, they could be delivered relatively easily (in some cases, within a day).

3. Lamina was selected for several reasons: First, it is a lightweight building material. When used as roofing, it is not only durable, but, more important for building in an earthquake zone, it substantially improves the performance of a structure in tremors. (It has been estimated that a lamina roof improves the survivability of a house in an earthquake 40-60%, depending on other factors such as the height of the walls and the balance of the structure.)** At the time of the decision, the exact engineering principles involved were not known, but everyone was able to see that the roofs were less lethal than clay tile and that distribution of lamina was the quickest way

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*Much of the following material is reprinted from the Personal Termination Report, Gersony, Jackson, and Froman, Guatemala City, March, 1976.

**W.F. Reps and E. Simlu, Design of Housing to Withstand Earthquakes and Windstorms, N.B.S., 1975.

to see that as many people as possible would have a durable roof "by the start of the rainy season" (a time constraint that was perceived by all the intervenors).

Second, the OXFAM field director felt that lamina offered a solution to the emergency shelter needs of the victims and at the same time, because lamina could be reused many times, OXFAM could make a contribution to reconstruction. At that time, most people had already built an improvised shelter, and the lamina could be used to improve it. The director also approached Ian Davis, an architect with UNDRO, to design a simple A-frame shelter that could be made from the lamina, which could later be disassembled and reused in building a permanent house. (This latter proposal was never carried out due to the fact that everyone either built their own shelter or intermediate house or began reconstructing permanent housing.)

Initial Purchases:

Through the assistance of the United Nations, OXFAM initiated negotiations almost immediately with Metales y Estructruas de El Salvador, S.A. (METASA), a subsidiary of the United States Steel Corporation in San Salvador. (U.S. Steel also owns the Nicaraguan METASA factory.)

OXFAM made the following purchases from METASA:

26 gauge		28 gauge	
7,500 sheets	8 feet		
25,000 sheets	9 feet		
55,000 sheets	10 feet	7,500 sheets	10 feet
70,000 sheets	12 feet	7,500 sheets	12 feet
157,500 sheets		15,000 sheets	

TOTAL: 172,500 sheets

In addition to these purchases, OXFAM bought about 8,000 sheets locally, bringing the total up to about 180,000 sheets.*

Prices and Conditions of Purchase:

The price of lamina in Guatemala before the earthquake was 50¢ (all prices in U.S. dollars) per linear foot, for 26 gauge. A discount of 5% was obtained through the United Nations, and the normal 2% import duty was waived.

Immediately after the purchase, the replacement cost for this lamina went up to about 60¢ per linear foot, an increase of 20% caused in part by a jump of about 20% in the international price of the raw material, and in part by additional increases due to local market pressures.

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*Note: OXFAM's total purchases of lamina amount to about 2,000 short tons of steel, or about 2.5% of the lamina consumed in Central America in one year.

Due to the proximity of the factory and its same-day delivery of production, distribution started almost at once and transport costs were kept to a minimum. In addition, at least one set of loading and unloading charges was avoided when the factory agreed to deliver the lamina directly to the distribution point in Tecpán, at a very slight additional cost.

The delivery schedule was set as follows:

about 120,000 sheets		within 6 to 8 weeks
12,500 sheets		during May
40,000 sheets		during June

A large part of the delivery could be made within the first 6 to 8 weeks because, by chance, the producer had a good quantity of steel-roll stock on hand.

The METASA contract offered one excellent advantage, through the following payment schedule:

for the first 120,000 sheets	30 days after final delivery
for the second 12,500 sheets	30 days after final delivery
for the third 40,000 sheets	30 days after final delivery

As a result, about $30,000 to $35,000 in interest was saved, versus the usual conditions of cash in advance or at delivery.

An analysis of the total financial transaction, including savings, appears in Table I .

With the quantities purchased, and estimating ten sheets of lamina per family, a good, basic roof could be provided for up to 18,000 families - almost all before the beginning of the rainy season, the rest within the first 30 days thereafter.

Options for the Distribution of Materials:

OXFAM had acted quickly to purchase these materials, but considerable time had been spent in trying to establish a policy for distribution that would be both equitable and at the same time serve those who most needed the material.

Three principal alternatives were discussed for the distribution of lamina:

1. Free gifts. Some agencies proposed that lamina be given away at no cost to the recipient. Under this system, all families, regardless of their economic capabilities, would receive free lamina.

   The weaknesses of this system are:

   a. By providing materials free of charge, no financial return accrues to the agency making the gift. Because lamina and other construction materials are expensive, and because most agencies have limited funds, this give-away policy restricts the agencies' ability to cover a wider area.

TABLE I

METASA PURCHASE: FINANCIAL ANALYSIS

		Actual Cash Costs	Accumulated Net Savings
1.	Amount of Purchase (before discount)	US$ 973,220.00	
2.	Minus 5% Discount	- (46,345.00)	US$ 46,345.00
3.	Actual Transport Costs	48,700.00	
4.	Expenses Avoided:		
	a. 2% Import Duty		19,464.00
	b. Loading, unloading, and additional transport avoided through direct Tecpán delivery system.		7,000.00
	c. Net benefit of 90 days on full purchase, using contracted credit system calculating interest at 1% per month (standard local rate).		32,000.00
5.	Increased Replacement Cost: Purchase: 50¢ per linear foot Currently: 60¢ per linear foot estimated replacement cost. Difference: 10¢ per foot = 20% higher than actual purchase, minus 5% of the difference which might have been discounted.		184,912.00
	TOTAL	US$ 975,575.00	US$ 289,721.00

b. A strong feeling existed among groups with experience working in Guatemalan rural areas that giving things away was not harmonious with ongoing development programs in the area and that recipients would lose their sense of dignity as the result of a "charity" approach.

However, one of the strengths of the give-away system, theoretically, is that people who simply could not afford to buy lamina, such as widows, the elderly, and others left virtually defenseless by the disaster, would still receive roofing materials.

2. Long-term loans. Proponents of this system argued that people did not have cash to spend on roofing materials right away, but could pay the full costs of the materials plus interest and administrative charges on a long-term basis. The problems with this approach are:

   a. The staff estimated that the loans would cost about 30% to administrate just in the first year.

   b. The repayment of such loans is always doubtful, and by making unrealistic loans, it would undermine the rural credit system which has been built up over the years.

   c. In the end, the add-on costs of administration would have to be added to the cost of the materials.

   d. There were no existing rural credit facilities capable of providing this type of service.

   e. The people did not like to undertake loans because they believed that their land would be placed in jeopardy if they did not repay.

3. Cash subsidy. Under this system, it was proposed that lamina be sold to people at a significantly reduced rate, usually about 50% of cost. The most apparent weakness of this system is that there are people who cannot afford to pay for lamina at any price.

   However, the advantages of this system are:

   a. If the people pay 50% of the cost, lamina can be supplied to double the population covered under give-away plans, since this money can be reinvested in further lamina purchases.

   b. The choice of whether or not to acquire lamina (as opposed to other available roofing materials), as well as some choice regarding gauge, size, and quantity, are left to the consumer.

   c. The system turns over cash immediately.

   d. It is simple to administrate. Costs, complexity of administration, and problems of distribution are minimal.

   e. The consumer is involved in a commercial transaction, not a charity scheme.

The OXFAM Subsidy Plan:

The opinion of local residents of the rural areas, as expressed through World Neighbors extensionists (who are from these areas and work closely with farmers); community groups from the areas, including local ad hoc emergency committees; and individual local people, was, more or less universally, that most people could and would buy lamina at a subsidized rate. A reduction of 50% of cost price was suggested. Several local groups said they would prefer to buy good quality (26 gauge) lamina than to receive inferior qualities (34, 36 gauge) at no cost.

However, the subsidy plan still left out those who couldn't afford lamina, even at the reduced price.

In response to its chief concerns, OXFAM made the following compromise plan:

1. To make lamina available at roughly a 50% subsidy price.
2. To undertake surveys at a later date, to ascertain which families were not able to acquire lamina through the subsidy system. For families who could not afford to purchase lamina, either:
   a. A lamina-for-work program would be set up for families who could provide some work, or
   b. A gift of the lamina would be made to families who could not provide any work.

This type of plan was possible because of the extensive local contacts and organization provided by the World Neighbors extentionists and staff.

Initial Distribution System:

Two distribution systems were being tried:

1. In San Martín, people came to the distribution point individually, as heads of families. Their identity document (cédula) number was noted in a card system to insure that no family received more than one lío (ten sheets) of lamina.

   Because of road damage, only small trucks could initially reach the San Martín distribution point, so the trailers from El Salvador were unloaded in the OXFAM Guatemala City warehouse (loaned by the Phillip Morris Company). Loads of about 400 sheets were then sent to San Martín.
2. In the other three municipalities, local villages (aldeas, etc.) were asked to organize themselves, to insure that only one lío of lamina went to each independent head of a household, and to collect the funds and arrange transportation from the Tecpán distribution point. The same identification control system was used by the distribution center, but lamina was dispatched on a village-by-village basis.

   The lamina reached Tecpán in the trailers that brought it from El Salvador. Each trailer could carry approximately 2,000 sheets. Once in Tecpán, it usually took about two hours to unload, sell, and dispatch a load. Usually, there were a number of village representatives ready to take delivery as soon as the trailer arrived.

   The subsidized sales prices were:

26 gauge:	30¢ per linear foot
28 gauge:	25¢ per linear foot

After the 15th of March, all distribution was taken over by the Kato-Ki co-op. In return for its services, the cooperative received a per-sheet commission, which covered its expenses, overhead, and included a small profit. In addition, its 600 affiliated families who did not live in the four municipalities assigned to OXFAM were permitted to purchase one lío of lamina each on the subsidized basis.

Although the cooperative provided this service, the sales were open to the general public without respect to their cooperative or other institutional affiliations. This was especially important because, in this area, only 5% to 7% of the farmers are co-op members (versus 2% national average). The cooperative thus served the community in the widest sense. With a long-range view of the cooperative movement in mind, this was considered a good strategy, as was the approach of providing a service and charging a small commission.

Other Materials:

In addition to lamina, Kuchuba'l sold other materials. In the initial program, nails, plastic sheeting, and some other building materials were sold. As the scope of the entire OXFAM reconstruction effort changed and as new construction methods were introduced in the education program, it became necessary to expand the number of materials offered. Appendix E lists the materials that were eventually sold by the program. (Section III, B of this volume discusses the efforts of OXFAM to provide wood.)

Later Distribution System:

After the initial distribution of lamina and other materials was complete, the program determined that reconstruction was going to be a larger process than originally estimated and that continued availability of subsidized building materials would be necessary in order to have a continued report on changing construction methods in the area.[5] However, the marketing system used during the first six months of the program was not suited to the slower pace of building and was too costly to maintain. Thus, OXFAM proposed that a number of stores be set up and operated by the Co-op where individuals would come in and buy the construction materials they needed "over the counter". Prices would continue to be subsidized and the amount sold would remain limited on many of the items (again by checking cédula numbers).

Issues Relating to the Distribution Program:

The materials distribution program generated many issues and policy questions which had to be answered throughout the conduct of the program. The initial issues related to whether or not the program should sell, give away, or subsidize lamina have already been discussed in detail. However, there are several other issues which arose and which bear mention.

1. National lamina distibution policy. From the very beginning, the OXFAM staff in Guatemala City was active in trying to get the government to adopt a uniform policy for the distribution of lamina. OXFAM had already decided that it would subsidize its lamina sales and felt that this policy, being both a realistic approach to the problem of massive

material distribution and also consistent with the wishes of the local people, should be adopted by the government or at least by all the foreign relief agencies. Initially, the government rejected this policy, for it felt that the victims should not have to pay for anything. However, after a number of discussions with the OXFAM staff, the government changed its mind and requested voluntary agencies to follow such a policy. Several agencies, however, most notably CARE, refused to go along. They pointed out that, in their advertising in the United States, they promised not to sell the materials. In fact, many of the materials had been donated to them under laws or agreements which expressly prohibited their sale. Therefore, they were determined to give the materials to the victims at no cost.

These programs caused many problems for those organizations which were selling materials. Many agencies which had worked in Guatemala for a long time and had undertaken subsidy programs were severely criticized by the people with whom they had been working for years because they wouldn't give away the materials as agencies in neighboring areas were doing. Programa Kuchuba'l's educational efforts were especially hampered by the CARE program (see the evaluation report by Paul and Charlotte Thompson), as were other agencies who were attempting educational programs along the lines of Programa Kuchuba'l.

2. Use of reflow funds. As the lamina distribution program expanded far beyond what had originally been planned, massive amounts of money came back into the program. As originally planned, this money was re-invested into the materials distribution program, and the money was used to buy new materials, which, in turn, were sold, and again the money was reinvested. There were questions, however, as to whether or not all this money should be put back into the materials distribution program. Once the initial distribution was completed, and most of the people had their first ration of lamina, there were a number of people who proposed that the money reflow be placed back into the communities in a series of work programs. It was suggested that the reflow funds be turned over directly to the communities, based on the amount of lamina which had been purchased, and that this money be used to finance local or village projects. Several other programs which utilize the same approach as Kuchuba'l used their reflow funds in this manner. For example, the Save the Children programs in Joyabaj and Quiché turned the money directly over to the communities to let them use it as they wished for municipal projects.

After much discussion, it was decided that the reflow funds would continue to be reinvested in materials. OXFAM obtained another grant to provide money to instigate a road construction program. (This program is described in detail in Section III,D of this volume.) There are two reasons why Programa Kuchuba'l chose to reinvest the reflow funds into the materials distribution program. First, the program, by this time, was being operated by the cooperatives, and it was felt that any money that was left over could be used by the cooperatives to help them further develop their services to the members and to the community. Second, it was felt that by making the money available to the communities, it would be used to finance projects which were normally carried out by the people voluntarily, thus destroying a tradition which was felt to be one of the most positive aspects of the rural social system. (The roads program, which was undertaken by OXFAM, is not considered to affect this community tradition, as the Roads Department of Guatemala normally pays village laborers to improve the roads in their communities.)

It is too early to tell whether the provision of the reflow funds directed to the communities by the other relief programs will have a long-term positive or negative impact.

3. Requirements for obtaining lamina. As soon as the OXFAM/World Neighbors team decided to undertake a housing education effort, a question arose as to whether or not those receiving the building materials should be required to attend building classes before they obtained the lamina and other building materials. It was argued that this prerequisite would assure that a larger number of people were familiar with safe methods of construction for the materials which they were purchasing. (Several other programs which had both educational components as well as materials distribution utilized this approach.) In the end, however, Programa Kuchuba'l rejected this requirement for the following reasons:

   a. There were not enough trained staff to carry out such a program at all the distribution centers.

   b. It was felt that by requiring people to attend the classes, distribution would be slowed down.

   c. Some members of the staff felt that to force people to sit through the classes would make them resent the educational effort, and thereby, they would reject the use of the building techniques.

   d. The consultant felt that the reconstruction process would take place over a number of months and that very few people would remember the things taught in the classes or given out when the people purchased the materials.

   It was suggested that a pamphlet on the sequence of building a safe house be provided with the lamina, and also that simple pictures or instructions depicting ways in which materials could be used safely be attached or pasted onto the lamina. Neither of these approaches was used, however, due to the time it took to produce the pamphlet and the fact that other needs diverted the production of the paste-on.

4. A restricted sales policy. Another question which arose after the education program had been set up was whether or not materials should be sold only to those people who would agree to build an earthquake-resistant house or agree to use a certain number of the techniques advocated by Programa Kuchuba'l. Again, several other programs adopted this approach. (It was controlled by having persons building the house obtain their materials through a program-certified albañil.) Programa Kuchuba'l, however, decided to continue to sell materials to anyone who applied for them. There were several reasons, but most important, the program decided that it had an obligation to provide the information to those who wanted it, but did not have the right to force people to build using these techniques.

5. The experience of Programa Kuchuba'l points out one of the most important factors to consider when setting up a post-disaster housing program: timing. It is especially important in rural areas and in any area where indigenous materials, such as adobe, are used for the majority of the structure. In every country, there is a traditional building season; that is, the time when people have the combination of time, money, and materials to devote to housing. If any one of the three elements are not present, then people will not be able to build.

In Guatemala, the earthquake struck during the traditional building season. In most cases, people had some money (from crops) and in many cases, they had access to materials. However, they did not have the time, for they spent that time recovering from the earthquake and tending to the normal agricultural cycle, which they viewed as a greater priority. Most of the people built makeshift structures which would get them through the remainder of the year and into the middle of the following year. The relief agencies and the government, however, concentrated their housing activities in the immediate post-disaster period, in an attempt to construct as many houses as possible before the rainy season, which came three months later. By the end of the rainy season (nine months after the earthquake), the vast majority of the agencies had ended their housing operations.

A year later, at the end of the harvest, the people were ready to begin construction, for now they had the money from the sale of their crops, the materials, and the time. But most of the housing assistance which had been available immediately after the disaster was gone. The few agencies who were still operational were not prepared for the demand and, thus, an opportunity to affect the permanent housing of the majority of the population was lost. Any agency which undertakes a housing reconstruction program must operate within the time constraints of the victims, not their own, and agencies making commitments to assist in reconstruction must be prepared to make a long-term commitment.

III. SPECIAL PROJECTS

A. Seismic Analysis and Geologist's Reports

Immediately following the earthquake, there were numerous fears concerning the cracks and landslides which had been caused by the quakes. There was also the fear that the earthquake would trigger new volcanic activity and that some of the cracks (and, especially, hot springs) represented the initial stages of a new volcano. In response to these fears, INTERTECT retained a geologist to visit the project area and to check various sites which were causing concern among the local people. Specifically, the geologist's responsibilities included the following:

1. To conduct an extensive inspection of the geological changes in the area, in order to determine the sites of villages or houses which were vulnerable to further damage from either renewed tremors or from other earthquake-generated phenomena;
2. To determine the sites which would be safe for the relocation of houses from areas which were vulnerable;
3. To help in determining the new faulting patterns in the area, and to advise on seismic risk throughout the area;
4. To examine various landslides which had slid into the bottom of valleys and subsequently dammed up various streams and rivers in the area; to determine whether or not there would be potential problems arising from the lakes created by the damming, and also to determine whether or not these temporary dams would be able to hold the rising waters or would have to be bulldozed before they collapsed and created flash-flooding downstream;
5. To work with the housing program in the initial training of staff, to underscore the need for rebuilding earthquake resistant housing.

This last point was one which the program considered to be of utmost importance, for Guatemala is one of the most active seismic areas in the world. Guatemala is one of the few countries in the world where three major tectonic plates come together and two major faults run through the country.

When an earthquake occurs along the Motagua fault, as it did in February of 1976, it has often been followed by a second earthquake which occurs along the Cocos Plate, which lies off the southern coast of Guatemala. Therefore, all the staff felt that it was of vital necessity that the geologist visit the project areas, in conjunction with the training programs, to explain to the instructors and to the villagers the importance of constructing earthquake resistant houses, due to the fact that the seismic risk was still great and future earthquakes could be expected with the same intensity of the earthquake just past.

While the geologist was working in the project area, he received a request from the city of Antigua to examine some of its flooding problems. Therefore, he spent several days working on flood control recommendations for the municipality.

The final role of the geologist was to address a meeting of the field staff of all the voluntary agencies working in the earthquake-affected region, to inform them of his findings for the project area. He also pointed out to them how they could make simple investigations along similar lines in their own areas.

The various geologist's reports are contained in the supporting volume of this study.

Comments:

It is felt by the staff that the geologist played a vital role in calming many of the fears of the local people following the quake. By sending him out to work directly in the villages, to answer questions and to check various faults and landslides, he provided a direct response to one of the villagers' most immediate security needs.

B. Wood Projects

Proposals:

From the beginning of the program, the staff of Kuchuba'l was worried about where the people would find the wood resources necessary for reconstruction. As pointed out earlier, there is a severe deforestation problem in Guatemala. In the towns especially, this was considered to be a potential problem, as bull-dozing had removed much of the salvageable building materials. Two proposals were explored by Kuchuba'l.

1. Wood purchase and resale. The OXFAM field director arranged to buy wood from Co-operativa Argetta, a lumber cooperative in the area which was assisted by FAO and the Swedish government. OXFAM would purchase wood at 14¢ a board foot, pay a delivery fee of 2 - 4¢ a foot, and sell the wood at 20¢ a foot (the regular commercial price). All the profits would be used to set up and operate a reforestation program.

A total of 20,000 board feet was ordered.

2. Tecpán Sawmill Project. One of the more interesting proposals for obtaining wood was a project to set up a sawmill in a municipally-owned forest on a hillside above the town of Tecpán. Years ago, a portion of the forest had burned, and several thousand acres of forest had been destroyed. While most of the trees were killed and many were scorched, it was felt by the program personnel that much of the wood (predominantly cypress) could still be usable. There was one commercial sawmill in the area, but they felt that the timber which could be saved was too small to be of commercial value. However, the project staff felt that a small-scale, co-op-operated mill to recover and process the wood would be feasible, as the wood sizes necessary for use in the housing reconstruction were smaller than commercial needs.

During the latter part of March, OXFAM-Quebec arranged for a specialist in logging operations to visit the site in order to determine:

a. Whether the wood was still of such a quality that it could be used.

b. Whether the wood could be extracted from the forest economically.

c. Whether such a program could be set up and run by a co-op, using local labor.

The specialist's report claimed that while many problems existed, the wood was acceptable and the project was feasible. The primary constraint was that much of the wood lay on fairly steep slopes, and it would be necessary to import a "skidder" (a specialized tractor-like device) in order to retrieve the wood. A simple sawmill could easily be erected.

Before the project proceeded, however, it was learned that the land and the forest were tied up in a legal case which had been pending in court for years, and that it would be virtually impossible to get the wood before Programa Kuchuba'l ended. Therefore, the project was dropped.

At about the same time as OXFAM was exploring options for providing wood, U.S. AID imported thousands of creosote-treated poles (most of them from the tops of telephone poles) and offered to sell them through the co-ops at a subsidized price. After one year, not all of the original OXFAM order had been sold and very few of the USAID poles had been sold.

Analysis

In retrospect, there was not a large market for wood from the people for whom it was intended (i.e., the lower-income people in the project area). As it turned out, people could find wood resources, even though the deforestation continued. The problem, Kuchuba'l feels, is the question of distribution. Everything purchased for a house at the co-op stores must be carried by hand to the housing site, often hours away by way of steep mountain trails. Therefore, why should a man walk hours away to buy the necessary poles and then have to make six to eight trips to carry them back to his site, when he could go a few yards at most and cut them from the forest at no cost?

C. Tecpán Market

Another project which was proposed but never got off the ground was the Tecpán market. CARE and the Salvation Army had been working together to help in the reconstruction of the pueblo. In mid-March, CARE asked Kuchuba'l to assist in designing a new market building on the site of the old market. A new and active market had grown up around the co-op site on the edge of the town, and, as few people had moved back into the town, it was felt that a new marketplace might bring them back and help speed up reconstruction of the town. (It was felt that increased activity in the town itself would slow down the bulldozing and help get urban people back to work.)

INTERTECT assigned an architect to the project and he immediately began to meet with local people who had used the market before the earthquake to determine their ideas for the new market. The concept that evolved was a large central galera (a tin-roofed, open-sided building) surrounded by small, individual stalls which could be set up by the people themselves from materials salvaged in the rubble. The staff of Kuchuba'l suggested that some form of assistance could be given to those who would build their stalls using earthquake resistant building techniques, especially cross-braces. CARE suggested having the mayor make it mandatory that all stalls use the earthquake resistant principles; but this suggestion was dropped because the traditional stalls would be lightweight anyway and the cross-braces recommended for houses would inhibit movement between stalls, taking up too much space which could be used to display goods. A simple design was prepared, however, which would be a strong core frame to build on which would meet the merchants' requirements.

The market, as proposed by Kuchuba'l and CARE, was never built. The government of Guatemala vetoed the project because they wanted a large, enclosed, air-conditioned structure which would symbolize a "reborn Guatemala".

In the beginning of May 1976, the temporary market on the edge of the town moved back onto the old site in preparation for the rainy season. The old site had a concrete floor; the temporary site had been in a cornfield and would have been a mess during the rainy season. Today, the market is an ad hoc group of self-made stalls occupying the old site.

D. Road Construction Project

Background:

The aim of the materials distribution program had been to distribute materials throughout the affected area on a cash basis. The materials' cost was subsidized so that more people would be able to afford to buy them. Priority was to get the materials out to those people who could afford to buy at the subsidized price first, and then to develop labor-intensive programs which would pay people to work on community projects, in order to provide them with the money to buy needed materials. The number of people who could afford to purchase the materials was much greater than anticipated, and by the beginning of the rainy season, there had been no let-up in demand for the materials, nor in the people's ability to pay for them.

However, many reports came back to OXFAM that there were large numbers of people who could not afford to buy the materials. It was, therefore, decided to initiate work programs during the rainy season and to increase the amount of lamina available so that everyone would be able to purchase the roofing material before the end of the rainy season. (It should be pointed out that originally the intention had been to conduct the work program before the rainy season, so that all the people would be able to have lamina by the beginning of the rains. However, during the period before the rains, it became obvious that most people had built some form of emergency shelter or temporary dwelling which could last through the rainy season, and there was no need to rush the sales of lamina and overtax the distribution network.)

Another objective of the work program came as a realization on the part of the Kuchuba'l staff that the money being paid for materials for reconstruction represented a sizable amount of the cash available in the rural communities. It was felt that the program had an obligation to return as much of that money as possible to the community, not only in projects which would return the money, but also projects which would provide permanent and meaningful improvements to the rural areas.

After much discussion, it was decided that the best type of program to undertake would be a road improvement project. Most of the roads in the area are not hard-surfaced. If covered at all, they are covered with gravel. Few of the roads have provisions for adequate drainage, and many are virtually impassable during the rainy season. Also, many of the roads which go to the small aldeas are not big enough to be traversed by trucks or buses, and, therefore, the people have to hand-carry most of their crops into the towns in order to sell them. After consultations with the program staff, the co-op, and the alcaldes and their auxiliaries in each of the municipios, it was decided that Kuchuba'l would undertake a road improvement program to try to make all the roads in the project area into all-weather roads capable of taking intermediate to large-size trucks.

Most of the roads chosen to work on were roads which were not maintained by the government, but by the aldeas themselves. It is traditional in Guatemala for the alcalde to summon laborers to work on municipal projects such as schools and other projects. The World Neighbors extensionists felt that to pay the local people to do these type projects would diminish this tradition in the future. Road construction and improvement projects (not road repair), however, were carried out by caminos (the road department) and they always paid the men for their work. Thus, it was felt by Kuchuba'l that a road construction project would not be destroying the tradition of self-help.

Originally, Programa Kuchuba'l had not intended to improve any of the roads which the government of Guatemala kept under maintenance. In several cases, however, most notably the road from San Martín to Joyabaj, the government-maintained roads were in extremely poor condition. Also, several of the aldeas along these roads requested that Programa Kuchuba'l institute a road repair program in these areas. The government indicated that its road repair teams would not be working in these areas during the year due to extensive commitments along the major highways; therefore, Programa Kuchuba'l agreed to work in those sections.

Organization of the Project:

It was the policy of Programa Kuchuba'l to pay the people in either cash or lamina for their work. There was extensive debate over this policy. Some felt that the program should ensure that people had decent building materials by paying for work with lamina or other materials; while others felt that they should be paid in cash, thereby giving them the freedom to choose how to spend the money. The final decision of the staff and the junta directiva (board of directors) was to do both. Other agencies (especially those who instituted lamina-for-work projects) have criticized Programa Kuchuba'l for this decision. They argue that many people who needed lamina felt that there were other needs that were more important at the time and, therefore, they did not get lamina, which the agencies believed they should have in order to weather the rainy season and begin reconstruction. The Kuchuba'l staff believed that it is preferable to leave the decision-making up to the local people. Thus, the people working on the program were given two options: they could work on the project for a total of 15 days for which they would receive sheets of lamina, or they could work for 12 days for the cash rate of Q 1.69 a day. Everyone had the opportunity of working additional days for cash after each eligible person who wanted to work, under either method, had had an opportunity to do so.

The number of people working for lamina steadily declined. The staff felt that this was because many people had already obtained lamina and other necessities, such as agricultural needs, etc., were of a higher priority.

To support the road program, the education office of Kuchuba'l prepared a pamphlet on how to build and repair roads. The pamphlets were used in classes at the beginning of work in each new area. The project staff consisted of two coordinators, an engineer, and part-time use of World Neighbors extensionists for community organizing and teaching the classes.

Techniques:

The techniques used were not sophisticated. They mainly included:

1. Surfacing poor or slippery areas with small stones.
2. Construction of drainage ditches alongside the roadway.
3. Installation of culverts.
4. Excavation of small cuts on the surface of the roads to slow and divert water off the road.
5. Widening roads where necessary.

6. Removing earthquake-caused slides and debris.

7. Building stone surfaces on hills or curves to prevent slipping.

Analysis:

The staff feels that this program was one of the most successful elements of the entire reconstruction program. It was very popular with the local people and the government. Not only were the techniques being taught and demonstrated, a significant improvement over the traditional methods; but more important, money was put back into the community at a critical time. How much of that money was used for the purchase of building materials is unknown, but the point is that it was available.

The long-term implications are not yet known. However, it is hoped that by opening new sections of the roads and improving the old ones, there will be increased access to these regions, and that the transport of fertilizers and agricultural implements into the area and the transport of more crops out of the area will bring benefits to the remote areas. In addition, bus services have now been extended to many new areas.

IV. INFLUENCE AND IMPACT OF PROGRAMA KUCHUBA'L

As has been pointed out earlier, Programa Kuchuba'l had wide-ranging effects on many of the programs in Guatemala. Numerous agencies either copied elements of the program or utilized materials produced by Programa Kuchuba'l and, in some instances, adopted policies similar to those adopted by the program. It is difficult, however, to measure the full effect of Programa Kuchuba'l on the overall construction efforts in Guatemala, but an estimate of the impact on certain portions of the reconstruction activities can be made.

A. Influence and Effect of the Program

Influence on Other Programs in Guatemala:

The example set by Programa Kuchuba'l in the way it organized and conducted its program had an impact on other programs in the area in three ways. First, it influenced how other agencies conducted their own programs. Programa Kuchuba'l was one of the first programs to express the concept of "relief in the development context", in other words, to look at the long-term goals rather than the short-term goals. Many of the agencies that arrived to help Guatemala had had no prior experience in the country and, therefore, had no idea of how to begin. Moreover, they were not conversant with the basic development issues that were prevalent in Guatemala. Even among those agencies which had been involved in Guatemala before the earthquake, there was some doubt about how to proceed with relief and reconstruction programs. The leadership, resourcefulness, and forcefulness of the program staff set an example for other programs and encouraged them to utilize many of the techniques and the policies employed by Programa Kuchuba'l. Of all the ways in which Programa Kuchuba'l affected the other programs, this is the most difficult to measure; but the fact that many programs undertook such activities as housing education programs, subsidized materials distribution programs, and the fact that many utilized the same price structure when subsidizing materials, are all an indication of the impact Kuchuba'l had on the way other agencies conducted their programs.

Second, Kuchuba'l had an influence on the way in which many of the programs were organized. For example, the way in which materials distribution and housing education programs were structured was similar in a number of the programs conducted by foreign relief agencies. The tables of organization of these programs closely resemble those of Programa Kuchuba'l, and many of the job specifications were borrowed directly from the program.

Third, Programa Kuchuba'l had an influence on policies adopted by the various relief agencies. The most important of these policies was the materials distribution policy. OXFAM was the first program to develop a comprehensive policy for the sale, subsidy, and use of reflow monies from lamina sales. From the outset, the staff took a leading role in trying to get the other organizations to adopt the same policy, and even encouraged the government to adopt the policy of subsidizing materials as a uniform, national materials distribution policy. While not entirely successful in the latter, OXFAM was successful in encouraging most of the organizations operating in Guatemala to adopt such a policy.

Influence on National Policy:

Throughout both the emergency period and the reconstruction period, OXFAM maintained a direct working relationship with the National Emergency Committee and the National Reconstruction Committee. Due, in part, to the fact that it was the quickest to organize and the one that seemed most sure of its objectives, the government committees and agencies often turned to OXFAM and Programa Kuchuba'l for suggestions and advice in setting national policies relating to reconstruction. As mentioned earlier, OXFAM was instrumental in trying to get the government to adopt a national policy on the subsidizing of lamina. Though this national policy was not adopted, due mainly to the refusal of CARE to follow the government's recommendations, the government did ask other agencies to adopt such a practice.

Influence on Local Groups:

Probably the most important effect of Programa Kuchuba'l was the encouragement that it gave small, local groups at the village level throughout the affected area to seek solutions on their own. The example set by the co-ops working with Programa Kuchuba'l was to have a great impact on the whole co-op system in the country. Many of the methods employed, the materials used, etc., were adopted or integrated into programs conducted by the other co-ops in the country. At the village level, many groups got together to send representatives to Programa Kuchuba'l for training and to learn how local groups in the areas served by Kuchuba'l organized self-help efforts for reconstruction. Of all the influence that Programa Kuchuba'l had, this will undoubtedly be the most important and the one which will have the longest impact.

Influence on Programs Outside of Guatemala:

Many of the agencies which came into contact with Programa Kuchuba'l also operate housing and reconstruction programs in other parts of the world. There has been much interest in the way in which Programa Kuchuba'l operates and the overall framework of the program. Information disseminated about the program from sources such as USAID, the United Nations Disaster Relief Office, and other international agencies will undoubtedly have some effect on the way in which programs in other parts of the world are conducted. In particular, many of the policies developed by Programa Kuchuba'l will play a large part in the way in which reconstruction programs are conducted. For example, the policy of subsidizing materials and using the reflow funds from sales to create a fund for projects which would return that money to the communities has already created much interest in that approach among the international relief agencies as well as many of the donor governments. Materials distribution programs are not new, but the methods and policies adopted by Programa Kuchuba'l substantially advanced this concept and demonstrated that it was a viable alternative to the distribution of emergency shelter units (such as tents) after a disaster. A recent study by the United Nations Disaster Relief Office on the provision of emergency shelter has cited this approach as an element which will contribute to the long-term recovery of a disaster-affected population, as opposed to the emergency shelter approach, which only contributes a short-lived "artifact".*

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*The Provision of Emergency Shelter: Issues and Perspectives, The U.N. Disaster Relief Office, Geneva, 1977, Vol. I.

In addition to the influence of the policies and approach developed by OXFAM, the various training aids prepared by the program have had a substantial impact on the existing state-of-the-art for the preparation of housing training aids. To date, most research on development of training aids comprehensible to illiterate and semi-literate people has concentrated on family planning and medical assistance. Effective training aids for teaching how to build low-cost, earthquake resistant housing were non-existent before Programa Kuchuba'l developed its series of training aids. These materials have received widespread distribution, not only by OXFAM and World Neighbors, but by organizations such as USAID, the United Nations Disaster Relief Office, other voluntary agencies which utilized the materials in Guatemala, and a number of appropriate technology information-sharing networks. Many of the housing specialists who visited Programa Kuchuba'l have further distributed the materials throughout the world. Some of the materials have already been modified for use in programs in Peru, Colombia, and El Salvador. (Funds are currently being sought to develop a report and instructional pamphlet on lessons learned from the Guatemalan experience and methods of producing housing education materials.)

B. Contributions Made by Programa Kuchuba'l

Development and Distribution of Training Aids:

The training aids developed by Programa Kuchuba'l were widely used by many other agencies in their own relief programs. The willingness of Programa Kuchuba'l to share its educational materials meant that other organizations who did not have the capabilities of producing these materials were still able to proceed with housing education programs. The materials, by their very nature, encouraged many organizations to adopt much more realistic programs that would have a longer-term impact on the target population. Had these materials not been available, and had Programa Kuchuba'l not been willing to share its time and expertise with these other organizations, housing programs which concentrated on providing victims with only a housing unit, and not with improved skills or knowledge about how to build better houses, would have been far more common, especially among the foreign relief organizations. (Appendix F lists those organizations that utilized materials from Programa Kuchuba'l.)

Clearinghouse for Technical Information:

Throughout the reconstruction period, Programa Kuchuba'l served as a clearinghouse for technical information relating to the reconstruction of housing. In the first two months after the earthquake, the staff of Kuchuba'l held weekly meetings which were open to anyone from any organization or agency who wished to share information about housing. The meetings were divided into two parts. The first was a class on how to build earthquake resistant housing, which provided basic information on the techniques, the materials, and the skills necessary to build, as well as the principles involved. At the same time, those who had already attended the class held an open meeting wherein technical problems were discussed which were common to all the programs. The technical consultants from Programa Kuchuba'l reproduced many pamphlets and technical papers on various aspects of housing construction and made these available at the meetings at no charge (see Appendix G). If particular problems arose, for which no information was available in-country, the staff sought and obtained such information through INTERTECT or OXFAM.

Programa Kuchuba'l set up and maintained a small library on building construction, wood preservation and appropriate technology. This library was available to anyone working in the field of housing. Later on, the consultants to the program assisted CEMAT, a Guatemalan appropriate technology center, in setting up its own library with these materials.

By sharing its technical information, Programa Kuchuba'l was able to bring many agencies in contact with its ideas and policies. While not every agency adopted or used these ideas, the willingness to share them with the other agencies paid off in good relationships between those who were actually carrying out the construction projects, and facilitated coordination and liaison at the field level.

C. Problems

The leadership and coordination roles undertaken by OXFAM and Programa Kuchuba'l generated the typical accompanying problems. Many of the agencies who attended the classes or utilized the materials, or who copied various components of the OXFAM/World Neighbors program, did not utilize these in the same way as Programa Kuchuba'l. Many of the agencies did not comprehend the greater development objectives of the program and took short-sighted "relief" objectives instead. Many organizations, because they had received some training from Programa Kuchuba'l, used this as leverage to help obtain funds or services from funding agencies, such as USAID, who were familiar with, and who in part als used many of these ideas and approaches. Several of the USAID officials, in fact claim that many organizations used the coordination meetings, training sessions, and materials as a de facto stamp-of-approval for their own programs, when the programs had no real resemblance to Programa Kuchuba'l.

A second problem is that many organizations that attempted to use Programa Kuchuba'l techniques or programs in their own areas found that these did not fit the particular situation in which they were operating. It has been pointed out that Guatemala has many cultural, linguistic and traditional groups, and, even in the mountainous region of the central highlands, there were substantial differences from one community to the next. Furthermore, there were changes in the housing styles and construction practices. Agencies that attempted to utilize techniques developed by Kuchuba'l for areas where they were working, ofte found that many did not apply in other localities. Programa Kuchuba'l was blamed for many of the resulting failures, despite the fact that the Kuchuba'l program staff consistently warned organizations who had had no prior experience in those areas to develop specific approaches to meet the needs of each particular area.

The final problem was the fact that the leadership and coordination role assumed by Programa Kuchuba'l was very time-consuming. Throughout the first six months, there was rarely a day on which some organization or individual did not approach Programa Kuchuba'l for advice or assistance in setting up or conducting a program. Furthermore, scores of researchers and reporters descended on the program staff asking for information about the program. While the vast majority of these requests were met, the time devoted to answering them reduced the overall time that could be devoted to Programa Kuchuba'l.

There has been much debate among the staff as to whether or not the leadership and coordination role undertaken by them had more positive or negative impact. The consensus, however, is that the overall results were more posi-tive than negative, and the negative side was to be expected as a matter of course. In the long run, Programa Kuchuba'l will not only have had an impact on the other programs in Guatemala, but will also have an effect on the way housing programs are conducted by relief agencies in many other parts of the world.

APPENDIX A

The official damage and casualty estimates for the municipios assigned to Program Kuchuba'l are as follows:

Population	Dead	Injured	Percent Dead	Percent of Damage	Estimated Houses Needed Rural	Urban
San Martín Jilotepeque:						
33,066	2,920	5,000	8.78	100	592	4,604
Tecpán:						
24,181	3,023	7,000	12.41	100	918	2,881
San José Poaquil:						
9,795	1,000	2,657	10.21	90	340	1,199
Santa Apolonia:						
4,182	900	844	21.52	85	70	489
Totals						
71,224	7,843	15,501	13.23	93.75	1,920	9,173*

* Kuchuba'l's surveys revealed that this figure was on the conservative side, and that the actual figure was closer to 15,000.

B-1

INITIAL BUDGET ESTIMATE FOR PROGRAMA KUCHUBA'L (February, 1976)

Direct Inputs

A. Subsidized Bldg. Mat'ls.	Cost (Q)	Sale (Q)	Net (Q)	
Lamina	1,000,000	500,000	500,000	
Wood	50,000	25,000	25,000	
Tools	25,000	-	25,000	
TOTAL	1,075,000	525,000	550,000	550,000

B. Training and Education		
20 prototype houses	4,000	
Salaries	11,048	
Visual Aids	3,500	
Travel	500	
Office Expenses	1,500	20,548

C. Marketing of Food	Cost	Loan Repayment	Net	
Wheat	60,000	60,000	-	
Maize	40,000	40,000	-	
Other	-	-	-	
Storage	20,000	-	20,000	
TOTAL	120,000	100,000	20,000	20,000

Total direct inputs: Q590,548

Field Expenses

Salaries (see attached)		103,488	103,488
Office costs:			
San Martín	2,500		
Tecpán	2,500		
Santa Apolonia	2,000		
San José Poaquil	2,000	9,000	9,000
Radio Communication (25% depreciation)		1,750	1,750

Travel Costs:

Vehicles (Four of these vehicles will be provided by World Neighbors who already have them in use.)

	Running Costs	Insurance	Depreciation 33 1/3	Total	
Pick-ups (7)	7,000	1,500	6,540	15,040	
Motorcycles (4)	1,000	600	1,333	2,933	
TOTAL	8,000	2,100	7,873	17,973	
Other travel:				400	18,373

Total Field Costs: Q132,611

Central Costs

Salaries (see attached)		Q51,488
Office Upkeep:		
Rent	2,700	
Remainder	5,000	7,700
Travel Costs:		
Vehicles:		
Running Costs	3,000	
Insurance	1,500	(One vehicle is to be provided by OXFAM, as already in use.)
Depreciation (33 1/3)	3,200	7,700
Other		300
Warehousing:		
Miscellaneous		1,000
	Total Central Costs	Q68,188

Total Budget, assuming one year project

Direct Inputs		Q590,548
Field Expenses		132,611
Central Expenses		68,188
	TOTAL COSTS	Q791,347
Capital Budget		Q 41,720
Salaries		166,024
Cost per house (around 15,000 units)		86

Capital Budget

2 Toyota Pick-ups	13,120	
1 Toyota Jeep	6,600	
1 Microbus	6,500	
1 Second-hand Car	3,000	
4 Suzuki 185cc Motorcycles	4,000	Q33,220
6 Radio Sets	7,000	
2 Typewriters	1,000	
Office Furniture/Equipment	500	8,500
	Total Capital Budget	Q41,720

Cost per House Constructed (15,000 assumed at 120 ft. lamina per house)

Total cost of project		Q 791,347
Plus: Sales of materials		525,000
	Total cost of houses	Q1,316,347
Less: Cost of food marketing		20,000
	Total Cost per House Constructed	Q1,296,347

Cost per house recognizing that project staff will also be working in other fields (e.g. food marketing): Q86

N.B. The project will also have the use of four World Neighbors vehicles and one OXFAM car currently owned.

Cash Flow Statement (Q)	March/Apr	May/Jly	Aug/Oct	Nov/Jan	Feb/Mar
Building Materials	350,000	200,000	-	-	-
Training/Education	8,500	5,500	3,000	3,000	548
Marketing/Food	120,000	-	-	(100,000)	-
Field Expenses	22,000	30,250	30,250	30,250	10,238
Central Costs	10,000	16,000	16,000	16,000	6,091
Capital	41,720	-	-	-	(28,000)
TOTALS	552,220	251,750	49,250	(50,750)	(11,123)

TOTAL: Q791,347

STAFF STRUCTURE AND BUDGET

OXFAM/World Neighbors Councils
(Coordinated through Oxford)

Project Director
(Q by OXFAM)

Executive Director
(Q 12,000)

Finance Director
(Q by OXFAM)

Field Director
(Q 12,000)

Training/tech. program (a)
(Q11,048)

St. Martín prog. coordinator (b)
(Q28,800)

Tecpán prog. (c)
(Q23,904)

St. Apolonia prog. (d)
(Q6,192)

S.J. Poaquil (e)
(Q20,112)

Co-op liason
(Q12,48

Govt. & Agency Liaison/Purchasing Officer
(Q6,000)

Distribution/Admin. Officer
(Q6,000)

Chief Storeman
(Q1,728)

Clerk
(Q1,440)

Typist
(Q2,880)

Assistant Storeman
(Q1,440)

Total Salaries Cost:		
	City Base	Q 31,488
	Field	114,536
	2 OXFAM Staff (est.)	20,000
	TOTAL:	Q166,024

DETAILED STAFF ANALYSIS (PROPOSED)

Job Description			Salary
City Staff			
Director			OXFAM Payroll
Executive Director			12,000
Finance Director			OXFAM Payroll
Government and other Agency Liaison/Purchasing Officer			6,000
Administration/Distribution Officer			6,000
Chief Storeman			1,728
Assistant Storeman			1,440
Clerk			1,440
Typist			2,880
	TOTAL	Q	31,488
Field Staff			
Field Director		Q	12,000
San Martín			
Program Coordinator			8,352
Housing Coordinator			1,872
Accountant			1,872
Clerk/Typist			1,296
Extensionists (Male)			6,480
Extensionists (Female)			1,728
Masons			7,200
	TOTAL	Q	28,800
Tecpán			
Program Coordinator			5,760
Secretary/Accountant			1,872
Extensionists (Male)			6,480
Extensionists (Female)			2,592
Masons			7,200
	TOTAL	Q	23,904
Santa Apolonia			
Program Coordinator			no salary
Accountant/Storeman			1,872
Masons			4,320
	TOTAL	Q	6,192
San José Poaquil			
Program Coordinator			6,000
Extensionists			6,480

Job Description			Salary*
Accountant/Storeman			1,872
Masons			5,760
	TOTAL	Q	20,112

Kato-Ki/El Quetzal Co-op

Co-op Liaison Officer			6,000	
Housing Coordinator & Materials Development Officer			1,728	
Grains Storage Supervisor			1,728	
Extensionist First Class			1,728	
Extensionist Second Class			1,296	
	TOTAL	Q	12,480	

Housing - Training & Education Program

Housing Consultant			1,000	(one month only)
Housing Advisor			3,000	(1/2 time)
Senior Mason			2,880	
Housing Liaison Officer			1,728	
Clerk			1,440	
Artist			1,000	(commission)
	TOTAL	Q	11,048	

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*Salary includes 20% gross salary being social security payments for local staff.

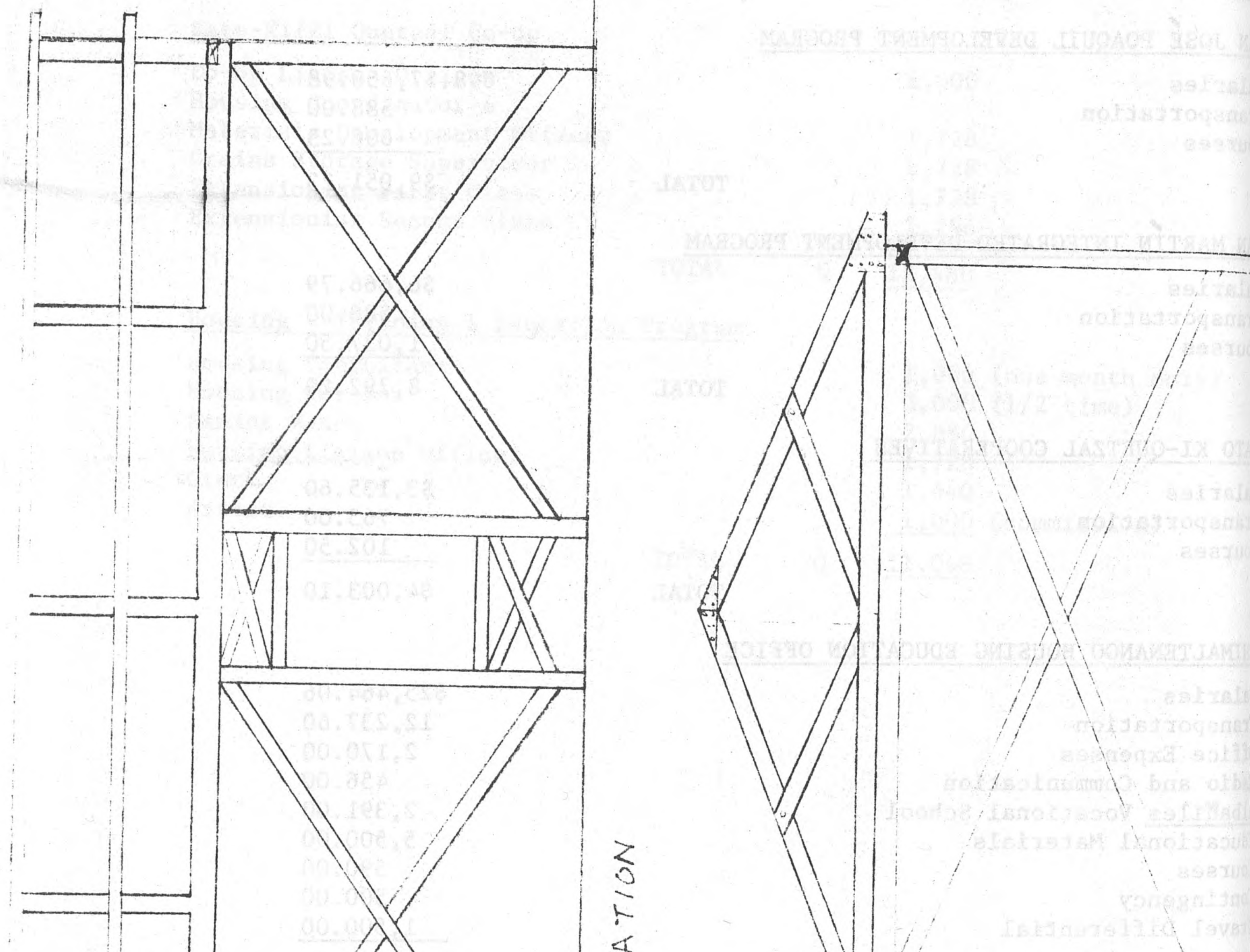
B-3

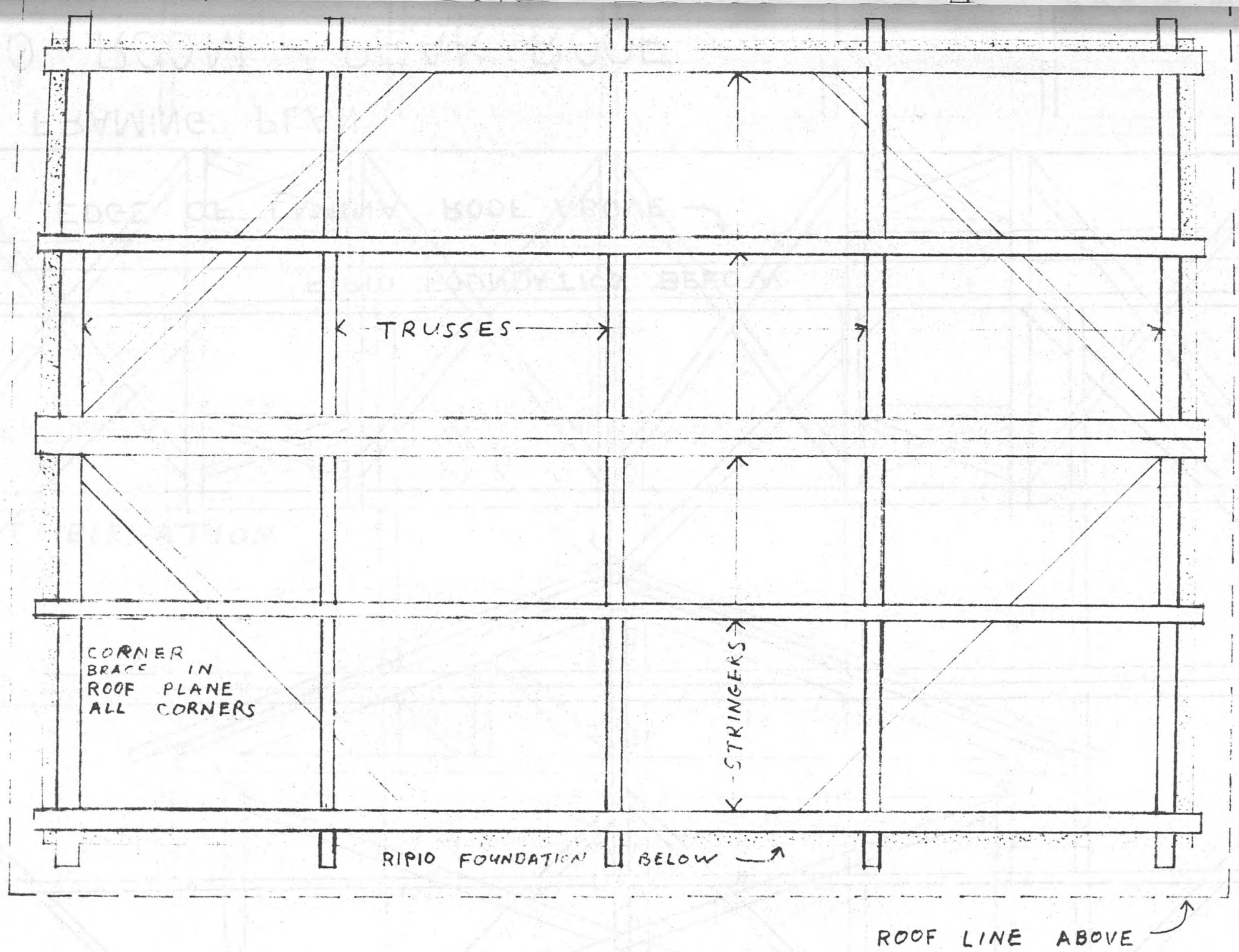
PROPOSED BUDGET

July 1, 1977 - June 30, 1978

Items		Annual Expenses
SAN JOSÉ POAQUIL DEVELOPMENT PROGRAM		
Salaries		U.S.$7,656.98
Transportation		588.00
Courses		806.25
	TOTAL	$9,051.23
SAN MARTÍN INTEGRATED DEVELOPMENT PROGRAM		
Salaries		$6,666.79
Transportation		588.00
Courses		1,037.50
	TOTAL	8,292.29
KATO KI-QUETZAL COOPERATIVES		
Salaries		$3,135.60
Transportation		765.00
Courses		102.50
	TOTAL	$4,003.10
CHIMALTENANGO HOUSING EDUCATION OFFICE		
Salaries		$25,464.06
Transportation		12,237.60
Office Expenses		2,170.00
Radio and Communication		456.00
Albañiles Vocational School		2,391.00
Educational Materials		5,500.00
Courses		590.00
Contingency		500.00
Travel Differential		1,500.00
	TOTAL	$50,808.66

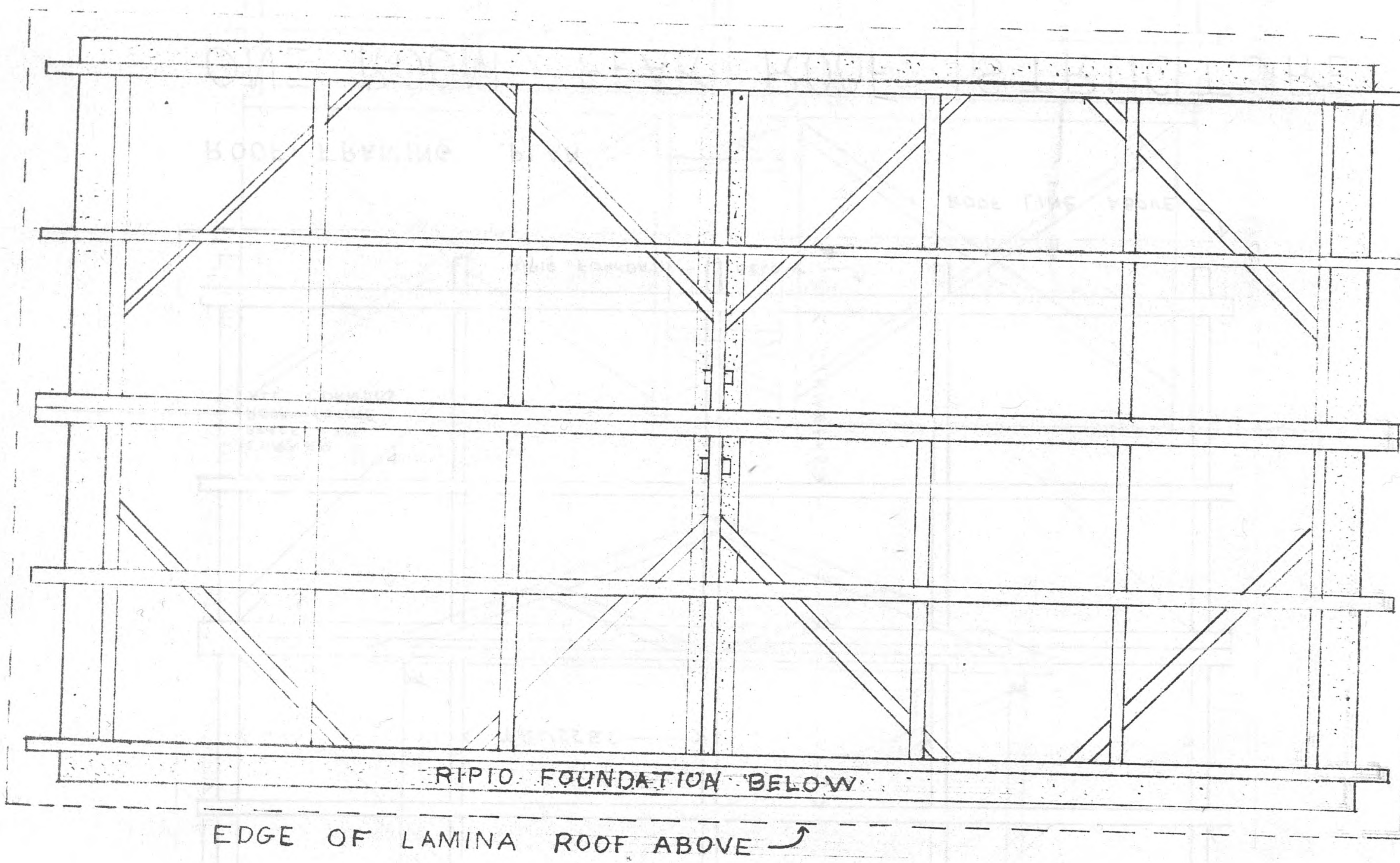
APPENDIX C: Plans for Typical Houses using Construction Techniques Advocated by Programa Kuchuba'l





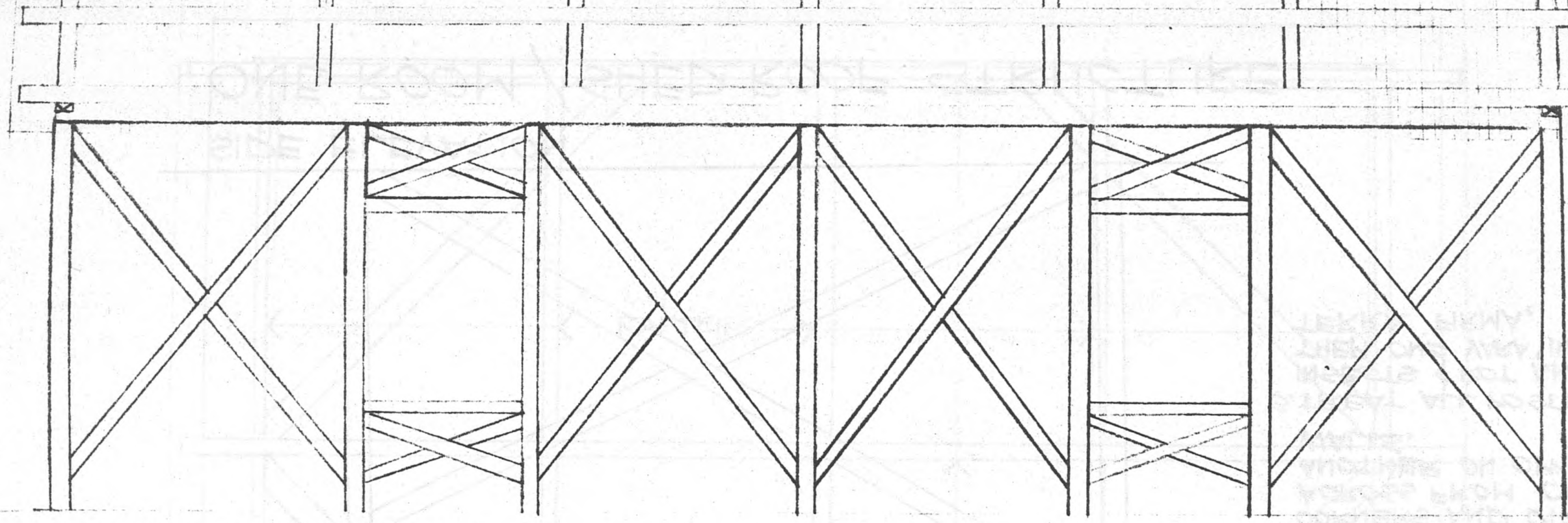
ROOF FRAMING PLAN

ONE ROOM / PEAK ROOF STRUCTURE

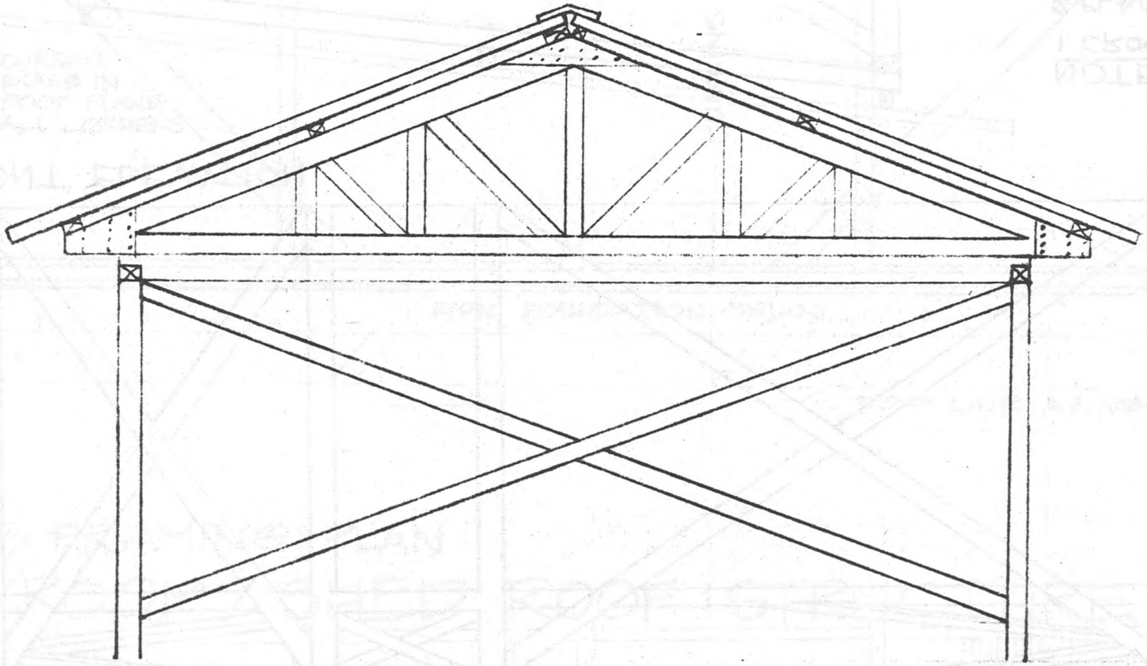


ROOF FRAMING PLAN

TWO ROOM / PEAK ROOF

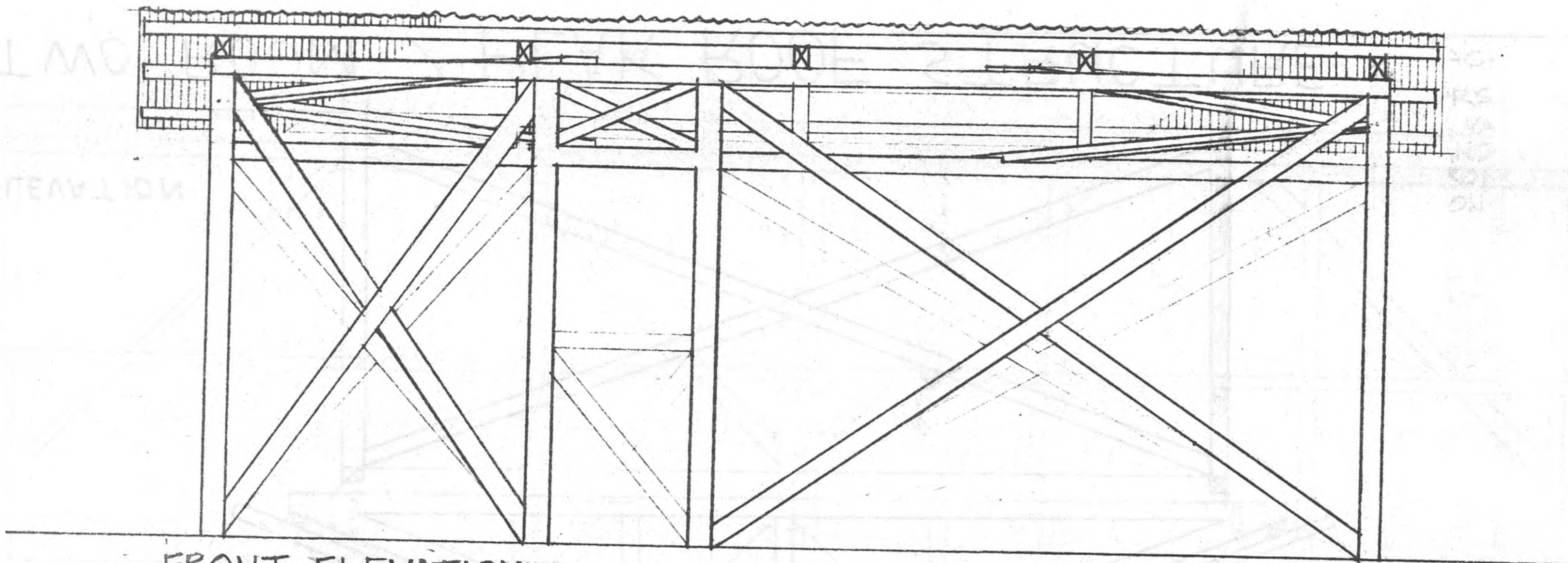


FRONT ELEVATION

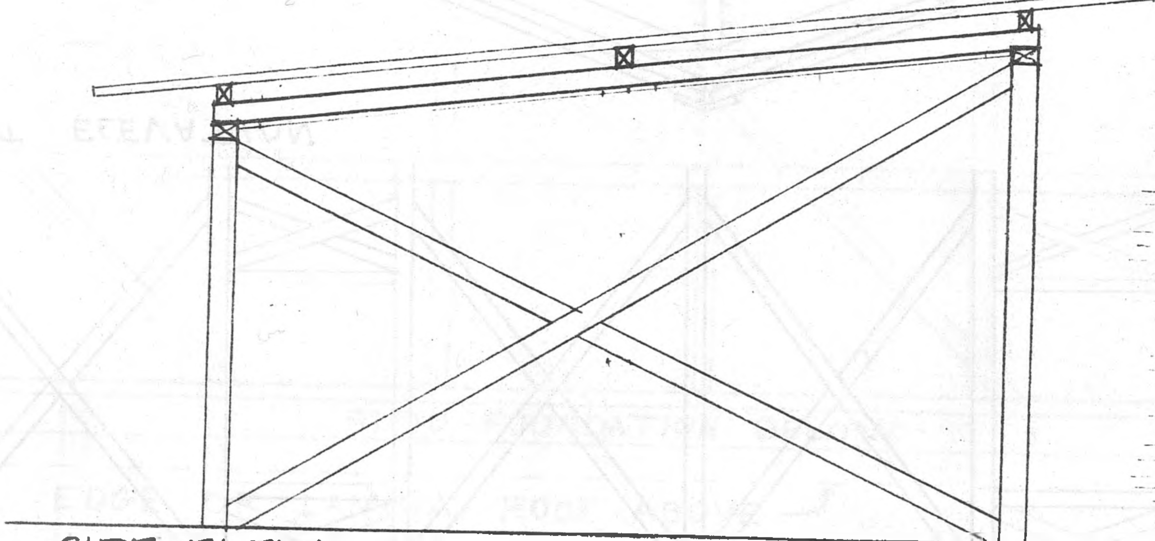


SIDE ELEVATION

TWO ROOM / PEAK ROOF STRUCTURE



FRONT ELEVATION

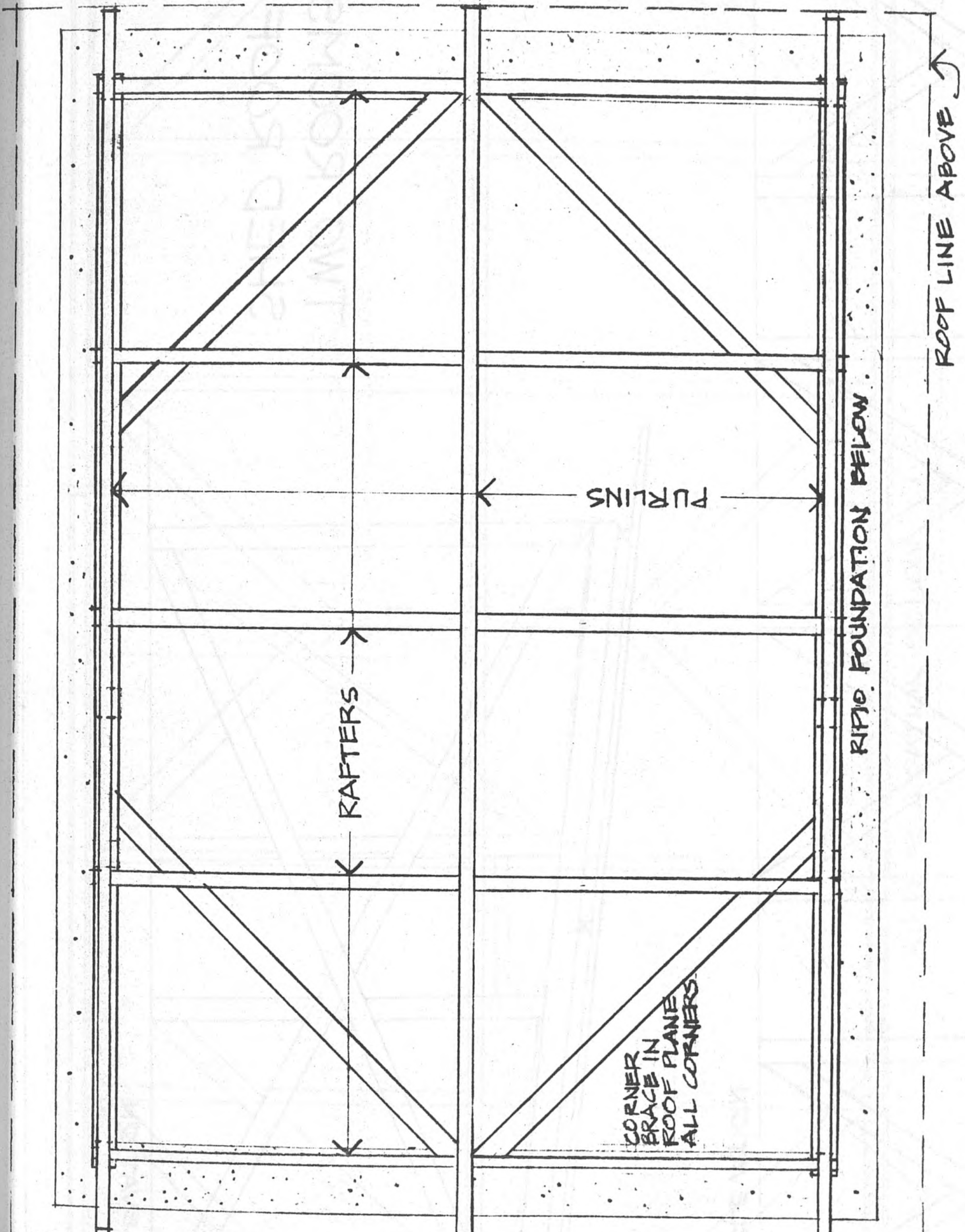


SIDE ELEVATION

NOTES:

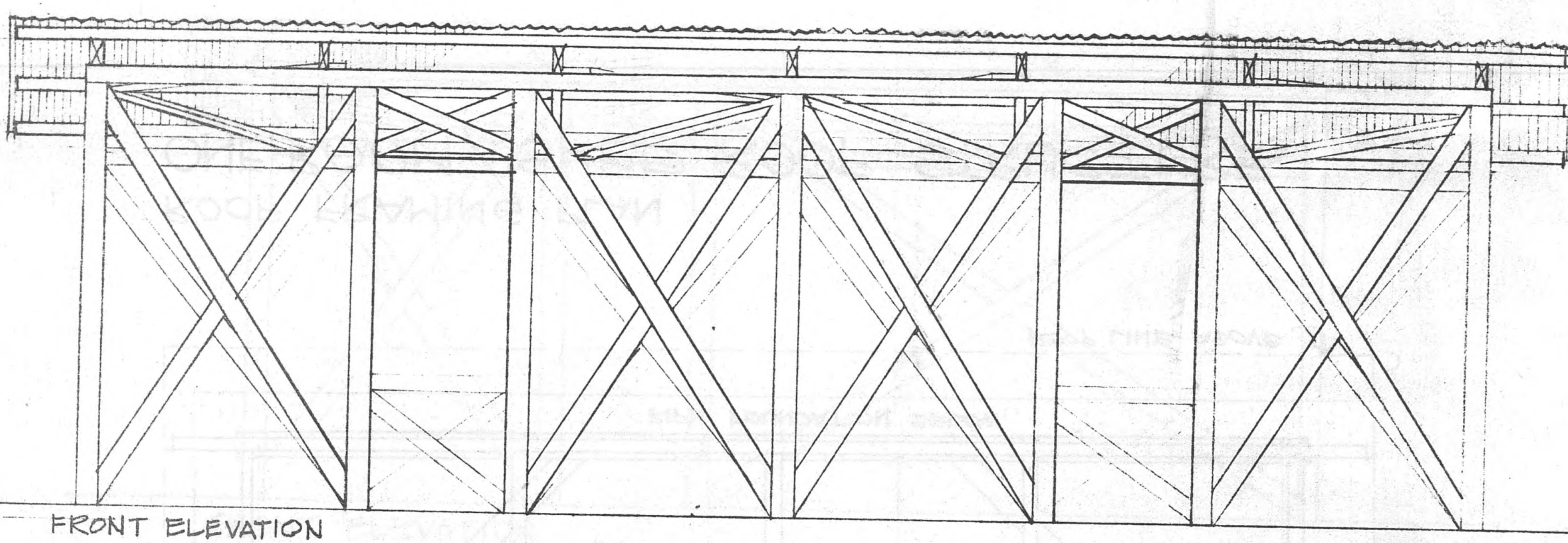
1. CROSS BRACE ALL WALLS
2. PLACE DOORS & WINDOWS AT LEAST 1 VARA FROM CORNERS AND DIRECTLY ACROSS FROM ONE ANOTHER ON OPPOSITE WALLS.
3. TREAT ALL POSTS AGAINST INSECTS & ROT AND SINK THEM ONE VARA INTO TERRA FIRMA.

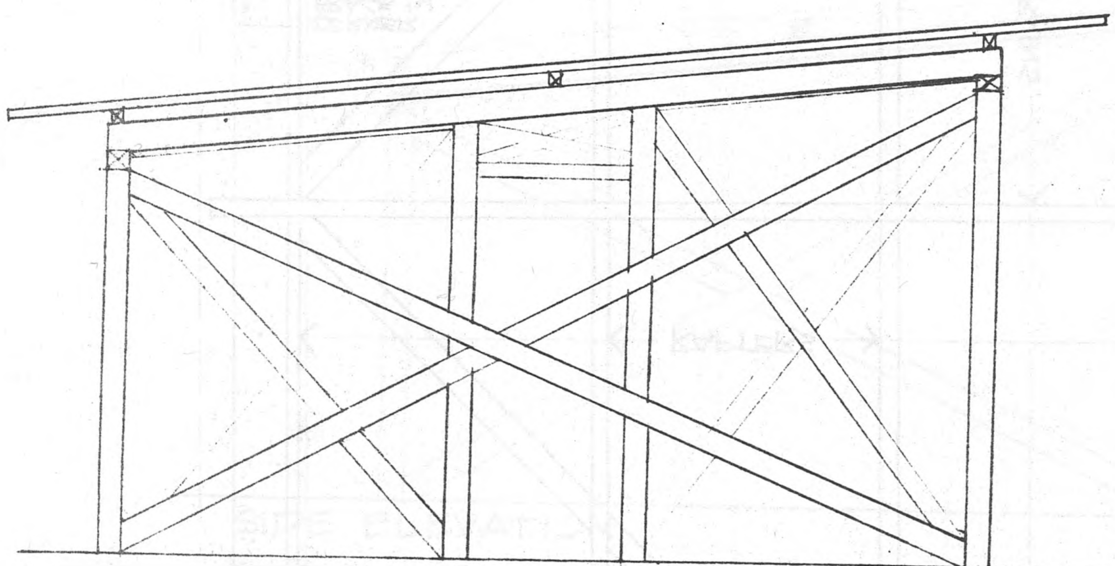
ONE ROOM / SHED ROOF STRUCTURE



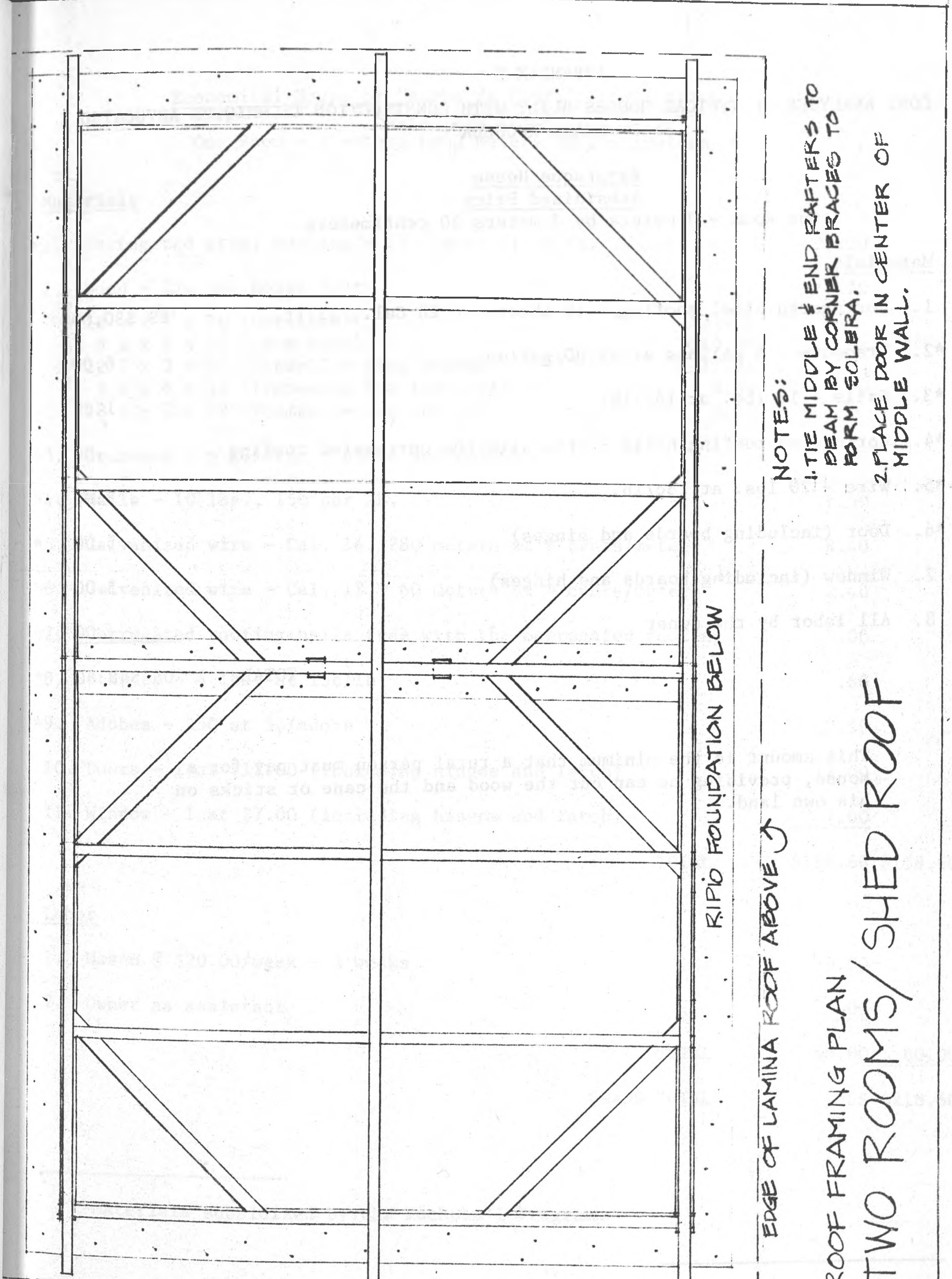
ROOF FRAMING PLAN

ONE ROOM/SHED ROOF STRUCTURE


FRONT ELEVATION


SIDE ELEVATION

TWO ROOMS
SHED ROOF


NOTES;
1.TIE MIDDLE & END RAFTERS TO BEAM BY CORNER BRACES TO FORM SOLERA.
2.PLACE DOOR IN CENTER OF MIDDLE WALL.
RIPIO FOUNDATION BELOW
EDGE OF LAMINA ROOF ABOVE
ROOF FRAMING PLAN
TWO ROOMS/SHED ROOF

APPENDIX D

COST ANALYSES OF TYPICAL HOUSES BUILT WITH CONSTRUCTION TECHNIQUES ADVOCATED BY PROGRAMA KUCHUBA'L

Bajareque House
Subsidized Price

One Room - 7 meters by 3 meters 30 centimeters

Materials

1.	Corrugated steel roofing - 10 sheets of 28 Cal., 12 ft.	US $30.00
*2.	Creosote - 6 gallons at $1.00/gallon	6.00
*3.	Nails - 12 lbs. at 15¢/lb.	1.80
*4.	Corrugated roofing nails - free with the corrugated roofing	.00
*5.	Wire - 20 lbs. at 15¢/lb.	3.00
*6.	Door (including boards and hinges)	5.00
7.	Window (including boards and hinges)	3.00
8.	All labor by the owner	.00
	TOTAL	US $48.80

This amount is the minimum that a rural person must pay for a house, providing he can cut the wood and the cane or sticks on his own land.

*Materials subsidized by the Kuchuba'l Program.

Economical House of "Adobe de Canto" Construction
Subsidized Price

One Room - 7 meters by 3 meters 30 centimeters

Materials

*1.	Corrugated steel roofing - 10 sheets of 12 ft. 28 cal.		$ 30.00	
2.	Wood - 17¢ per board foot		78.20	
	12 4 x 5 x 10 (uprights)	$34.00		
	6 3 x 5 x 12 (ring beam)	15.30		
	12 2 x 3 x 12 (2 smaller ring beams)	12.24		
	5 2 x 5 x 12 (framework for the roof)	8.50		
	8 2 x 3 x 12 (framework for the roof)	8.16		
*3.	Creosote - 6 gallons @ $1.00 per gallon		6.00	
*4.	Nails - 10 lbs., 15¢ per lb.		1.50	
*5.	Galvanized wire - Cal. 14, 280 meters at 3 cents/meter		8.40	
*6.	Galvanized wire - Cal. 12, 60 meters at 4 cents/meter		2.40	
*7.	Corrugated roofing nails free with the corrugated roofing		.00	
*8.	Staples - 4 lbs. at 15¢/lb.		.60	
*9.	Adobes - 250 at 5¢/adobe		12.50	
10.	Doors - 1 at $12.00 (including hinges and latch)		12.00	
11.	Window - 1 at $7.00 (including hinges and latch)		7.00	
		TOTAL	$158.60	$158.60

Labor

1.	Mason @ $20.00/week - 3 weeks		60.00	
2.	Owner as assistant		.00	
		TOTAL	60.00	60.00
		GRAND TOTAL	US	$218.60

*Materials subsidized by the Kuchuba'l Program.

Economical House of "Adobe de Canto" Construction
Current Price in Chimaltenango
One Room - 7 meters by 3 meters 30 centimeters

Materials

1. Corrugated steel roofing - 10 sheets of 28 cal., 12 ft.		US$57.20
2. Wood - 17 cents per board foot		78.20
12 4 x 4 x 10 (uprights)	$34.00	
6 3 x 5 x 12 (ring beams)	15.30	
12 2 x 3 x 12 (2 smaller ring beams)	12.24	
5 2 x 5 x 12 (framework for the roof)	8.50	
8 2 x 3 x 12 (framework for the roof)	8.16	
*3. Creosote - 6 gallons at $2.50/gallon		15.00
4. Nails - 10 lbs. at 35¢/lb.		3.50
*5. Galvanized wire - Cal. 14, 280 meters at 6¢/meter		16.80
*6. Galvanized wire - Cal. 12, 60 meters at 8¢/meter		4.80
7. Corrugated roofing nails - 2 lbs. at 56¢/lb.		1.12
8. Staples - 4 lbs. at 40¢/lb.		1.60
9. Adobes - 250 at 5¢/adobe		12.50
10. Doors - 1 at $12.00 (including hinges and latch)		12.00
11. Window - 1 at $7.00 (including hinges and latch)		7.00
TOTAL	US	$209.0

Labor

1. Mason $20.00/week - 3 weeks	60.00	
2. Owner as assistant	60.00	
	.00	
TOTAL		60.0
GRAND TOTAL	US	$269.7

*Prices in Guatemala City

"Adobe de Canto" House
For the Guatemalan Rural Middle-Class
Subsidized Price
Two rooms - 3 meters 50 centimeters by
3 meters 30 centimeters

Materials

1.	Corrugated steel roofing - 10 sheets of 28 Cal., 12 ft.		$ 30.00	
2.	Wood - 17¢ per board foot		108.72	
	18 4 x 5 x 10 (uprights)	$51.00		
	7 3 x 5 x 12 (ring beams)	17.85		
	14 2 x 3 x 12 (smaller ring beams)	14.28		
	5 2 x 5 x 12 (framework for the roof)	8.93		
	8 2 x 3 x 12 (framework for the roof)	8.16		
*3.	Creosote - 6 gallons @ $1.00/gallon		6.00	
*4.	Nails - 10 lbs. at 15¢ per lb.		1.50	
*5.	Corrugated roofing nails-free with corrugated roofing		.00	
*6.	Barbed wire - one roll		7.50	
*7.	Staples - 4 lbs., 15¢/lb.		.60	
8.	Adobes - 250 at 5¢/adobe		12.50	
9.	Chicken wire - 2 1/2 meters @ 90¢/meter		2.25	
*10.	Cement - 25 lbs.			
*11.	Asphalt paper - 4 meters at 3 cents per meter		.12	
12.	Doors - 3 at $16.00/door (including hinges and latch)		48.00	
13.	Windows - 2 at $8.00/window (including hinges & latch)		16.00	
		TOTAL		US $233.64

Additional Materials

Plaster

1.	White sand - 4 carts at $4.00/cart	16.00	
2.	Lime -- 9 sacks of 100 lbs/sack at $2.00/sack	18.00	
	TOTAL		$ 34.00

Cement Floor

1.	River sand - 1 cart at $5.00	5.00	
2.	Cement - 4 sacks of 100 lbs/sack at $1.80	7.20	
	TOTAL		$ 12.20

Wood Ceiling

1.	Tongue and groove boards at 18¢/board foot	47.52	
*2.	Nails - 2 lbs. at 15¢/lb.	.30	
	TOTAL		$ 47.82
	TOTAL ADDITIONAL MATERIALS		US $ 94.02

Labor

1.	Mason $20.00/week; 3 weeks basic house, 2 weeks plaster, floor, and ceiling	100.00	
2.	Assistant $12.00/week	60.00	
	TOTAL LABOR		US $160.00

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*Materials subsidized by the Kuchuba'l Program.

Resumé of Construction Expenses

Basic Materials	US $233.64
Additional Materials	94.02
Labor	160.00
GRAND TOTAL	US $487.66

"Adobe de Canto" House
For the Guatemalan Rural Middle-Class
Current Price in Chimaltenango
Two rooms - 3 meters 50 centimeters by
3 meters 30 centimeters

Materials

1.	Corrugated steel roofing - 10 sheets of 12 ft., 28 Cal.		$ 57.20	
2.	Wood - 17 cents per board foot		108.72	
	18 4 x 5 x 10 (uprights)	$51.00		
	7 3 x 5 x 12 (ring beams)	17.85		
	14 2 x 3 x 12 (smaller ring beams)	14.28		
	5 2 x 5 x 12 (framework for the roof)	8.50		
	7 2 x 5 x 9 (framework for the roof)	8.93		
	8 2 x 3 x 12 (framework for the roof)	1.16		
3.	Creosote - 6 gallons at $3.50/gallon		15.00	
4.	Nails - 10 lbs. at 35¢/lb.		3.50	
5.	Corrugated roofing nails - 2 lbs. at 56¢/lb.		1.12	
6.	Barbed wire - one roll		16.00	
7.	Staples - 4 lbs. at 40¢/lb.		1.60	
8.	Adobes - 250 at 50¢/adobe		12.50	
9.	Chicken wire - 2 1/2 meters at 90¢/meter		2.25	
10.	Cement - 25 lbs - $1.80/cwt.		.55	
11.	Asphalt paper - 4 meters at 6¢/meter		.24	
12.	Doors - 3 at $16.00/door (including hinges and latch)		48.00	
13.	Windows - 2 at $8.00/window (including hinges and latch)		16.00	
	TOTAL BASIC MATERIALS			US $282.80

Additional Materials

Plaster

1.	White sand - 4 carts at $4.00/cart	16.00	
2.	Lime - 9 sacks - 100 lbs./sack at $2.00/sack	18.00	
	TOTAL		34.00

Cement Floor

1.	River sand - 1 cart at $5.00/cart	5.00	
2.	Cement - 4 sacks - 100 lbs./sack at $2.20/sack	8.80	
	TOTAL		13.80

Wood Ceiling

1.	Tongue and groove boards at 18¢/board foot	47.52	
2.	Nails - 2 lbs. at 45¢/lb.	.90	
	TOTAL		48.42
	TOTAL ADDITIONAL MAT'LS.		US $ 96.22

Labor

1.	Mason - $20.00/week; 3 weeks basic house, 2 weeks plaster, floor, and ceiling	$100.00	
2.	Assistant - $12.00/week	60.00	
	TOTAL LABOR		$160.00

Resumé of Construction Expenses

Basic Materials	US $282.80
Additional Materials	96.22
Labor	160.00
GRAND TOTAL	US $539.02

APPENDIX E

LIST OF MATERIALS SOLD BY PROGRAMA KUCHUBA'L

Material		Price*
1. Cement	Q	2.00 per 100 lbs.
2. Creosote with Aldrin		1.00 per gallon
3. Galvanized Wire (Calibre 14)		.20 per lb.
4. Galvanized Wire (Calibre 12)		.20 per lb.
5. Steel Wire		.15 per lb.
6. Barbed Wire		7.00 per roll
7. Wood Nails (1 1/2")		.15 per lb.
8. Wood Nails (2 1/2")		.15 per lb.
9. Wood Nails (2", 3", 4", 5", 6", 7", 8")		.15 per lb.
10. _Lamina_ Roofing Nails		.20 per lb.
11. Iron Reinforcing Bars (3/8")		7.00 per 100 lbs.
12. Iron Reinforcing Bars (3/16")		10.00 per 100 lbs.
13. Carpenter's Chisels (9")		1.75 each
14. Carpenter's Chisels (6")		1.50 each
15. Crowbars		1.75 each
16. Carpenter's Squares		.90 each
17. Carpenter's Levels		1.05 each
18. Saws (26")		2.25 each
19. Sawblades		.30 each
20. Clear Plastic Sheeting		.85 per roll
21. Black Nylon Sheeting		.30 per meter
22. Carpenter's chisel (1 1/4")		1.65 each
23. Carpenter's chisel (1/2")		1.10 each
24. Carpenter's chisel (3/4")		1.20 each
25. One-pound Hammer		1.25 each
26. Carpenter's Tacks		.35 per lb.
27. Staples		.15 per lb.
28. Meter Sticks		.35 each
29. Galvanized Steel Roofing (12 ft., 26 Calibre)		36.00 for 10 sheets
30. Galvanized Steel Roofing (10 ft., 26 Calibre)		30.00 for 10 sheets
31. Galvanized Steel Roofing (9 ft., 26 Calibre)		27.00 for 10 sheets
32. Galvanized Steel Roofing (12 ft., 28 Calibre)		30.00 for 10 sheets
33. Galvanized Steel Roofing (10 ft., 28 Calibre)		25.00 for 10 sheets
34. Galvanized Steel Ridge Caps (for _lamina_ roofs)		1.00 each
35. Untreated Wood (pine - 2" x 3" x 12 feet)		.20 per board ft.
36. Untreated Wood (pine - 2" x 5" x 12 feet)		.20 per board ft.
37. Untreated Wood (pine - 3" x 5" x 12 feet)		.20 per board ft.
38. Untreated wood (pine - 4" x 5" x 10 feet)		.20 per board ft.
39. Untreated wood (pine - 1" x 12" x 12 feet)		.20 per board ft.
40. Carpenter's Plumbs (1 1/2 lb.)		1.75 each
41. Cement Blocks (4" x 6 1/3" x 10 1/3")		125.00 per 1,000

*Q 1.00 = $1.00 (U.S.)

APPENDIX F

ORGANIZATIONS WHICH HAVE USED KUCHUBA'L EDUCATIONAL MATERIALS

1. Berhorst Clinic Extensionists
*2. CARE
*3. Catholic Relief Service (& CARITAS)
*4. CEMAT (Central American Centre for Appropriate Technology)
5. El Quetzal Co-operatives
6. FEDACOAG (Federation of Agricultural Co-operatives)
**7. Joyabaj Reconstruction Program (Save the Children Alliance)
8. Mennonite Central Committee
9. National Reconstruction Committee (of the Gov't. of Guatemala)
**10. OXFAM Housing Programs, Guatemala City
**11. Southern Quiché Reconstruction Program (Save the Children Alliance, SCF-Sweden)
12. Summer Institute of Linguistics (Reconstruction program near Rabinal)
13. University of San Carlos
14. U.S. Agency for International Development
15. U.S. Peace Corps

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*Agencies that produced educational materials of their own based on ideas and materials obtained from Kuchuba'l.

**Programs that produced educational materials in co-operation with Programa Kuchuba'l.

APPENDIX G

REFERENCE MATERIALS MADE AVAILABLE TO OTHER AGENCIES BY PROGRAMA KUCHUBA'L

1. Building in Earthquake Areas. Overseas Building Notes No. 143, Overseas Division, Building Research Station, Garston, Watford, WD2 7JR England.
2. Small Buildings in Earthquake Areas. (A. F. Daldy), Building Research Establishment, Department of the Environment, Garston, Watford WD2 7JR, England.
3. Design Essentials in Earthquake Resistant Buildings. Architectural Institute of Japan, Elsevier Publishing Co., New York, 1970.
4. Wiegel, R. L., Earthquake Engineering, Prentice-Hall, Englewood Cliffs, N.J., 1970.
5. Manual of Asphalt Emulsion Stabilized Soil Bricks. International Institute of Housing Technology, California State University, Fresno, California, 1972.
6. Earth for Homes. Department of Housing and Urban Development, Washington, D.C., June, 1970.
7. Properties of Earth Wall Construction. Building Materials and Structures Report BMS 78, National Bureau of Standards, Washington, D.C., 1941.
8. Ayarza, H., Aseismicity in Low-Cost Housing, Santiago, Chile, 1971.
9. Colling, R. C., Colling, H., Cravens, R. P., and Fox, R. M., Modern Building Inspection, Building Standards Monthly Publishing Co., Ltd., Los Angeles, 1951.
10. Hodgson, J. H., Earthquakes and Earth Structure, Prentice-Hall, London, 1964.
11. Steffens, R. J., Earthquake-Proof Design in Theory and Practice, HMSO, Building Research Station. A selected bibliography, 1957.
12. Richter, C. F., Elementary Seismology, W.H. Freeman & Co., San Francisco, 1958.
13. Duke, C. M.,"Effects of Ground on Destructiveness of Large Earthquakes", Proceedings of the American Society of Civil Engineers, Vol. 84, SM3, Aug., 1958.
14. Seed, H. B., Idriss, I. M., Influence of Local Soil Conditions on Building Damage Potential During Earthquakes, California Univ. Earthquake Eng. Research Centre Report No. EERC 69-15, 1969.

APPENDIX C

REFERENCE MATERIALS MADE AVAILABLE TO OTHER AGENCIES BY PROGRAMA KUCHUMATÁN

Building in Earthquake Areas, Overseas Building Notes No. 143, Overseas Division, Building Research Station, Garston, Watford, WD2 7JR England.

Small Buildings in Earthquake Areas. [illegible] Building Research Establishment, Department of the Environment, Garston, Watford WD2 7JR England.

Design Essentials in Earthquake Resistant Buildings, Architectural Institute of Japan, Elsevier Publishing Co., New York, 1970.

Wiegel, R. L., Earthquake Engineering, Prentice-Hall, Englewood Cliffs, N.J., 1970.

Manual of Seismic Design on Stabilized Soil Blocks, International Institute of Housing Technology, California State University, Fresno, California, 1972.

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Kearns, R., Aseismicity in Low-Cost Housing, Guatemala, [illegible]

Collins, R. C., Collins, J., Cravens, R. P., and [illegible], Building Inspection, Building Standards Monthly Publishing Co., Los Angeles, 195[illegible].

Hodgson, J. H., Earthquakes and Earth Structure, Prentice-Hall, London, 1964.

Steffens, R. J., Earthquake-Proof Design in Theory and Practice, [illegible] Building Research Station. A selected bibliography, 1957.

Richter, C. F., Elementary Seismology, W.H. Freeman, Inc, San Francisco, 1958.

Duke, C. M., "Effects of Ground on Destructiveness of Large Earthquakes", Proceedings of the American Society of Civil Engineers, Vol. 84, SM3, Aug. 1958.

Seed, H. B., Idriss, I. M., Influence of Local Soil Conditions on Building Damage Potential During Earthquakes, University of California, Berkeley, Earthquake Engineering Research Center Report No. EERC 69-15, 1969.

EVALUATION OF THE ACTIVITIES OF THE OXFAM/ WORLD NEIGHBORS POST-DISASTER HOUSING PROGRAM, GUATEMALA: FEBRUARY 1976 - MARCH 1977

Paul and Charlotte Thompson
Guatemala, C.A.

April 1977

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EVALUATION OF THE ACTIVITIES OF THE OXFAM/ WORLD NEIGHBORS POST-DISASTER HOUSING PROGRAM, GUATEMALA: FEBRUARY 1976 - MARCH 1977

I. Methodology

This interim evaluation of the OXFAM/World Neighbors housing program was made at the request of Fred Cuny, INTERTECT, a technical consultant to the program. The purpose was multi-faceted. In general terms, it sought to describe the impact of the program on the reconstruction of housing in the disaster-affected area; to determine the effectiveness of educational materials produced by the program; to document the accomplishments, difficulties and deficiencies of the program at this point in time; and to make recommendations for improvements in its current operations and for next year's program.

A successful implementation of the evaluation procedure was difficult in some respects. The work was pursued without knowing whether there would be a "final" evaluation made during August 1977, or a later one made in three to five years. The completeness of the evaluation is also limited in data due to the limited amount of time available to carry out the study. There were other factors which complicated the available time to pursue details of the program operations and impact in the field. One was a three-day seminar held for the entire staff during this period; another the normal decrease of work activities preceding Holy Week, and the subsequent lack of any educational classes on housing given to the public at this time. (The evaluation was conducted between March 21 and April 11, 1977.)

Given these limitations, the evaluation concentrated on the following topics:

1. The quality and application of the training for albañiles (house builders);

2. The communication effectiveness of the visual aids used as educational materials;

3. The role of the extensionists in the program;

4. The means by which the general public receives the benefits of the program;

5. The significance of some of the related projects to the effectiveness of the whole program -- for example, the model structures, materials distribution, and road construction;

6. Establishing criteria and/or a method to determine additional data regarding a possible future evaluation (see Appendix A for base survey).

This, then, is not a comprehensive evaluation of the entire program. It does not deal with such components as the initial roofing sheets distribution, technical assistance, and special projects such as concrete block making.

The procedure employed during the course of the evaluation included:

1. Identifying issues about which the staff was most concerned;

2. Reviewing reports, files and budgets of the program;

3. Interviewing Kuchuba'l office staff, field extensionists and albañiles;

4. Visiting model structures, the communities where the program is working, albañil school classes, and interviewing local residents;

5. Participating with the staff in planning program modifications and future programming.

II. Introduction

During the course of the past 15 months, we have studied on-site approximately seventy programs of post-disaster housing in Latin America. Before the Guatemala earthquake, none of those programs were based on the combined principal concepts of educating people in anti-seismic construction, supporting self-determination in the process of rehousing, supporting local organizations, usin low-cost local materials and skills.

The program developed by OXFAM/World Neighbors became the first of its type; a few others sought to employ two or three of those concepts. This program has already become a forerunner for other post-disaster assistance program It has provided an example for others in Guatemala and predictably in future locations.

That, in turn, means that a careful study of the implementation process would be valuable. The difficulties which were inevitable can provide lessons to others. The realities of the evolution of the post-disaster housing in this particular situation could not all be anticipated in the emergency period when the program was formulated.

We assume the readers of this report are familiar at least with the basic description of the program and its various components. It is not our task to write the history of the program; but we would like to point out several elemen which were particularly important to the program's development.

It was very commendable, though arduous, that the basic formulation of the program was not done hastily (though under extreme pressure) and was accomplish with considerable participation of "core" people from several different groups.

The program had an important impetus, having formulated a technical soluti which could be offered as a safe house with local origins. The concept is probably the best feasible. But the specific criteria for the house design should be reviewed in the light of a year of its application:

1. It must be anti-seismic. It is, but the safety depends on a wood frame which must be protected from deterioration.

2. It must be of local materials. It is, except for corrugated metal roofing sheets (lamina) and barbed wire (not a critical problem).

3. It must be economically feasible. There is a range of resources available to rural families, but the vast majority have not yet rebuilt because the cost of construction is too high.

4. It must be culturally acceptable. For the most part, the solution is acceptable; but a galera, or wood frame, is not received enthusiastically as the structural frame for a house. One of the proposed techniques of wall construction -- bajareque (similar to wattle-and-daub) -- is a relatively low status, though previously used, process. At present, high status is seen as having a concrete block house, but most rural residents cannot afford that.

5. It must not exceed local building skills. A drastic change is not required, but considerable training is necessary to be able to apply all of the details. Some details seem complicated and are different from traditional construction.

6. It must not cause environmental damage. It was recognized during an early area inspection that a limited supply of wood existed. The extensive demand caused by this and other programs has contributed to the region's deforestation problems.

The overall goal of preventing future deaths, the specific criteria for the technical solution, the philosophic base and the program components were clearly conceived.

However, objectives in terms of measurable goals and expected results were not established. This evaluation tried to establish the major accomplishments of the program to date, and to set the groundwork for a future and final evaluation.

Spanish terms and abbreviations used:

Albañil: house builder (it has a more general application than "mason")

Lamina: corrugated steel roofing sheets

Lio: ten sheets of lamina

Bajareque: method of construction similar to wattle-and-daub

ERCT: earthquake resistant construction techniques

III. Training

The core of the housing program has been the training component. The general objective was to teach earthquake resistant construction techniques (ERCT) which, in turn, would be employed in the new construction of housing. Exactly who was to be taught, by whom and by what method, has undergone several changes and modifications.

The process of teaching this information has been complicated by the desire to communicate it to several different groups: albañiles who will work in Proyecto Kuchuba'l as instructors or supervisors; albañil students; extensionists of the World Neighbors Rural Development Program; volunteer extensionists; and the general public. Each of these groups has different demands, learns in a different way, and needs a different amount of information presented in different ways.

Such an objective has resulted in, if not an ambiguity of method, an apparent lack of clarity as to what has actually been done. It is difficult to identify accurately for the evaluation either the quantity of the training or the extent to which the participants have been trained.

A. Training of Albañiles

Objective: Initially, to train existing albañiles in ERCT who would, in turn, teach other albañiles who would begin building houses according to those principles. This was modified to teach student albañiles an entire program in construction, including the earthquake resistant principles.

Discussion: It is not possible to determine at this time the data on the number of classes given to practicing albañiles, how many attended, nor all of the locales where the classes were given.

It is clear, however, that the great bulk of the instruction fell to Pedro Güitz. He was instrumental in giving virtually all of the classes during the first months of the program. Through this process of teaching albañiles, approximately eight have been trained well enough to become instructors. Of those, five are now on the staff of the program. Even among these few, there is a noticeable range of competence at communicating this information to others.

More albañiles have actually been trained through the construction of the model structures. This method has probably been by far the most thorough and consistent. In this case, the albañil has had the advantage of receiving the theoretical and practical training simultaneously and in the sequence of the construction of the model. Though the errors in construction details indicate that the technique of teaching/supervising was not perfect, they were generally minor errors.

The important feature has been that an albañil from the community has been trained in the community, building a structure for the community, in full view of the community's residents and working with some of them as they contributed labor. Our evaluation did not establish it as fact, but it is our opinion that this would be one of the most effective approaches to introducing new construction technologies or details in a community.

A measure of its success would be the extensive employment of the newly trained albañil in the construction, or assistance through advice, of new houses in his community. Our observations show that this is beginning to happen, but not on an extensive scale. This is in part a reflection on this component of the program, but more on the general circumstances that have kept a vast majority of the families from rebuilding.

School for Albañiles: It is to the credit of the program that the personnel recognized early in the operation that a school for albañiles would be one of the most effective ways of ensuring the long-term impact of the program. It may have initially been thought that the benefits of the school would be felt immediately after the training of the first class of students was complete. Instead, the potential impact of the students has been limited by the same causes as have affected the previously existing albañiles. We took a survey among the extensionists which shows that perhaps 18 students have built at least one house in the surveyed San Martín area, and 6 - 8 students have done likewise in Poaquil.

Three schools have been established. The first one, at San Martín, began activities on June 17, 1976; the second, at Tecpán, began August 31, 1976; and the third, at Poaquil, started on September 3, 1976. The first set of courses was completed by about 20, 15, and 8 students respectively, at the three schools. The course lasted for about six months. For the first month, it met one-half day a week for classroom work. This was followed with the actual construction of one or two buildings. The three schools are presently working with their second group of students. Very few of the trained students are reported to have left the area.

The second group of students contains a proportion between 1/2 and 2/3 at San Martín and Poaquil who are volunteer extensionists of the World Neighbors Rural Development Program. It is our understanding that most of them do not necessarily expect to directly use their training to build houses, so much as to extend their services as extensionists to include classes and advice on the construction of safe houses. These students attend classes in agriculture during the other half of the class day.

This mix of people -- some of whom will practice building construction, and others who will teach it -- seems an effective use of the school, although it confuses the kind of information which may need to be taught. It likely reinforces the tie between the temporary Proyecto Kuchuba'l and the long-term World Neighbors Rural Development Program, thereby improving the probability of the continuation of the program after its operations have actually ended.

The present approach to the curriculum of mixing the theoretical subjects with the practical experience of actually constructing buildings or their components is a good one. It is possible, however, that the sequence of activities and subjects, and related building activities, has not been the most useful or thoroughly developed. Perhaps this has been so for a number of good reasons, including the difficulty of coordinating field practice with classroom subjects, and the lack of staff time to completely analyze objectives and teaching curriculum.

Some issues concerning the training program for albañiles have not been established. One central issue is that the program has not determined how many albañiles are needed in the area to answer the demand of an also undetermined number of families who will want to hire their services.

Recommendations: The following recommendations are made in the context th decisions have been taken at this time to continue the program for another year Central to that program will be a continuation of the schools for albañiles.

1. The entire curriculum and school program should be reexamined, i.e., looked at with a fresh perspective, accepting the idea that major changes in approach may need to be made. Some general suggestions include:

   a. Hold the classes in a facility where all necessary experiments or small construction projects can be easily accomodated, i.e., a shop-like atmosphere.

   b. Have plenty of building materials and tools on hand to be able to thoroughly demonstrate every phase of any subject, as they arise.

   c. Minimize classroom-type situations, but rather teach even theoretically-oriented subjects with direct application to actual materials or buildings. Basically, the intention is to determine and approximate the normal learning process of the class members.

   d. Keep class sizes to a minimum so that each student can experience each problem or building exercise simultaneously (or as much so as is feasible).

   e. Where dealing with more theoretical or abstract subjects, develop a set of problems (in a working manual format) that each student can perform. These problems should take the student through the entire thought process from a representative sample probably encountered in the field. Examples: scale; reading plans; calculating board feet (how many board feet in the bench upon which you are sitting? how many board feet in a 4" x 5" x 8' post? how many in an entire house of a designated design?).

2. Separate clearly the teaching of traditional construction techniques from that of block and brick. The more professionally the student learns block and brick, the more likely the program and the community will lose him to the city. Perhaps teach one group the former subject, and another group the latter.

3. Investigate several sources to locate existing teaching materials, including vocational schools; INTECAP; CAPS; CEMAT; VITA; U.S. Dept. of Housing & Urban Development, Office of International Affairs; U.S. Government Printing Office; SINDU, Bogotá, Colombia; IDESAC (a

private architectural or planning office in Guatemala City, Tel. 29063, Arq. Victor Basauri); and Roberto Morales of the Facutad de Arquitectura, U.S.M.C.; and local bookstores with carpentry and building books.

4. Assemble an albañil manual/workbook for a complete course from existing materials where possible. Develop these materials in sequence, but with a few weeks lead time over the school. Design the manual so that it can have an application beyond the school itself, for use possibly throughout Guatemala.

5. If the needed materials are not located, and if technical assistance is needed in their development, contact some or all of the above mentioned Guatemalan agencies. Some of them may be able to offer informed assistance or even contract to develop specific information or materials.

B. Training of Extensionists

Objective: To train the existing extensionists in the World Neighbors Rural Development Program to be able to teach the principles of safe construction in the rural areas. The objectives were not made clear regarding whether the extensionists were intended to only make the rural population aware of ERCT or to actually teach the population how to build their houses as well.

Discussion: This approach was chosen over the suggestion of hiring albañiles to represent the program. The wisdom and success of this method of implementing the education program has been one of the most debated aspects of Proyecto Kuchuba'l. Without reviewing the entire history of using the extensionists, some observations should be made about their present status and effectiveness.

In the San Martín area, the ten extensionists (according to their own records) on the average give slightly less than one class every two weeks, with each class attended by about ten persons. In total, during one 6-week period, about 27 classes were given with about 280 total in attendance. In addition, about fifteen individual lessons or supervisions were given. This was from the first of February to the middle of March 1977, at the height of the traditional building season. Some extensionists may not be giving more classes because they have given the basic introductory classes. Classes concerning specific details of construction are not well received because so few people are involved in construction at this time.

In Poaquil where the education program functions quite differently, there are three extensionists who are basically full-time on promoting the reconstruction program. This consists mainly of organizing the work groups, where five or six families build their houses using mutual aid. Their activities generally do not include the supervision of houses under construction; that task is left to the albañiles who have been hired by the program.

The training for the extensionists has been in the form of classes given on an irregular and inconsistent basis. Intensive week-long courses, or other attempts to present the material in a comprehensive manner, were not given. Some extensionists, though, still attend classes of the albañil school.

There seemingly was an attitude of not bringing the extensionists up to the level of being able to build their own houses. That required too much training and some did not want to become "builders". In fact, not many have rebuilt their own houses; those that have, that we know of, did not participate in the construction nor even supervise the construction. (It should be important to Proyecto Kuchuba'l that the Save the Children Alliance has determined that an aspiring albañil student needs to build, on the average, two complete anti-seismic houses before the lessons and principles are really "learned". If that is the case for the average albañil student, it is likely even more difficult for the lay-builder to learn.)

On the other hand, the activity of the extensionists has been reflective of the reality of the demand. Perhaps more accurately, it reflects their interest and abilities for their services in the rural areas. However, there will be a future value of having these people readily available in the area when the residents do need advice on building their houses.

The seminar for the staff, held March 28-30, 1977, was to address the issue of the role of the extensionists, such as what proportion of their time, especially in the next three months, would be spent on housing. Actually, this issue was not resolved.

Recommendations:

1. The function, ability and motivation of the extensionists is presently being reexamined. Our recommendation is that the role of the extensionist be to do what is necessary to keep the issues of reconstructing safe housing before the public, to update their knowledge on the possible sources of material assistance to the families, and to supervise houses under construction. Classes on details of construction should only be given when there is a demand for them. Perhaps an emphasis should be placed on their input into upgrading the CARE houses into permanent houses.

   For the supervision process, the guidelines or checklist now under production should be of use to them. A step-by-step review of the list with them might be necessary to ensure they understand each aspect.

2. The Kuchuba'l group system, as described under the section on training the general public, is an excellent use of the extensionists. However, acceptability of working in groups may not be feasible throughout the program area. The work of the extensionist organizing the group and the albañil carrying through seems to be a perfect combination.

3. The extensionists who have not received enough, or proper, training wish to have more training. This should be carefully developed, given in several two or three-day intensive sessions, and cover the method of his redefined role as promoter. Workshops could begin by reviewing what has been taught in the villages, what could be repeated or developed, and what would be in tune with the present status of building and interest (to get beyond rhetoric). For example, in several cases the extensionists seem

to be working in a case-by-case situation, analyzing with the resident his resources and planning for the future building.

C. Training of the General Public

Objective: The training of the general public aspect of the program is the most ambiguous or unclear component, but, ultimately, the most important. The initial objectives stated: communicating the technical solutions of anti-seismic housing construction to the albañil, extensionist, staff, and other agencies. This was indirectly, and later directly, stated as a means of communicating to the rural people of the program area.

Implementation: The methods used have been varied, each implying a different goal:

1. Teaching albañiles to teach other albañiles how to build anti-seismic houses for the general public.

2. Teaching the World Neighbors Rural Development Program extensionists and program albañiles to make the general public aware of the basic principles of earthquake resistant construction.

3. Building model structures to demonstrate to the public these anti-seismic principles.

What is not clear is the program's objectives in pursuing these activities. The evidence suggests some possibilities, which include the process of making the public:

1. Aware of the purpose and rationale of the anti-seismic construction so that they will be motivated to hire an albañil to build their houses along these principles;

2. Able to build their houses themselves along these principles;

3. Motivated to join a Kuchuba'l (mutual aid) group to build their houses under the supervision of a program albañil.

Achievement of the first possibility is perhaps the easiest. There seems to have been a general openness on the part of the public to find alternative methods of construction to replace the methods used for the construction of their previous unsafe homes. The problem then fell back to the program to train the albañiles to build the houses. This solution only applies to those families who can afford, and choose to hire, albañiles.

There is a continuing debate regarding the extensiveness of individuals who will hire albañiles to build their houses. Even within the program, there is no consensus. The estimates of the number of individuals who will hire albañiles range from, very roughly, one-third to two-thirds. To address the problem in terms of program efficiency, the program should make an effort to establish that very significant piece of information, as well as when the people plan to rebuild.

Achievement of the second option is perhaps the hardest. To train a non-albañil to build his own house using several totally new-to-him techniques is a formidable task. The program has, for all practical purposes, established that it cannot be efficiently done. This was demonstrated through the training of the extensionists. If these people -- who were considered by many to be among the most educable, eager, receptive people in their community -- have difficult in building their houses, how will other non-albañiles do? The program obvious does not intend to abandon the up to two-thirds of the population who cannot hire an albañil. Probably 80% of the population have already built their own provisional shelter using lightweight roofing, a post structure and lightweight nails. By virtue of the impact of CARE, perhaps 40%-50% of the houses have "X"-bracing (although not always well attached). The other methods of construc-tion, though, are not a by-product of the education program but rather what the people did because of other circumstances.

The real problem is to keep these proportions from dropping seriously as people rebuild their permanent, "formal" houses. If that is the program's objective, perhaps all that is necessary is the continual reminder by the extensionists of these basic earthquake resistant principles, as the people eventual rebuild. On the other hand, if the program is going to pursue with diligence the implementation of the approximately ten other less basic, but still importa aspects of anti-seismic construction, another approach is essential.

That approach is the third possibility mentioned -- that of working in mutual aid groups under the supervision of a trained albañil. Another related possibility is the supervision of individuals, not working in groups, by the trained albañil.

This method of training the general public is the most costly in both time and money. It is also the most effective in getting the most anti-seismic princ ples incorporated in individual houses. The two alternative ways need to be examined for their impact.

The mutual aid groups -- in this program called Grupos Kuchuba'les -- are currently working in the Poaquil area. They are formed through the efforts of a extensionist. He typically presents the idea of the method at community meeting delivers a class on anti-seismic construction principles, and identifies usually five families who agree to build all their houses collectively with the supervision of an albañil trained by Proyecto Kuchuba'l and paid by the World Neighbo Rural Development Program. Another method has been for the extensionists to recruit the participants with a more door-to-door process. Both methods may require a period of three or more weeks to set up a group. There were thirteen groups organized in April 1977, and seven other possible groups.

After each family has prepared the house site and assembled all the necessa building materials, the group begins to work. By constructing only the structur walls and roof, each house can be built in about twelve working days. The individual family is responsible for such finishing details as floor, doors and wind

This method has several significant advantages. By the end of the cycle of building five houses, all participants should be quite competent at this form of construction. Some of the individuals will then, no doubt, be in a position to build additions onto their own houses or to build other houses without further supervision. In other words, the base of albañiles in the community has been significantly expanded. Furthermore, the virtues of a group working together are a valuable by-product of the process.

This system, however, is more costly to the program than its alternative. Each cycle of five houses takes about 2½ months to complete, costing about $24.00 per house to the program.

The alternative of a program albañil supervising the individual houses is the form typically practiced in the San Martín area. The method is somewhat simpler. Once a person has decided to build his house based on the earthquake resistant principles -- presumably after being convinced through a class given by an extensionist -- he asks for supervision of his work. In this method, the supervisor probably spends only a short amount of time per day, three or four times a week, with the individual. The number of houses that an albañil can supervise is, no doubt, increased over that of his counterpart in the Grupo Kuchuba'l; but there are also probably more errors made in the construction because of less personal attention.

The individual receives less of a training experience on his own house, and also does not have the opportunity to improve his knowledge or experience through construction of subsequent houses. Although a supervisor could probably supervise twice as many houses in the same period as it takes the Grupo Kuchuba'l to build five houses, the individual in San Martín probably has to pay one or two hired helpers. In other words, the cost to the program is less for the individual supervision approach, but the cost to the individual is generally greater and he is less well trained in the end.

There are several other questions to be asked of the two approaches towards supervision. The Grupo Kuchuba'l approach was initially intended to only supervise the first of the five houses. The method, however, evolved into the practice of a program albañil continually supervising all the houses. It may still be possible to revert to supervising the first house, with the albañil returning on a regular basis to check up on the construction of subsequent houses. However, the latter four families may feel cheated on this form of service, which had been a "major reason" why they joined the group.

Another question is whether the offer of a paid "trained" albañil (who also needs supervision from the program's experienced personnel) is a significant motivation to use the earthquake resistant construction principles. Preliminary observations indicate that it was relatively important in the families' decision to build with this form of program support. The question, then, is whether the program can afford it. It benefits few, subsidizes these families, and is conditional on using the earthquake resistant principles.

The method of training the general public through direct supervision of construction (of individuals or in groups) is possibly the most inefficient way for the program to reach a large number of people. There are approximately 8,500 families in the San Martín and Poaquil area (to say nothing of Tecpán and Santa Apolonia) who were in need of rebuilt houses. One year later, there are probably about 7,800 families who are either still in need or will be in a very few years. The counter argument is that the program will likely receive very high returns in the long term on its relatively high investment in assisting the construction of a number of the anti-seismic houses. By the end of this program year, that number may be around 100 in Poaquil and 150 in San Martín.

The initial number is crucial, because it may or may not be large enough to set the precedent in a community, or to set an example by means of which many of the rest of the population will be influenced enough to follow the precedent. If the first people in the community to rebuild do so with a good anti-seismic house, there is a good chance the majority will follow.

Recommendations:

1. Make a survey of a statistically representative sample of the program's target population.

   a. Determine how many families will:
      --- plan to hire an albañil to build their house;
      --- plan to hire an albañil on a part-time basis to only advise them on the critical aspects of the construction;
      --- plan to build their house themselves.

   b. Determine when people expect that they will be able to build and with what materials (what is needed to bridge gap from existing house to "formal" house).

   c. Determine how many families plan to build according to anti-seismic techniques and need further support in this area, and what kind of support is necessary (see Appendix C).

2. The program should continue with supervision of construction. In terms of effectiveness, Grupos Kuchuba'l are preferable. One form of supervision program should be continued until several examples of the anti-seismic method of construction are built in the target communities. To lower the cost to the program, the service could be provided part-time, or the families could be responsible for half of the albañiles' salary while working with them.

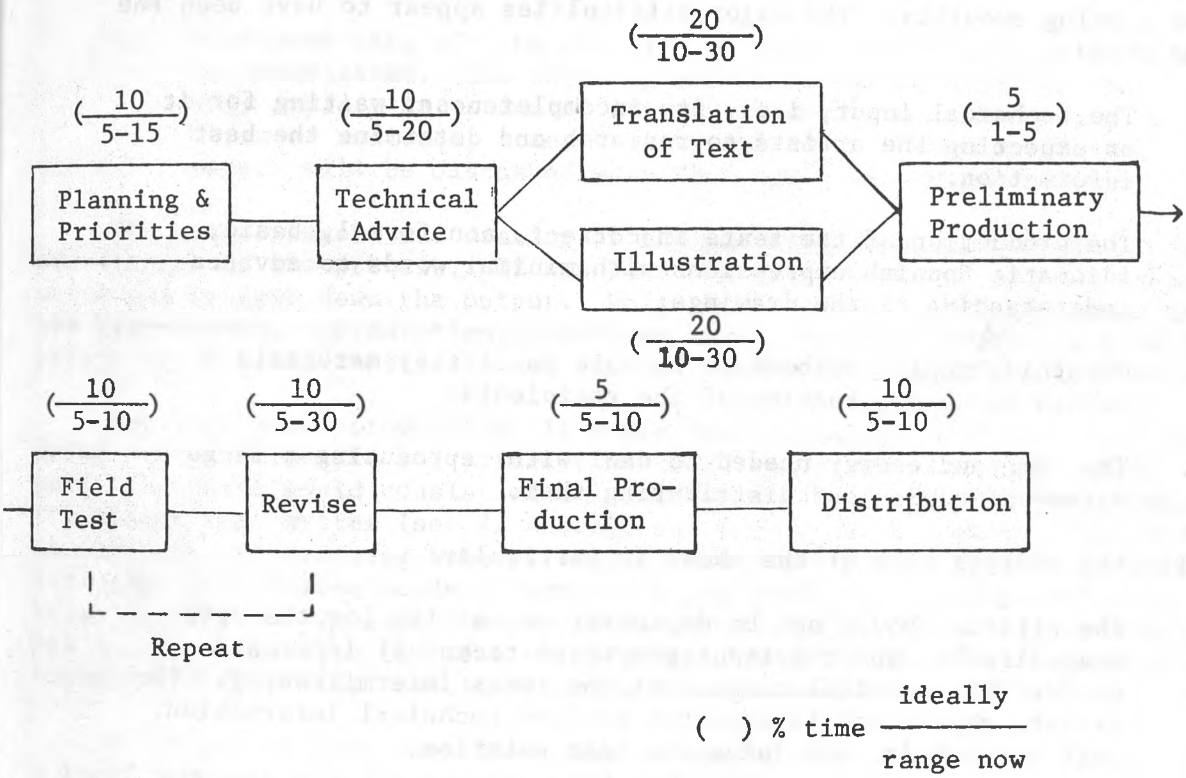
IV. Educational Materials (Training Aids)

The objective of the use of educational materials is to develop supportive means to communicate information needed in the presentation of the earthquake resistant construction techniques. Generally, this meant development of illustrative public handouts or visual aids to be used in classes.

A. Process of Production

The production of a visual explanation of the basic principles for the proposed method to construct a safe house, in a pamphlet and poster format, was achieved soon after the earthquake. It was an important element which helped the staff and the public to understand what the program was about, and was an essential tool in communicating the ideas. Having the information "concretely" stated provided an "answer" on how to approach rebuilding. While the pamphlet went through five revisions, there were no major changes in content, but rather minor clarifications of presentation. The information and simplicity of the initial work were essentially correct, so that it was a matter of working out the details.

After the initial critical period, there was a slow-down of production and a review to establish the process and priorities for the next year (i.e., June 1976-1977). The following diagram represents the steps outlined for the development of the educational materials.



In theory, this would be ideal; but in practice, several difficulties have arisen.

The issue of planning and setting priorities developed into a conflict over who should set them -- an outside technical expert or local people who know best the local needs. A list of subject matters (with several outputs each, e.g., instructor's guide, course outline, public information and visual aid) was advised by the technical consultant as necessary to cover the scope of information associated with construction of housing. The other aspect was to be responsive to requests from the field staff as the problems arose. The overview of needs provided by the consultant was, in general, important; but the idea for instructor's guides and course outline was projected onto Program Kuchuba'l from another program. Kuchuba'l did not develop them because the extensionists are very capable and had previous teaching experience. Some other training would have been helpful, however, to stimulate interest and clarify the various classes which would be responsive to the kind of building activity in the community.

In principle, the production of educational materials should be done with the input of the staff that will use them, to ensure that they will be responsive and acceptable. In this case, the extensionists, for the most part, were not involved directly enough with actual construction to provide adequate feedback to the production of materials. The albañiles who were supervising were more likely to perceive the needed information. Probably because the extensionists previously had very limited, or no, educational materials available to them, their requests were very minimal. They had little perspective on the now potentially abundant resource.

The result is that the production should and could have been a combination of responsive and anticipatory materials, if the momentum and working conditions had been running smoothly. The major difficulties appear to have been the problems with:

1. The technical input, i.e., its incompleteness, waiting for it or expecting the artists to research and determine the best information;
2. The production of the texts in correct, non-formal, basic, idiomatic Spanish expressions with minimal words to advance understanding of the drawings;
3. Obtaining ample feedback to be able to clarify materials within the understanding of the recipients;
4. The time and energy needed to deal with reproducing a large volume of copies and distributing them.

The following address each of the above in particular:

1. The artists should not be dependent on waiting for the very busy director who can input practical technical information, or for the technical consultant who comes intermittently. The artists should not be expected to find technical information, sift through it, and judge the best solution.

   The person needed for technical advice may not be easy to find but should be a Guatemalan, in agreement with the program philosophy, experienced in low-cost rural housing, sufficiently expert in construction, practical, and able to communicate with local albañiles and artists.

2. Neither an expatriate nor a secretary can be expected to be sufficient to write the texts. A person very familiar with local expressions, vocabulary of building, with an educational background of, for example, editing textbooks, would be good to have available. The interest in and knowledge of this type of communication is critical.

3. More than one meeting, once or twice a month, with the extensionists is needed to get feedback on new materials. The

classes given should be visited by the artists to see how the materials are presented and what the response is from the public. Informal interviews with various recipients of the pamphlets should go through the material carefully to determine problematic details. In other words, one day a week, at least, should be spent in the field by the coordinator.

4. There is a person who was hired to deal with material reproduction errands, but who since has become more involved in designing the buildings for the co-op. Another person should be found who understands various reproduction processes and can deal also with distribution.

5. A clearer idea of the quantity of each production needed should be established. The existing budget is rather arbitrary but very ample. An estimated utility of each should be gauged in terms of audience, accessibility and cost. The distribution aspect will be discussed more thoroughly in the next section.

The actual layout and drawing of the material is a critical part, but only one element in the process. It has been the distraction of all the other aspects which has dragged down the output. While other persons were available to do the translation, reproduction, compiling, etc., it is necessary to have one person who has the continuity and overall concept to administer the process.

For full-speed production, it would seem necessary to have a team with three part-time people and a full-time coordinator and full-time artist. The part-time staff would consist of a local technical advisor (see #1 above), a translator/text writer (see #2 above), and a production person. The artist is full-time if training a local artist, but otherwise could be half-time. The full-time coordinator needs to work with the staff on planning, needs to establish format, incorporate the proper technical information, explain what drawings are needed, work with the text writer, spend time in the field determining changes and recycling that information for the revisions, and establish output.

It is our opinion that this team should be developed so that it could be a local resource for future use. This will be discussed further under "Future Directions".

B. Distribution

The policy of the program is that the educational materials are to be distributed only along with a class or an explanation. This is a sound principle, in that the materials are developed as backup resources. However, in order to spread the information, the comic book and the "How to put on lamina" are given to people purchasing construction materials. This is beneficial because numerous people receive them who might not otherwise.

The significant concern to the success of the program is the degree to which the information has gotten out to those who need it. The following chart indicates what has been available (approximate figures):

Distribution of Educational Materials

Item	Reproduced Mimeo & Offset	Sold or given to other agencies	In stock as of April 10, 1977	Approx. San Mart pán, SJP op after
1. Flipchart	500	200 AID 35 Alianza 45 Peace Corps 40 Other agencies 320	105 (58 complete)	
2. How to Build Safe Houses in Earthquake Zones (various editions)	19,975	4,325 Alianza 2,100 6 agencies 275 Misc. 6,700	6,250 (?)	7,025 (2-3,000 May)
3. above in Cakchiquel edition	1,550	380	100	1,070 (?)
4. Road Building Techniques (first edition)	2,500	100	110	2,000
5. Road Building Techniques (second edition)	100			50 extension
6. Comic book "How to Build a Safer House"	100,00 by Philip Morris; 50,000 given to OXFAM/WN Program +25,000 possibly	11,000 Alianza 3,400 CARE 2,100 Peace Corps 1,200 Other agencies 1,000 OX/WN elsewhere 18,700	3,775 + ? in bodega de OXFAM	7,195 (for clas and with chase of materials
7. Lamina (two editions - how to put on corrugated roofing sheets)	14,350	4,000 Alianza	300	10,617 (plus with const. mat
8. What are Earthquakes?	3,567	250 Alianza 400 Co-op 350 ILV 200 Maryknoll 50 Misc. 1,250	100	2,217
9. Questions & Answers about Earthquakes (just out in March)	350	100 AID	70	40 extension

Item	Reproduced Mimeo & Offset	Sold or given to other agencies	In stock as of April 10, 1977	Approx. out to San Martín, Tecpán, SJP and co-op after May 76
Corner Braces	1,500	200 Alianza 100 AID 300	200	250
Lightweight Gables (first edition)	500	200 Alianza	50	432
Balanced Wall Heights and Lightweight Gables	1,000	100 AID	400	75
Corredors	100	(just out in March)		40 extensionists
How to Attach X-braces	100	"	15	40 extensionists
Cost Analysis	250	200 (Alianza, Nat. Committee, CARE, etc.)	0	100
Wood Preservatives	300	(suspended because information not complete)		
Repair of Houses	100	Various	30	50
OXFAM Urban Program Basically:				
Recommendations on Construction with Block	7,000 (should have been 4,000)	2,000 Chiché 150 Joyabaj 100 AID 50 Misc. 2,300	2,125	2,400
Principles in Block	7,000	4,500 Alianza 100 AID 50 Misc. 4,650	1,886	2,690
Building Sequence - Special Block	4,000 (should have been 1,000)	150 Joyabaj 100 AID 250	1,240	2,365
Building Sequence - Regular Block	6,500		1,235	1,680

Note: Add 50 to list of program use for each production (except for the ones already indicated. Also, from 50-100 of each product have gone into "folders".

It was not possible in our limited time to field survey the existence of educational materials in the homes of families throughout the program areas. The extensionists stated that they had distributed them. A significant proport however, have gone out with the purchase of construction materials.

The chart does indicate the extensiveness to which various materials have been purchased in large quantities by other agencies. The major buyers have be Save the Children Alianza, U.S.AID, CARE, Peace Corps, Summer Institute of Linguistics, Kato-Ki Quetzal Cooperative, Maryknoll (Huehuetenango), Voice of Nahuala (Maryknoll/local radio education). These people pay the cost of reproduction. The numerous samples made available free to agencies and individuals represents another avenue of influence.

It is not clear whether the albañil school students and the mutual aid construction groups have visual aids on the technical details. This needs to be followed up. The new materials to address some of the common errors of construction should be gotten to them as soon as possible.

There is a lack of a clear goal or statement as to whom the materials are to reach. The number needed to provide each family or person in the process of construction with a copy of a specific material (or at least accessibility to a neighbor's copy) can be calculated. There is probably no need to distribute materials such as the handout on corner bracing except to those albañiles or families who are in that process of building.

A step has been taken to provide a shelf with existing pamphlets in each of the San Martín and Poaquil offices so that extensionists will have better access to the materials. They might even keep a small supply in their homes to help increase potential distribution. For the future, it would be beneficial to project how many people would find each production useful, and how to get it to them.

C. Reception of the Materials

The real test of the educational materials is whether the recipients seek out, understand and apply the information which they contain. That needs to be measured directly from/in the field. It is also important to obtain feedback from the extensionists and other agencies who use the materials. A review by other people or programs with related experiences could also be beneficial.

Based on our limited contact with residents in each area, the following are only general impressions and questions which should be addressed in developing future educational materials in this or similar programs, and in viewing their impact.

Several San Martín extensionists mentioned that, in comparison with receiving lamina from CARE or a house from the Red Cross (with 12 days' work), the offer of pamphlets and educational courses from Programa Kuchuba'l just could not compete. On the other hand, some people realized that their Red Cross wood house would only last a few years. They would then not know how to replace it and rebuild with a safe house. Those people were seeking out the program's informatio

Another issue was that, for those people who were not planning to rebuild soon, there would be only minimal interest in the materials and classes at this time. It appears, however, that many agree with the ideas; and if they have more practical details available when they are ready to build (such as a bajareque building sequence), they will use the ERCT rather than revert to the previous techniques.

In order to present a rationale for using ERCT as a response to the God-sent earthquakes, it was important to produce the booklet on "What are Earthquakes?". It was a motivation to change one's ways, in that building with ERCT would not just be defiance of fate. It was a difficult subject to present very simply. Although the booklet may not be completely understood, it at least offers a "scientific" explanation. Consequently, the people have a reason to consider "scientific" improvements in housing construction.

It is also important to consider the previous experience of the residents in regard to similar visual aids, their customary learning process, and their reading level. Previously within the World Neighbors Rural Development Program, the extensionists received a newsletter-type publication with written articles on various experiences of improvement projects. They would sometimes sketch very simple illustrations which were mimeographed and handed out to the public. It could be said that the materials produced now are in-between the two formats described above; i.e., more complicated than the simple handouts, but more practical than the newsletter descriptions.

Books and printed materials are rather expensive and not frequently found in most rural homes. The handouts and pamphlets may be considered quite valuable. It would be very valuable information for the program to make a survey that could determine the perceived worth.

When producing this type of educational material, a checklist of criteria is useful to gauge the potential communicativeness:

1. Pictures Clear -
   a. no unnecessary or excessive detail
   b. not abstract (lack of sufficient detail or need to infer other parts)
   c. familiar elements
   d. no unrealistic or imaginary characters unless identifiable
2. Words Clear -
   a. headlines or captions complete, or add something descriptive; reinforce lesson (SI - NO)
   b. common usage
3. Not too many concepts
4. Logical Sequence (no major gaps)

The artists who produced the Kuchuba'l materials have been careful in applying these criteria to their materials. The overall result has been an excellent job of communicating in a manner which is clear and understood. There is some variation among the materials regarding the amount of verbal explanatio Some observations have been made to us that the comic book (which only received advice from Kuchuba'l and was not produced by it) is too complicated and too much for most recipients to read.

Other problems have arisen, for example, in the matter of details which, although not the main focus of a drawing, are not technically correct. The problem is that many people are inclined to assume all details to be correct.

The issue of presenting the best approach to a specific solution of a deta or system, rather than illustrating improvement in the "normal" way which is at least good, has its pros and cons. It is important to present the most recommended way ("best"), but is advisable also to illustrate a "good" way which may be the reality. If the "best" solution is viewed as too costly in time, effort or money, the users may either abandon the idea altogether or apply a misinterpretation or variation which may not be satisfactory.

A problem of the details and the materials for them never being "complete" has now been seen by some of the extensionists as a deterrent. A new piece of information may imply that those who have already built did something wrong. This is not serious but can be irritating.

We spent time going through various existing productions pointing out deta which could be improved. Making such corrections is secondary to developing th new materials needed before June, but the examination was made nevertheless. Rather than repeat the page-by-page comments here, only an example will be offered.

Two versions of "How to install <u>lamina</u>" have been produced. A combinatio of the two, and making several changes, could clarify the process. The last page is good with the <u>costanera</u> shown; the SI-NO should be emphasized relative to other words. A detail of the nailhead with a washer could be shown.

The first page of the second edition is a house drawn at a good size; this should be used with a larger overhang than shown. The circle to designate the area of the detail should be enlarged and emphasized. On the bottom of the pag an enlarged <u>"traslape"</u> close to the size of the first edition should be illustrated. The verbal explanation should be in larger letters clearly written across the bottom of the page.

Another page should use the same size house with overhang as did the previ page to illustrate the vertical overlap (not over-large as done on the double page in the center, second edition). The detail circle and blow-up should be pulled out. Point out what is four inches (other sources recommend the overlap to be 20 centimeters). Instructions should be explained in two steps.

A fourth page could then be used to show a close-up of the recommended overhang dimensions. The reasons why an overhang is useful -- i.e. rain fallin protects the house (sun protection of windows is not too relevant here) -- can also reinforce the issue with a simple drawing.

This fourth page could also include little sketches showing three houses: one with a two-sloped roof; one with a one-slope; and one with a corredor. This could demonstrate how to calculate for various sized houses the number of lamina sheets (of various dimensions) needed to cover, allowing for a sufficient overhang. This does get a bit complicated, however.

A revision of the lamina handout could thus become a long-term resource, because people will be installing the lamina for some time in the future. Copies might be made available to other lamina distributing agencies, such as BANDESA, at cost of reproduction.

This particular example demonstrates the value of this kind of educational material when introducing a new building material or technique. Many people will learn from the experience of others installing it; but, to many, it is a new problem. Having the correct information illustrated and available to a significant portion of the population initially has been important in addressing the potential which lamina has created in the process of reconstruction.

The scale-model structure which can be put together from separate pieces, thereby demonstrating the cross-braces and structural rigidity, created interest. That model seemed more effective as a teaching tool than the two models which were "already built". The radio programs were also said to have been of considerable interest and importance as a major medium.

D. Future Directions

The Tecpán program (now closed down) and the San Martín program were given a list of possible educational materials to be produced. The priorities which they designated in effect did not help much in programming the production. The opportunity of the staff seminar provided the outlet for several new productions and a chance to request others.

Previous to the seminar, the priorities were for Kathy to do a building sequence for bajareque and adobe de canto construction. Nancy would rework a simplified version of the earthquake pamphlet, and would work on how to change poles and various treatments of posts during her remaining month with the program. We are in agreement with these as needed primary outputs.

After the seminar, and particularly during the field trip where various construction problems or errors were seen, it became apparent that several of these should be addressed with additional information. For use by the Kuchuba'l groups, the albañiles supervising houses, and general availability to others currently building, the following materials would help to correct common mistakes:

1. With minor revisions, the material on corredors and corner braces should be gotten out;

2. The section of the handout about the placement of joints, developed by Joyabaj, should be made available;

3. A new (about 3-page) handout concerning the construction of trusses is very critically needed;

4. We also went through the "Building Inspection Steps" and reworked it so that it could become a checklist for supervision for extensionists;

5. In addition, a simple explanation of how to mix and cure concrete was outlined;

6. Since the shortage of wood was a frequent excuse for lack of building or missing details, it would be useful to develop information to demonstrate various combinations of the means to obtain the wood and calculate the need.

The above items are anticipated to be completed before June 30, 1977. The list should also be checked against the requests of the field <u>albañiles</u> accordin to their analysis of the field trip and perceived needs.

With the possibility of a program extension, several additional materials can be anticipated. Depending on the form of the future program, there could be at least several alternatives as to the general category of educational material to be produced. A series of details using similar format can be expanded from the existing pamphlets on corner braces, gables and <u>lamina</u>. These, in turn, can be developed into a training manual for the <u>albañiles</u>' school.

Two other projects could be a series for the extensionists on elements of home improvements, often integrated with health aspects; and a series of considerations basically relating to the unique conditions of an urban lot.

Beyond these, there is potential to address other subjects such as cooperativism, water and agricultural practices. In effect, the ability to produce "How to Build a Safer House" could develop into a permanent resource center for educational materials. Much of the information is available (see #3, page 6), b it needs to be reworked and made available in a better format for communication the extensionists and the public.

Only if other agencies, local communities and organizations such as co-ops would be interested in purchasing such materials at cost of reproduction should the funds for their development be put forward. With the need established (chec to see who would utilize such a service) and with the ability to put together a local team, the potential should be strongly considered. This is preferable, i our opinion, to just limiting the next year to the supply of training materials to the <u>albañil</u> school.

E. Recommendations

Throughout this section, and in discussions with the staff, the recommendations have been put forward; hence, this is only a summary:

1. The priorities regarding which materials are to be produced must be a compromise between being responsive to the field and seeing the overview.

2. A team, as described, could make future production more efficient; but the feasibility depends on the scope of work/direction funded.

3. A clearer idea of quantities of materials, who they are going to, and how they get there, should be developed for more effective distribution.

4. Some time should be spent reviewing existing productions with about fifty residents in the area, in order to determine access, interest and value, and to check the presentation for understanding and details.

5. Several handouts should be developed to combat common errors in construction; but the two basic building sequences are of more long-term significance.

6. We would like to see a locally-controlled and operated resource center for the production of developmental education materials (not just safe housing) result from the Programa Kuchuba'l experience.

V. Model Structures

The objectives of the model structures component of the program were:

--- Learning by working - the training of a local albañil in earthquake resistant construction techniques (as of October 1976, 48 albañiles have participated);

--- Providing a demonstration of the ERCT using local materials and skills (as of October 1976, 48 models completed);

--- Building 70-100 structures which would serve as community meeting halls, offices and staff houses (total built: 48, 3, 3 respectively).

A. Tool for Teaching Earthquake Resistant Construction Techniques

To implement on-site training, one albañil per model was chosen by the community. He was paid and supervised by Program Kuchuba'l. The community selected the location, size and wall type of the structure, but had a limit of only using thirty sheets of 9' long (or 25 sheets of 10'long) lamina provided by the program. Various residents of the community participated in the construction, providing general labor, and thereby being exposed directly to the building process.

The residents of the community who would be planning on building their own homes were expected to be able to use the model as a reference through their visits to it, during construction and/or after completion.

The measure of success of the first objectives would be the evidence that the hired albañil had built other houses using the ERCT, and that the community would have some structures built by other individuals along the same principles. At this point, it would be difficult to substantiate such evidence. In most villages, our survey found from none to about four houses being built using the ERCT. On an average, about two houses per village were using the ERCT, out of an average of ten to fifteen houses being built.

In one particular case, an albañil was interviewed who had built two houses as virtual replicas of the model house. He had neither been to a class given in the community, nor participated in the construction of the model, nor received supervision from someone in Programa Kuchuba'l. He explained that all he needed was to see the model in order to know what to do. Though this builder's experience was an encouraging example of the usefulness of the model, he appears to be the exception.

A possible detriment to learning from the model is that the buildings are usually under lock and key. For those who want to see how some of the interior details were executed, they need to first borrow the key. This may prove a block in cases where the person with the key is not readily available, or perhaps is not on good terms with the person seeking to get into the model. Usually, the exterior is left unfinished so most can see the basic ideas.

To summarize, the model is undoubtedly a very good learning tool for the one albañil who built the entire structure under the supervision of Programa Kuchuba'l. It may have had more impact if the other assistants had participated in a more disciplined manner. That is, instead of being volunteers who worked on the model only a few days, they perhaps should have been the same two or three people who worked every day and were given a salary. By upgrading their role in the construction, they might have become better trained and thereby have increased the number of people in the community with a working knowledge of the ERCT. This advantage, however, is sacrificed for the other advantage of the community's contribution and involvement.

Construction of the model also offered several occasions for the presentation of courses on the ERCT to the local residents. It is much more convincing to be able to point to the cross-bracing or other details when presenting the technique, than to use printed material. In each location of a model, it is assumed that at least two courses on the principles of ERCT have been given. Future refresher courses should be given in these models which would point out the different anti-seismic characteristics.

B. Community Participation

The kind of community participation that has taken place for the construction of the model structures has been particularly important. The fact that a community generally put up a significant portion of the cost of the model, through their contribution of land and much of the materials and labor, means a commitment. Since they saw the use of the local materials and the amount of purchased materials needed, it gave them a better idea of what it would take to build their own homes using these techniques. The investment of local time and materials also enhances the future utilization of the model by the community.

MODEL COMMUNITY MEETING HALL
VILLAGE OF XESUJ, SAN MARTIN JILOTEPEQUE

This is an example of how the agreement between the Kuchuba'l Pro- and the village has worked out in a specific case. The villagers ed all of the labor, wood, and adobes but they have given me its ximate value. All of the wood used had been salvaged from build- destroyed in the earthquake and the value listed is the post-earth- price for used wood in San Martín.

ge of Xesuj Provided:

e site. In this case it ready belonged to the mmunity	$ .00
l the wood 8 uprights (salvaged wood)	27.00
9 1/2 doz. 2 by 4's of varying lengths (salvaged wood)	66.50
2 large beams (salvaged wood)	45.00
Tongue and groove boards (salvaged) for siding between the roof and ring beam	4.00
dobes - 300 at 3 ¢/adobe	9.00
wo doors and two indows (not yet obtained) nticipated value using alvaged wood	20.00
28 days of labor at 1.50/day	192.00
Total	$363.50

Kuchuba'l Program Provided:

1. Corrugated galvanized roofing, 30 sheets of 9'	$140.00
2. "Cap" for the roof peak (strips of galvanized roofing material)	8.75
3. Creosote - 10 liters	—
4. Nails - 10 lbs.	—
5. Barbed wire - 1 roll	16.00
6. Lime - 4 sacks of 100 lbs (used for white-wash only(	8.00
7. Salary for one builder from the community	48.00
Total	$228.66

al Cost : US $592.16
e: 10 meters, 30 centimeters by 5 meters

C. Use of Model Structures

If a further justification were necessary for the expenditure of resources on the models, other than as a tool for teaching, it could be made in terms of facilitating the on-going process of community organization. The incentive of completing a building for the use of the community was probably essential for the extensive participation by the community in its construction.

Nevertheless, the present use of the approximately fifteen models visited for this evaluation varied a great deal. Two or three of them were being used as storage rooms for construction materials or, in one case, for medical supplies for the health clinic which was under construction. The rest of them essentially were in use as community meeting rooms. Descriptions of the intensity of use varied from occasional to five or six times per week. In a few cases, the models appear to have been significant additions to a community where there had not previously been an adequate facility. In a few others, however, the model merely replaced a damaged facility, but usually one which was identified with a particular church, family or school. The new building was seen as a more neutral territory, probably more accessible to some members of the community. The relatively small size (8 x 5 meters, typical) limits the kind and size of meetings which can be held there.

Unfortunately, this evaluation was not able to measure the change in the patterns of community meetings, or in what other ways the models may have altered the social life of the community.

D. General Impressions

The relatively large number of models spread over a wide area provides exposure to the majority of residents. The use of bajareque has also been a demonstration which provided incentive for others to use that technique. The actual example of bajareque was generally more convincing than just an explanation of that method of construction. Most people had either forgotten how to use it or considered it "low status".

The quality of construction of the models has been a bit uneven. Virtually all of them conform to all of the basic principles of earthquake resistant construction techniques. However, on the execution of details, there are many errors or poor workmanship. These errors or poor quality of workmanship are generally found in the other houses built in that village. For example, the trusses in all of the observed model structures in the municipio of Tecpán were inadequately constructed. Similarly, all the observed trusses in private houses in Tecpán were just as badly built or worse.

This suggests that there was inadequate supervision given to the construction of these models. Another very likely possibility is that there is an area-wide indifference to that particular aspect of construction. Such an area-wide attitude may prove too strong to overcome on the initial effort of the model structures.

Another problem with many of the models constructed of adobe de canto is that the barbed wire used to hold the adobes in place is exposed. The apparent intention was to clearly demonstrate the method of construction, but instead it has become a health hazard. In fact, during a visit to one of these model houses, we saw a boy with a very large bruise and gash on his face. We asked what had happened, and he told us that he had fallen against the barbed wire while playing. Plastering over all but perhaps the top part of the back wall should be an urgent item for completion on these model structures.

It perhaps could be viewed as a problem that the construction of the models has covered such a long period of time. In fact, as of April 1977, a few more are planned or under construction. Contrary to being a problem, this deliberate pace of continually having models under construction can be seen as an advantage. Because such a large proportion of the permanent housing has not yet been rebuilt, the lessons learned from building the models should not be forgotten before the building of private houses is undertaken. Furthermore, these latter models have the advantage of getting feedback from the earlier ones and incorporating subsequent changes or new ideas. A pragmatic cause for the slow construction cycle is the need for careful supervision. The staff could not cover too many at one time, and the organization of communities to build the models by the extensionists also takes considerable time.

E. Recommendations

1. Follow up on the albañiles trained by building the models to find out what they are doing and how effective their training has been.

2. Since the existing models are bajareque and adobe de canto (with two exceptions), it should be investigated among the remaining communities who will build a model to see if other alternatives would be of interest.

3. Possibly demonstrate how a CARE frame can be corrected and terminated as a "formal" house.

4. Make a survey to see how the model structures have affected or facilitated community organizations.

VI. Construction Materials Distribution

The objectives of the distribution of construction materials were, for the first phase, to get roofing out in a non-paternalistic way in order to provide protection from the rains, and for the second phase, to provide an incentive and to facilitate families in adapting ERCT for building permanent housing.

A. Policy

During the first phase, the policy was to initially make available the purchase of one lio (10 sheets) of lamina and the necessary nails to each family in the four designated areas, at approximately one-half the normal cost, which represents a significant portion of the funds for the entire program. The purchase of 172,500 sheets of various lengths and gauges from METASA, El Salva (see March 1976 report by Gersony, Froman, Jackson), represented an investment of $975,575.00. Approximately 8,000 more sheets were purchased in Guatemala. The accounting during this period (up until November 1976) could not be verifi but the sale of this lamina should have returned about $500,000 back into the general budget.

The difficulties encountered in this phase included:

1. the fact that other groups in the designated areas, especially CARE, were giving away roofing;
2. the fact that some residents could not afford the $30.00 cost of the 10 sheets, which meant that some did not obtain lamina and others were said to have sold other goods in order to be able to purchase roofing (these were considered minor cases, however).

The program did provide 498 sheets to fifty widows and invalids, at no charge, in the Tecpán area. A road program (see later section) was also developed whi enabled people to work to obtain lamina.

Out of a population of 87,089 (estimate as of January 1976) in these four areas, it is estimated that 15,000 families obtained lamina through this progr (later, approximately 5,000 individuals received lamina through road work). T 15,000 represents 45% of the population (this figure is also the number of hou destroyed in both the urban and rural areas according to the Evaluacion de los Daños Causados por el Terremoto, Secretaria General Consejo National de Planifi cacion Economica, March 1976). In a report by Reggie Norton (May 28, 1976), t other 55% of the population is described as "5% covered by other agencies, 30% did not want it, 5% got free elsewhere, 5% wanted it but did not have time to participate in road work, and 10% could not afford it at that time". Our evalu tion could not verify these figures, but it is clear that the program made a major contribution in this first phase and employed a sound policy of subsidiz distribution.

$50,000 worth of tools such as shovels and wheelbarrows were also made available to local organizations for rubble clearance. These were later used on the road projects.

During the second phase, an amount of $300,000 (to benefit 15,000 families was made available to purchase a diverse range of materials and tools needed to build safer houses. Most of these items, in turn, would be sold at half-price. Each person in the four areas who had a "cedula", an official identification ca plus the members of the Kato-Ki Quetzal Co-op, had the right to purchase $10 worth of materials (worth about $20). In addition to the $10 limit, these resi dents could purchase four more sheets of lamina at half-cost, three bags (100 pounds) of cement at cost, and an unlimited amount of wood at cost (see list of materials following). This program is open to all residents of the four areas, making no distinction between rural and urban.

This is a very reasonable approach, but several difficulties have been encountered. A complaint brought forward by many of the extensionists and co-o

LISTA DE MATERIALES EN BODEGA Y SUS PRECIOS

Cemento Gris	Q.2.00	Quintal
Carbolineo Mezclado con Aldrin:	" 1.00	Galón
Alambre Galvanizado Calibre 14	" 0.20	Libra
Alambre Galvanizado Calibre 12	" 0.20	"
Alambre de Amarre :	" 0.15	"
Alambre Espigado:	" 7.50	Rollo
Clavo de Madera de 1 1/2"	" 0.15	Libra
Clavo de Madera de 2 1/2"	" 0.15	"
Clavos de Madera de 2", 3", 4", 5", 6", 7", y 8":	" 0.15	"
Clavo de lámina de :	" 0.20	"
Hierro de 3/8"	" 7.00	Quintal
Hierro de 3/16"	"10.00	"
Cucharas de Albañilería de 9":	" 1.75	Unidad
Cucharas de Albañilería de 6"	" 1.50	"
Uñas:	" 1.75	"
Escuadras:	" 0.90	"
Niveles de Madera de 12"	" 1.05	"
Serruchos de 26" :	" 2.25	"
Sierras de Acero Plata:	" 0.30	"
Pita de Nylon:	" 0.85	Rollo
Nylon Negro:	" 0.30	Metro
Formón de 1 1/4"	" 1.65	Unidad
Formón de 1/2"	" 1.10	"
Formón de 3/4"	" 1.20	"
Martillo de 1 libra:	" 1.25	"
Tachuelas de 1 pulgada:	" 0.35	Libra
Grapas o Lañas:	" 0.15	"
Metros de madera:	" 0.35	Unidad
Lámina Galvanizada de 12 pies, calibre 26:	"36.00	Lio
Lámina Galvanizada de 10 " " 26:	"30.00	"
Lámina Galvanizada de 9 " " 26:	"27.00	"
Lámina Galvanizada de 12 " " 28:	"30.00	"
Lámina Galvanizada de 10 " " 28:	"25.00	"
Capotes de Lámina:	" 1.00	Unidad
Madera Rústica de Pino de 2 x 3 x 12 Pies	" 0.20	Pie Tablar
Madera Rústica de Pino de 2 x 5 x 12 "	" 0.20	" "
Madera Rústica de Pino de 3 x 5 x 12 "	" 0.20	" "
Madera Rústica de Pino de 4 x 5 x 10 "	" 0.20	" "
Madera Rústica de Pino de 1 x 12 x 12 "	" 0.20	" "
Plomos de Albañilería de 1 1/2 libra:	" 1.75	Unidad.
Block de 4 x 6 1/4 x 10 1/4 pulgadas, tecnificación-Brasileña, conteniendo Arena, Cal y cemento.-	"125.00	Millar.

Vo.Bo. [signature]
Lorenzo Vidal
---OXFAM----

staff is that people say they are unable to get what they need within the $10 limit. This is true, in that many people want to get some tools (e.g. hammer and saw) and they need more than one roll of barbed wire to build a house of 8 x 5 meters (a fairly typical size). There is no doubt that more materials are necessary if a family is to build according to the recommended techniques. One response is that often more than one person per family has a <u>cedula</u>. The average, however, would not be more than two, because many women do not have <u>cedulas</u>, and grown sons or grandparents often have a separate dwelling.

The other side of the problem is that some cannot afford, nor do they pl to purchase this year (before June 30th), because they are not able to build. It appears that many families, though, are buying what they can and storing i for future use.

Another complaint is that fourteen sheets of <u>lamina</u> is not enough to cov a house. A family generally does not build until all the materials are avail The fourteen sheets, if they are 12 feet long, can cover a 5 x 5-meter space. Rural houses seem to range from 3.50 x 5 meters to 5 x 9 meters. Urban houses often expand to much larger sizes.

It was suggested that, to obtain more <u>lamina</u> at subsidized prices, resid could go to the U.S.AID outlet, but there is seemingly none left there.

The point, however, has been made by the program directors that people should not come to expect too much or get used to subsidized prices, because the future that will not be available. The issue is that the earthquake did create a need to obtain building materials, although their priority relative other items may be exaggerated, and the recommended earthquake resistant cons tion techniques do cost more than previous construction methods.

It was wisely established that no conditional requirements would be atta to the purchase of these subsidized materials. Self-determination was respec but it was hoped that, with the influence of the other parts of the program available, the people would use the materials for safer houses.

Because of the problems of getting wood and enough purchased materials t build according to the ERCT, one area program director suggested special arra ments for those families who are working in groups, supervised by the program, building according to the principles of ERCT. While it is an aim to support efforts, a change in policy which would link special benefits to special buil methods was turned down.

B. Present Conditions

The demand for subsidized materials is high; in fact, lines form at the warehouses on market days. The continuous and ample supply of materials has difficult to maintain, particularly with cement. An analysis of sales should determine the most popular items. This may indicate what types of constructi are preferred and planned for by the residents. The system of sales does not make it easy to establish trends or to determine who is buying what (i.e., urban - cement; rural - wire, for example).

The card index and four-copy receipts have greatly enhanced the accountability compared to previous procedures. But an insufficient staff has meant some extensive waiting times to handle the peak sales periods (not considered unacceptable by residents).

The distribution of materials is made through the Kato-Ki Quetzal Co-op under contract with OXFAM. This was done as part of an effort to support local groups, and also because of their previous administrative experience. The co-op has been given a $30,000 grant (for six months) to cover administrative costs (i.e., 16 employees, three warehouses, and the Chimaltenango office). They will also receive a 10% commission at the end of the program on materials sold. The co-op person in charge stated that the grant was insufficient to operate properly. But, if thought of as 20% overhead (grant and commission), that should be adequate.

There is no major concern or problem, seemingly, in the possible abuse of the system. If people wish to re-sell their subsidized materials, that is their choice and may reflect a priority other than building. Any effort to check up on purchasers, or to enforce any rules, would not be very possible or worth the bother.

The reflow of funds (i.e., what the resident pays goes back to the general funds) does not appear to affect demand or residents' opinions towards the program. Some residents are aware of U.S.AID reflow funds going into community work projects, but a similar policy has not been requested by staff or residents. This may be in part because OXFAM/World Neighbors has the separate road program.

It was not possible to verify, but there is some belief that this part of the program did at least two things other than getting materials out. One is that women may have obtained cedulas; and the other, that "normal" prices of construction materials were not as inflated as could have been the case. There was no difficulty in being perceived as unfair competition to regular business, either.

C. Future Directions

At the rate of sales (i.e., $50,157.14 for January and February), it does appear that $150,000 of subsidized materials (or $300,000 total worth) could be sold by June -- the normal building season when people have the most money. Purchases consequently may drop off as people start planting and purchasing the seeds, fertilizers, etc.

What is needed, as in most businesses, is a careful analysis to see if the funds will be expended and most materials sold by June 30th.

The purpose of setting a cut-off date was to limit the administrative costs and to encourage the people to buy now. By simply counting the cards (one per person), it should be easy to ascertain how many people benefitted from this part of the program. An average purchase amount could also be calculated.

D. Recommendations

1. The program seems to have provided the "stimulus to make a sacrifice", i.e., to buy certain materials for future building. The $10 limit spread the benefit to a lot of people. If it had been $20 including cement, for example, the funds would have gone to fewer people, but several more might have started building sooner. It should not, however, be changed at this late date.

2. A systematic analysis of purchased materials could show some interesting trends which, in turn, might indicate the kinds of training and educational materials which could be useful.

VII. Road Project

A special project, this was an effort to pay for work which would benefit a community, so that residents could earn lamina or income which could possibly be used to purchase construction materials. It was also a means of returning to the community the money that was taken out because of the earlier purchase of lamina.

Data:		
	Total Budget	$130,000.00
	Kilometers improved	85-95
	Persons employed	3,000
	Aldeas/number of projects	24

A. Policy

An individual participant in the roads program must first work two days free as has been the tradition; then he can work 21 days for a lio of lamina. He must then stop and give others the opportunity to work for lamina. If there is more work to be done, a worker is paid at Q.1.69 per day (Government minimum salary) for up to 21 days. After that, he may be paid again in lamina for up to 21 days.

For example, in the Tecpán/Santa Apolonia/San José Poaquil area during May, June, July and August 1976, 1,128 sheets of lamina and $4,636.31 were paid out for 4,435 man-days of work on the roads in fifteen different communities.

B. Discussion

This appears to be a direct, simply-administered part of the reconstruction program. It supports labor intensive methods, has improved the roads, and has gotten lamina and cash into numerous communities. Some side-effects have been suggested, for instance:

1. That people are busy working on roads instead of maybe building (but others cannot afford to build until they get paid from the road project);

2. That trucks and buses now come to some areas which had not previously been serviced. (This may have dramatic economic and social impact.)

It would be interesting to obtain some statistics as to average earnings per worker; whether mainly those who could not have obtained lamina otherwise were able to participate; and to document preference for lamina or cash.

While criticism of the food-for-work programs is widespread, a comparison to this as a lamina-for-work program does not quite match the conditions. Often, food is given to support a family while working to build their house. There is no community, "public" benefit, and it is not the "enabling" factor which makes the difference between building safely or not. Food given away also has detrimental effects on the normal market, while the lamina would not present the similar problem for the average family selling the "replaced" goods. With cash, the decision of how it is spent is also left to the individual.

The pamphlet which was developed as a visual aid for this program is quite complicated, but should be of future and broader use than for only this program.

C. Recommendations

1. For future reference, it would be good to document the conditions of the roads prior to the work done under this program, immediately after the work has been completed, and the condition of maintenance several years later.

2. The other issue is to follow up on the economic impact of the work opportunity and cash income this year versus future conditions.

VIII. Physical Impact

One measure of the physical impact of the program in the entire earthquake-affected area would be the number of houses that have been built using at least some of the earthquake resistant construction techniques. This impact has been felt in several different ways, only a few of which were quantifiable in this evaluation.

--- Houses that received lamina through the program: approximately 15,000, although the great majority are only provisional houses.

--- Houses built under the supervision of Programa Kuchuba'l personnel: approximately 160 as of April 1, 1977.

--- Houses built in the four municipios of the program area which were influenced by the education program (classes, model structures, educational materials) but without supervision from the program: approximately 130 as of April 1, 1977.

--- Houses built under the influence of the CARE program: estimated 27,000, although many structures were built inadequately and most are probably temporary.

--- Houses built under the supervision or influence of the Save the Children Alliance: approximately 100 as of March 1, 1977.

--- Houses built through other programs which used some of the educational materials: no estimate.

--- Houses built, influenced by the distribution of educational materials to the general public: no estimate.

At this point in time, it is clear that the biggest impact of the program has been through CARE. Even though in many cases the construction principles were applied badly, at least a large-scale effort was made at putting them before the public -- if not into their consciousness.

There is no real way of quantifying the impact of the program on the vast numbers of houses that have been constructed as provisional homes. Virtually all of them employ some of the ERCT, but for the most part it is unrelated to the program. This observation was referred to earlier under the section on training the general public.

The other area where it is impossible to make an estimate is the future impact of the continuing education program, and how many people will use the earthquake resistant construction techniques when they eventually rebuild their "formal" houses. Where the education program has been active in the rural villages, it is most common to be emphatically assured by the residents that, when they do build, it will be in conformity with the ERCT.

A. Acceptance of the Basic Principles of Anti-seismic Construction

The extent of the use of the ERCT is as varied as the previously listed situations where they have been employed. In general, the more under the control of the education and supervision of construction by the program, the greater has been the use of the ERCT in each house. Nevertheless, it was common to find some errors in construction even on the program's model structures. Most common were:

1. Improperly made trusses, usually having inadequate bracing, or braces were end-nailed. Instead, they should have overlapped the major truss elements, nailing them through the sides.

2. Horizontal corner braces at top sill plate (esquineras) were improperly installed.

3. Posts too far apart for adobe de canto walls.

4. Many of the wood joints were improperly made or located.

The above-listed problems were also commonly found in the private houses under the program's supervision. In addition, there were other errors frequently found in these houses, such as:

--- The door almost never opens outwards;

--- The wire X-bracing is poorly installed;

--- Minimal effort is made at treating the wood with preservative;

--- A 4 or 5 inch mud-filled gap is between the top adobe de canto and the underside of the top plate, solera;

--- The porch (corredor) is attached poorly and without diagonal bracing;

--- There is inadequate cross-bracing between roof trusses.

Less frequently found but worthy of comment were:

--- Unbalanced walls or door and window placement;

--- Joints in the columns.

It is difficult to be specific regarding which principles of ERCT were most commonly accepted outside of the program's supervision. Generally, though, corner posts, lamina roofing and lightweight walls were used. As such structures were utilized before the earthquake and many were built as provisional houses before the program began, it is impossible to estimate how much the education program has effected their widespread use.

In spite of the professed objective of the program to not introduce new building technologies or materials into the area, there were some of both. The scale of these new introductions is admittedly small. In some cases, the techniques were, in fact, not new but only used in other applications, or had been abandoned.

Nevertheless, an assemblage of more or less twenty anti-seismic details that are to be combined in a certain manner constitutes a new technology for many people. Such apparently small matters as building a proper truss are not really so simple where it is a new idea. In this respect, the program did not anticipate the difficulty of the entire effort required to communicate how the whole building system would work.

There were inevitable problems and details of construction that needed to be worked out. Currently, the workmanship of some of the houses can be most accurately described as sloppy. But this is only the first step of a method of construction that will inevitably go through a process of evolution. Traditional adobe construction has evolved from crude houses to highly refined and noble structures, even though frequently humble. Similarly, the new method will require a period of time to resolve the problems of detail and to establish a general level of acceptance in the community. This process has already begun.

B. Use of Bajareque

One of the potentially most important impacts of the program may be the reintroduction in some areas of the use of bajareque construction. In spite of initial cultural resistance to it, the program is now having some success with using it, especially in San José Poaquil and Tecpán. It appears that the several families now rebuilding their formal house with <u>bajareque</u> may be establishing a trend in their communities.

This phenomenon of individuals voluntarily electing to use a culturally less desirable construction method is very important in terms of effecting a developmental change. The program should examine and try to determine the causes and effects in this change.

Many of the CARE structures which are now temporarily enclosed with corn stalks could possibly be converted to permanent houses with <u>bajareque</u> walls or <u>adobe de canto</u>, depending upon how the frame and bracing are built.

The actual, initial impact of the program will not be seen for at least three or five more years, when most people will have returned to normalcy regarding their housing.

CT/PT:jwp

APPENDIX A:

SURVEY

The following survey was completed during the first week of April 1977. It was a rough attempt to establish a base of data so that, three-four years from now, someone can come back and compare the changes made in each village. The extensionists filled in the forms from their knowledge of the areas in which they worked, but they were not required to do a house-by-house tabulation. The original forms will remain at the INTERTECT office, but copies have been made and will stay with the Kuchuba'l office or with World Neighbors.

The questionnaire form is included at the end of the overall tabulation.

For the San Jose Poaquil/Tecpán Area:

5 extensionists reported on 16 village areas.

In total, the number of "casas" (defined as family units, i.e., if there are three buildings -- one a kitchen, one for storage, and one for sleeping -- it only counted as one casa):

1,641 houses in area, approximately, of which 150 were not damaged in the earthquake of February 1976.

In 15 of 16 places, the Programa Kuchuba'l had built a model structure.

30 houses had received supervision from the Program.

555 had received lamina from CARE in 12 of the 16 villages.

Only 2 CARE models were built.

29 houses were built in accordance with the ERCT.

The 29 houses were built typically of bajareque and adobe de canto.

In 6 villages, Red Cross, CARITAS or CEPA had assisted 275 houses total.

64 housing classes had been given, the range being from 2-10 per village.

For the San Martín Jilotepeque Area:

8 extensionists reported on 19 village areas.

2,453 houses in area, approximately of which 79 were not damaged in the earthquake of February 1976.

In 9 out of 19 places, the Programa Kuchuba'l had built a model structure.

45 houses had received supervision from the Program, with possibly 113 in conjunction with CARE.

1,183 had received lamina from CARE in all but one village.

Only 4 CARE models were built.

43 houses were built in accordance with the ERCT.

The 43 houses were built typically of ½ adobe de soga with boards or cana above, or adobe de canto.

In 6 villages Red Cross had assisted 170 houses total.

125 housing classes had been given (possibly 52 more as noted in two forms), the range being from 2-18 per village.

(The degree to which the ERCT are applied was not defined)

APPENDIX A: SURVEY (Cont'd)

San Jose Poaquil/Tecpán Area:

12 albañiles have built safe houses in this area.

23 students of the albañil school live in the area.

San Martín Jilotepeque Area:

18 albañiles have built safe houses in this area.

31 students of the albañil school live in the area.

(This question was presumably misunderstood, because it asked how many of the albañiles who had built safe houses were from the school; but in both cases the number was considerably greater. We doubt that all who built were students, but there are many students who have not yet built a house.)

The reasons cited for the majority of people not yet building their formal house were, in order of frequency, lack of money; lack of water to make adobes; lack of materials, especially wood and lamina; lack of labor, i.e., time rather spent on agriculture, and lack of skilled labor; have provisional houses; have CARE house; or are planning to build next year.

Very few people responded to the two questions which were added to the form: the people who are not in agreement with the ERCT -- why?

Two mentioned that wood rots, that the houses take too much wood, that they have provisional houses (or one stated that the house pre-earthquake had posts and survived, so the "X's" are just adornment), or that nothing happened to their houses.

But the majority stated that all were in accord with the principles generally, repeating that they are convinced ERCT is a safe way because they learned in the classes and via the pamphlets.

APPENDIX A:
SURVEY FORM

PROGRAMA KUCHUB'AL
OXFAM/VECINOS MUNDIALES
CHIMALTENANGO

Nombre del caserío o aldea ______________________ Fecha: ______________

Nombre del Extensionista ______________________

Número total de casas en la aldea (aproximadamente) ______________

Cuántas de estas casas no se dañaron con el terremoto? ______________

Construyó el Programa Kuchub'al una casa modelo? Si _____ No _____

Cuántas casas han recibido supervisión del Programa Kuchuba'l? ______________

Número de casas que recibieron lámina de CARE ______________

Construyó CARE una casa modelo? ______________

Cuántas casas más se han construído de acuerdo a los principios básicos de construcción enseñados por el Programa Kuchuba'l? ________ Y de qué clase de construcción? ______________

Cuántas casas se han contruído con la ayuda de otra institución? ______________

Cruz Roja ______________

Otra ______________

Cuántas clases sobre vivienda ha impartido el Programa Kuchub'al en esta aldea o caserío? ______________

Cuántos albañiles en este caserío o aldea han construído una casa segura? ______________

Cuántos de ellos son alumnos de la Escuela de Albañilería? ______________

Porqué razones la mayoría de la gente no ha construído su casa formal?

_____ Falta de dinero para comprar los materiales

_____ Falta de agua para hacer los adobes o el lodo para el bajareque

_____ Falta de mano de obra

_____ Otra razón (especifíque) ______________

La gente que no estan deacuerdo con la construccion antisismica - porque no estan de acuerdo?

La gente que estan de acuerdo con la construccion antisismica - porque estan de acuerdo?

APPENDIX B: JOYABAJ SURVEY FORM

ENCUESTA SOBRE CONSTRUCCION DE CASAS EN EL MUNICIPIO DE JOYABAJ

Fecha ______________________

Area ______________________ COORDINADOR ______________________

Cantón (especifique) ______________________

Nombre del dueño (a) ______________________

INSTRUCCIONES:

Marque con una X el cuadro que toque. Cuando toque "OTRO (especifique)" escriba claramente y con detalle la información necesaria.

1. Va usted a reconstruir su casa? ☐ SI ☐ NO ☐

2. Si no va a reconstruir, porqué? a) Va a reparar ☐ b) Ya reconstruyó ☐

Si ya reconstruyó, siguió las normas de seguridad Si ☐ No ☐ Otro (especifique)

____

3. Si va a reconstruir, cuándo piensa hacerlo?

Año 1977 ☐ 1978 ☐ 1979 ☐ Mes ______________ Día ______________

4. De qué materiales va a hacer su casa?

Adobe de soga ☐ Adobe de canto ☐ Adobe de canto 1/2 y 1/2 soga ☐ Adobe 1/2 y tabla 1/2 ☐ Bajareque ☐ Palopique ☐ Tabla ☐ Blok ☐ Blok tabla 1/2 ☐ ladrillo y tabla 1/2 ☐ Otro especifique ______________________

____

5. De qué tamaño la va a hacer?

6 X 5 ☐ 7 X 5 ☐ 8 X 5 ☐ 9 X 5 ☐ 10 X 5 ☐ Otro (especifique) ______

____

6. Le va a poner corredor? SI ☐ NO ☐

7. De qué material va a techar?

Teja ☐ Hoja de maíz ☐ Canaleta ☐

Paja ☐ Lámina ☐ Otro (especifique)

Hoja de Caña ☐ Duralita ☐ ______________________

8. Si va a techar con lámina o duralita, cuántas tiene ahorita?

Donde las consiguió	Número de láminas	Medidas	Calibre
Alianza ☐			
Caritas ☐			
Herrera ☐			
Tiendas ☐			
	Total ______________		

9. Piensa comprar más para completar las que le faltan? SI [ ] NO [ ]

10. Si no va a comprar más lámina o duralita, porqué?

No tiene dinero [ ] Otro (especifique) ____________

11. Si va a comprar más, cuántas, de qué tamaño y qué calibre?

Número ________ Pies 10 [ ] Calibre 26 [ ]
12 [ ] 28 [ ]
Otro ________ Otro ________

12. Cómo piensa conseguirlas?
Comité Nac. De Reconstrucción [ ] Almacén [ ] Otro(especifique) ____________

13. Puede comprarlas a precio de Costo? SI [ ] NO [ ]

14. Piensa hacer (reparar) su casa siguiendo las normas contra terremotos?
SI [ ] NO [ ]

15. Desea recibir cursillos y folletos sobre construcción? SI [ ] NO [ ]

16. Desea recibir supervisión para construir casas seguras? SI [ ] NO [ ]

Para el Pueblo de Joyabaj y Pachalum.

a) Qué tipos y cantidades de materiales necesita?

Blok Unidades ________ Cemento ____qq Hierro ____qq Cal ____qq Alambre - de amarre ______lbs. Piedrín ______M^3 Clavos 6" ____lbs 5" ______lbs -- 4" ____lbs. 3" ______lbs. 2" ______lbs. Grapas ______lbs. Alambre espigado ______rollo Carbolineo ______gals. Penta ______gals. Pasador de Piso ________ Pasador de Cielo ______ Pasador de Ventana ______ Jaladores ______ Candados ______ Bisagras ______ Pasador de Candado ______

b) Desea recibir servicio de transporte gratuito? SI [ ] NO [ ]

OBSERVACIONES: ____________________________________

____

____

APPENDIX C:

SUGGESTED FIELD INFORMATION TO BE GATHERED

We did not have the time to obtain the following information, but we feel it would be useful feedback to the program. It is our opinion that the Kuchuba staff or the extensionists could gather all of this information.

1. Determine what each <u>albañil</u> trained on the models is doing and whether he has applied the ERCT elsewhere. This can also be done for the first group of <u>albañil</u> school graduates.

2. Visit the housing classes given by the extensionists to see:
   a. if explanation of the material is clear;
   b. if residents understand the material;
   c. if residents participate in the class with interest and questions;
   d. if the educational materials are passed out, or if most already have them.

3. Interview a cross-section sampling of the residents to determine:
   a. whether they have been to any program courses;
   b. whether they have any educational materials;
   c. whether they purchased subsidized construction materials, and if not, why;
   d. whether they like and understand the educational materials;
   e. when they plan to build;
   f. of what materials and how do they plan to build;
   g. if they plan to hire an <u>albañil</u> or build it themselves;
   h. what information would be useful to help them build safely.

   This may need to be two different surveys.

4. Check to see whether <u>albañiles</u> on staff who are supervising Kuchuba'l groups or individuals have building details and are distributing them to the families.

5. Compile the costs of the various models. Check the total against that allocated in the area program budgets, and determine whether more are needed and/or feasible.

6. Take a sample of purchaser's cards to tabulate the kind and quantity of materials purchased. Determine if the $10 limit, plus the possibility of buying cement, <u>lamina</u> and wood at cost, policy has been pushed to its bounds, or if many are not able to, or using, the full amount.

7. Wood and its acquisition is one of the most critical details which affects the success of the program. Get a better idea of what proportion of wood is obtained by just cutting down trees without paying, or buying a tree and cutting or purchasing milled lumber.

8. Examine a sampling of "provisional" houses (i.e., adobe partial wall and <u>caña</u>, etc; CARE frames; maybe Red Cross) to see what materials can be re-used and what is needed to make a transition to a "formal" house. The issue of changes needed in siting, size and image should also be studied.

APPENDIX D:

ADVICE GIVEN FOR NEXT YEAR'S PROPOSAL

At the outset of our evaluation, we were told that the Kuchuba'l Program would, for the most part, terminate on June 30, 1977. Later, the possibility of funding for another year was opened up. Consequently, some of our effort was directed to the process of advising on the writing of a proposal. We sought to assist the staff in how to develop the content, not to tell them what should result. This included the following suggestions:

1. Determine the need from the field by at least consulting their field personnel.

2. Examine the whole program as critically as any other potential use of the OXFAM funds. It should not be perceived as an automatic continuation of the existing program.

3. Determine carefully, with realistic numbers, the potential houses planned to be built which would be influenced, how many albañiles will be trained, and at what cost. Use several alternative approaches.

4. Re-examine in detail the albañil training objectives, process and content.

5. Look at the challenges which could be addressed from Programa Kuchuba'l's base of experience in producing educational materials. Determine what subjects or issues should be addressed; what materials are needed to communicate them and could be produced; what kind, and the amount of production with what staff.

6. Inquire about other sources of similar (vocational training) services within the country, and/or what potential other areas/agencies would benefit from the OXFAM/World Neighbors program; coordinate the program with those existing services or needs.

7. Consider staffing based on the building season demands for albañiles, and review job descriptions. Do not just assume the continuation of the existing roles. (This may be offset by stronger advantages of maintaining an already organized and trained staff.)

8. Establish the budget in detail and work out the trade-offs of the alternative use of resources in accord with specific objectives.

9. Establish precise criteria which can be used to measure the progress of the program.

APPENDIX [illegible]

[illegible]ING THE NEXT YEAR'S PROPOSAL

At the outset of our evaluation we were [illegible] that the [illegible] Programme [illegible] for the next [illegible] terminate on June 30, 1977. Later, the possibility [illegible] funding for another year was opened up. Consequently, much of our effort [illegible] directed to the purpose of [illegible] on the setting of a [illegible] to assist the staff in [illegible] to develop the request, but [illegible] should result. This [illegible] the following recommendations:

Determine the need from the field by at least consulting these field personnel.

Keep the whole programme as realistic as we [illegible] practicalities of the OXFAM funds. It should not be operated as an automatic [illegible] of the existing programme.

Determine rationally, with realistic budgets, the potential [illegible] to be built which would be influenced, however, [illegible] and at what costs [illegible] alternative approaches.

Re-examine in detail the [illegible]

Look at the challenges which could be [illegible] a base of experience in producing educational materials. Determine [illegible] audience or groups should be addressed, what materials are needed [illegible] and the need [illegible] tion with what staff.

Involve more [illegible] of [illegible] training [illegible] in the country, and/or what [illegible] from the OXFAM [illegible] programme [illegible] materials [illegible] needs.

Consider [illegible] the existing [illegible] already organised and trained staff.

Establish the budget in detail and work out the trade-offs of the [illegible] between [illegible] with specified objectives.

Establish [illegible] criteria [illegible] to measure the progress of the programme.

TRAINING AIDS DEVELOPED BY THE EDUCATION
OFFICE OF PROGRAMA KUCHUBA'L

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INTRODUCTION TO TRAINING AIDS
DEVELOPED BY PROGRAMA KUCHUBA'L

Background

The attached materials were prepared by Programa Kuchuba'l as training aids in a program of teaching improved housing construction methods to persons affected by the earthquake of February 4, 1976, in Guatemala. The materials represent an attempt to instruct the local people in basic earthquake-resistant building principles and are used as part of a comprehensive training program which encompasses specific courses designed for specific groups of people, including local builders, extensionists, as well as the general public.

The vast majority of the people for whom these training aids are intended are illiterate or semi-literate - rural people who speak Spanish only as a second language. Thus, the language which accompanies the drawings is presented in the local form, i.e., basic, non-formal, idiomatic Spanish. The materials explain the fundamental earthquake-resistant building principles, how to use these principles in a program of construction, and the sequence of building a structure using these principles.

The materials are meant to be used in a training program, which includes both classroom and practical training. The classroom portion consists of a broad discussion of how an earthquake affects buildings and why they fall down during an earthquake, an explanation of the principles of earthquake-resistant construction, and finally how the principles can be incorporated into an actual building. It is stressed throughout that it is not the selection of materials that makes a house safe - it is the way in which the materials are used, in other words, the incorporation of as many of the building principles as possible in each and every structure.

Using the Materials

Two points should be made. First, it is important that the materials not be presented all at one time. There is a great deal of information contained in each and every one of the pages and each chart or booklet. Each one of these must be discussed fully at the time it is presented. Therefore, it is necessary to divide the materials and to use them in a training program which may last over several sessions. This is especially important for people who have never received formal education of any type.

Second, it is important to emphasize again that the users or the instructors develop their own supporting materials to go with the aids. For instance, in Guatemala, many of the instructors found that a simple wooden frame which could be easily bolted together provided an excellent means of demonstrating the principle of using cross-braces. Others found that with a large piece of paper and a crayon, they could cover the suject just as well. It is up to the individual instructor to present the material the best way he can, and he should use these aids only as his primary training material. He should expect to develop his own aids to go with them, in order to explain in detail certain things such as the actual way in which certain parts are fastened together, or where they should go in a particular type of structure.

Third, a training aid is only as good as the instructor. As much, or more, time should be spent on developing the skills of the instructor as on preparati of the aids.

Problems to be Expected

Extensive use of the training aids has led to the recognition of various problems. The first is an over-reliance on the part of the instructors on the aids to do the teaching. It is important that, when using these materials in a complete training program, the classes be observed and the instructors be critiqued on their performance. In many cases, when the instructors first beg to use the training aids, there is an attempt to let the training aid do all th teaching. The instructor merely stands in front of it and interprets it to his audience. It should be remembered that the aid is only to serve as a visual reminder to the class. The instructor must be thoroughly versed in all the pri ciples relating to that particular drawing and must be able to explain it care-fully and thoroughly.

A second problem which has occurred time and time again is that the in-structors attempt to use all the training aids at one time. There is a tre-mendous amount of information on each one of the training aids; and, therefore, they must be broken down into various groups such as siting, wall construction, or roof construction, and presented at different sessions.

Each of the instructors is allowed to use the training aids in the sequence that he feels will be most appropriate and easiest for him to remember. However many of the pages do fall into a logical sequence, and the instructors should be encouraged to use them in sequence as much as possible. For instance, in talk-ing about walls, it is ideal to use the normal building sequence as the way of presenting the principles, rather than to start with a finished wall and work backwards, or to go from ring beams to foundations to cross-braces.

The final problem is that the instructors often do not use different aids to complement and supplement each other. Often, this is the result of the instructors trying to economize on the aids which they pass out during classes. Thus, they will use the flip-chart and then use the historieta, rather than using both together. Each of the training aids is designed to complement the ones which are used in the class, or to complement materials which have been presented in another class.

How to Use the Materials

There are four types of materials:

A. Training materials for teaching the instructors. These are booklets or pamphlets which give detailed explanations of a topic. As the instructors used by Programa Kuchuba'l were literate in Spanish, the drawings were accompanied by written text. This group of materials includes:

   1. Instructors manual: "How to Build a Safe House". Detailed booklet describing how to build an earthquake-resistant house and why certain building principles should be used.

   2. Pamphlet: "What are Earthquakes?". Geological information about earthquakes, their causes and how they affect houses.

3. Pamphlet: "Road Building Techniques". For Kuchuba'l Road Improvement Program. 700.

4. Pamphlet: "Recommendations for Building a Concrete Block House". Produced for use in both Programma Kuchuba'l and the OXFAM projects in Guatemala City. Details on proper ways to build an earthquake-resistant house of concrete block.

B. Course Outlines. These are designed to help the instructor organize his class and to make sure that all the main points are covered in each class. Course outlines include:

1. Outline for basic course in building an anti-seismic house.
2. Outlines for teaching special courses.
3. Outlines for demonstrating special building techniques.
4. Outline of procedures for inspecting houses.

C. Training aids for use by instructors in the classes. These are designed to help the instructors present the materials and to give a visual impression of the lesson to the students. Some aids use very limited Spanish but are still designed to convey the thought to those who do not read. Training aids of this type include:

1. Flip-chart: Como Hacer Casas Seguras en Zonas Propensas a Terremotos ("How to Build Safe Houses in an Earthquake Zone"). A multicolored visual aid for classes printed by silkscreen on muslin which is used with an accompanying pamphlet.

2. Model of house showing how cross-braces work. A small model of the frame of a house which folds up for carrying made for use by instructors. Only one model was built.

3. Model house. Two small models were built to show the details of how the cross-bracing should be attached to the frame. These are primarily used by the artists to prepare drawings for the other training aids.

D. Pamphlets and handouts. These are given to those attending the classes to help remind them of the subjects covered in the classes. Several of these aids are the same drawings as those of the cloth flip-charts used by the instructors. This group of materials includes:

1. Pamphlet: "How to Build Safe Houses in an Earthquake Zone". This is the basic educational material and is the first pamphlet a student receives. There have been many editions and revisions, and over 10,000 were distributed.

2. Pamphlet: "How to Build Safe Houses in an Earthquake Zone". Cakchiquel translation. By special request of Tecpán Program. 300, mimeograph.

3. Comic book: "How to Build a Safer House". A picture book of a building sequence, step by step, incorporating anti-seismic

housing principles. Produced through a special grant from the Philip Morris Company. Artwork by their advertising agency, but in consultation with Kuchuba'l engineer/technical advisor and the program's education materials coordinator. 100,000 were produced by offset, of which 80,000 were made available at no cost to Kuchuba'l for distribution. Many other agencies used it as a primary teaching aid or distributed it with lamina.

4. Handout: "Use of Creosote as a Wood Preservative". Produced as a stop-gap measure during period of heavy creosote sales by the Co-op. Production suspended because of unsatisfactory and incomplete information. Mimeograph, about 500 copies.

5. Handout: "How to Place the Diagonal Brace in the Corner of the Ring Beam so as not to Interfere with the Ceiling". First in a series of "technical details" for instructors and students, solving specific problems commonly encountered. 1,000 by mimeograph, and more as requested by the field staff.

6. Handout: "Correct Placement of Lamina". For instructors and students, many of whom have not used this corrugated zinc roofing material before. Also for distribution where lamina is sold by our program. 1,000 by mimeograph and more as needed.

7. Handout: (Technical Details Series) "How to Build Lightweight Mojinetes". Suggestions for the part of the wall between the ring beam and the roof which should not be filled in with adobe or block or other heavy material.

8. Handout: (Technical Details Series) "Balancing the Walls of Your House". Reminder that walls should have the same height, with reference to specific problematic situations.

9. Handout: (Technical Details Series) "How to Fasten X-Braces Securely".

10. Handout: "Landslides and Home Safety". What signs to look out for when choosing a dwelling site.

11. Handout: Topographical Map of Guatemala with Geological Cross-Section. A graphic interpretation of the continental plates beneath Guatemala.

12. Handout: "Overlapping Your Lamina". Shows correct method of attaching lamina to the roof frame.

13. Handout: "How to Make a Safe House of Block". Proper construction sequence for people building a house of block.

14. Handout: "Principles and Basics for Building a House of Concrete Block". Similar to #1 but designed for use by people building with block houses. Made on request of OXFAM Guatemala City project as well as Kuchuba'l staff.

15. Pamphlet: "How to Build a Safe House Using Special Block". Produced for use in the OXFAM Guatemala City projects as well as one co-op in El Tejar that was using a special block making machine provided by OXFAM.

In addition to the above, the program staff served as advisors, editors, and/or reviewers of the materials produced by several other reconstruction programs. The most important of these were two projects sponsored by the Save the Children Alliance; one project in Joyabaj and one in Southern Quiche. As each program needed similar materials, an attempt to coordinate the production and avoid overlapping was made. The most important of the materials produced by other programs under this arrangement are included in this volume. They include:

A. How to Inspect and Repair a Damaged House, by the Southern Quiche Reconstruction Program, Save the Children Alliance.

B. Joints (for wood) 2 parts - How to Make Better Wood Joints and Which Joints to Use in Different Parts of a House, produced by the Joyabaj Reconstruction Program, Save the Children Alliance.

I. Introduction: What is an Earthquake?

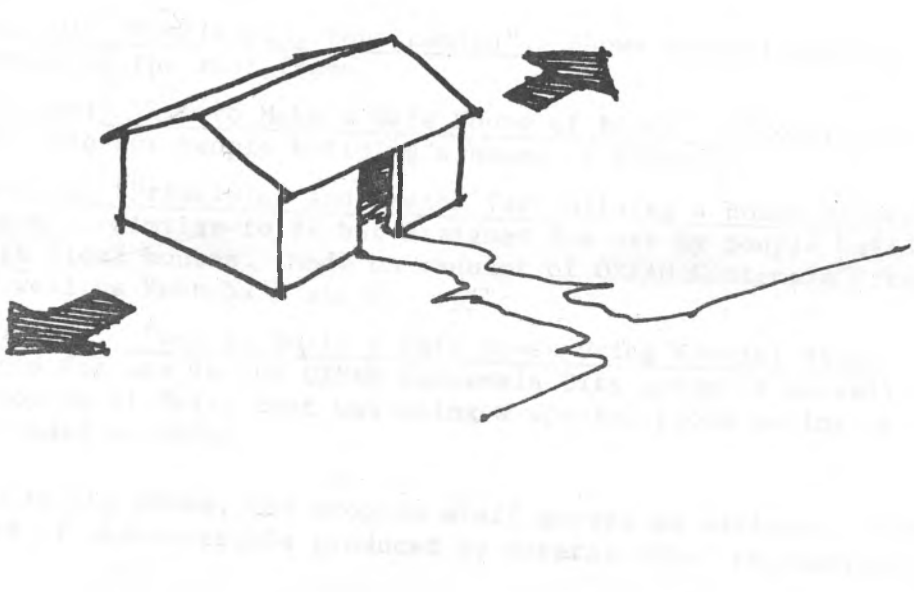
To design a house that will resist the forces of a major earthquake, we must first understand what an earthquake is and what happens to the earth during one.

The surface of the earth is composed of large land masses, called plates, which lie under whole oceans and continents, like North or South America. These plates are always in motion (although only a few centimeters each year) and in several places they bump into each other. Where the plates meet, one will try to go over the other. This causes a lot of pressure to build up over a period of years, and sooner or later this pressure will cause something to break deep below the surface. This breakage is an earthquake.

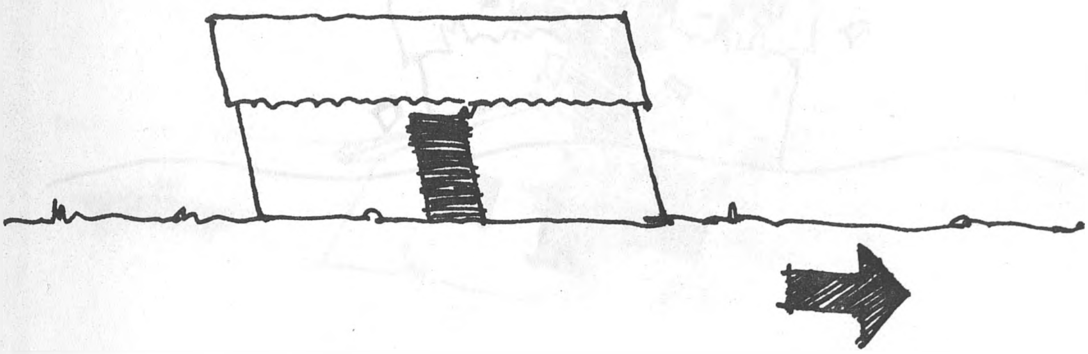
Earthquakes can be expected wherever these plates come together. In Guatemala three plates come together! So we can always expect earthquakes in our country. The point on the earth's surface over the place where the breakage occurs is called the "epicenter". The earthquake causes vibrations to go out in all directions from the epicenter. These vibrations are called "waves". There are two types of waves which affect houses. The first make the earth move back and forth along the same line. The second, which travel slower, cause what we call "shock waves".

II. How an Earthquake Affects a Wall

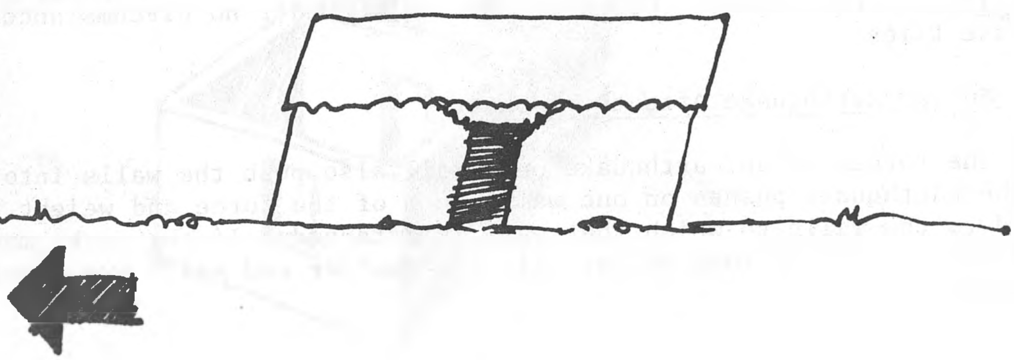
When an earthquake strikes, the earth begins to move backwards and forward along the same line.



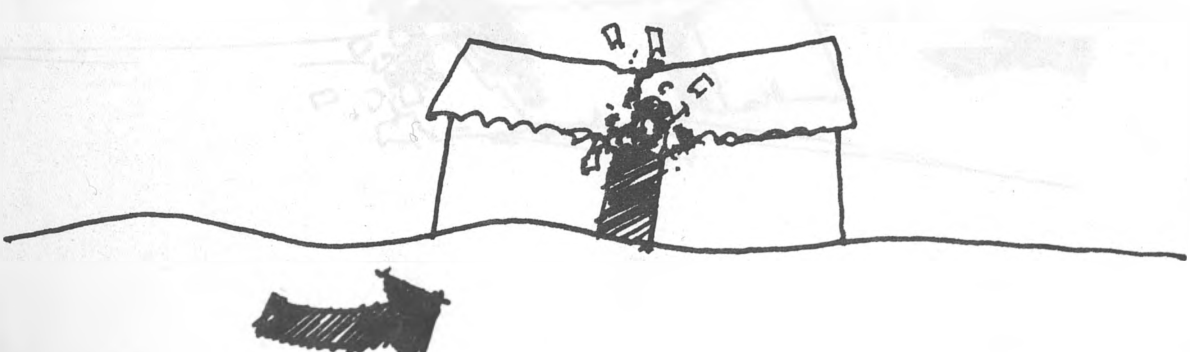
The foundations and lower part of the house, which are attached to the earth, immediately move with the earth. The roof, however, remains where it is; so the house immediately looks like this:



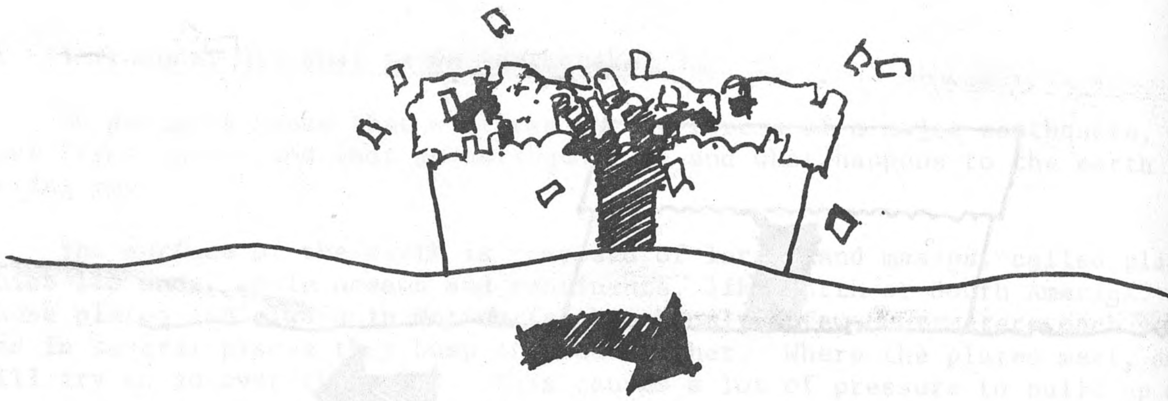
Gradually, the upper part of the house tries to catch up with the bottom but as it does so, the earth moves in the other direction, thus speeding up the top.



As the shock waves hit the wall, different parts of the wall begin to move in opposite directions,



and the wall will try to first crush itself, then throw itself apart.



The damage caused by the earthquake depends on the height and weight of the walls and the roof. The higher the walls, the greater the speed and force at the top, and thus the greater the damage. Therefore, in an earthqua zone, it is important to build low, lightweight walls.

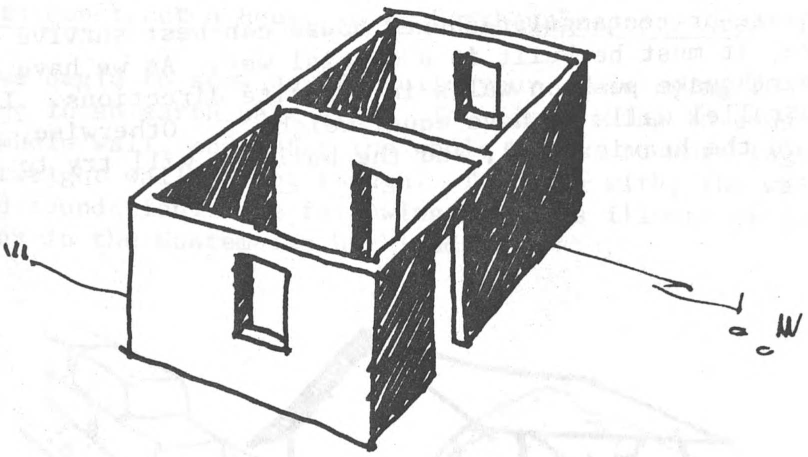
Because the roof of the house sits on the walls, the height and weight of the roof must also be added to that of the walls. Thus it is extremely important to build light roofs. In Guatemala, we recommend paja, lamina, duralita, or palm leaves (Guano or Corrosa). Under no circumstances should you use tiles.

III. How an Earthquake Affects a House

The forces of an earthquake on a wall also push the walls into one anothe If the earthquake pushes on one wall, much of the force and weight is then added to the walls to which that wall is attached. If the quake moves paralle to the direction of long walls, only the smaller end walls are likely to be damaged.

But if the quake moves parallel to the short end walls, much greater damage can be expected. The long walls may fall in the entire length of the house and also push in the small end walls.

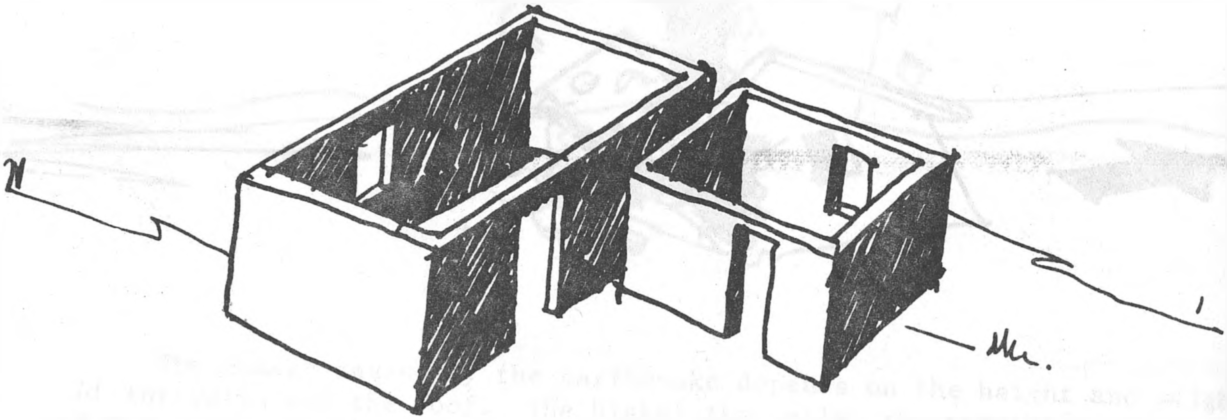
A strong interior wall can help to hold the long walls up.



IV. <u>Shapes of Houses</u>

If the earthquake strikes the house at an angle, it will push the walls in opposite directions and the house will look like it is twisting on its foundations.

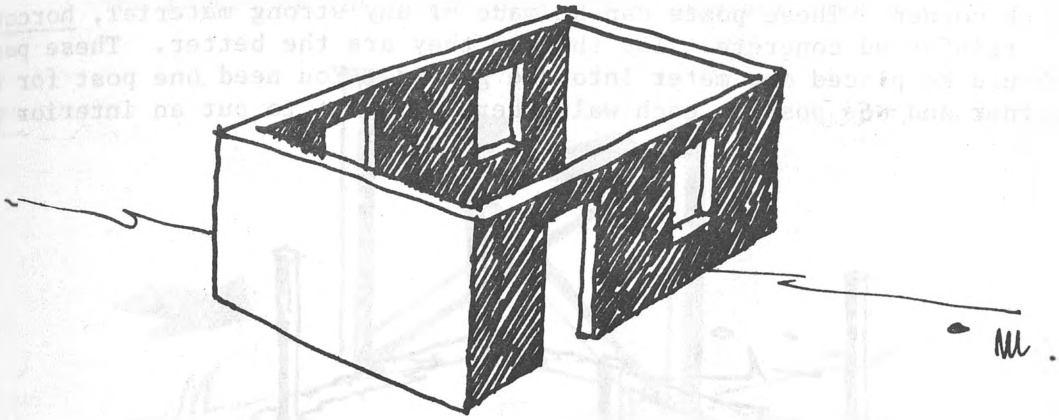
It is best to build square or rectangular-shaped houses to withstand these forces. An "L"-shaped or "T"-shaped house is the worst possible desi for an earthquake zone. If your site is small and you need additional spac you must build two separate rooms at least one meter apart.



V. Balance

While a square or rectangular-shaped house can best survive the forces of an earthquake, it must be built in a special way. As we have seen, the forces of the earthquake push on walls in opposite directions. It is very important for parallel walls to have equal weight. Otherwise, the earthqua will push more on the heavier wall, and the building will try to twist on its foundations.

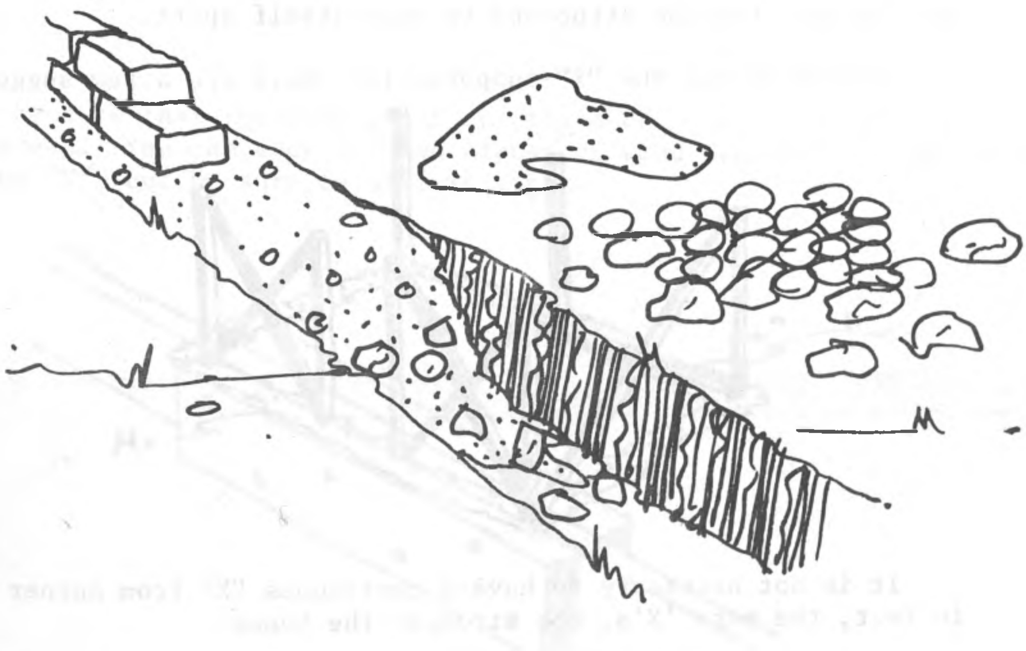
Thus, it is wise not to have more openings on one side of the house than the opposite side. To make a house strong, you must have roughly equal openin in parallel walls. For every door or window in one wall, there should be an opening of roughly equal size directly opposite in the parallel wall. It is best not to have openings in the small end walls; but if you need them, be sur to put one directly opposite the other.



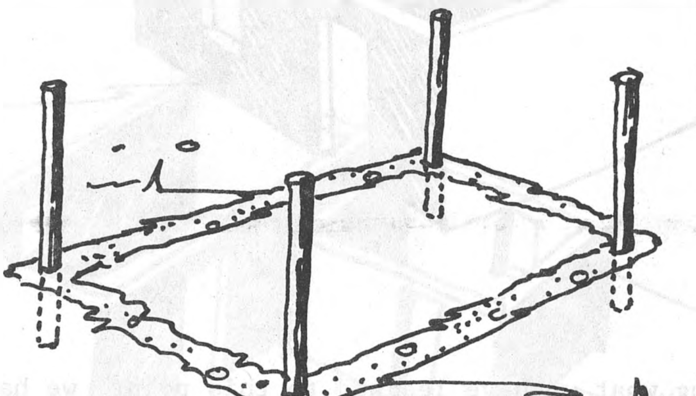
In reviewing what we have learned to this point, we have stated that the force on a building increases with the weight and height of the building, and we have seen what happens to the walls when an earthquake strikes. We now know that we must build square or rectangular buildings with light, low walls, and put a lightweight roof on it. To help provide strength, we must balance the doors and windows.

VI. How to Construct a House in an Earthquake-prone Area

Now we begin to show how to build your house using the special techniques of building in an earthquake area. The first thing to consider is how we can help the whole wall, and later the whole house, to move together. Building a low, lightweight wall is not enough. To begin with, the wall must rest on a good solid foundation. The following drawings illustrate the best ways to make foundations in the Guatemalan highlands.



A. Walls: To build a strong wall, we must place good strong posts in each corner. These posts can be made of any strong material, horcones or reinforced concrete. The thicker they are the better. These posts should be placed one meter into the ground. You need one post for each corner and one post in each wall where you want to put an interior wall.



The wood posts must be treated with a preservative before they are put in the ground. Even so, you must inspect the wood at the end of each rainy season, expand and replace it as soon as it begins to rot or get eaten by insects.

Now comes the most important part of building an earthquake resistant house.

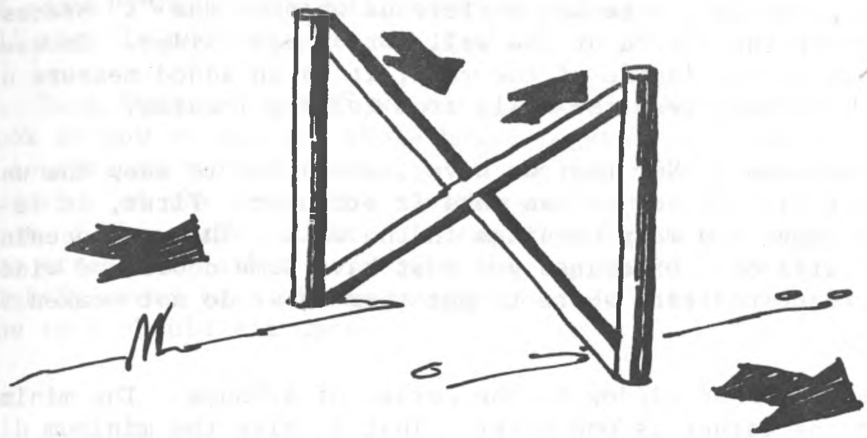
B. Cross-Bracing: You must use cross-braces or "X"-supports to tie the posts together. If you do this, the top of the wall will be able to move at the same time as the bottom. The house will shake, the walls may crack but the great forces at the top of the walls will be reduced and it will not be easy for the structure to tear itself apart.

How do we put the "X"-supports in? Here are a few suggestions:

It is not necessary to have a continuous "X" from corner to corner; in fact, the more 'X's, the stronger the house.

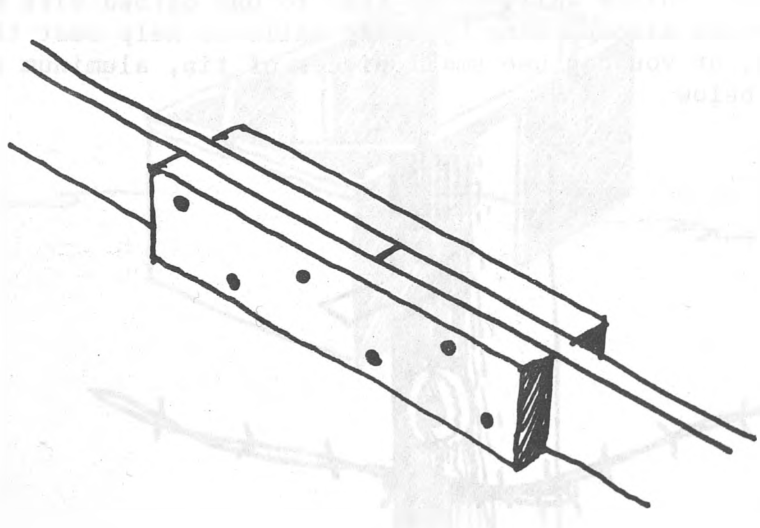
The best material for making the 'X's is rigid material such as wood or iron. Surprisingly, it does not even have to be too thick. Wood 1" by 3" is fine as long as the length is not more than 10'.

The forces on the board in an "X"-brace act like this:



If you do use very thick wood for your crossbraces, you can cut and notch it to make it easier to cross the pieces, like this:

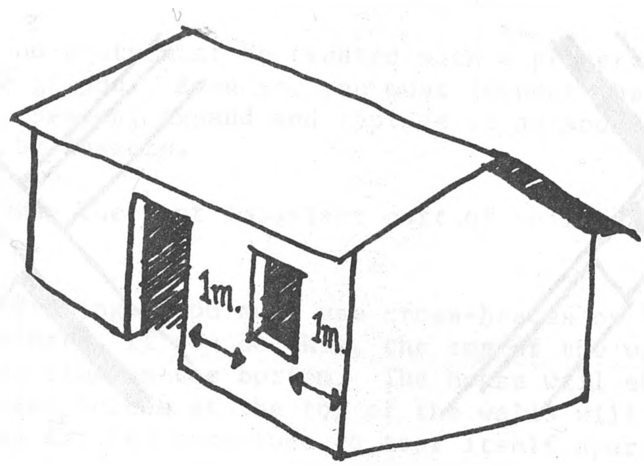
Just be sure that the wood isn't cut too much - not more than half the thickness. You can even put two pieces of wood together to make a part of the "X", but be sure to nail it tight.



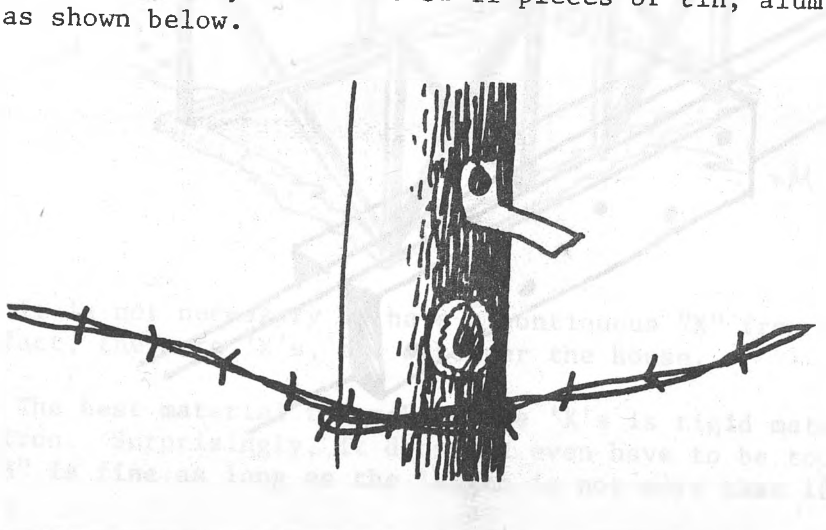
Other materials which can be used for your "X" braces include wire, barbed wire or cable. Be sure that they are tight. As far as holding up the posts, it doesn't make any difference whether the "X" braces are on the outside or the inside of the wall, or on both sides. However, if you put them on the inside of the wall, it is an added measure of safety as it will help keep the walls from falling inwards.

C. Doors and Windows: Now that we have learned how to keep the wall together, let's look at how we can make it stronger. First, it is important not to have too many openings in the wall. The more openings, the weaker it will be. Of course you must have some doors and windows, so it is important to learn where to put them so we do not weaken the wall.

<u>Never</u> put a door or window in the corner of a house. The minimum distance from the corner is one meter. That is also the minimum distance between a door and a window, or between windows. It is also the minimum distance between a door or window and the place where an interior wall joins an outside wall. The best place for a door in an inside wall is in the middle.

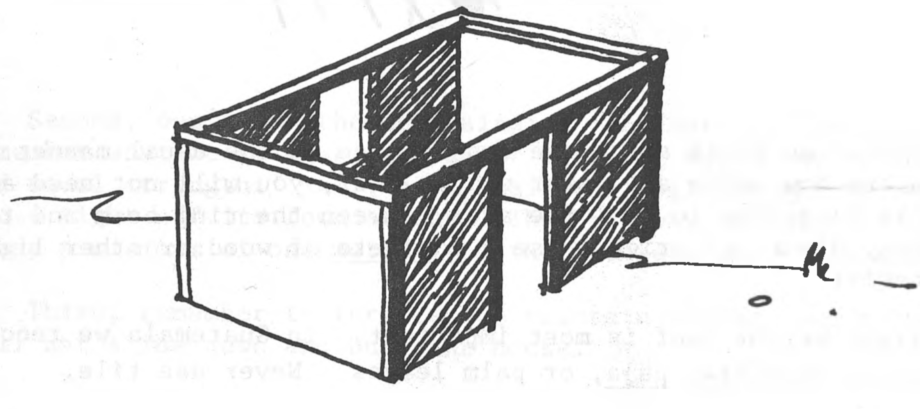


D. Securing the Walls: The second thing to remember about building a strong wall is to make sure that it is secured tightly to the posts. In an adobe, brick or block wall, it is best to use barbed wire between courses. This can also be done by using nails to help seat the mortar as shown below, or you can use small pieces of tin, aluminum or <u>lamina</u>, also as shown below.

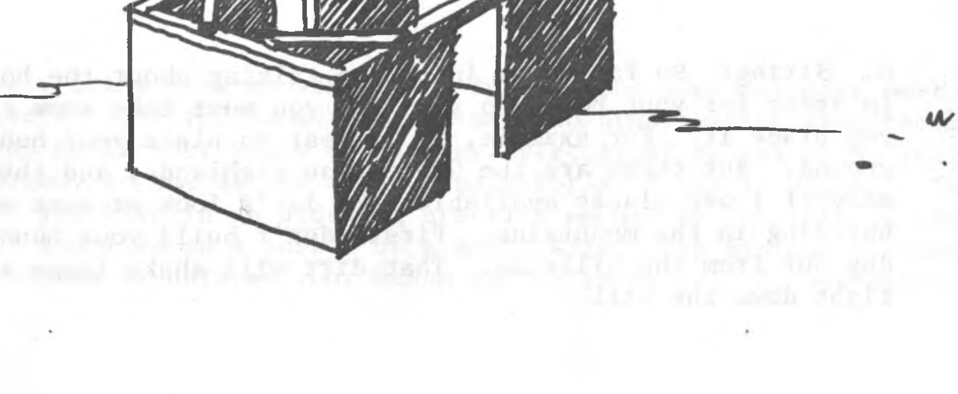


Finally (and a very important thing to remember), use less mortar. In Guatemala, many people use 2" - 4" of lodo or mescla between layers of adobe. While this will save on adobe, it seriously weakens the wall. All that is necessary is about 1".

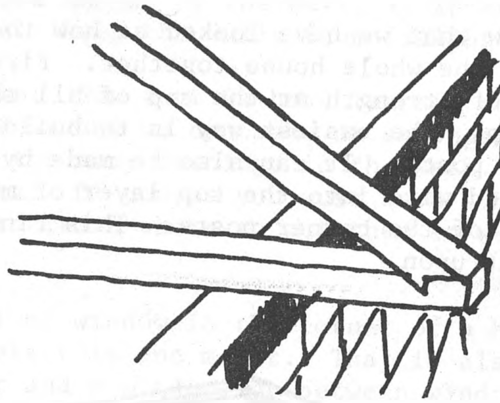
E. Ring Beam: Now that we have looked at how to build the walls, let's look at how to tie the whole house together. First, there needs to be a continuous belt of strength at the top of all the walls to tie the house together at the top. The easiest way is to build it of wood, connecting each of the corner posts. It can also be made by cementing a continuous strand of barbed wire into the top layer of mortar, and wrapping it tightly round each of the corner posts. This ring beam or solera is what the roof should sit upon.



Once the solera has been attached, a final thing should be added to hold the walls together. If you have used a wooden ring beam, the easiest way is to attach boards approximately two meters long across each corner as shown below.

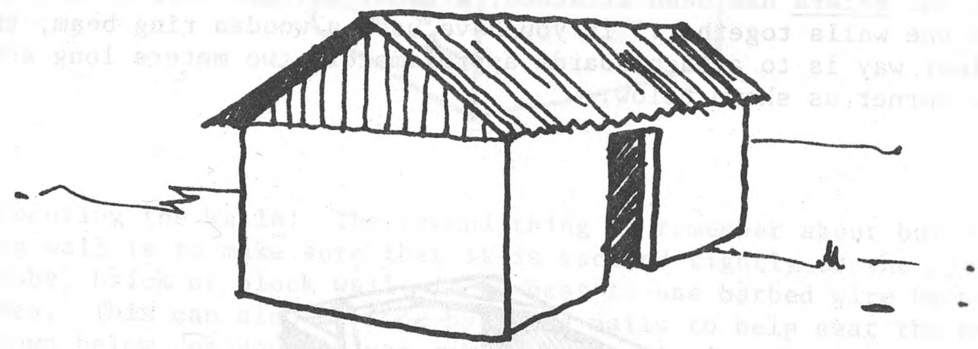


F. Roof: Now for the roof. It should rest on and be attached to the ring beam. It should never be placed on wood in the walls.

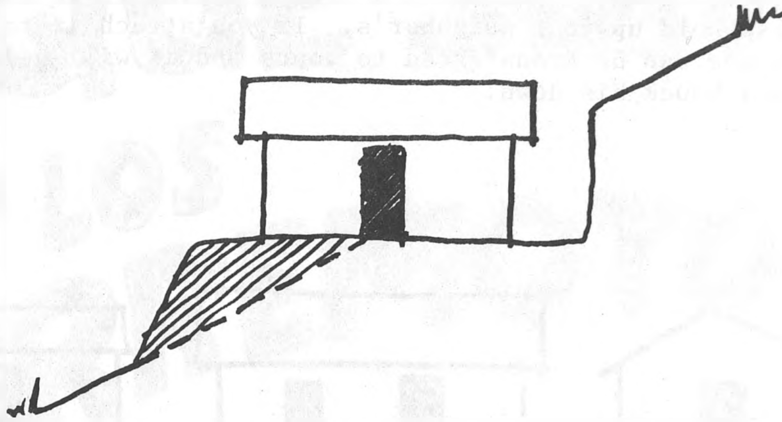


The roof supports and frame can be made in the usual manner but, because you are now using a lighter weight roof, you will not need as much wood. It is dangerous to fill the area between the ring beam and the roof with adobe, block, or brick. Use a mojinete of wood or other lightweight material.

A light weight roof is most important. In Guatemala we recommend lamina, duralita, paja, or palm leaves. Never use tile.

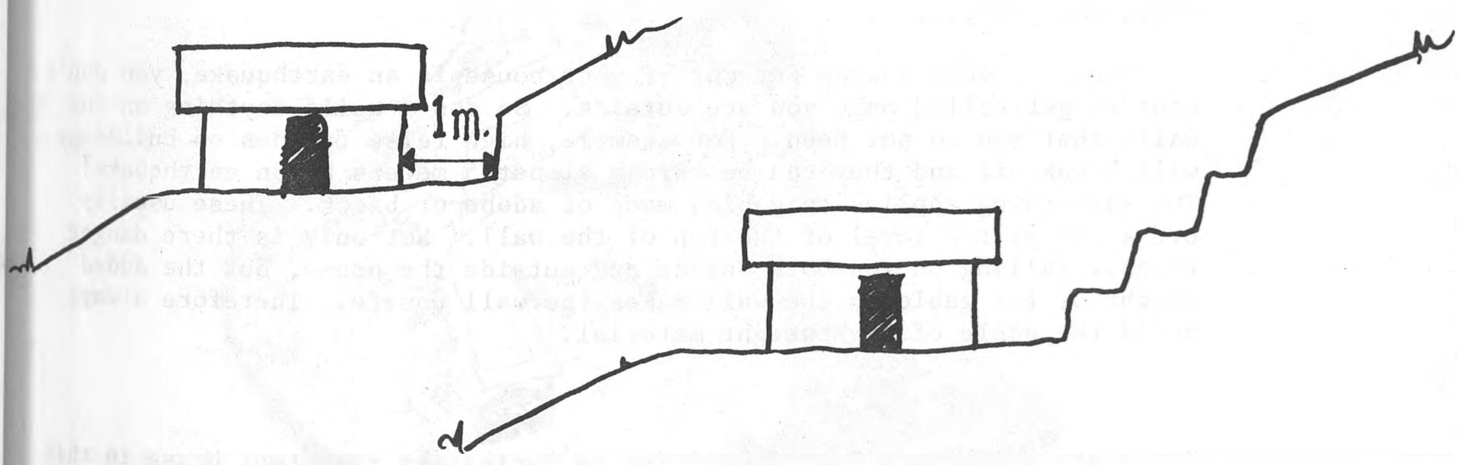


G. Siting: So far we've just been talking about the house itself. But in order for your house to survive, you must take some care as to where you place it. For example, it is best to place your house on firm, level ground. But these are the Guatemalan highlands, and there aren't too many of those places available. So let's look at some simple rules for building in the mountains. First, don't build your house on the dirt dug out from the hillside. That dirt will shake loose and pull your house right down the hill.

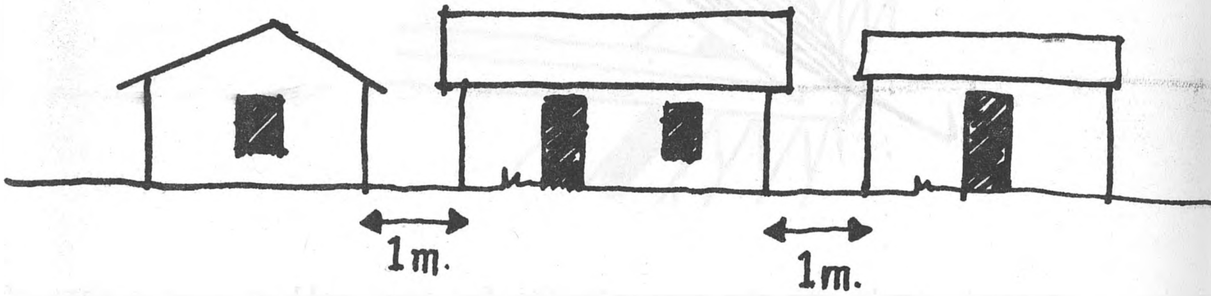


Second, don't use the mountainside for your wall or even a part of it. Remember what we said earlier about parallel walls having equal weight and equal strength. Well, a mountain wall will knock the rest of the house right off its foundations. The best way to build is to put your house a minimum of one meter from the mountain and build a back wall.

Third, remember to terrace the mountain behind your house so that it will not slide down and bury the house.



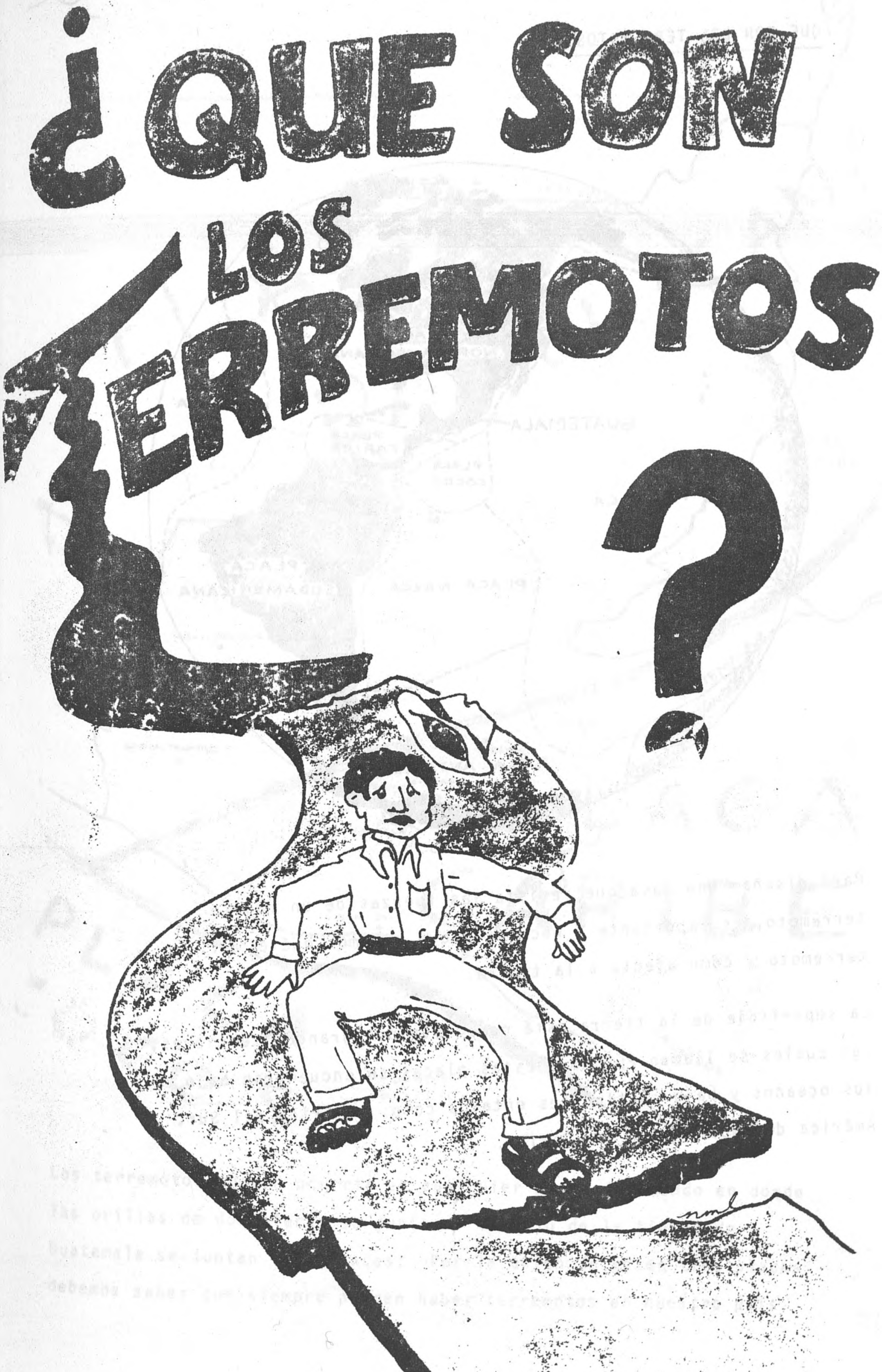
Next, let's look at some rules for placing your building next to your neighbor's. Did you know that the men who study earthquakes recommend that you build your house a distance apart equal to twice the geight of your house, or the height of your neighbor's if his is higher! That is fine if you live in an aldea or are rich enough to own lots of land; but what if you live in a pueblo on a small site? The minimum distance between houses or between your house and an adobe wall is one meter. If you insist on building your house next to your neighbors, you are asking for trouble. Even if you build a strong house, it is doubtful that it could also hold up your neighbor's. If you attach it to his, the weight of his house can be transferred to yours and it will help knock it down. Or you may knock his down!



H. Safety: Now for a few final thoughts about safety. Did you know that most people who are killed in an earthquake are found near the doors? This is because people had to stop and try to open the door inward. If you place your door so that it can open outward, you can hit it running and force it outward. It can save you a second or two, and those seconds could save your life!

Finally, when you do get out of your house in an earthquake, you don't want to get killed once you are outside. So don't build anything on the walls that you do not need. For example, high false facades on buildings will break off and they can be thrown almost 5 meters by an earthquake! The same thing applies to gables made of adobe or block. These usually break off at the level of the top of the wall. Not only is there danger from it falling on you both inside and outside the house, but the added weight of the gable in the wall makes the wall unsafe. Therefore always build the gable of lightweight material.

These are the principles of building an earthquake resistant house in this area. As we said earlier, a house that uses all or a majority of these principles will privide you with the time you need to get safely out of the house, and will probably help the house survive without excessive damage. Use these principles in your new house and remember to check regularly to see that all wood is not rotten or infested, and that the braces remain secure and tight. You and your family will once again have a house that is a friend, not an enemy.

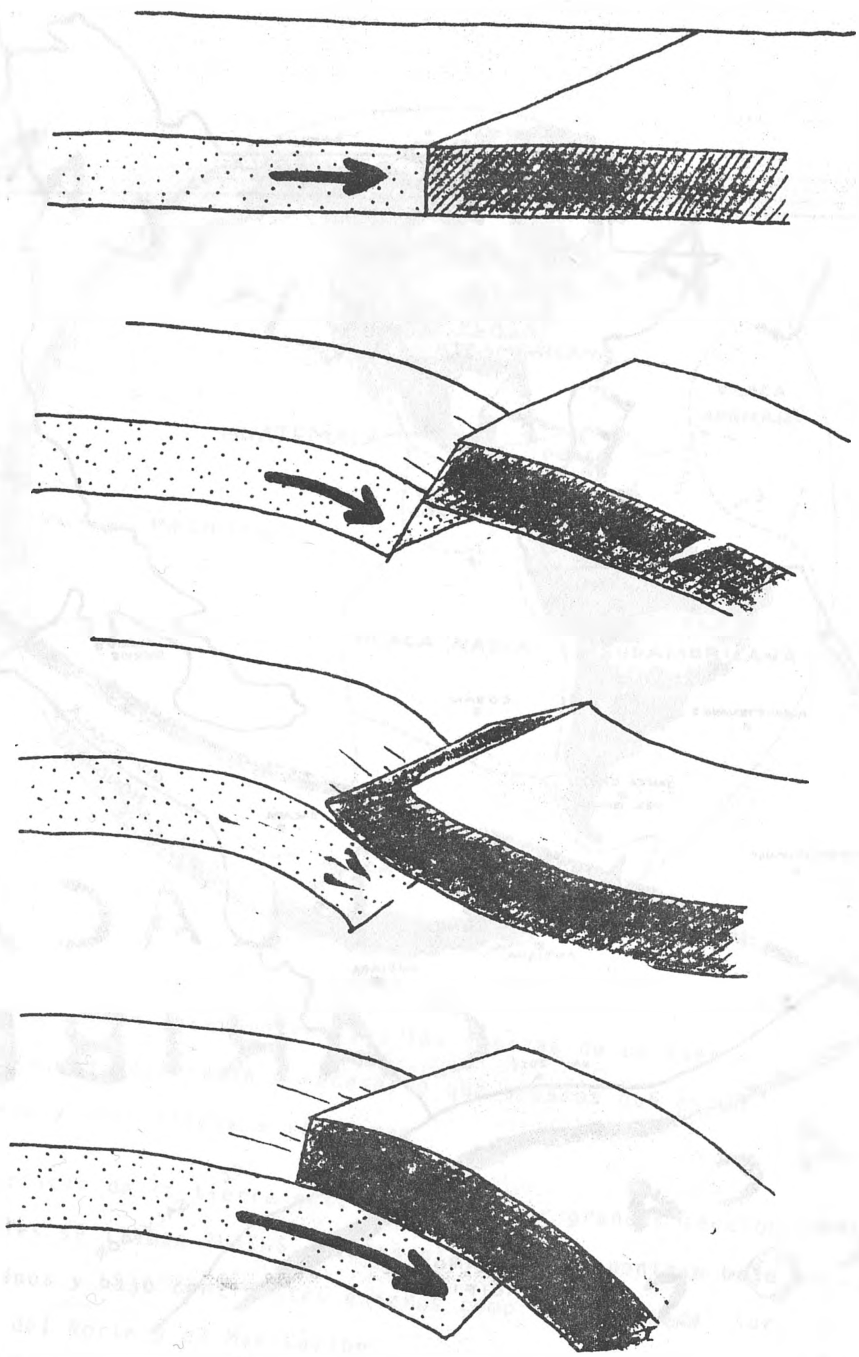

¿QUE SON LOS TERREMOTOS?

¿QUE SON LOS TERREMOTOS?

Para diseñar una casa que resista las fuerzas de un fuerte terremoto, es importante y necesario que sepamos qué es un terremoto y cómo afecta a la tierra.

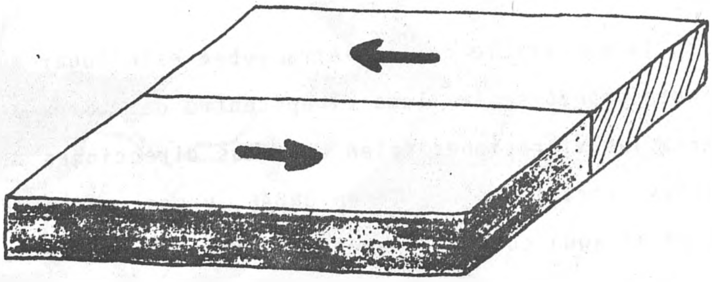
La superficie de la tierra está compuesta por grandes secciones, las cuales se llaman PLACAS. Estas placas se encuentran bajo los oceanos y bajo continentes enteros como: América del Sur, América del Norte y el Mar Caribe.

Los terremotos pueden ocurrir en cualquier parte del mundo en donde las orillas de dos placas se junten. ¡Debajo de la tierra de Guatemala se juntan tres placas! Por la unión de estas tres placas debemos saber que siempre pueden haber terremotos en nuestro país.

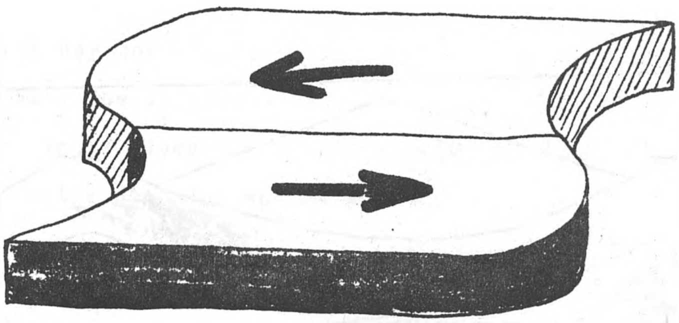


Todas las placas siempre se mantienen en movimiento, aunque se muevan solamente unos cuantos centímetros cada año. A causa de este movimiento, las placas se chocan una contra otra en muchas partes del mundo. Una cosa que pasa cuando las placas se chocan es que una placa trata de pasarse bajo la otra.

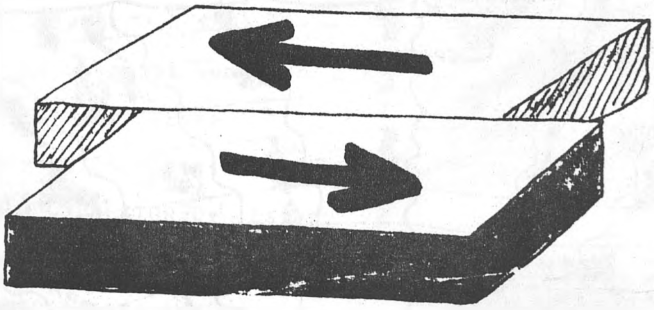
Otra cosa que puede ocurrir cuando dos placas se chocan es que las dos tratan de pasarse en direcciones opuestas. Durante muchos años, estas dos placas halan en direcciones opuestas aunque no haya movimiento en la superficie de la tierra.



Esto causa una presión increíble que va aumentando año con año bajo la tierra. Tarde o temprano algún lugar más debil dentro de la tierra ya no aguanta esta presión y entonces el movimiento empieza allí.

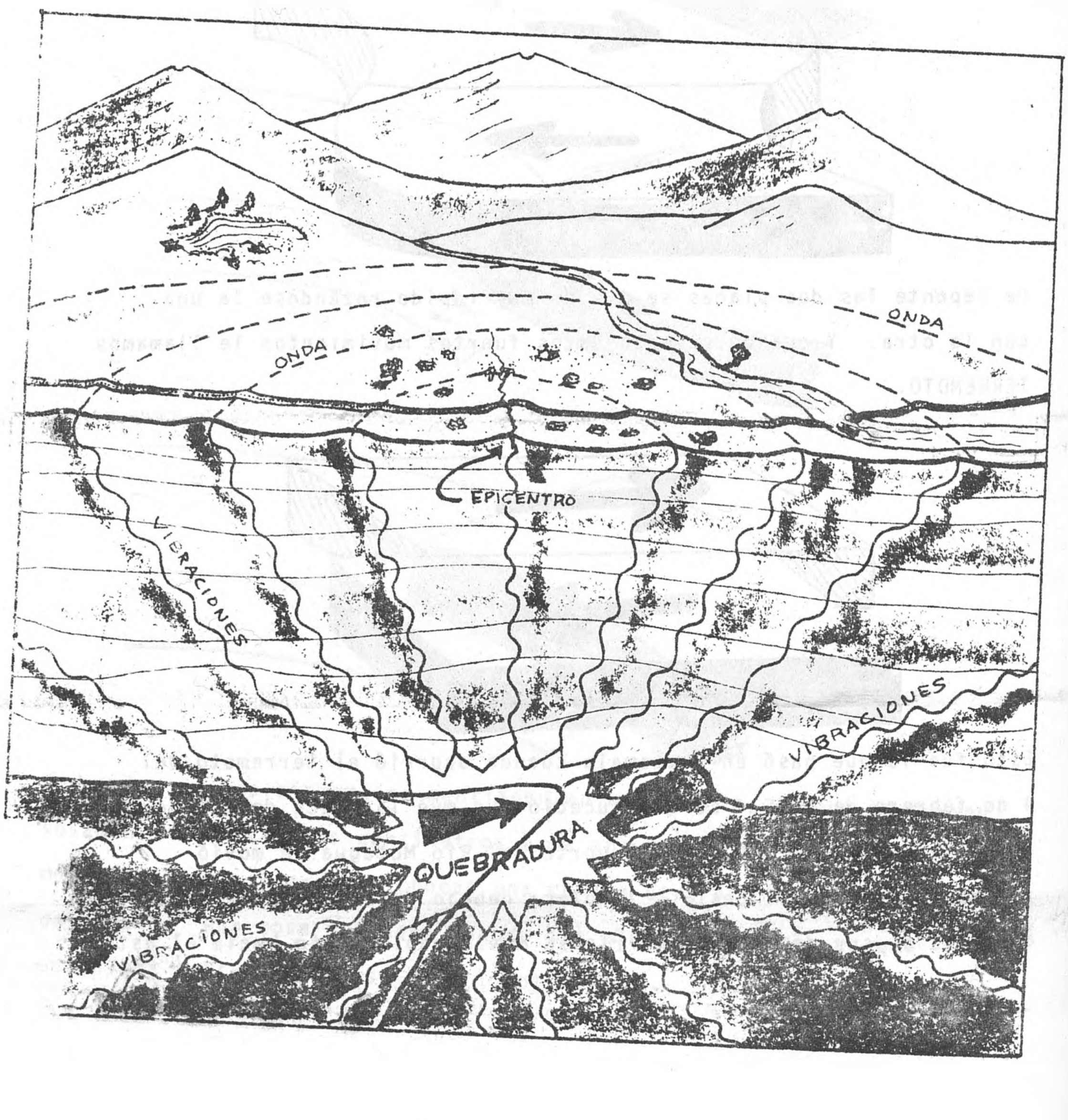


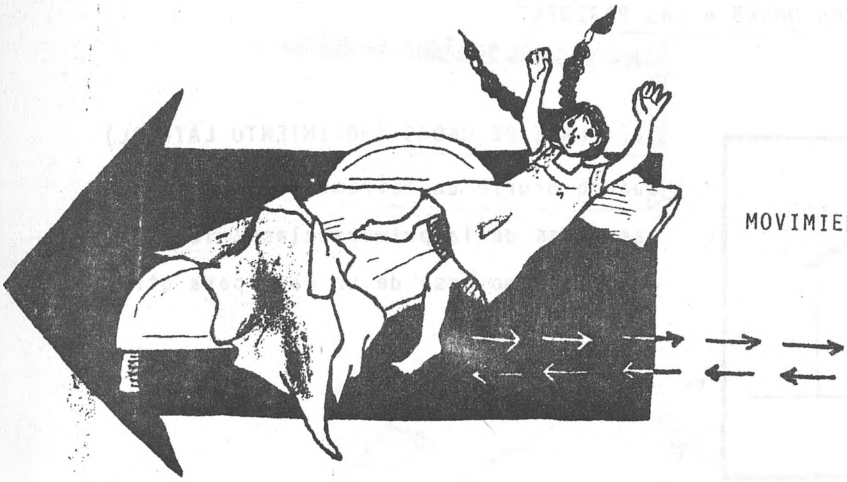
De repente las dos placas se mueven muy rápido rozándose la una con la otra. Y cuando suceden estos fuertes movimientos le llamamos TERREMOTO.



Esto fue lo que pasó en Guatemala cuando ocurrió el terremoto del 4 de febrero de 1976. Lo que sucedió fue que la placa debajo de la parte de Guatemala que está al norte del Río Motagua se movió rápidamente hacia el oeste y la placa debajo de la parte de Guatemala que está al sur de este mismo río se movió rápidamente hacia el este.

Al punto en la superficie de la tierra sobre este lugar donde el movimiento empezó se le llama el epicentro del terremoto. Dentro de la tierra las vibraciones salen en todas direcciones desde este punto. Estas vibraciones se llaman ONDAS, y son muy parecidas a las que vemos en el agua cuando tiramos una piedra en una pila.





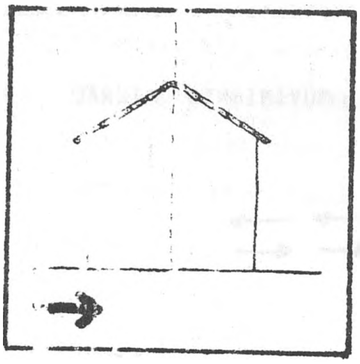
MOVIMIENTO LATERAL

Básicamente hay dos clases de ondas que afectan a las casas: La primera, hace que la tierra se mueva de un lado para otro. A este movimiento se le llama MOVIMIENTO LATERAL. El movimiento lateral nos hace sentir que algo nos hala y nos empuja.

La segunda clase de ondas que se mueven un poquito más despacio, produce un movimiento como el que nosotros vemos en las olas del mar. Este movimiento lo conocemos como MOVIMIENTO ONDULATORIO. Estas ondas nos dan la sensación de que nos tiran para arriba y para abajo.

MOVIMIENTO ONDULATORIO

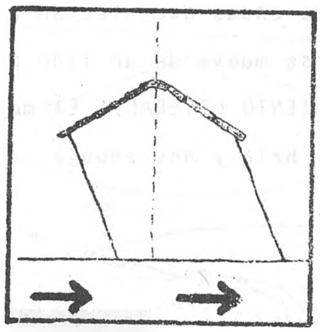
¿COMO AFECTAN LAS ONDAS A LAS PAREDES?



1a. CLASE DE ONDAS (MOVIMIENTO LATERAL)

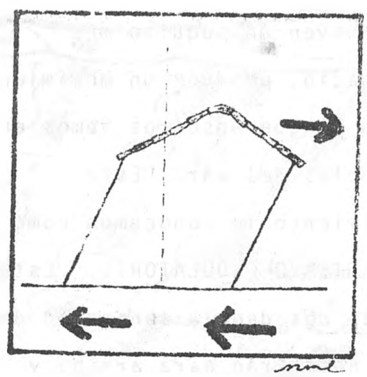
Cuando ocurre un terremoto y se sienten las ondas de la primera clase, la tierra empieza a moverse de un lado para otro.

El cimiento y la parte de abajo de la casa que está pegada a la tierra, inmediatamente se mueven juntamente con la tierra.



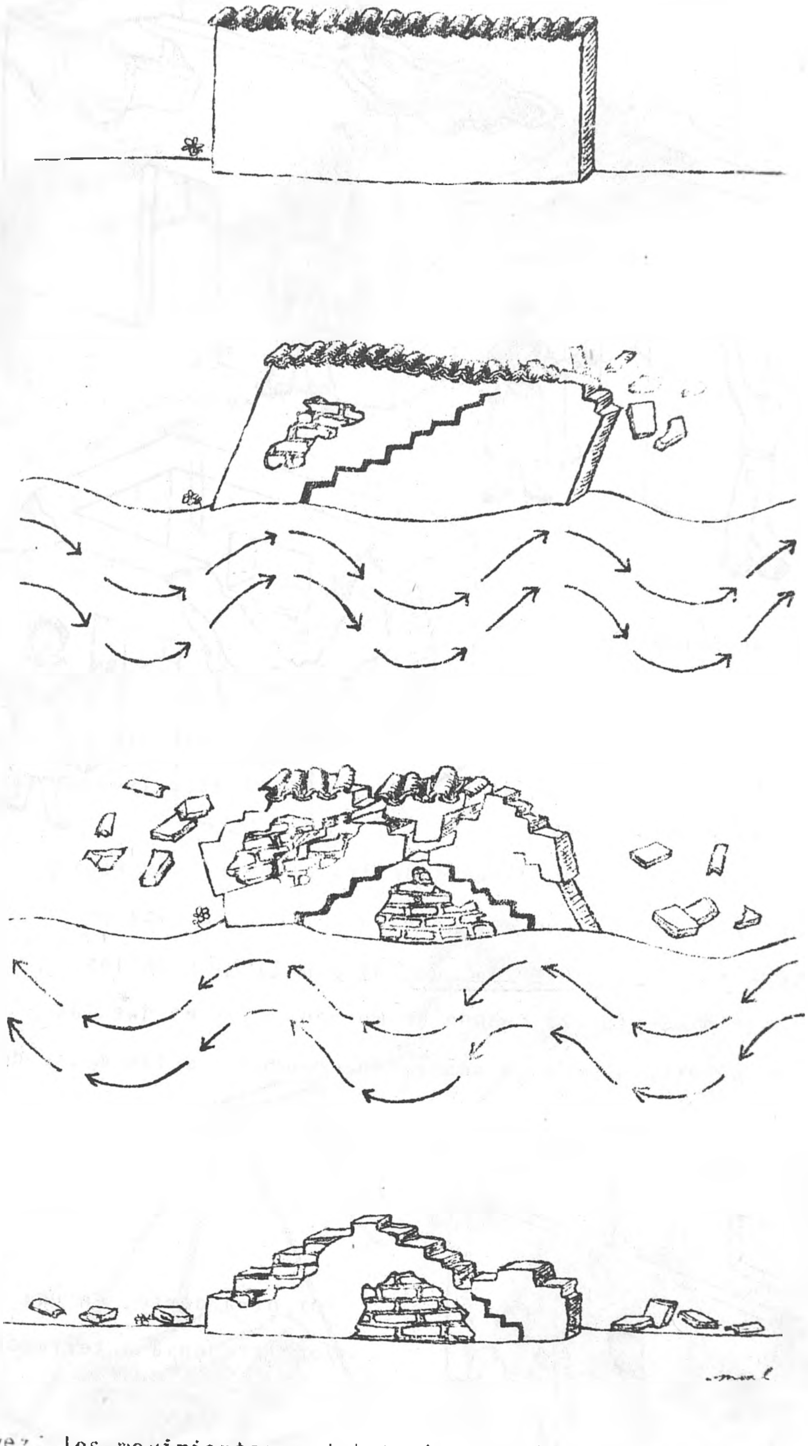
Sin embargo, el techo se tarda un poquito en seguir este movimiento, y entonces la casa se inclina como lo vemos en este dibujo.

Luego la parte de arriba de la casa trata de alcanzar el movimiento de la parte de abajo. Mientras tanto el movimiento de la tierra cambia de dirección o sea que viene una onda de otra dirección. Así que el techo y la parte de arriba de la casa se mueven en dirección opuesta a la parte de abajo y se mueven más rápido por estar en alto.

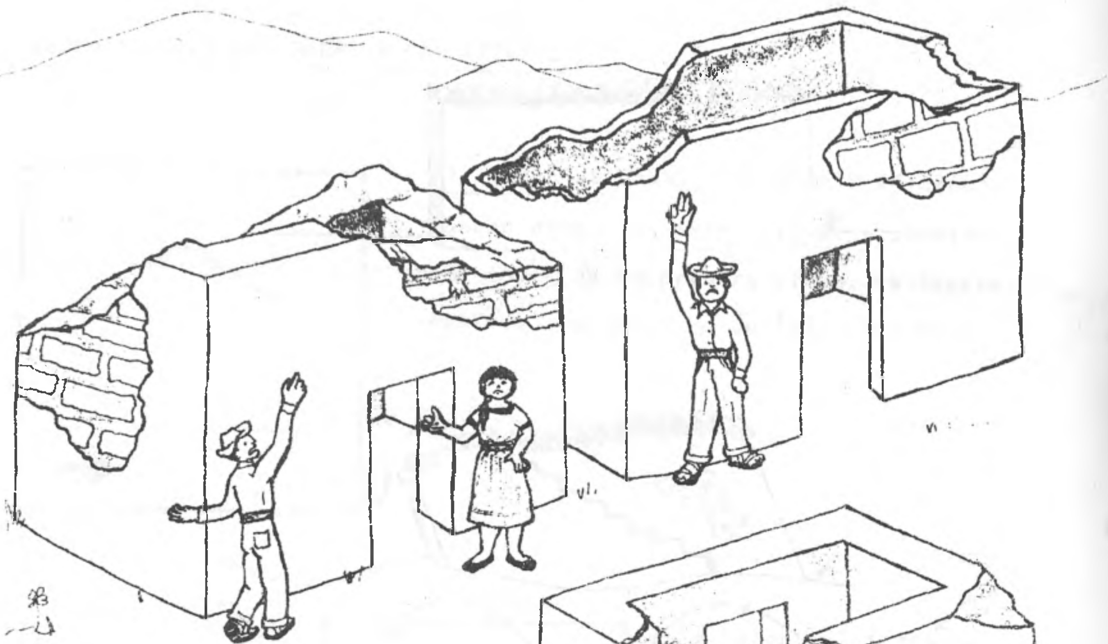


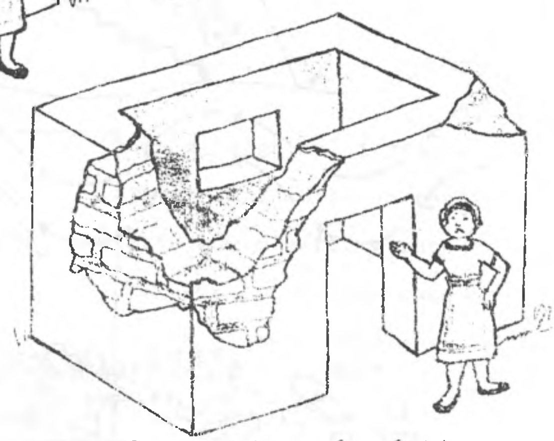
Este movimiento lo podemos comprobar cuando vamos parados en una camioneta, cuando la camioneta empieza a caminar sentimos que nos vamos para atrás; y cuando la camioneta para, sentimos que nos vamos hacia adelante.

2a. CLASE DE ONDAS (MOVIMIENTO ONDULATORIO)

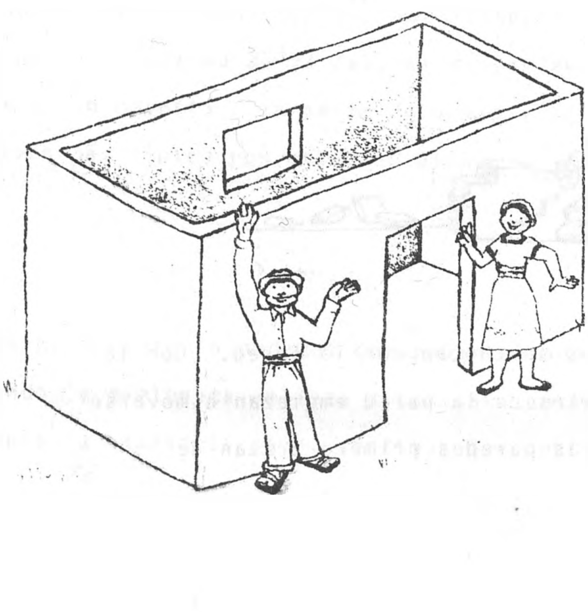


A la vez, los movimientos ondulatorios se chocan con la pared. Con la fuerza de estas ondas, diferentes partes de la pared empiezan a moverse en direcciones opuestas, y entonces las paredes primero tratan de juntarse y después de separarse.

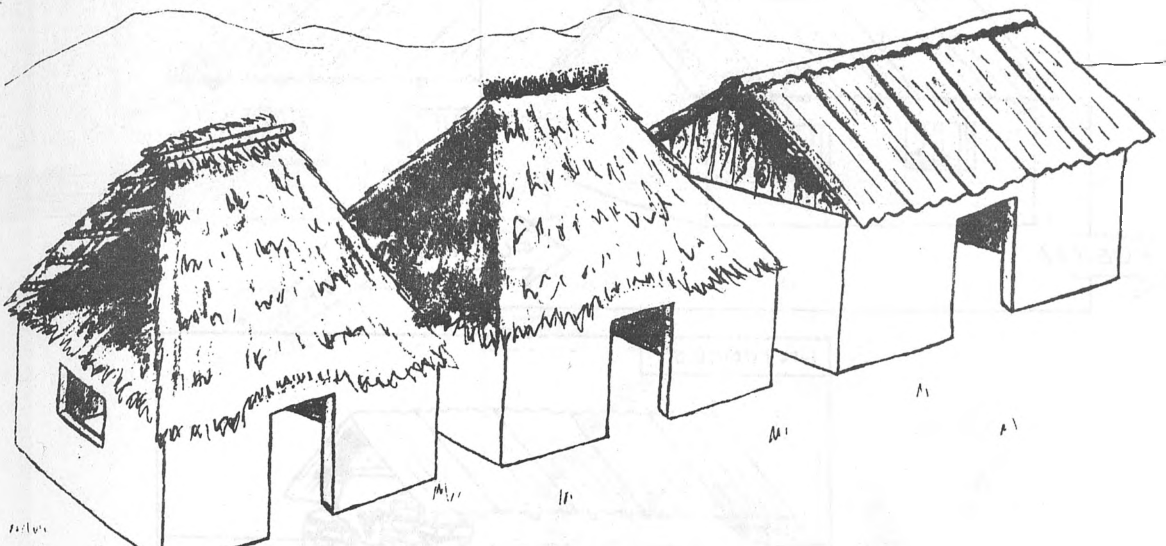




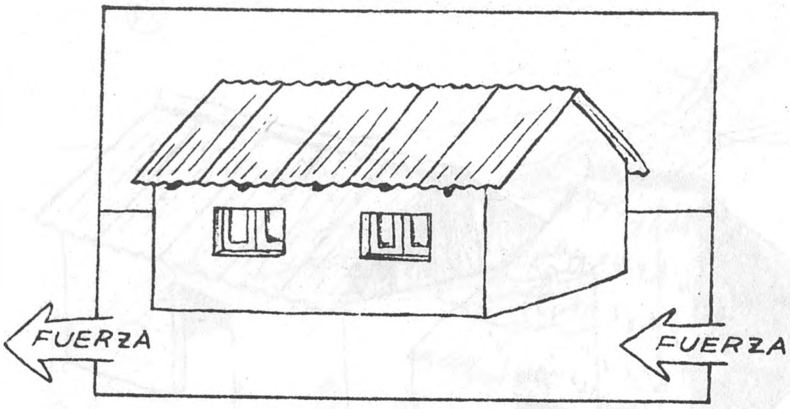
El daño que causa un terremoto en una casa depende de su construcción. Dos de las cosas más importantes son la altura y el peso tanto de las paredes como del techo de la misma. Entre más altas sean las paredes, más rápido será el movimiento y la fuerza que agarrará la parte de arriba de la casa y el daño será mayor. Y entre más anchas y pesadas sean las paredes, éstas tendrán más fuerza cuando se muevan. Así es que las paredes a causa de su propio peso se destruyen cuando se están moviendo.

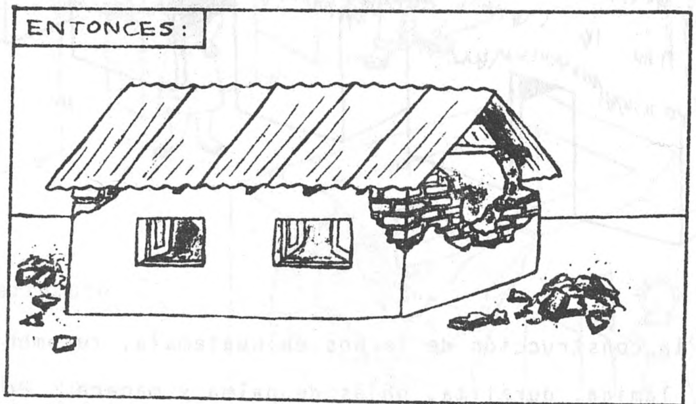


Por otra parte, en una zona propensa a terremotos es muy importante <u>construir paredes bajas y livianas</u>.



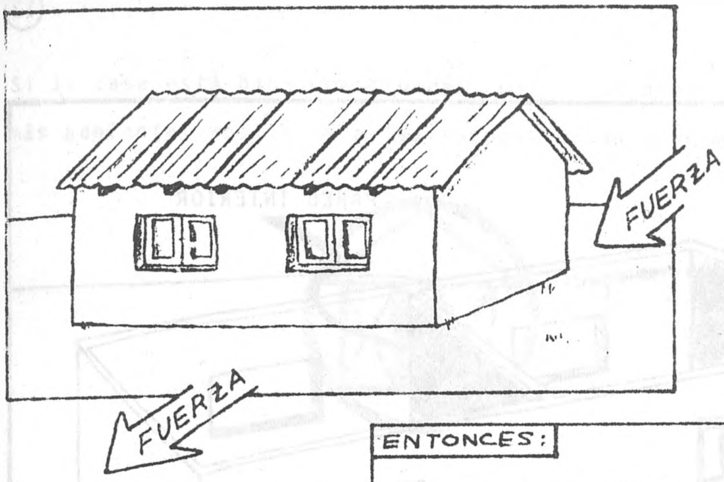
Para la construcción de techos en Guatemala, recomendamos: paja, lámina, duralita, hojas de palma y manaca. Por ningún motivo debemos usar tejas en los techos de nuestras viviendas.

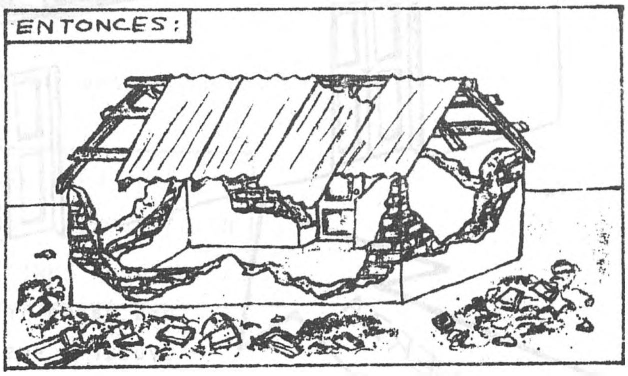




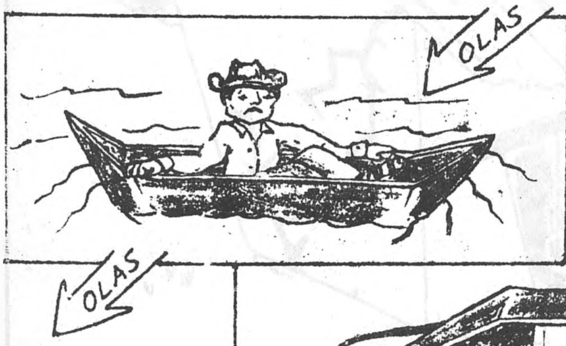
¿COMO AFECTA UN TERREMOTO A UNA CASA?

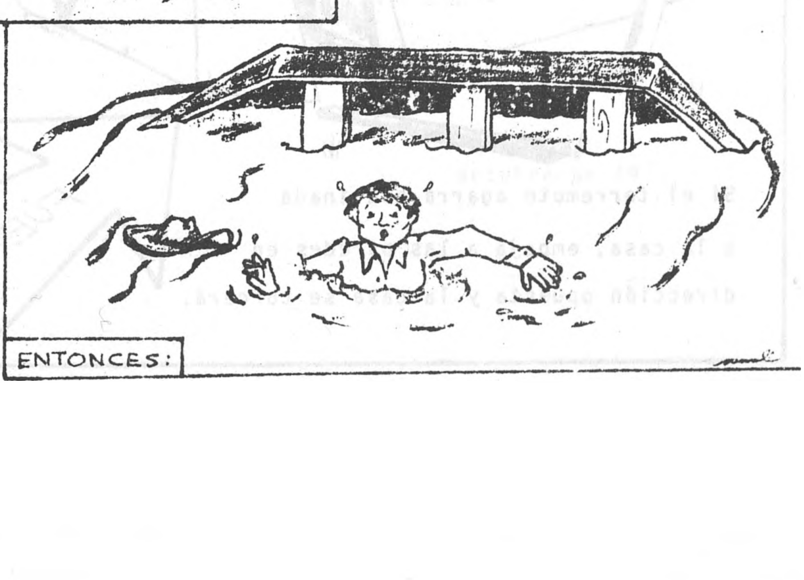
Cuando la fuerza de un terremoto empuja una pared, esta pared se acuesta con todo su peso sobre las dos paredes vecinas. Si las ondas del terremoto se mueven en la misma dirección a las paredes largas, es probable que sólo estas paredes largas soporten el peso y las paredes cortas se dañen. Esto lo podemos ver cuando las olas agarran a un cayuco de punta, el cayuco rompe las olas y resiste las fuerza de las mismas.

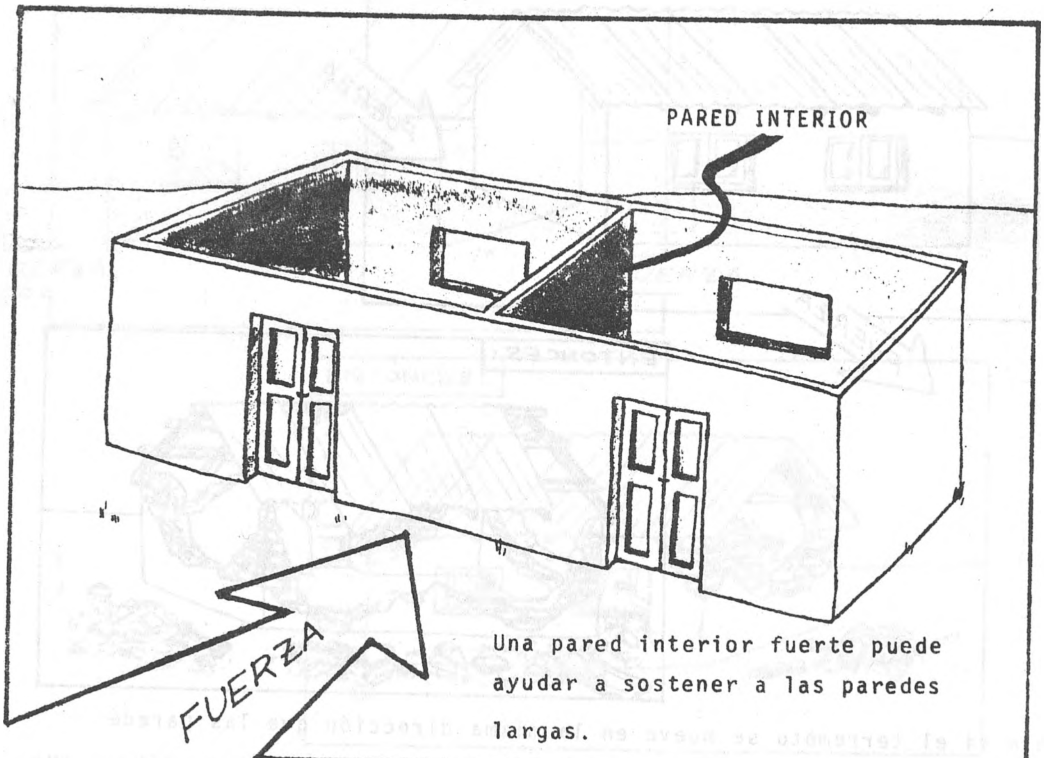




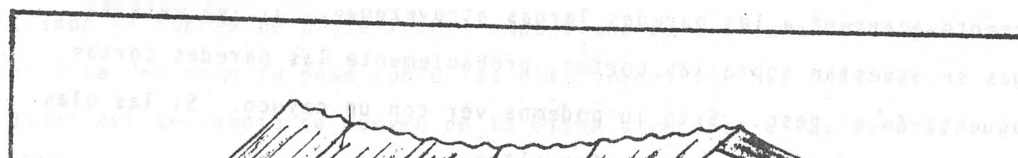
Pero si el terremoto se mueve en la misma dirección que las paredes cortas, pues el daño será mucho más grande, porque la fuerza del terremoto agarrará a las paredes largas atravezadas. Si las paredes largas se acuestan sobre las cortas, probablemente las paredes cortas no aguantarán el peso. Esto lo podemos ver con un cayuco. Si las olas lo agarran de lado el cayuco dará vueltas.







Una pared interior fuerte puede ayudar a sostener a las paredes largas.



Si el terremoto agarra esquinada a la casa, empuja a las paredes en dirección opuesta y la casa se torcerá.

Sí la casa está bien construida, con las técnicas que discuteremos más adelante, resistirá a las fuerzas de un terremoto.

Para mayor información puede comunicarse con:

PROYECTO KUCHUBA'L

PROGRAMA DE RECONSTRUCCION

OXFAM - VECINOS MUNDIALES

Oficina de Educación

Kilómetro 56 1/2

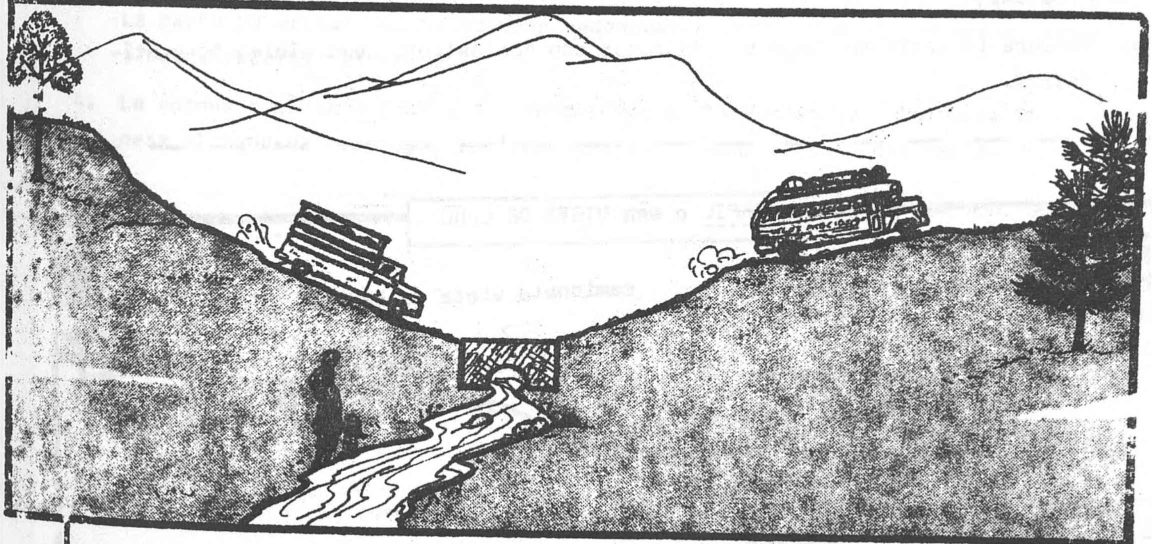
Carretera Panamericana

Chimaltenango

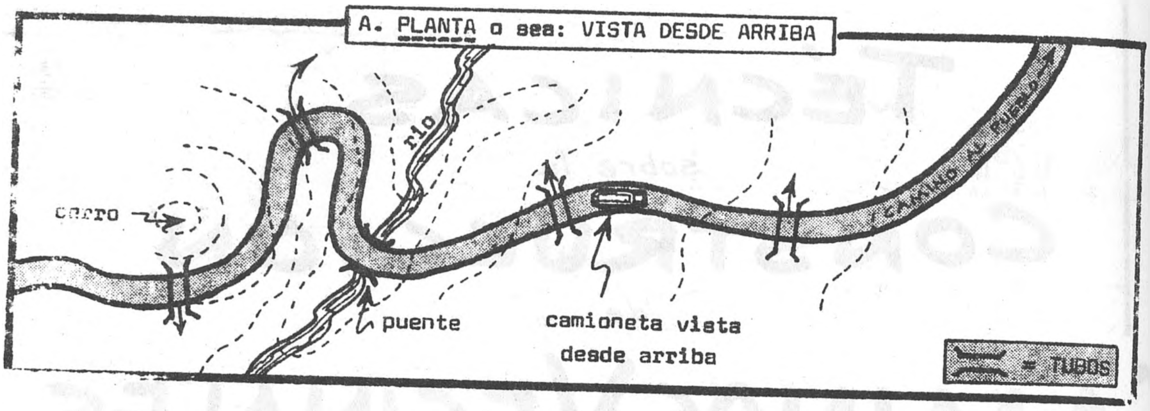
Apartado Postal 52

Edición # 1 octubre de 1976

TÉCNICAS sobre la CONSTRUCCIÓN de CAMINOS VECINALES a las MONTAÑAS

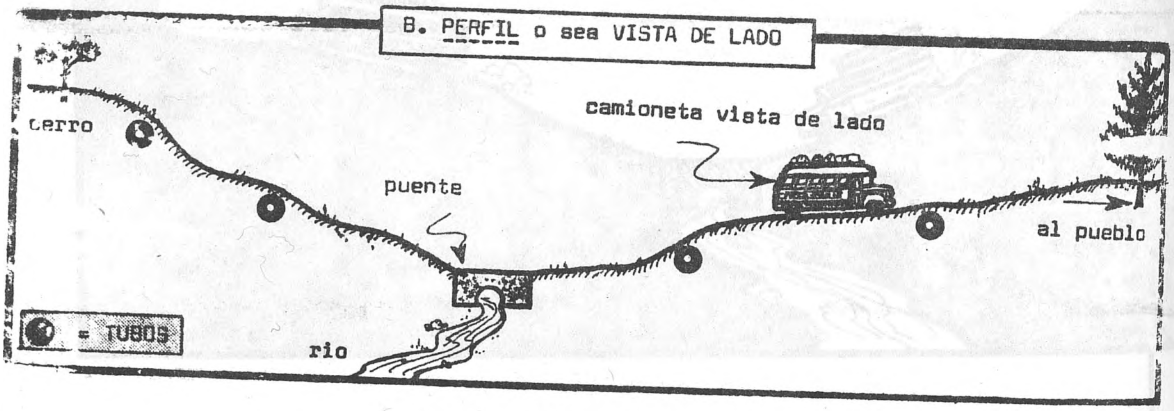


DIBUJOS QUE MUESTRAN LO QUE ES UNA SECCION TIPICA



LO QUE INTERESA DE LA PLANTA

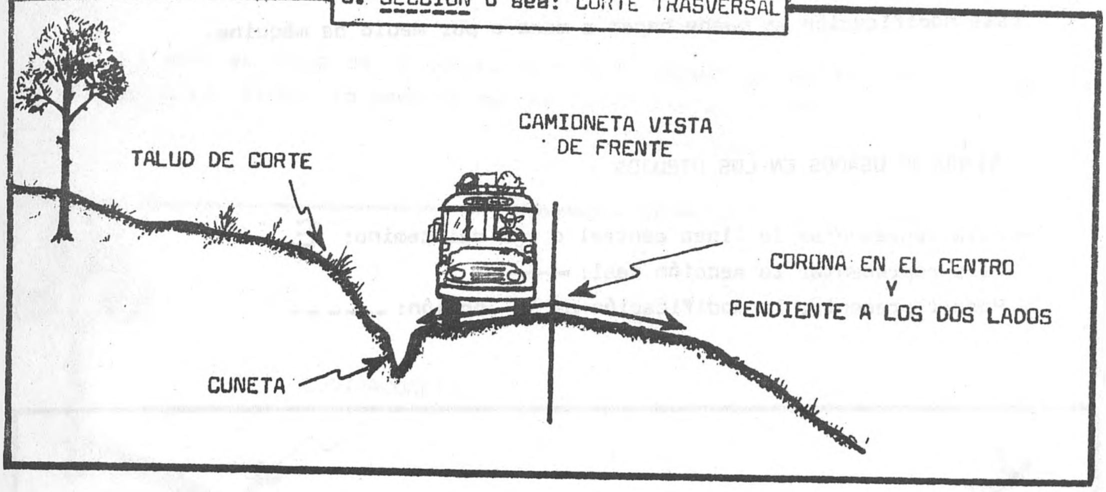
1. Los tubos deben colocarse a una distancia no mayor de 120 metros.
2. El tamaño de los tubos debe ser mayor de 12 pulgadas, y éstos deben colocarse a una inclinación del 2%.
3. La parte inferior de la boca de entrada debe colocarse lo suficientemente baja para asegurar el buen funcionamiento de la cuneta.
4. Las salidas tendrán que estar puestas en tierra firme y con protección a la erosión.
5. Recubra la parte más baja de los tubos con "balastro", como mínimo 50 centímetros.



LO QUE INTERESA DEL PERFIL

1. Las pendientes de los caminos no deben ser mayores del 14%, ni menores del 2%.
2. Los caminos con pendientes mayores no retienen el "balastro", especialmente durante las temporadas de lluvia. Los caminos sin pendientes se llenan de hoyos, y se forman pozas de agua. Además, las cunetas no sirven porque en ellos se estanca el agua en vez de correr a otro lado.

C. SECCION o sea: CORTE TRASVERSAL



LO QUE INTERESA DE LA SECCION

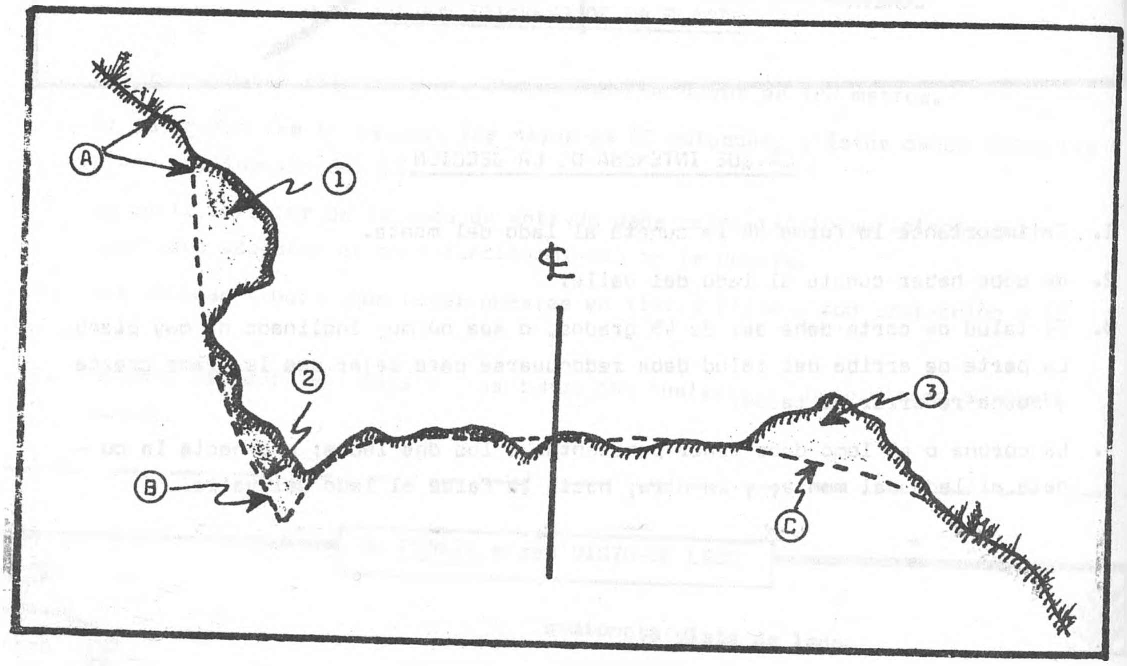
1. Es importante la forma de la cuneta al lado del monte.
2. No debe haber cuneta al lado del valle.
3. El talud de corte debe ser de 45 grados, o sea no muy inclinado ni muy plano. La parte de arriba del talud debe redondearse para dejar que la grama crezca y pueda reforzar el talud.
4. La corona o el lomo debe tener pendientes a los dos lados: una hacia la cuneta al lado del monte; y la otra, hacia la falda al lado del valle.

VISTA DE UNA SECCION REAL INDICANDO DONDE SERA MODIFICADA

Esta modificación se puede hacer a mano o por medio de máquina.

SIMBOLOS USADOS EN LOS DIBUJOS :

- Para representar la línea central o eje del camino: ℄
- Para representar la sección real: ——
- Para representar la modificación de la sección: ------



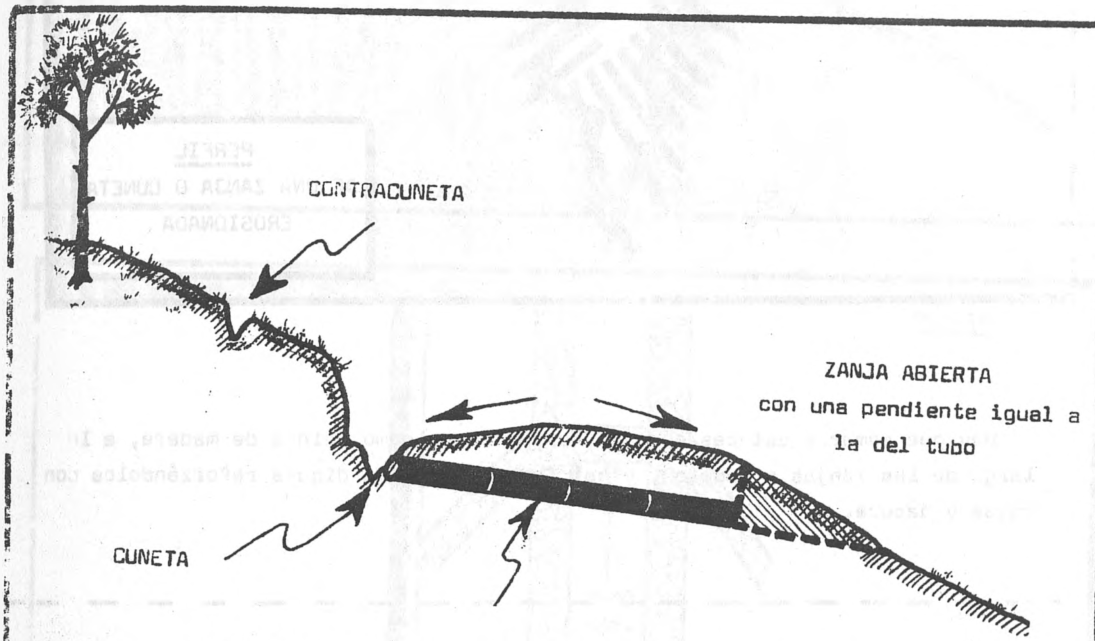
Las partes sombreadas (1), (2), (3), tendrán que quitarse. Se podrá usar como balastro sobre el mismo camino solamente en el caso poco común que se trate de un buen material que no sea barro o arcilla, y que no tenga materia vegetal.

Quitando la parte (1) se evitarán derrumbes que podrían tapar las cunetas; y quitando las partes (2) y (3) se facilitará la eliminación del agua de las lluvias.

Al redondear el talud (A) se facilita el refuerzo del talud por medio del crecimiento de la grama y vegetación. (B) indica la forma en que se hace la cuneta del lado de la montaña, y (C) indica la forma que deberá tener el lado del valle pero sin cuneta.

EL AGUA

El agua es amiga de la agricultura pero es enemiga de los caminos. Hay que sacarla lo más pronto posible por medio de cunetas, contracunetas y tubos.



LOS TUBOS COLOCADOS CON UNA PENDIENTE MAYOR DEL 2%
AL LADO DE DONDE SALE EL AGUA

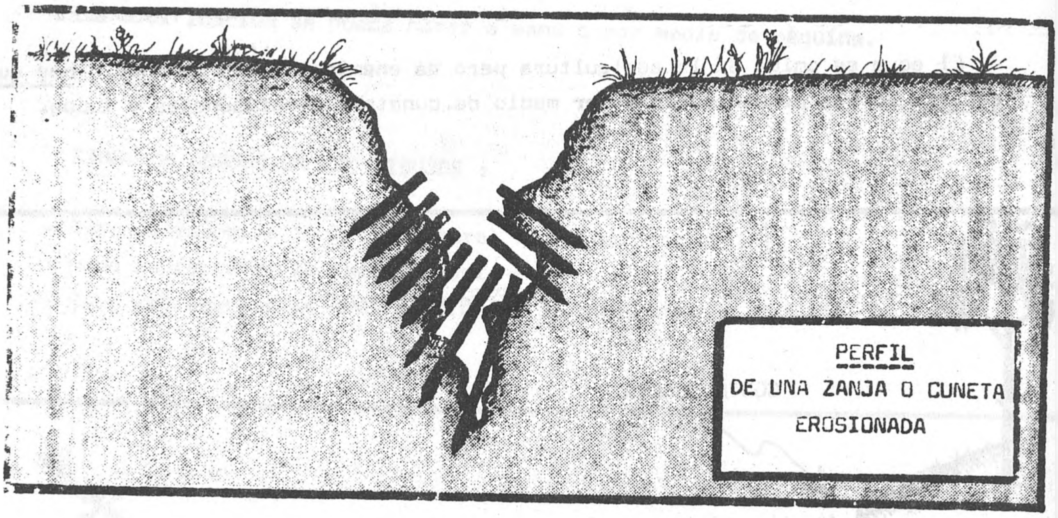
1. Los tubos serán colocados a distancias regulares entre sí, para sacar el agua de las cunetas.

2. Además, se colocarán tubos en donde bajen pequeñas corrientes de agua o en donde hayan quebraditas del lado del cerro, los cuales atravesaban anteriormente en donde pasa el camino ahora.

3. La zanja que se abre a la salida del tubo tendrá la misma pendiente del tubo y se debe colocar en tierra firme, nunca en un relleno.

   Si la pendiente del tubo es menor del 2%, la zanja se rellenará con el tiempo y se perderá el tubo. Si la pendiente del tubo es demasiada, habrá erosión.

COMO EVITAR LA EROSION:



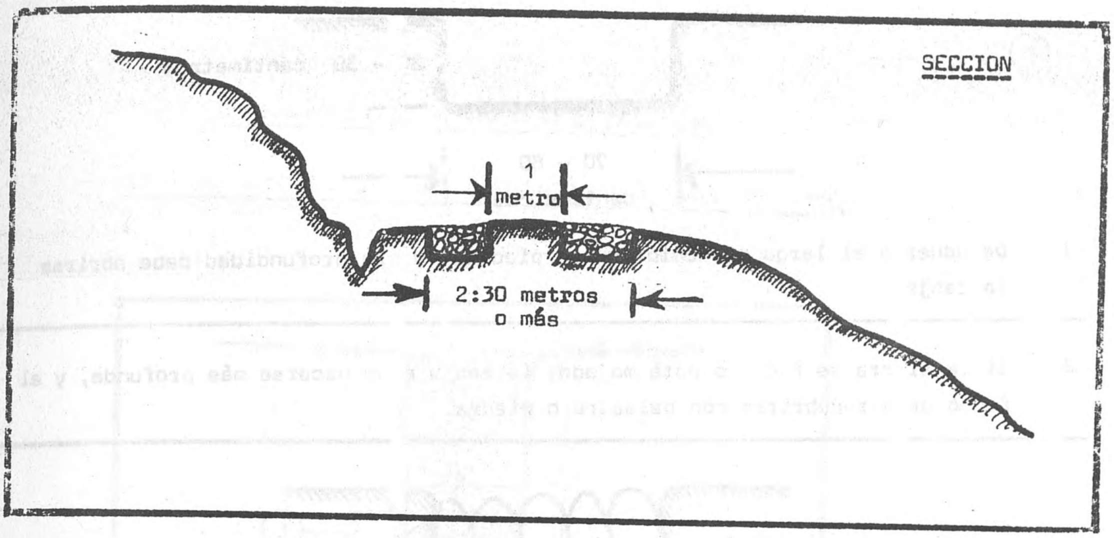
Hay que sembrar estacas en esta forma, o sea como peines de madera, a lo largo de las zanjas o cunetas, y así formar pequeños diques reforzándolos con hojas y basura.

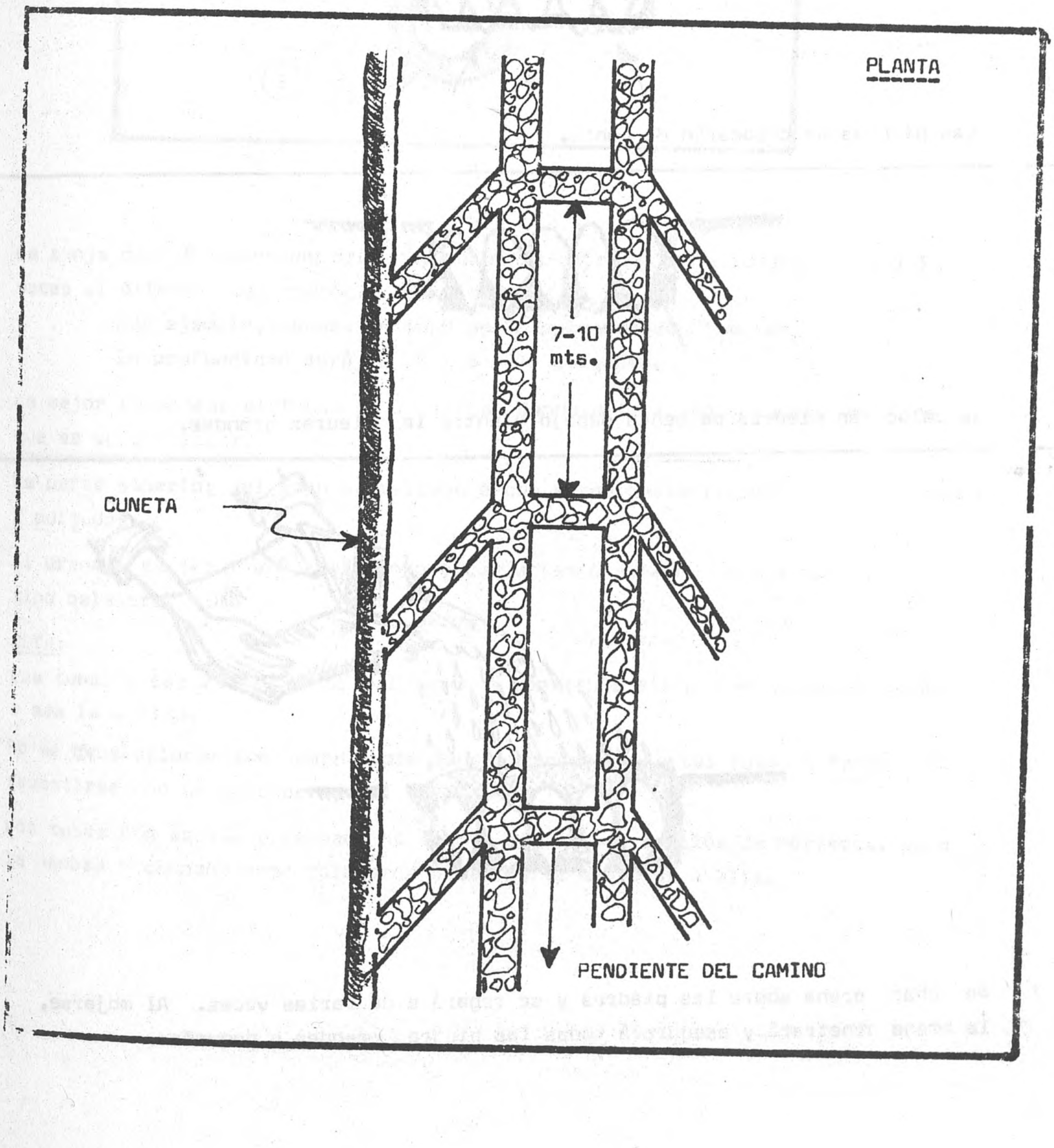
LA TIERRA

Toda la tierra que es buena para la agricultura, es mala para los caminos. Los caminos tienen que ser revestidos con un buen material llamado balastro, que es granulado, fuerte y pesado. El buen balastro no se deshace con el agua y tiene muy poca arcilla.

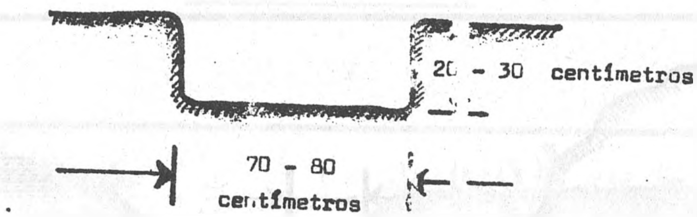
Cuando las pendientes son mayores del 14% el balastro se lavará o se perderá por la acción de la lluvia y por el paso de las llantas de los vehículos. En este caso, solo el empedrado podrá usarse. El empedrado es un trabajo tardado y costoso, pero tiene la ventaja de que puede hacerse a mano, y tardará muchos años si está bien hecho.

EJEMPLO DE EMPEDRADO SIMPLE Y DE UNA SOLA VIA



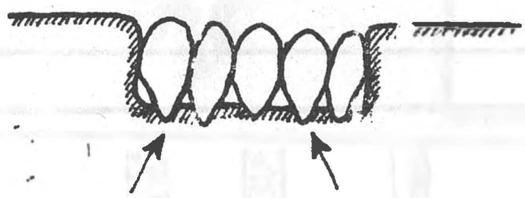


EMPEDRADO: LA PIEDRA Y COMO SE COLOCA

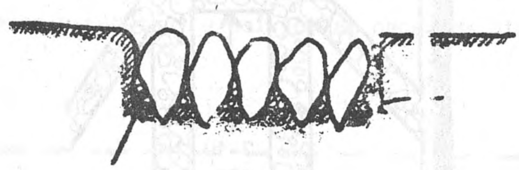


1. De acuerdo al largo promedio de las piedras, a esa profundidad debe abrirse la zanja.

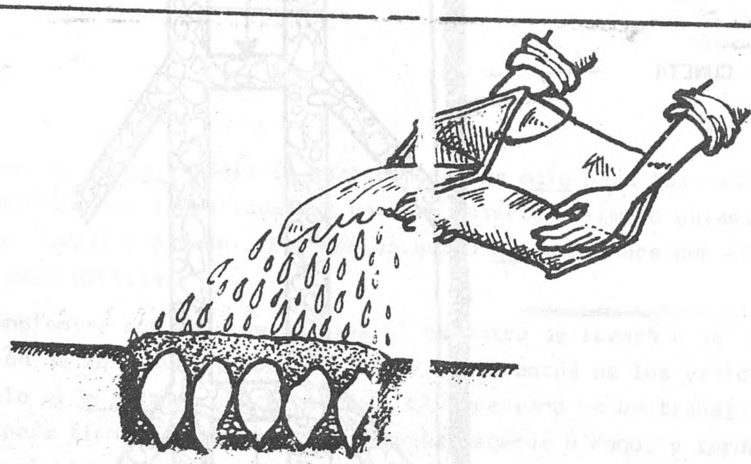
2. Si la tierra es floja o está mojada, la zanja debe hacerse más profunda, y el fondo debe recubrirse con balastro o piedra.



Las piedras se colocarán de punta.

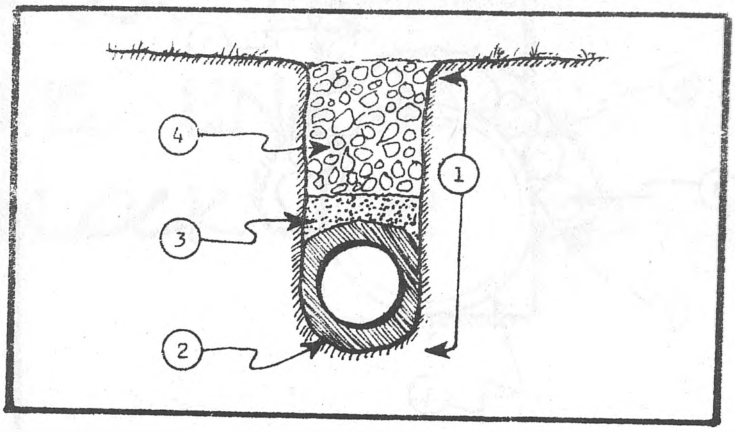


4. Se colocarán piedras pequeñas debajo y entre las piedras grandes.



5. Se echará arena sobre las piedras y se regará agua varias veces. Al mojarse, la arena penetrará y asegurará todas las piedras grandes y pequeñas.

FORMA DE COLOCAR UN TUBO DE CONCRETO
Y
FORMA DE CONSTRUIR UN BUEN DRENAJE USANDO TUNELES GRANDES



(1) La zanja deberá tener una profundidad en la entrada de la tubería de 2 o 3 veces el diámetro del tubo que se va a colocar.

Por ejemplo, usando un tubo de 12 pulgadas de diametro, la profundidad será de 12 x 3 = 36 pulgadas.

(2) Es mejor redondear el fondo de la zanja, dándole la forma y tamaño del tubo que se va a colocar.

(3) La parte superior del tubo se rellenará con arena hasta recubrirlo por lo menos 2 pulgadas.

(4) El drenaje se terminará rellenando y compactando a mano, usando buen material tipo balastro.

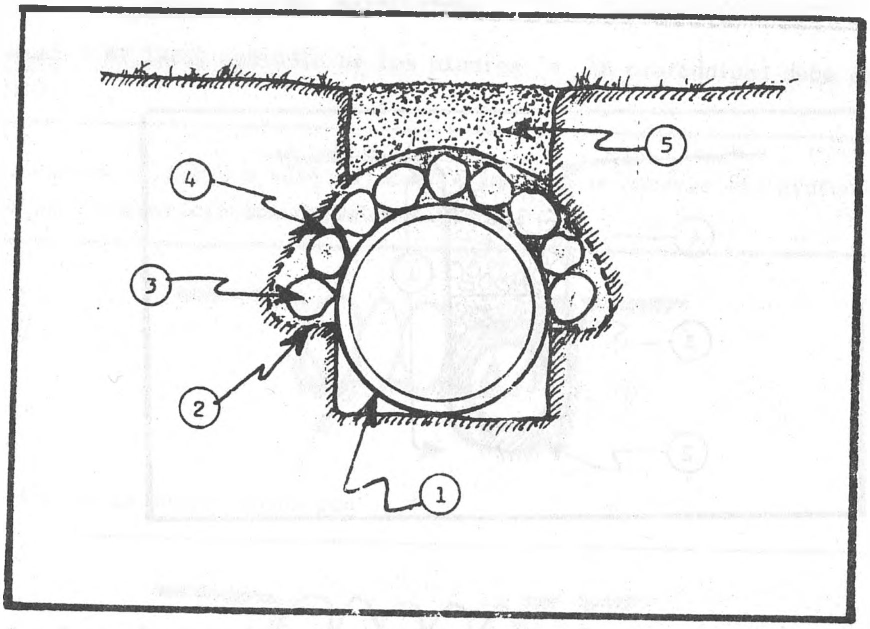
NOTA:

Los tubos y las zanjas se principiarán a construir siempre en la parte inferior o sea la salida.

No se debe colocar los tubos sobre fondos rocosos. En tal caso el fondo debe revestirse con un poco de arena.

Los tubos con espiga y campana no tienen que llevar anillos de morteros, pero la hembra o campana debe colocarse en la parte superior o alta.

EL USO DE TONELES COMO FORMALETA



(1) Se abre la zanja y se coloca el tonel.

(2) Se escarvan a los lados del tonel dos zanjitas o cejas.

(3) Las piedras se colocan como en la figura, en forma de arco apoyando bien en las zanjitas de los dos lados.

(4) Se hace una fundición de arena con cemento y cal, y se echa entre las piedras del arco.

(5) Se rellena la zanja con material selecto o balastro.

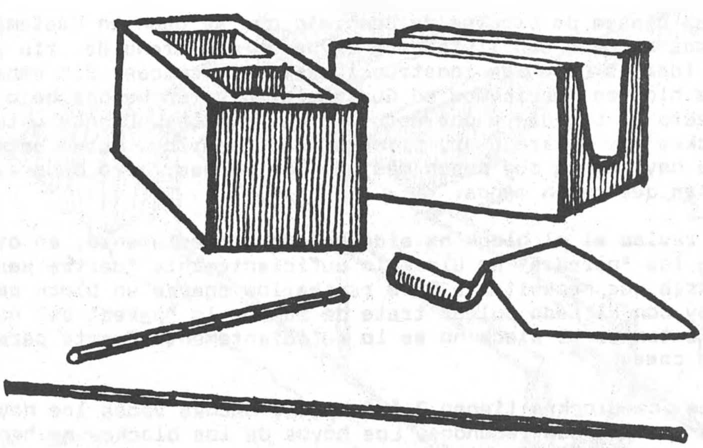
Preparado por:
Proyecto Kuchub'al
OXFAM - Vecinos Mundiales

Asesoría Técnica:
Ingeniero Pietro Vitali

Chimaltenango

Julio de 1,976
Marzo de 1,977

RECOMENDACIONES PARA LA CONSTRUCCION DE UNA CASA DE BLOCK DE CONCRETO



PRODUCIDO POR OXFAM/VECINOS MUNDIALES
CON LA ASESORIA DE INTERTECT
DICIEMBRE DE 1976

RECOMENDACIONES PARA LA CONSTRUCCION DE UNA CASA DE BLOCK DE CONCRETO

I. PRINCIPIOS DE CONSTRUCCION

Todos los principios de construcción antisísmica, o sea construcción resistente a un terremoto, deben ser considerados y usados de la mejor forma posible cuando se construya una casa de block de concreto. Debemos recordar que el material que se usa en una construcción no es lo más importante. Lo importante es la forma en que se use este material, a no ser que la casa de block se construya de acuerdo con todos los principios necesarios en una construcción resistente a terremotos, la casa de block no será más segura que otras casas construídas con cualquier otro material. Dá lo mismo que la casa sea de adobe o de madera, lo principal es que esté hecha de acuerdo a las necesidades de una construcción antisísmica. Debido a la naturaleza del material, hay ciertas áreas de la estructura a las cuales les debemos poner una atención especial para que la casa sea más segura. Algunos de estos principios probablemente ya los conocen, tales como el uso de hierros con concreto para poder hacer las soleras y las columnas que serán necesarias para reforzar la estructura.

Si usted sigue los principios de este manual, tendrá una estructura fuerte, la cual resistirá fácilmente un terremoto.

II. DIFERENTES CLASES DE BLOCKES DE CONCRETO

Hay muchas clases de blockes de concreto que se usan en Guatemala. Muchos de estos blockes son livianos y se hacen con arena de río y cemento, y son ideales para las construcciones antisísmicas. Sin embargo, muchos de los blockes fabricados en Guatemala no están hechos bajo un control correcto de calidad y por ésto son muy débiles. Cuando usted escoja los blockes que quiera usar, primero debe pesarlos. Usted se dará cuenta de que hay muchos que pesan más que los adobes, pero debe escoger siempre blockes que pesen menos.

Después, revise si el block ha sido curado correctamente, en otras palabras: son las "paredes" de block lo suficientemente fuertes para resistir la fuerza que necesitan?. Para revisarlos agarre un block por uno de los hoyos y con el dedo pulgar trate de romper la "pared" del mismo. Si se rompe, entonces el block no es lo suficientemente fuerte para usarlo en una casa.

Casi todos los blockes tienen 2 ó 3 hoyos. Muchas veces los hoyos son cuadrados y otros son redondos. Los hoyos de los blockes se hacen para que éstos sean más livianos, pero también los hoyos sirven para que los blockes tengan más resistencia. La ventaja de usar blockes con hoyos es que las columnas de concreto se pueden fundir dentro de ellos. También tienen otra ventaja: si usted no tiene blockes en forma de "U" para hacer la solera, puede poner una hilada de blockes, quitarle las paredes exteriores e interiores a los blockes, echar el concreto y fundir varras de hierro para reforzar y hacer la solera que sea necesaria, la cual sostendrá la estructura.

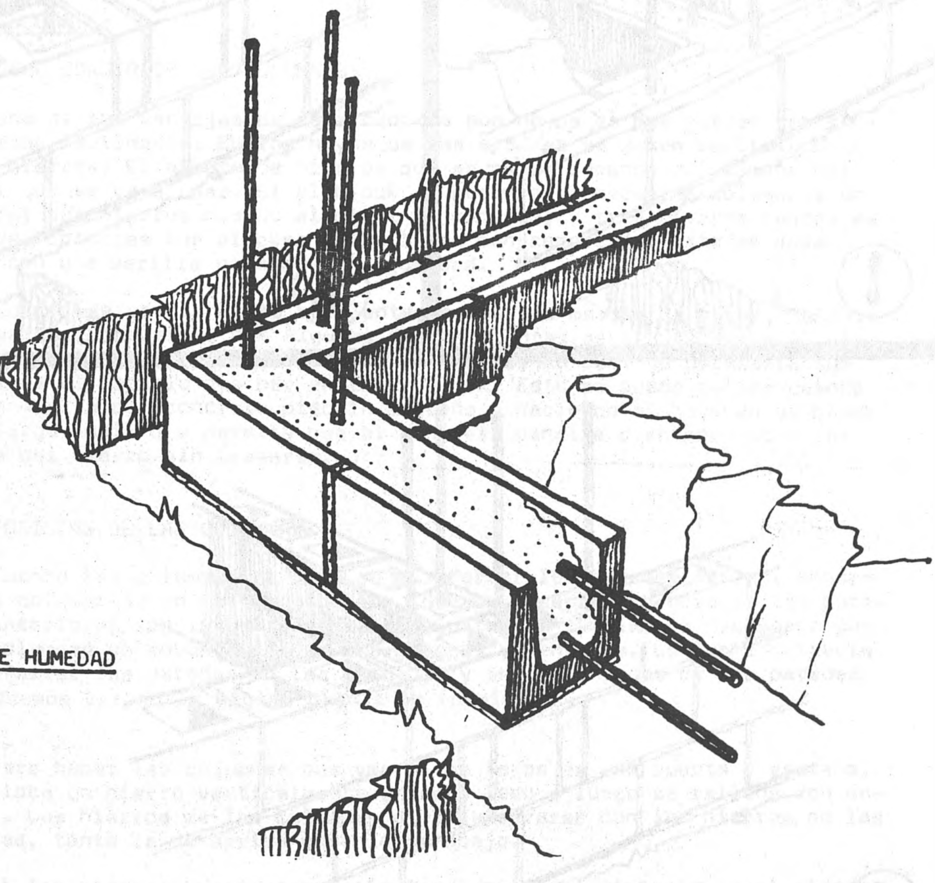
Muy pocas veces usted podrá encontrar blockes sólidos de concreto. Estos no deben usarse en zonas propensas a terremotos. (Estos blockes no deben confundirse con los blockes "CINVA-RAM", o con los ladrillos que se hacen para fines comerciales en Guatemala).

III. CONSTRUCCION DE LAS PAREDES

A) COMO AMARRAR LAS PAREDES AL CIMIENTO DE LA CASA:

En un terremoto hay muchas posibilidades de que una pared se resbale de su cimiento o base. Esto no ocurre si entre los cimientos y las paredes existe una buena conexión. La parte de arriba de la base debe picarse y estar limpia para lograr una buena unión con la mezcla. En tiempo de calor o de sequía (o sea durante el verano), es bueno mojar el cimiento, porque el concreto de que está hecho el mismo se chupará parte del agua de la mezcla y por lo tanto hará que esta mezcla sea más débil.

Los cimientos que se usan generalmente en Guatemala para las paredes de block de concreto son lo suficientemente buenos. Es necesario hacer una solera arriba de las paredes; también es necesario poner soleras en la base de las paredes sobre los cimientos, y a la mitad de las paredes.



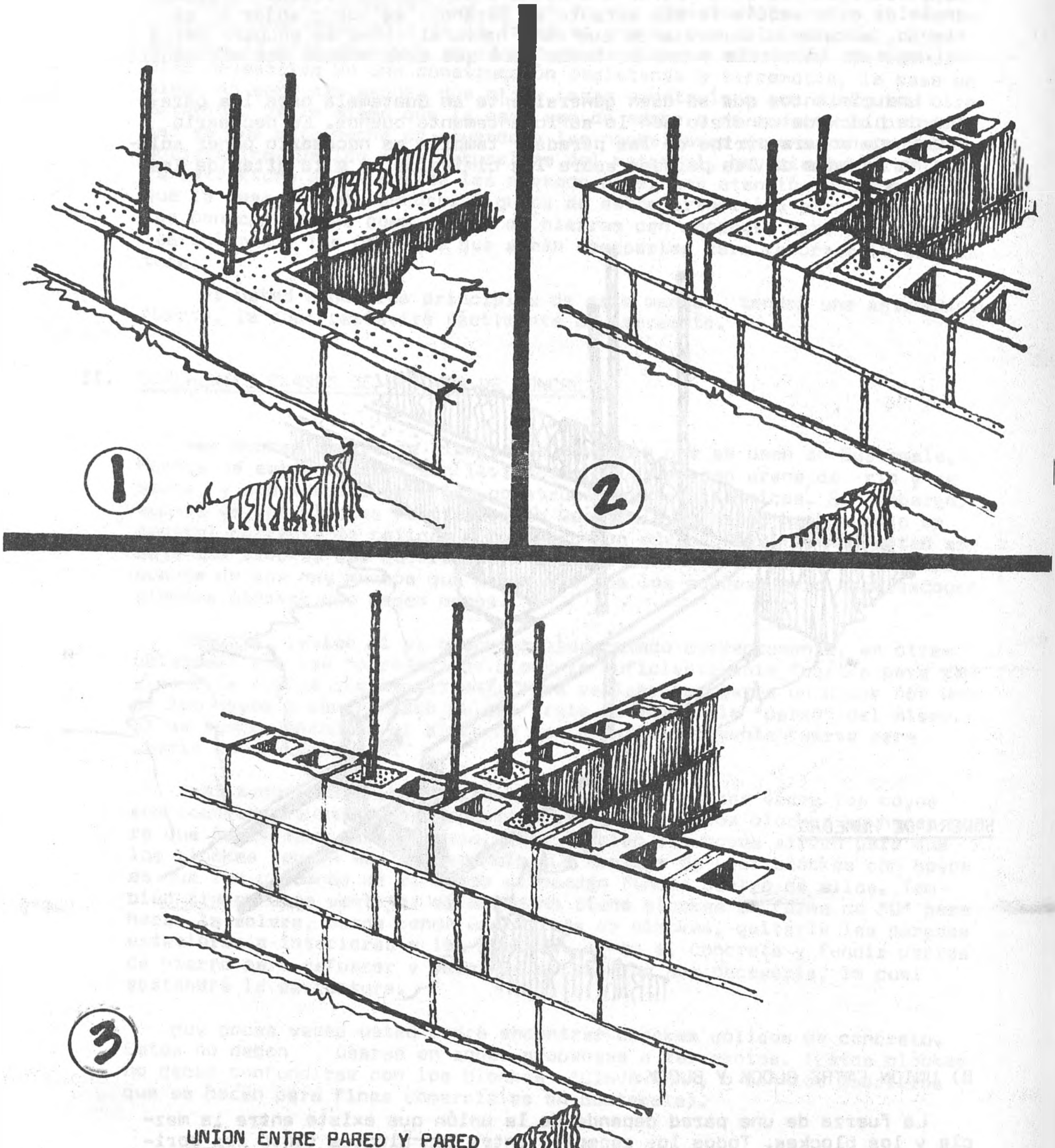
SOLERA DE HUMEDAD

B) UNION ENTRE BLOCK Y BLOCK:

La fuerza de una pared depende de la unión que existe entre la mezcla y los blockes. Todos los espacios entre los blockes tanto los horizontales como los verticales deben rellenarse completamente con mezcla. Cuando haya sequía o calor, momentos antes de colocar los blockes, debemos mojarlos.

C) UNION ENTRE PARED Y PARED:

Es importante que todas las paredes estén bien unidas, principalmente en las esquinas y en las uniones de las paredes interiores con las exteriores. Si las paredes no están bien unidas, éstas están muy propensas a caerse con un terremoto. La forma correcta de unir una pared interior con otra es la siguiente:



UNION ENTRE PARED Y PARED

D) COMO COLOCAR LAS HILADAS DE BLOCK:

A partir del cimiento de la casa, en las esquinas se deben colocar los blockes en forma de gradas hasta llegar a 1/2 metro de altura; después se va rellenando hilada por hilada. Las paredes de block son más resistentes si se construyen a la vez varias hiladas; se debe empezar desde un punto dándole la vuelta a la construcción, es decir alrededor de la casa. Después de haberse rellenado entre las esquinas, se levanten las paredes parejas hacia arriba, en todo el rededor de la estructura. En algunos lugares acostumbran a levantar las esquinas hasta la altura de la pared. Esto no es recomendable, pues es como si se dejara un espacio débil en la esquina; el cual no se puede rellenar debidamente con mezcla. Y mientras que las esquinas están paradas solas, pueden moverse hacia adelante o hacia atrás y así debilitarse.

E) CUANDO LOS BLOCKES TENGAN HOYOS SOLO EN UN LADO se deben colocar con los hoyos para abajo; la razón de ésto es porque un poco de la mezcla entre las hiladas con el peso del block subirá y llenará parte de los hoyos. Por tanto se logrará una mejor unión.

IV <u>LAS COLUMNAS</u>:

A) COMO CONSTRUIR LAS COLUMNAS:

Una de las ventajas de usar blockes con hoyos es que pueden ser reforzados fácilmente. En los hoyos de los blockes se ponen verticalmente unos hierros. El número de hierros que se ponen depende del tamaño del block que se va a usar. Si el block es pequeño se necesita solamente un hierro; dos hierros cuando el block es mediano; y tres hierros cuando es grande. Entonces los blockes se rellenan con concreto y éste se puya bien con una varilla para mayor seguridad.

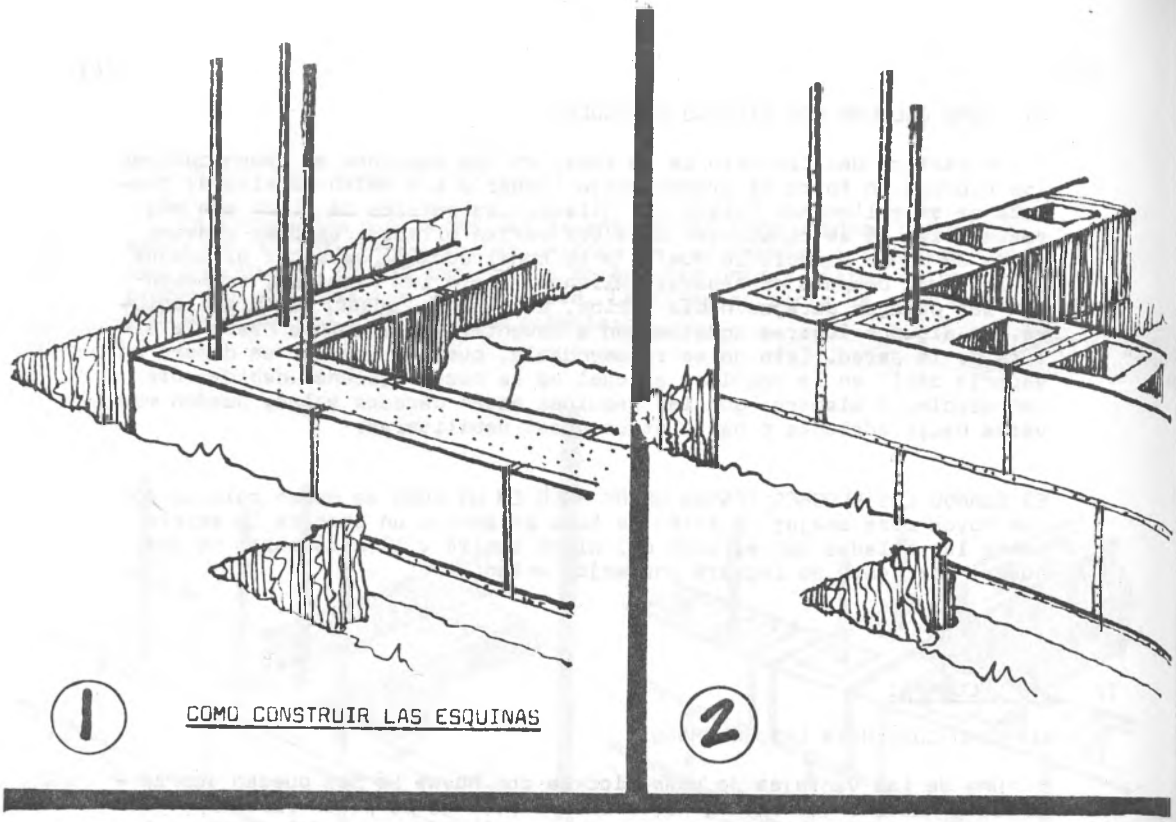
Cuando se usa concreto corriente, o sea una mezcla de arena, cemento y piedrín, es posible que algunas de las piedras se traben entre el hierro y el block, y no dejen pasar el concreto, lo cual no permitirá que se llene el espacio que hay entre el block. Esto se puede evitar usando en la mezcla del concreto piedrín pequeño y haciendo el hoyo en el block más largo hasta que permita que el concreto penetre bien por todos los lados del hierro sin trabarse.

B) POSICION DE LAS COLUMNAS:

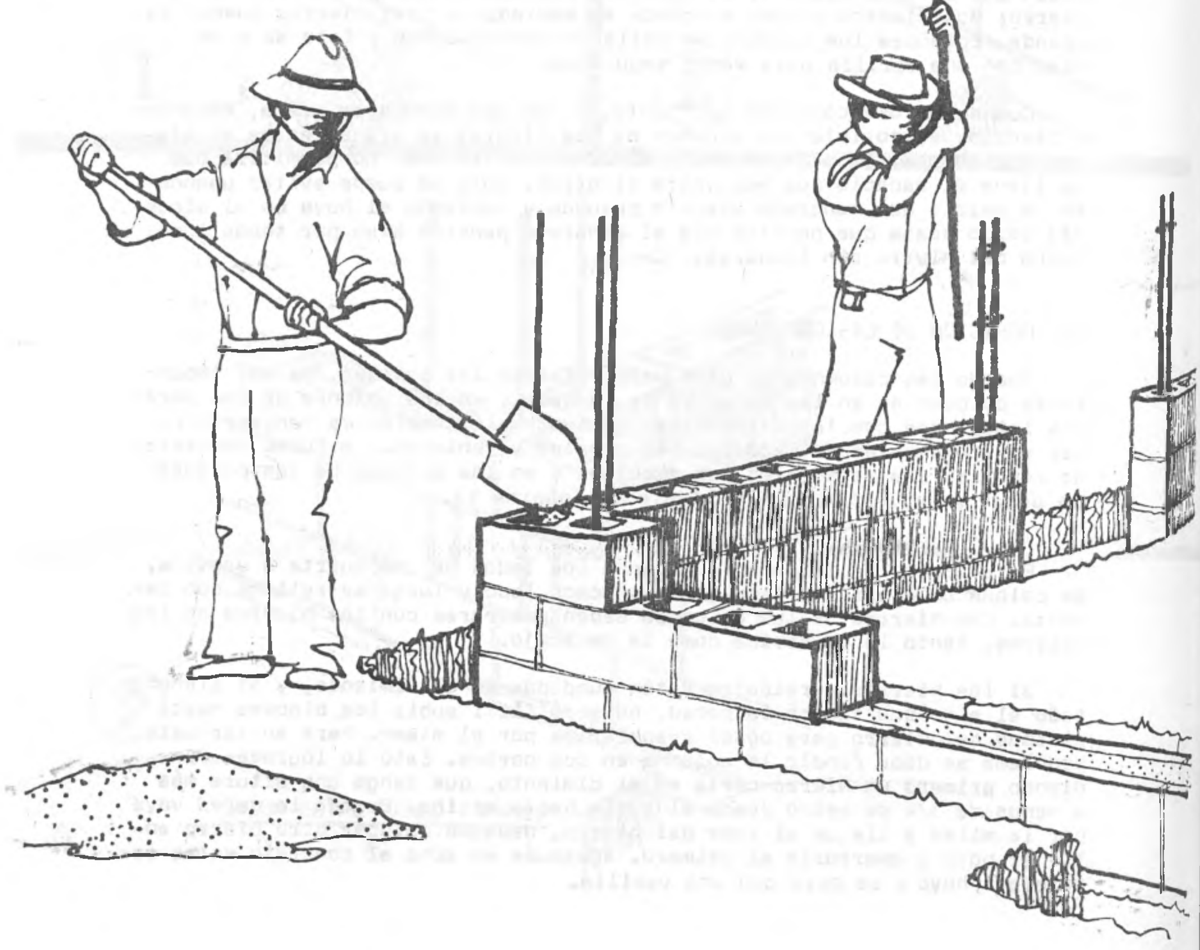
Cuando las columnas se usan para reforzar las paredes, es muy importante colocarlas en las esquinas de la casa y en las uniones de las paredes interiores con las exteriores. En Guatemala también es necesario poner columnas en ambos lados de las puertas y ventanas. La forma correcta de reforzar las paredes en las esquinas y en las uniones de las paredes la podemos ver en la página siguiente (página 5).

Para hacer las columnas que van a los lados de una puerta o ventana, se coloca un hierro verticalmente en cada lado y luego se rellena con cemento. Los hierros de las columnas deben amarrarse con los hierros de las soleras, tanto la de arriba como la de abajo.

Si los hierros verticales están fundidos en el cimiento, y si tienen todo el alto que tendrá la pared, no será fácil subir los blockes hasta el tope del hierro para poder resbalarlos por el mismo. Para evitar este problema se debe fundir la columna en dos partes. Esto lo logramos fundiendo primero un hierro corto en el cimiento, que tenga una altura más o menos de 3/4 de metro desde el suelo hacia arriba. Cuando la pared vaya por la mitad y llegue al tope del hierro, debemos colocar otro hierro entre el hoyo y amarrarlo al primero. Después se echa el concreto entre este mismo hoyo y se puya con una varilla.

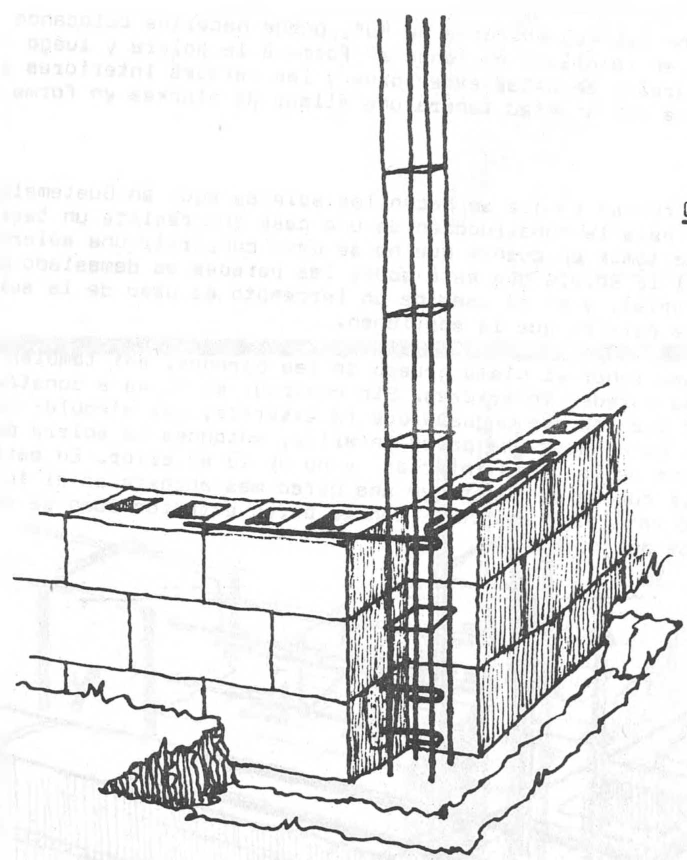


COMO CONSTRUIR LAS ESQUINAS



C) OTRA FORMA DE REFORZAR LAS PAREDES DE BLOCK en las esquinas consiste en fundir una columna reforzada en cada esquina y en las uniones de las paredes interiores con las exteriores. Cuando se usa este método es necesario agregar un par de hierros en forma de "L" entre cada tercer hilada o fundirlo en las soleras. Los hierros pequeños en forma de "L" deben pasar entre los hierros verticales alrededor de los cuales se fundirán las columnas como se muestra en el dibujo de abajo.

D) NO ES ACONSEJABLE FUNDIR LAS COLUMNAS ANTES DE LEVANTAR LAS PAREDES, porque cuando las columnas están paradas solas, se pueden mover hacia adelante o hacia atrás y así se pueden debilitar. Además puede ser difícil que el último block quepa entre la columna y el penúltimo block en cada hilada, y sería dificil echar la mezcla suficiente entre este último block y la columna.



COLUMNA FUNDIDA

V. SOLERAS O ANILLOS DE SEGURIDAD

Es necesario construir una solera en el tope de todas las paredes hechas de block. La solera amarra entre sí a todas las paredes y hace que la construcción sea más rígida. Además la solera ayuda a que el peso del techo no empuje las paredes hacia afuera. Las soleras deben hacerse del mismo ancho de las paredes y colocarse sobre todas las paredes incluyendo las interiores. Deben reforzarse contínuamente y conectarse a las paredes por medio de un amarre con las columnas verticales. En donde se juntan dos paredes, los refuerzos de las columnas y de las soleras que van colocadas sobre las paredes deben ir amarradas entre sí.

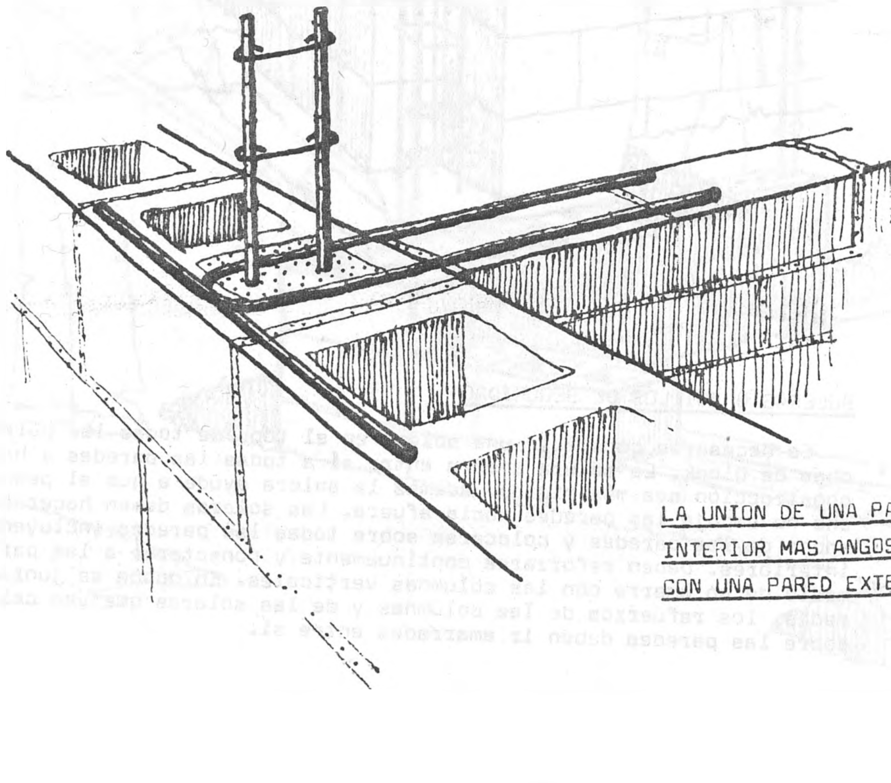
También es muy importante usar soleras al nivel del suelo. A este tipo de solera se le dá el nombre de solera de humedad. Si la construcción es liviana y el suelo es sólido, la solera puede usarse en lugar de una parte o de casi todo el cimiento. Además debe construírse una solera a la mitad de la pared, más o menos a un metro de altura. Si se están construyendo paredes bajas, como se debe construir en una zona propensa a terremotos, esta solera que va en medio de la pared puede servir como el sillón de la ventana. La solera que va arriba de la pared puede formar el tope de la ventana, pero si la pared es más alta de lo debido se tendrá que construir una mocheta de concreto que forme el tope de la ventana.

La mejor forma de hacer una solera consiste en usar blockes de concreto en forma de "U", como lo vemos en la siguiente página (página 8). Con estos blockes se forma la hilada, y las varras de hierro se colocan en el hoyo del block. Luego se funde la solera sin necesidad de unir los blockes con mezcla. En Guatemala, se recomienda usar como mínimo 3 ó 4 hierros en la solera.

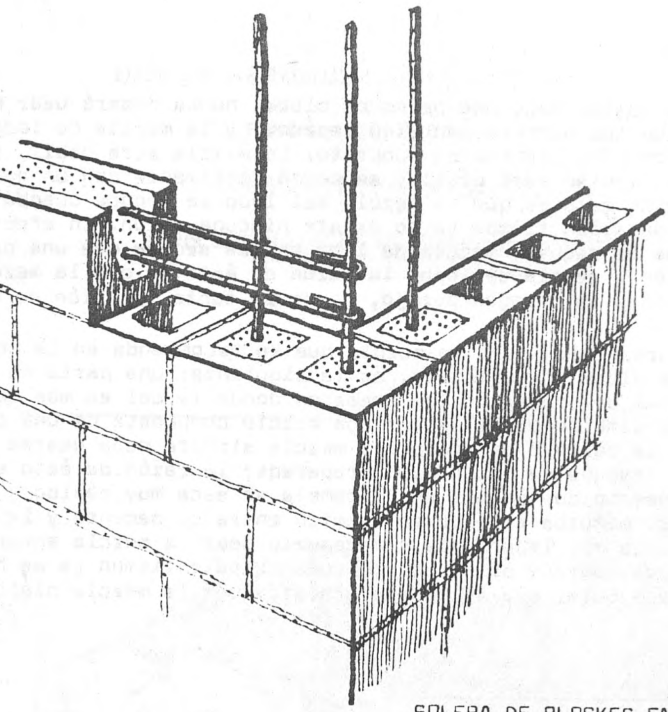
Si usted no tiene blockes en forma de "U", puede hacerlos colocando blockes corrientes en la hilada en donde se formará la solera y luego hay que quitarle las paredes angostas exteriores y las paredes interiores a los blockes. En esta forma usted tendrá una hilada de blockes en forma de "U".

En general, las formas en que se hacen las soleras aquí en Guatemala son satisfactorias para la construcción de una casa que resista un terremoto. Es importante tomar en cuenta que no se debe construir una solera muy grande, pues si la solera que está sobre las paredes es demasiado pesada puede debilitarlas, y en el caso de un terremoto el peso de la solera podría aplastar las paredes que la sostienen.

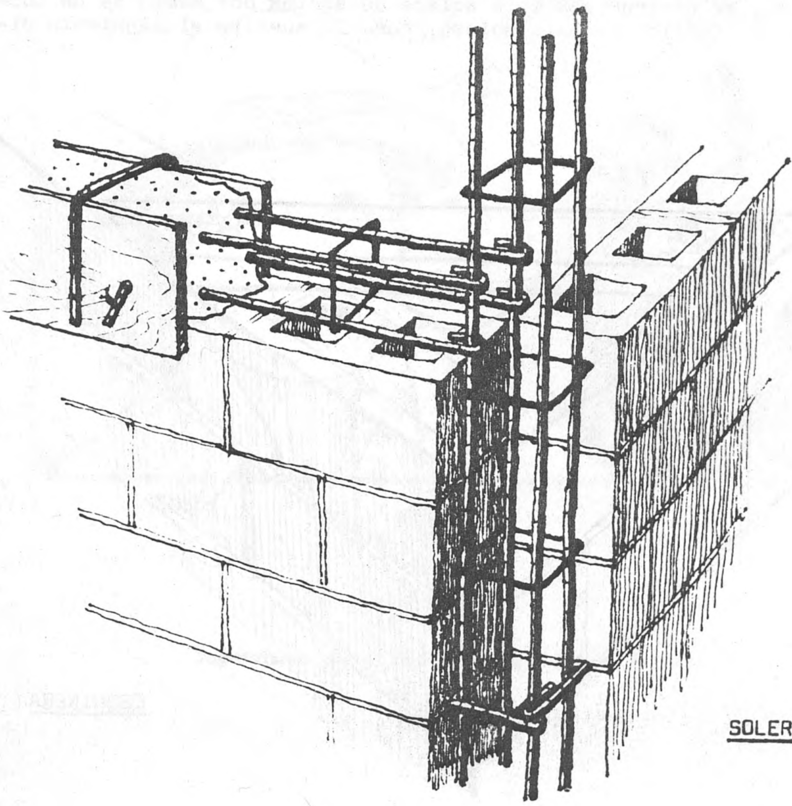
Las soleras deben tener el mismo grueso de las paredes, así también el mismo grueso de las paredes interiores. Sin embargo, si se va a construir una pared interior que sea más angosta que la exterior, por ejemplo: cuando se usa ladrillo para hacer una pared interior, entonces la solera debe tener el mismo ancho de la pared interior y no de la exterior. En este caso, es importante cuando se construye una pared más angosta en el interior, que la pared esté bien amarrada con la pared exterior como se muestra en el dibujo de abajo.



LA UNION DE UNA PARED INTERIOR MAS ANGOSTA CON UNA PARED EXTERIOR



SOLERA DE BLOCKES EN FORMA DE "U"



SOLERA FUNDIDA

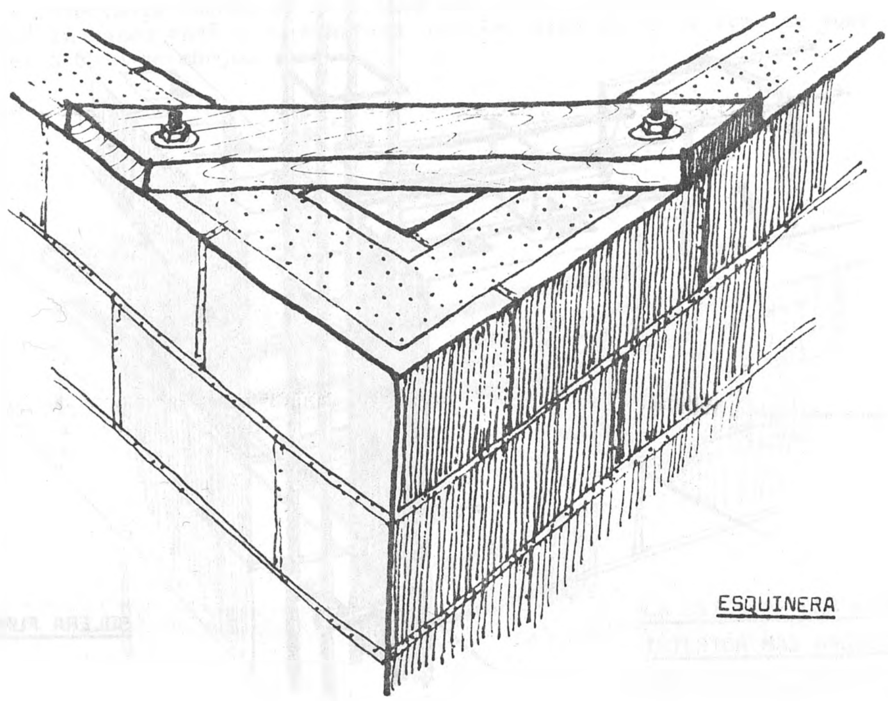
VI LA MEZCLA

Cuando usted haga una pared de block, nunca deberá usar mezcla de lodo, porque los blockes son algo pesados, y la mezcla de lodo no se junta bien con los blockes de concreto. La mezcla será débil, por lo tanto la pared también será débil y se caerá fácilmente con un suave temblor. La razón de ésto es que la mezcla del lodo se encoge cuando se seca, y después de algún tiempo ya no existe ninguna unión. En efecto, una pared hecha de adobe y mezcla de lodo es más segura que una pared hecha de blockes y mezcla de lodo; la razón de ésto es que la mezcla de lodo y los adobes se encogen parejo, y por lo tanto la unión es mejor.

La proporción para la mezcla que se recomienda en la construcción de casas de block en Guatemala, es la siguiente: una parte de cemento, y 5 ó 6 partes de arena. En las áreas en donde la cal es más barata que el cemento, también puede usarse una mezcla compuesta de una parte de cemento, una de cal y 8 de arena. La mezcla siempre debe usarse dentro de 20 minutos después de haber sido preparada; la razón de ésto es que la clase de cemento que se usa en Guatemala se seca muy rápido y si se deja más de 20 minutos el proceso químico entre el cemento y la arena ya ha ocurrido. Es muy importante y necesario usar la mezcla antes de que pasen 20 minutos, porque si no se usa durante este tiempo ya se ha terminado el proceso químico y si la movemos otra vez la mezcla pierde su fuerza.

VII USO DE REFUERZOS DIAGONALES

Cuando se usan blockes con hoyos, o sea cuando las esquinas se forman encadenando los blockes, es muy importante usar refuerzos diagonales en las esquinas de las paredes y en donde las paredes interiores se juntan con las paredes exteriores. Estos refuerzos se pueden hacer de madera y se amarran sobre la solera de arriba por medio de un tornillo grande fundido en esta solera, como lo muestra el siguiente dibujo.



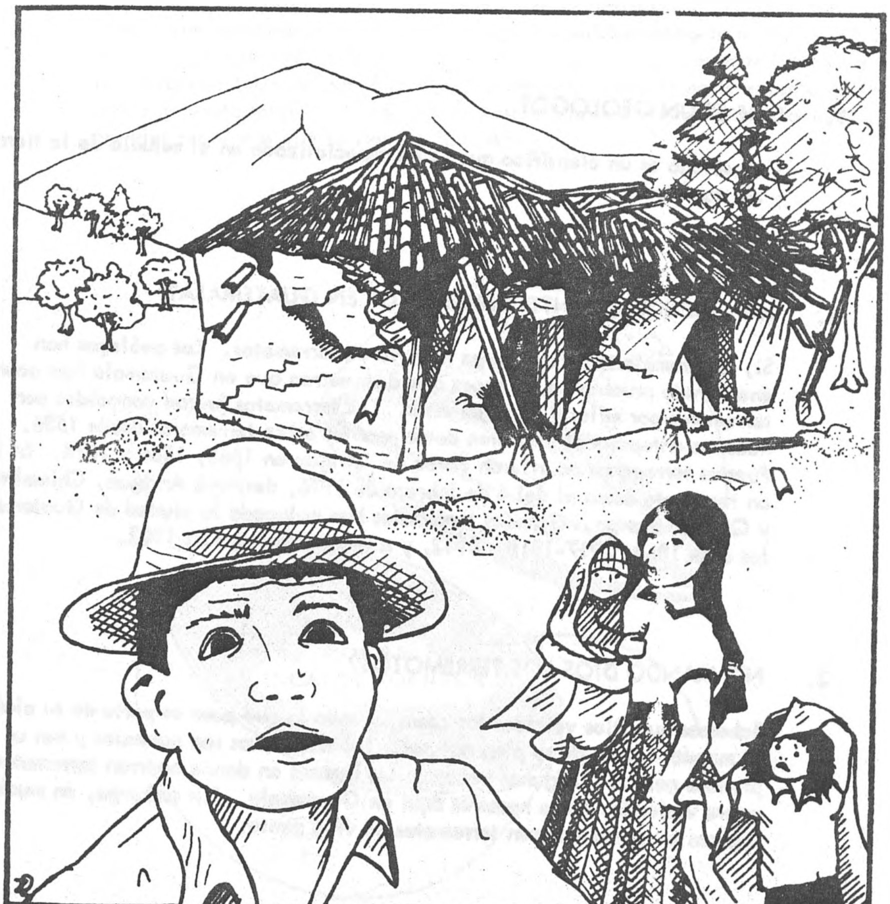
ESQUINERA

LISTA DE LAS PREGUNTAS MAS COMUNES

QUE HAN HECHO SOBRE

LO QUE SON LOS TERREMOTOS

CON SUS RESPECTIVAS RESPUESTAS



PORQUE?

Supervisado por el Dr. Loren Raymond, Geólogo

INTRODUCCION

Después del terremoto del 4 de febrero de 1976, las personas afectadas por el mismo tenían muchas preguntas sobre lo que son los terremotos. Las preguntas que presentamos a continuación fueron hechas por la gente que asistió a las clases sobre las causas y efectos de los terremotos que dieron nuestros extensionistas.

1. QUE ES UN GEOLOGO?

   Un geólogo es un científico que se ha especializado en el estudio de la tierra y sus cambios.

2. HAN OCURRIDO ANTES TERREMOTOS EN GUATEMALA?

   Si, Guatemala tiene una larga historia de terremotos. Los geólogos han encontrado pruebas en las rocas que demuestran que en Guatemala han ocurrido terremotos por miles y miles de años. Los terremotos fueron conocidos por nuestros antepasados y existen datos escritos sobre terremotos desde 1526. Fuertes terremotos ocurrieron cerca de Antigua en 1565, 1586 y 1874. En 1773, un terremoto como el del 4 de febrero de 1976, destruyó Antigua, Chimaltenango y Quezaltenango. Grandes terremotos han golpeado la ciudad de Guatemala en los años 1863, 1917-1918 y 1942, y a Quezaltenango en 1902.

3. NO MANDO DIOS LOS TERREMOTOS?

   Sabemos que Dios ve todas las cosas, y ~~todo lo que pasa es parte de su plan para~~ el mundo - parte de su plan natural. Los terremotos son normales y son un proceso natural. Algunas veces en los lugares en donde ocurren terremotos hay gente viviendo, como nosotros aquí en Guatemala. Sin embargo, en muchos lugares en donde ocurren terremotos no vive gente.

4. NO PODRIA SER QUE ALGUNA BOMBA DE LOS GRINGOS CAUSARA LOS TERREMOTOS?

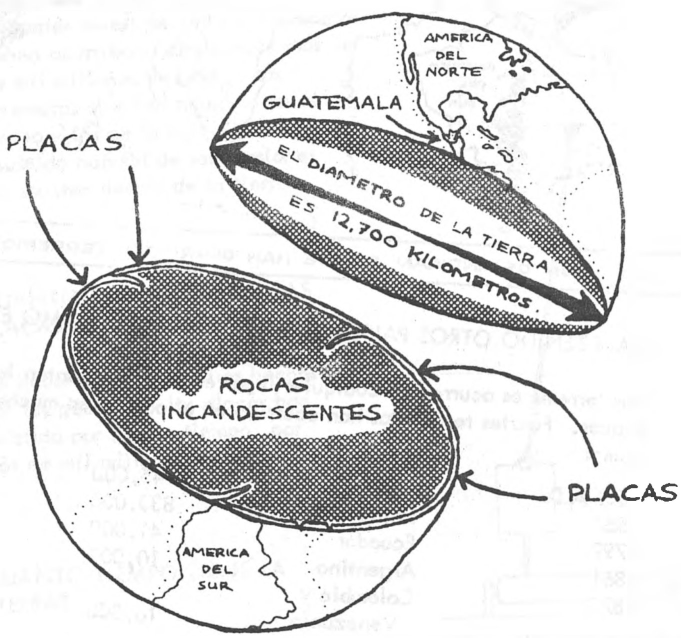
   Los terremotos se conocen desde tiempos muy remotos - son cosas naturales. Aunque, frecuentemente hay una relación entre las acciones de las personas y los procesos naturales, los geólogos no tienen ninguna prueba que nos demuestre que los terremotos son provocados por bombas. Hubo un caso donde explotó una bomba cerca de una falla muy grande, esto fue en las Islas de Aleutian en Alaska, pero no le siguió ningún terremoto.

5. EXISTE FUEGO EN EL CENTRO DE LA TIERRA?

En el centro de la tierra no hay llamaradas, como esas que vemos cuando prendemos fuego. Sin embargo, existe un gran calor y mucha presión, suficientes para derretir la parte de afuera del centro de la tierra. Las temperaturas se calculan que son más de cinco mil grados centígrados. Para dar un ejemplo de la presión que existe en el centro de la tierra, imaginémonos cuál sería el peso que habría hasta abajo si colocamos piedra sobre piedra, piedra sobre piedra, hasta llegar a una altura de 6,350 kilómetros!

6. COMO ES LA TIERRA POR DENTRO?

La tierra es una gran esfera. El diámetro de la tierra es de 12,700 kilómetros. Si nosotros pudieramos cortar la tierra en dos pedazos como lo hacemos con una naranja, la tierra se vería como en el siguiente dibujo. La parte interior de la tierra está formada por rocas incandescentes. Toda la parte externa de la tierra que está bajo la superficie, en donde nosotros vivimos, está formada por grandes secciones que se llaman PLACAS.



7. QUE PROFUNDIDAD TIENEN LAS PLACAS?

Las placas comienzan en la superficie de la tierra, o sea en donde nosotros estamos, y tienen unos 100 kilómetros de profundidad.

8. COMO SABEN LOS CIENTIFICOS QUE EXISTEN LAS PLACAS?

Los geólogos que se especializan en el estudio de los terremotos se llaman SISMOLOGOS. Los sismólogos usan instrumentos que se han colocado en muchas ciudades y países del mundo para localizar la posición exacta en donde ha ocurrido un terremoto. Usando un aparato que sirve para localizar las direcciones de donde vienen las ondas de un terremoto, y el tiempo que se tardan estas ondas para llegar a diferentes ciudades, los sismólogos pueden localizar la posición exacta en donde han ocurrido terremotos. Los estudios de esta clase que se han hecho durante muchos años, han demostrado que los terremotos solamente ocurren en ciertas zonas del mundo, y revelan cuáles son los bordes de las placas. El siguiente mapa del mundo nos muestra en donde están localizados los bordes de las placas.

LOS PUNTOS INDICAN DONDE HAN OCURRIDO TERREMOTOS

9. HAN TENIDO OTROS PAISES ALGUN TERREMOTO COMO EL DEL 4 DE FEBRERO?

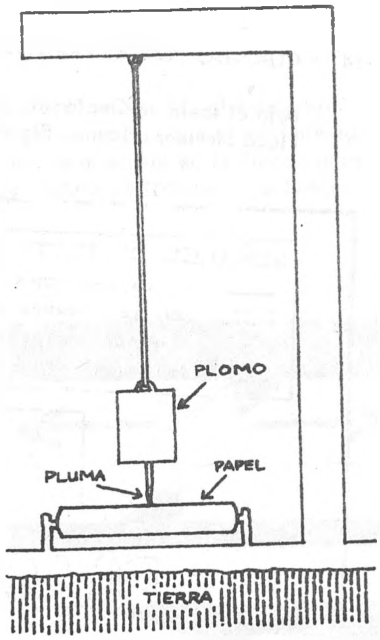
Los terremotos ocurren en cualquier lugar en donde se juntan los bordes de dos placas. Fuertes terremotos han ocurrido en el pasado en muchos lugares, tales como:

586 A.D.	Grecia	45,000	muertos
1556	China	830,000	"
1797	Ecuador	41,000	"
1861	Argentina	10,000	"
1875	Colombia y Venezuela	16,000	"
1906	San Francisco, California	650	"
1907	Jamaica	1,400	"
1939	Chile	10,000	"
1944	Argentina	10,000	"
1949	Ecuador	12,000	"
1951	El Salvador	400	"
1960	Perú	140	"
1970	Perú	50,000	"
1972	Nicaragua	10,000	"

En 1976 mucha gente en Guatemala, Italia, Filipinas, China y Turquia murieron a causa de fuertes terremotos. El de China fue el más fuerte y mató a más de 100,000 personas.

10. QUE CLASE DE INSTRUMENTOS USAN LOS SISMOLOGOS?

Uno de los instrumentos que usan los sismólogos se llama SISMOGRAFO. Este sismógrafo tiene un plomo pesado suspendido sobre un papel que está colocado sobre el suelo. Cuando las ondas de los terremotos mueven el suelo, el plomo pesado se queda sin movimiento a causa de su peso y una pluma que está conectada a este plomo pesado marca en el papel el movimiento del suelo.



11. CUANDO OCURRIO EL PRIMER TERREMOTO?

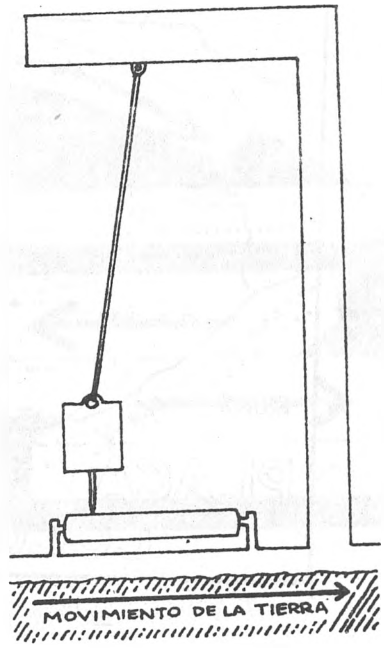
No sabemos cuando empezaron los terremotos, pero los geólogos han encontrado pruebas en las rocas, las cuales muestran que los terremotos vienen ocurriendo desde hace más de dos mil millones de años. Los terremotos que han ocurrido en el pasado y los de la actualidad son un resultado natural de las presiones que existen dentro de la tierra.

12. CUANTO TIEMPO TIENEN LAS PLACAS?

De acuerdo a los estudios hechos por los geólogos, las placas han existido por mucho tiempo, por más de mil millones de años.

13. CUANTO TIEMPO TIENE LA TIERRA?

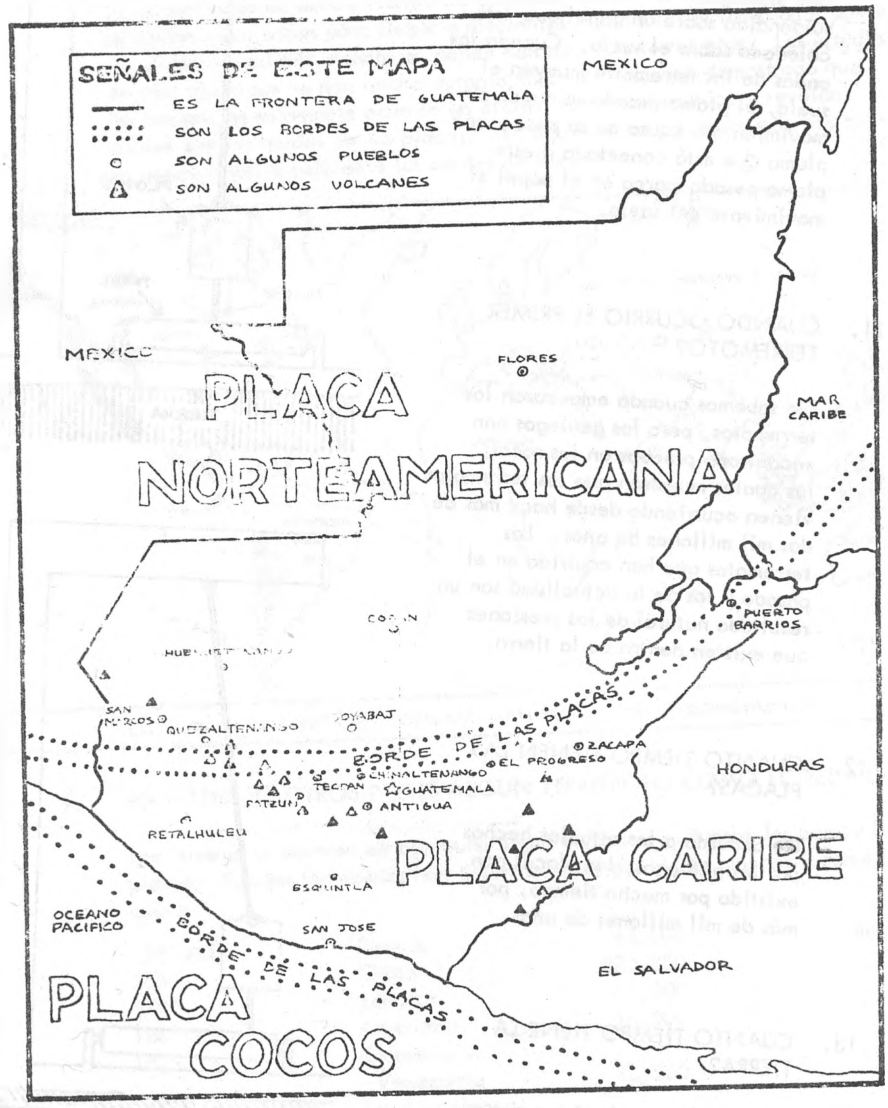
Se calcula que la tierra tiene cuatro mil seiscientos millones de años.



Dibujo que nos muestra la forma en que trabaja un SISMOGRAFO cuando tenemos un movimiento en la tierra.

14. CUANTAS PLACAS EXISTEN BAJO EL SUELO DE GUATEMALA?

Bajo el suelo de Guatemala se juntan tres placas. Estas placas se llaman: Placa Norteamericana, Placa Cocos y Placa Caribe.



15. CUAL FUE LA PLACA QUE CAUSO EL TERREMOTO DEL 4 DE FEBRERO?

Después del terremoto, vinieron a Guatemala muchos científicos para estudiar los efectos que causó el mismo. Estos científicos llegaron a la conclusión de que el movimiento que se produjo en los bordes de la Placa Norteamericana y Placa Caribe causó el terremoto. La Placa Norteamericana se movió más o menos un metro hacia el oeste y pasó rozando a la Placa Caribe.

16. COMO AFECTO EL TERREMOTO A LA PLACA COCOS?

Los geólogos no están seguros de los efectos que el terremoto del 4 de febrero haya causado en la Placa Cocos. Sin embargo, es posible que el movimiento de la Placa Norteamericana haya causado nuevas presiones en la Placa Cocos, haciendo que ocurran con mayor probabilidad futuros terremotos en el borde de esta placa.

17. EN QUE FORMA SE MUEVEN LAS PLACAS?

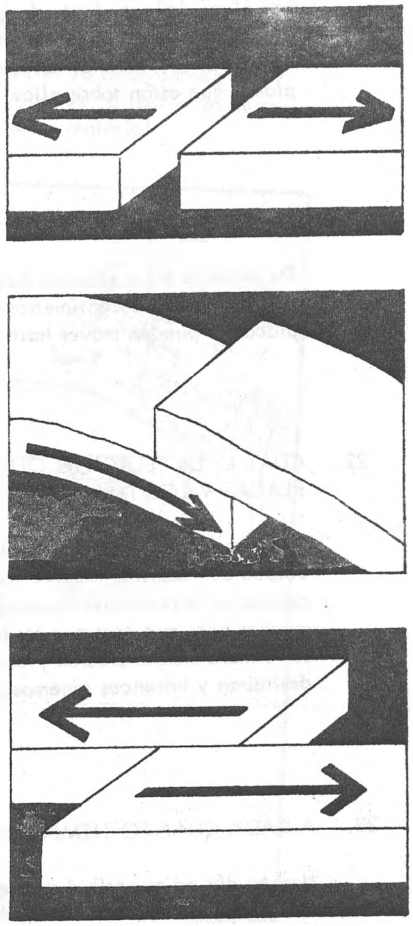
Las placas se mueven en tres formas:

1) Las placas se mueven separándose, causando terremotos y formando volcanes.

2) Las placas se mueven encontrándose y tratando de pasarse una sobre la otra. Cuando pasa ésto, ocurren terremotos y hay erupciones de volcanes. Los volcanes de Guatemala se han formado porque la Placa Cocos que está en la costa sur del Océano Pacífico está caminando hacia la Placa Caribe.

3) Las placas se rozan al tratar de pasarse en direcciones opuestas y cuando ocurre ésto hay terremotos sin acción volcánica. El terremoto del 4 de febrero ocurrió en esta forma.

El dibujo de esta página muestra los tres diferentes movimientos de las placas que ya mencionamos.



18. DE QUE ESTAN HECHAS LAS PLACAS?

Las placas están formadas por diferentes clases de rocas. En la parte de abajo de las placas se encuentran rocas pesadas y en la parte de arriba rocas menos pesadas.

19. QUIEN HACE QUE SE MUEVAN LAS PLACAS?

Las placas se mueven como resultado de un proceso natural en la tierra. Dios estableció estos procesos naturales.

20. QUE ES LO QUE HACE QUE SE MUEVAN LAS PLACAS?

La mayoría de los geólogos creen que el movimiento de las placas es provocado por el movimiento lento de la capa de rocas incandescentes que está bajo las placas. Estos movimientos los causa el calentamiento que existe en el interior de la tierra, y cuando estas rocas se mueven, también hace que se muevan las placas que están sobre ellas.

21. A QUE DISTANCIA SE MUEVEN LAS PLACAS?

De acuerdo a los estudios hechos por los geólogos, las placas generalmente se mueven de 2 a 6 centímetros por año. Sin embargo, durante un terremoto las placas se pueden mover hasta 6 ó 7 metros.

22. CUAL ES LA RELACION QUE EXISTE ENTRE EL MOVIMIENTO DE LAS PLACAS Y LOS TERREMOTOS?

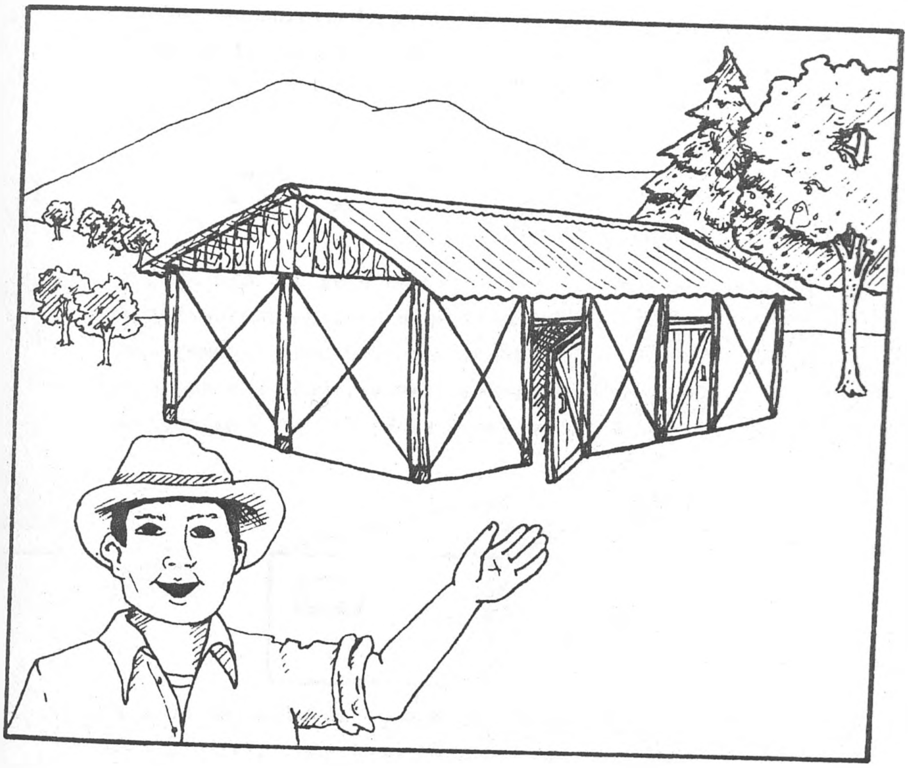
La mayoría de las placas siempre están en movimiento, aunque se muevan muy despacio. Ocasionalmente los bordes de las placas se traban cuando tratan de pasarse en direcciones opuestas. Si el resto de las placas ha caminado por muchos años mientras que los bordes se han quedado trabados y sin movimiento, se formará mucha presión y cuando esta presión es demasiada los bordes se destraban y entonces tenemos un fuerte temblor o terremoto.

23. A CADA CUANTO TIEMPO OCURREN LOS TERREMOTOS?

Hoy en día no es posible determinar la fecha y el lugar exactos donde va a ocurrir un terremoto. Ahora, los científicos están tratando de encontrar la manera para poder determinar con exactitud la fecha y el lugar en donde ocurrirán los terremotos, pero no han tenido mucho éxito. Cada año ocurren cientos de pequeños terremotos en el mundo. Además, cada año hay más o menos 14 fuertes terremotos, como el del 4 de febrero que asotó Guatemala. Aqui en Guatemala ocurren fuertes temblores cada año. A cada 20 ó 40 años tenemos fuertes terremotos, pero algunas veces han habido terremotos con diferencia de 3 años, por esta razón le recomendamos que construya su casa de acuerdo a las técnicas de construcción antisísmica.

24. COMO DETERMINAN LOS CIENTIFICOS QUE VAN A OCURRIR TERREMOTOS?

Los científicos todavía no pueden determinar con anticipación el lugar ni la fecha en donde va a ocurrir un terremoto, pero ya han descubierto muchas señales que indican la posibilidad de que va a ocurrir alguno en cierto lugar. Por ejemplo, cuando un topógrafo encuentra que grandes partes del suelo se han abultado, ésto significa a veces que puede haber un terremoto. También, haciendo exámenes químicos en el agua de los pozos, los resultados de estos exámenes muestran que algunas veces el agua cambia un poco antes de que ocurra un terremoto. Estas y otras señales están siendo investigadas por los geólogos, aunque no tienen pruebas exactas todavía. Mientras tanto, los ingenieros y albañiles han descubierto técnicas positivas sobre construcción antisísmica, las cuales ya están siendo aplicadas. Al construir su casa, usted también puede aplicar estas mismas técnicas de construcción, usando cualquier tipo de material.



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Oficina de Educación sobre Reconstrucción
Marzo, 1977

INSPECCION Y REPARACION DE CASAS DAÑADAS

(Minutas de la plática con el Ingeniero Federico Guny).

Al hablar de la reparacion de casas, tendrá que inspeccionar la casa que se va a reparar una persona que sepa cuales son las cosas principales que afectan la seguridad de la casa.

A. DAÑO A LAS PAREDES:

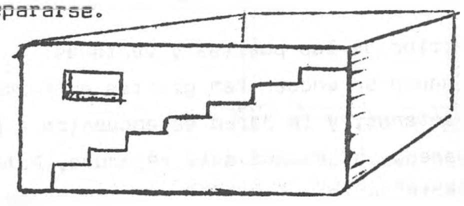
Para hacer la reparación de una casa, se tendrá que buscar en las paredes dos cosas muy importantes:

- RAJADURAS
- EL PLOMO DE LAS PAREDES

TIPOS DE GRIETAS O RAJADURAS

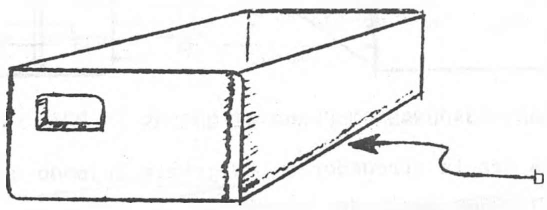
1. Aunque nos sorprenda, la rajadura de la pared en forma de gradas es la menos peligrosa, y puede repararse.

RAJADURA EN FORMA DE GRADAS:



2. La rajadura que se encuentra verticalmente a la par de una esquina, es peligrosa porque ésta significa que la pared vecina probablemente se ha desplomado. Tendremos que inspeccionar las dos paredes para ver si se encuentran a plomo, y hay que ver la pared vecina en la parte de abajo por dentro y por fuera para ver si tiene una rajadura horizontal.

RAJADURA VERTICAL

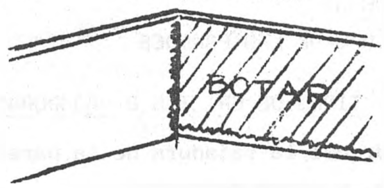


3. La peor rajadura es la que se encuentra en forma horizontal, porque ésta significa que toda la pared que está arriba de la grieta está suelta y se tendrá que quitar. Por ejemplo: si la rajadura se encuentra en la parte de abajo de la pared casi pegada al piso, habrá que botar la pared entera; si se encuentra la rajadura a la mitad, la pared puede reforzarse en las esquinas, solamente quitando la que está arriba de la grieta.

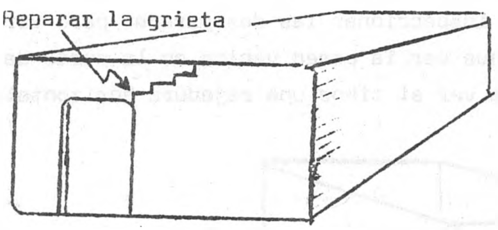
RAJADURA HORIZONTAL

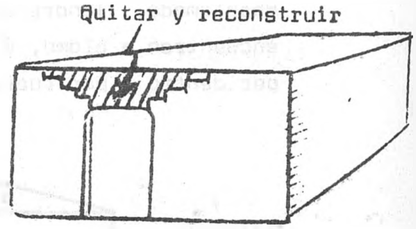
B. EN DONDE HAY QUE BUSCAR GRIETAS:

1. En las esquinas:
Cuando una rajadura se encuentra exactamente en la esquina, o se ven separadas las dos paredes, hay que averiguar cual de las dos no está a plomo. Con el movimiento de la tierra las paredes han chocado y se han separado, y aunque no se note después en la pared eso es lo que ha sucedido. Se tendrá que bajar la pared que no está a plomo. La pared que tenga además de la rajadura en la esquina, una grieta en la parte de abajo es inservible y se tendrá que botar.



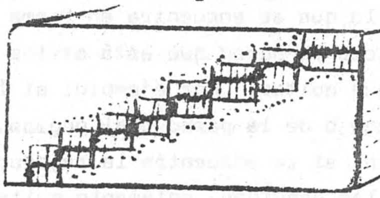
2. Arriba de las puertas y ventanas:
Cuando se encuentran grietas en forma de gradas arriba de las puertas y ventanas, y la pared se encuentra a plomo, entonces se puede reparar la pared. Si es una sola rajadura, ésta se puede reparar sin botar ninguna parte de la pared. Si son dos rajaduras en forma de gradas, habrá que quitar la parte de la pared que está entre las grietas y volverla a construir.





C. COMO REPARAR LAS RAJADURAS EN FORMA DE GRADAS:

1. Se quita la mezcla alrededor de la grieta dejando a la vista un adobe arriba y un adobe abajo de la grieta.



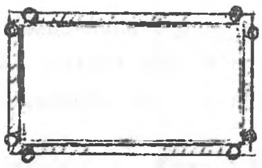
2. Se quitan los adobes enteros con machete.
3. Si los adobes se encuentran en buena condición, se ponen de nuevo con lodo o mezcla, pero si están dañados hay que usar nuevos.
4. Siempre cuando se trata de una reparación, hay que usar material del mismo tipo, especialmente que el adobe sea del mismo tamaño y material.

D. REFUERZO DE LA CASA ENTERA

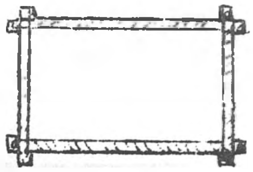
Las cosas principales para reforzar una casa de adobe y hacerla más segura, son las siguientes:

1. Que sea el techo más liviano
2. Bajar la altura de las paredes a 2.25 metros como máximo
3. Quitar el mojinete si es pesado
4. Poner solera y amarrarla a la pared

Cuando se hace una casa nueva se deja espacio para los postes o las columnas, pero en el caso de una casa ya existente es preferible no abrir un bocado en la pared vieja, porque eso solamente la hace más débil. En este caso la casa se puede reforzar únicamente por medio de postes pegados a las paredes desde afuera, asegurando la solera encima de los postes. Hay dos maneras de hacer eso:

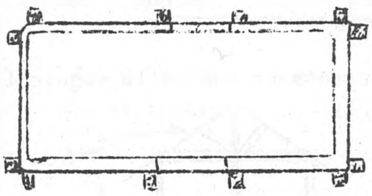


a. La solera colocada sobre los postes, pero afuera de las paredes.



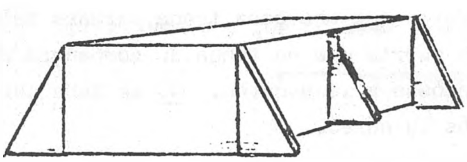
b. La solera colocada sobre los postes y sobre las paredes.

En las áreas rurales donde las casas están más separadas se puede utilizar BASTIONES en vez de postes, colocándolos en la siguiente forma:

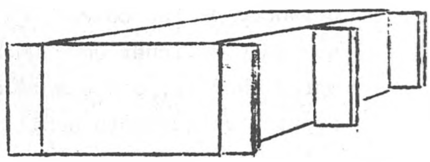


La solera se sienta sobre los bastiones y se coloca una hilada más de adobes encima.

Los bastiones pueden hacerse de dos formas: en forma triangular o en forma vertical.

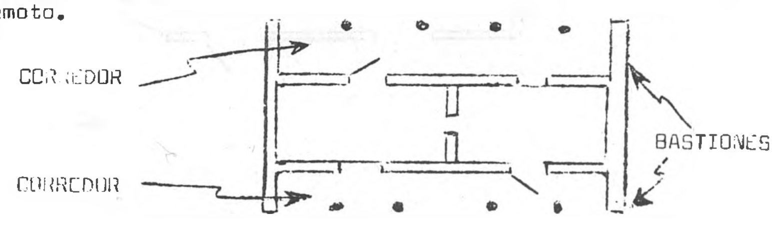


BASTION EN FORMA TRIANGULAR O INCLINADA



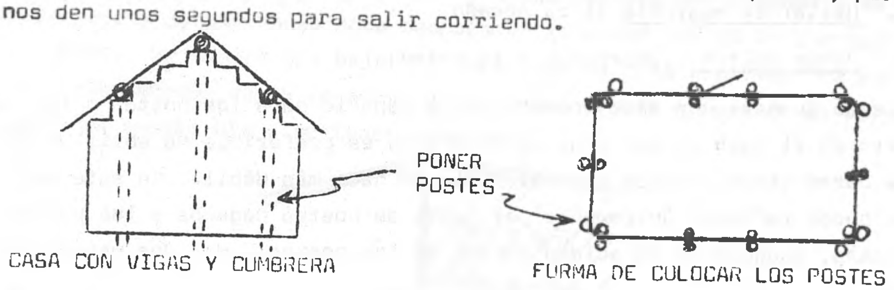
BASTION EN FORMA VERTICAL

La forma inclinada da más fuerza. El bastión en estilo vertical hemos visto en ciertas casas que tienen un corredor a cada lado y muchas de ellas resis - tieron el terremoto.

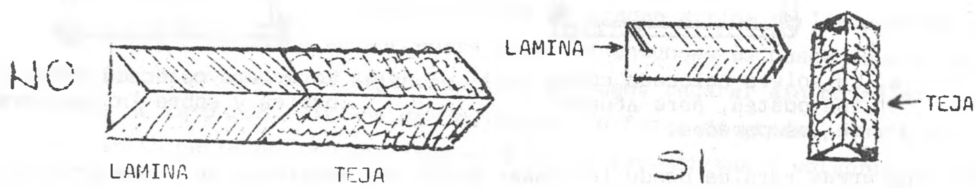


E. ALGUNOS PROBLEMAS COMUNES

1. Las casas que no tienen tijeras para sostener el techo, sino que usan vigas y una cumbrera las cuales descansan sobre mojinetes de adobe: esta forma de construir es muy peligrosa, y de preferencia debe quitarse y techarse por medio de tijeras. Si no es posible cambiar la forma del techo, por lo menos se deben reforzar las paredes adentro y afuera con postes, para que nos den unos segundos para salir corriendo.

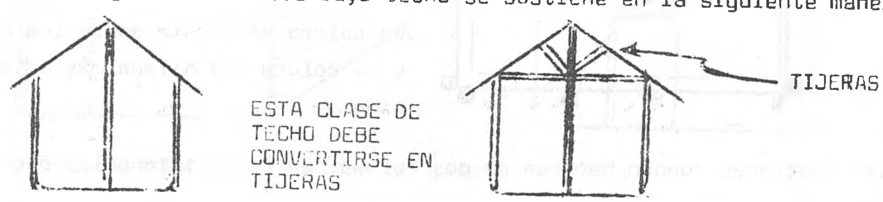


2. Nunca deben usarse dos clases de techos en una sola casa. Por ejemplo, no se debe techar un cuarto con teja y el otro con lámina. Es preferible esperar hasta que se pueda techar de una vez con lámina.

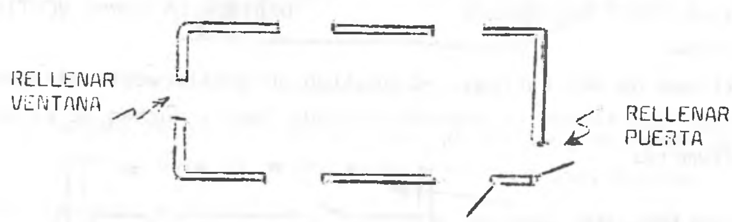


Si la casa tiene dos partes separadas, entonces se puede techar con dos tipos diferentes de techos.

3. No tiene seguridad la casa cuyo techo se sostiene en la siguiente manera:



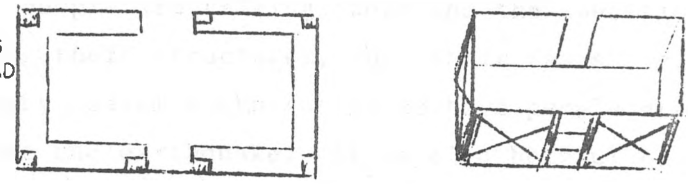
4. Balanceo de las casas: Para lograr que una casa tenga paredes balanceadas, se puede rellenar una ventana o puerta que no tenga su compañera en la pared opuesta, o que esté muy pegada a la esquina. NO se debe cortar nuevas puertas porque esto debilita más la pared.



F. COMO REFORZAR LAS CASAS CON PAREDES MUY GRUESAS:

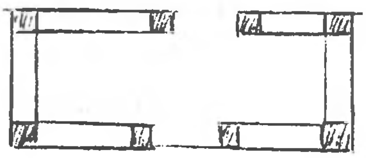
Siempre hay que tomar en cuenta que al hacerse un corte o un bocado a la pared, ésta se debilita. Por lo tanto, si la casa únicamente tiene rajada una esquina, se abren bocados solamente a la mitad del grueso de la pared para poder colocar los postes o columnas. En este caso, los refuerzos en "x" tendrán que colocarse desde afuera, asegurándolos a los postes o columnas.

ABRIR BOCADOS HASTA LA MITAD DEL GRUESO DE LA PARED

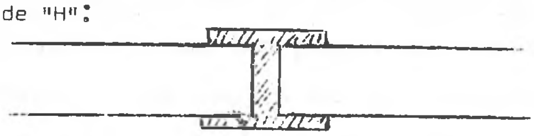


LOS REFUERZOS COLOCADOS DESDE AFUERA

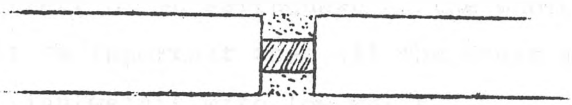
Si se trata de una casa que tiene dañada más de una esquina, o que tiene paredes desplomadas, entonces es necesario abrirles bocados que pasen el grueso de la pared.



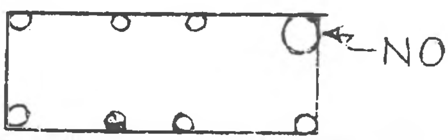
Hay varias formas de construir los parales. La mejor manera es por medio de tablas en forma de "H":



También se puede hacer el paral colocando un poste en el bocado de manera que tope con las dos secciones de la pared, y después rellenar con mezcla:



Para la construcción o reparación de casas, siempre se deben usar postes que sean del mismo tamaño y que no sean exagerados.



NOTA:
No se puede hacer reparaciones a las casas de bajareque, sino solamente a las de adobe, block, etcétera.

(English translation)

COURSE OUTLINE FOR INSTRUCTORS

I. A Discussion of What is Happening in Your Area:

It is extremely important that, before you begin your class, you conduct a discussion of problems that people are having in the area. It is important to find out what the people are talking about and the specific problems they are having in building their structures, what their fears are, and what materials they are using. A very useful technique is to have people draw their structures as they existed before the earthquake. It is also helpful to have them draw their site. Once the drawings are completed, review them with the people and discuss some of the more obvious problems, such as where the walls are not balanced properly due to too many doors or windows on one side or the other. Point out problems such as the L-shaped house; and discuss such other things which show up as improper siting on the side of a hill and the proximity of other structures.

II. A Discussion of What Happens and the Effects of An Earthquake:

It is important, in order that the people understand why it is necessary to properly brace their houses, that they know what happens in an earthquake, how the earth moves, and the effects of shock waves on a structure.

A. Explain the effect of an earthquake on a wall.

B. Explain the effect of an earthquake on the whole house.

C. Explain why it is important that all the house move together and that the house be lightweight with low walls.

III. How to Build:

A. Exterior walls

1. Low walls
2. Light walls
3. Balanced walls (balancing doors and windows)
4. Strong corner posts
5. Cross-bracing
6. Minimum distances (minimum distance between corners and the door or window; minimum distance between windows and doors; minimum distance between windows and other windows)

B. Interior Walls

1. Posts where interior walls are attached to exterior walls
2. Cross-bracing
3. Location of the door (in the middle)

C. Tying the House Together

1. The importance of the ring beam and how to construct it
2. Bracing in the corner (the diagonal cross-brace)
3. Bracing the interior walls (the use of the diagonal brace for interior walls)

IV. <u>Siting</u>:

It is important to explain that having a strong house does no good whatsoe unless the house is properly sited; and that the siting of the house, especiall in relation to other structures and to exterior walls that separate houses, is important as having a good strong house.

A. Location of a house on hills or mountains
B. Separation of houses and minimum distances in rural areas
C. Separation of houses and minimum distances in towns

V. <u>Safety</u>:

A. Doors (stress that doors must open outwards)
B. Windows (stress that windows must open outwards also)
C. Cornices (stress the danger of cornices falling once people have evacuated the structure)

(English translation)

Course Outline: BAJAREQUE WALLS

I. Posts

A. Size
B. Spacing and balance
C. Treatment

II. X-braces

A. Wood
B. Wire

III. Horizontal Poles

A. Wood
B. Bamboo

IV. Building Sequence

A. Foundation
B. Posts and braces
C. Poles
D. Stucco
E. Mud
   1. Mixture
   2. Packing

V. Doors and Windows

A. Columns
B. Lintels
C. Sills

VI. Tying Walls Together

A. Ring beam
B. Diagonal braces

(English translation)

Course Outline: Half-and-Half Adobe

I. Posts

   A. Size
   B. Spacing and balance
   C. Treatment
   D. Use of cement columns

II. X-braces

   A. Wood
   B. Wire

III. Building Sequence

   A. Foundations
   B. Posts
   C. Wire
   D. Mortar
   E. Seating and ring beams
   F. Stucco
   G. Base

IV. Doors and Windows

   A. Columns
   B. Lintels and sills

V. Tying It All Together

   A. Upper ring beam
   B. Diagonals

(English translation)

Course Outline: ADOBE DE CANTO

I. Posts
   A. Size
   B. Spacing and balance
   C. Treatment
   D. Use of cement columns

II. X-braces
   A. Wood
   B. Wire

III. Building Sequence
   A. Foundation
   B. Posts and braces
   C. Wire
   D. Mortar
   E. Seating and ring beams
   F. Stucco
   G. Base

IV. Doors and Windows
   A. Columns
   B. Lintels and sills

V. Tying It All Together
   A. Upper ring beam
   B. Diagonal braces

(English translation)

Course Outline: BLOCK WALLS

I. Types of Blocks

   A. Large blocks
   B. "Urbano" blocks
   C. Special blocks
      1. "U" blocks
      2. Corner blocks with holes
      3. "T" blocks

II. Columns

   A. Interior columns (inside the block)
   B. Poured columns
      1. With iron rebars
      2. With iron pipe
   C. Formed columns
   D. Spacing and balance

III. Foundations

IV. Ring Beams

   A. Making beams of iron
   B. Making beams of wire
   C. Making beams of wood
   D. Mix of sand and cement
   E. Location of beams

V. Erecting the Wall

   A. Mortar
   B. Doors and windows
      1. Columns
      2. Lintels and sills
   C. Corners

(English translation)

Course Outline: BRICK WALLS

I. Advantages of Brick

A. Lightweight
B. Strong
C. Pretty
D. Good insulation

II. Types of Bricks

A. Solid
B. Holes

III. Columns

A. Wood columns
B. Poured concrete columns
C. Spacing and balance

IV. Foundations

V. Ring Beams

A. Iron reinforced ring beams
B. Wire reinforced ring beams
C. Masonry joiners
D. Mixing of sand and cement
E. Location of beams

VI. Erecting the Wall

A. Mortar
B. Doors and windows
    1. Columns
    2. Lintels and sills
C. Corners

(English translati

Course Outline: HOW TO READ TECHNICAL DRAWINGS AND PLANS

I. Why We Use Drawings

II. Types of Drawings

- A. Plans
- B. Perspectives
- C. Elevations
- D. Sections
- E. Cross sections
- F. Details

III. What Drawings Show

- A. Completed structure
- B. Parts of the structure
- C. Construction sequence

IV. Parts of a Drawings

- A. Data box
  1. Title of project
  2. Title of drawing
  3. Scale and types of scales
  4. Date of drawing
  5. Draftsman
  6. Architect or engineer approving drawings
  7. Revisions and date of revisions
- B. North point
  1. True north
  2. Magnetic north
  3. Deviation
- C. Descriptions and titles of sub-drawings
- D. Specifications

V. Drafting Symbols

- A. Solid lines
- B. Dashed lines
- C. Arrows
- D. Broken arrows
- E. Numbers
- F. Size lines (inside and outside)
- G. Measurements - English and metric

VI. How Plans Should Be Used

- A. In conjunction with specifications
- B. To review the project
- C. To see the proper sequence
- D. To see how to do the details
- E. To orient the structure on the ground

(English translation)

Course Outline: USE OF BARBED WIRE

I. Uses of Barbed Wire

- A. X-braces
- B. Ring beams
- C. Fixatives for holding wall to posts
- D. Supports for adobe de canto

II. Advantages of Wire

- A. Strength
- B. Durability
- C. Adhesion and non-slippage

III. How to Use Barbed Wire

- A. X-braces
  1. Tie the cross brace at the bottom.
  2. Build the wall.
  3. Tie the brace at the top.
- B. Ring beams
  1. Tie or nail at post, wrapping at least once with end on outside of house.
  2. Lay wire in mortar in the middle of the course.
  3. Wrap at next pole at least once and cut on outside of house; tie or nail end.
  4. Repeat process between each pole.
- C. Supports and guides for adobe de canto
  1. Nail and wrap at post.
  2. Run alongside where adobes will be placed to next post on outside of house; wrap, cut and nail.
  3. Repeat for inside of house.
  4. Place adobes inside of wire strands.
  5. When wall is finished, add stucco.

IV. Splicing Wire

- A. Methods and knots
- B. Where not to use spliced wire

(English translati

Course Outline: CORRIDORS

I. Types of Corridors and Advantages and Disadvantages of Each

- A. Extended truss
- B. Continuation of roof line (1-agua roof)
- C. Extension of roof at end of house (2-agua roof)
- D. Surrounding roof (4 corridors surrounding)
- E. Separate frame

II. Problems of Corridors

- A. Weight
- B. Balance
- C. Shear and blockage

III. Materials

- A. Lamina
- B. Asbestos cement

IV. How to Reinforce Your Corridor

- A. Frame
- B. Tendales
  1. Size
  2. Fastening to ring beam and truss
- C. Diagonals
- D. Supports
  1. Fastening posts to corridors (at top)
  2. Diagonals
  3. Fastening posts to the ground

I.

II.

III.

(English translation)

Course Outline: SPLICING WOOD

I. Types of Joints

   A. Lap
   B. Butt
   C. Heel

II. Use of Gussets

   A. How to make them
   B. Minimum distances

III. Hints on Splicing

   A. Where to use them
   B. Where not ot use them
   C. Where to put them
   D. How to cut them
      1. Depth of cut
      2. Proper side
      3. Smoothing the cuts for maximum function

(English translati

Course Outline: WOOD TREATMENT

I. Why Treat Wood?

A. Rot
B. Termites
C. Other pests

II. Types of Treatment and Results

A. Creosote
B. Pentachlorafine
C. Oil and insecticide
D. Burning
E. Copper acetate
F. Screen and barriers (plastic tubes)

III. Methods of Treatment

A. Brushing
B. Pressure treatment
C. Hot and cold baths

IV. Recommended Ways to Use Creosote

A. Heat the creosote.
B. Smooth the wood.
C. Puncture the base.
D. Puncture the part that will be in the ground at an upward slant.
E. Steam the wood.
F. Dip the wood in the creosote at the base of the wood and cover to 1/2 vara above ground level.
G. Leave in creosote 5 minutes, then dip in cold bath of creosote.
H. Brush hot creosote on rest of pole.

(English translation)

Course Outline: HOW TO PROTECT YOUR WOOD

I. Proper Treatment

   A. Creosote
   B. Pentachlorofine
   C. Paint
   D. Others

II. Keep Dry

   A. Outside - using a stucco. Use screen on outside of wood.
   B. Inside

III. Keep Clean

IV. Keep Away from Fires or Heat

V. Keep Away from Fire Wood or Scrap Wood

(English translati

Outline: VENTILATION

Did you know that each year the smoke from cooking fires in the kitchen probably kill more people in Guatemala than the earthquake did? Next time you look at the black soot on the roof and walls of the kitchen, think about how your lungs might look, too. We must remember that our wives and children spend most of their lives in the kitchen. So it is important to learn how we can build a safe kitchen that will keep the heat in and let the smoke out.

There are several ways we can do this. First, we can build a stove and add a stovepipe which will take the smoke out of the house. Several types of stoves can be made out of adobe or brick. More important than the type of stove is to make sure that the smoke goes up the chimney. To do this, you need to have a hood over the fire, like the one shown below.

(Drawing)

It is very important not to place the fire or chimney too close to the wood columns or the ring beam. If it is too close, it will heat the wood, and warm wood expands and contracts, loosening the connections. It also attracts termites and the wood can be caused to sweat which will lead to rot.

The other way we can take the smoke out is by building some openings in the top wall which will help take the air out. To do this, it is important to know first which way the wind usually blows. In most of Guatemala, the wind usually blows S-N, but in the mountains, each place may be different. Once we know where the wind blows from, we can put our vents in. The drawings below show how to do it.

(Drawing) (Drawing)

(Drawing) (Drawing)

(English translation)

Outline: INFRASTRUCTURE

I. Sanitation

- A. Location of privy
- B. Hygiene
- C. Depths and distances

II. Drainage and Erosion Control

- A. Channels
- B. Catchments
- C. Dripline Stabilization

III. Water

- A. Location and construction
- B. Hygiene
- C. Runoff control

IV. Grain Storage

- A. Design of small silos
- B. Protection of stores

V. Storage

- A. Closets and shelves
- B. Closets at head of bed

VI. Heat and Insulation

- A. Fireplace
- B. Ceiling

(English translation)

Outline: ADD-ONS

I. Things to Remember

A. Don't make the house into an L-shape unless you build a crush section.
B. Don't get the house out of balance by making it too long.
C. Be sure to build the new part using all the principles.
D. Make the add-on at the same scale.
E. Make the add-on with the same materials, in the same manner (unless it is not one of the "approved" methods).
F. Kitchens should be separate from the main house, unless they use a butane stove.

II. How to Add-On (In Line)

A. Reroute drainage.
B. Extend the wall.
C. Tie in the X-braces (and check the wood).
D. Put door in middle of wall and frame it with wood.
E. Extend the ring beams and add diagonal braces.
F. Check dripline.

III. How to Add-On (In L Form)

A. Reroute drainage.
B. Build crush section.
C. Separate with passageway.
D. Check dripline.

(English translation)

Outline: SITE DEVELOPMENT

I. Where to Put Your House

A. Flat site
B. Solid ground, on rock
C. Separation from mountain
D. Separation from neighbors
E. Separation from walls
F. Separation from trees
G. Separation from erosion, drainage, or springs
H. Behind cracks in ground

II. How to Protect Your House

A. Plant grass.
B. Drain the site properly.
C. Plant shrubs and tress, but not too close to the house.
D. Terrace the site, especially behind your house.
E. Remove piles of wood, other debris (helps prevent termites and rats, and reduces chance of fire).

III. Making the Site More Livable

A. Plant flowers and gardens.
B. Erect a birdhouse.
C. Locate your privy in the proper place.
D. Shape the trees and shrubs to control circulation and assist ventilation.

(English translation)

REPLACING WOOD COLUMNS

When replacing the wood in a house when it becomes rotten or termite-infested, it is necessary to be sure that the wall is not weakened during the replacement process. If you use the following steps, the wall will be as strong after the wood is replaced as before.

To remove the old column:

1. Chip away the stucco with a hammer and chisel or piece of sharp metal to expose the wood and any wires that have been used.
2. Chip out the mortar between the wood and the wall material.
3. Pull the nails or staples out of the wire.
4. Unwrap the wire from the column.
5. Remove wooden cross braces by gently prying them from the wood columns.
6. Dig out the ground around the base of the column in the front and back only.
7. Remove the nails that hold the column to the ring beam.
8. Push the column back and forth from the top until it is loose enough to remove.
9. Check the area around the wall to see if there are any signs of termites or other damage.

To install new column:

1. Treat the new post.
2. Treat the area around the position where the post will go.
3. Put nails or strips of tin on the wood where it will be attached to the walls.
4. Put the pole in position and check it with a plumb bob for straightness.
5. Nail the column to the ring beam.
6. Place rocks or bricks in the hole to secure the column in the ground.
7. Wrap the wires back around the new column and tighten up using a crow-bar, then nail tight.
8. Fill in the space between the column and the wall with mortar.
9. Attach the cross braces.
10. Touch up any areas where treatment appears to have come off.
11. Patch up the stucco.

(English translation)

BUILDING INSPECTION STEPS

I. Site

A. Is the house the proper distance from the next house?
B. Is the house the proper distance from nearby walls?
C. If the house is in a mountain, is it the proper distance from the back of the mountain?
D. Is the house on a safe site? Is it too close to a slide or on too steep a slope? Are there large cracks in the ground nearby? Is the house between a large crack and the edge of a slide?
E. Is the house protected from runoff in a rainstorm?
F. Is nearby runoff going to cause serious erosion to the yard or to a neighbor?
G. Is there good grass cover on the yard?
H. Is the site generally clean?
I. Is the privy the minimum distance from the house?

II. Structure

A. Is the house square or rectangular or is it "L"-shaped?
B. Does the house have a lightweight roof of <u>lamina</u> or grass?
C. Does the roof have the proper overhang so that water will not damage the foundation and walls?
D. Is there a cornice or false front on the building?
E. Is the foundation safe and secure? Does it need erosion protection?
F. Are there any exterior signs of deterioration, cracks, or termite damage? Especially check exterior wood. Is the wall in plumb?
G. Is the house in balance? Are the doors and windows opposite each other? Are there too many openings in one wall and not the other? Are the doors and windows the proper distance from each other and the corners?
H. Is the wall the proper height?
I. Are the gables made of a lightweight material?
J. If house has an overhanging porch, is it attached and braced properly on the outside? Will it shear properly?
K. Do windows open outward? Are they framed with wood columns? Check doors for termite damage. Are lintels okay? Is there enough strength over door? Are hinges safe? Are latches safe and can they be opened easily in another quake?
L. Do doors open outward? Are they framed with wood columns? Check doors for termite damage. Are lintels okay? Is there enough strength over door? Are hinges safe? Are latches safe and can they be opened easily in another quake?
M. Is the house properly braced? Does it have corner posts and X-braces? Check the X-braces. If they are wood, are they securely fixed to the corner posts. Do they show signs of sagging, splitting, or bulging out? Do they have any termite damage? Are they big enough to do the job? Have children been playing on them? Are they treated or painted? Do they touch the floor; if so, check for rot there. If the cross braces are wire, do they go around the posts? Are they taut? Are the posts notched properly so the wire will not slip?

N. Check the corner posts for rot, termites, and other signs that they might be too weak. Especially check at the floor.

O. Check the posts around the windows from the inside.

P. Check the places where the interior walls are attached to the outside walls. Is there a post there? If so, does it show signs of rot, termites, splitting? Look down the outside wall - is it being pushed out by the inside wall? Look down the inside wall - is it bulging outward? Check the X beams.

Q. Does the house have a ring beam? Check the wood. Is the wall properly attached to the beam? Is the beam strong enough to hold? Are the splices good and strong? Do they need gusset plates? Do they have enough nails? Are they attached to columns properly? Are they attached firmly in the corners?

R. Are there diagonal braces in the corner of the ring beams? Are they strong? Are they at least 1 meter long?

S. Check the trusses. Are they built properly? If they are spliced together, are the splices made correctly? Are they resting on the ring beam or are they in the wall?

T. Check the supports for the roof. If the roof is made of <u>lamina</u>, are there too many supports? Are the supports the proper size? Do the posts show any signs of deterioration, rot, or termites? Are they treated properly?

U. If the house has a porch, check to see if it is properly attached to the truss and ring beam.

V. Check the kitchen. Is it properly ventilated? Are there any fire hazards? Is the floor collecting wastes in the cracks? Check the corners for wood rot. Are utensils being kept on the wood support?

(English translation)

Outline: CHECKING YOUR WOOD

I. What to Look for

A. Termites
B. Wood rot
C. Splitting
D. Mold
E. Bulging out or sagging
F. Excessive dirt build-up
G. Wear (especially children picking at corners)
H. Wood preservative or paint coming off or wearing thin

II. Where to Look

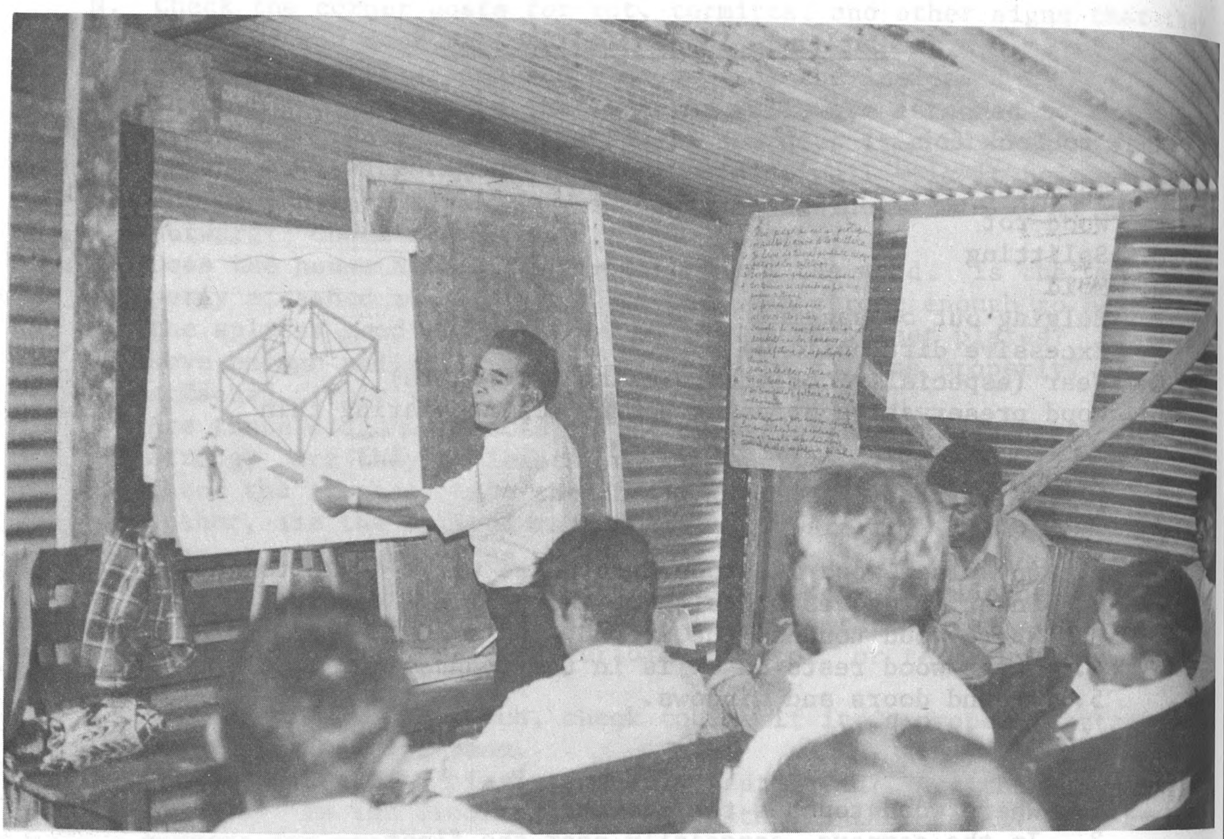
A. Outside

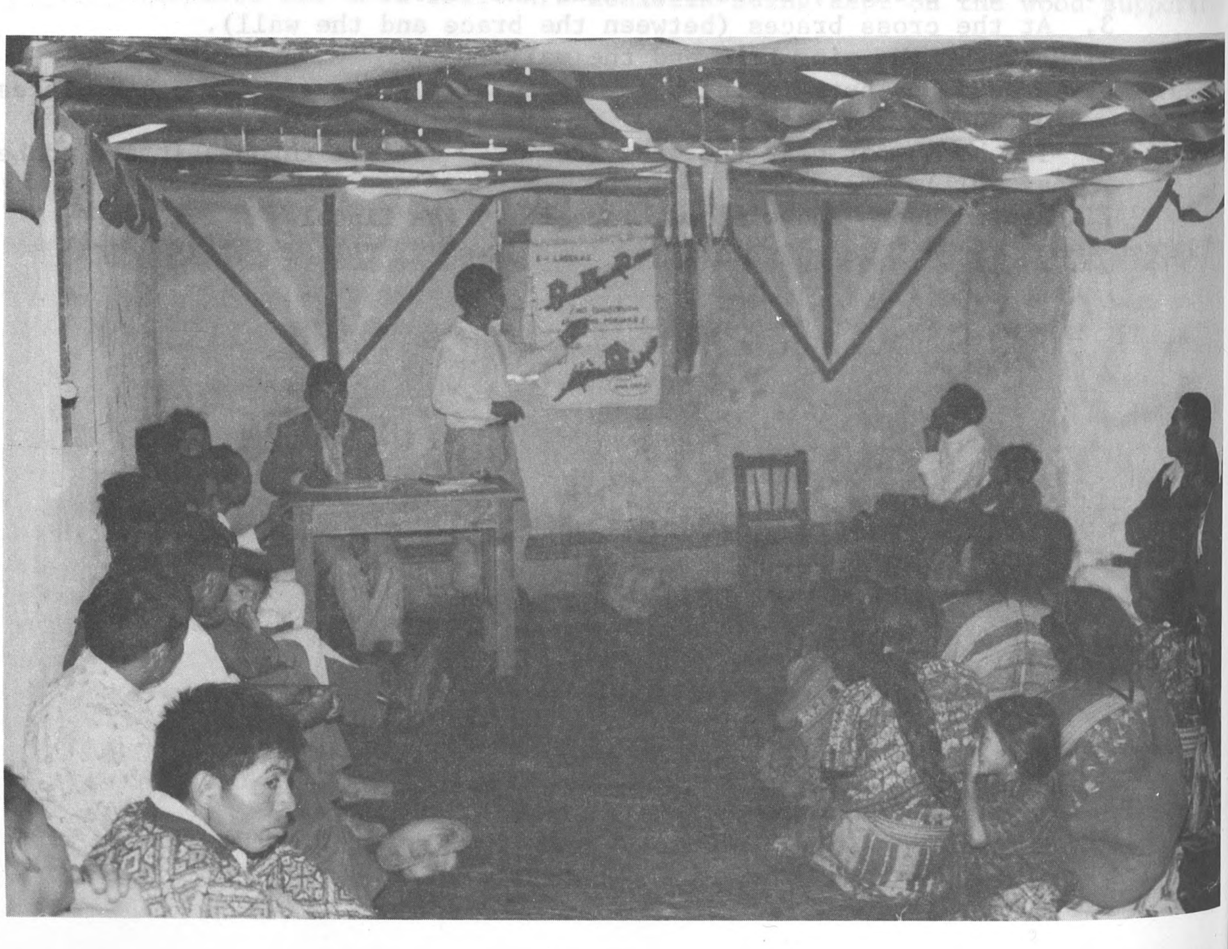
1. Any place wood is exposed to where water could touch it.
2. Under the eaves where there is no direct sunlight.
3. Where wood touches the ground.
4. Where wood rests on or is in the foundation.
5. Around doors and windows.

B. Inside

1. Where wood touches the ground.
2. In the corners, especially near the floor.
3. At the cross braces (between the brace and the wall).
4. Between the ring beam and the wall.
5. Around any cuts in the wood, especially where wire or other pieces of wood are joined.
6. In the mortar near the wood (termites can eat through it and adobe as well).
7. Around doors and windows, especially the lintels.

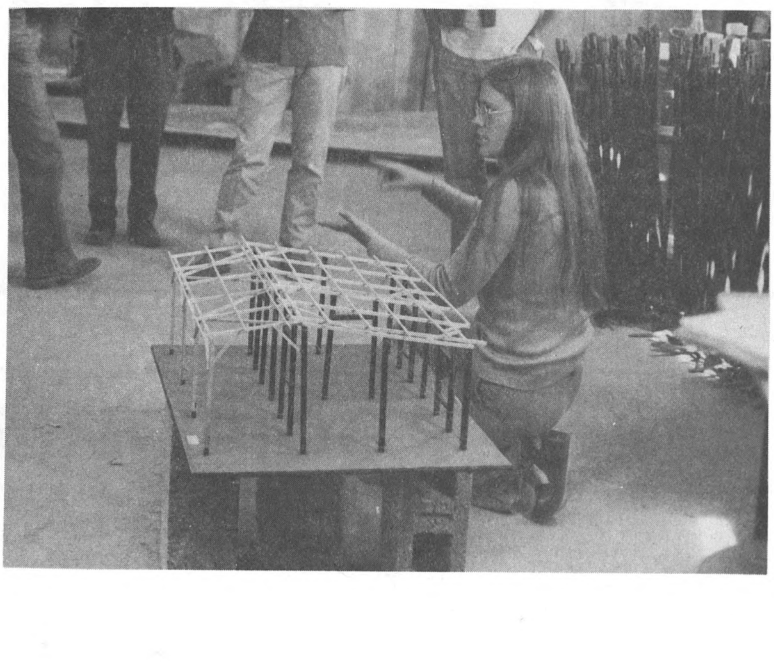
Use of the flipcharts in classes:



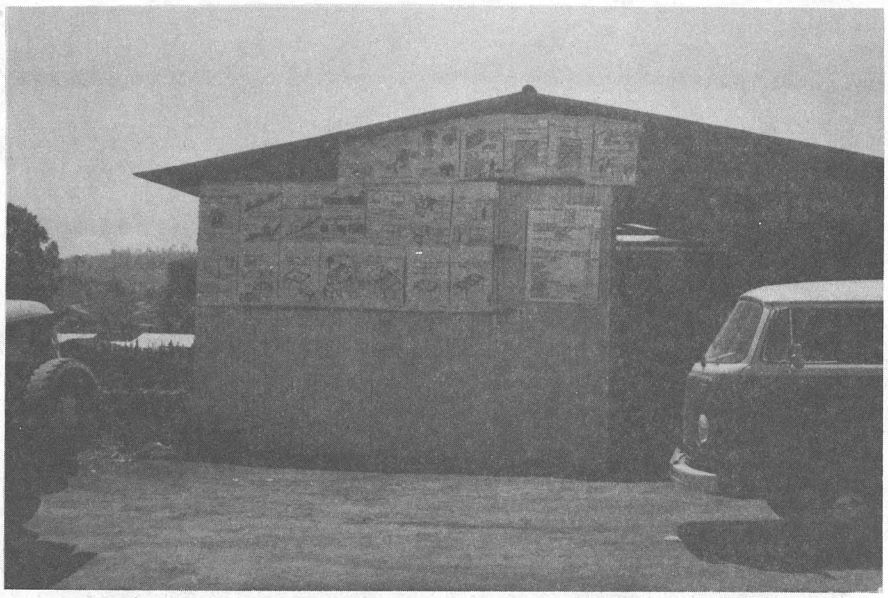


Flipcharts in use (continued)

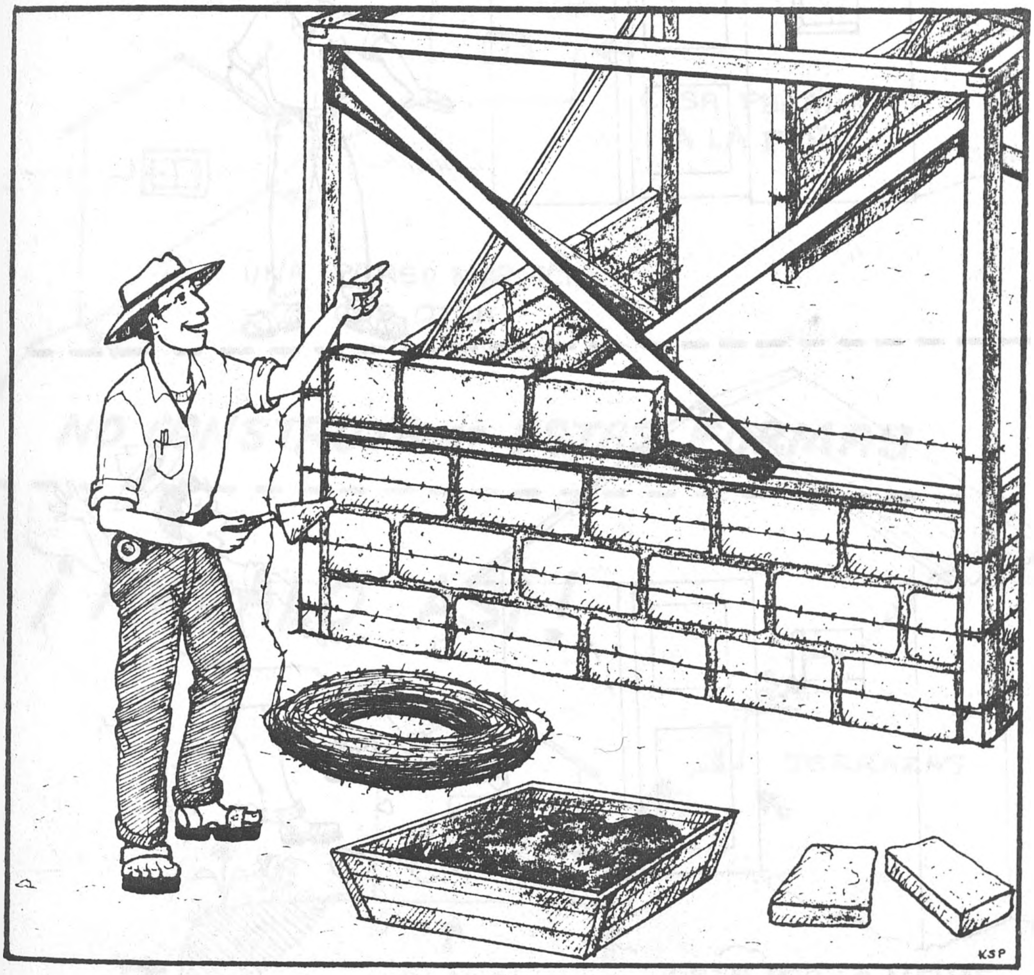
Use of a model house to illustrate earthquake resistant construction techniques:



Educational materials displayed on side of bodega at San Jose Poaquil:



COMO HACER CASAS SEGURAS en una ZONA PROPENSA A TERREMOTOS



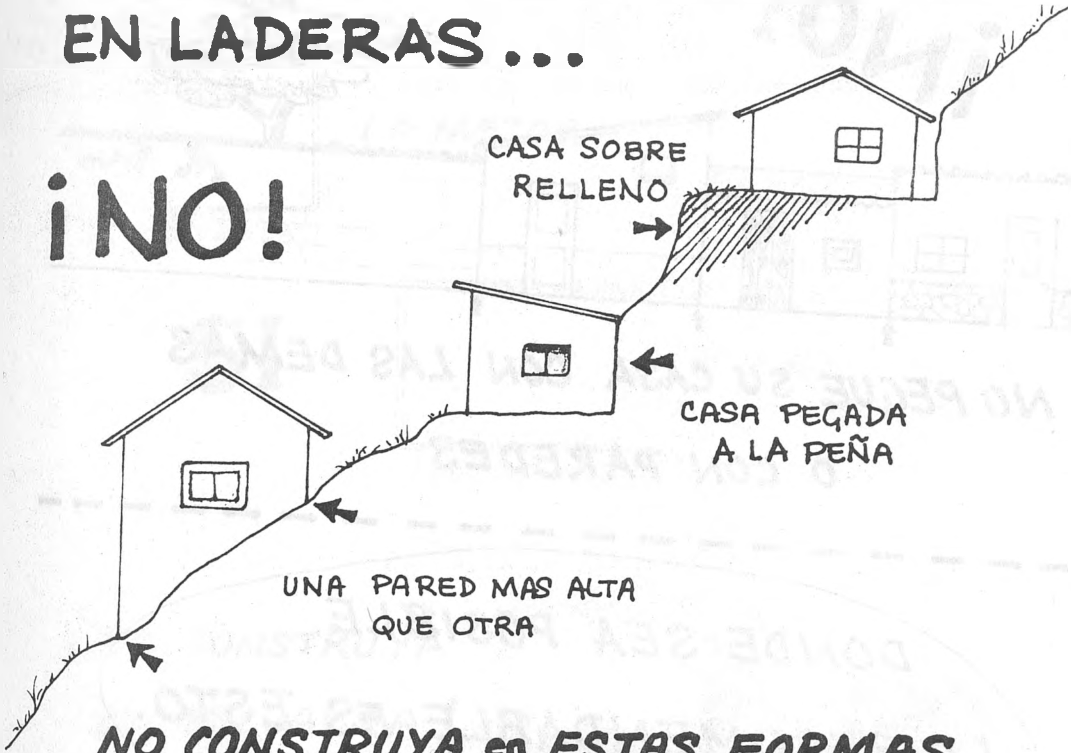
PRINCIPIOS Y BASES

ES MEJOR
EL TERRENO
PLANO...

LAS LADERAS
NO SON SEGURAS

EN LADERAS ...

¡NO!



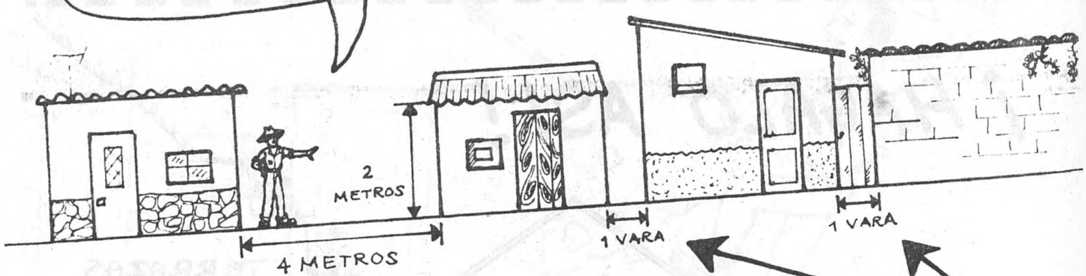
NO CONSTRUYA en ESTAS FORMAS

¡HAGALO ASI!

¡NO!

NO PEGUE SU CASA CON LAS DEMAS
O CON PAREDES

DONDE SEA POSIBLE
LO RECOMENDABLE ES ESTO.



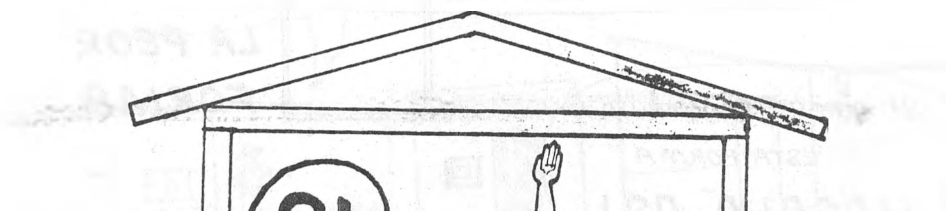
SI SU SITIO ES PEQUEÑO ...

SEPARE SU CASA DE LAS DEMAS
COMO MINIMO

UNA VARA

FORMAS DE CONSTRUCCION

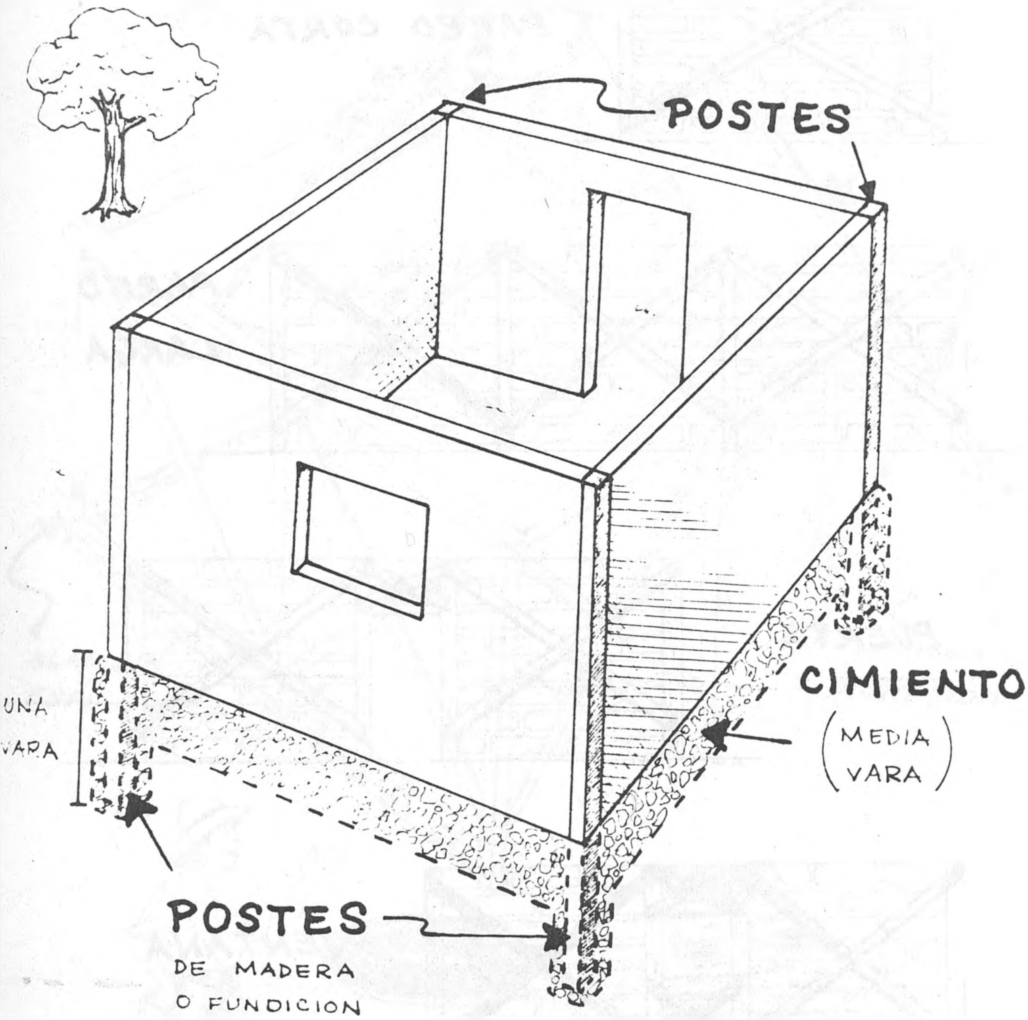
NO HAGA CASAS MUY ALTAS



HAGALAS de UNA ALTURA APROPIADA

USE SIEMPRE EN LAS ESQUINAS

POSTES u HORCONES



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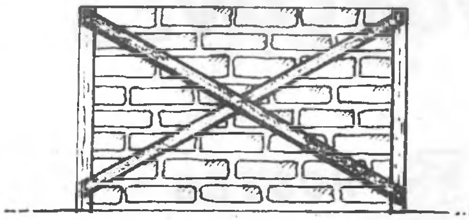
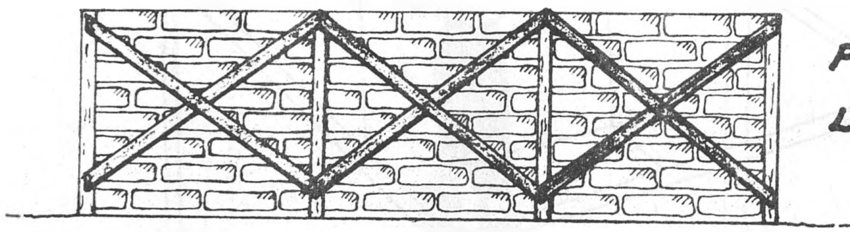
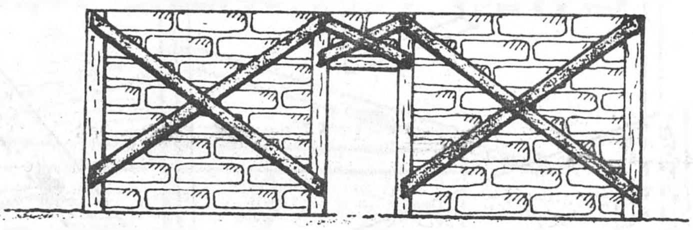


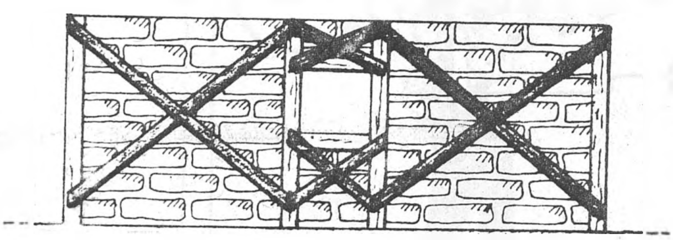
PARED CORTA



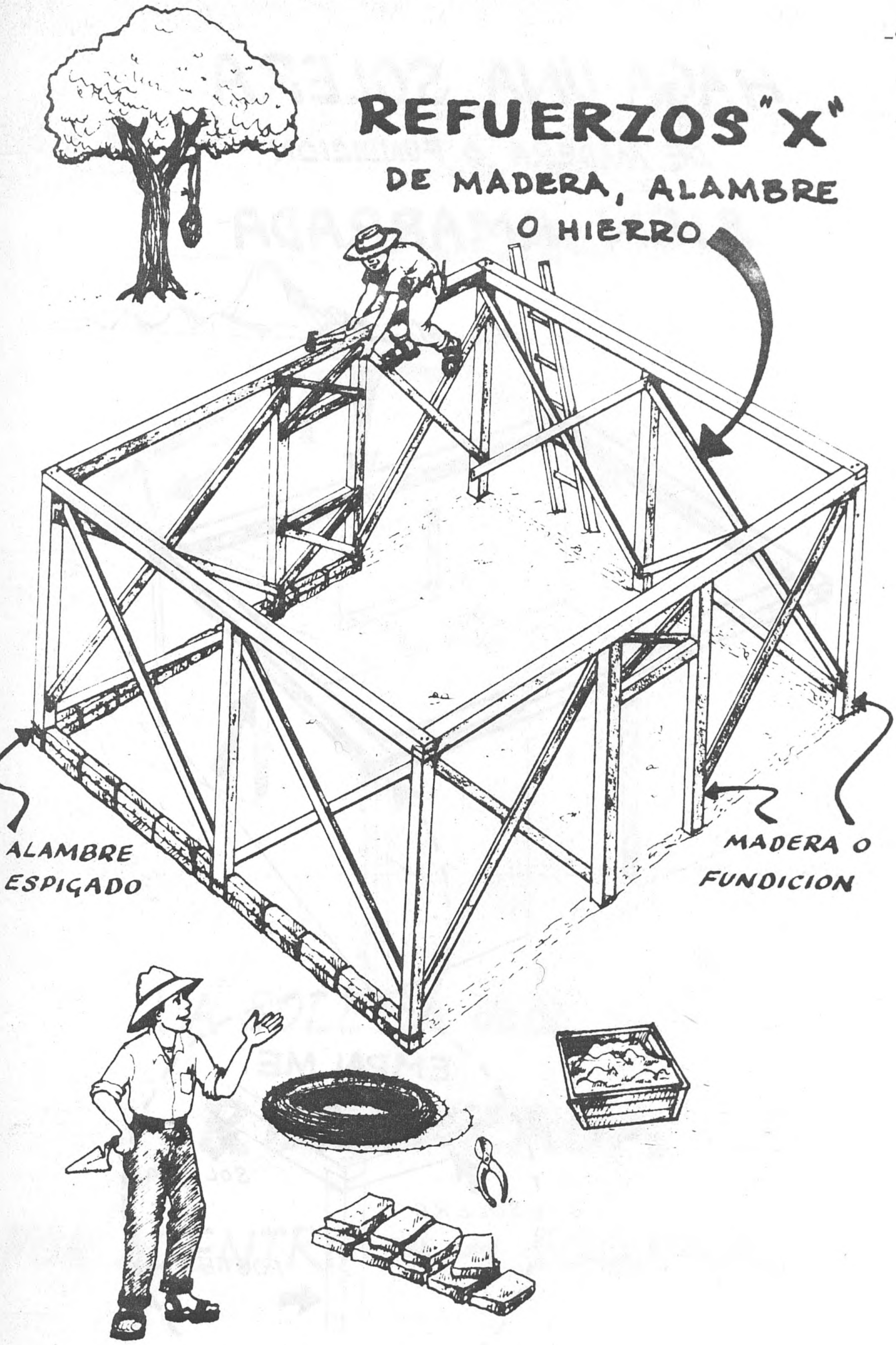
PARED LARGA

PUERTA





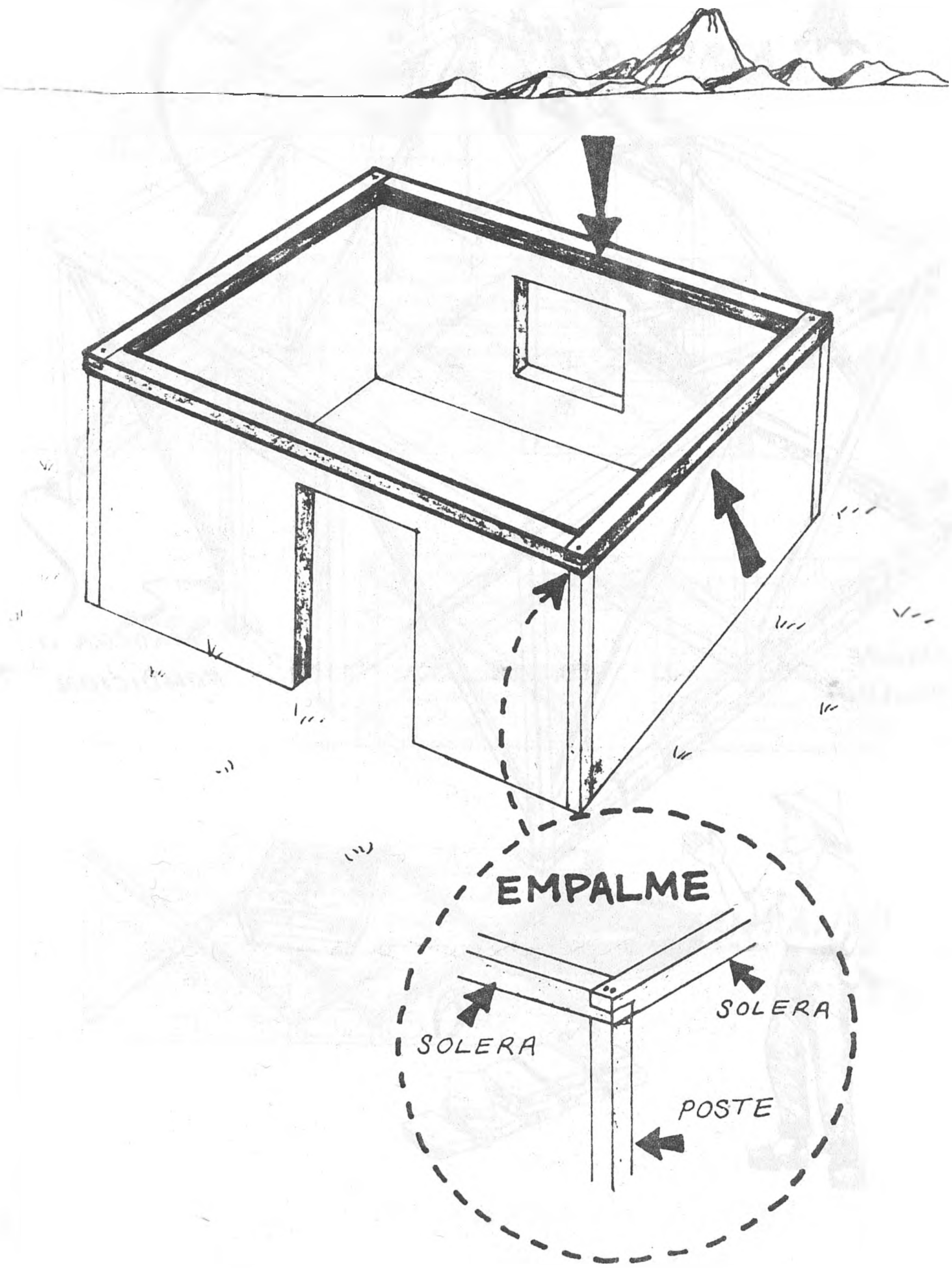
VENTANA

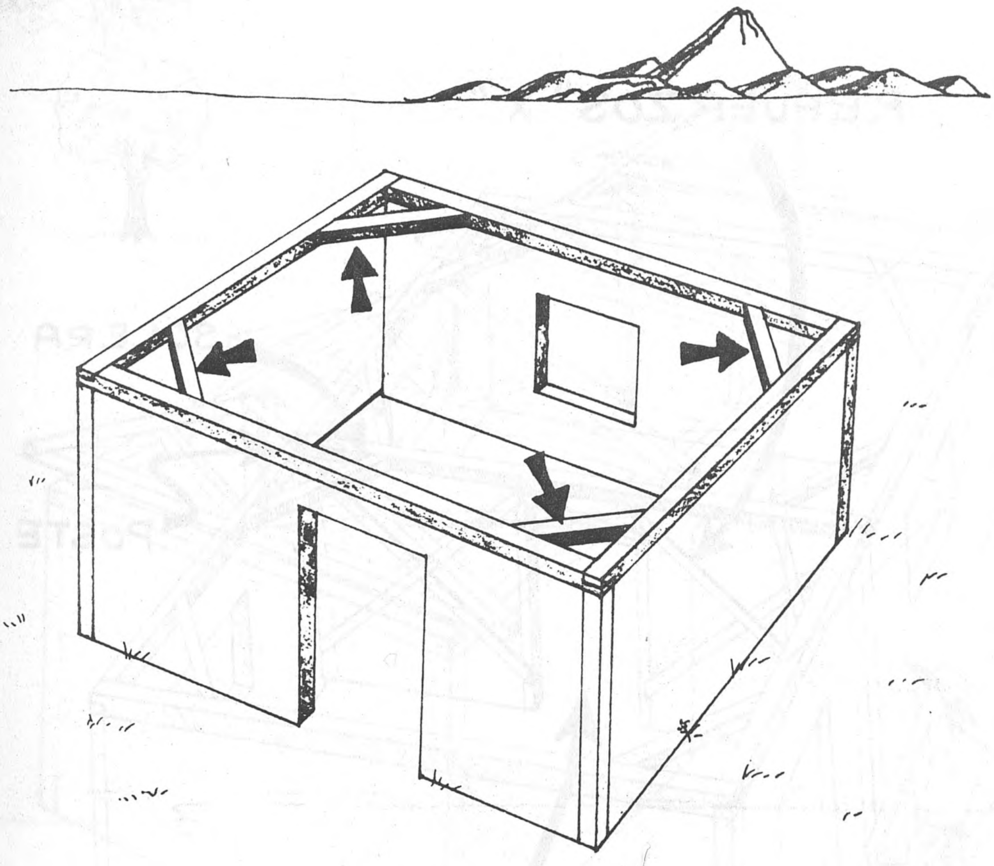

REFUERZOS "X"
DE MADERA, ALAMBRE
O HIERRO
ALAMBRE
ESPIGADO
MADERA O
FUNDICION

HAGA UNA SOLERA

DE MADERA O FUNDICION

BIEN AMARRADA



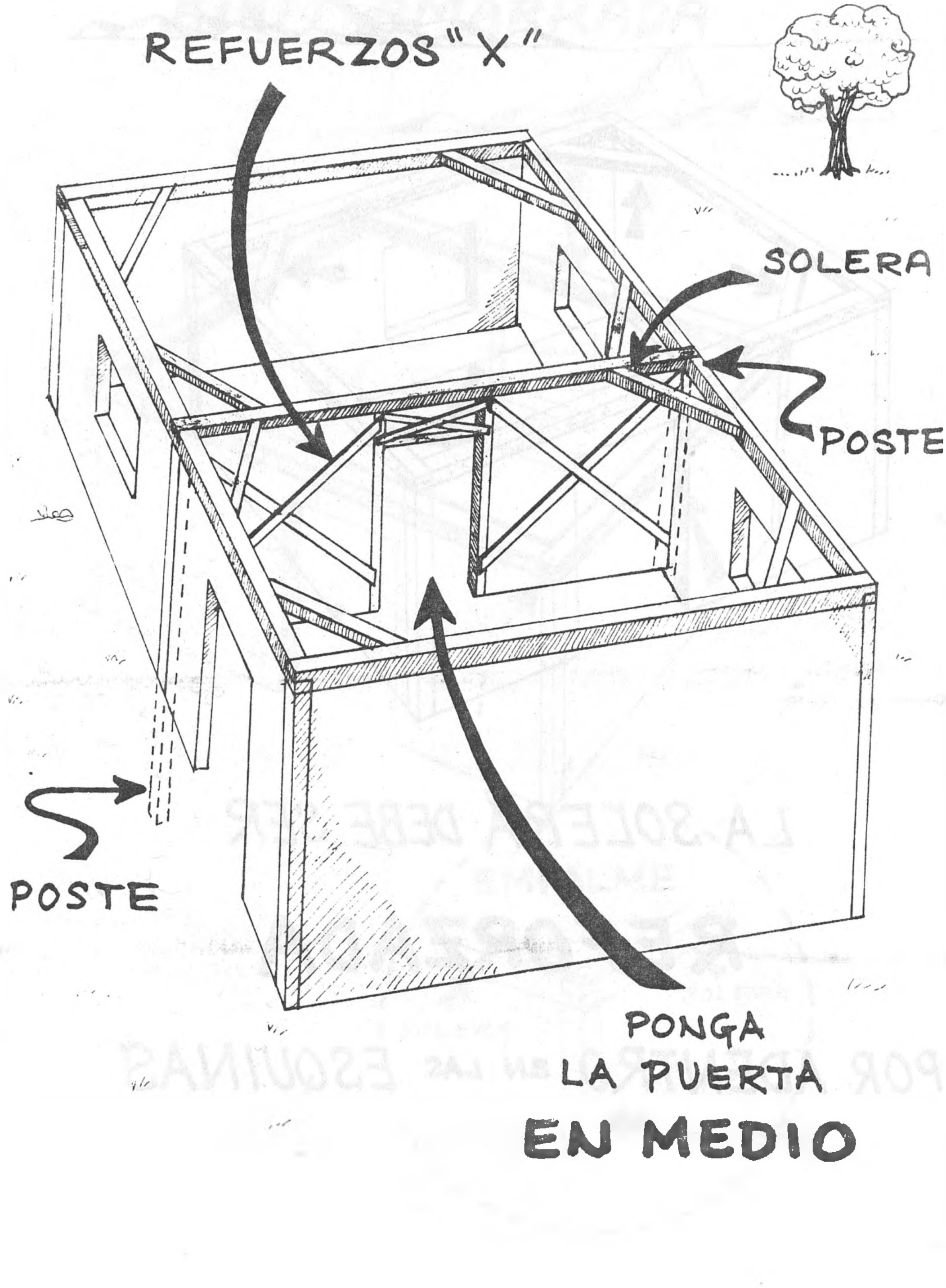


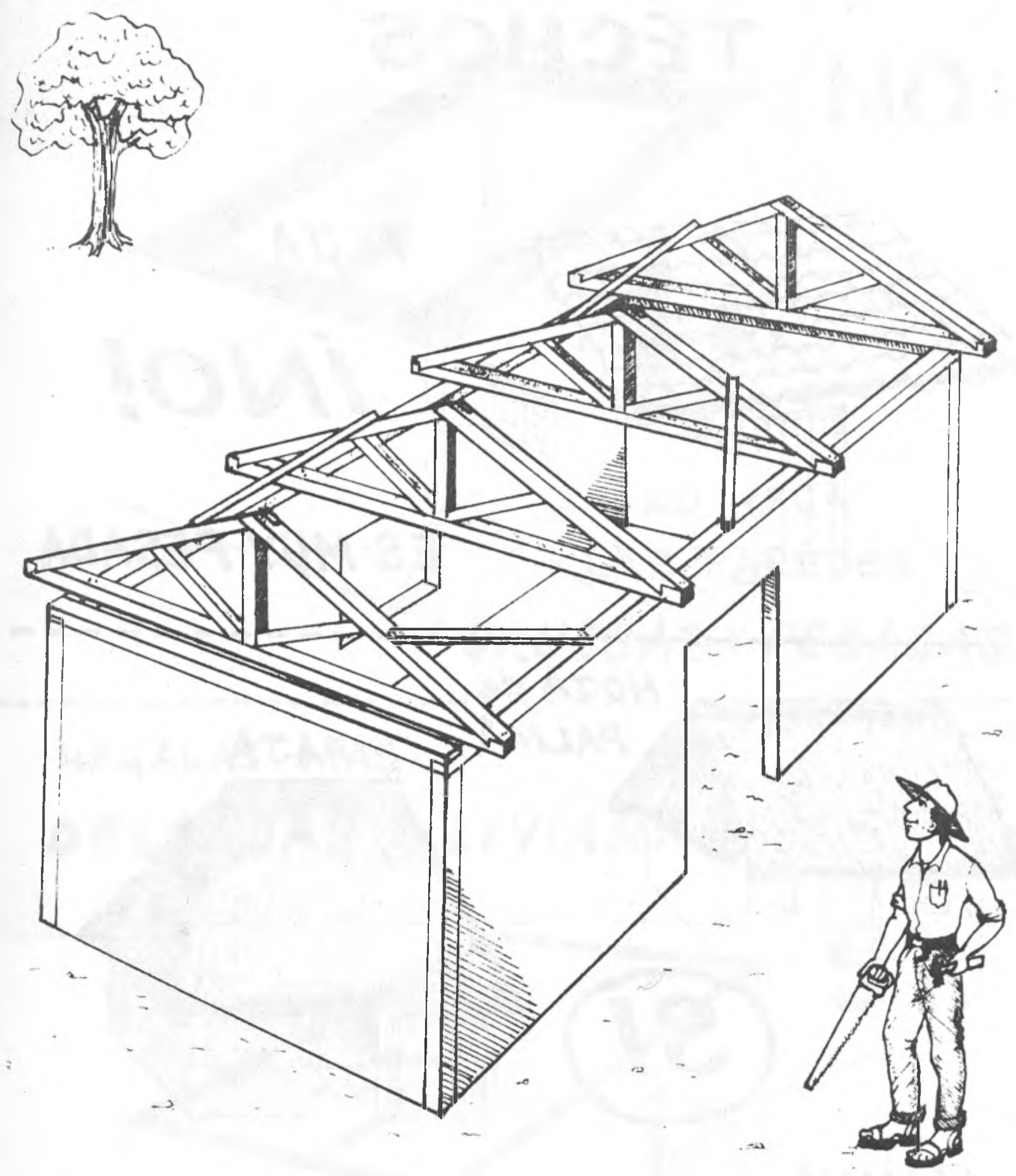
LA SOLERA DEBE SER

REFORZADA

POR ADENTRO EN LAS ESQUINAS

PAREDES INTERIORES

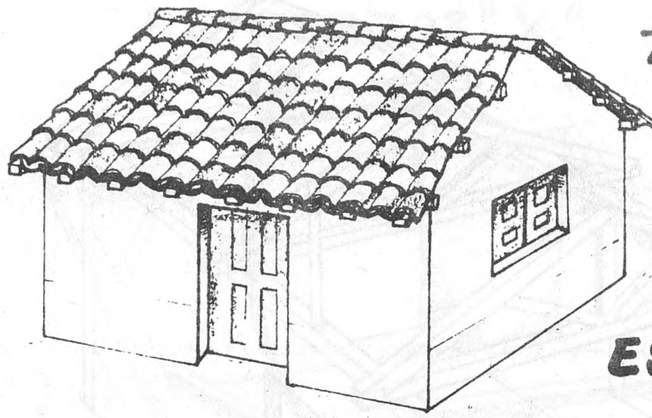




LAS TIJERAS ASEGURADAS

SOBRE LA SOLERA

TECHOS

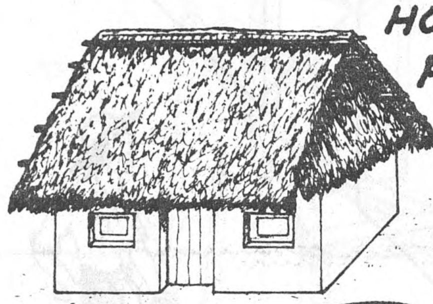


TEJA

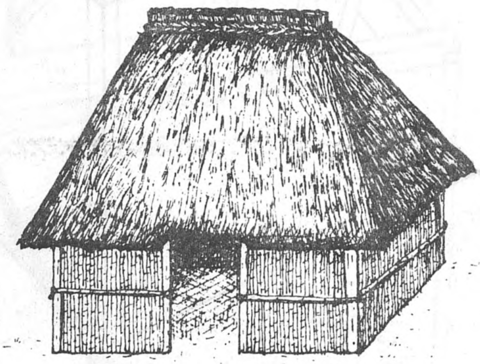
¡NO!

ES MUY PESADA

HOJA de PALMA

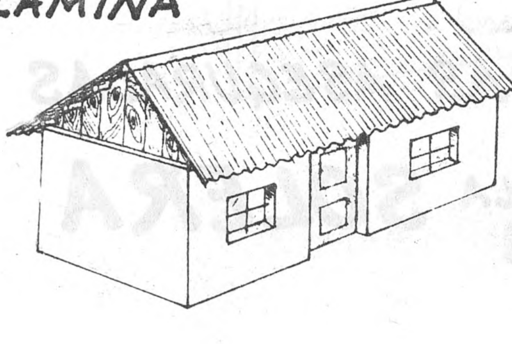


PAJA



SI

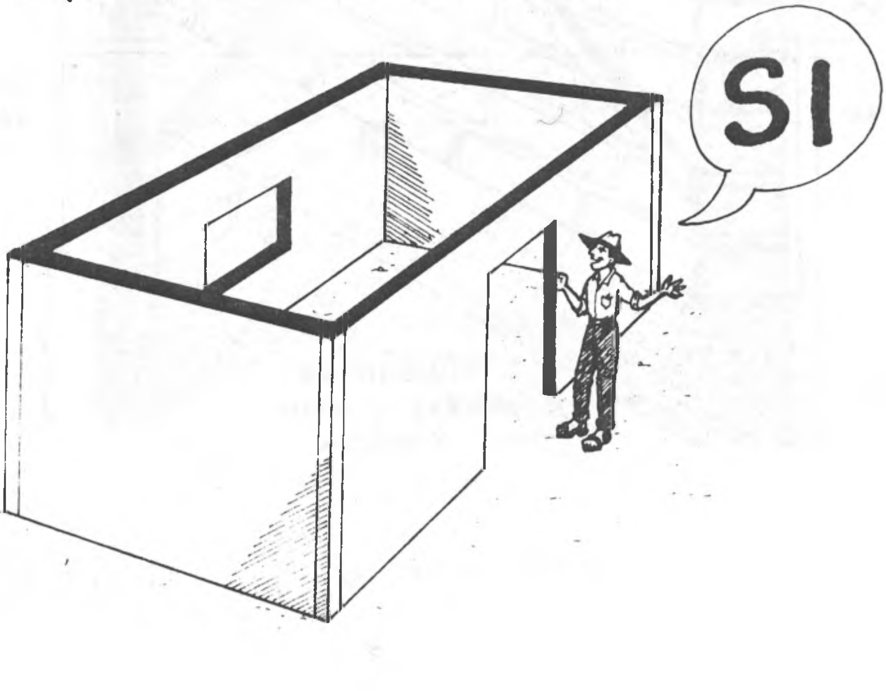
LAMINA



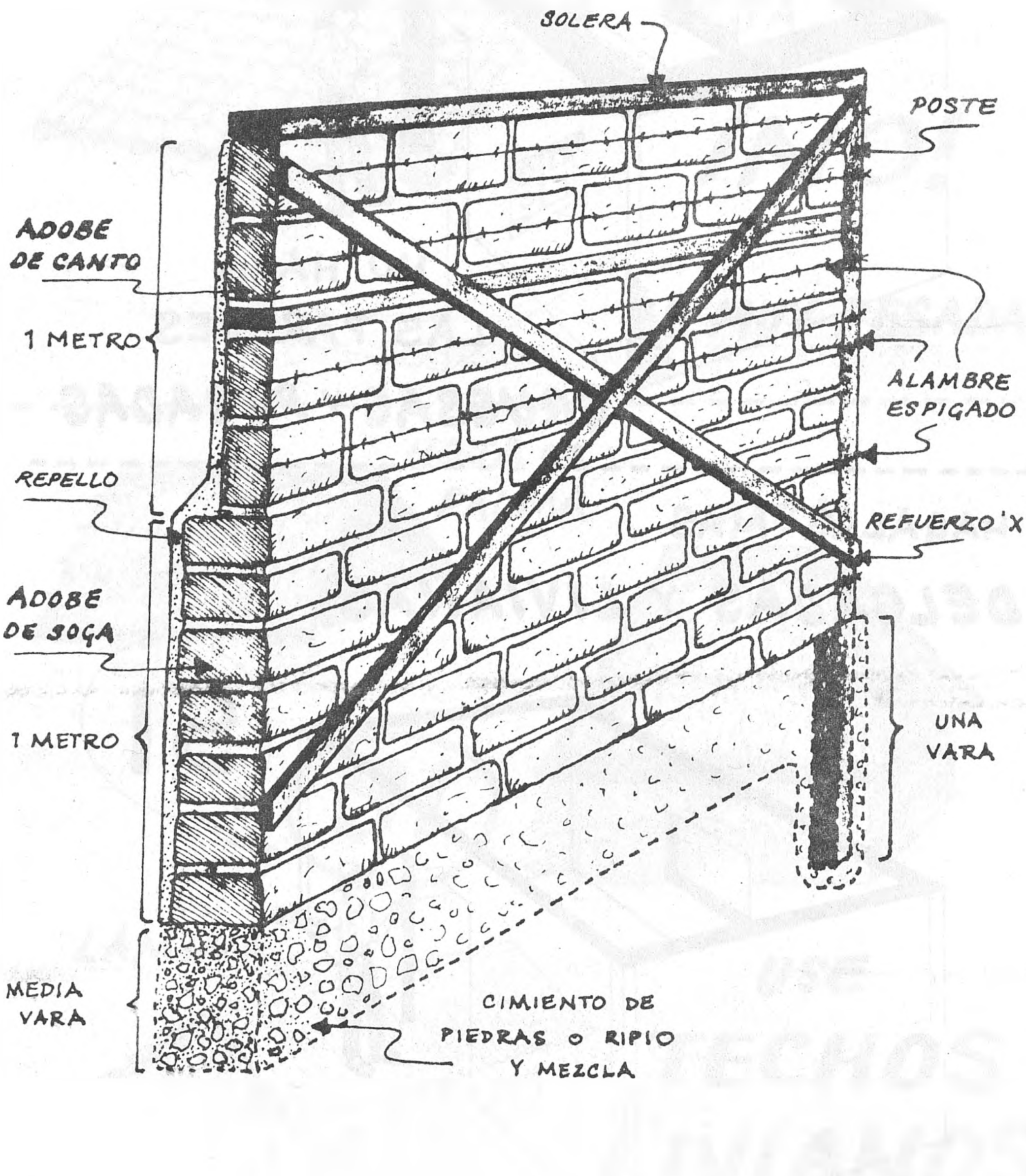
USE TECHOS LIVIANOS

NO HAGA
LAS PAREDES
GRUESAS Y *PESADAS*

HAGALAS MAS
DELGADAS Y *LIVIANAS*

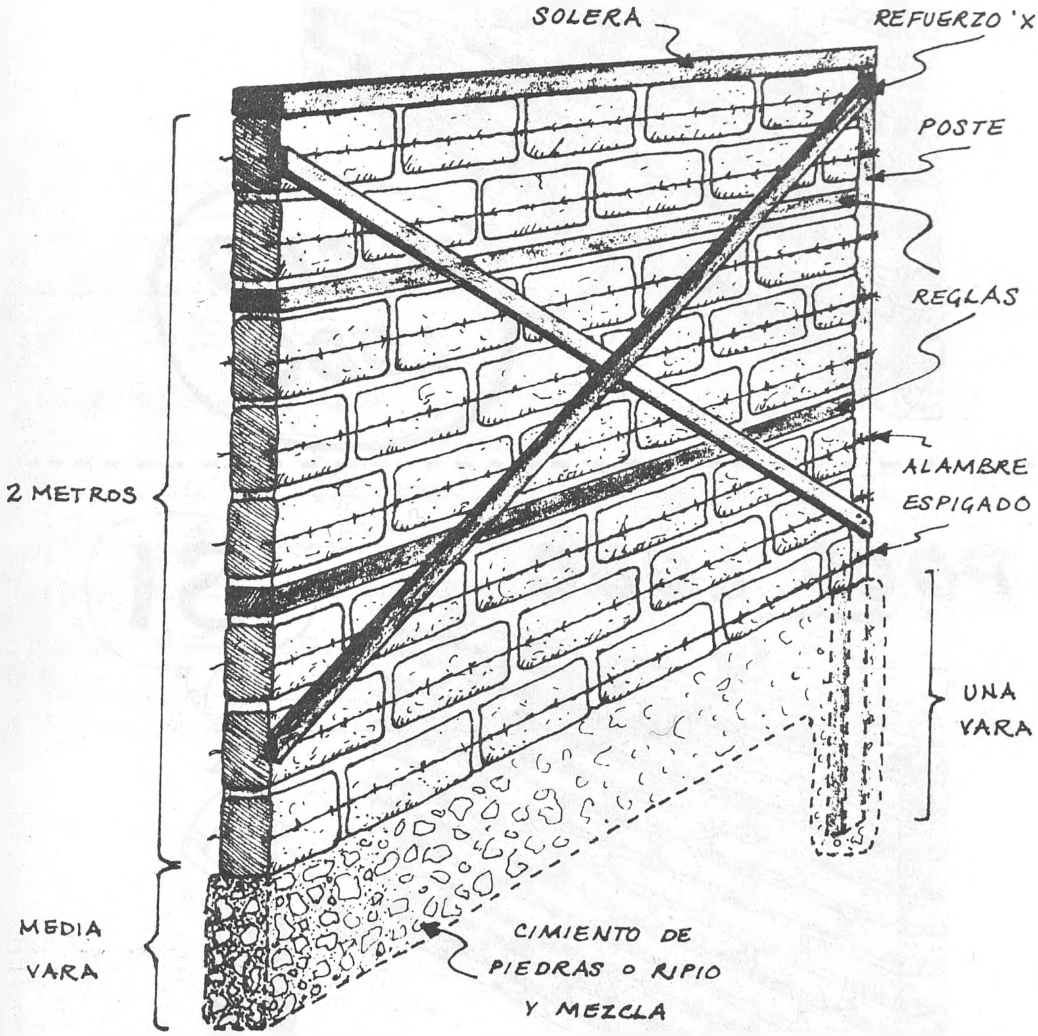


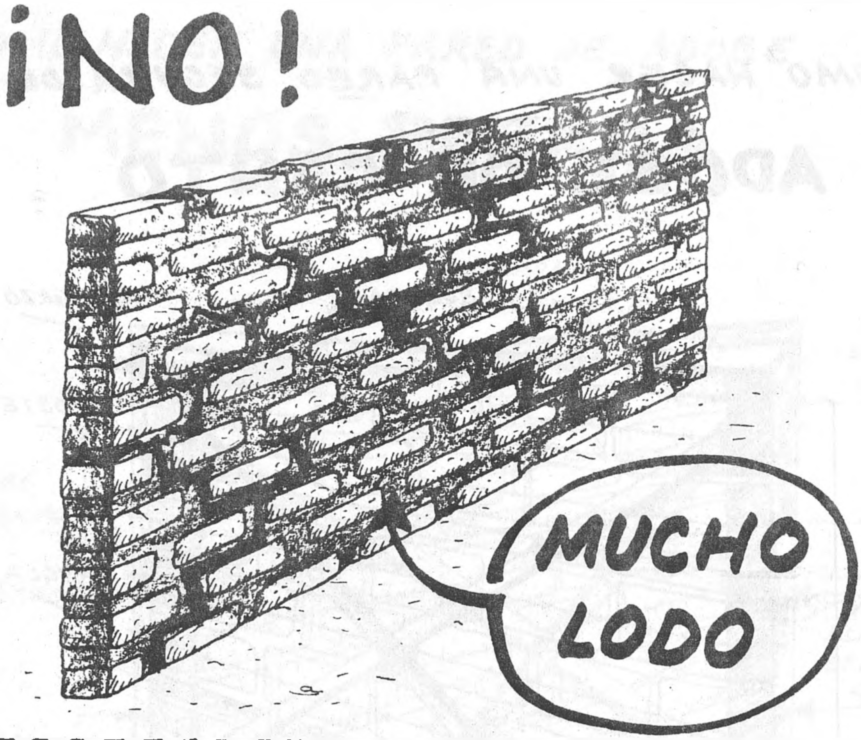
COMO HACER UNA PARED DE ADOBE
MENOS PESADA

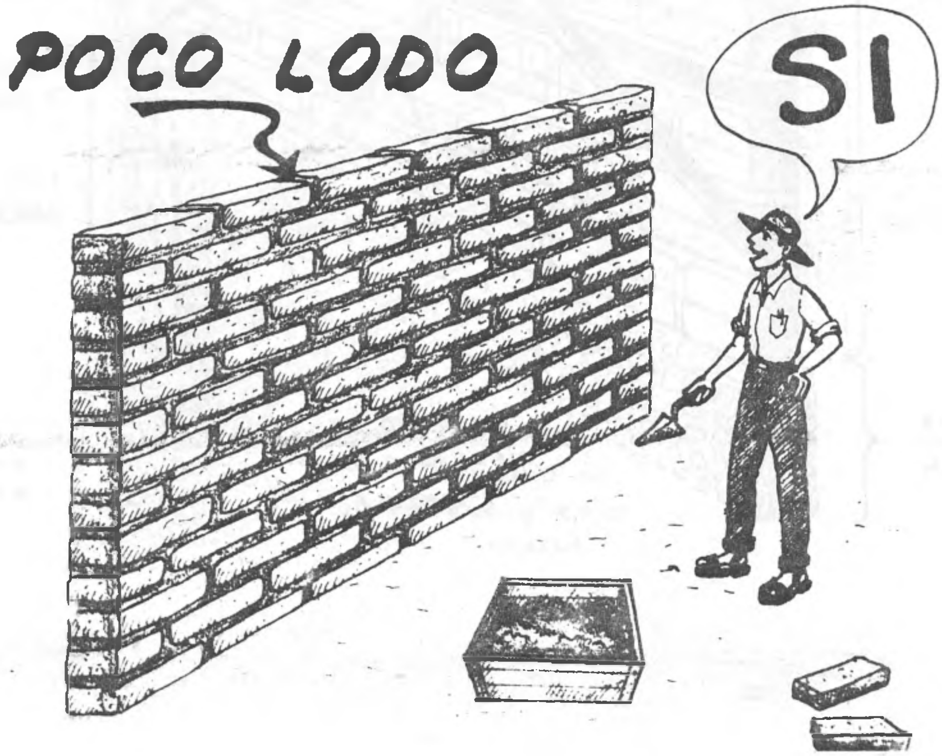


COMO HACER UNA PARED SEGURA DE

ADOBE DE CANTO

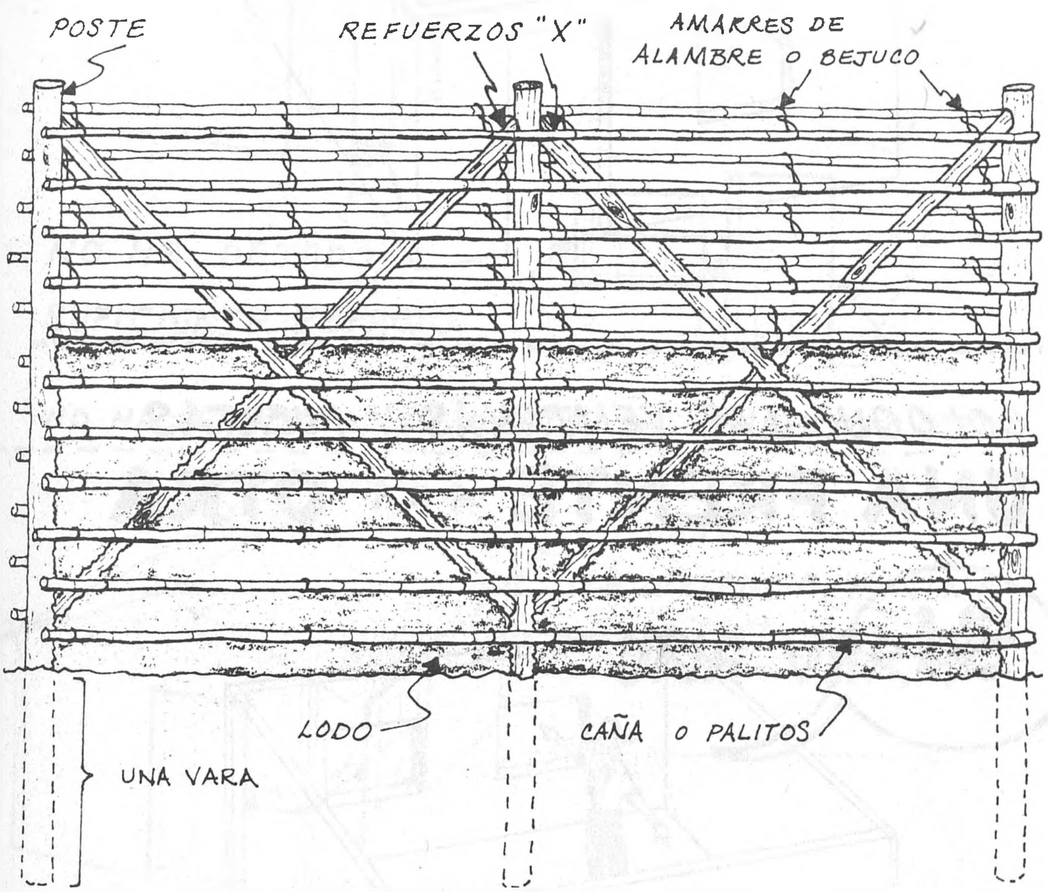


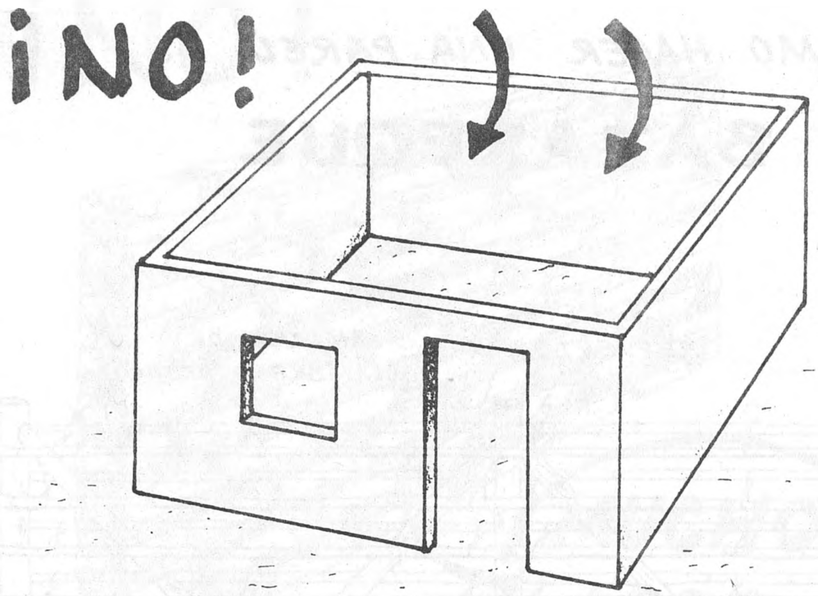

¡NO!
MUCHO LODO


POCO LODO
SI

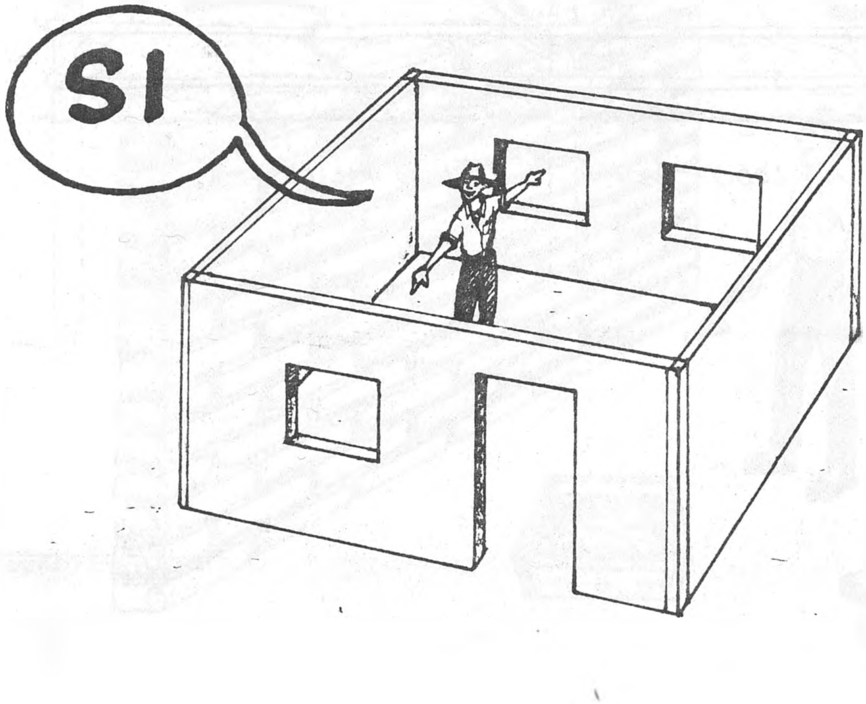
COMO HACER UNA PARED DE

BAJAREQUE



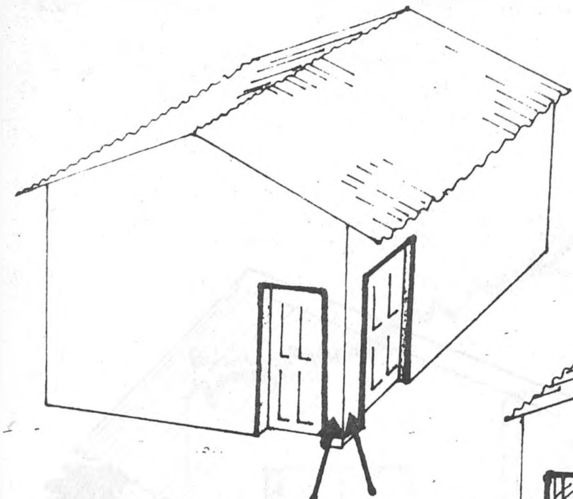


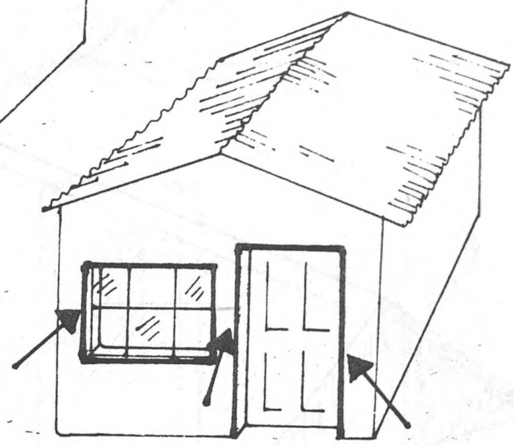
COLOQUE LAS VENTANAS Y PUERTAS
UNA FRENTE A LA OTRA



COLOCANDO PUERTAS Y VENTANAS

NO

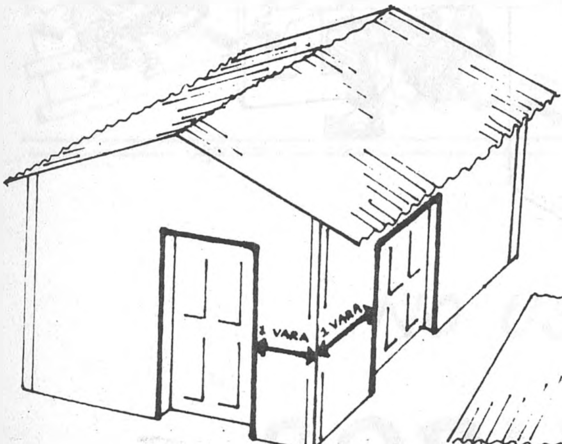


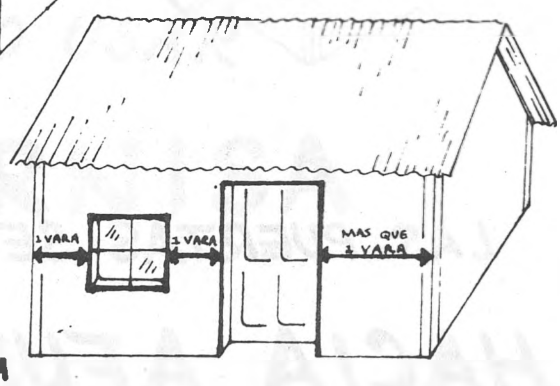


NO HA DEJADO
SUFICIENTE ESPACIO

NO HACER VENTANAS O PUERTAS EN LA PARED MAS CORTA

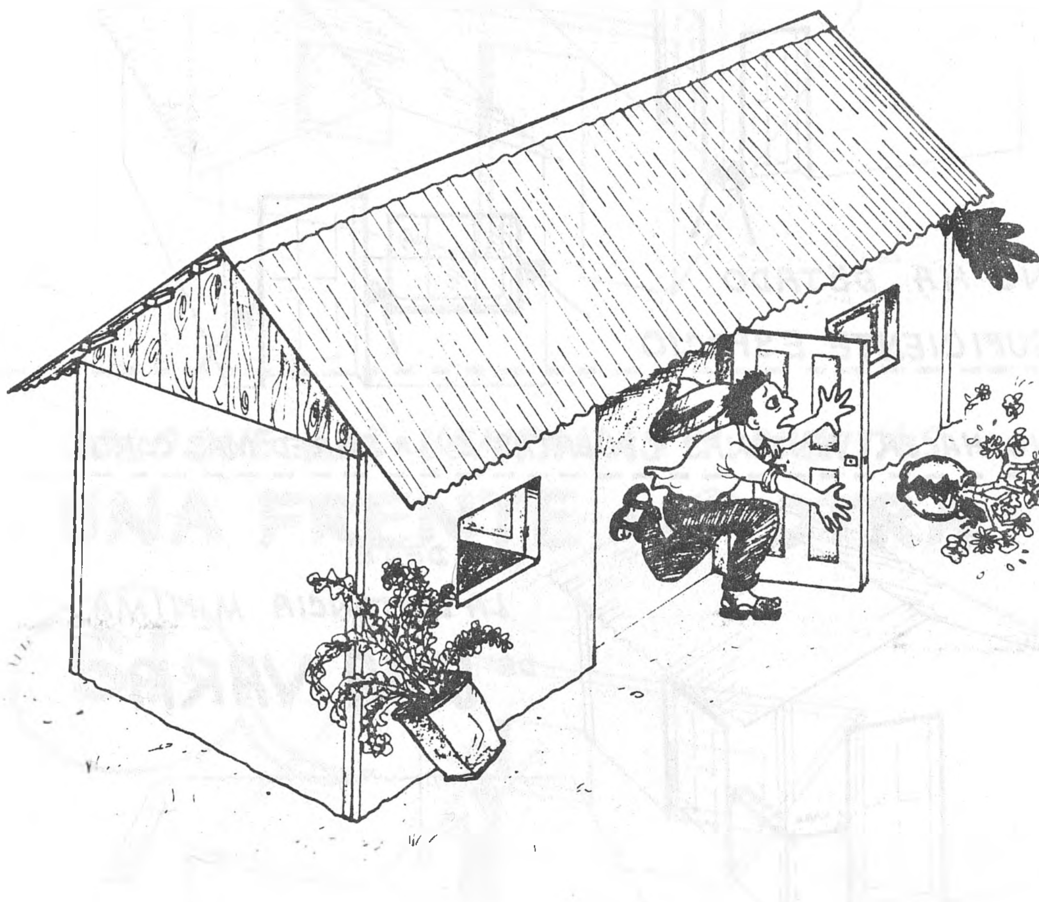
DEJE
LA DISTANCIA MINIMA
DE **UNA VARA**





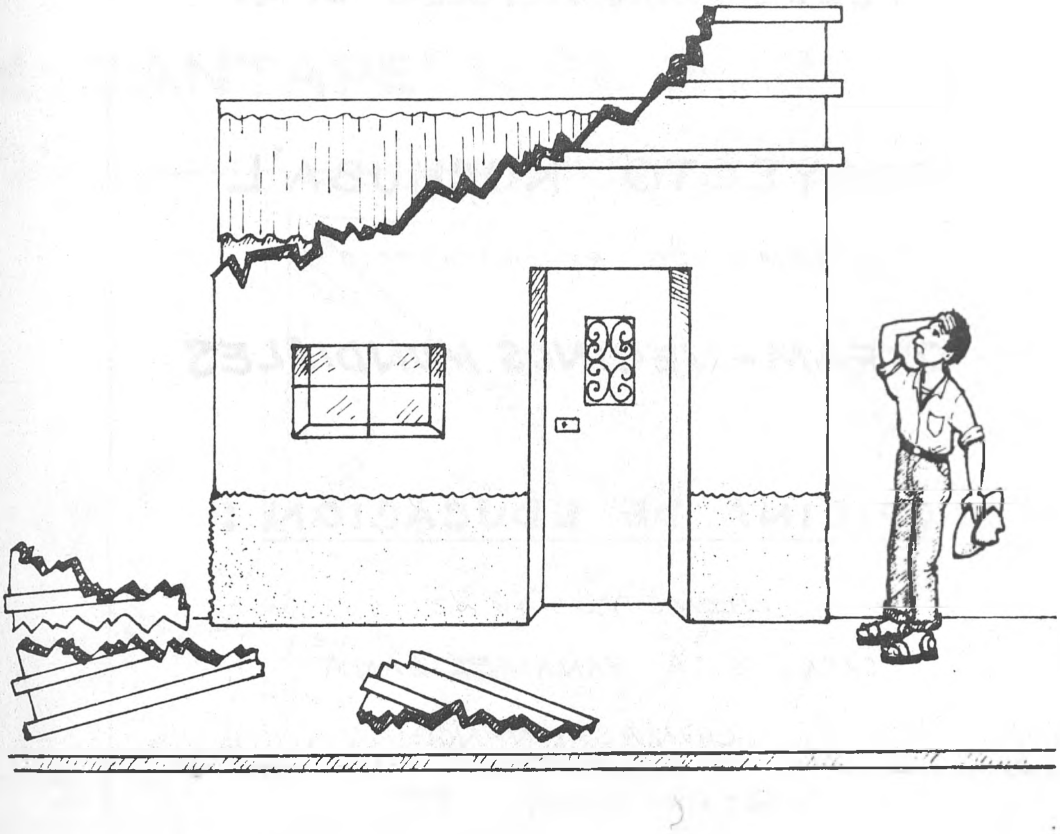
SI

DONDE SEA POSIBLE, PONGA
PUERTAS Y VENTANAS EN LA **PARED** MAS **LARGA**



LAS PUERTAS SE ABREN

HACIA AFUERA



NO USAR

CORNISA

PARA MAYOR INFORMACION
PUEDE COMUNICARSE CON:

PROYECTO KUCHUBA'L

PROGRAMA DE RECONSTRUCCION

OXFAM - VECINOS MUNDIALES

OFICINA DE EDUCACION:

KILOMETRO 56 1/2
CARRETERA PANAMERICANA
CHIMALTENANGO
APARTADO POSTAL 52

REVISION #4

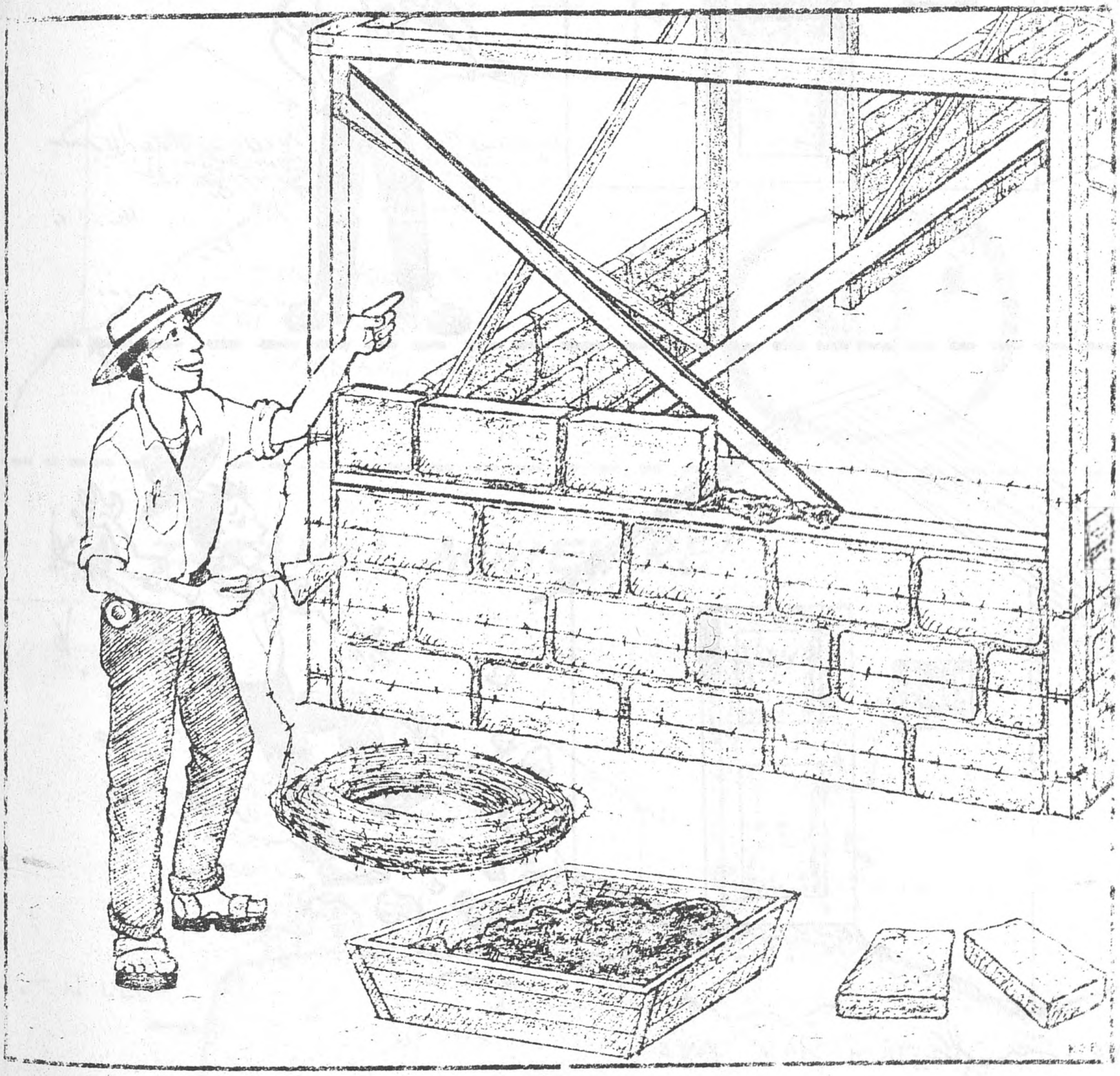
Septiembre de 1,976

ACHIQUE RUBANIQUIL TAK JAY

RI MAS UTZ

RICHIN NICOBIN

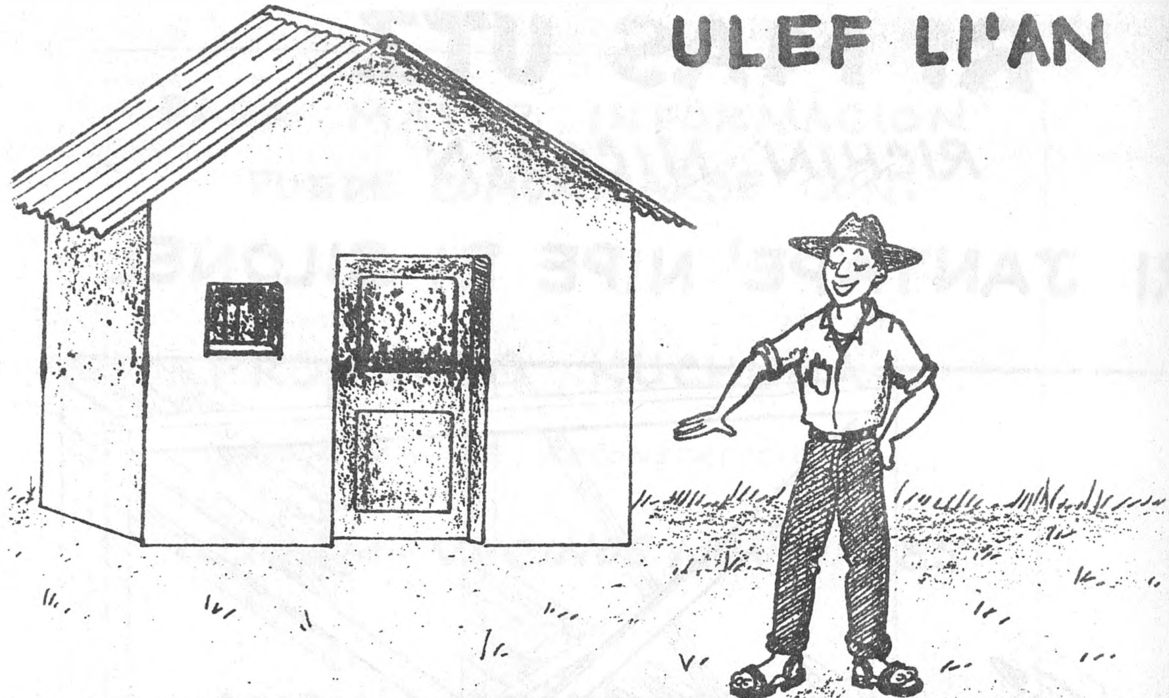
RI JANTAPE' NIPE RI SILONEL



NABEY TAK TZ'UBANIC

MAS UTZ RI

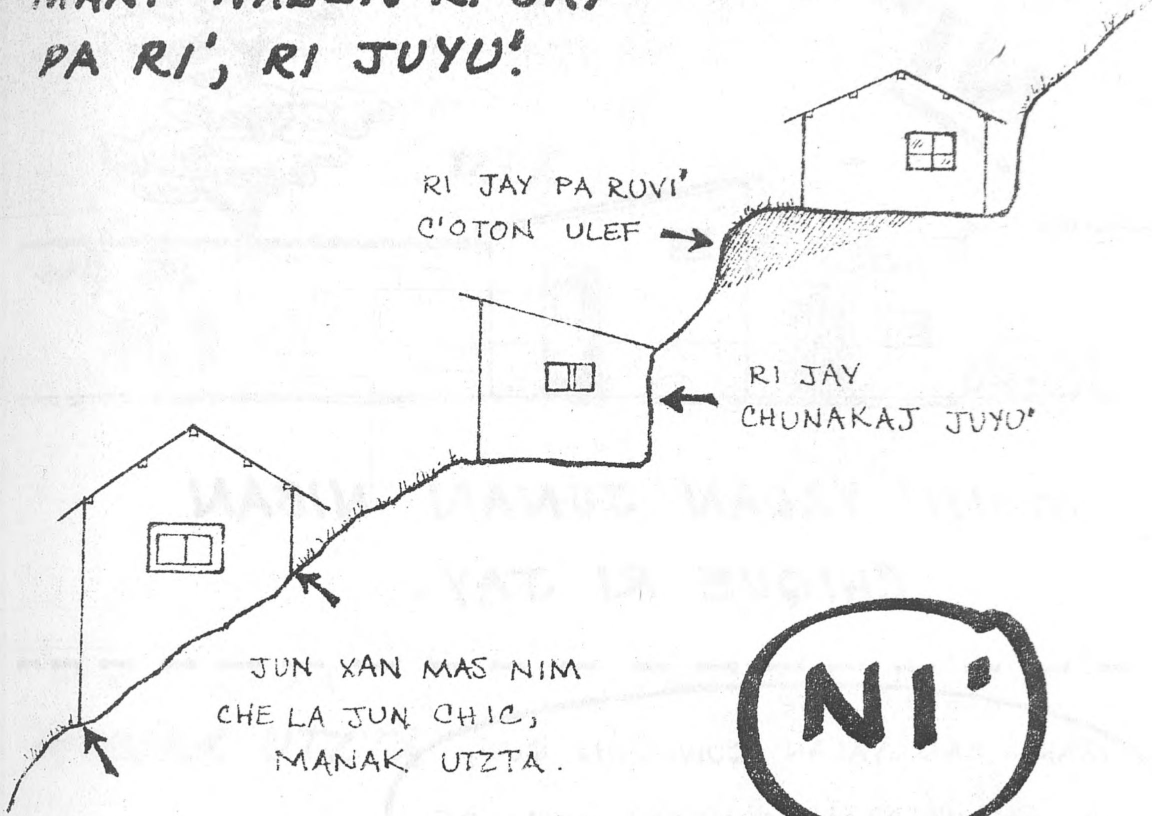
ULEF LI'AN



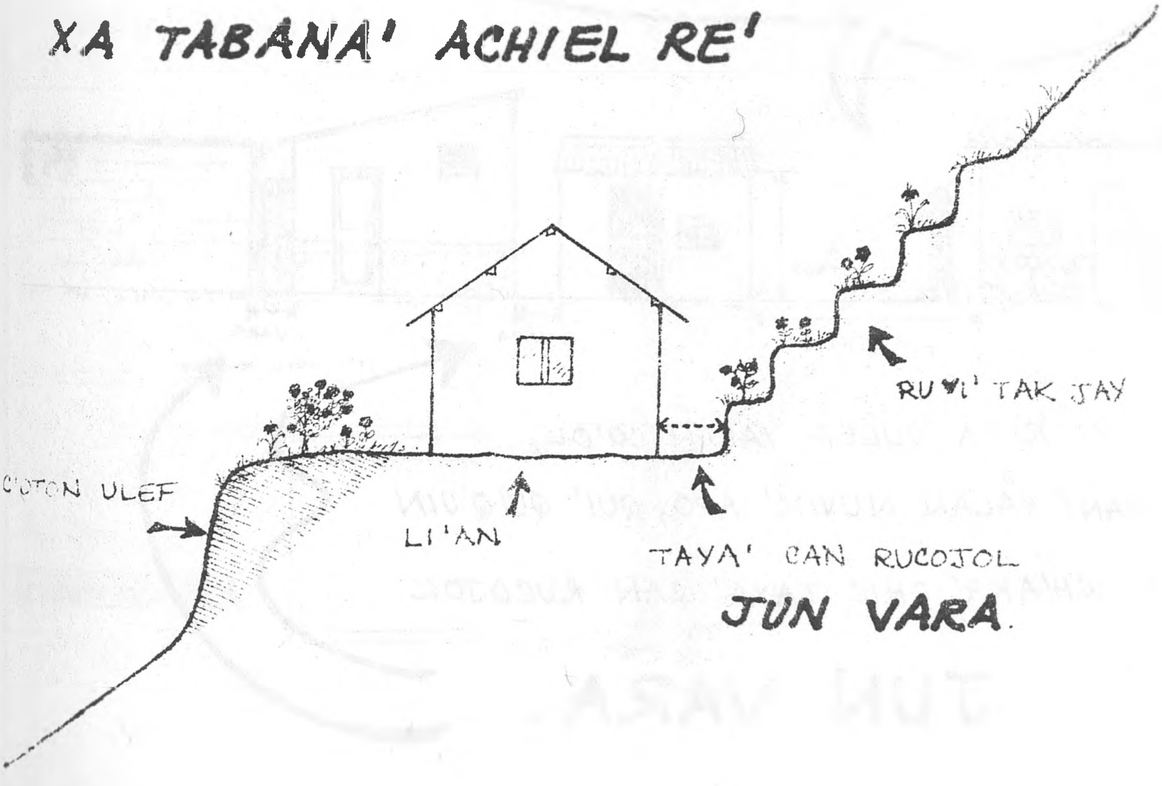
RI JUYU' TAK ULEF

MAN UTZTA

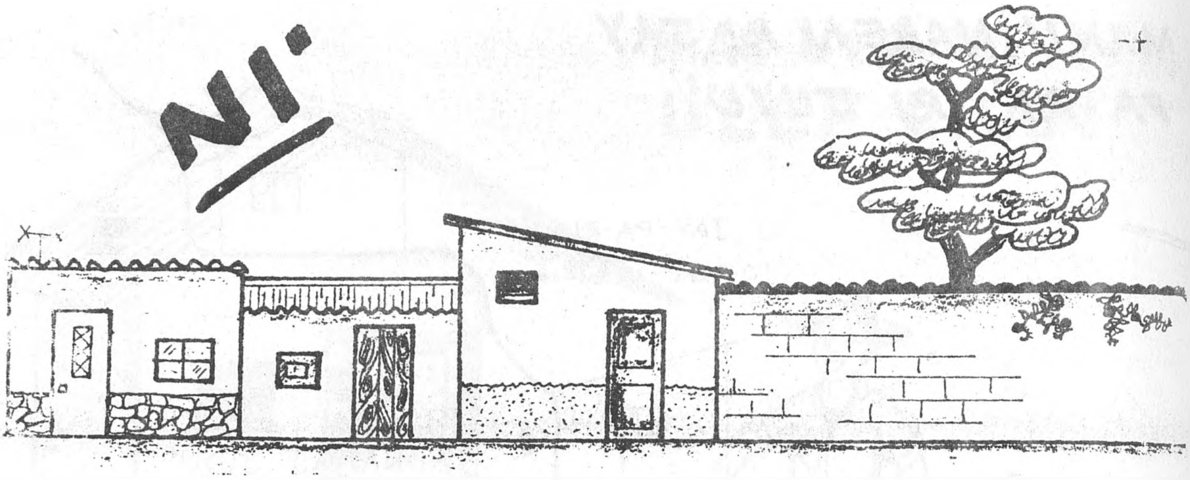
MANI' NABEN RI JAY PA RI', RI JUYU'!



XA TABANA' ACHIEL RE'



NI'

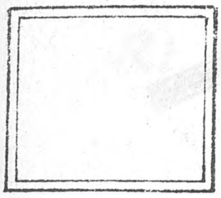


MANI' YALAN JUNAN NIBAN
CHIQUE RI JAY.

VI RI A VULEF YALAN CO'OL,
MANI' YALAN NUVIK' APO, QUI' QUIQ'UIN
RI CH'AKA' CHIC TAYA' CAN RUCOJOL

JUN VARA.

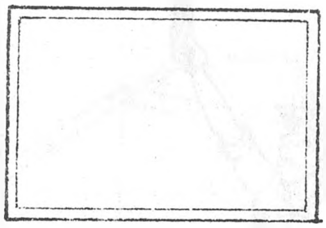
RUBANIQUIL TAK JAY



JA RI CUADRADA

UTZ.

RI'



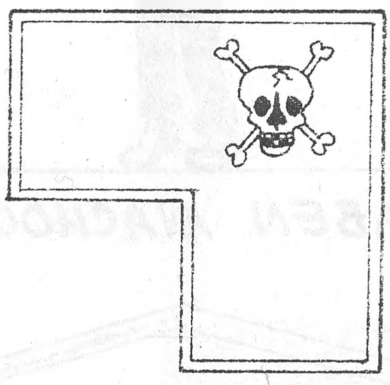
RI YUKUYIC
RAKEN CHUKA'

UTZ.

JA RI ESCUADRA

MANAK UTZTA

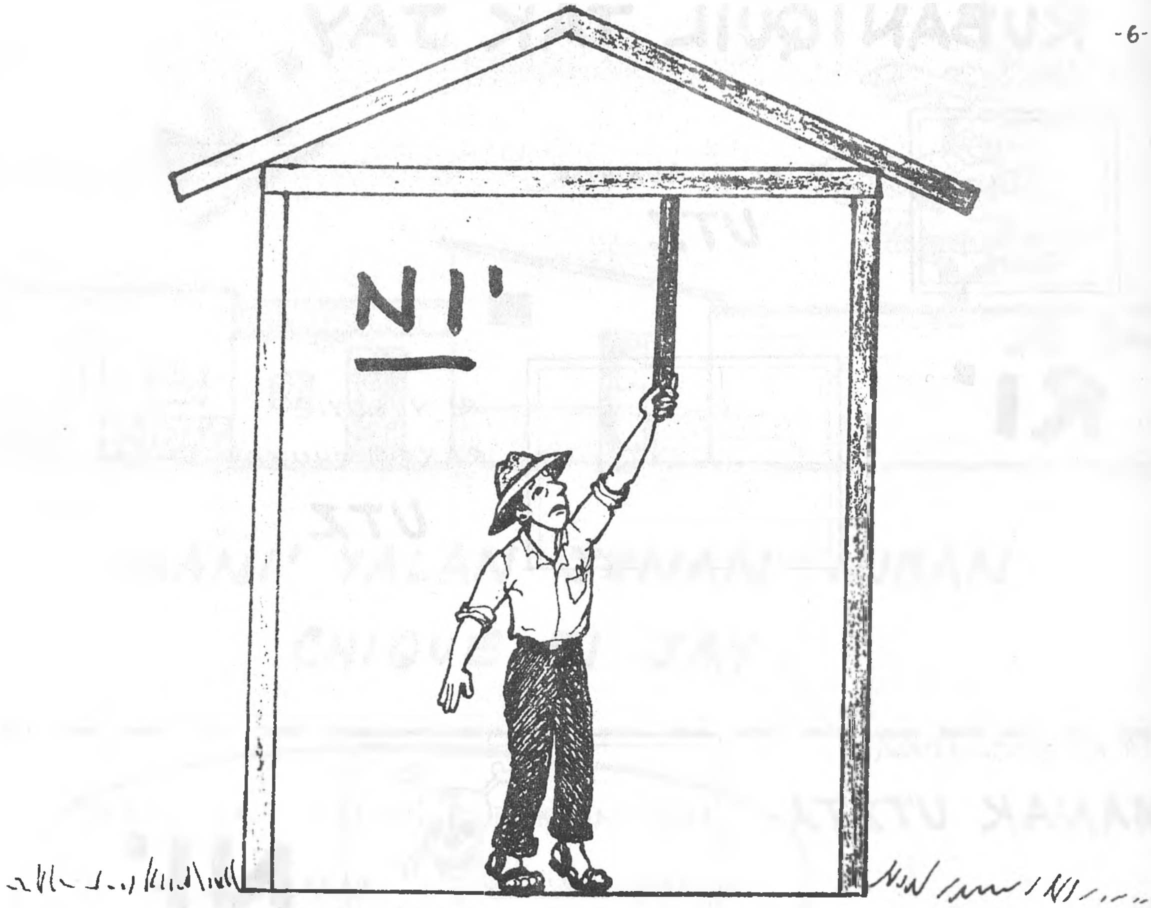
MANI' NABEN RI JAY
PA ESCUADRA.



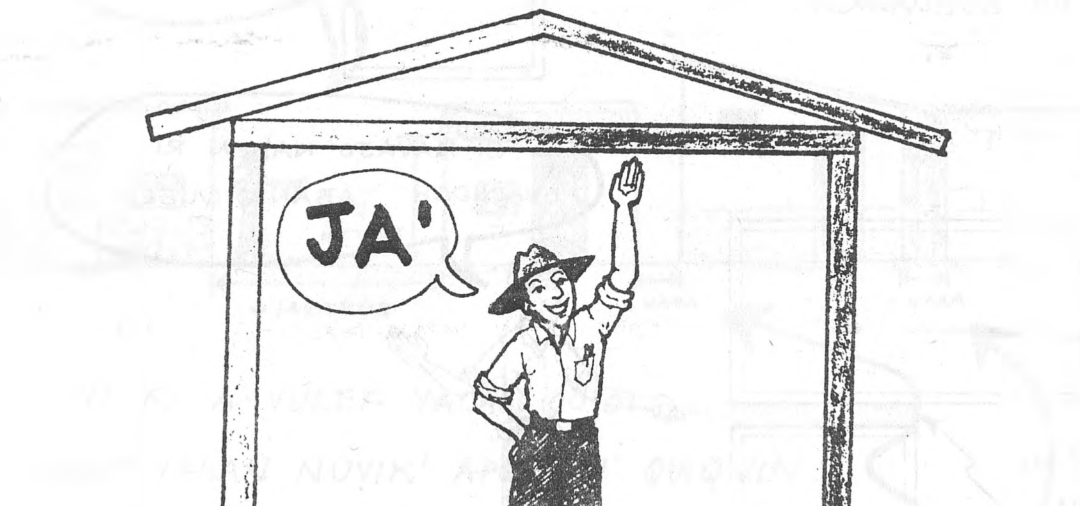
NI'

TAYA' CAN
RUCOJOL

JUN VARA.



MANI' NABEN AVACHOCH NIM RU RAKEN.

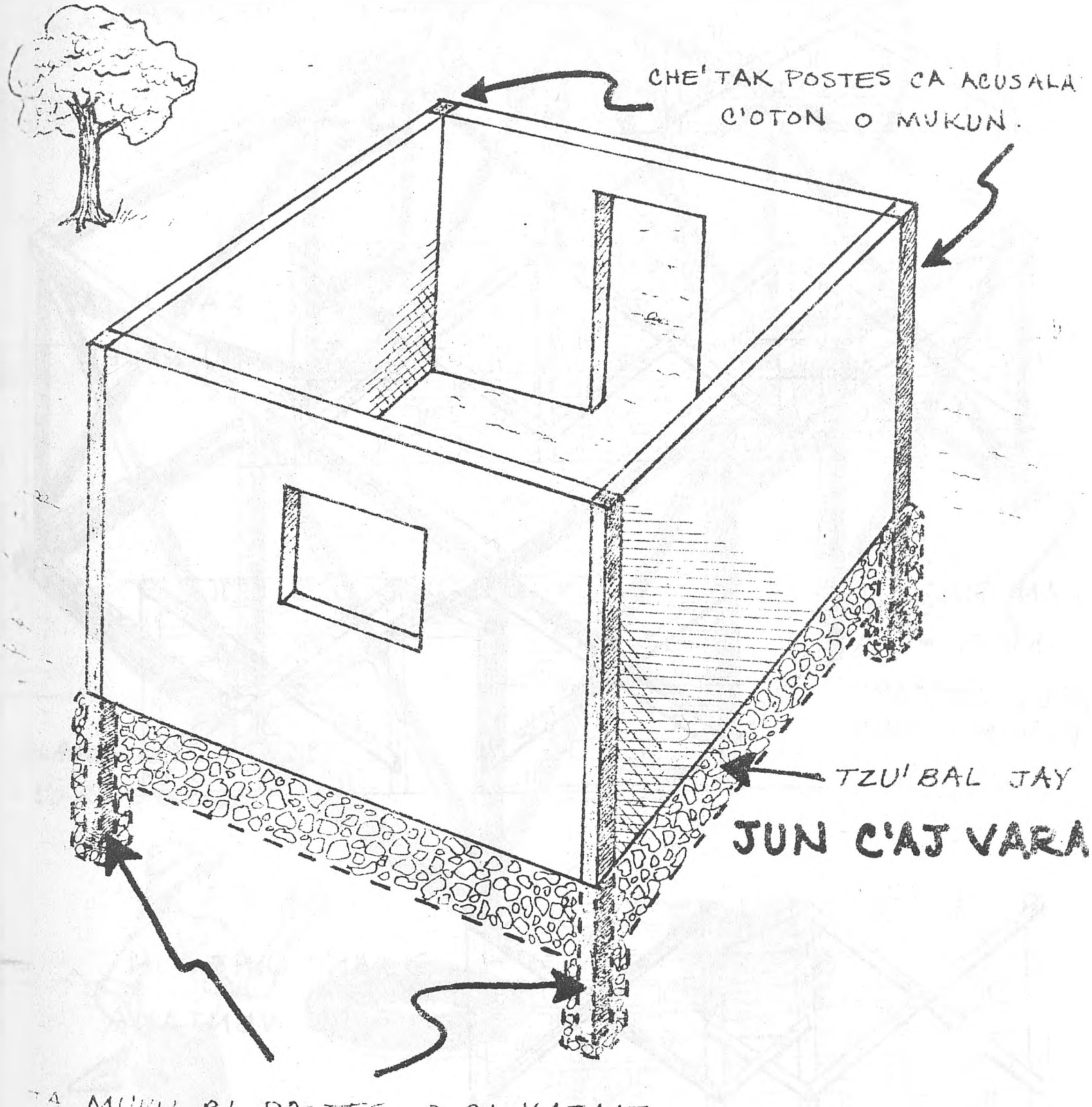


TABANA' RI MAS CO'OL OC.

TA UCUSEX SIEMPRE PA TAK ESQUINAS

RI POSTES o RI XATA'T,

ROMA C'O MAS RUCHUKA!

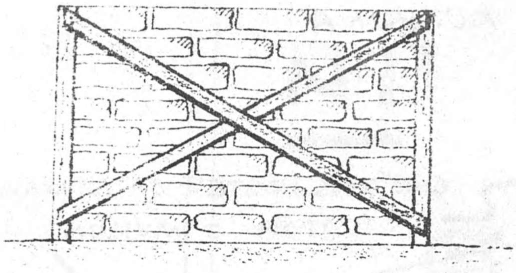


TA MUKU RI POSTES O RI XATA'T

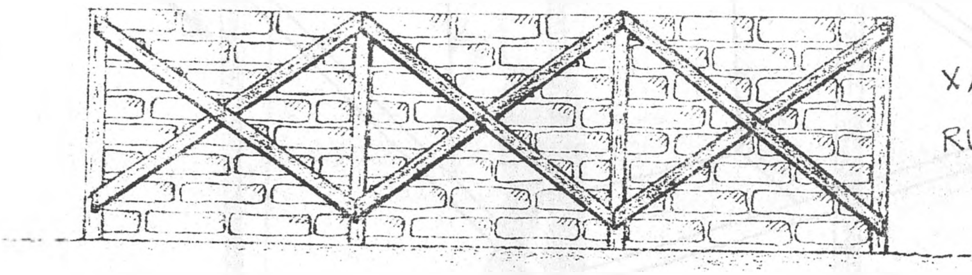
JUN VARA

CHUPAN RI ULEF

QUERI' NABEN RI
RUCHUKA' TAK JAY

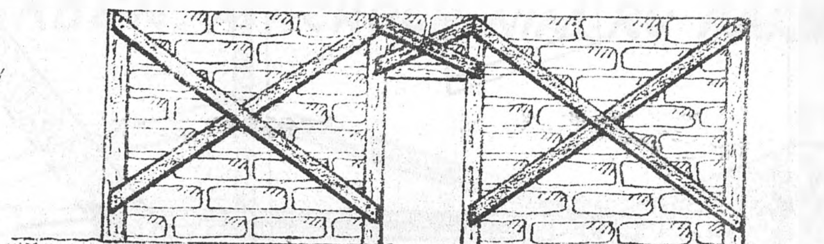


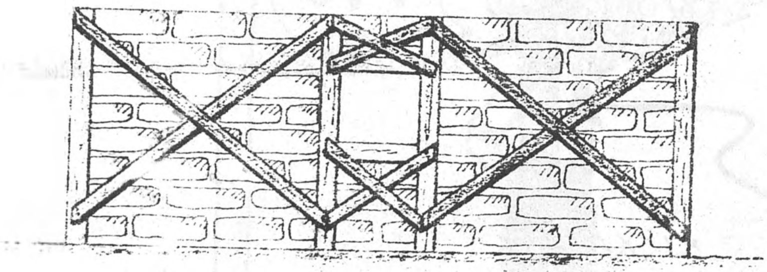
XAN CO'OL RU RAKEN



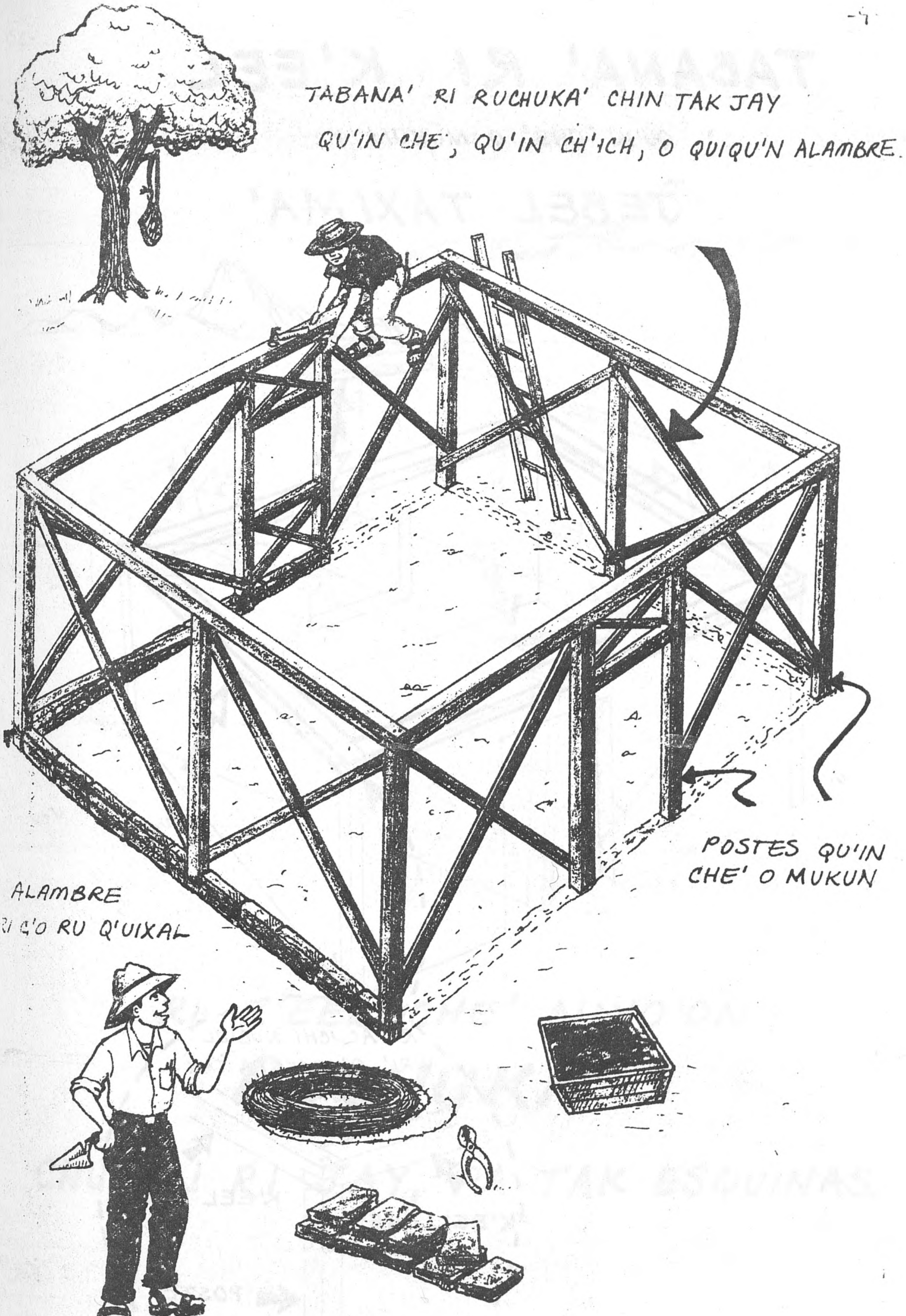
XAN NIM
RU RAKEN

XAN QUIQU'IN
RU CHI' JAY





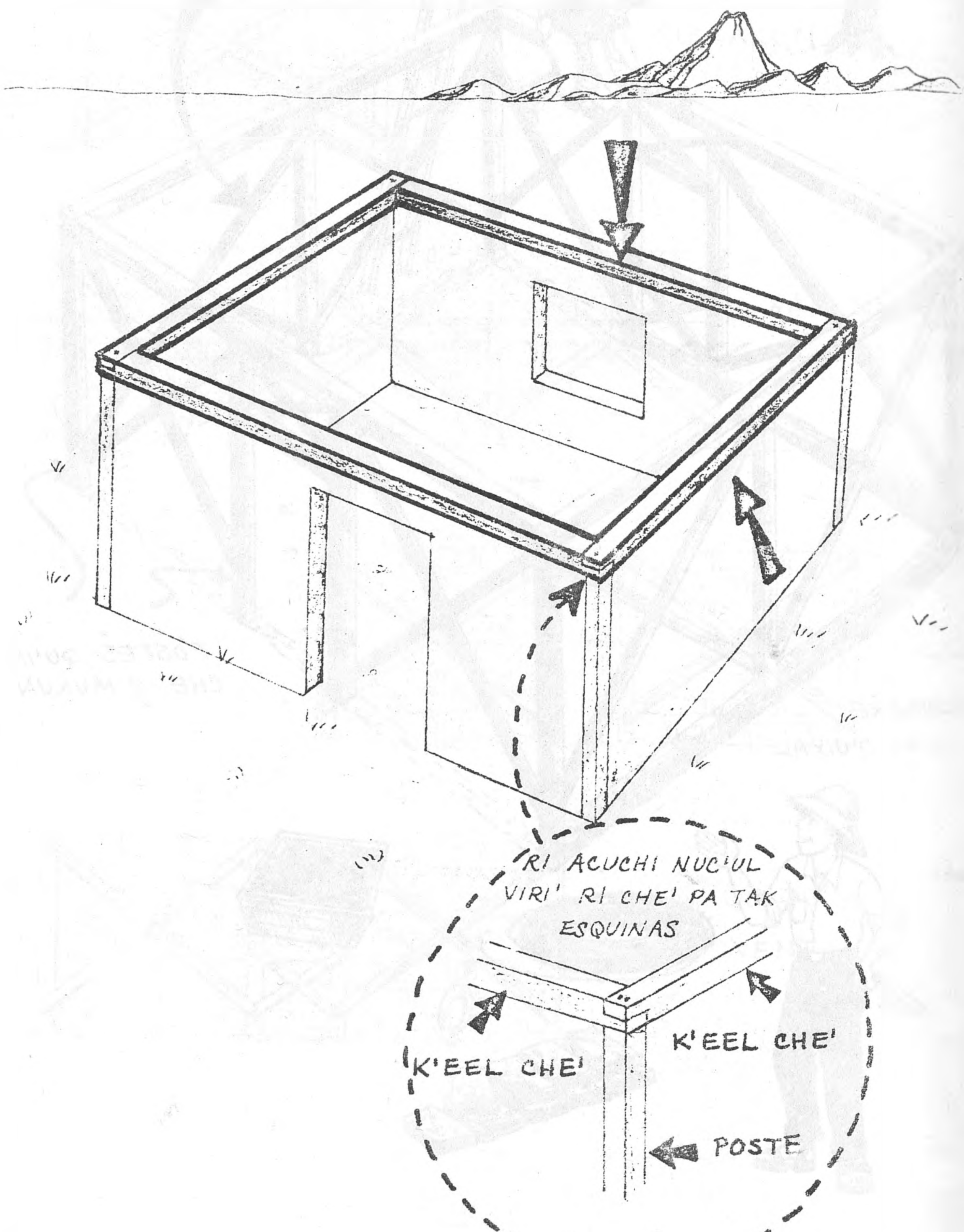
XAN QUIQU'IN
RU VENTANA

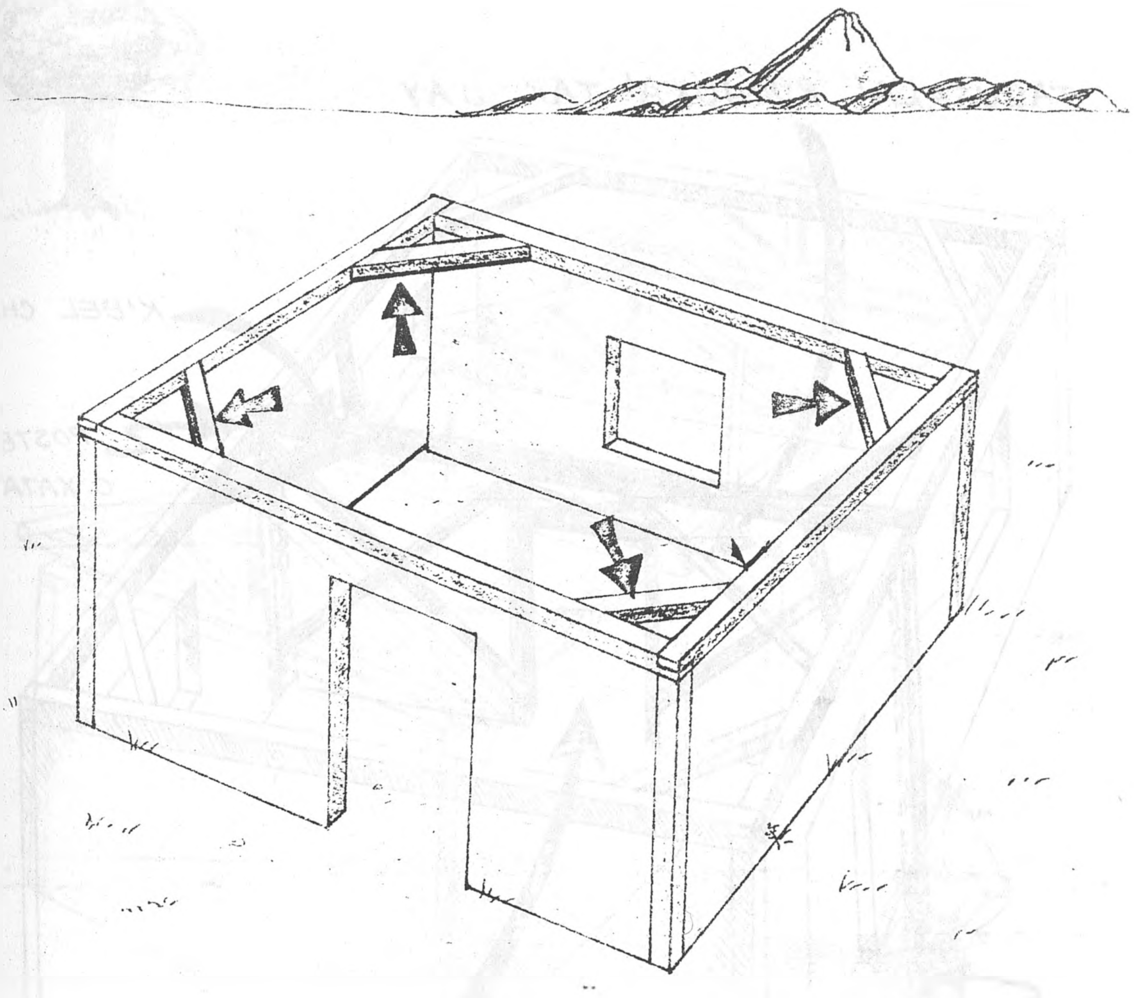

TABANA' RI RUCHUKA' CHIN TAK JAY
QU'IN CHE', QU'IN CH'ICH, O QUIQU'N ALAMBRE.
POSTES QU'IN
CHE' O MUKUN
ALAMBRE
RI C'O RU Q'UIXAL

TABANA' RI K'EEL

QU'IN CHE' O MUKUN Y

JEBEL TAXIMA'



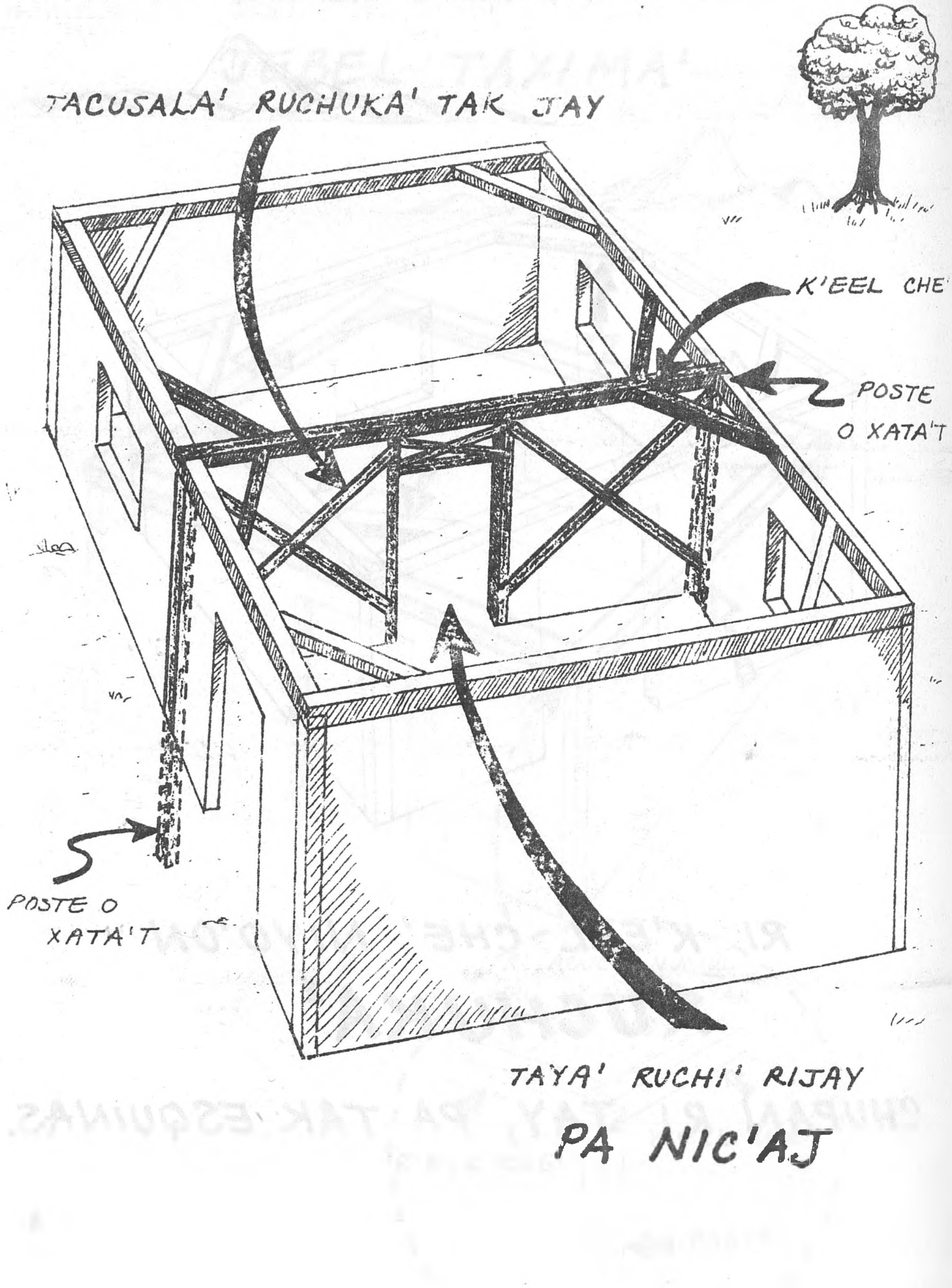


RI K'EEL CHE' NIYO'ON

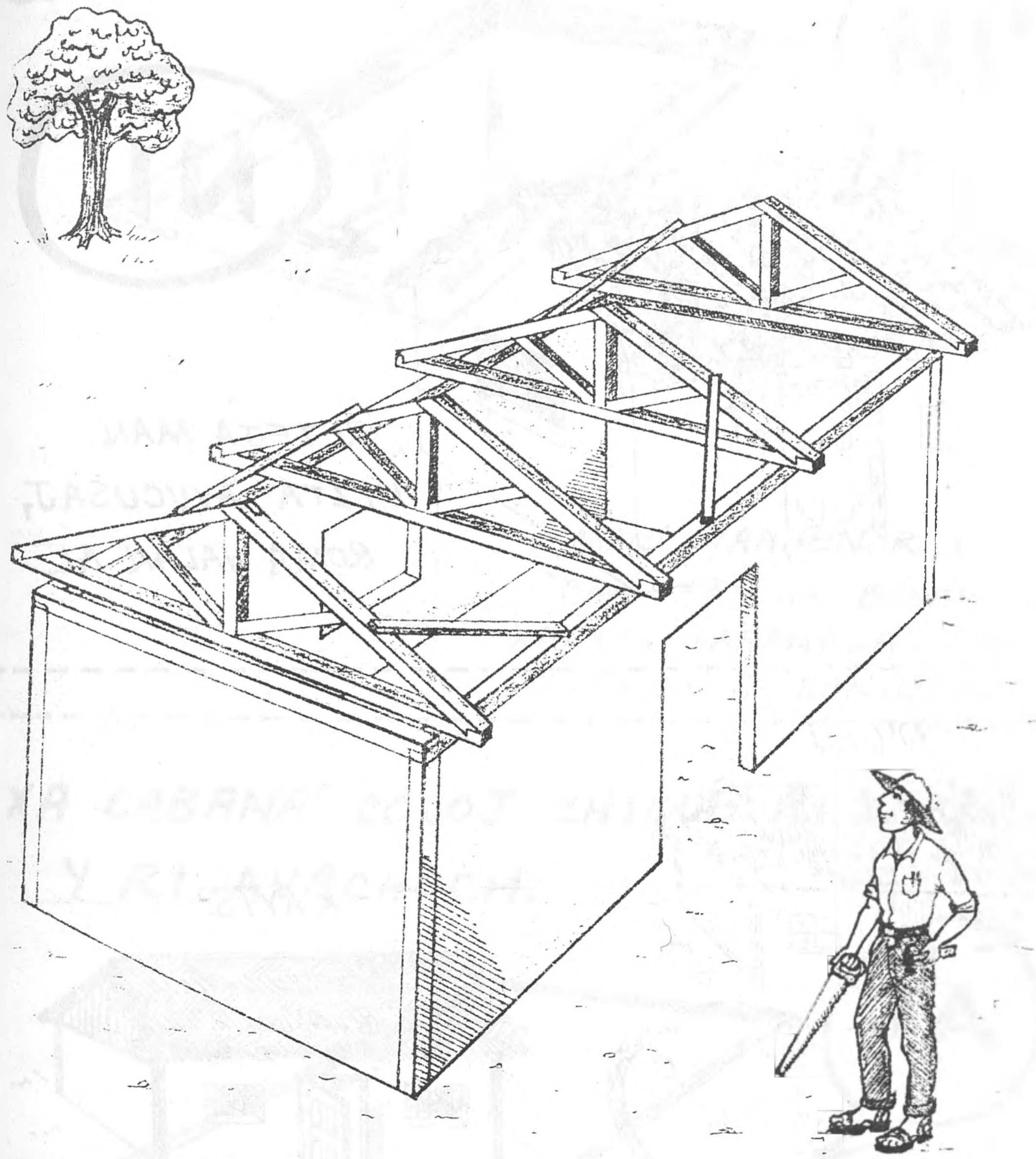
RUCHUKA'

CHUPAN RI JAY, PA TAK ESQUINAS.

NABEY TAK XAN



PA NIC'AJ

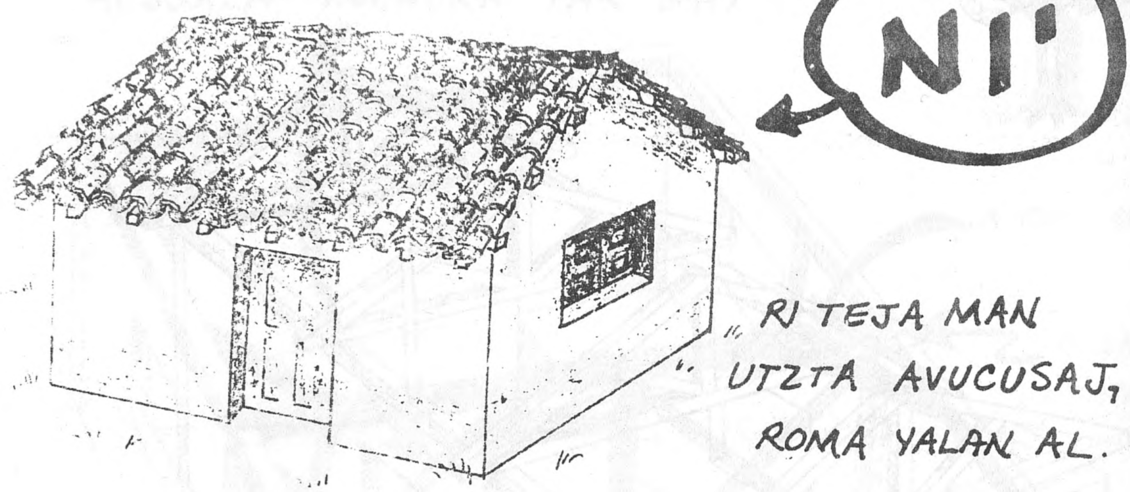


RI TIJERAS O K'EBAN TAK CHE'

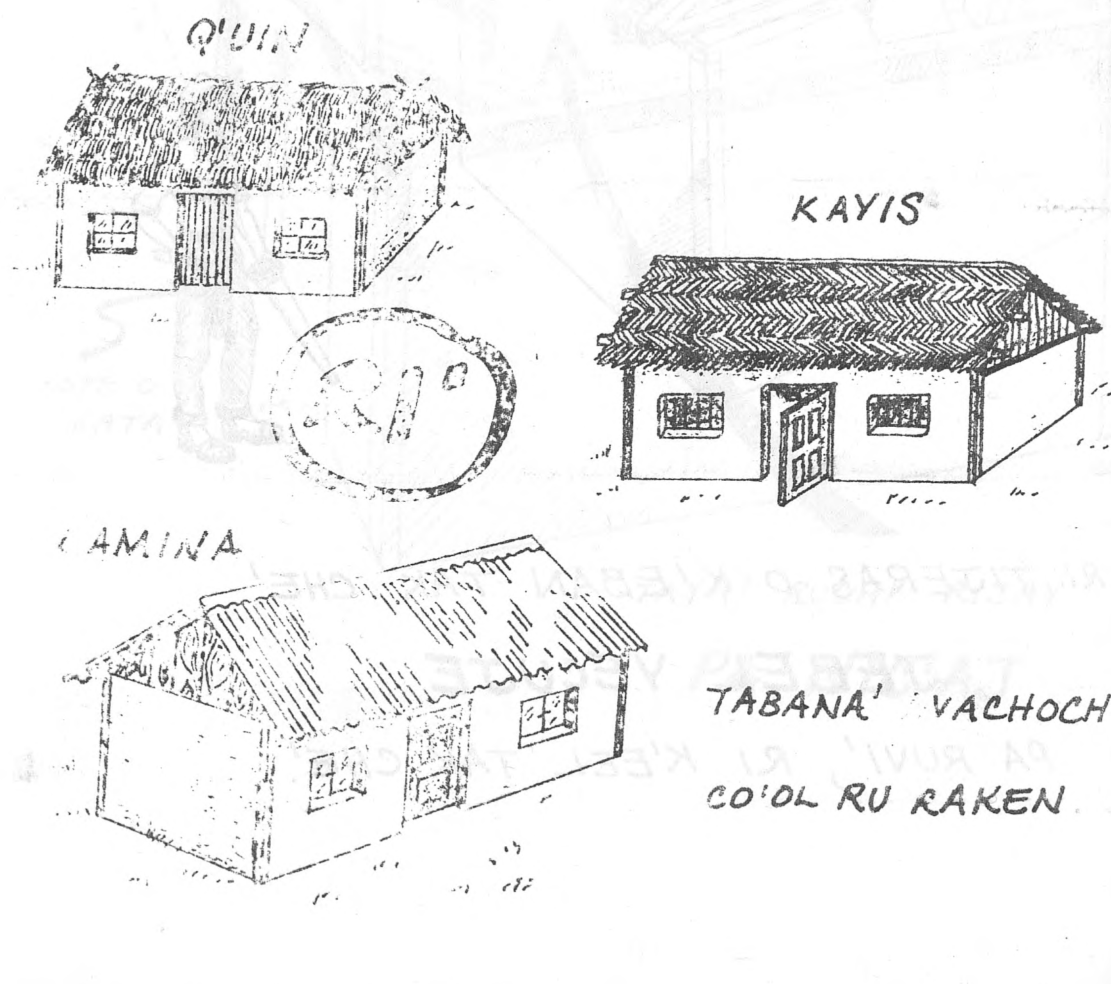
JEBEL YECUJE

PA RUVI', RI K'EEL TAK CHE'.

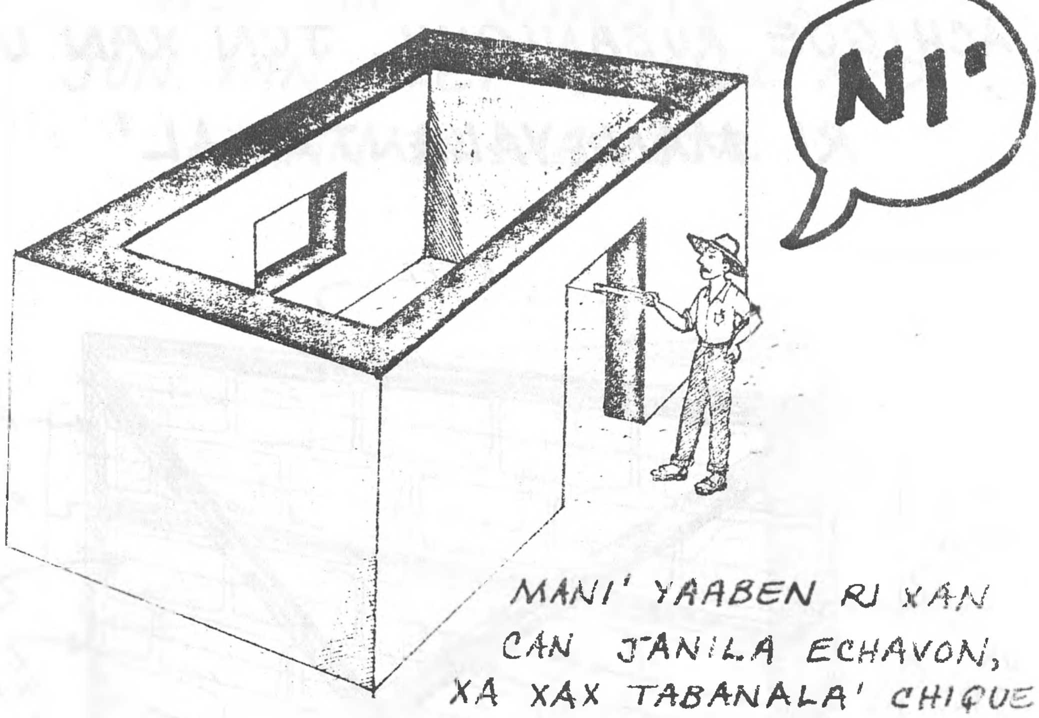
RUVI' RI JAY CAN MAS UTZ



RI TEJA MAN UTZTA AVUCUSAJ, ROMA YALAN AL.

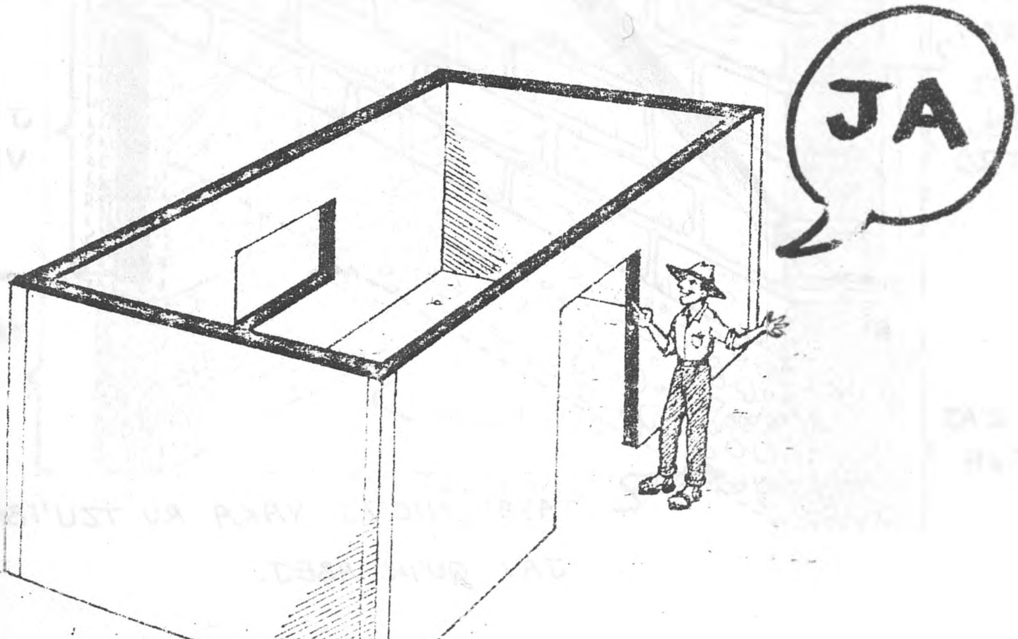


TABANA' VACHOCH CO'OL RU RAKEN

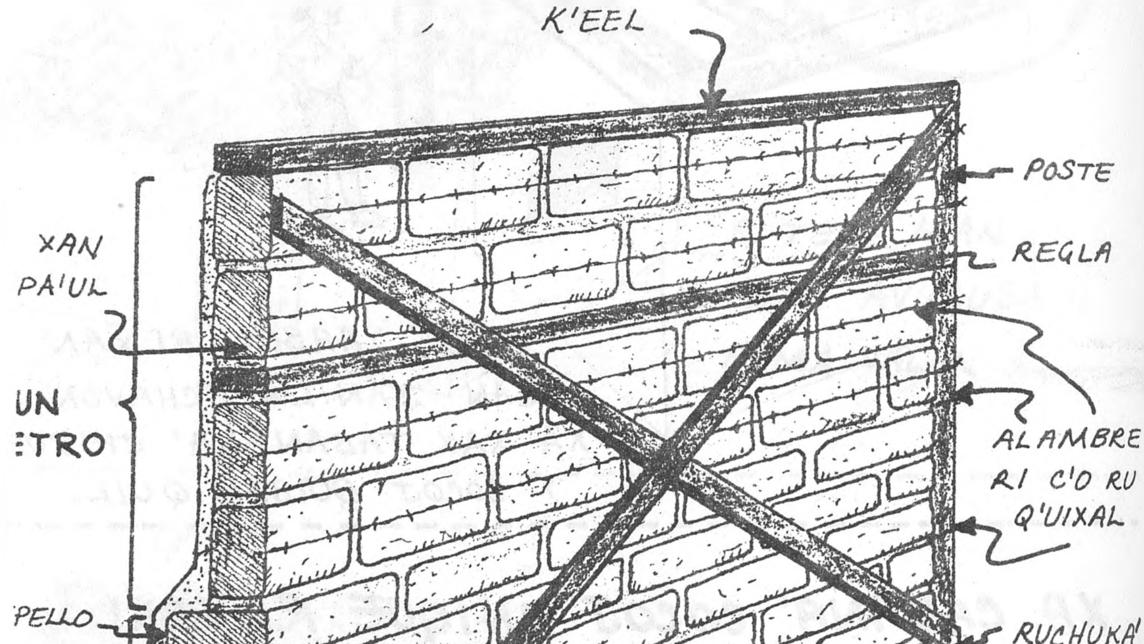


MANI' YAABEN RI XAN
CAN JANILA ECHAVON,
XA XAX TABANALA' CHIQUE
Y COCOJ QUIBANIQUIL.

XA CABANA' COCOJ CHIQUE RI XAN
Y RI AVACHOCH.



ACHIQUE RUBANIQUIL JUN XAN ULEF RI MAN YALANTA AL'



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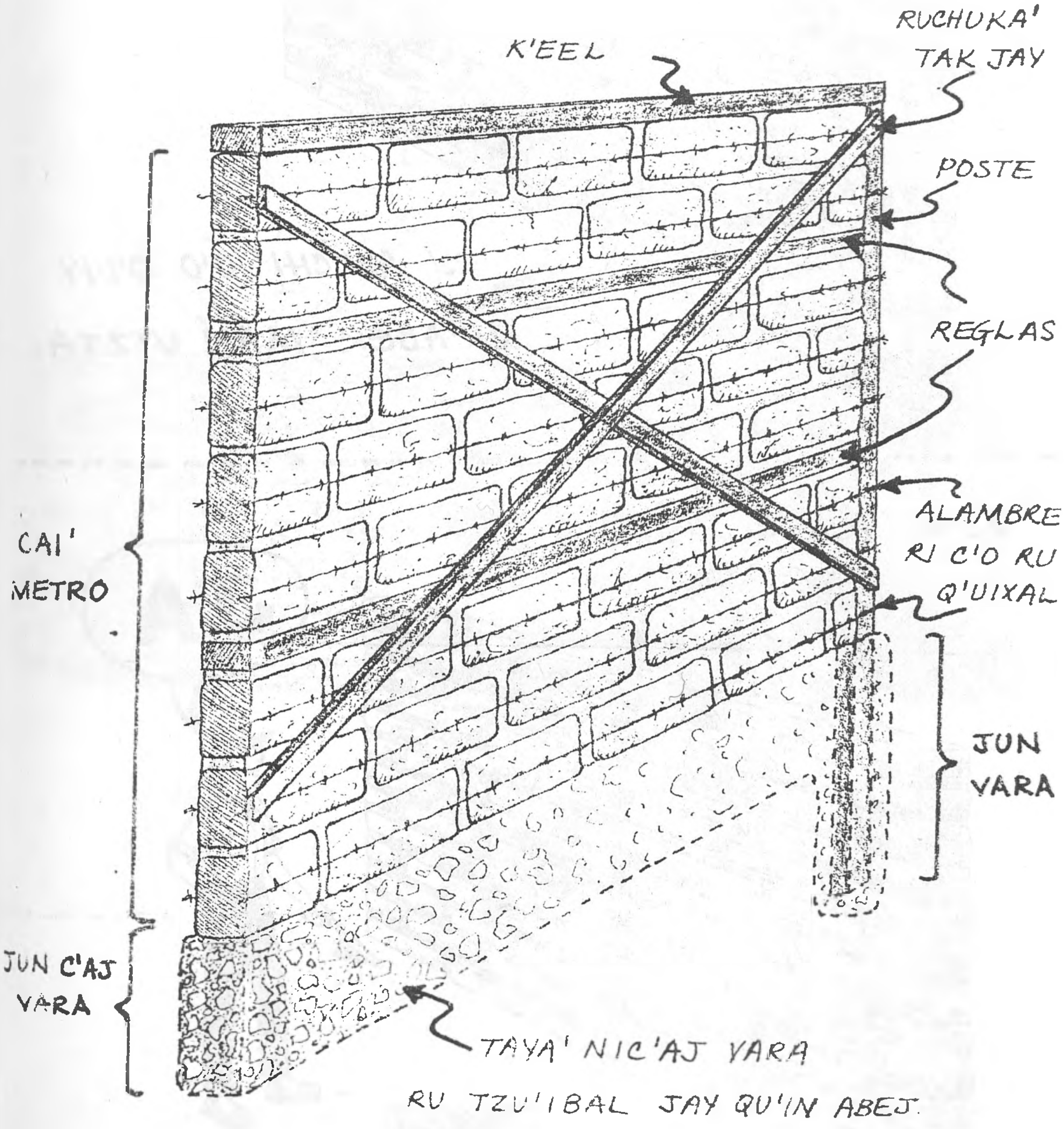
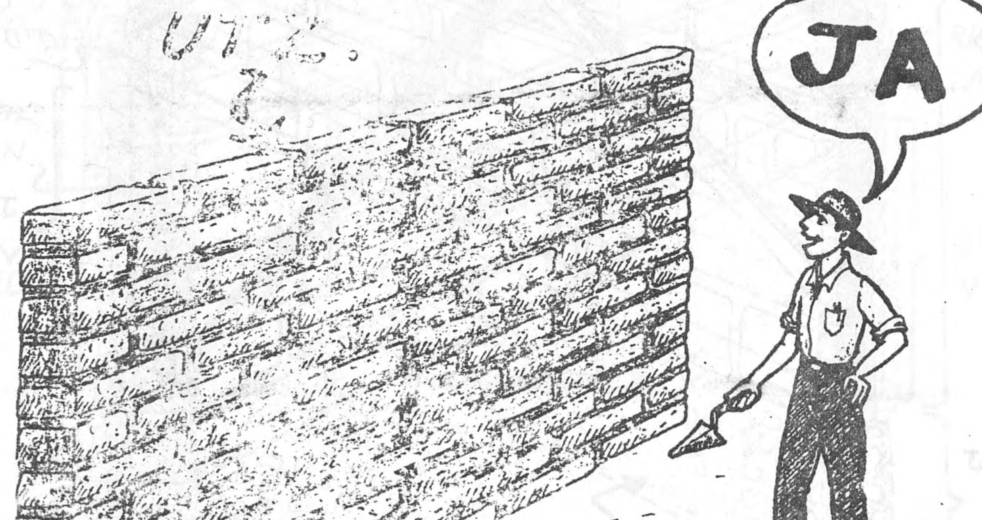


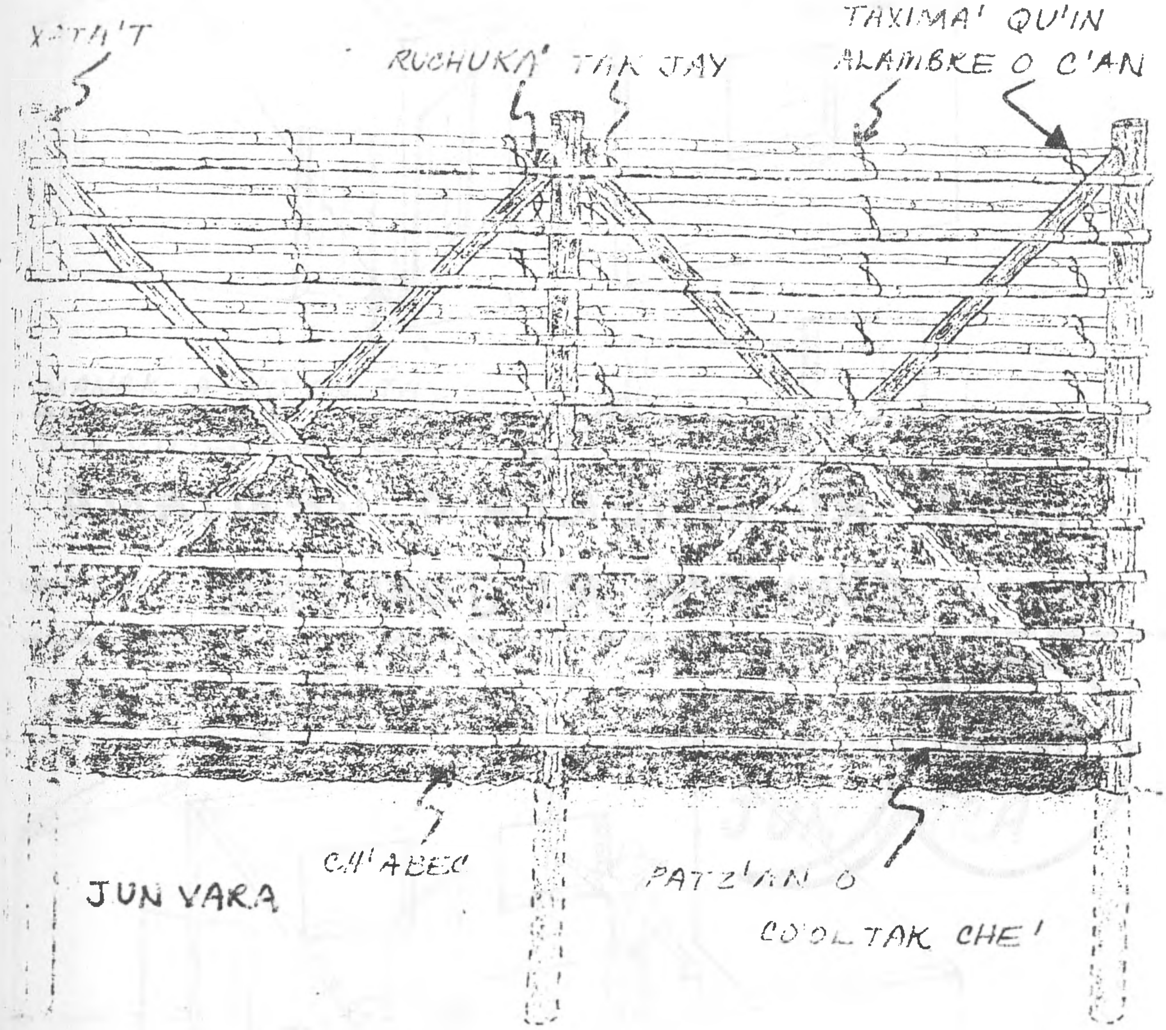
NI'

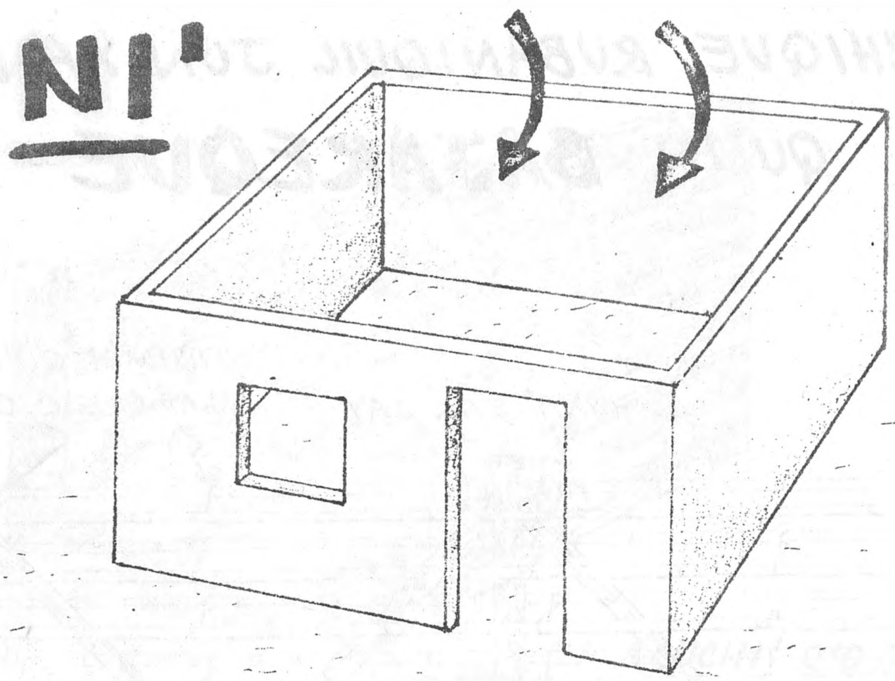
RI ACUCHI' C'O Q'UIY CH'ABEK MAN UTZTA.

JUBA RI CH'ABEK UTZ.

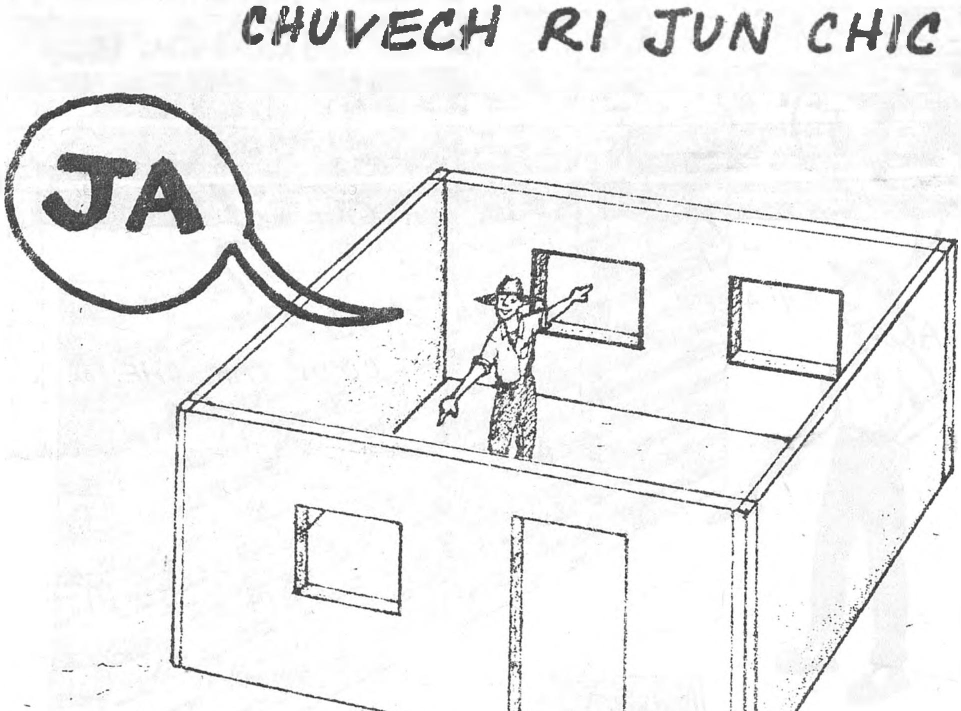


ACHIQUE RUBANIQUIL JUN XAN QU'IN BAJAREQUE

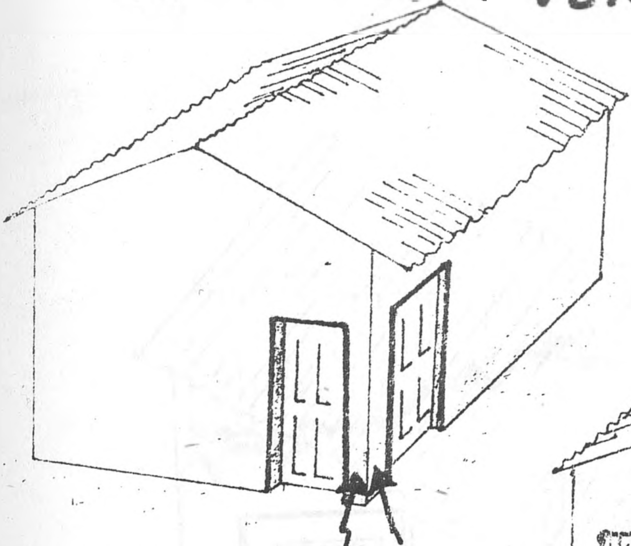




TAYA' RI APUERTA O VENTANA CHUVECH RI JUN CHIC.



UTZ QUIBANIQUIL RI APUERTAS Y VENTANAS CA ABANALA



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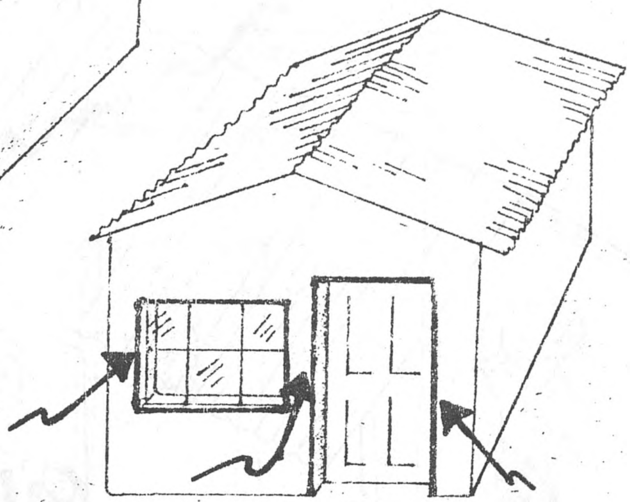
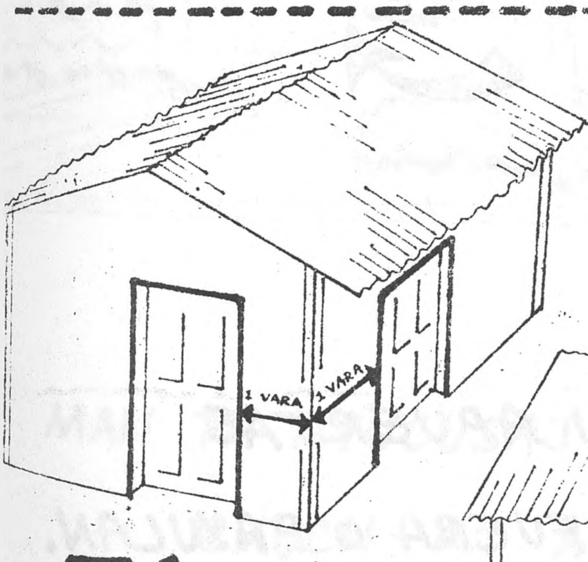


MANAK A YO'ON TA CAN SIPILEJ RU COJOL

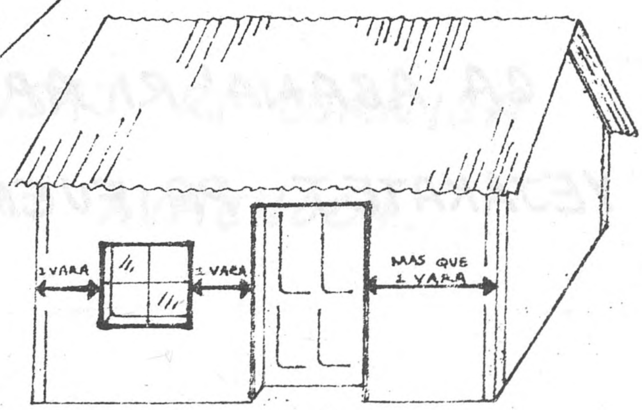
MANI NAYA' CAN APUERTAS Y VENTANAS CI RI XAN, RI YALAN CO'OL.



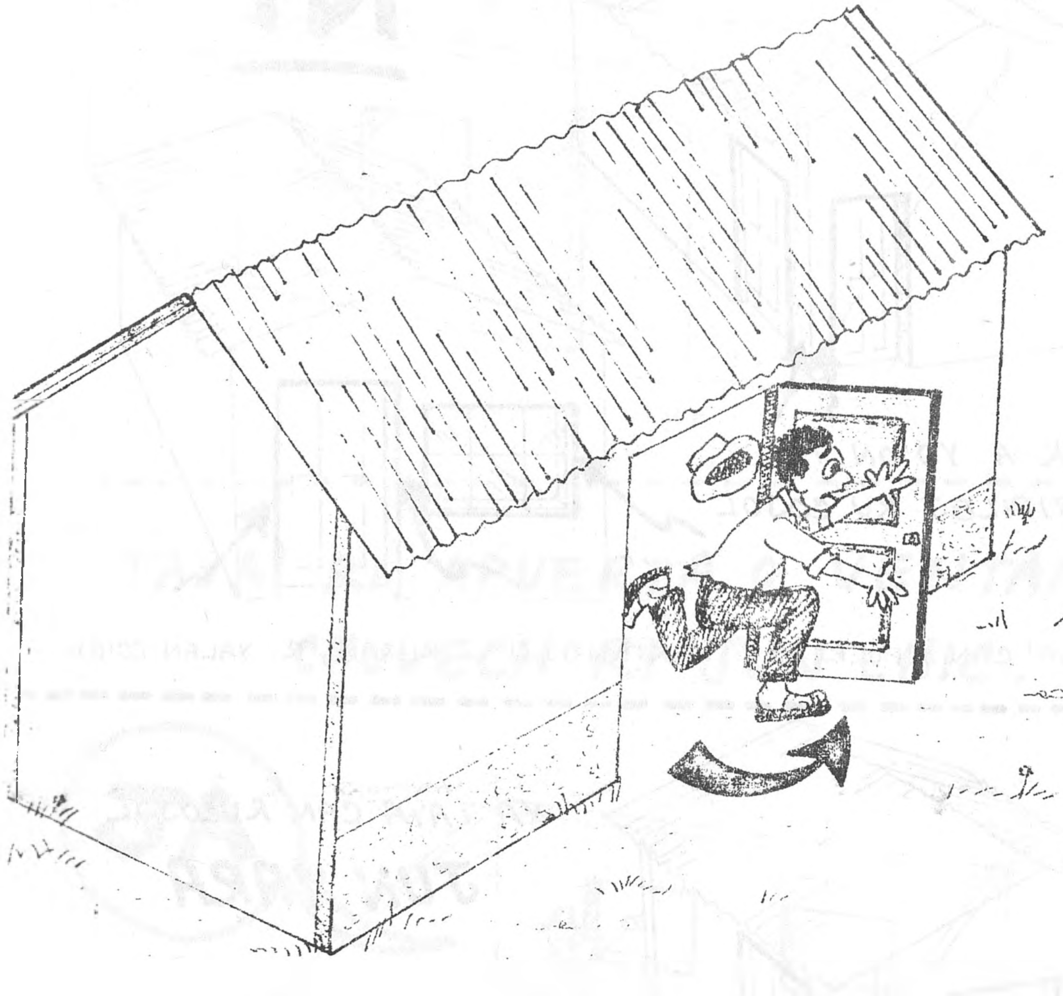
XA TAYA CAN RUCOJOL

JUN VARA

JA

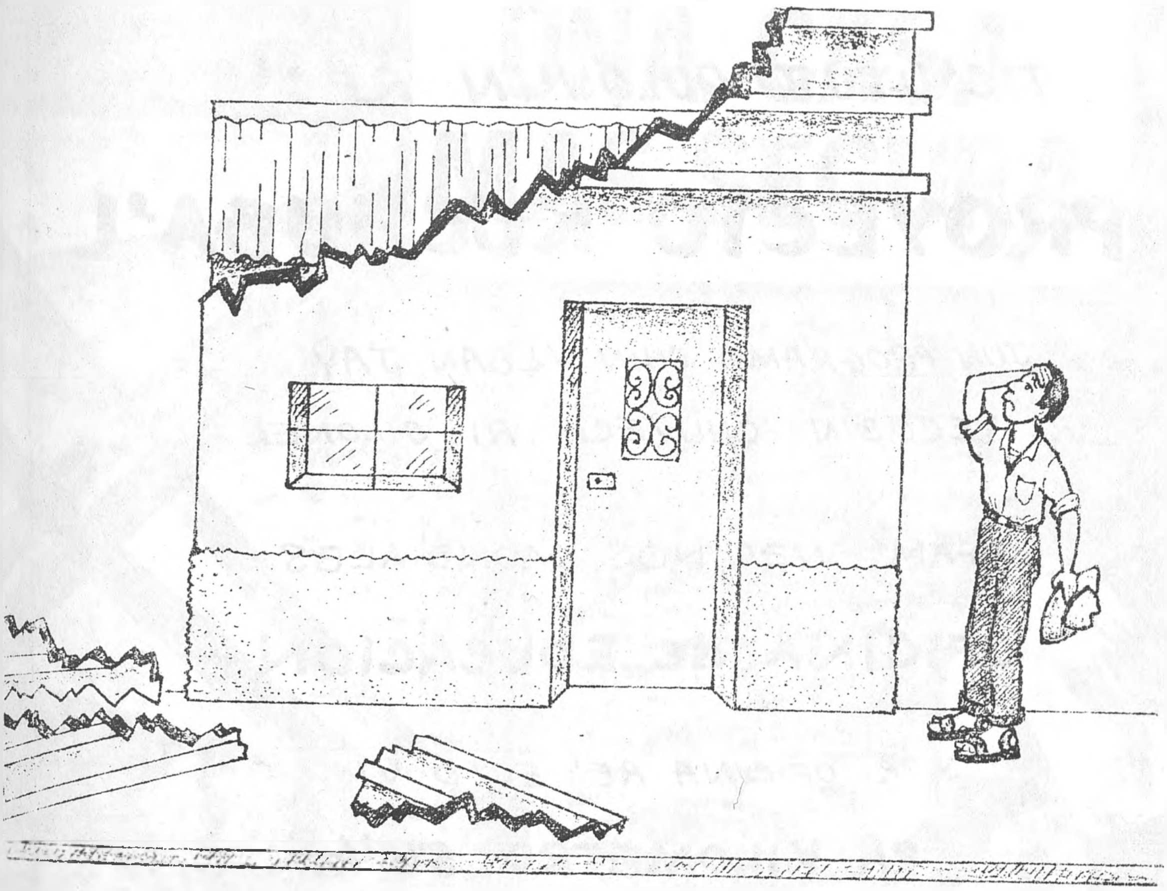


TAYA'RI APUERTAS Y VENTANAS ACUCHI' EC'O RI XAN MAS NIM VI.



CA ABANA' RI APUERTAS

YEJAKATEJ PA FUERA O PAXULAN.



MAN TA AVUCUSAJ RI CORNISA

CHUCH RI AVACHOCH.

VI RIX DIVAJO' NIVETAMAJ PA RU VI'
RI VUJ RE',
TIC'UTUJ QUIQU'IN RI :

PROYECTO KUCHUBA'L

JUN PROGRAMA CHIN YEBAN JAY
RI YECOBIN CHUVECH RI SILONEL

OXFAM - VECINOS MUNDIALES
OFICINA de EDUCACION

Y RI OFICINA RE' EC'O VI
PA KILOMETRO 56 ½
CARRETERA PANAMERICANA
CHIMALTENANGO
APARTADO 52

Septiembre de 1,976


COMO HACER
UNA CASA
MAS SEGURA

OBJETIVOS

La idea básica que motivó la preparación de este libro fue la de proporcionar a las personas cuyas casas fueron destruidas por el terremoto, un manual de instrucciones sobre cómo ellas pueden construir su nueva casa, de acuerdo con los siguientes objetivos:

1. Tener un costo mínimo.
2. Estar de acuerdo con costumbres locales
3. Usar materiales disponibles corrientemente.
4. Usar conocimientos locales.
5. Considerando el costo de la obra y el tipo de materiales empleados, proporcionar la mayor resistencia posible contra un terremoto.

Si se quieren usar otras técnicas de construcción más complejas, es indispensable emplear los servicios de un maestro de obra o, de preferencia, un ingeniero civil.

En la preparación de este libro se han explicado las técnicas recomendadas a través de dibujos que se explican por sí solos y con lenguaje sencillo.

La publicación de este libro se hizo posible mediante una donación de PHILIP MORRIS, INC., New York, U.S.A., a través de su filial en Guatemala, Tabacalera Centroamericana, S.A. (TACASA), como una manifestaicón de sus sentimientos y solidaridad con motivo del terremoto del 4 de febrero de 1976.

Las técnicas recomendadas en el libro son el resultado de trabajos realizados por las Cooperativas "Kato-Ki Quetzal" en Guatemala, con la asesoría de la compañía "INTERTECT".

La presentación gráfica fue diseñada con la ayuda del Programa de Educación Básica Rural del Ministerio de Educación de la República de Guatemala.

Antes de su publicación, el contenido de este Manual fue sometido al examen y revisión de los cuerpos técnicos del Comité Nacional de Reconstrucción y de la Universidad de San Carlos. Los editores agradecen la colaboración que prestaron dichos cuerpos.

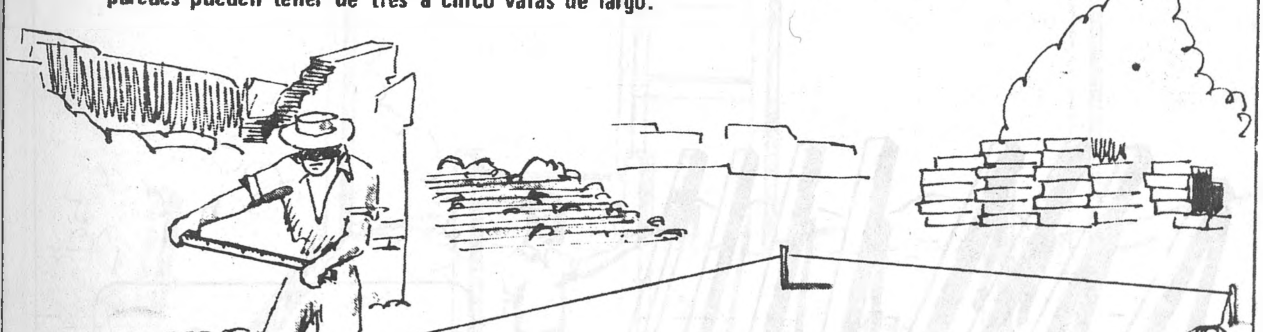
DISTRIBUCION GRATUITA


Faustino: ¿Qué podemos hacer? ¡Nuestra casa está en ruinas y las lluvias llegan pronto!

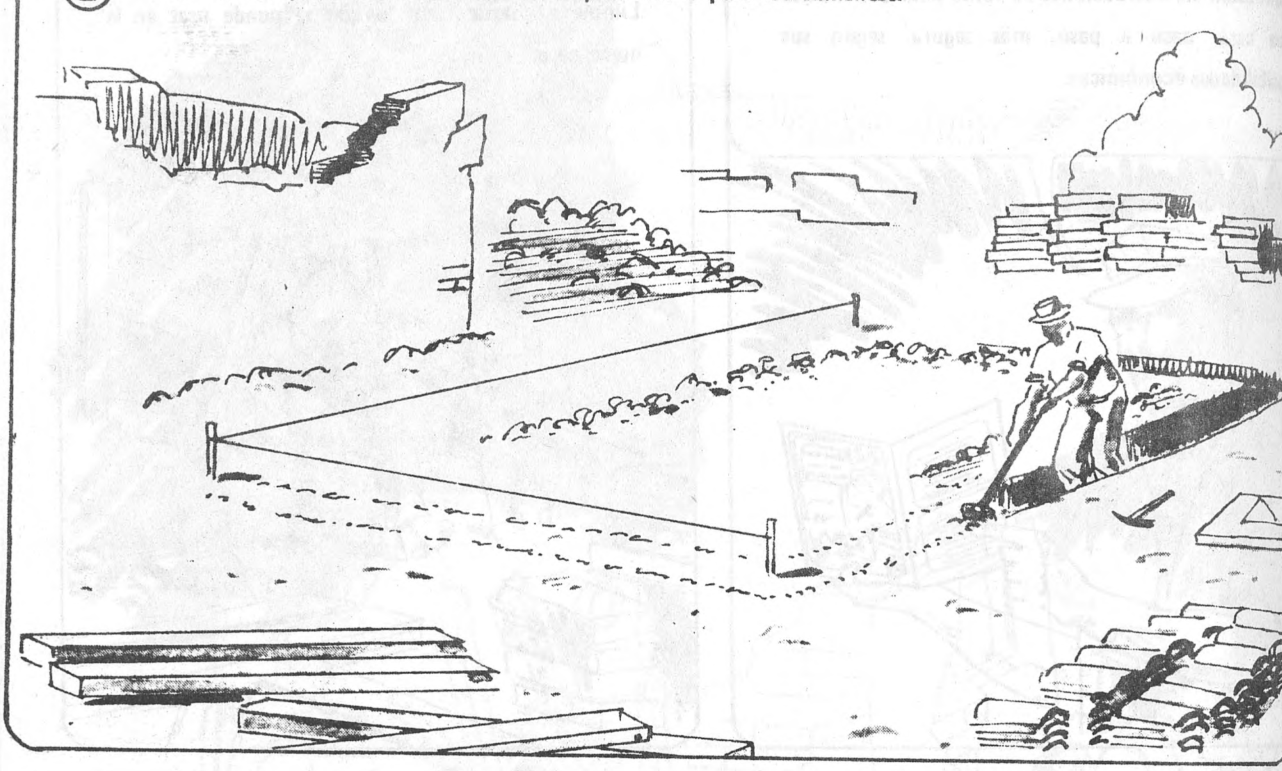
Aquí están las instrucciones de cómo debe construirse una casa, paso a paso, más segura, según sus posibilidades económicas.

① Limpie y guarde todo lo que se puede usar en la nueva casa.

② Marque la posición de la nueva casa. Debe estar por lo menos a una vara de cualquier otra casa o pared. La casa debe ser cuadrada o rectangular; *nunca* debe construirla en forma de escuadra. Las paredes pueden tener de tres a cinco varas de largo.



3. Haga una zanja de media vara de hondo y de ancho para los cimientos.



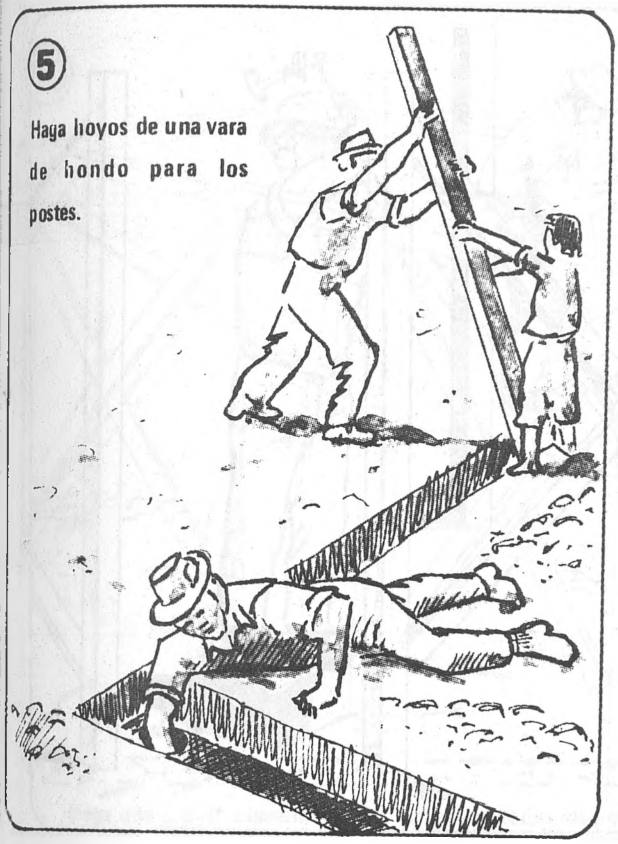
4. Obtenga postes de madera y reglas. *Pura mayor seguridad debe usar madera seca.* Pinte la madera contra la polilla y la humedad.

Contra polilla y humedad, use:

1. Carbolineo, o
2. Pentaclorofenol, o
3. Alquitrán, o
4. Aceite quemado

5

Haga hoyos de una vara de hondo para los postes.



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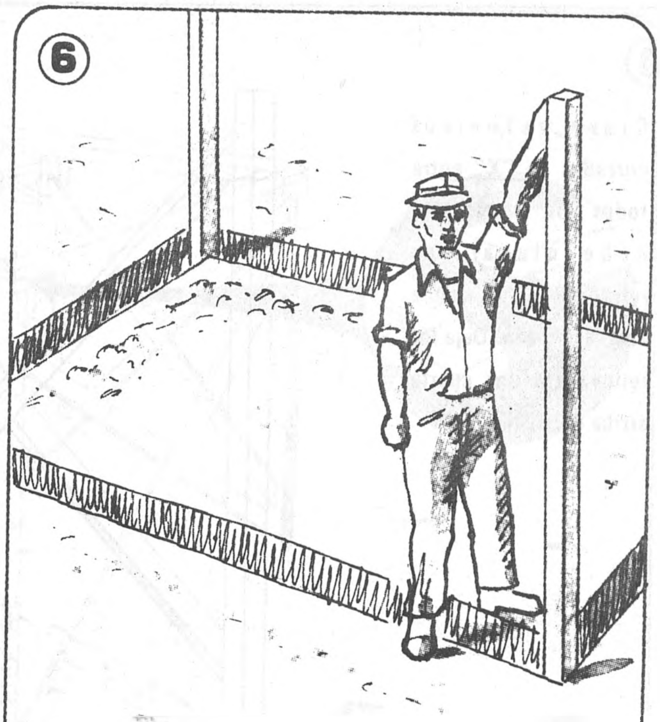
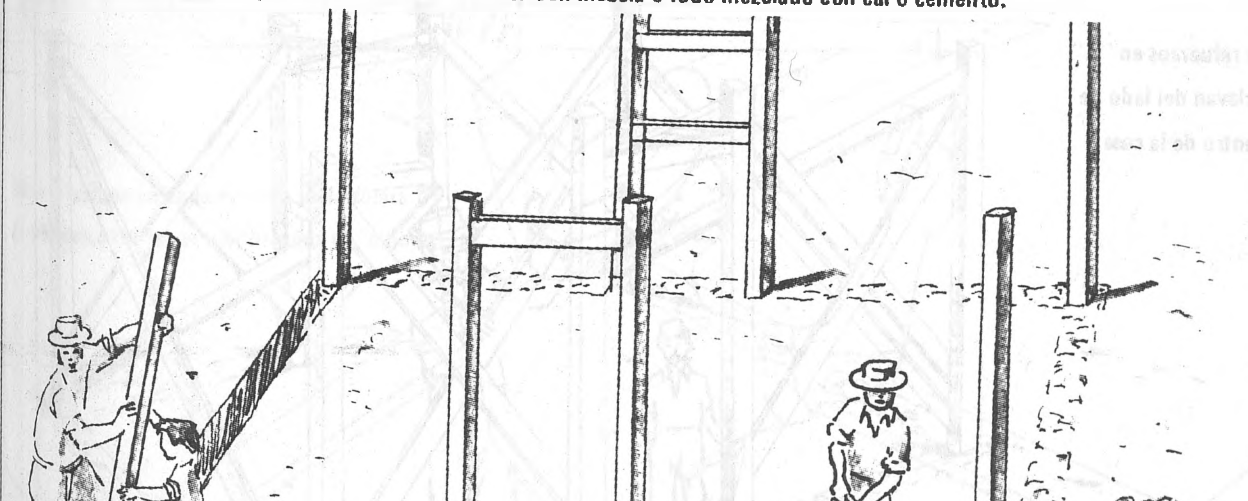


Los postes no deben ser muy altos. Debe poder alcanzar la parte de arriba con la mano.

7

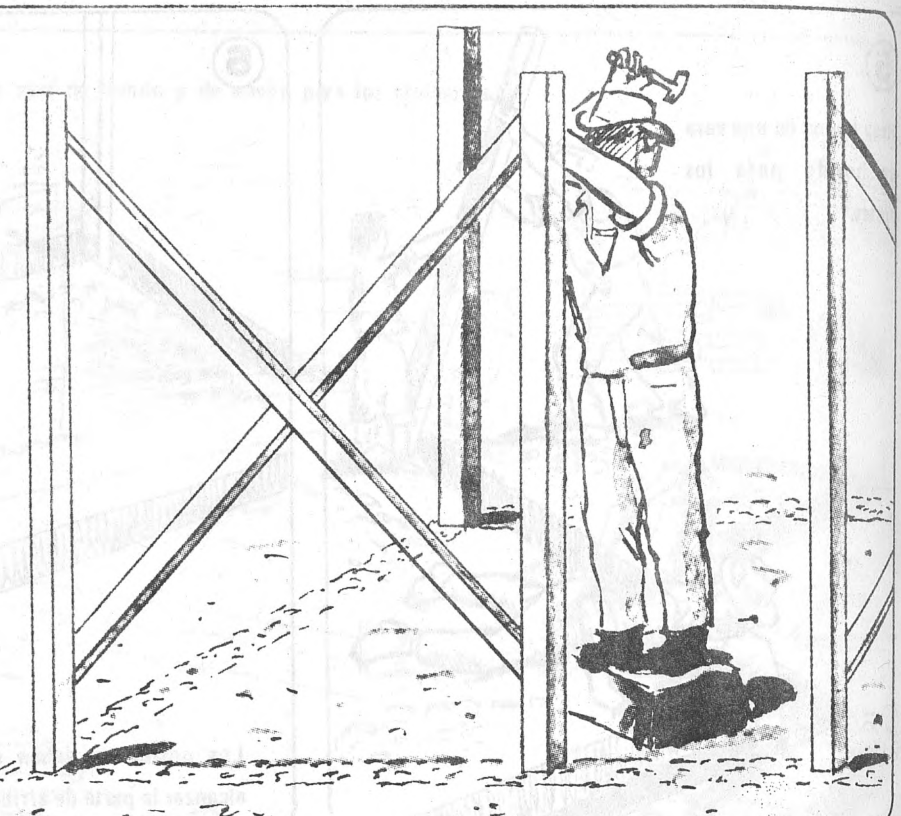
Meta los postes en los hoyos con mezcla, piedras o pedazos de ladrillo. Llene las zanjas con piedras, terrón, tejas quebradas o pedazos de ladrillo revuelto con mezcla o lodo mezclado con cal o cemento.



• La puerta y la ventana deben estar una enfrente de la otra en el centro de las paredes más largas.

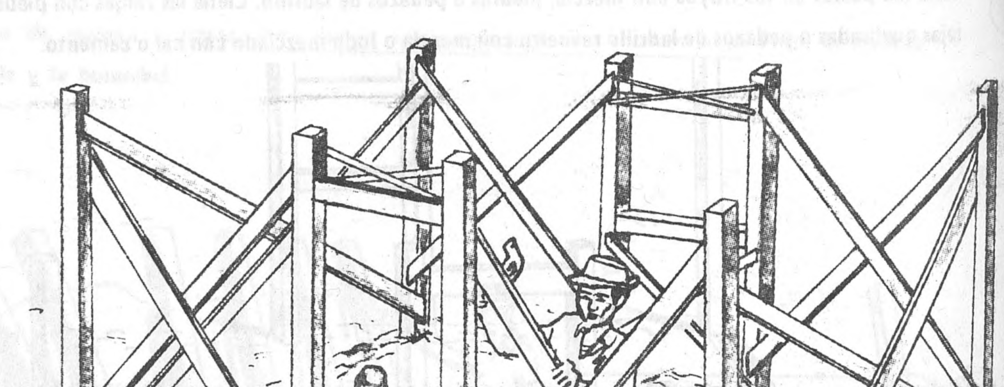
8

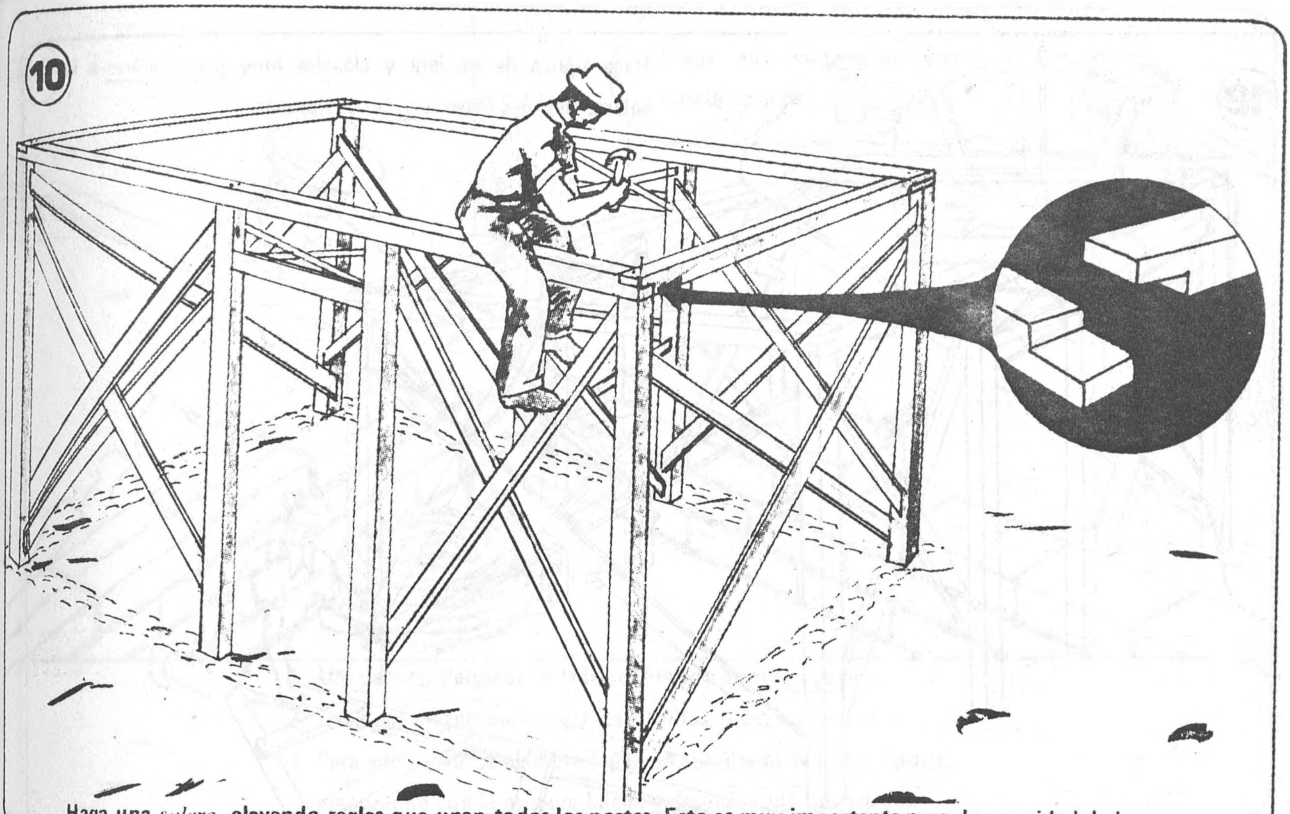
Clave refuerzos cruzados en "X" entre todos los postes. No debe clavar los refuerzos en "X" donde éstos se cruzan. Deje los refuerzos a una cuarta arriba del piso.



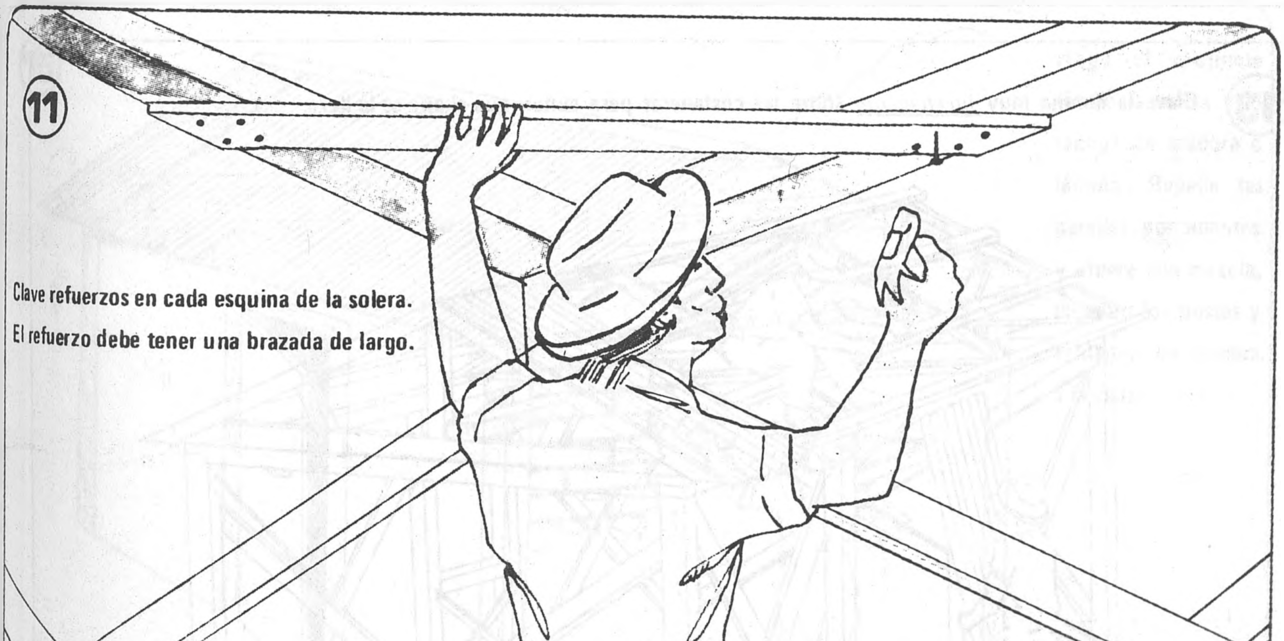
9

Los refuerzos en "X" se clavan del lado de adentro de la casa.





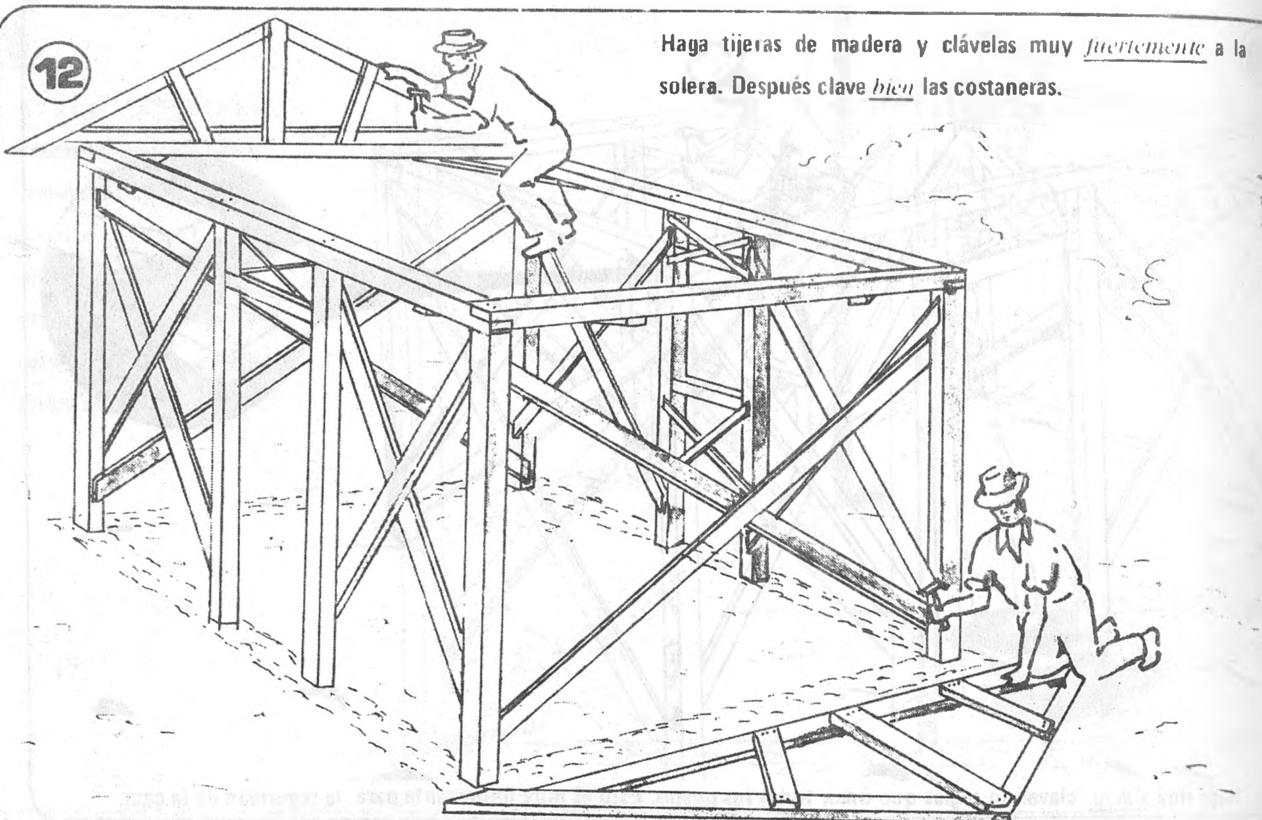
Haga una *solera,* clavando reglas que unan todos los postes. Esto es muy importante para la seguridad de la casa.



Clave refuerzos en cada esquina de la solera.
El refuerzo debe tener una brazada de largo.

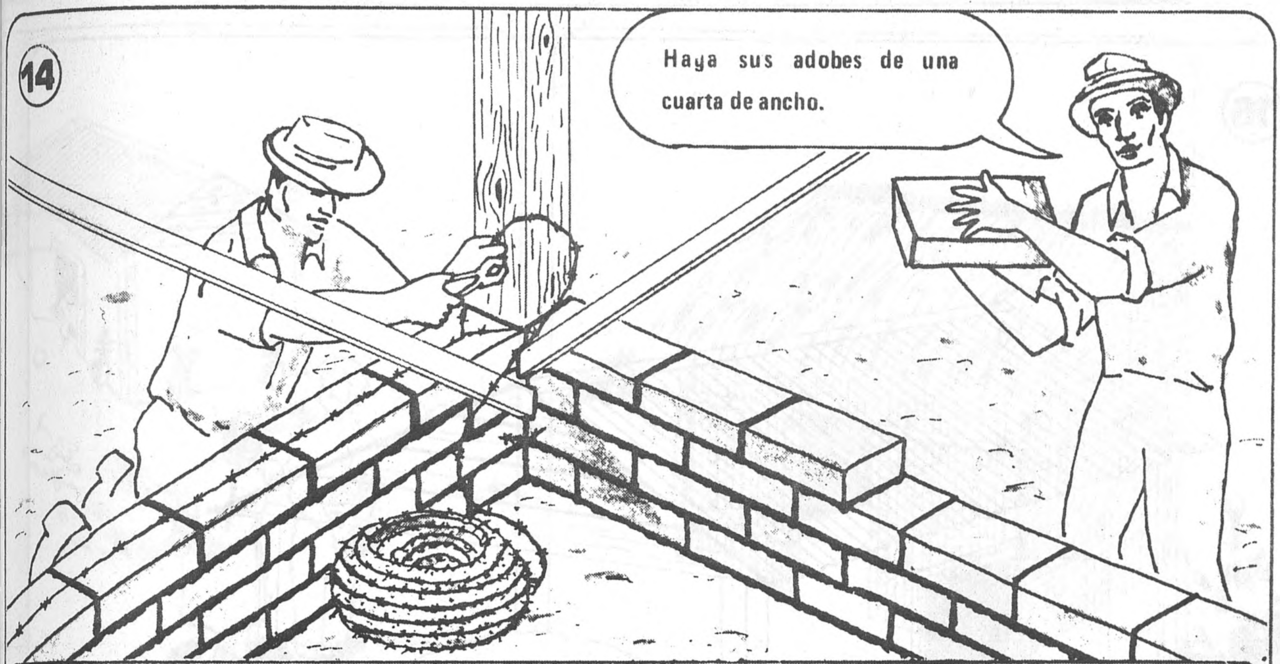
12

Haga tijeras de madera y clávelas muy *fuertemente* a la solera. Después clave *bien* las costaneras.

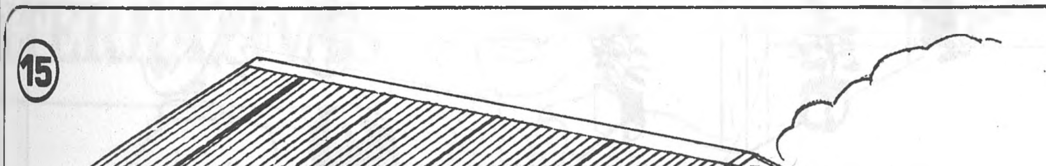


13

Clave la lámina muy *fuertemente* sobre las costaneras para evitar que el aire se la lleve.

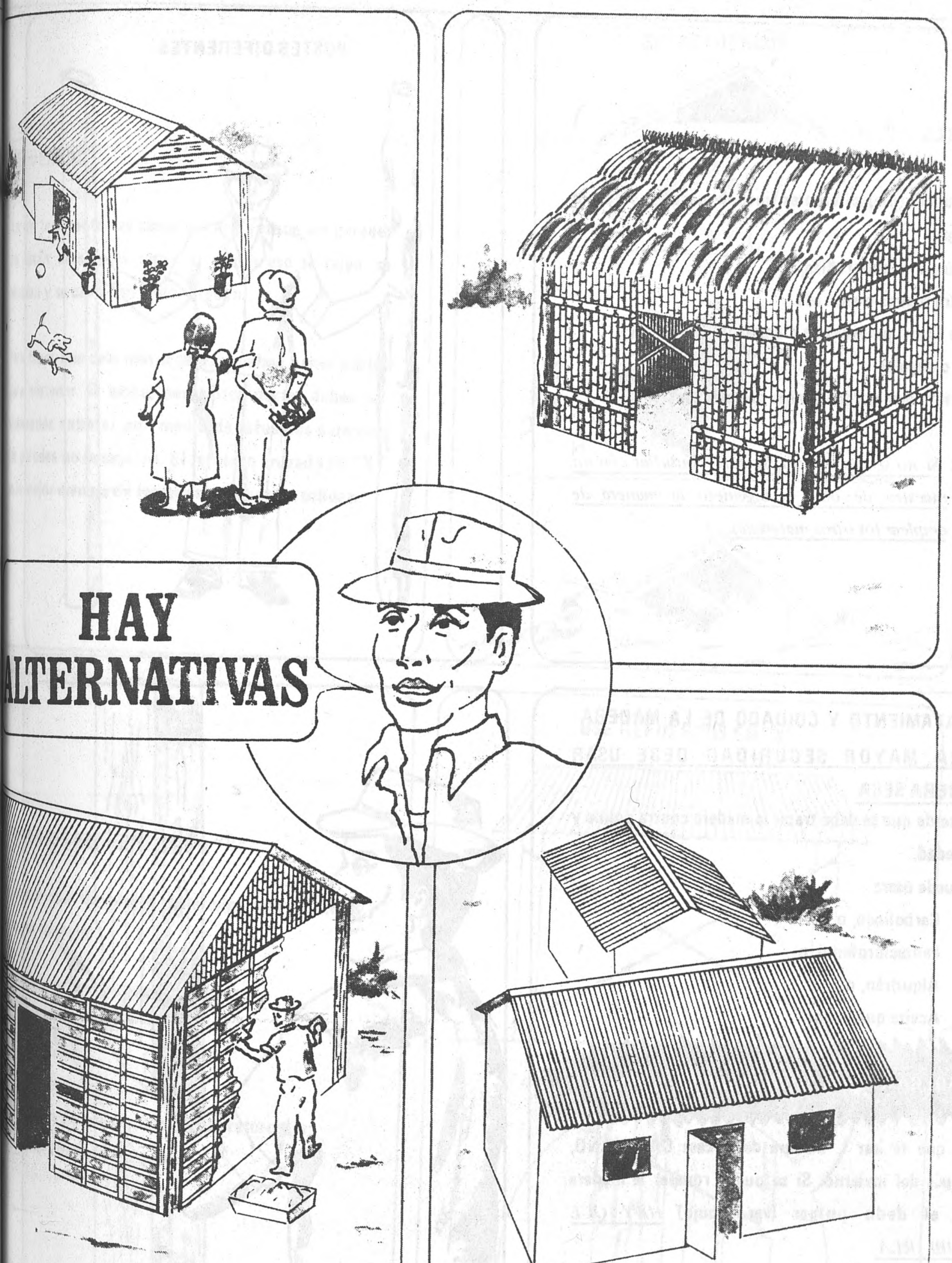


1. Use paredes delgadas de ladrillo, block o adobe *pequeño.*
2. Use poca mezcla para pegar los ladrillos, blocks o adobes.
3. Para adobe, ponga alambre espigado atirantado de poste a poste, empezando con la primera hilada y después cada tres hiladas.



Haga el mojinete (entre la solera y el techo) de madera o lámina. Repelle las paredes por adentro y afuera con mezcla, dejando los postes y refuerzos de madera a la vista.

YA TENEMOS NUESTRA CASA MAS SEGURA


HAY
ALTERNATIVAS

POSTES

Se pueden usar diferentes tipos de postes, como por ejemplo:

Horcón o madera rolliza,
Madera rústica o aserrada.
Tubo (3 ó 4 pulgadas de diámetro).
Hierro angular.
Concreto armado (columnas de cemento).

OJO: *Si no se usa madera, se debe consultar con un maestro de obra o ingeniero la manera de emplear los otros materiales.*

POSTES DIFERENTES

TRATAMIENTO Y CUIDADO DE LA MADERA

PARA MAYOR SEGURIDAD DEBE USAR MADERA SECA

Recuerde que se debe tratar la madera contra polilla y humedad.

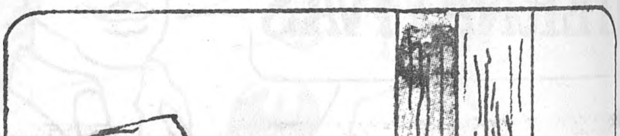
Se puede usar:

1. Carbolineo, o
2. Pentaclorofenol, o
3. Alquitrán, o
4. Aceite quemado.

LA MADERA NO DA UNA SEGURIDAD PERMANENTE

Hay que revisar la madera de la casa CADA AÑO, después del invierno. Si se puede romper la madera con el dedo pulgar (ver dibujo) *HAY QUE CAMBIARLA.*

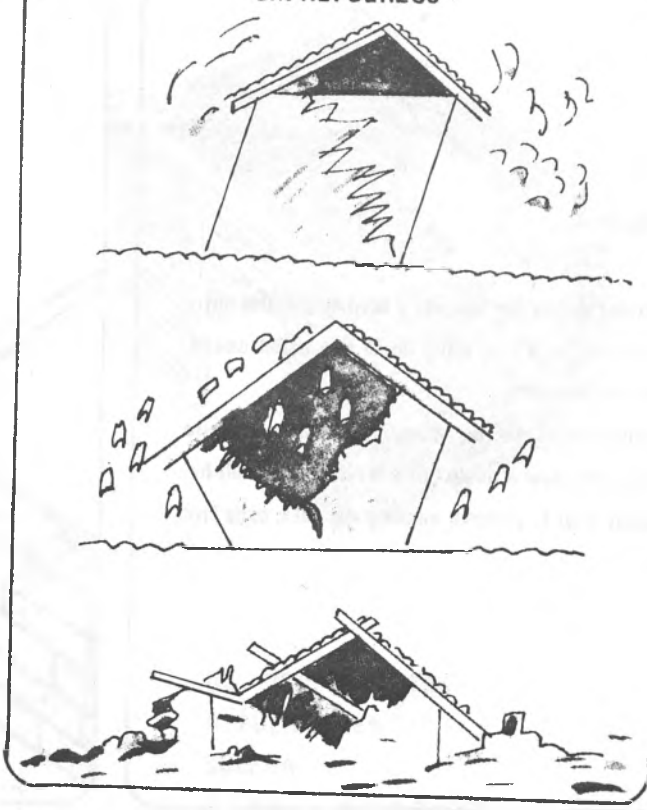
También hay que inspeccionar la madera enterrada.



REFUERZOS

En un terremoto las casas se caen porque sus paredes no están amarradas entre sí y por eso se rajan, se separan y se caen con todo y techo.

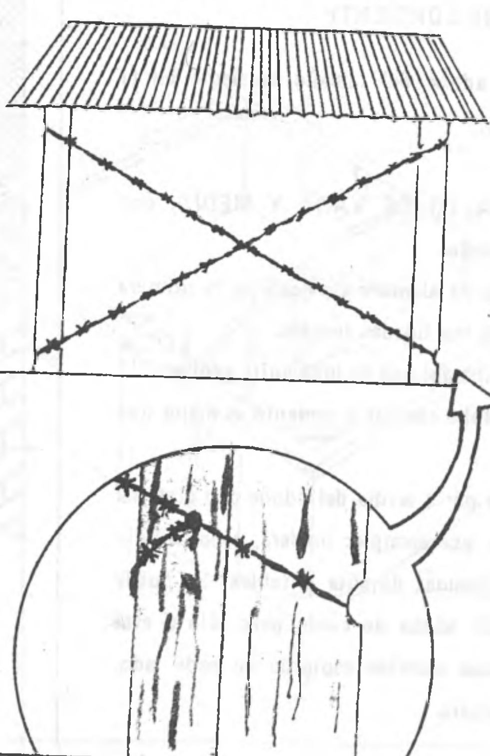
Para tener una casa más segura, se deben poner postes para sostener el techo, pero estos postes deben ser amarrados entre sí por medio de refuerzos para que las paredes no se separen. El refuerzo cruzado en "X" es la mejor manera de lograr esta firmeza y solidez.



FERENTES REFUERZOS EN "X"

pueden usar diferentes materiales para refuerzos, mo por ejemplo:

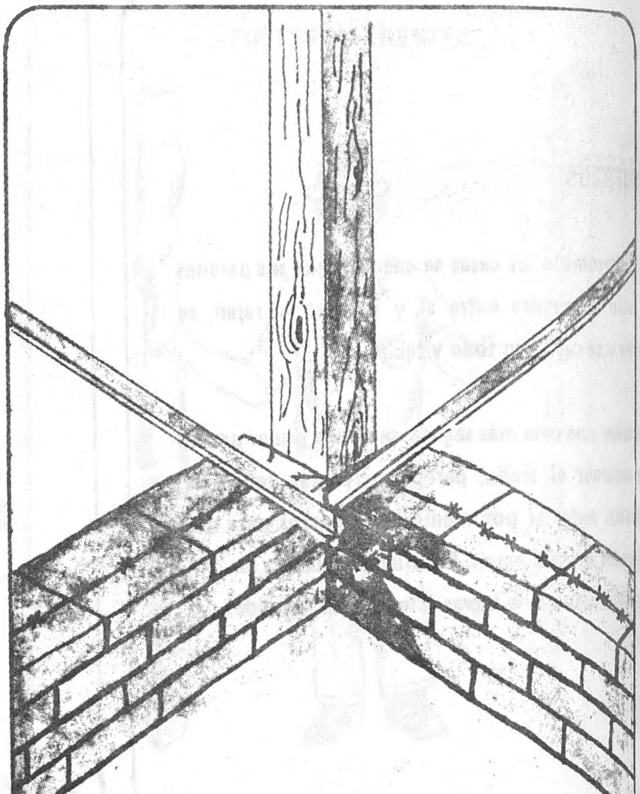
- Reglas de una pulgada de grueso;
- Alambre espigado;
- Palos rollizos;
- Cable de acero;
- Alambre de amarre, ocho hilos retorcidos;
- Hembra de hierro plano.



PAREDES

Las paredes deben ser livianas y bien amarradas entre sí. Nunca las haga más altas de lo que usted puede alcanzar con la mano.

Use muchos amarres, como alambre espigado atirantado de poste a poste entre las hiladas de adobe, empezando con la primera hilada y después, cada tres hiladas.

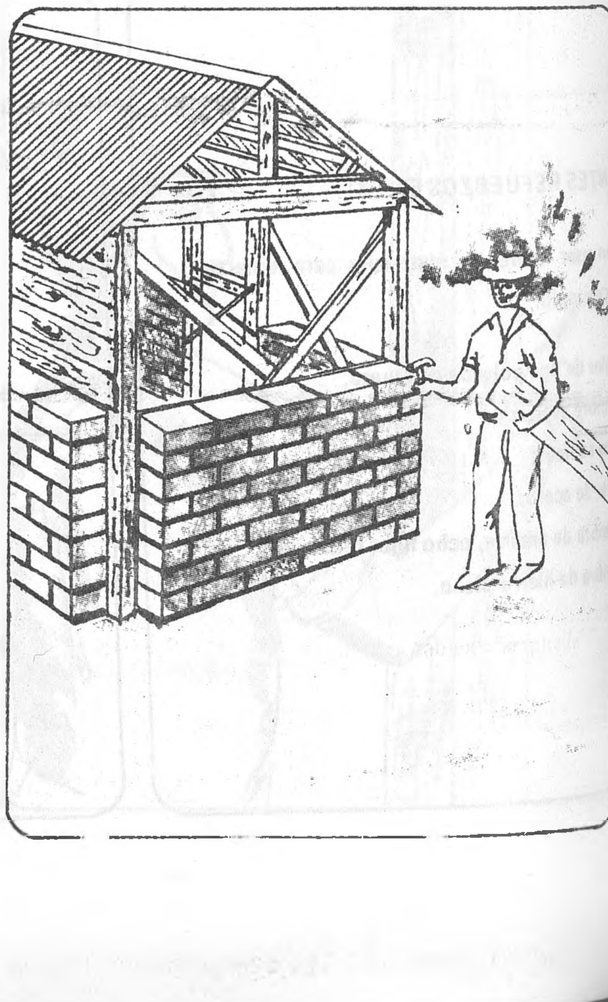


ADOBE TAMAÑO CORRIENTE

ADOBE TAMAÑO CORRIENTE

Se puede usar adobe del tamaño corriente en la siguiente manera:

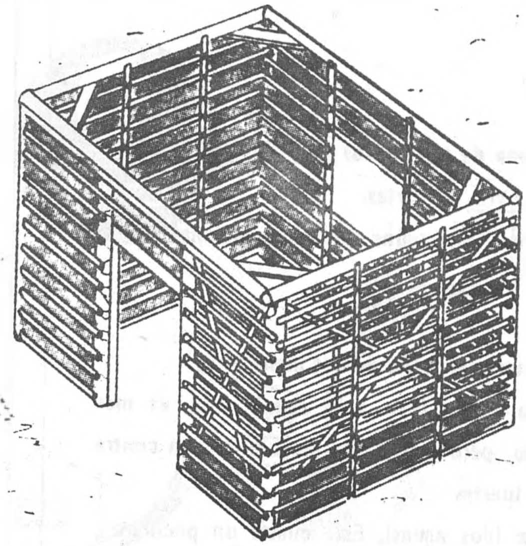
1. NO MAS ALTO DE VARA Y MEDIA, con adobes acostados.
2. Use amarres de alambre espigado en la primera hilada y cada tres hiladas después.
3. No más de una pulgada de lodo entre adobes.
4. Mezcla o adobe con cal o cemento es mejor que lodo.
5. Terminar la parte arriba del adobe con material más liviano, por ejemplo: madera, caña, ladrillo de canto, lámina, duralita o tablex. Se puede terminar con adobe de canto pero sólo si está amarrado con alambre espigado en cada lado, adentro y afuera.



PAREDES LIVIANAS

Siempre se deben usar postes, refuerzos en "X" y solera en la construcción de cualquier tipo de pared, pero se pueden usar muchos otros materiales para la pared, como por ejemplo:

1. Adobes más pequeños
2. Adobe de canto
3. Bajareque
4. Ladrillo
5. Caña
6. Madera
7. Block, de preferencia poma
8. Adobe prensado con cemento (terracreto)
9. Lámina
10. Duralita



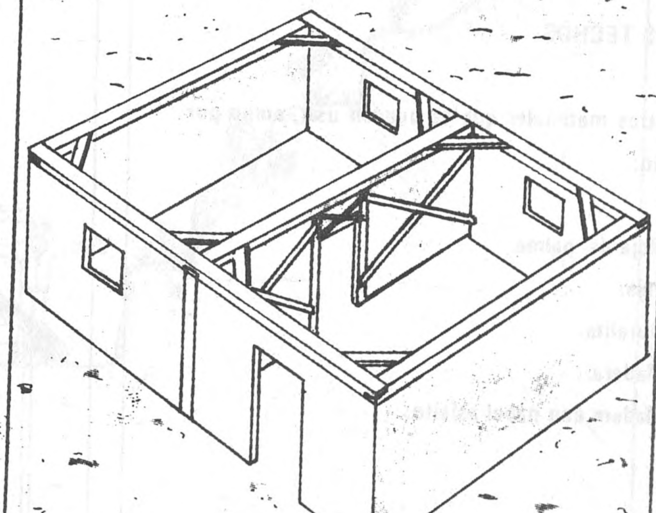
USE SIEMPRE POSTES
REFUERZOS EN "X"
SOLERA
PUERTA A MEDIA PARED

CASAS MAS GRANDES CON PAREDES INTERIORES

Una pared interior ayuda a sostener las paredes exteriores si está bien construida.

Se deben usar los mismos métodos ya explicados en este libro para construir las paredes interiores, es decir:

- Cimiento de piedra, ladrillo, etc.
- Postes en los extremos.
- Puerta en el centro de la pared.
- Refuerzos en "X".
- Solera de madera uniendo los postes.
- Refuerzos en las esquinas de la solera.
- Pared liviana con muchos amarres.



TECHOS

En una zona de terremotos *LOS TECHOS DEBEN SER LIVIANOS* y fuertes.
Un material que reúne estas condiciones es la lámina.

Se puede hacer el techo de dos maneras:

1. Media tijera (una sola agua). Este es más barato, pero se necesita asegurarlo bien contra aires fuertes
2. Tijera (dos aguas). Este cuesta un poco más, pero resiste más el aire fuerte.

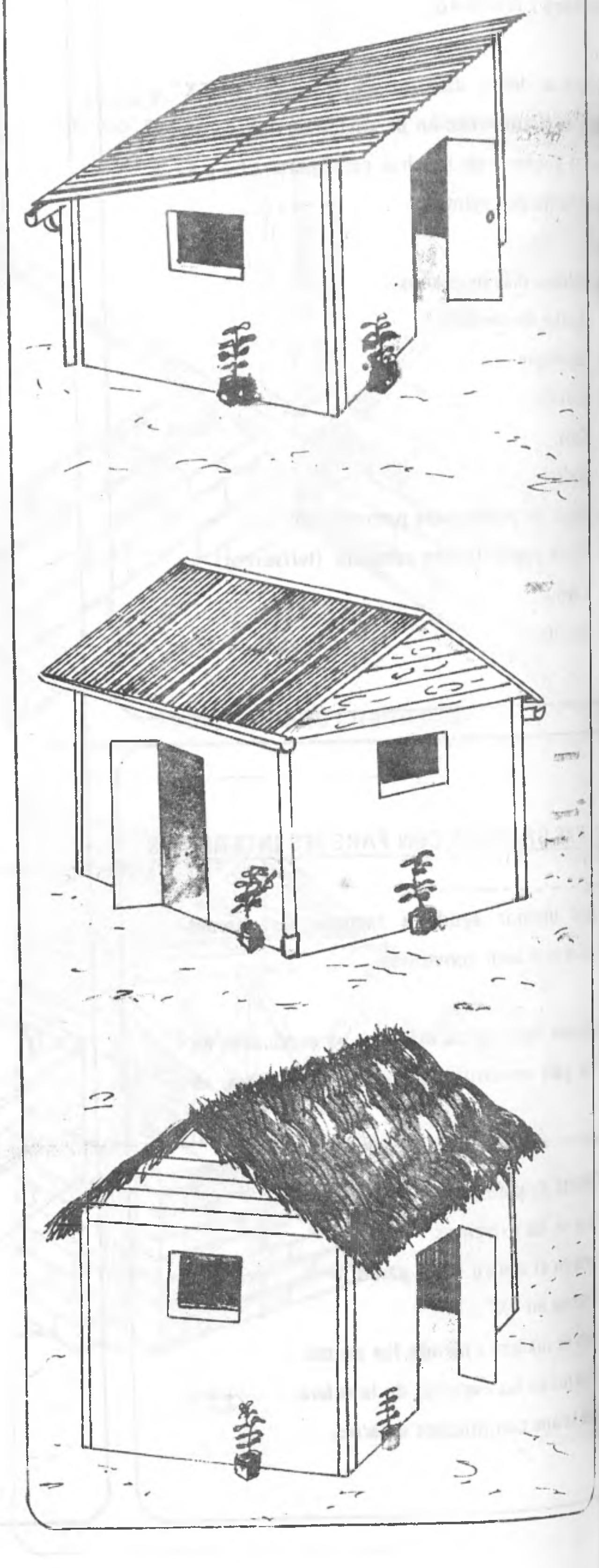
Un techo de lámina puede ser peligroso en regiones donde hay mucho aire SI NO SE CLAVAN BIEN LAS TIJERAS A LA SOLERA, LAS COSTANERAS A LAS TIJERAS Y LA LAMINA A LAS COSTANERAS.

OTROS TECHOS

Hay otros materiales que se pueden usar, como por ejemplo:

1. Hoja de palma.
2. Paja.
3. Duralita.
4. Madera.
5. Madera con papel asfalto.

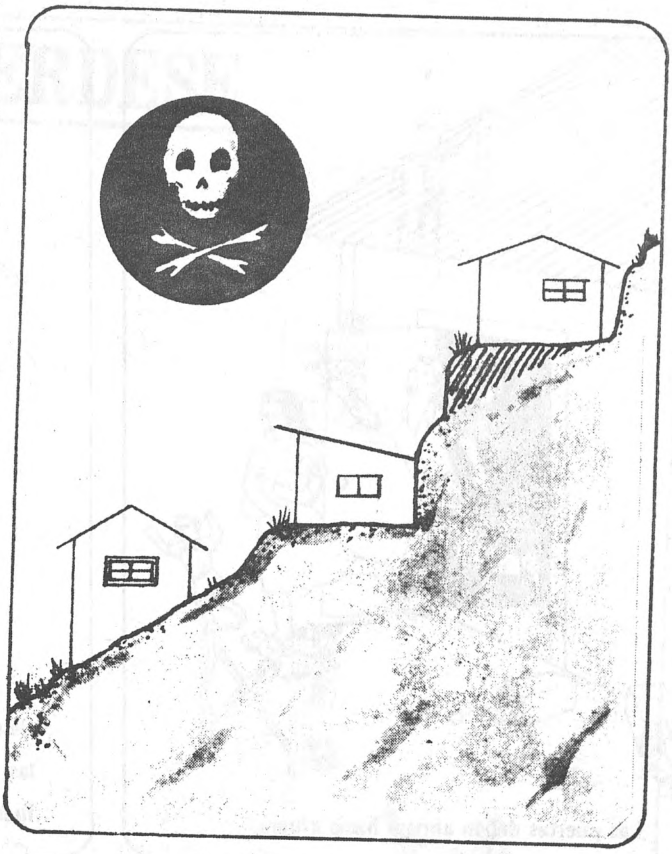
OJO: Las tijeras *siempre* deben asegurarse sobre la solera y *nunca* sobre el adobe.

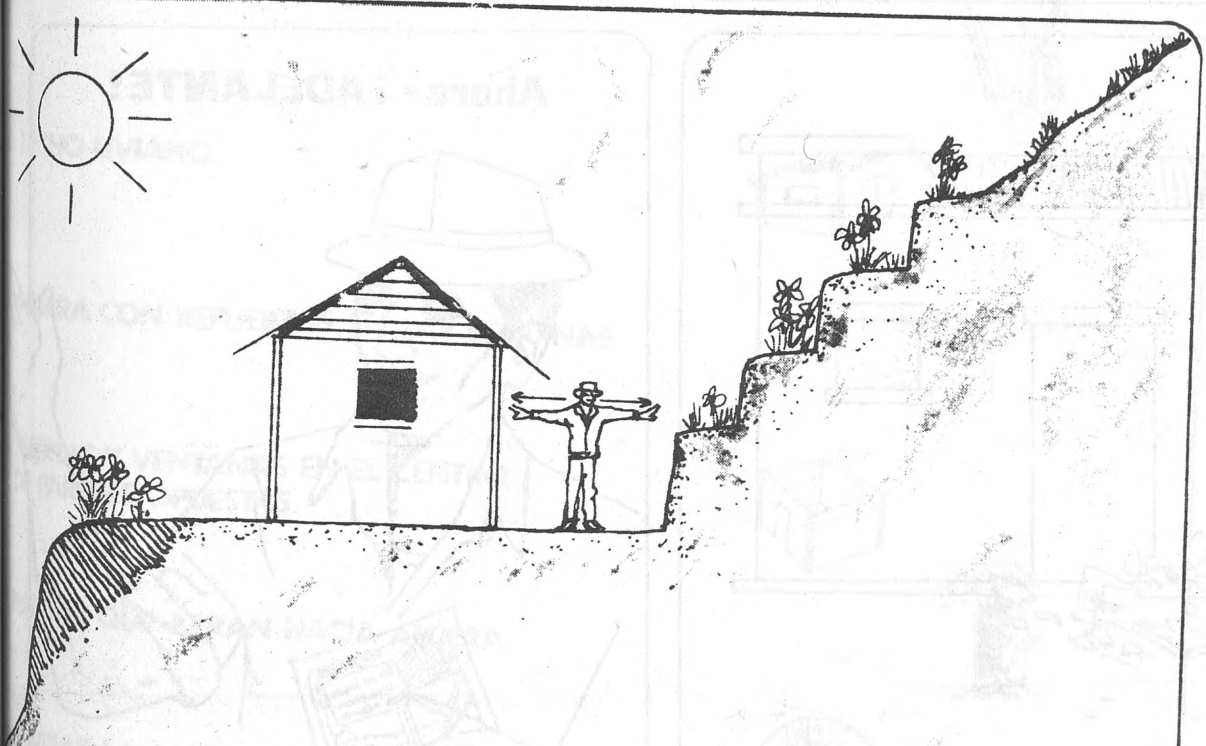


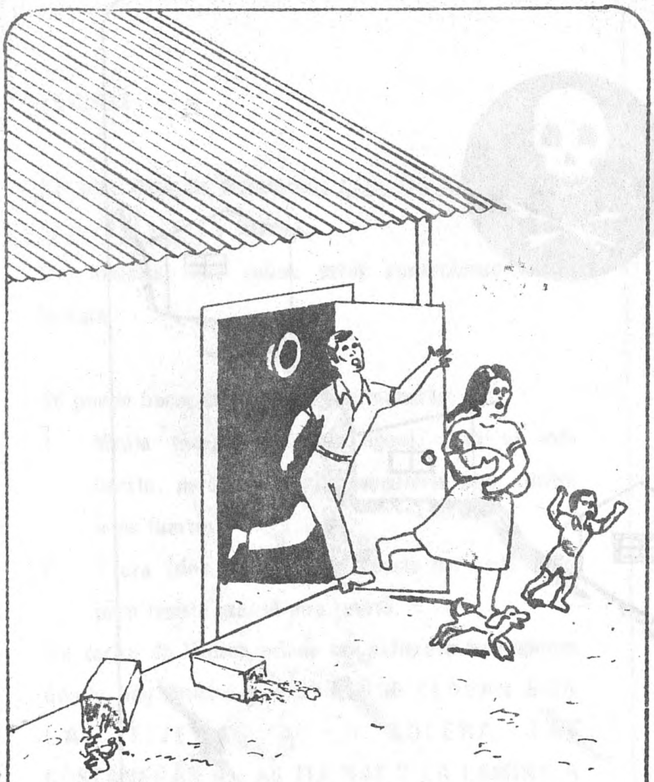
DONDE PONER LA CASA

La casa es más segura si se construye sobre un terreno plano y sólido. Si hay que construir en una ladera, se deben respetar las siguientes reglas:

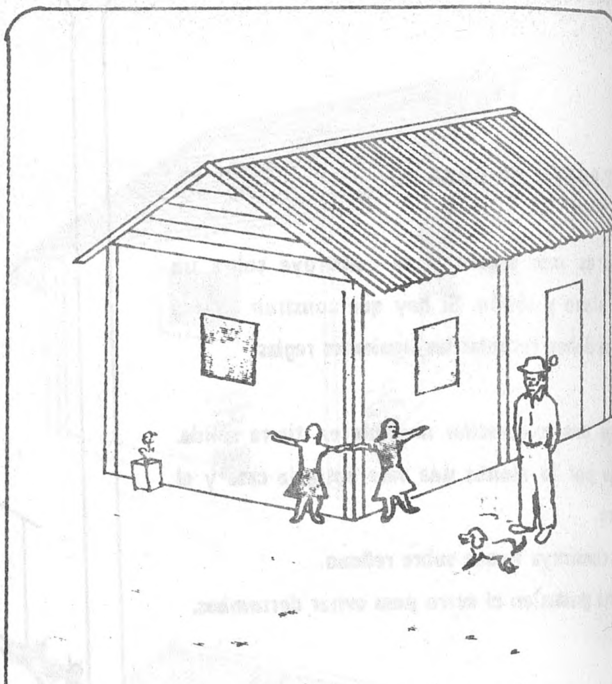
1. Haga una excavación nivelada en tierra sólida.
2. Deje por lo menos una vara entre la casa y el cerro.
3. No construya nunca sobre relleno.
4. Corte gradas en el cerro para evitar derrumbes.



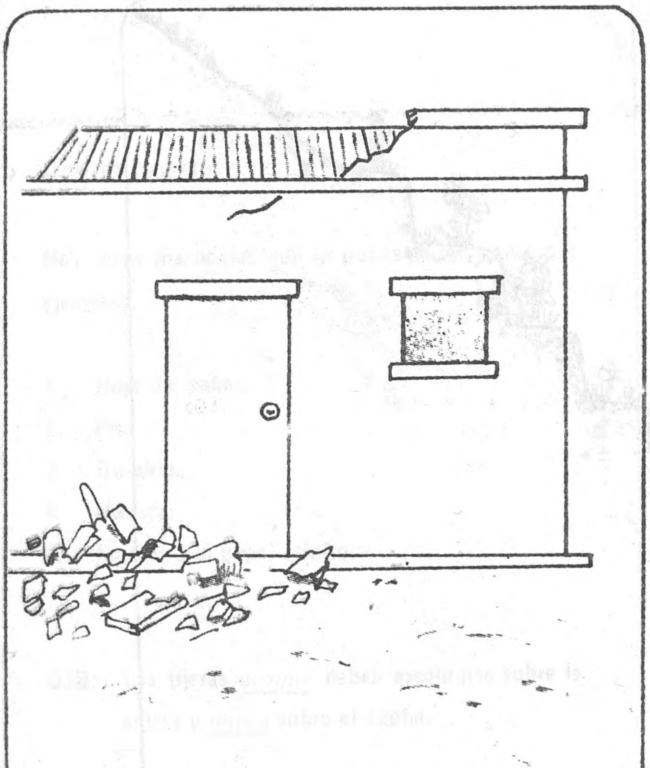




Las puertas deben abrirse hacia afuera.



Deje por lo menos una vara de pared a cada lado de las ventanas y puertas, para tener paredes más fuertes.



¡NO USE CORNIZAS!

Ahora- ¡ADELANTE!

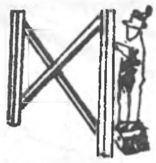
RECUERDESE

1. PAREDES BAJAS.

2. PAREDES LIVIANAS.

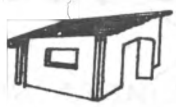
3. POSTES FUERTES.

4. REFUERZOS EN "X".

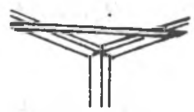


5. TRATAR LA MADERA.

6. TECHO LIVIANO.



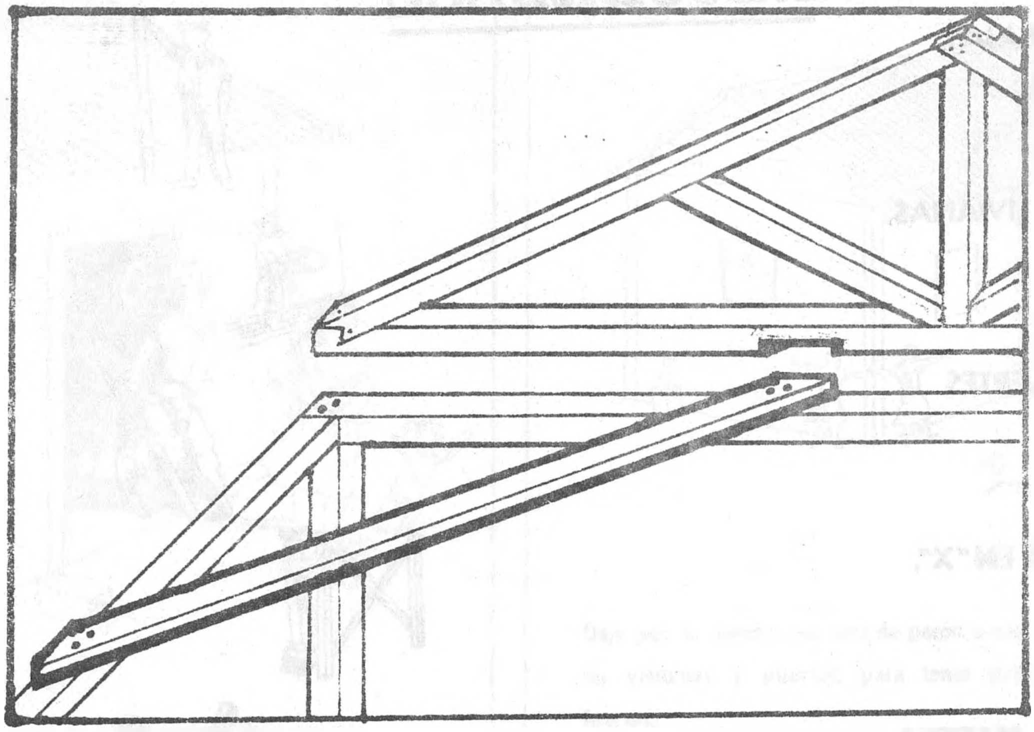
7. SOLERA CON REFUERZOS EN LAS ESQUINAS.



8. PUERTAS Y VENTANAS EN EL CENTRO DE PAREDES OPUESTAS.

9. PUERTAS QUE ABRAN HACIA AFUERA.

10. REVISAR LA MADERA CADA AÑO.

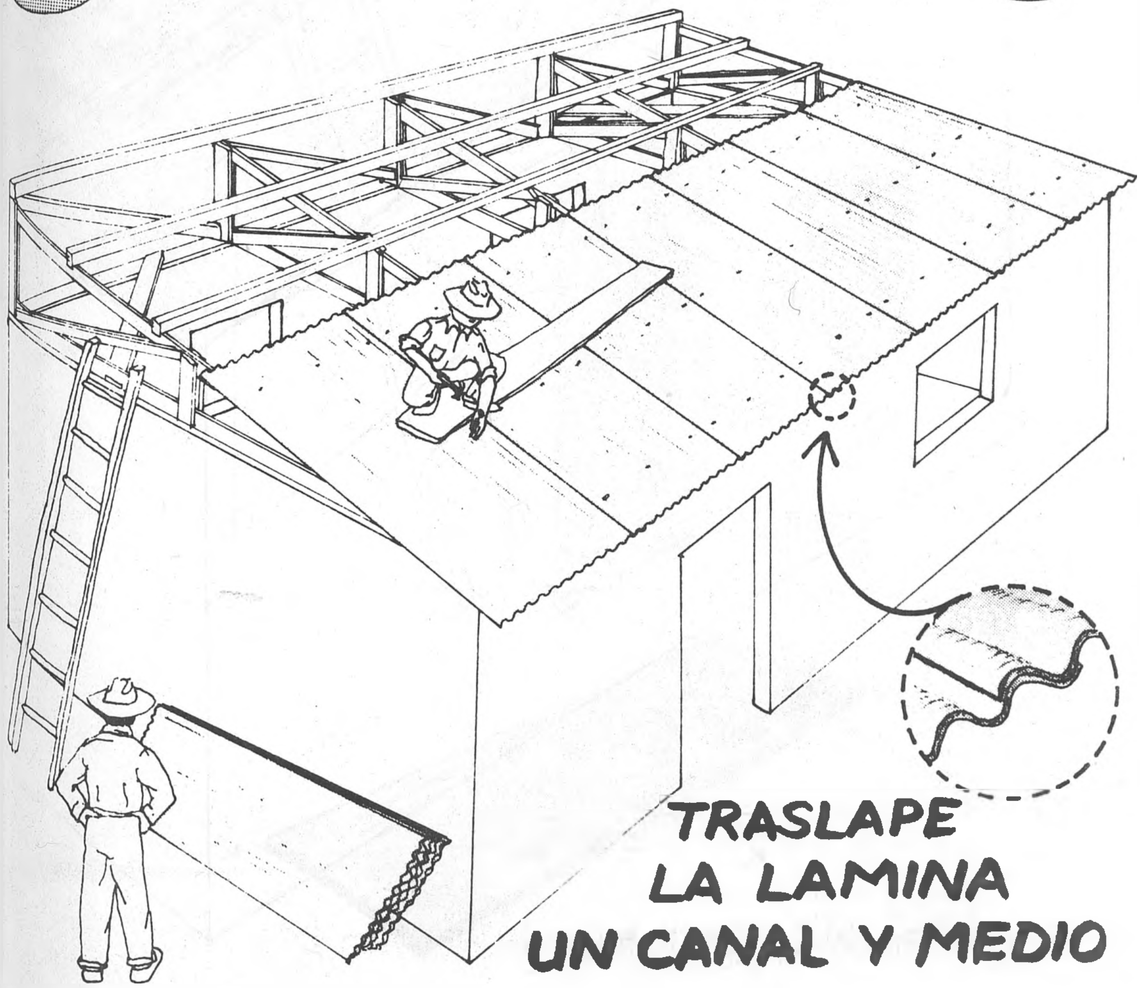


COMO COLOCAR LA ESQUINERA CUANDO SE VA A MACHIHEMBRAR:

PONGA LA ESQUINERA SOBRE LA SOLERA, QUITANDO UN-BOCADO DEL TENDAL DE LA SOLERA.

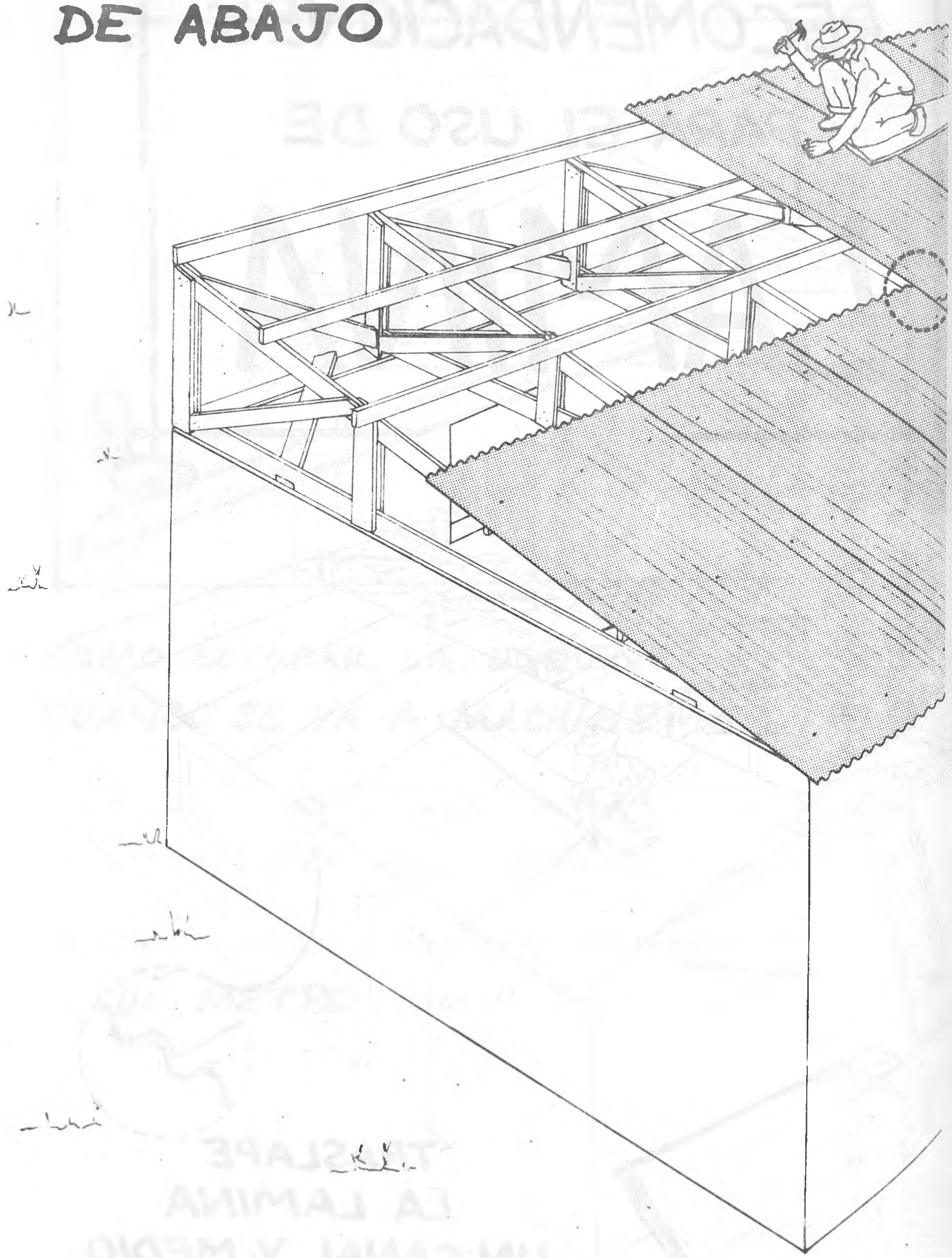
RECUERDE QUE LA ESQUINERA DEBE TENER UN LARGO DE **UN METRO**, COMO MINIMO.

RECOMENDACIONES PARA EL USO DE LAMINA

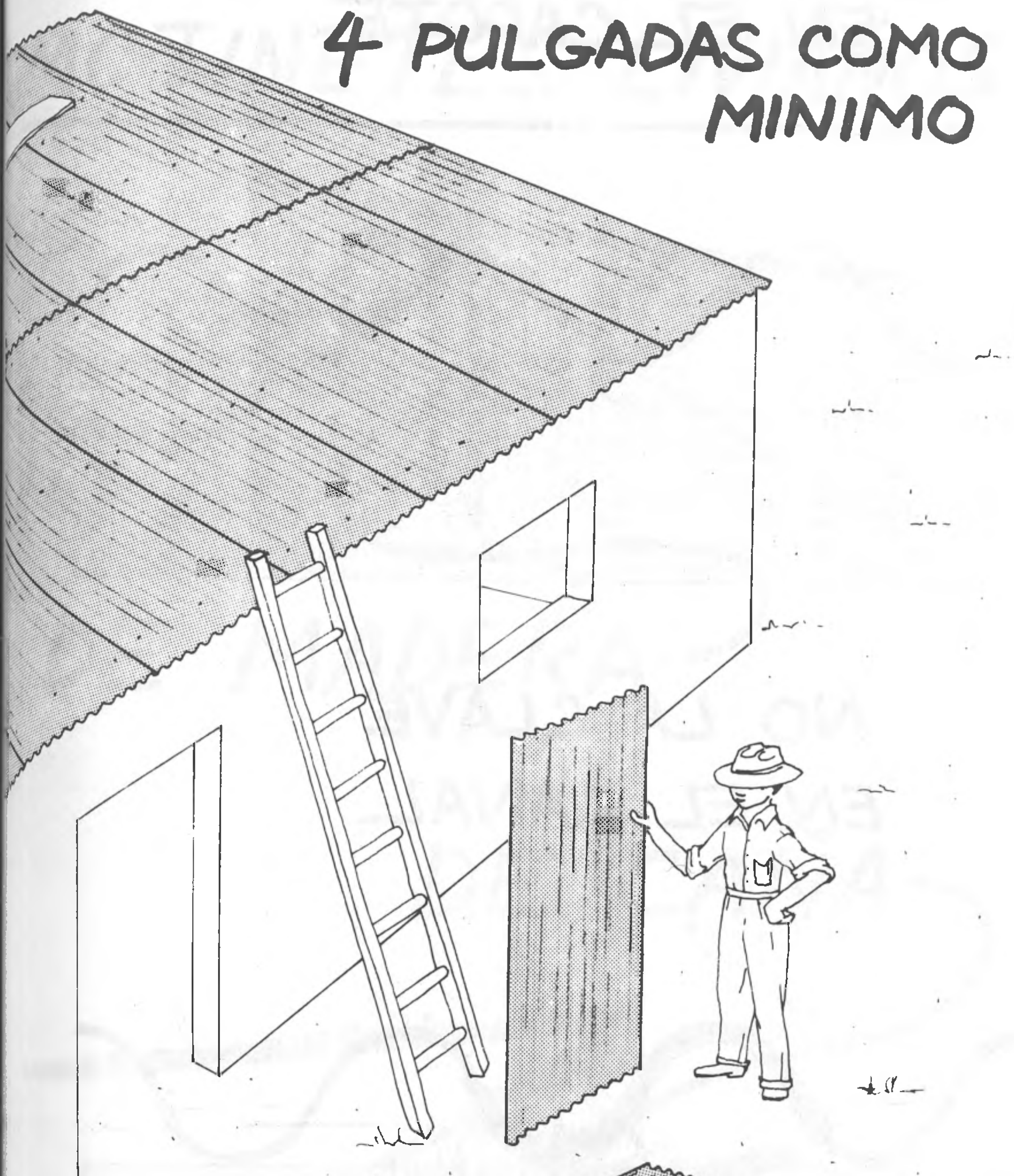


TRASLAPE
LA LAMINA
UN CANAL Y MEDIO

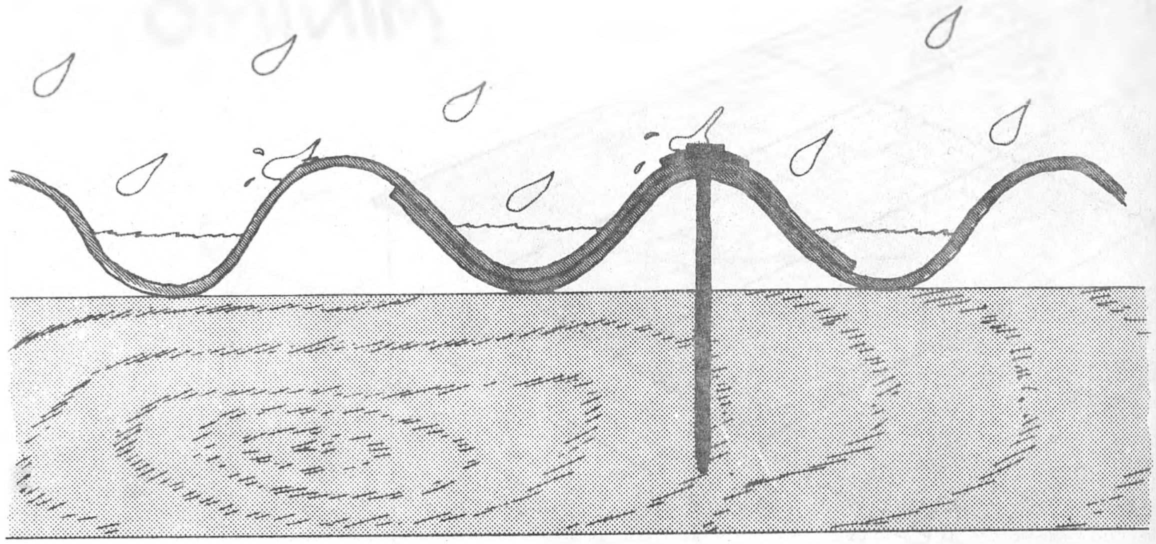
PRIMERO SE COLOCA LA CARRERA DE LAMINA DE ABAJO



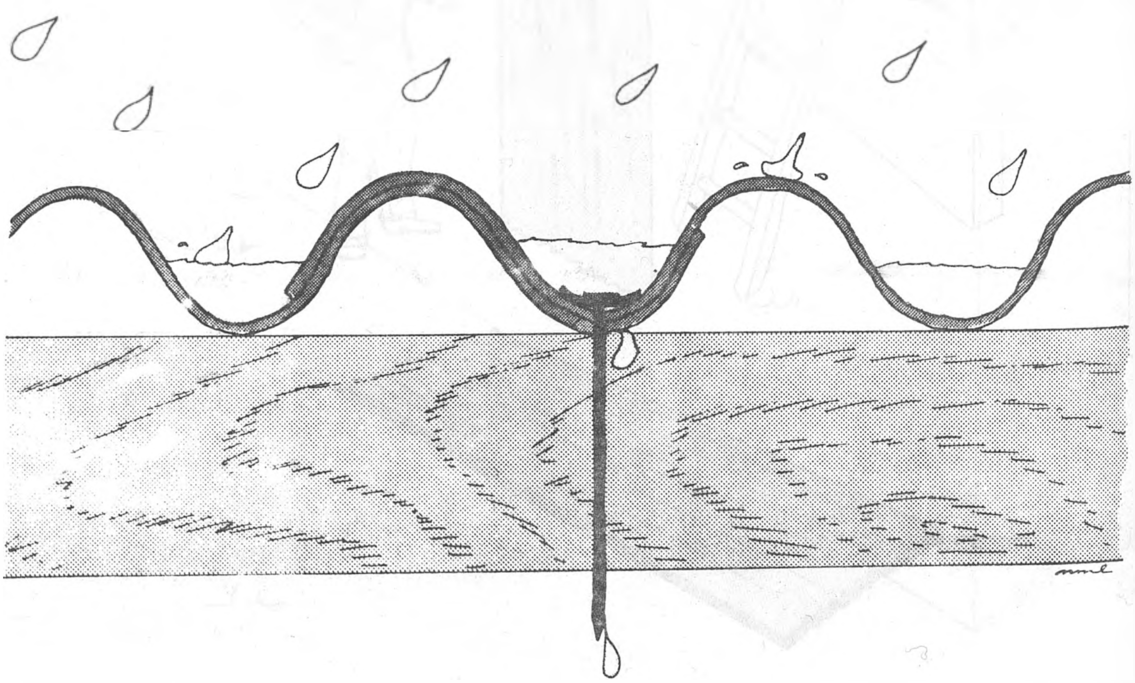
TRASLAPE LA SEGUNDA CARRERA DE LAMINA 4 PULGADAS COMO MINIMO



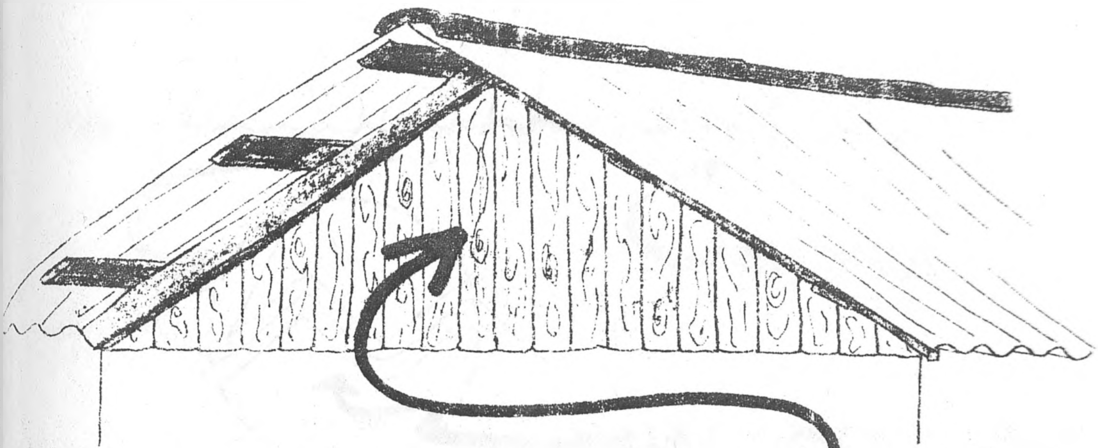
SI, CLAVE LA LAMINA EN EL CAPOTE



NO LA CLAVE EN EL CANAL



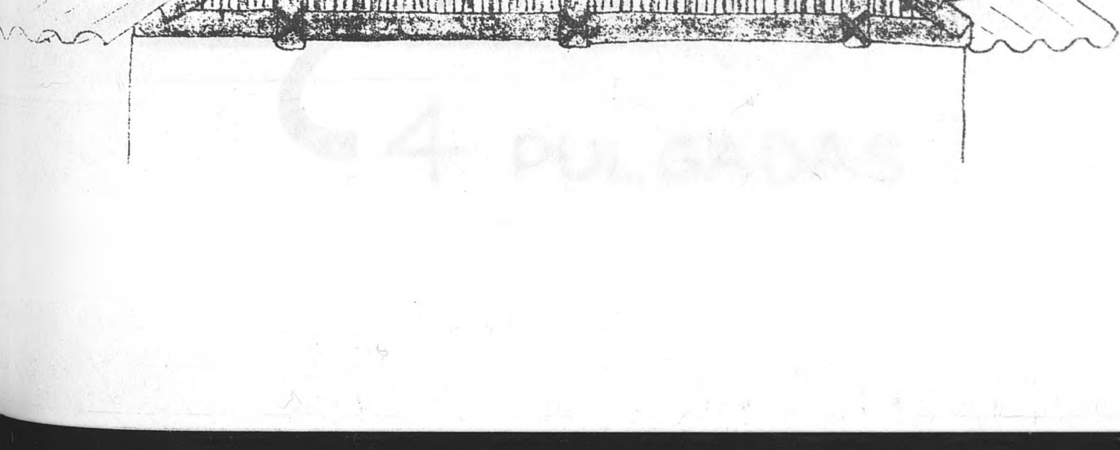
USE
MOJINETES LIVIANOS



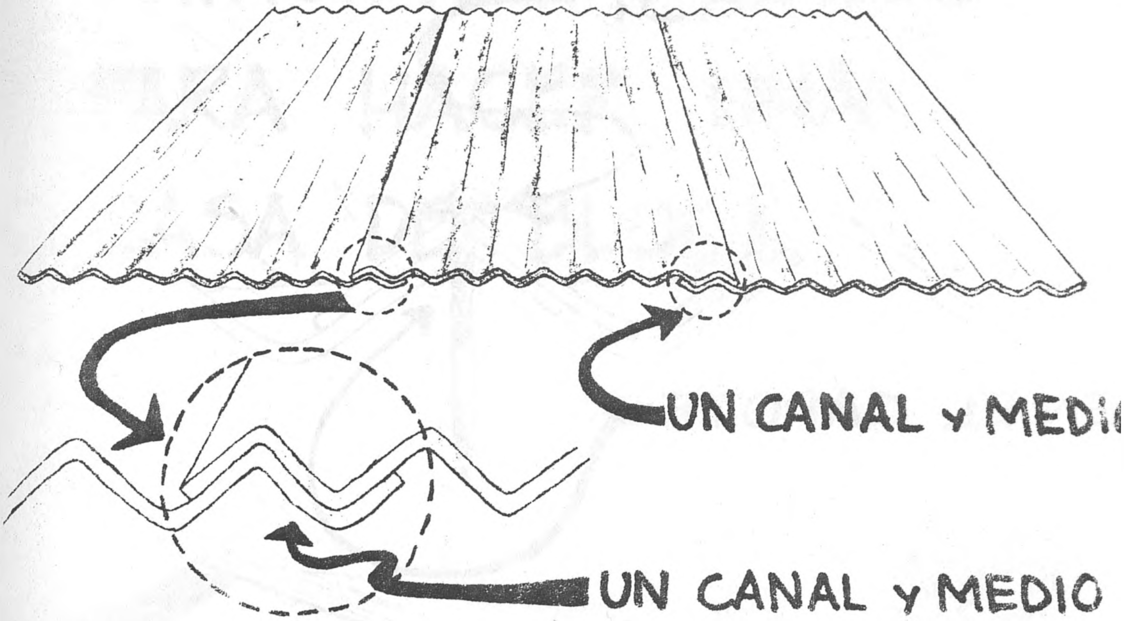
DE MADERA

O

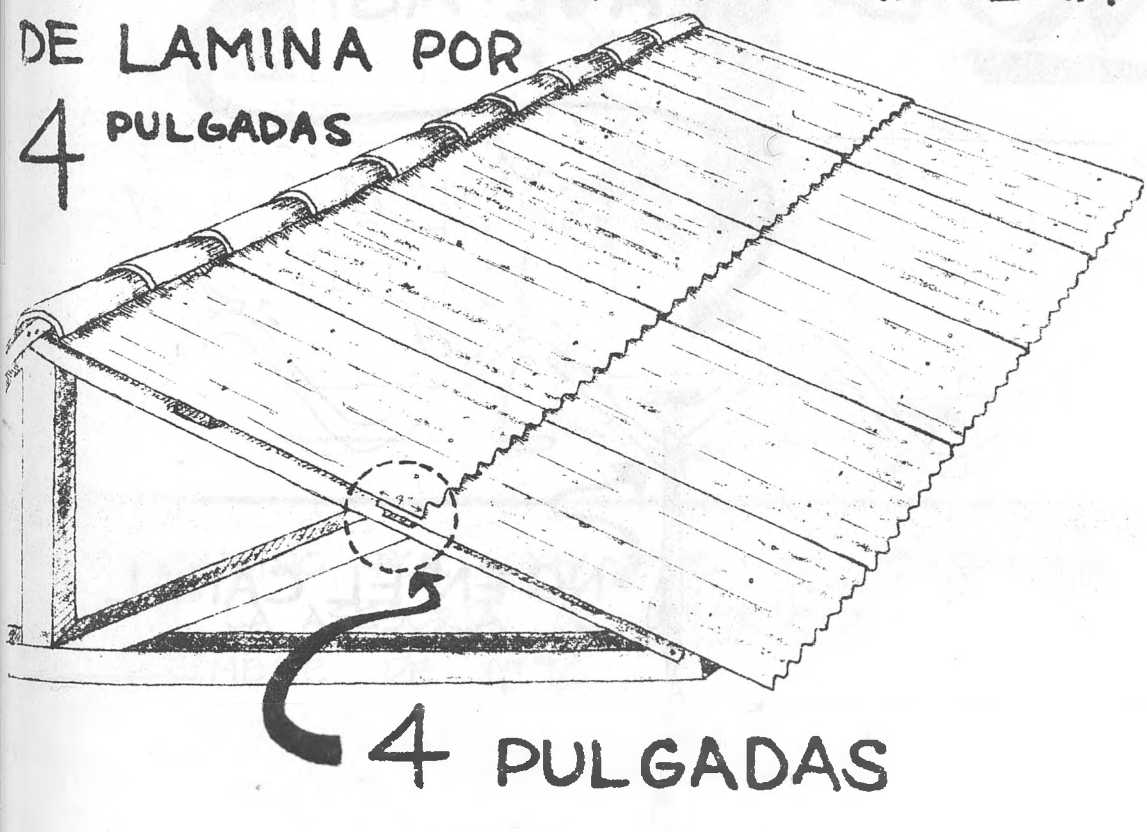
DE CAÑA



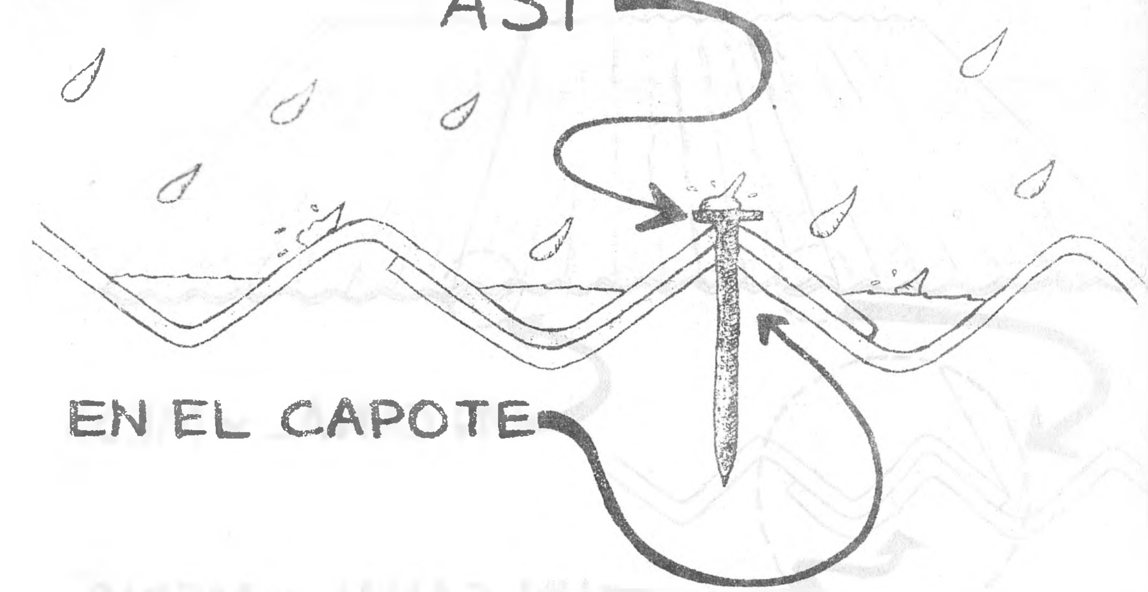
TRASLAPE SU LAMINA UN CANAL y MEDIO



TRASLAPE SU SEGUNDA CARRERA DE LAMINA POR 4 PULGADAS

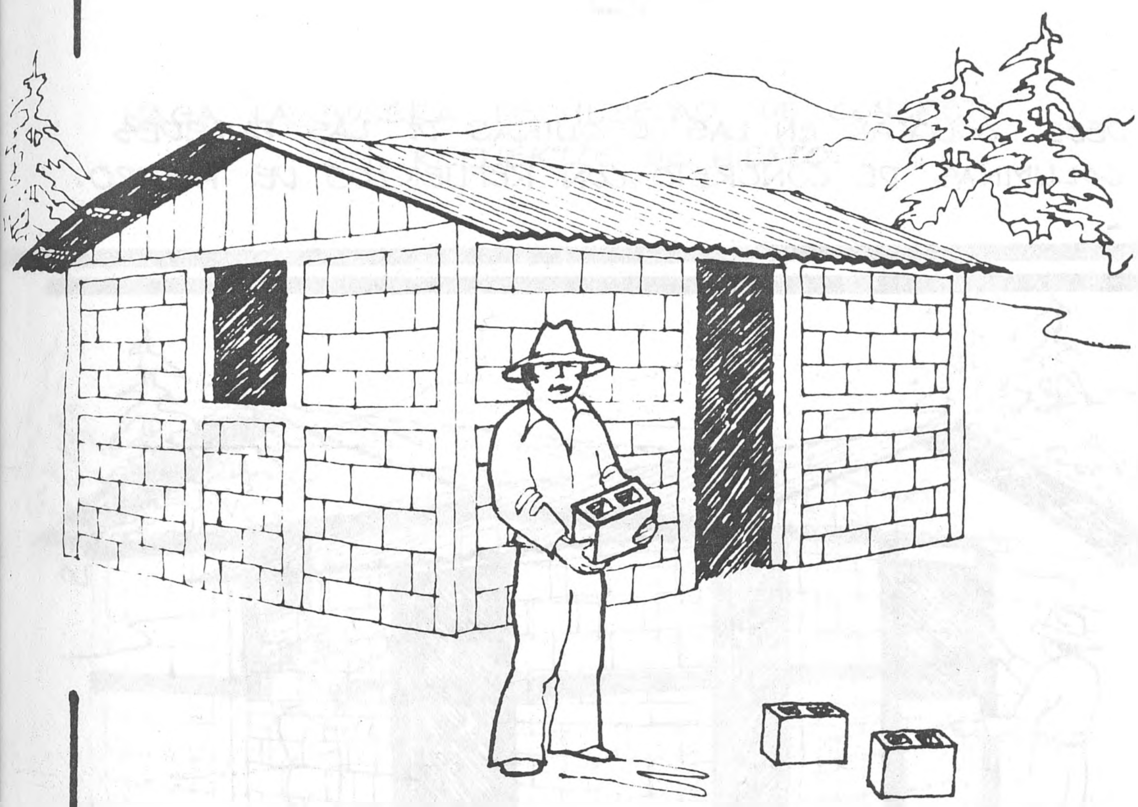


SI, CLAVE SU LAMINA ASI



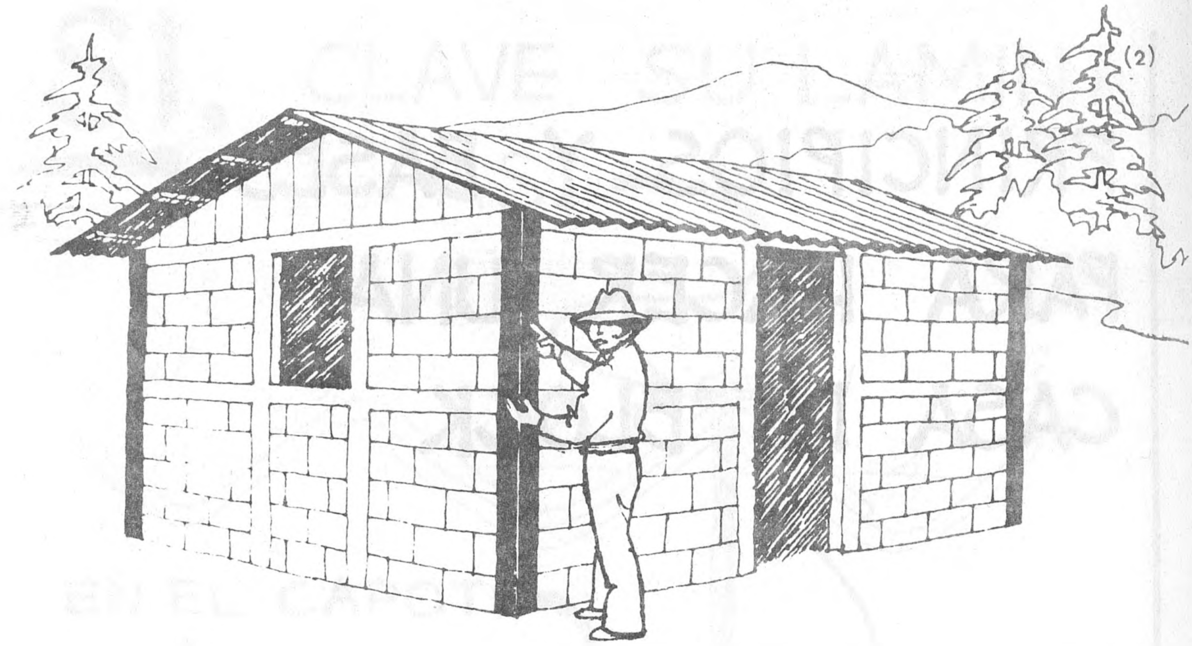
NO LA CLAVE ASI

PRINCIPIOS Y BASES PARA HACER UNA CASA DE BLOCK



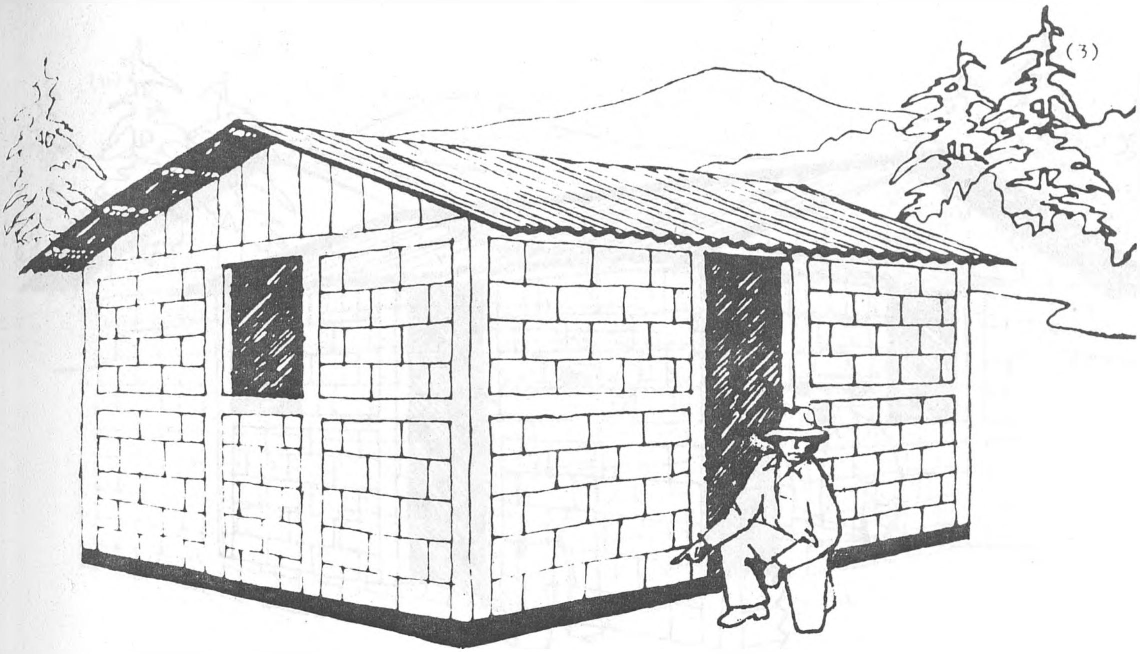
PRODUCIDO POR OXFAM/VECINOS MUNDIALES
CON LA ASESORIA DE INTERTECT
DICIEMBRE DE 1,976

(2)

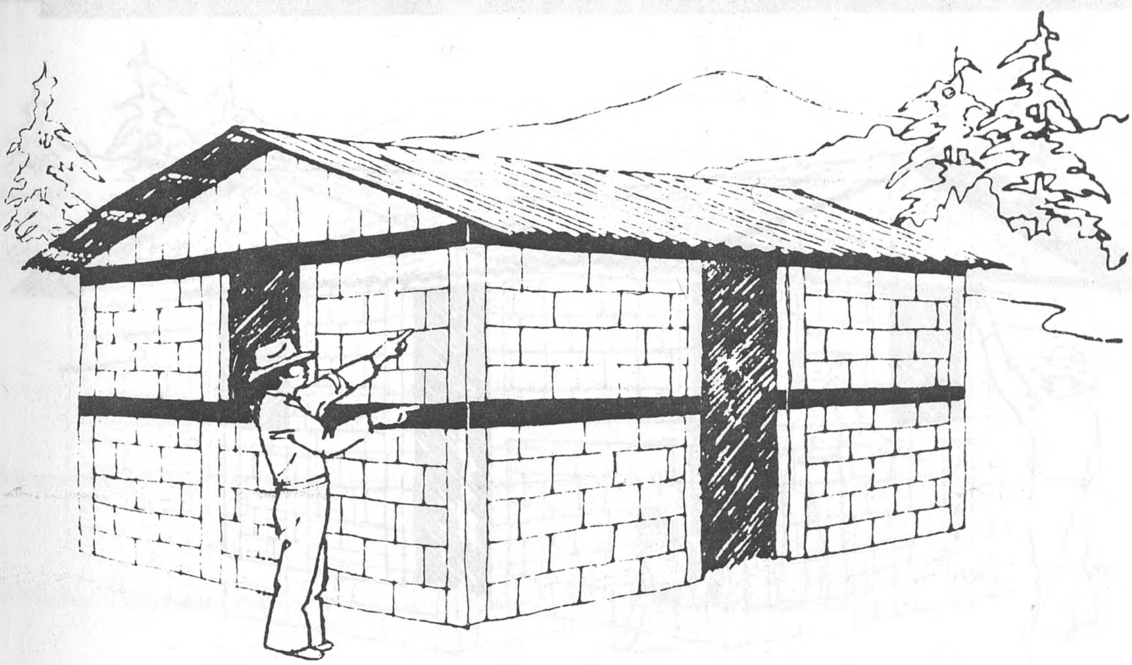


DEBE COLOCAR EN LAS ESQUINAS DE LAS PAREDES COLUMNAS DE CONCRETO CON REFUERZOS DE HIERRO.

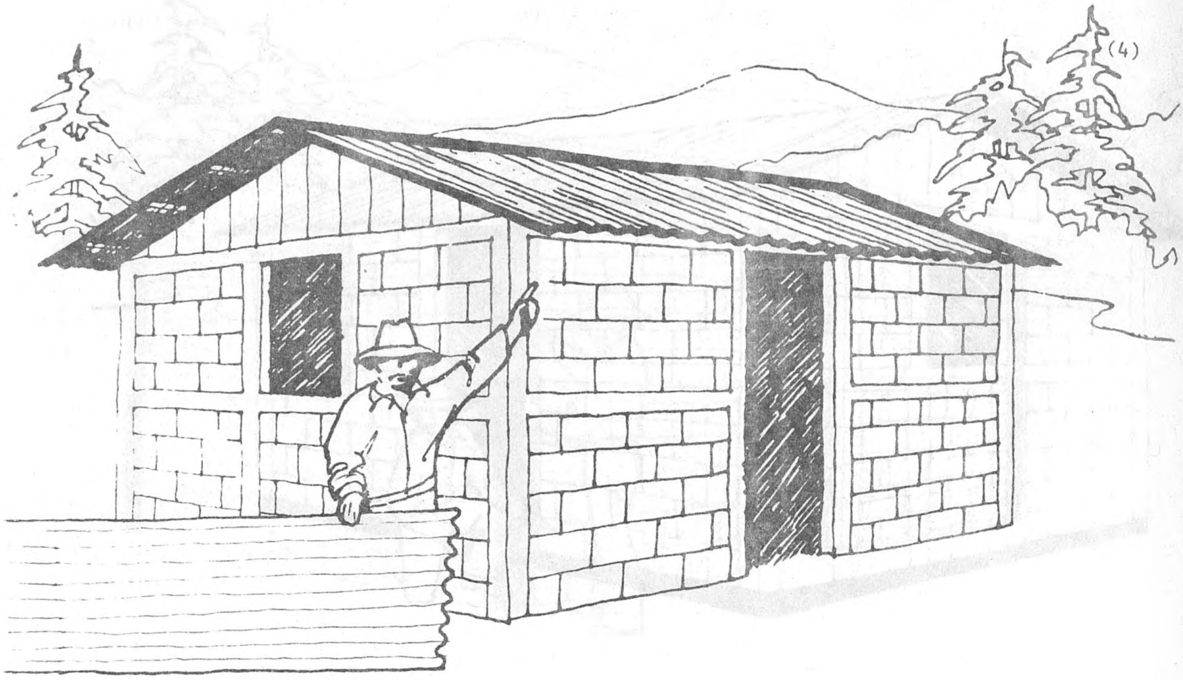
DEBE COLOCAR COLUMNAS A LOS LADOS DE PUERTAS Y VENTANAS.



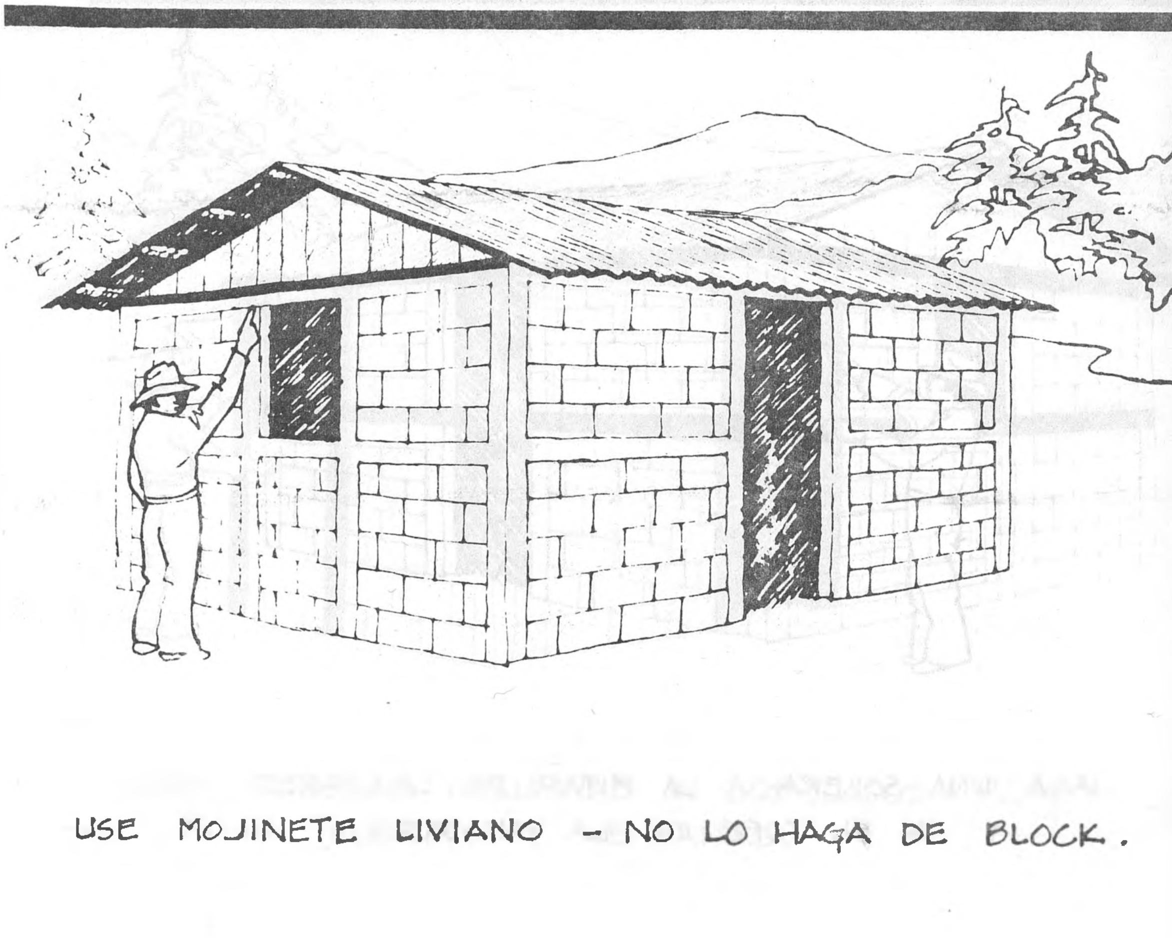
HAGA LA SOLERA DE HUMEDAD DE CONCRETO
CON REFUERZOS DE HIERRO.



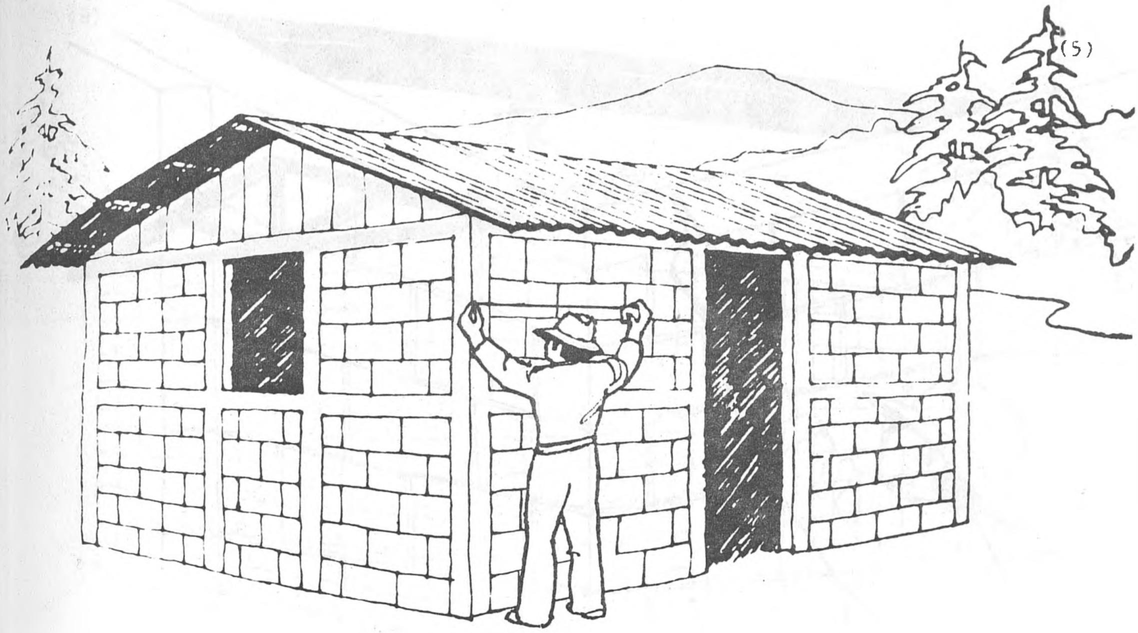
HAGA UNA SOLERA A LA MITAD DE LA PARED
Y EN EL TOPE DE LA MISMA.



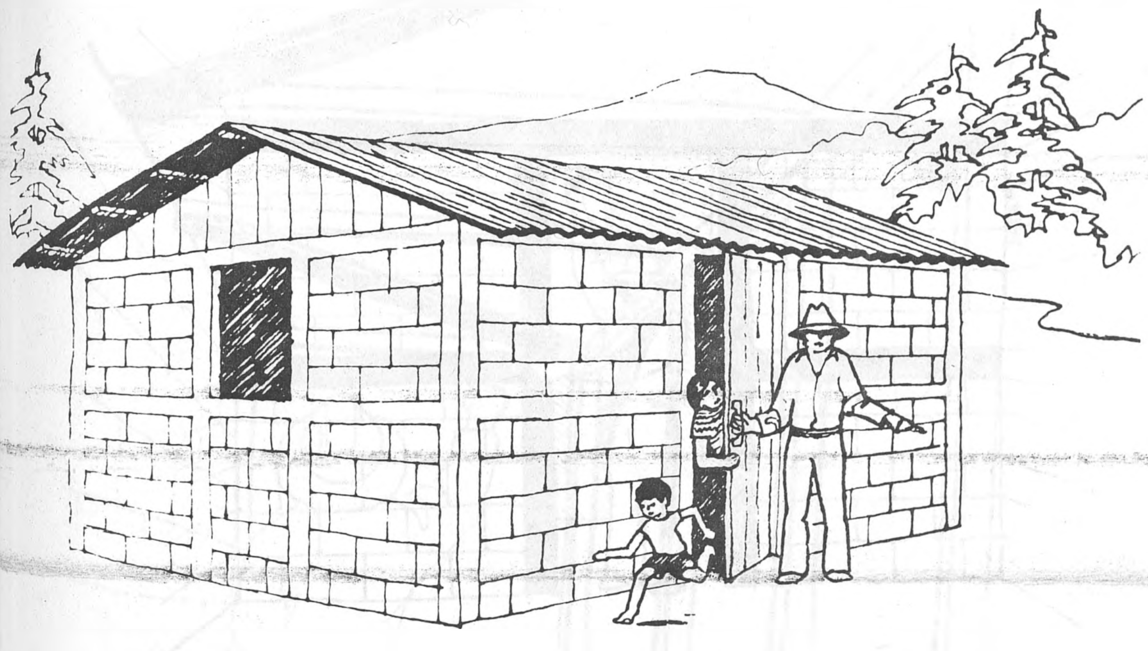
USE TECHO LIVIANO — NO USE TEJAS.



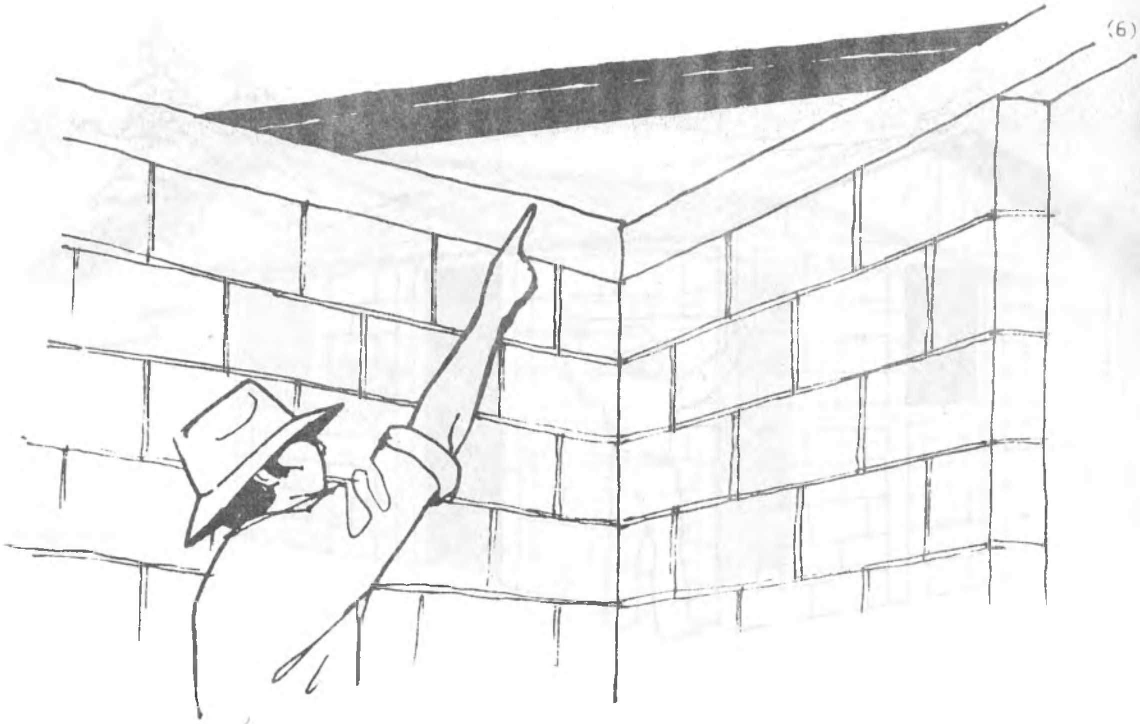
USE MOJINETE LIVIANO - NO LO HAGA DE BLOCK.



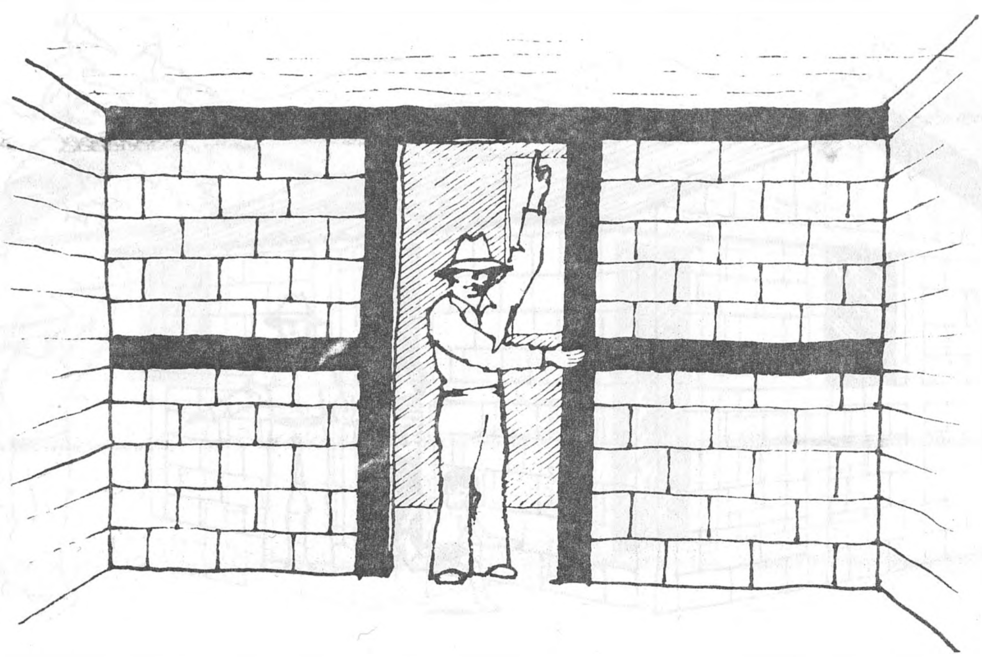
DEJE UN METRO DE DISTANCIA COMO MINIMO ENTRE LAS ESQUINAS DE LAS PAREDES Y PUERTAS O VENTANAS Y TAMBIEN ENTRE PUERTAS Y VENTANAS.



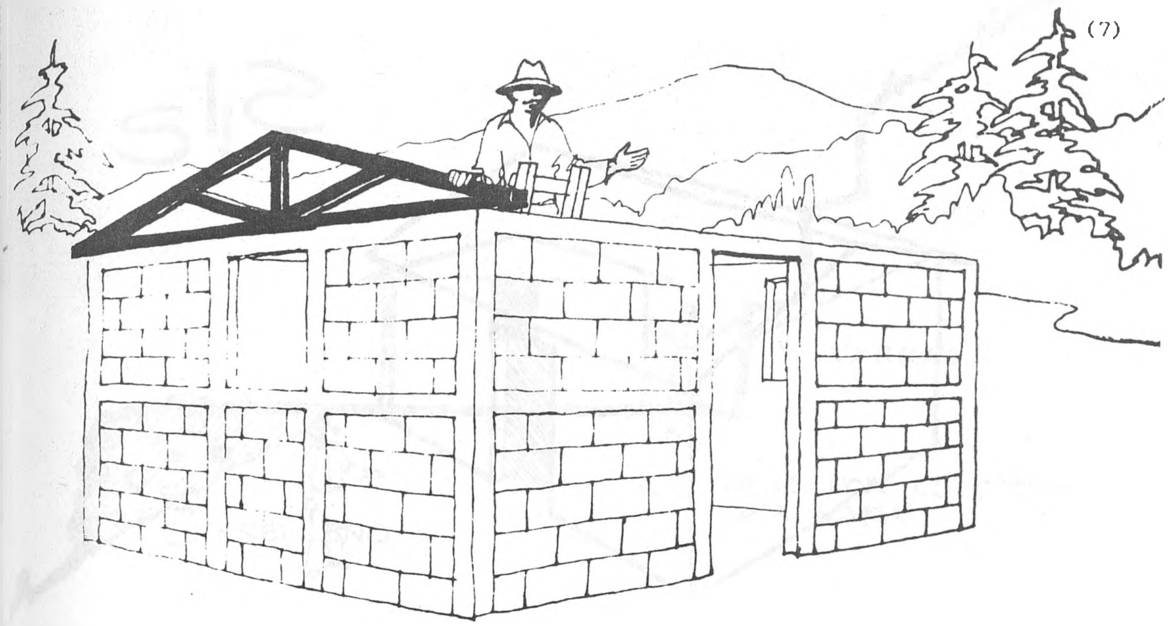
LA PUERTA DEBE ABRIRSE HACIA AFUERA.



USE ESQUINERAS SOBRE LA SOLERA DE TERMINACION.



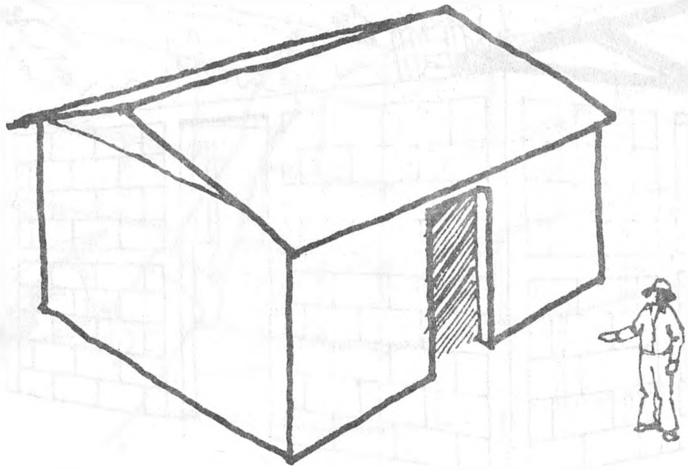
LAS PAREDES INTERIORES TAMBIEN NECESITAN COLUMNAS Y SOLERAS DE CONCRETO CON REFUERZOS DE HIERRO.
LA PUERTA DEBE COLOCARSE EN EL CENTRO DE LA PARED.



LAS TIJERAS SON EL MEJOR METODO PARA SOSTENER EL TECHO. ENTRE TIJERA Y TIJERA DEBE COLOCAR DIAGONALES.

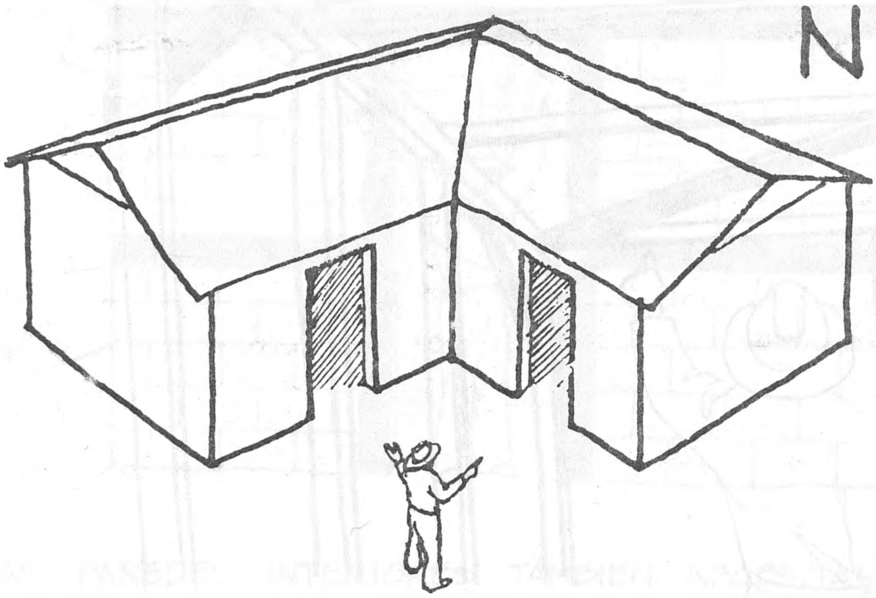
SI HAY CORREDOR, USE DIAGONALES.

SI



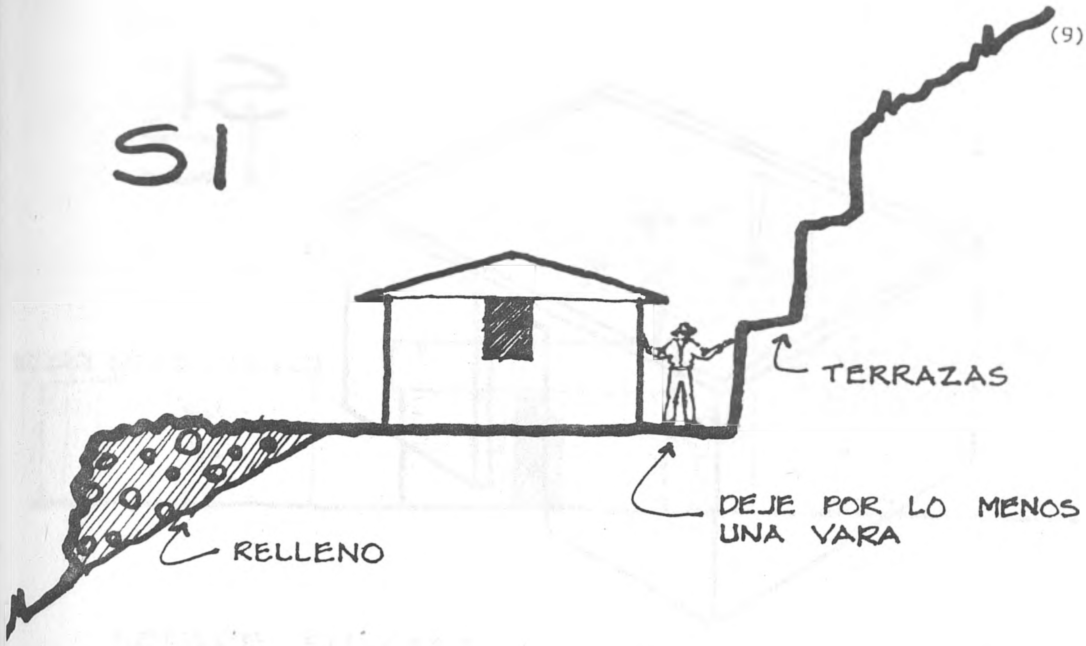
LA CASA DEBE SER CUADRADA O RECTANGULAR. LAS PAREDES LARGAS NO DEBEN SER MAS DE 1 ½ VECES DEL LARGO DE LAS PAREDES CORTAS.

NO



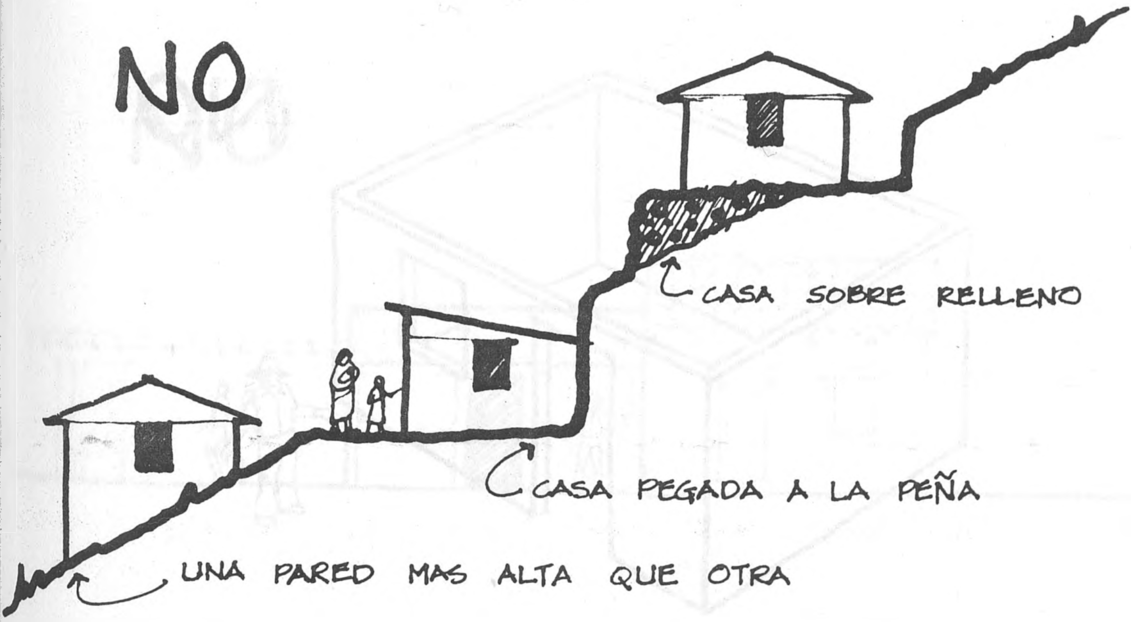
LAS CASAS EN FORMA DE ESCUADRA SON PELIGROSAS DURANTE LOS TERREMOTOS.

SI

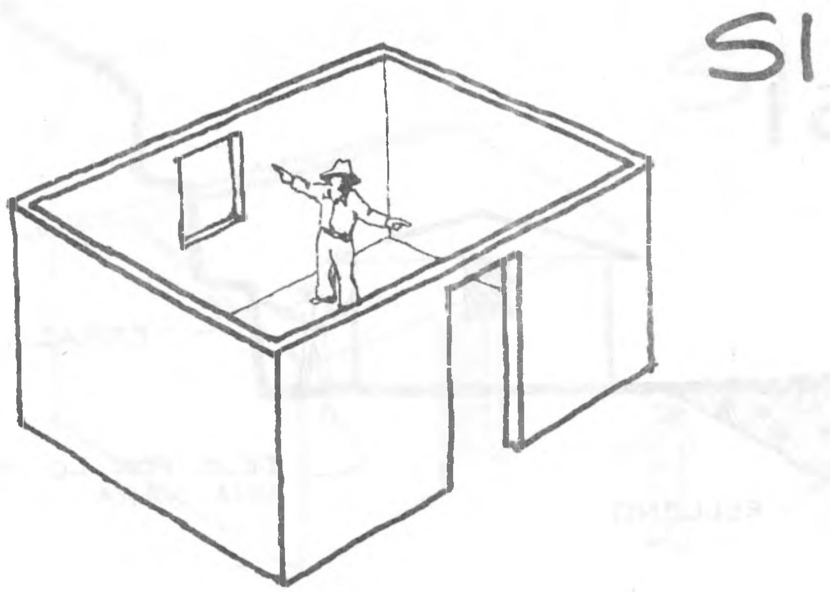


EN LADERAS HAGALO ASI

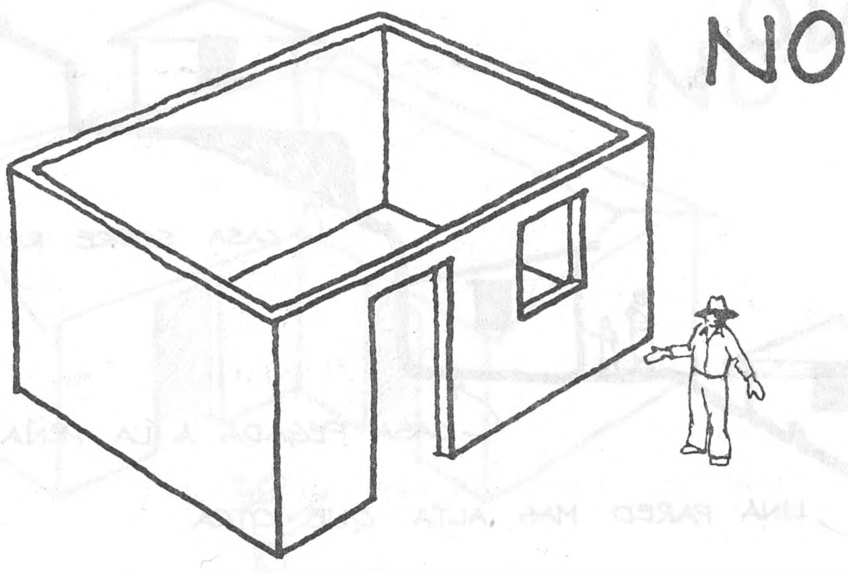
NO



NO CONSTRUYA EN ESTAS FORMAS

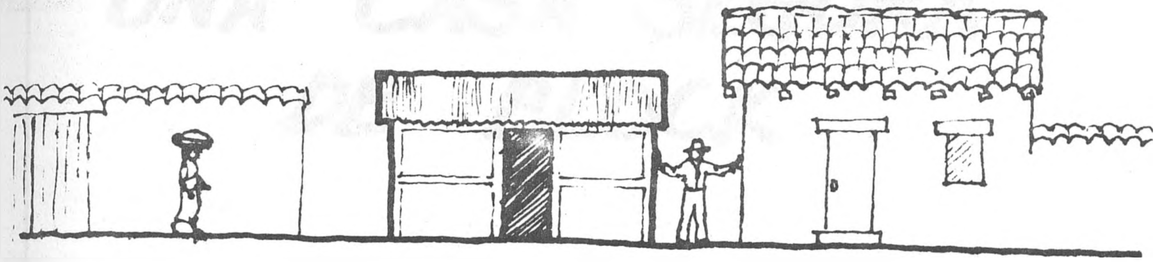


COLOQUE LAS VENTANAS Y PUERTAS UNA FRENTE A LA OTRA PARA BALANCEAR LAS PAREDES.



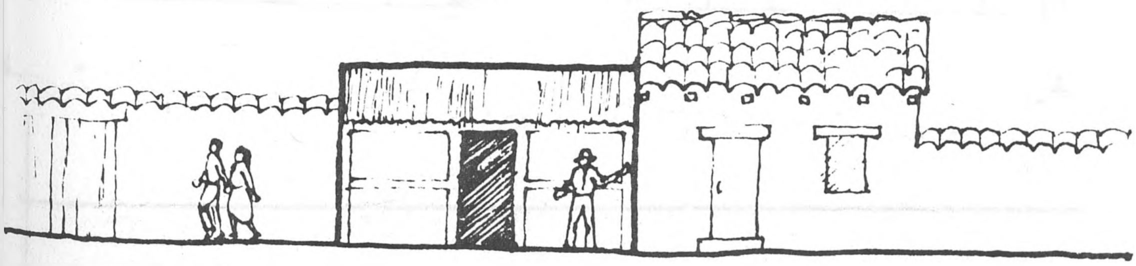
LAS PAREDES QUE NO ESTAN BALANCEADAS SON PELIGROSAS DURANTE LOS TERREMOTOS.

SI



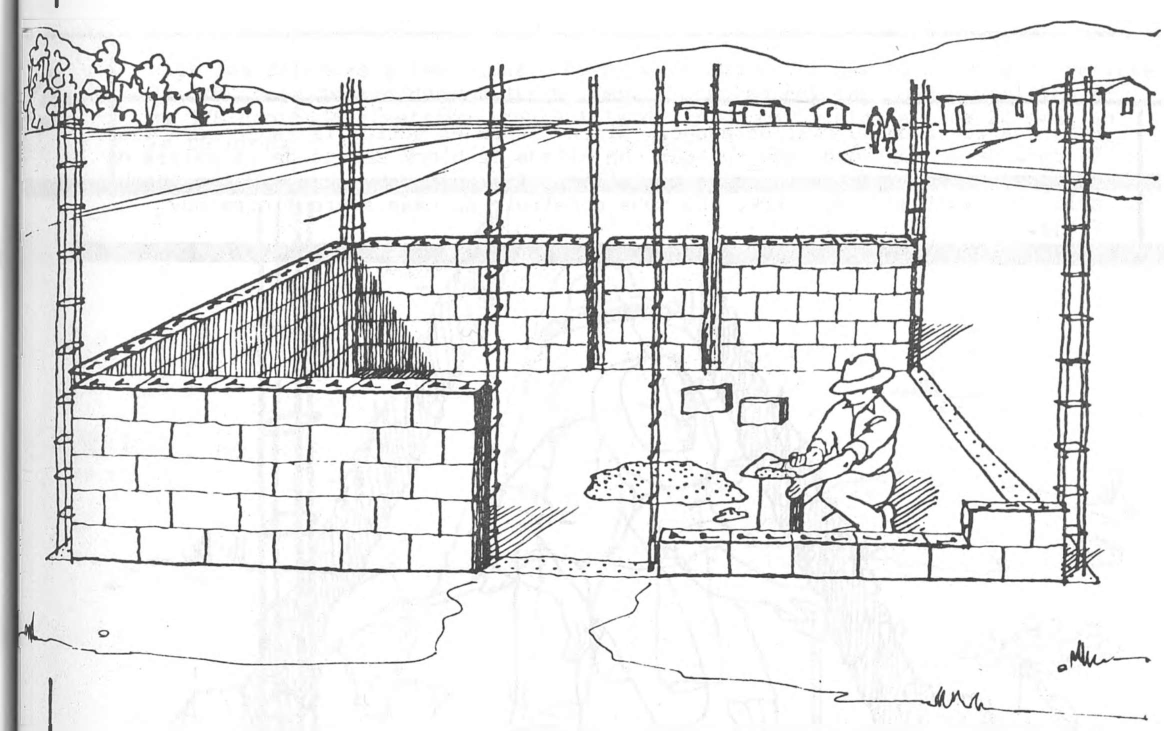
SEPARE SU CASA DE LAS DEMAS COMO MINIMO UNA VARA.

NO

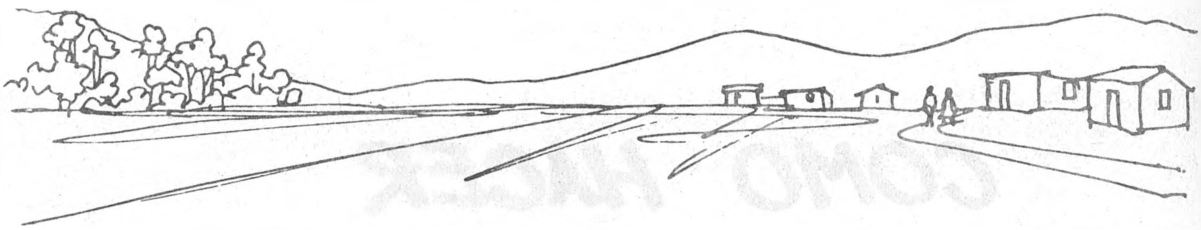


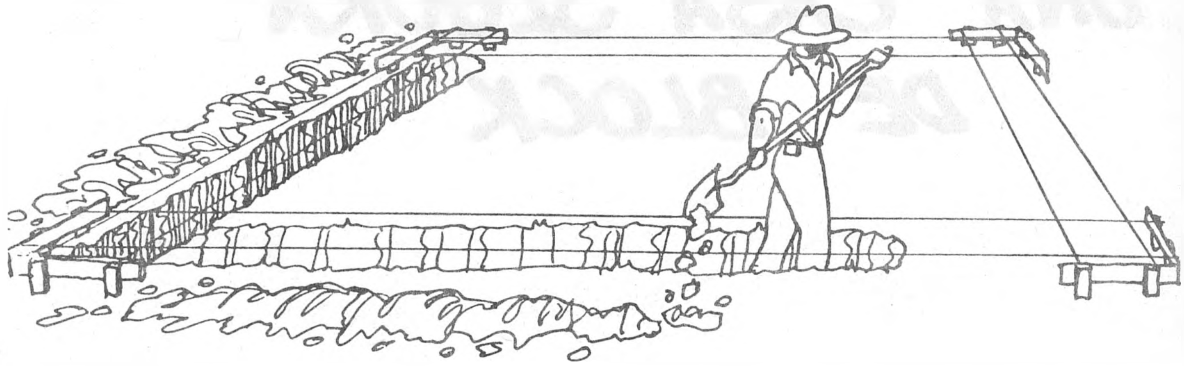
NO PEGUE SU CASA CON LAS DEMAS O CON PAREDES.

COMO HACER UNA CASA SEGURA DE BLOCK



PRODUCIDO POR OXFAM/VECINOS MUNDIALES
CON LA ASESORIA DE INTERTECT
DICIEMBRE DE 1976





1

Haga una zanja de 40 cms. de ancho. Si la tierra es sólida la zanja debe tener 50 cms. de profundidad para colocar una hilada de block debajo de la solera de humedad, pero si la tierra no es muy sólida, la zanja debe tener 70 cms. para colocar dos hiladas de block. No debe construir su casa sobre tierra muy floja.

2

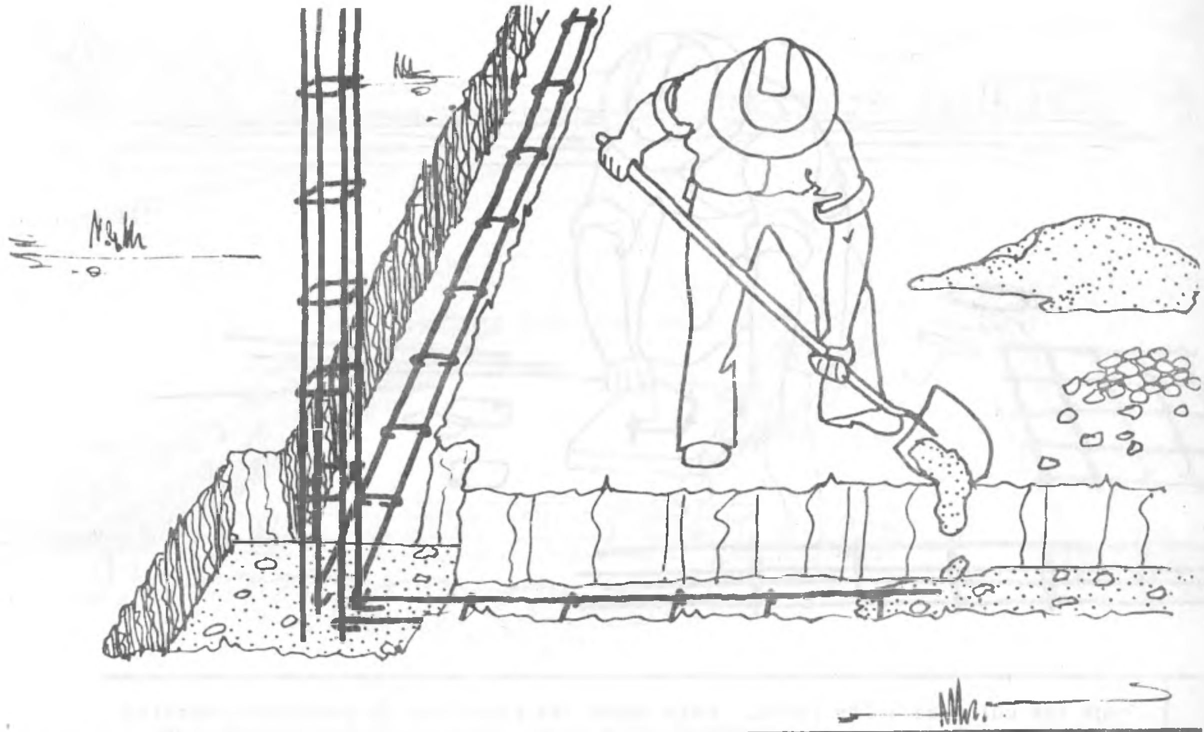
Abra un hoyo de 70x70 y de 75 cms. de profundidad para meter las columnas.

3

Haga las columnas y las patas. Para hacer las patas use 10 pedazos de varilla de 3/8, cada pedazo debe medir 60 cms. Para las columnas use 4 varillas de de 3/8 poniéndole estribos de varilla de 1/4 y colóquelos a cada 20 cms. en la columna.

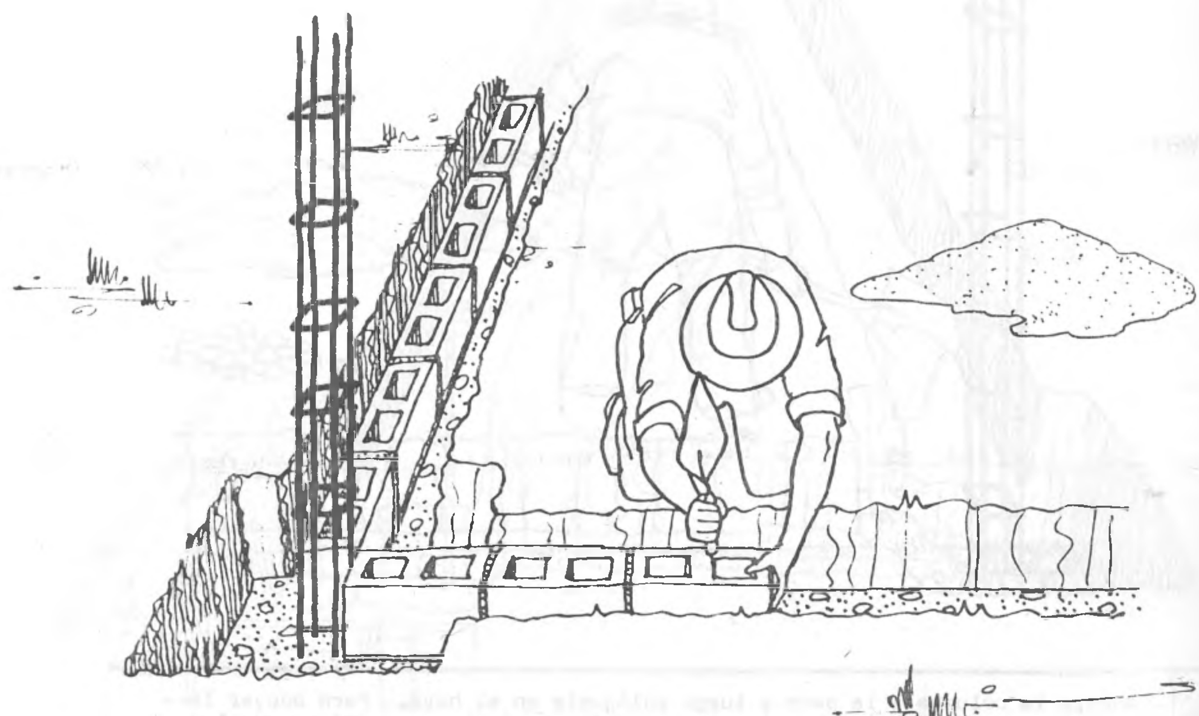
4

Amarre la columna a la pata y luego colóquela en el hoyo. Para apoyar la pata sobre el suelo debe usar cuatro piedras de 5 cms. de alto a cada lado. Luego debe llenar el hoyo a una profundidad de 25 cms. con concreto mezclado con piedras.



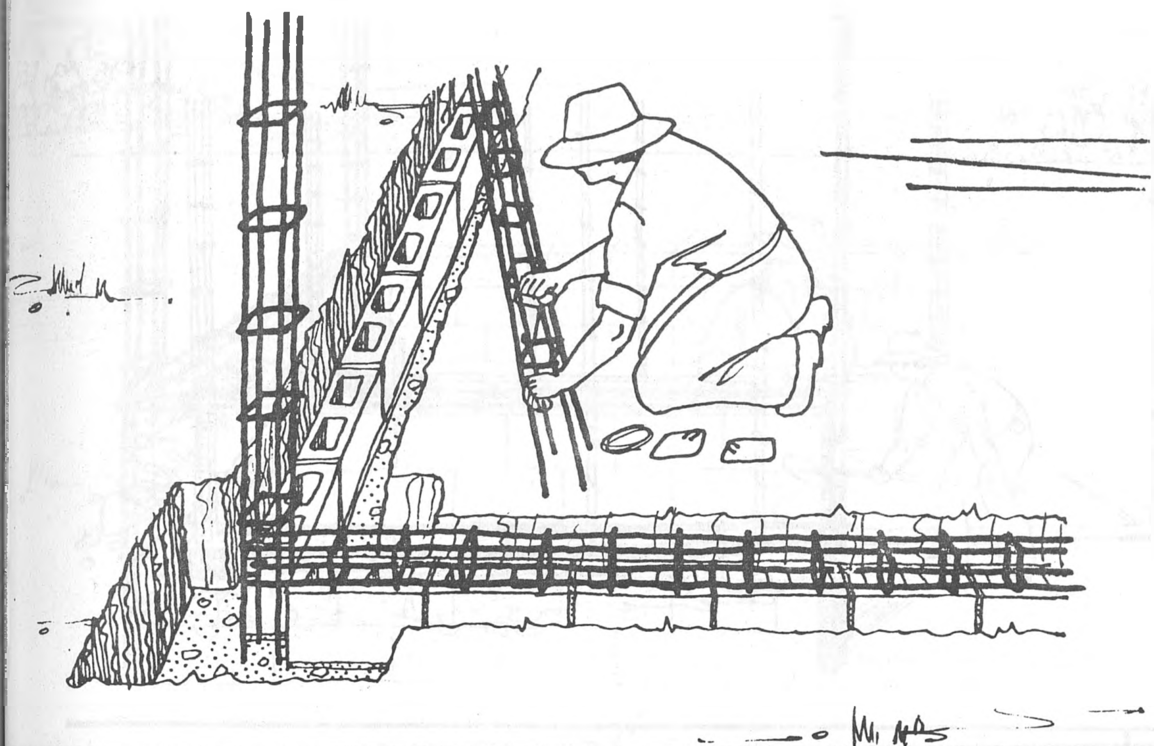
5

En la zanja ponga una armadura hecha con dos varillas de 3/8 que tenga eslabones de 1/4. Colóquela sobre piedras para que quede bien apoyada. Luego amárrela bien a la columna. Llene la zanja 15 cms. con concreto mezclado con piedras.



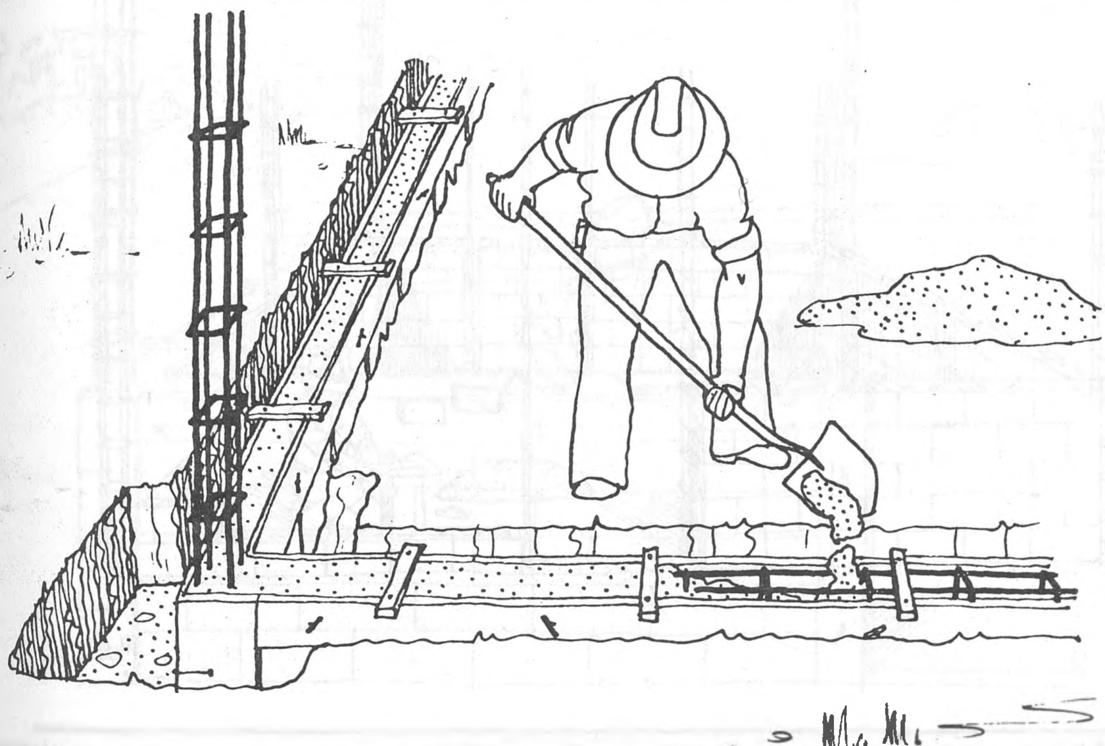
6

Coloque una hilada de block sobre la fundición y dos hiladas si la zanja se hizo a 70 cms. de profundidad. Cuando se colocan los blockes cerca de la columna quedan en escuadra y entonces forman las partes de adentro de la misma.



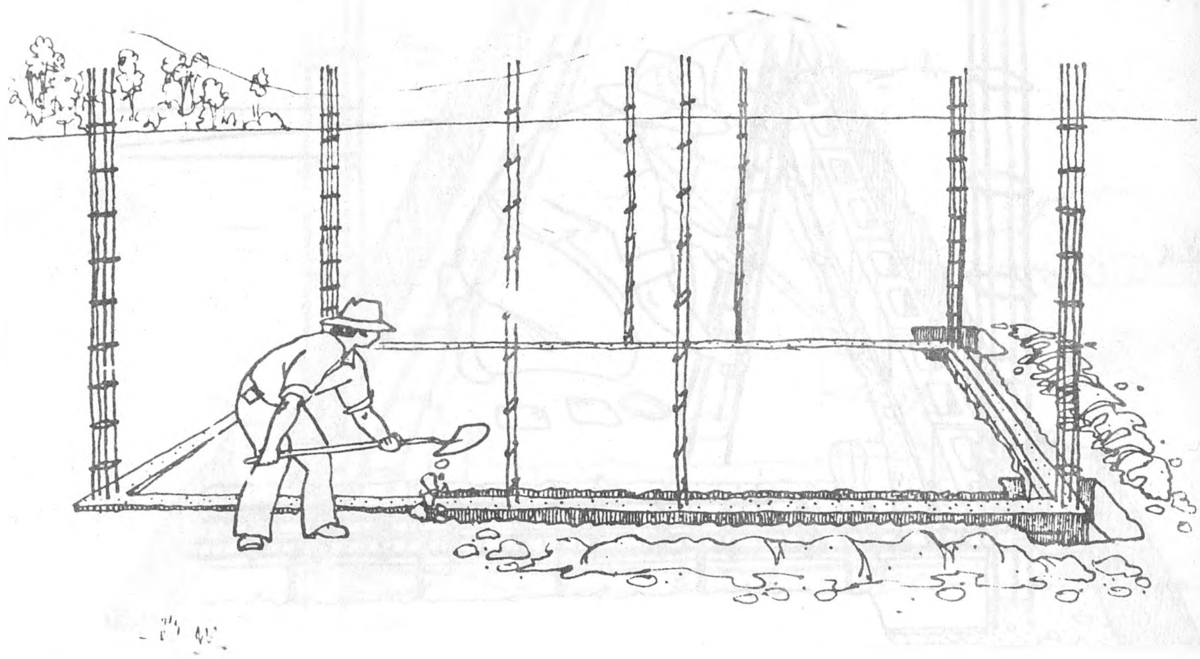
7

Haga la solera de humedad colocándola sobre la última hilada de block. Para hacerla use 4 varillas y estribos como cuando se hacen las columnas. La solera debe ir bien amarrada a la columna. El tope de la solera debe quedar 4 centímetros bajo el nivel del piso de la casa.



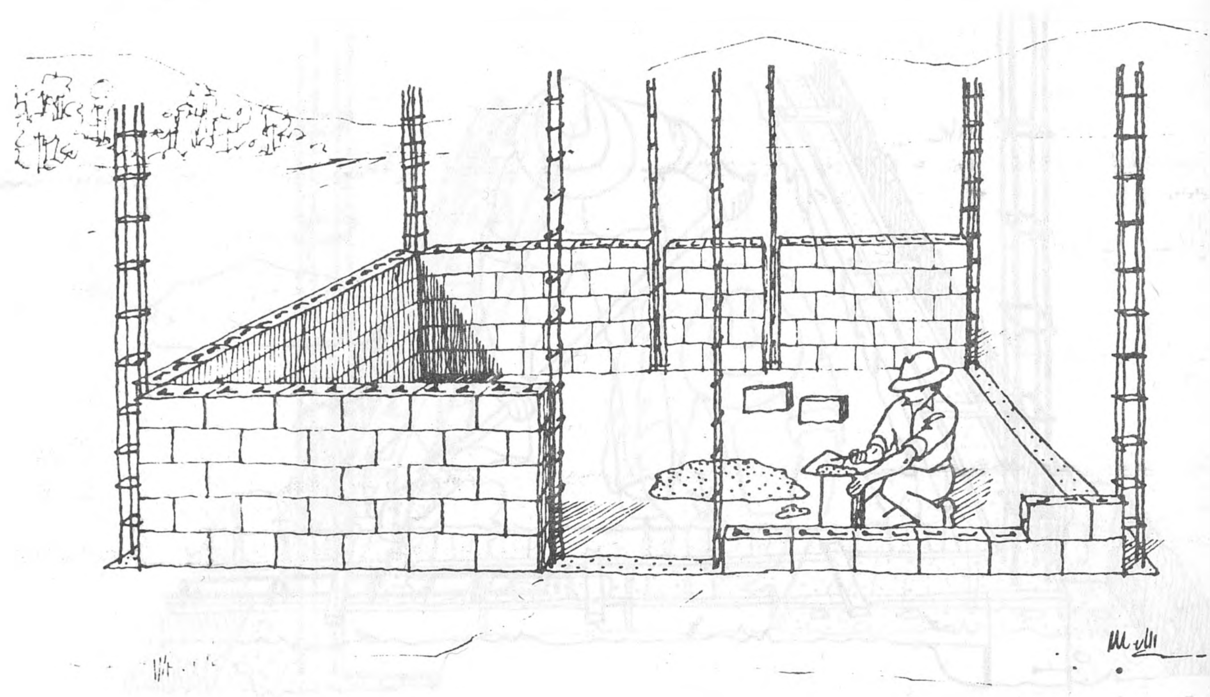
8

Haga las formaletas para la solera y la columna. Para la columna hágala hasta el nivel de la solera y luego rellene. Puye bien con una varilla para que quede firme.



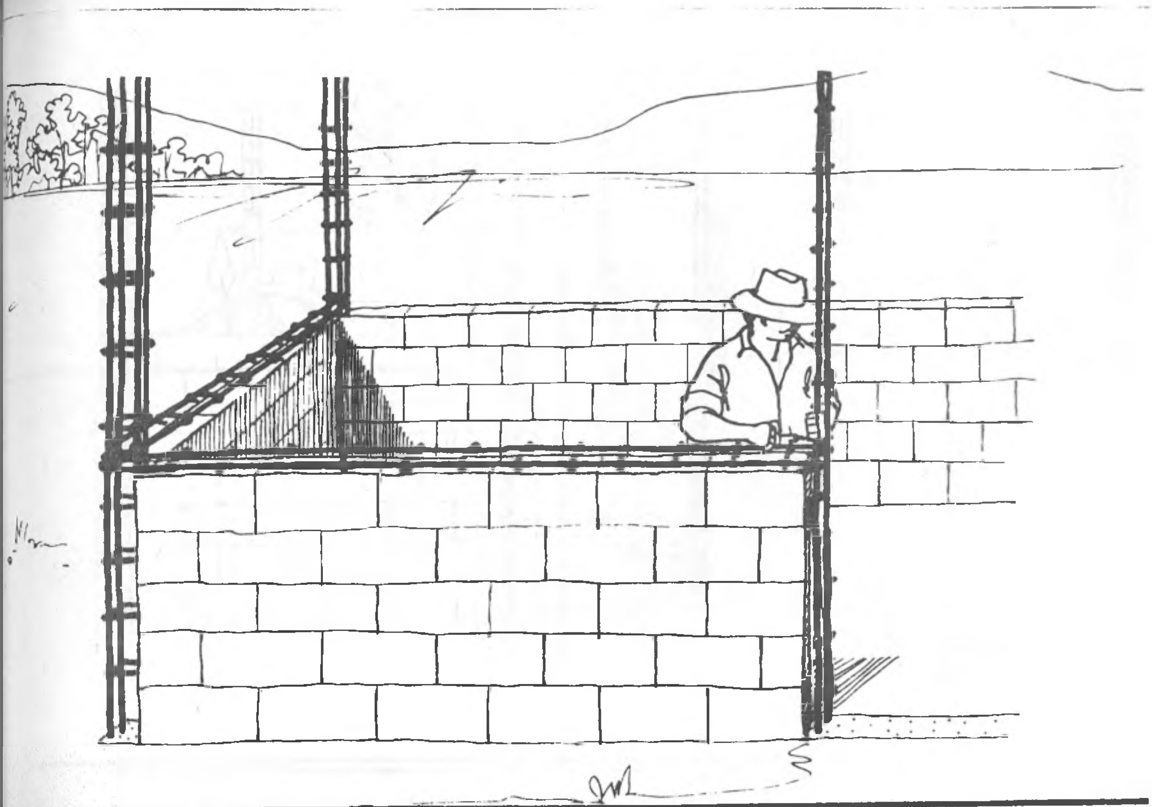
9

Debe colocar columnas en las esquinas y costillas a cada lado de puertas y ventanas. Las costillas deben ir amarradas a la solera y tener 10 cms. de grueso. En las paredes largas sin puertas o ventanas debe poner columnas a cada dos metros y medio.



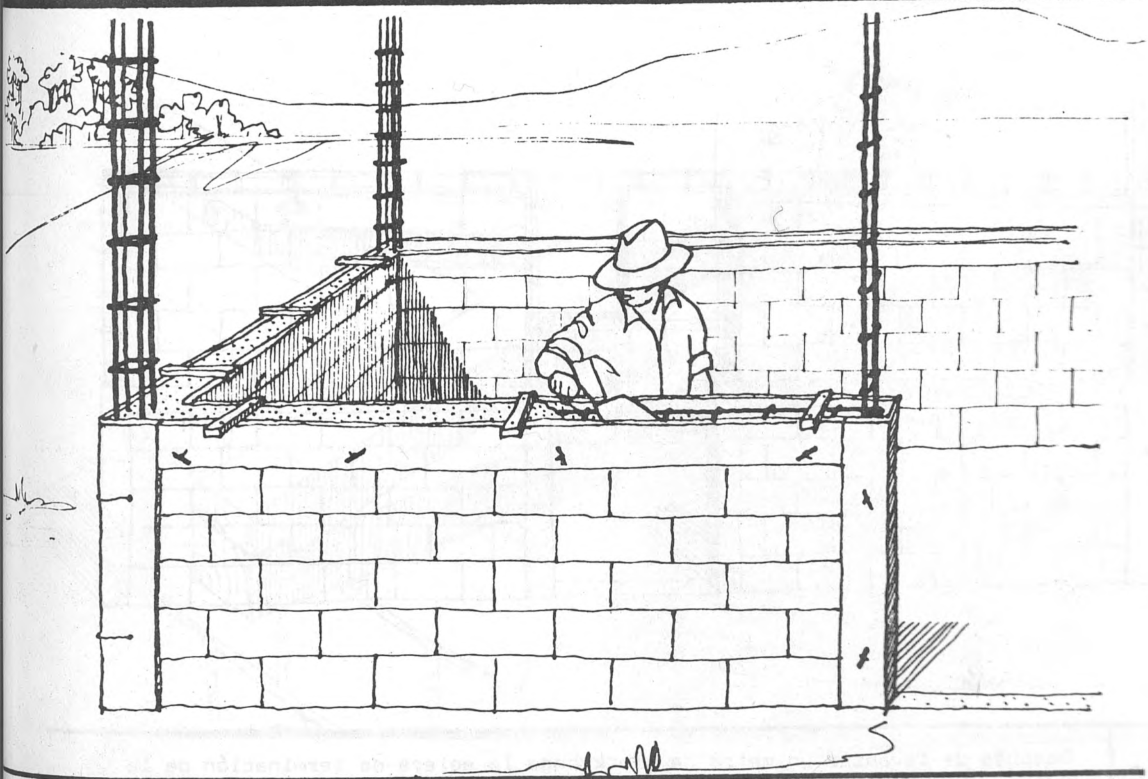
10

Debe empezar a levantar las paredes por las esquinas y antes de colocar los blockes debe mojarlos. Entre solera y solera debe dejar un metro de distancia.



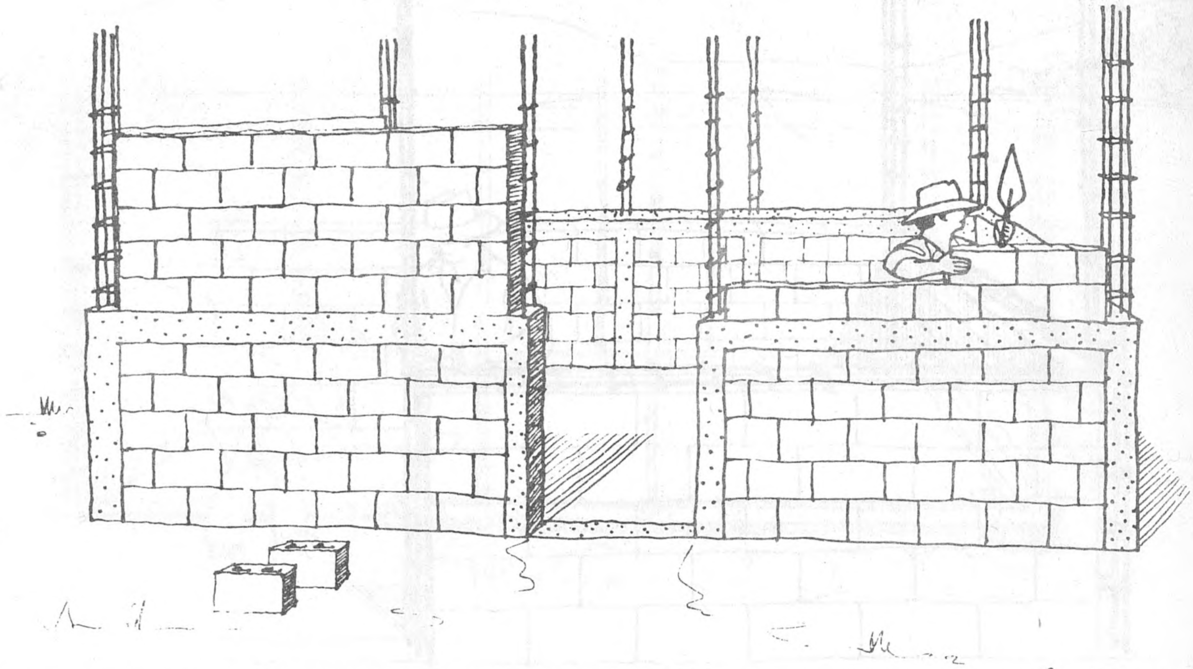
11

Después de un metro de block haga la solera de en medio. Esta debe hacerse como las costillas usando dos varillas y eslabones y debe tener 15 cms. de grueso.

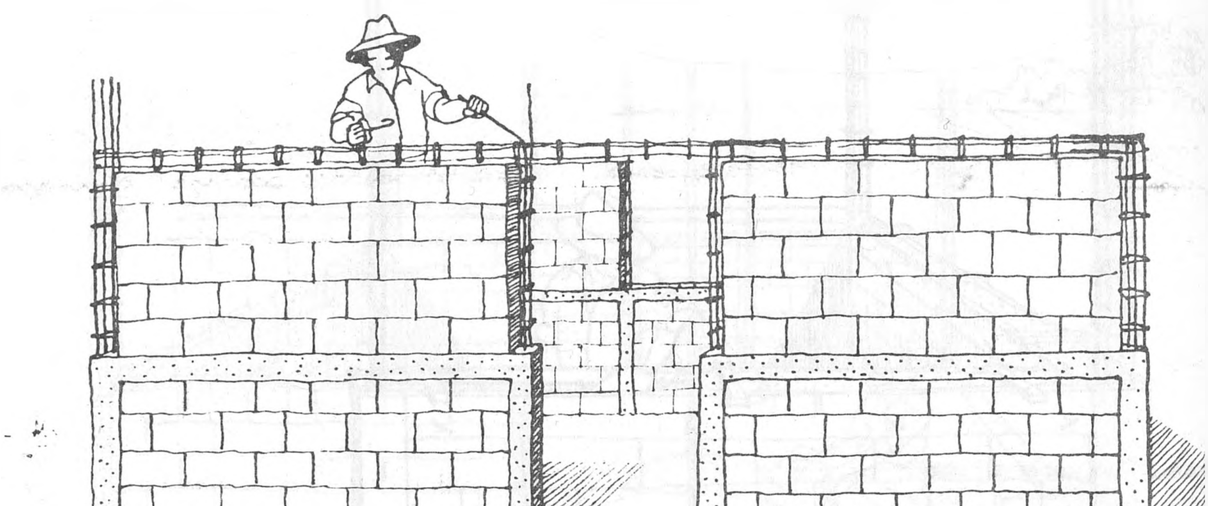


12

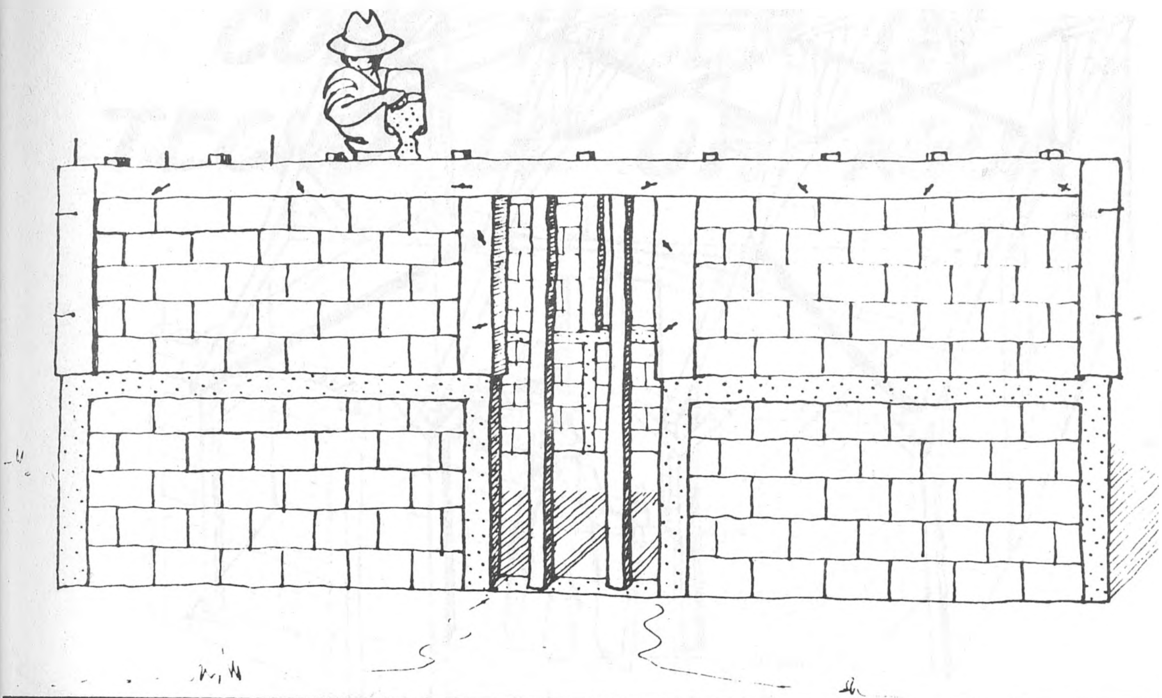
Coloque las formaletas para las soleras y columnas. Rellene y puye bien las columnas con una varilla para que no queden hoyos pequeños.



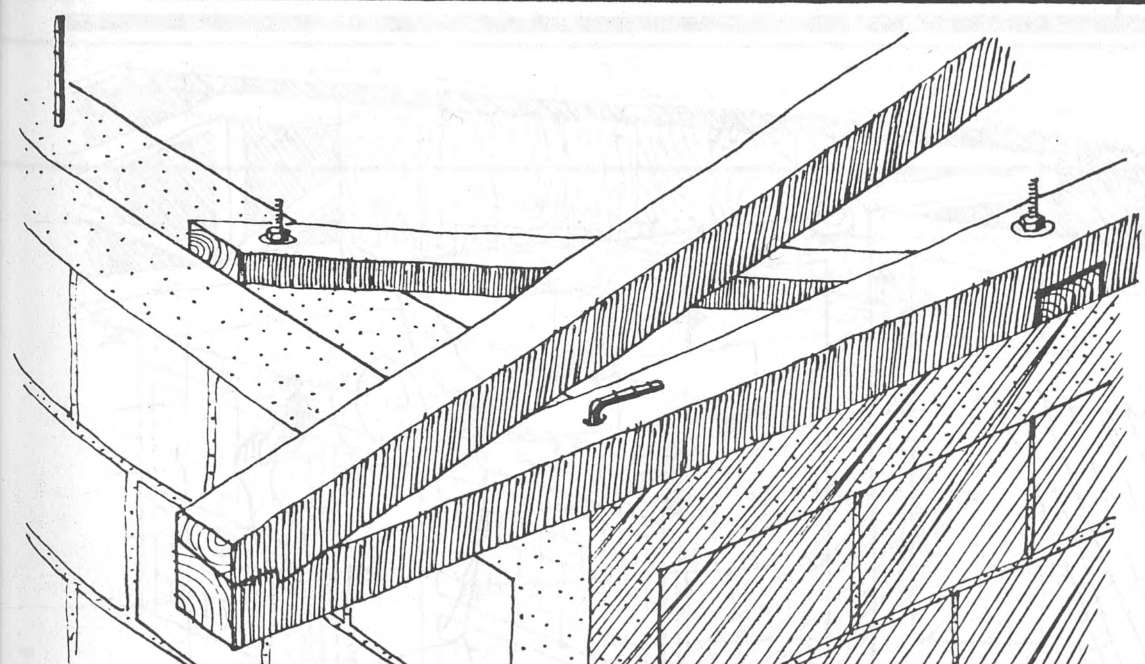
13 Debe seguir levantando la pared sobre la solera. Moje la solera y también los blockes antes de colocarlos.



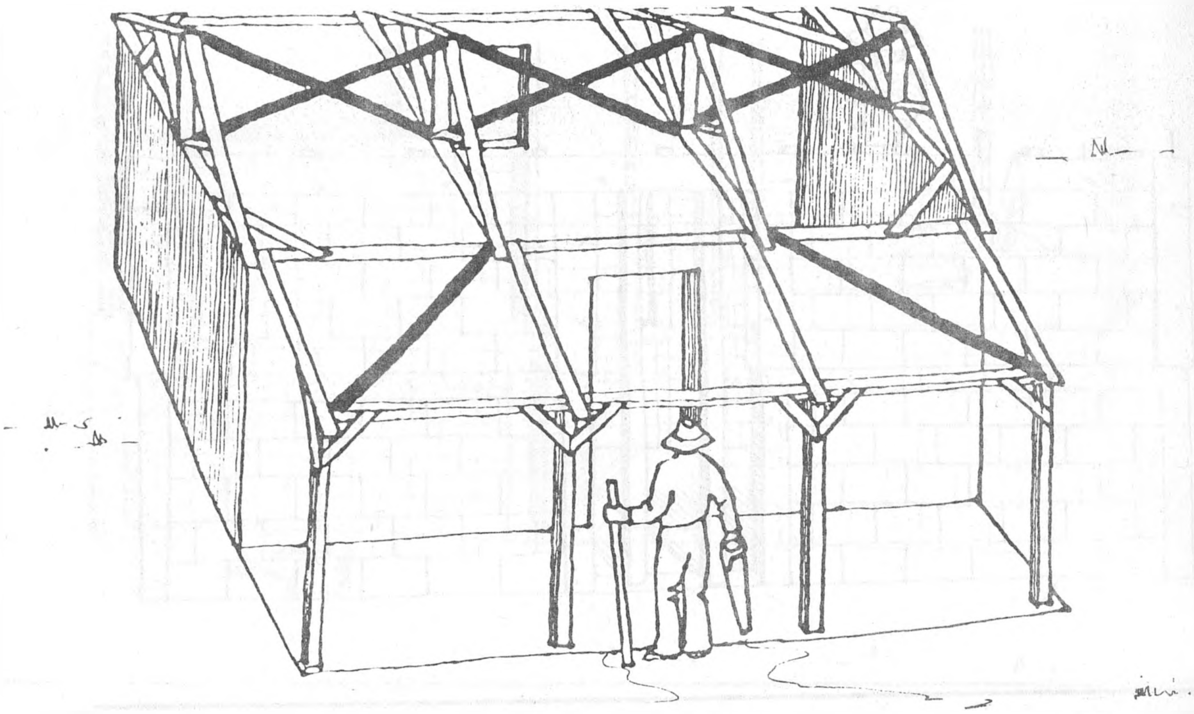
14 Después de levantar un metro de block haga la solera de terminación de la pared. Esta solera debe hacerse en la misma forma que la solera de humedad, usando cuatro varillas, estribos y también amarrándola a las columnas y costillas.



15 Coloque las formaletas para las soleras y columnas, luego rellene y puye bien con una varilla para que no queden pequeños hoyos. En esta solera debe fundir los pines para agarrar las tijeras y los tornillos para agarrar las esquineras.

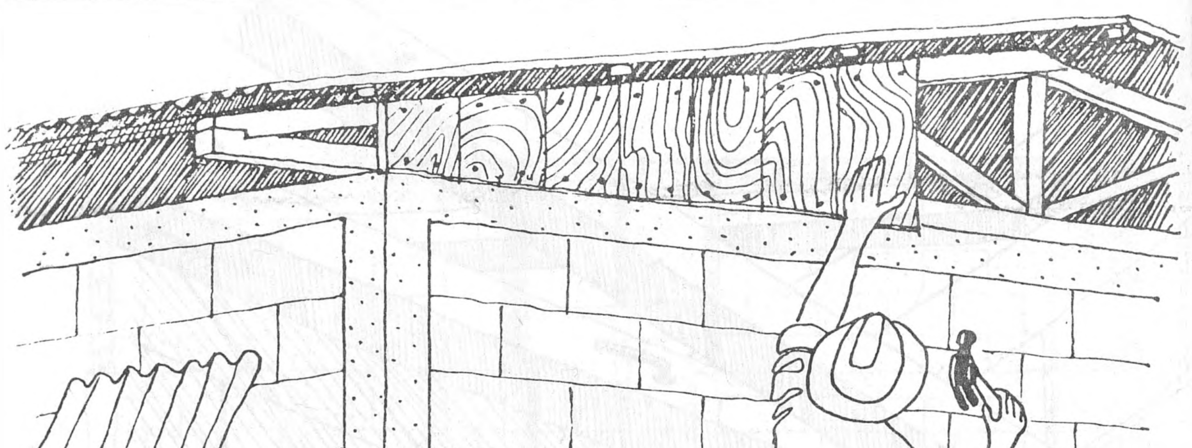


16 Las tijeras deben agarrarse a las paredes con pines de varilla fundidos en la solera. La esquinera debe agarrarse a ambos lados de las paredes con tornillos fundidos en la solera.



17

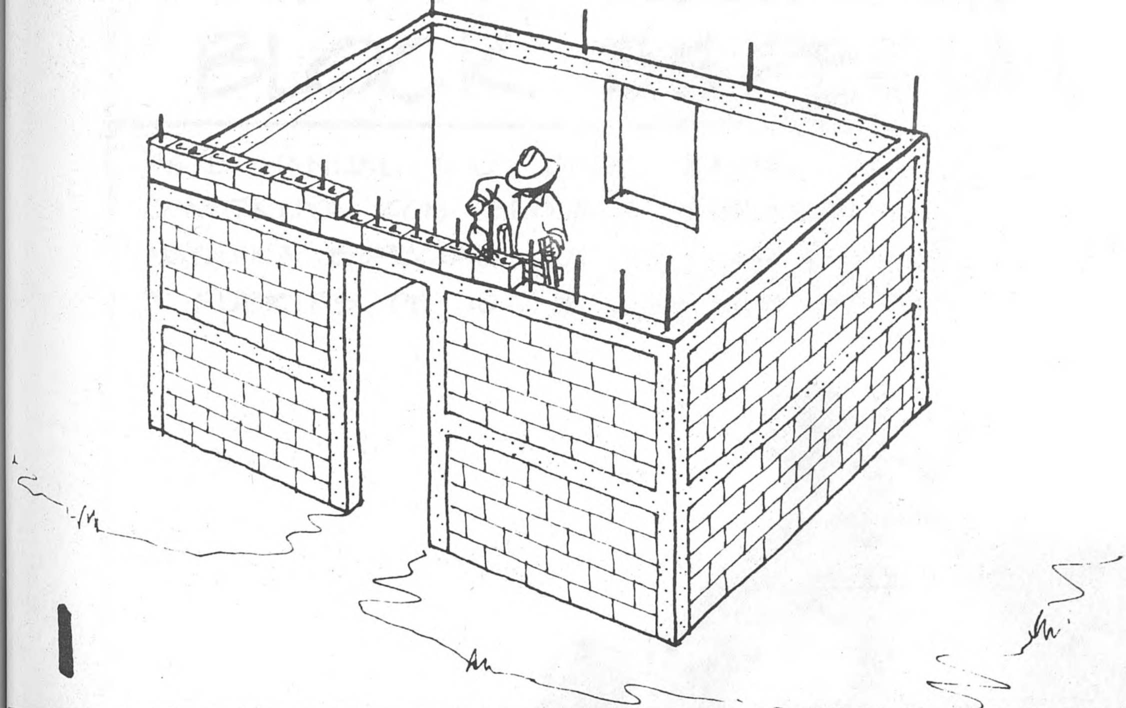
El mejor método para sostener el techo son las tijeras, las cuales deben tener refuerzos en "X". Si hay corredor debe usarse diagonales.



18

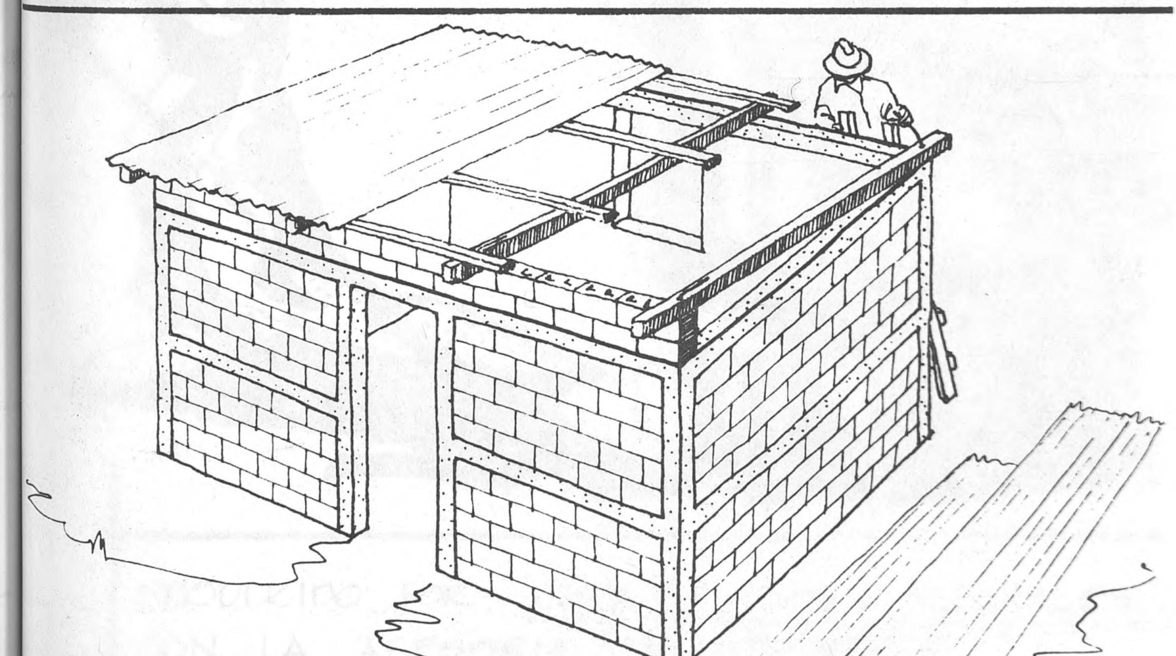
Para mayor seguridad tanto el techo como el mojinete deben ser livianos. Debe usar lámina para hacer el techo y madera para el mojinete.

COMO HACER UN TECHO DE UN AGUA



1

Amarre los refuerzos verticales de hierro a la armadura de la solera de terminación antes de echarle la mezcla a la misma. Estos refuerzos deben pasar a través de cada block, y los hoyos que quedan en cada block deben llenarse con cemento. No debe colocar más de 2 hiladas de block sobre esta solera.

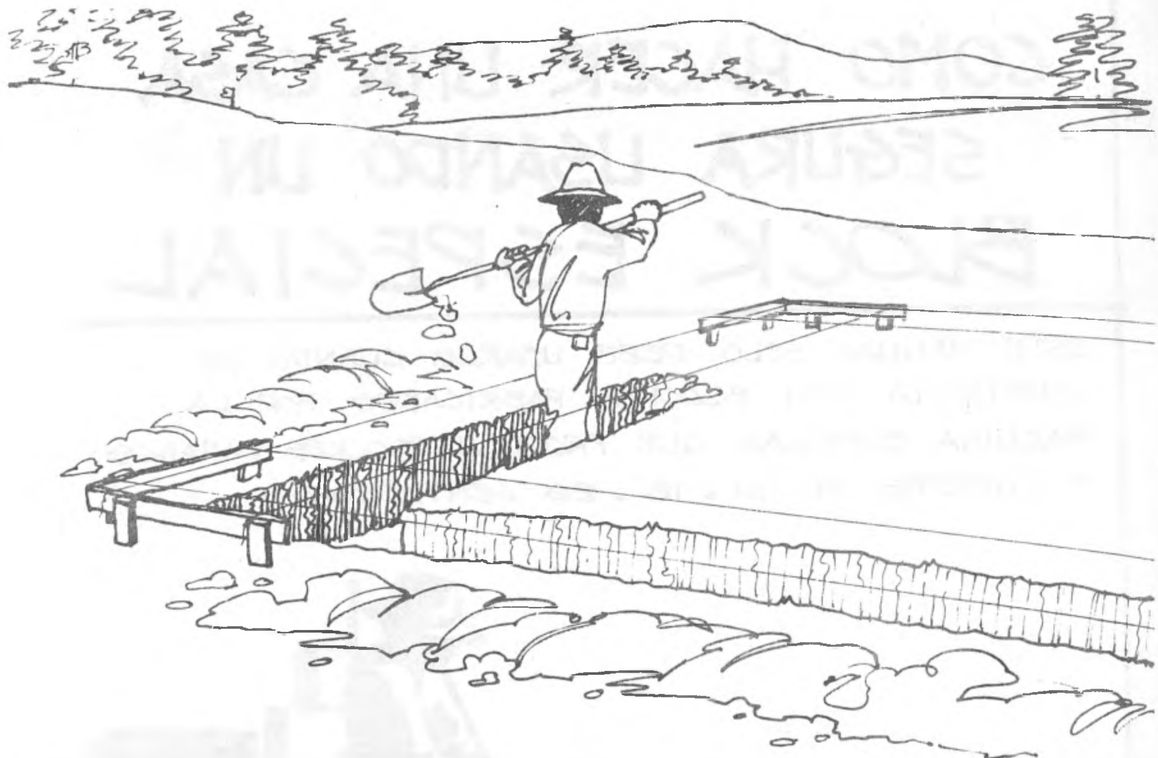


2

COMO HACER UNA CASA SEGURA USANDO UN BLOCK ESPECIAL

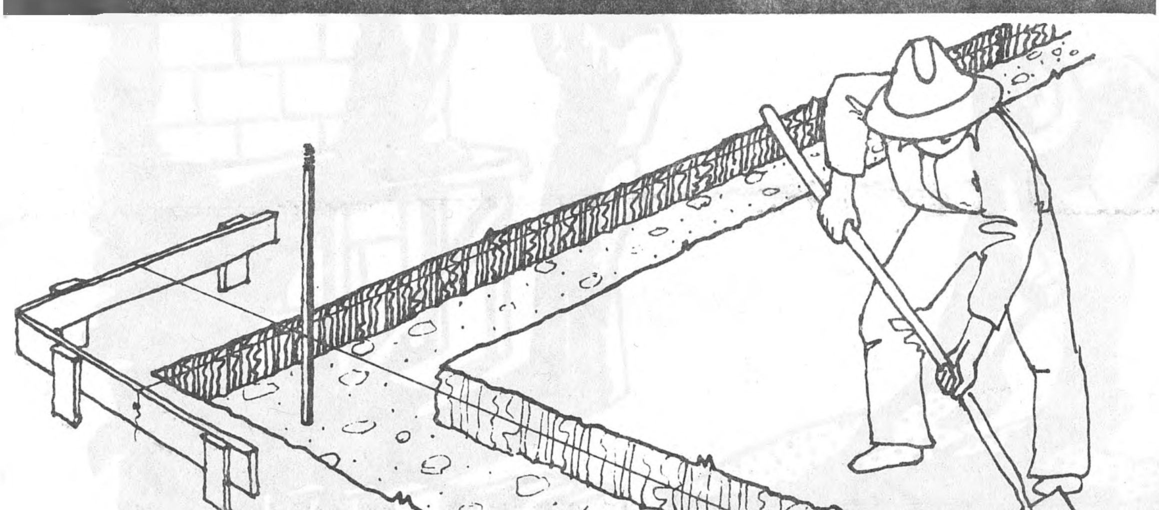
ESTE MANUAL SOLO DEBE USARSE CUANDO SE CONSTRUYA CON BLOCKES FABRICADOS POR LA MAQUINA ESPECIAL QUE PRODUCE BLOCKES LIVIANOS Y FUERTES DE 10 x 18 x 26 CENTIMETROS

PRODUCIDO POR. OXFAM/VECINOS MUNDIALES
CON LA ASESORIA DE INTERTECT
DICIEMBRE DE 1976



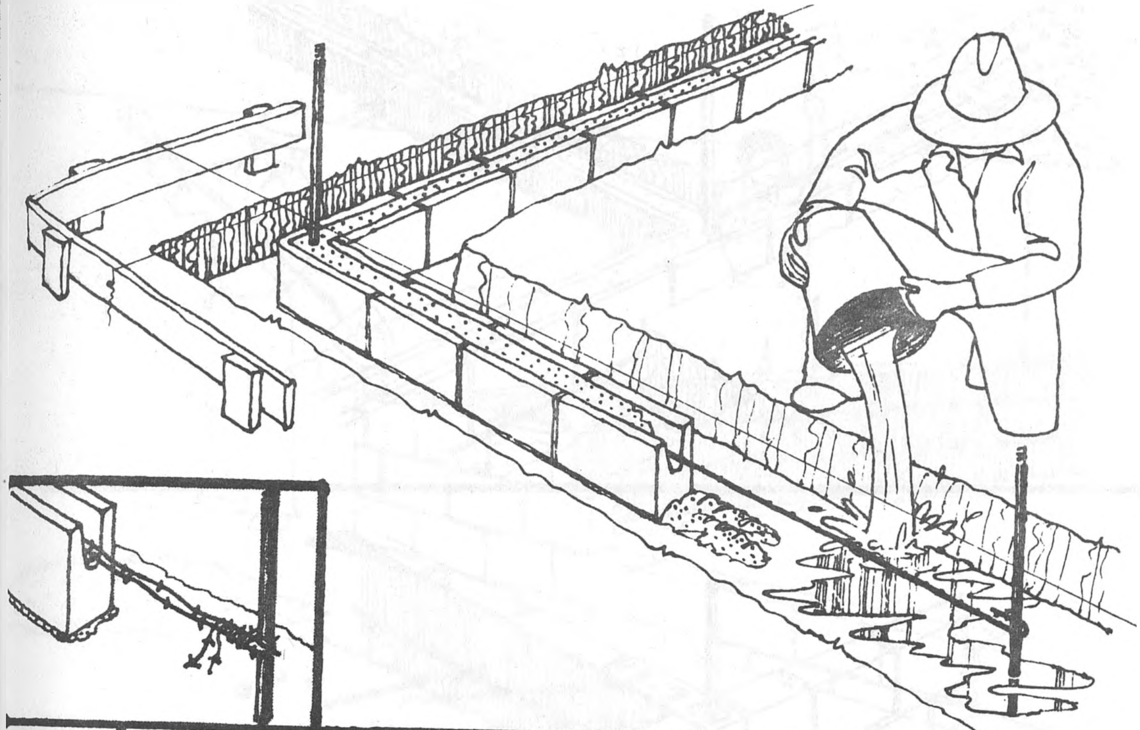
1

Marque la posición de la nueva casa. Debe estar por lo menos a una vara de distancia de cualquier otra casa o pared. La casa debe ser cuadrada o rectangular; nunca debe construirla en forma de "L". Haga una zanja de media vara de hondo y de ancho para los cimientos.



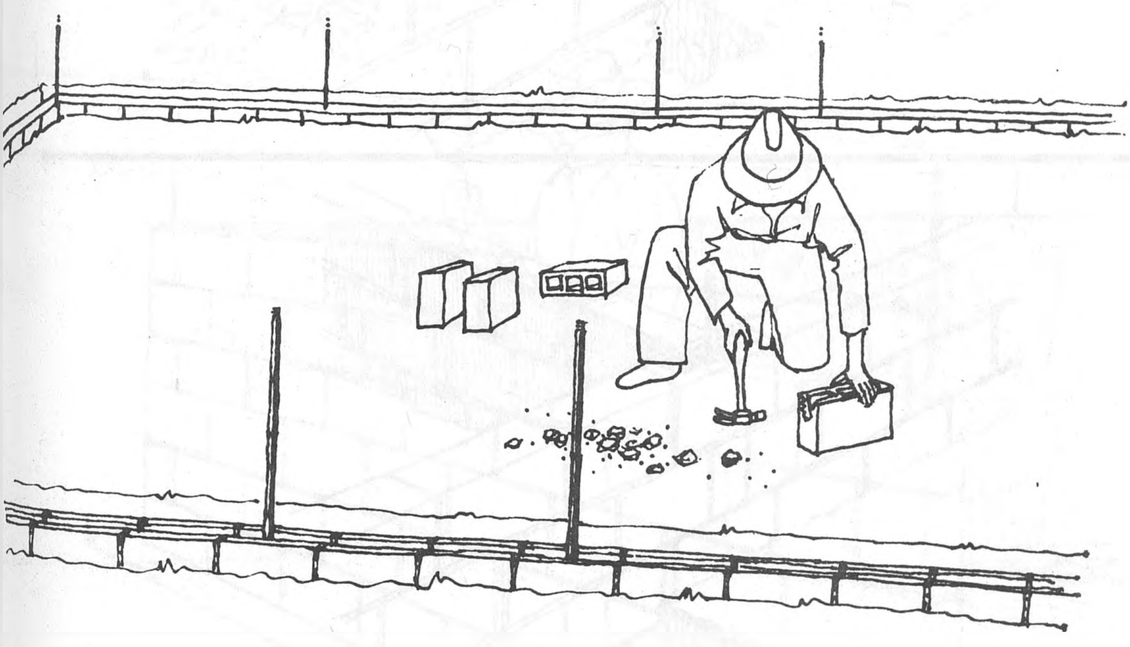
2

Llene la zanja 30 cms. con piedras, tejas quebradas o pedazos de ladrillo revuelto con mezcla. Ponga tubos atravesando la mezcla en donde se necesiten refuerzos verticales: en las esquinas, a los lados de puertas y ventanas y en uniones de paredes.



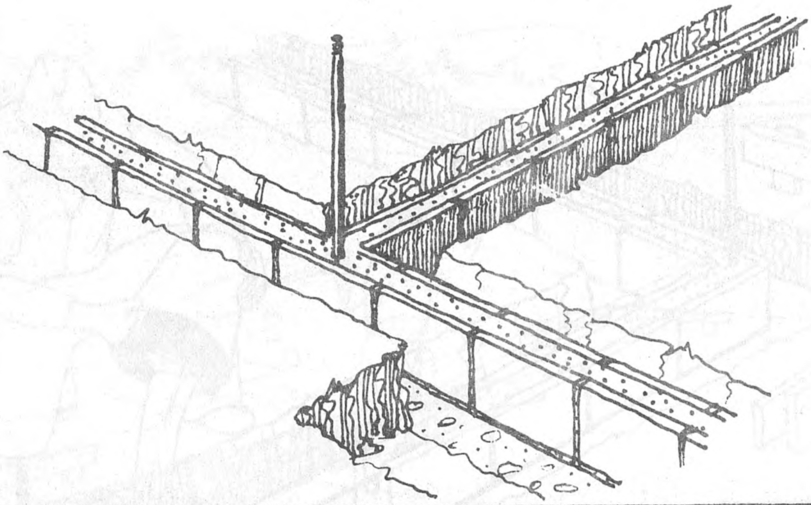
3

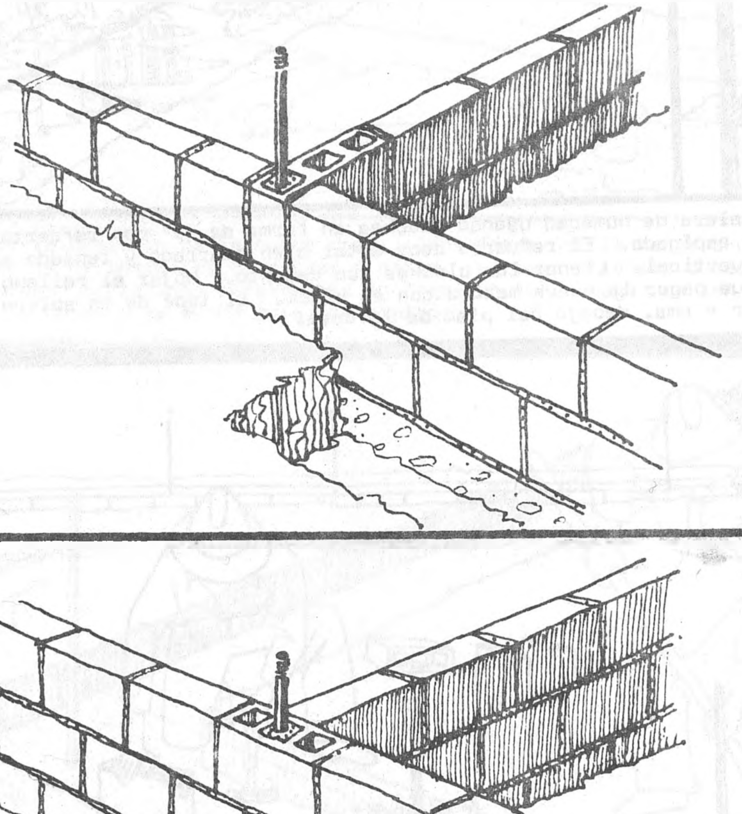
Haga la solera de humedad usando blockes en forma de "U" con refuerzo de varilla
o alambre espigado. El refuerzo debe estar bien amarrado y tensado al tubo del
refuerzo vertical. Llenar los blockes con cemento. Mojar el relleno de la zan-
ja para que pegue la nueva mezcla con el block. El tope de la solera de humedad
debe estar 4 cms. debajo del piso de la casa.

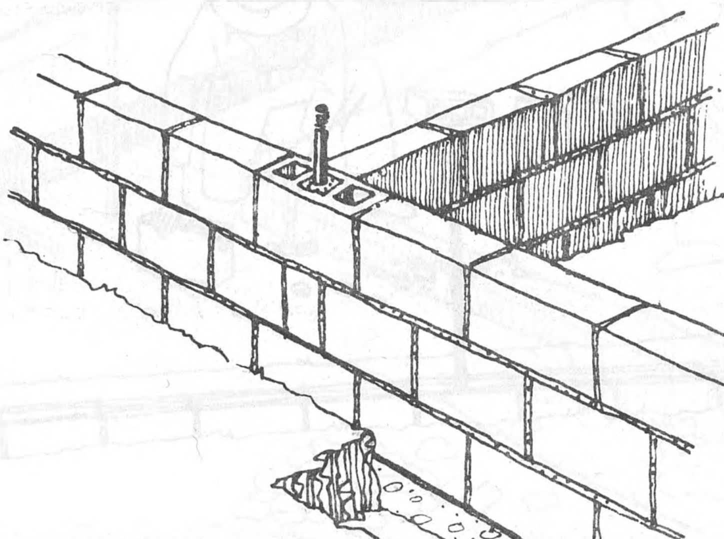


4

Los tubos deben estar en las esquinas y a los lados de puertas y ventanas.
Cuando la pared es larga, sin puertas y ventanas se debe poner tubos a cada
dos metros y medio. Si no tiene blockes en forma de "U" puede hacerlos
rompiendo con un martillo por donde debe pasar el refuerzo horizontal.

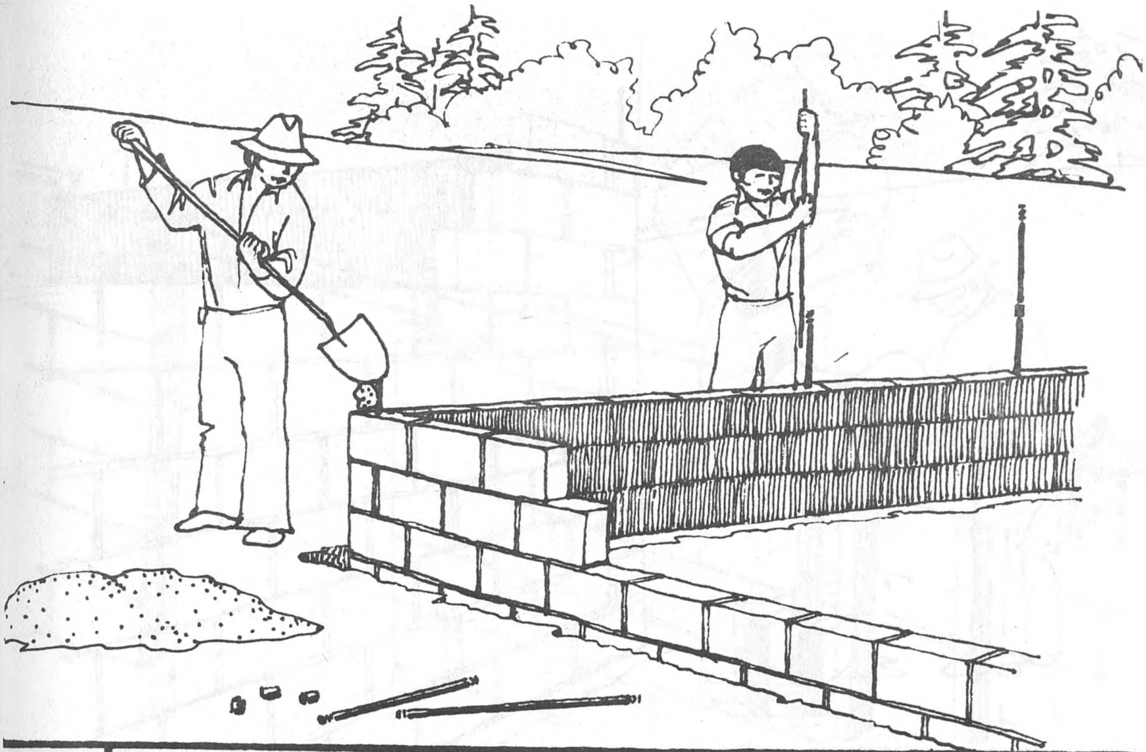




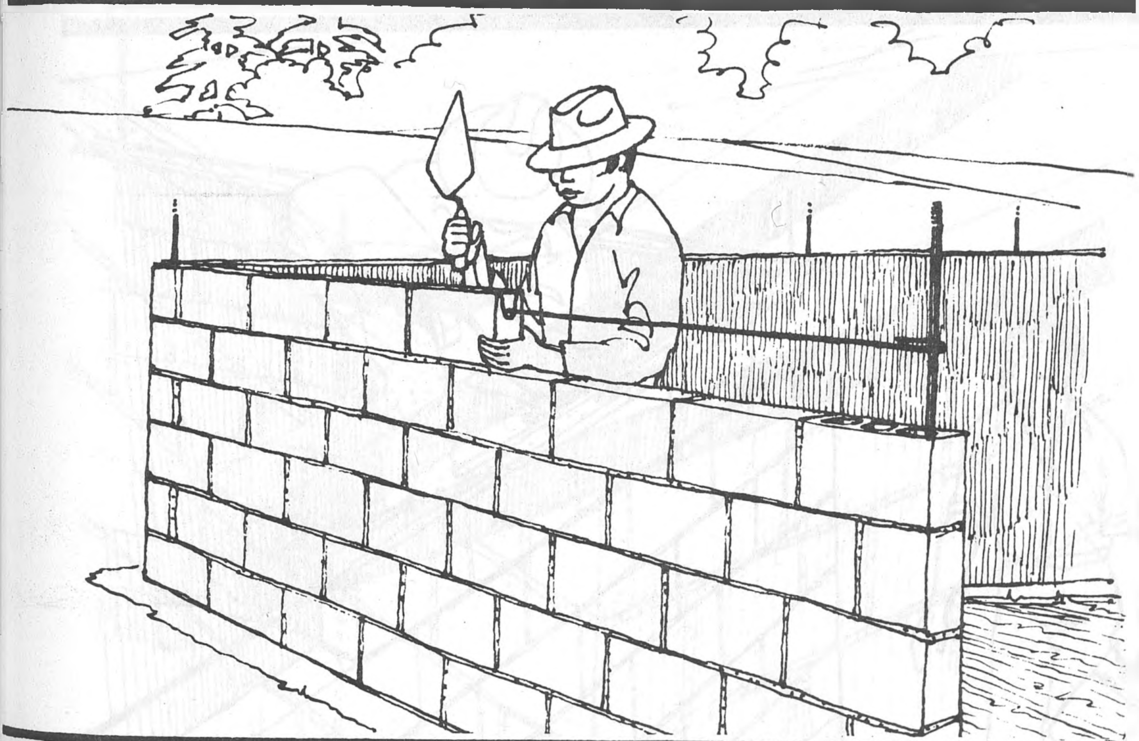


5

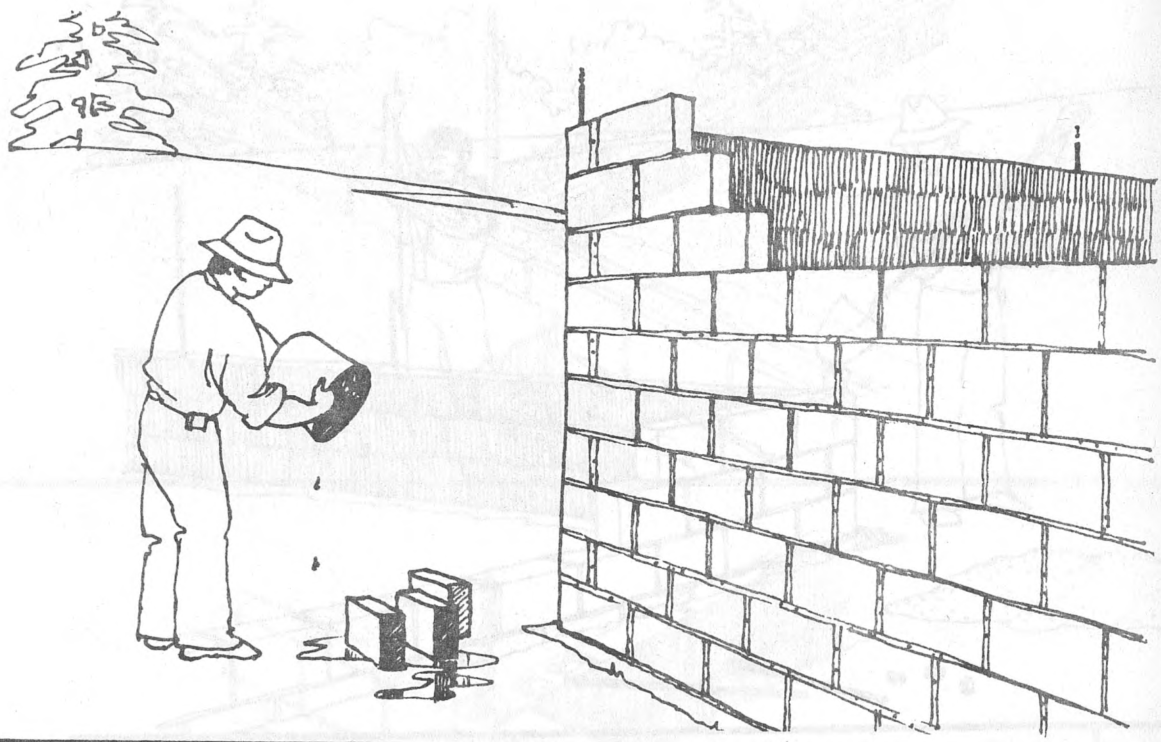
Un tubo debe ir en la unión de paredes interiores con las exteriores. Y debe estar traslapado como se ve en estos dibujos. Las paredes interiores deben construirse en la misma forma que las exteriores: con cimiento, soleras y refuerzo vertical en las puertas.



6 Debe empezar a levantar las paredes por las esquinas. Rellenar con mezcla los hoyos que tengan tubo y picarla bien con una varilla para que quede firme. Cuando necesite agregar otro tubo debe enroscarlo al primero. Los blockes deben colocarse con los hoyos hacia abajo.

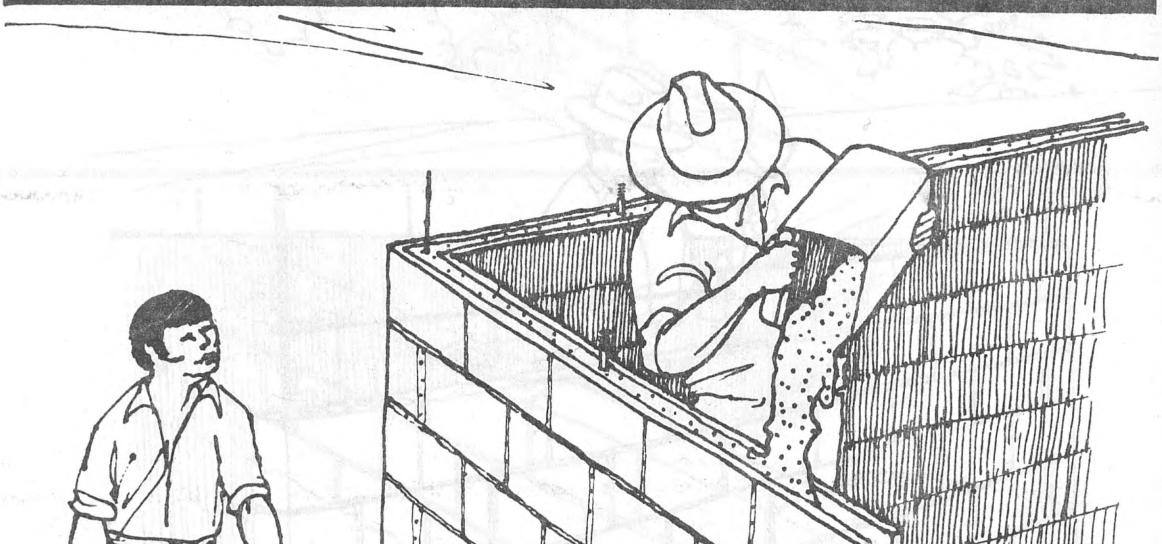


7 Debe hacerse otra solera en medio de cada pared en la misma forma que la solera de humedad; con blockes en "U", refuerzo horizontal bien amarrado a los tubos verticales y rellenar con cemento. Entre las soleras debe haber 5 hiladas de blockes.



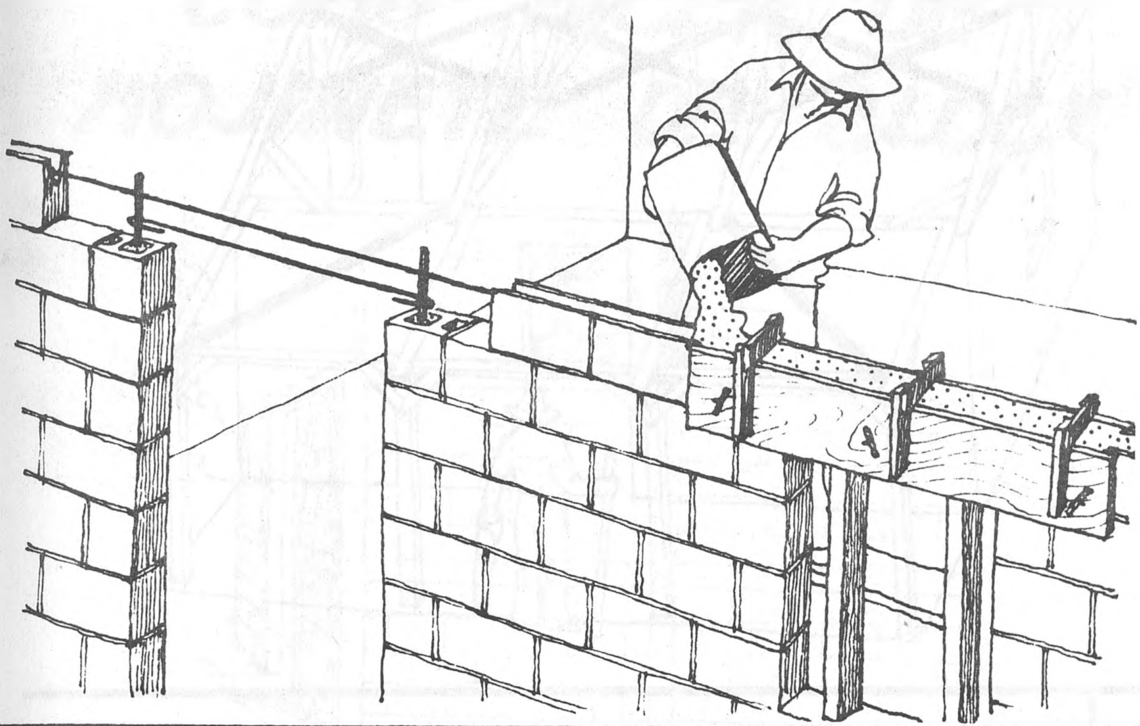
8

Debe seguir levantando la pared por encima de la solera, primero levantando las esquinas. En toda construcción, antes de colocar los blockes debe mojarlos.

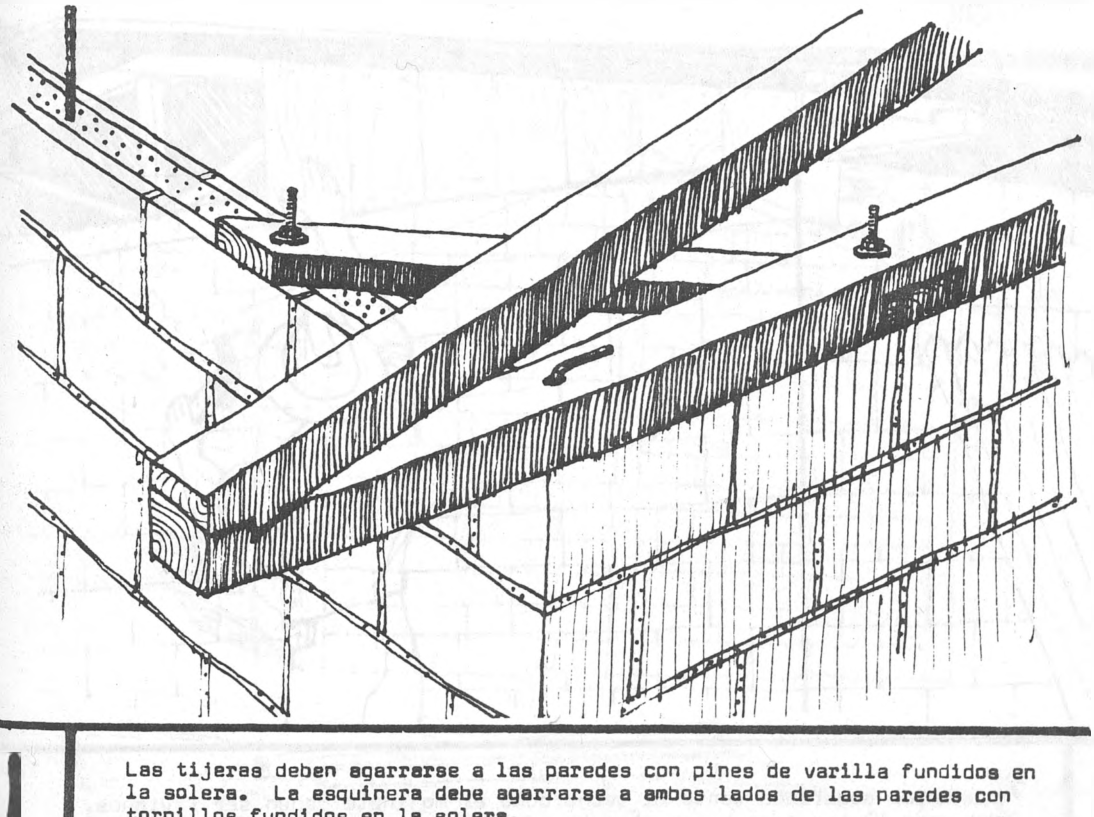


9

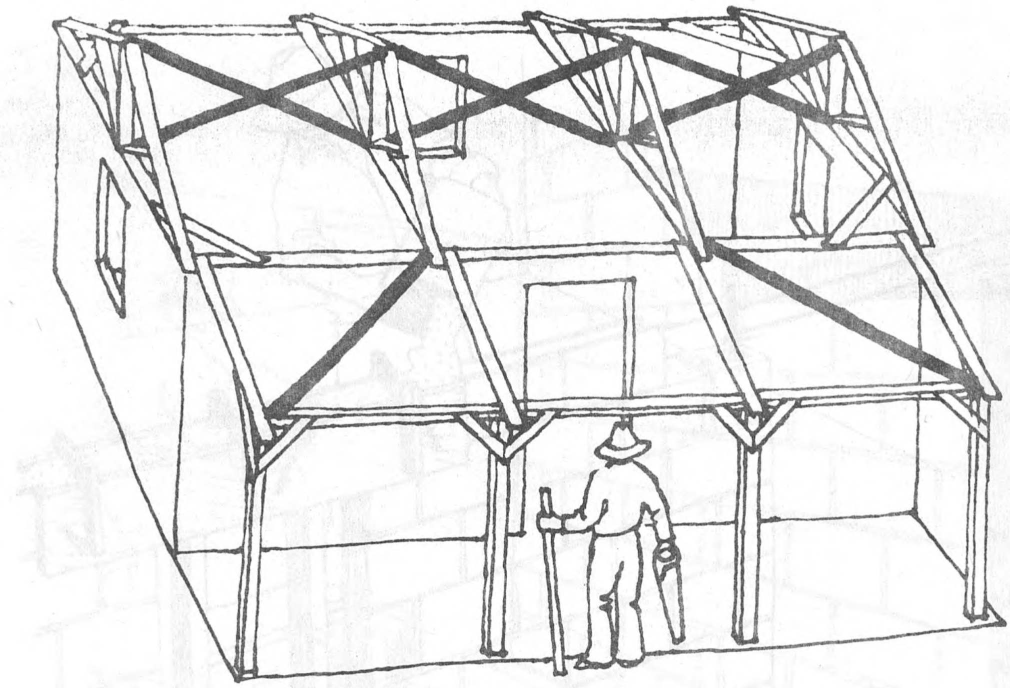
La última hilada debe ser otra solera igual a las anteriores. Entre solera y solera debe haber 5 hiladas de blockes. En esta solera se deben fundir los pines para agarrar las tijeras y los tornillos para agarrar las esquineras.



10 En la parte superior de las puertas y ventanas debe fundirse una solera de concreto, poniendo otro refuerzo horizontal y usando madera para darle la forma y para que no se salga el concreto.



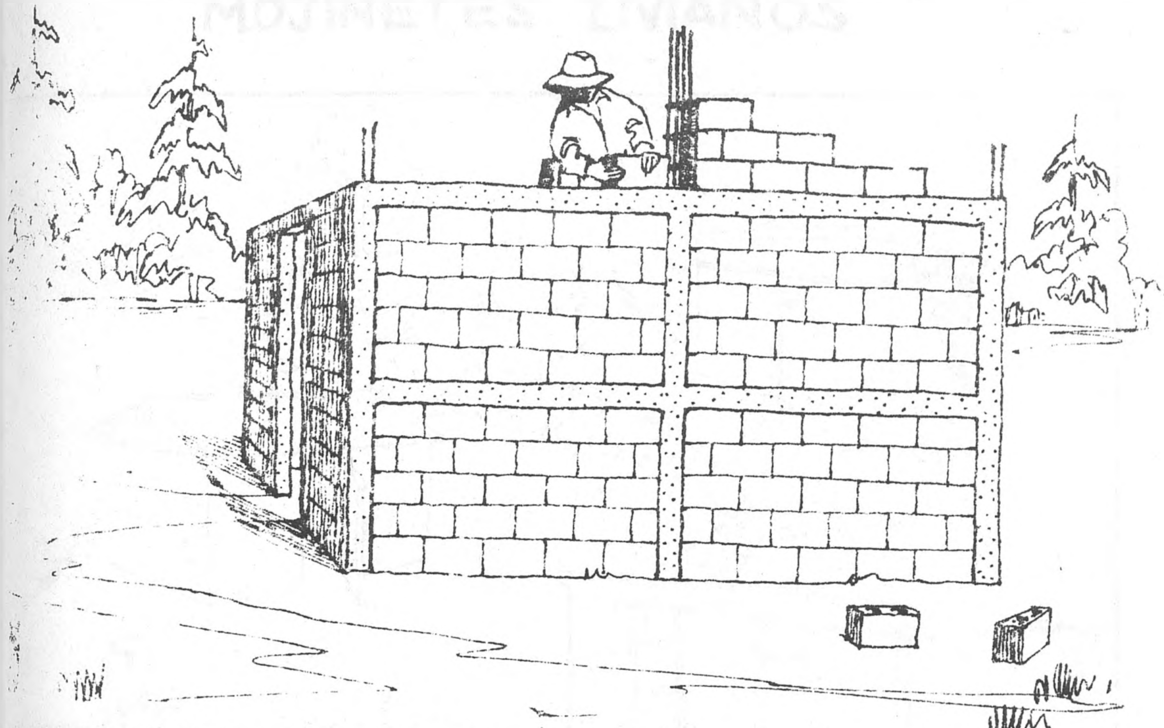
11 Las tijeras deben agarrarse a las paredes con pines de varilla fundidos en la solera. La esquinera debe agarrarse a ambos lados de las paredes con tornillos fundidos en la solera.

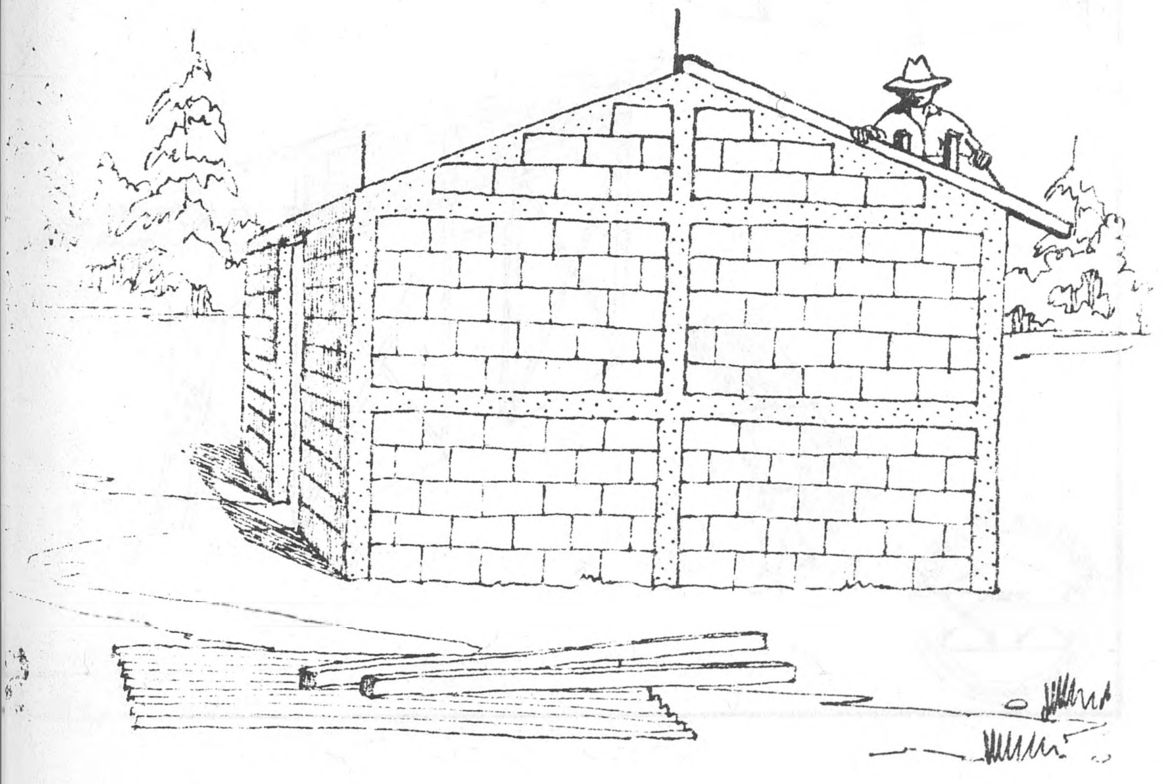


12 El mejor método para sostener el techo son las tijeras, las cuales deben tener refuerzos en "X". Si hay corredor debe usarse diagonales.

13 Para mayor seguridad tanto el techo como el mojinete deben ser livianos. Debe usar lámina para hacer el techo y madera para el mojinete.

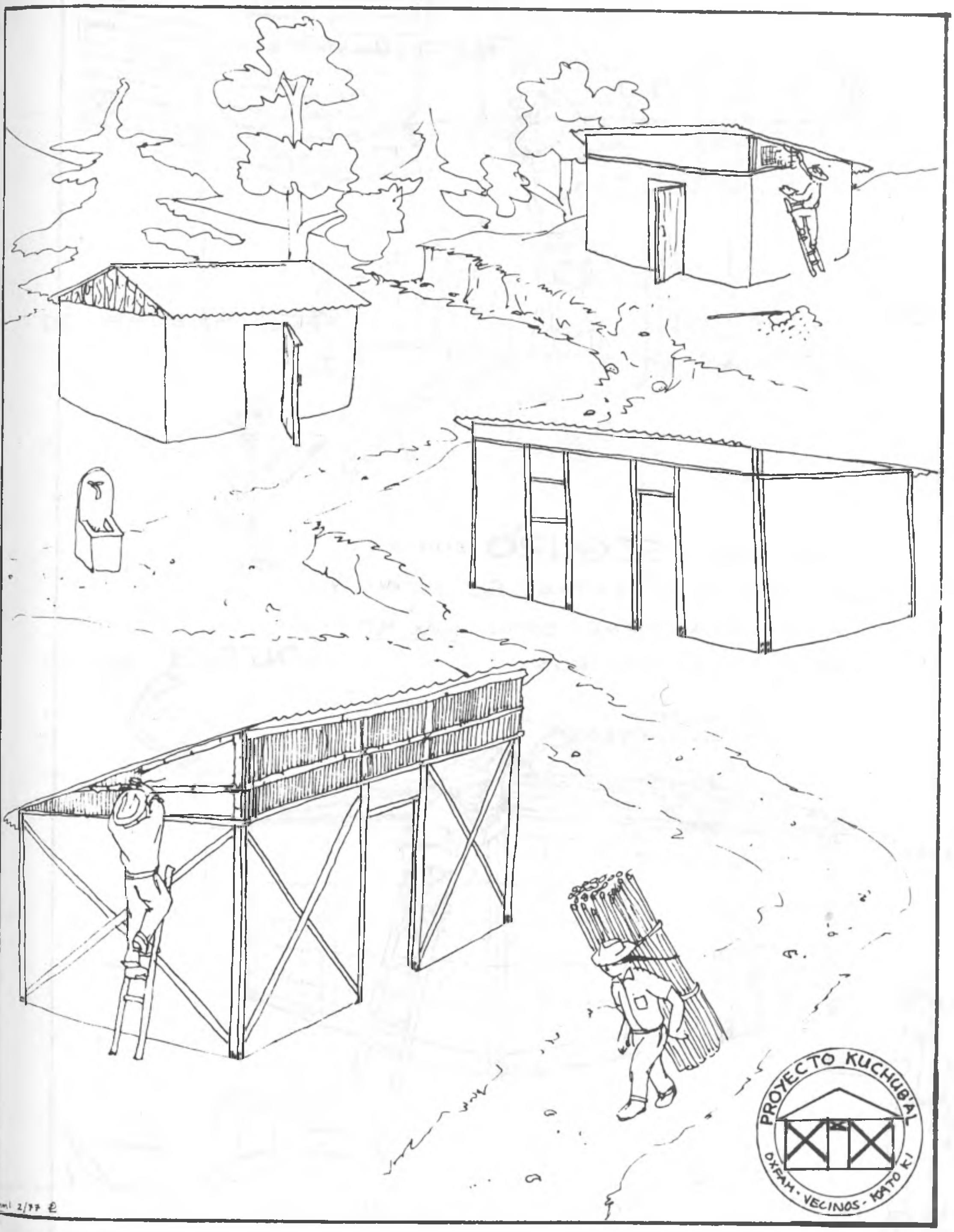
COMO HACER UN MOJINETE DE BLOCK





ADEMÁS DE LOS REQUISITOS BÁSICOS DE CONSTRUCCIÓN
UNA **CASA SEGURA** DEBE TENER

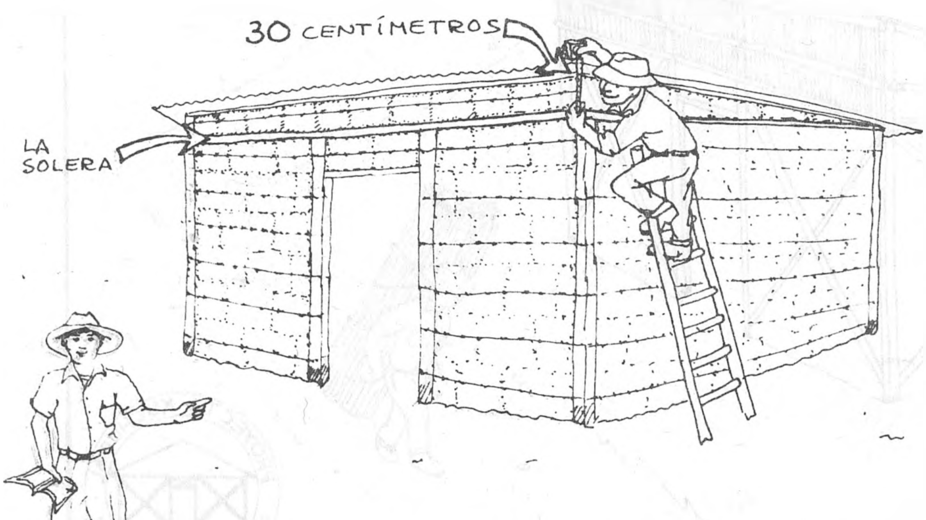
PAREDES IGUALES EN ALTURA
Y
MOJINETES LIVIANOS



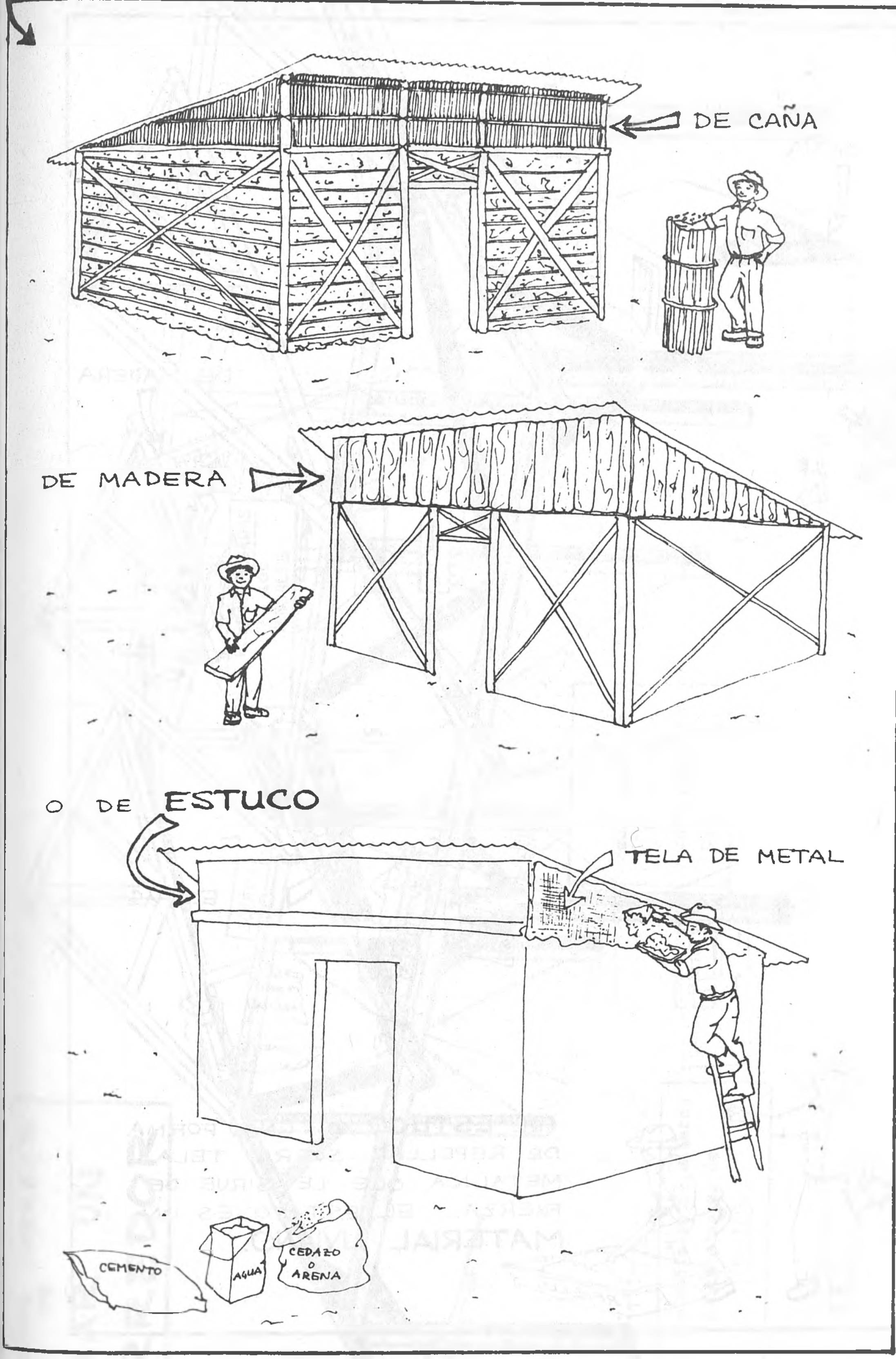
SI EL MATERIAL QUE VA SOBRE LA SOLERA ES PESADO

ES **PELIGROSO** CUANDO LA DISTANCIA ENTRE EL TECHO Y LA SOLERA TIENE MÁS DE TREINTA CENTÍMETROS.

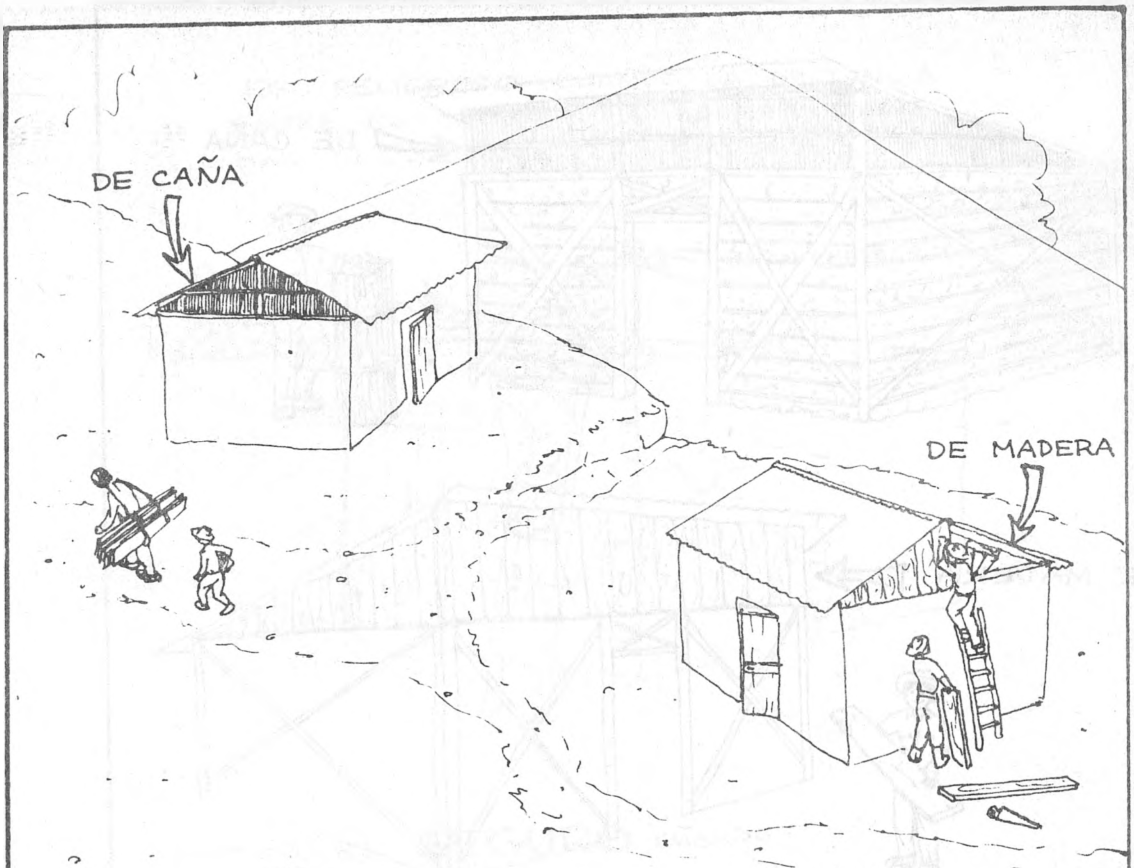
PERO ES **SEGURO** CUANDO LA DISTANCIA ENTRE EL TECHO Y LA SOLERA TIENE COMO <u>MÁXIMO</u> TREINTA CENTIMETROS.



PERO, HACIENDO UN MOJINETE CON MATERIAL LIVIANO PODEMOS LOGRAR MÁS ESPACIO ENTRE EL TECHO Y LA SOLERA

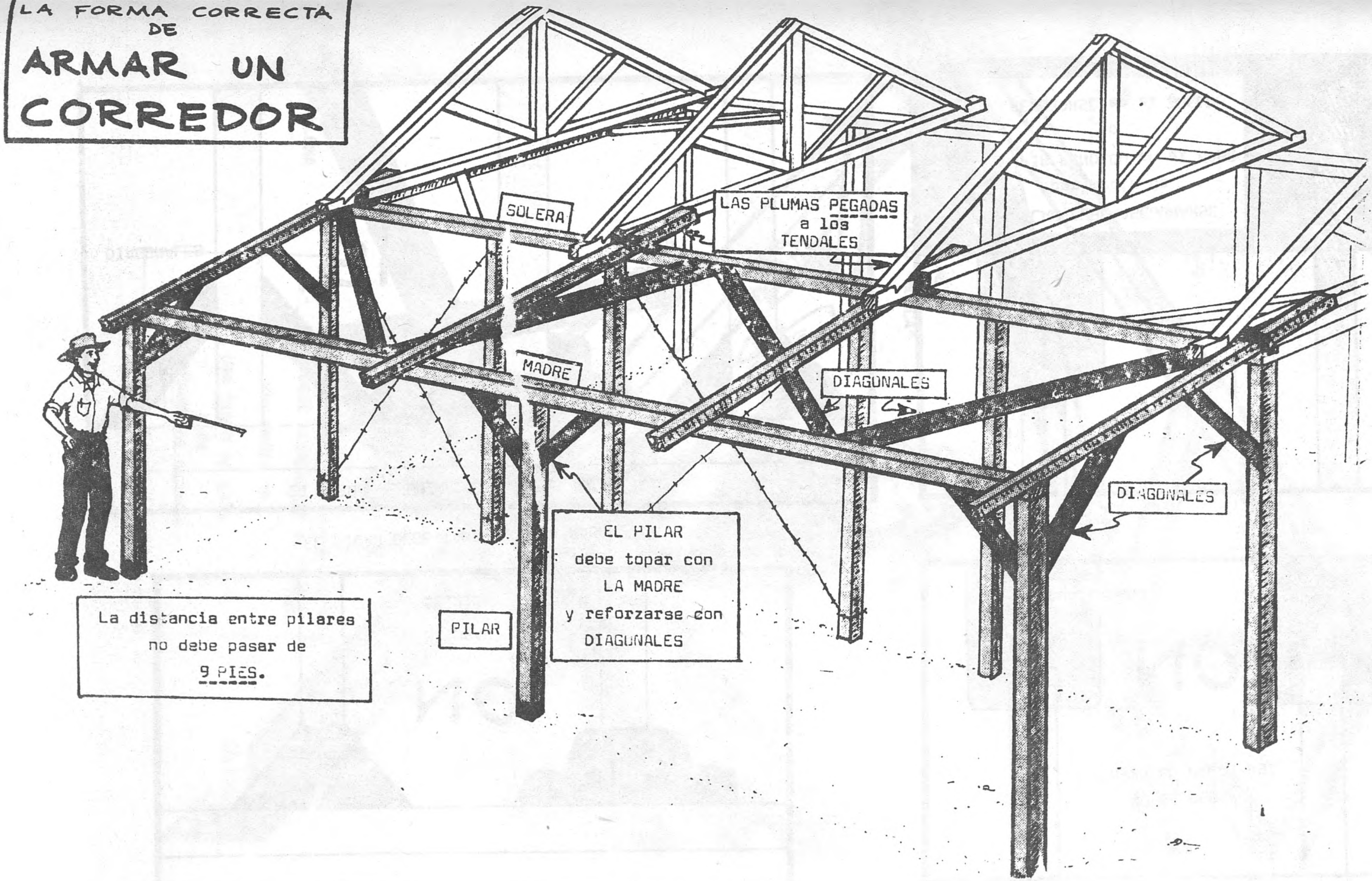


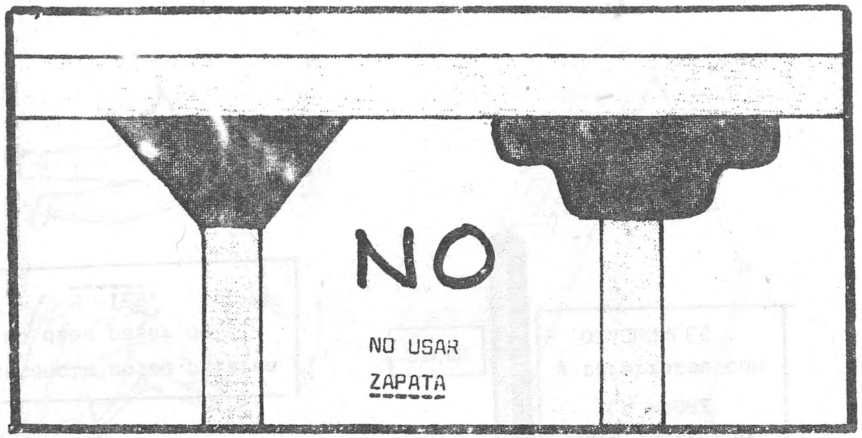
UNA CASA SEGURA DE DOS AGUAS
SIEMPRE DEBE TENER UN **MOJINETE LIVIANO.**



EL **ESTUCO** ES UNA FORMA DE REPELLAR SOBRE TELA METALICA QUE LE SIRVE DE FUERZA. EL ESTUCO ES UN **MATERIAL LIVIANO.**

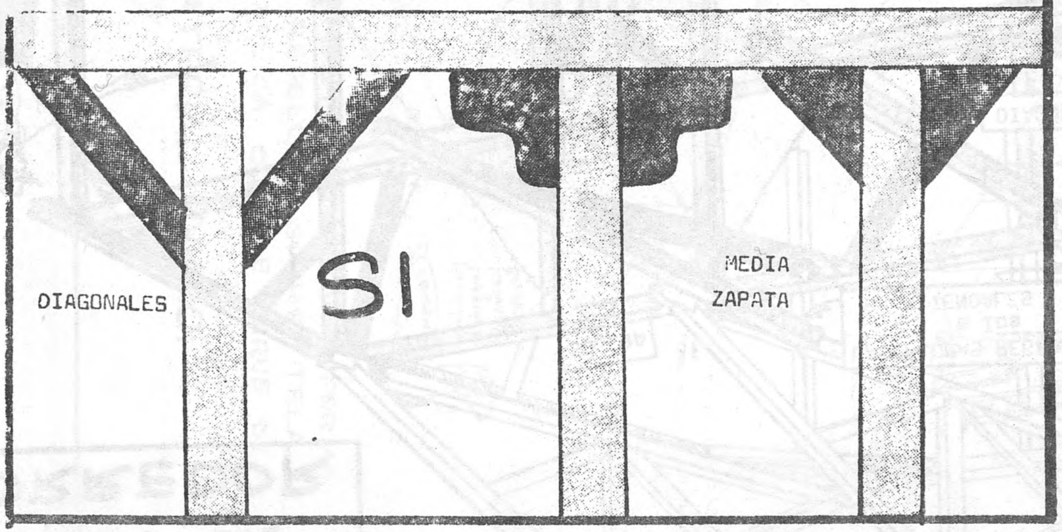
LA FORMA CORRECTA DE ARMAR UN CORREDOR

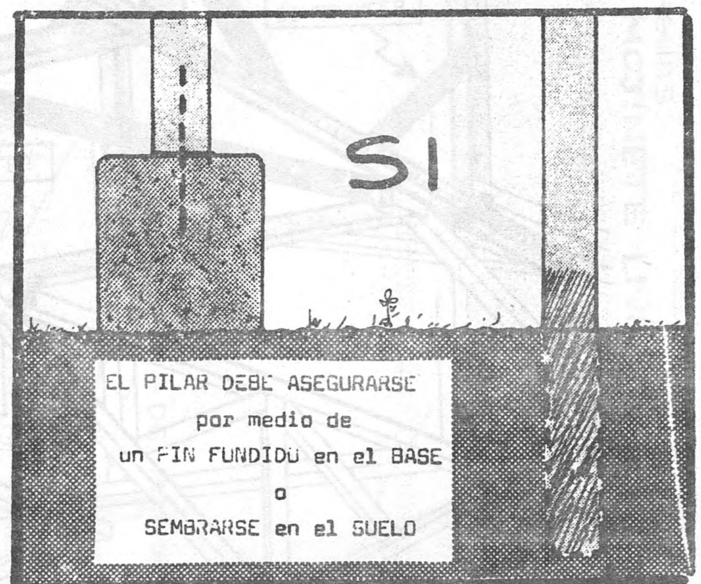


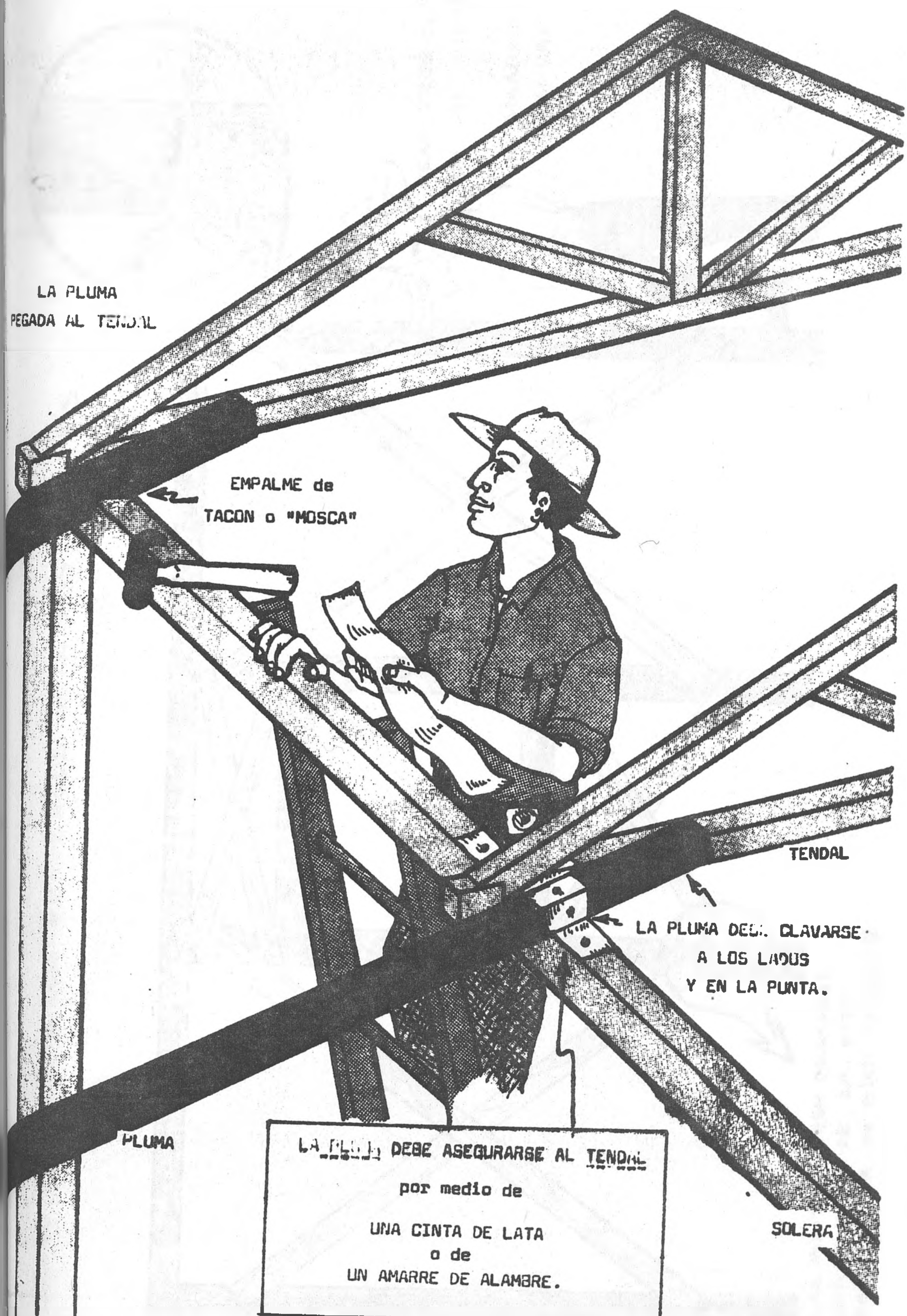


EL PILAR DEBE TAPAR CON LA MADRE.

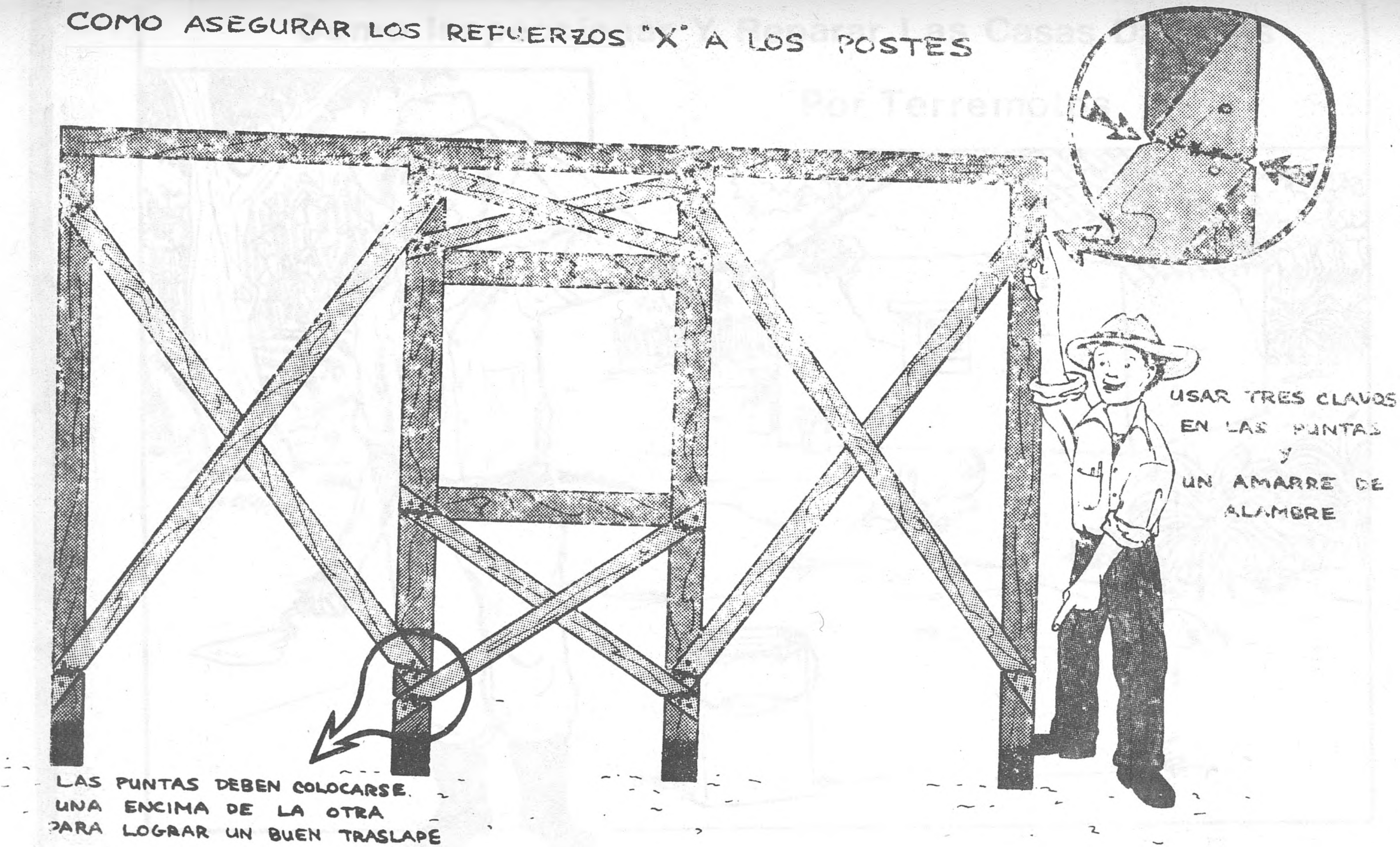
ES MEJOR REFORZARLO CON DIAGONALES.






LA PLUMA
PEGADA AL TENDAL
EMPALME de
TACON o "MOSCA"
TENDAL
LA PLUMA DEBE CLAVARSE
A LOS LADOS
Y EN LA PUNTA.
PLUMA
LA PLUMA DEBE ASEGURARSE AL TENDAL
por medio de
UNA CINTA DE LATA
o de
UN AMARRE DE ALAMBRE.
SOLERA

COMO ASEGURAR LOS REFUERZOS "X" A LOS POSTES



Como Inspeccionar Y Reparar Las Casas Dañadas

Por Terremotos

LOS OBJETIVOS DEL FOLLETO

COMO INSPECCIONAR Y REPARAR LAS CASAS DAÑADAS

El objetivo de este folleto es interesar y enseñar a la gente como inspeccionar y reparar sus casas dañadas por el terremoto

Dicho folleto trata de hacerlo por medio de los siguientes propósitos:

1. Reparación al más bajo costo
2. Uso de técnicas tradicionales
3. El uso de la experiencia de la comunidad
4. Uso de materiales de construcción disponibles
5. Instrucción sobre inspección y reparación para obtener casas más resistentes contra terremotos.

Ediciones FENACOAC

ALIANZA PARA DESARROLLO JUVENIL COMUNITARIO

Programa De Reconstrucción Del Departamento Del Quiché

1976

Este Folleto Fue Preparado por Juana Jobert y Miguel Marzolla

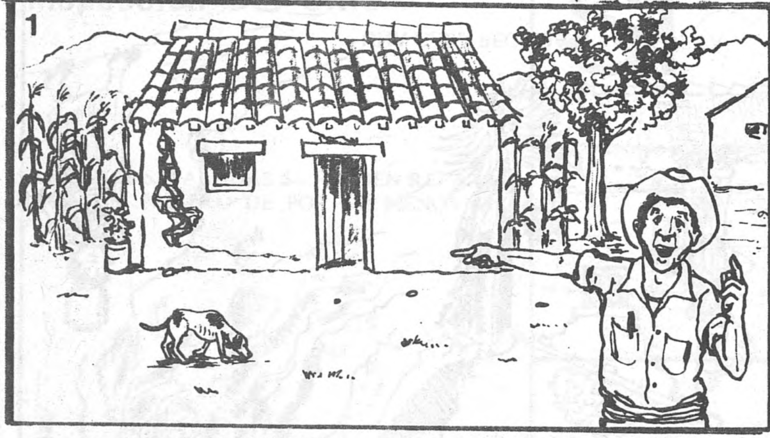
Bajo La Dirección de Robin Biellik y Pegi Henderson de Biellik

INDICE

ESTE FOLLETO ESTA DIVIDIDO EN CINCO CHARLAS. EL PRINCIPIO DE CADA CHARLA ESTA INDICADA POR EL NOMBRE Y EL NUMERO DE LA CHARLA.

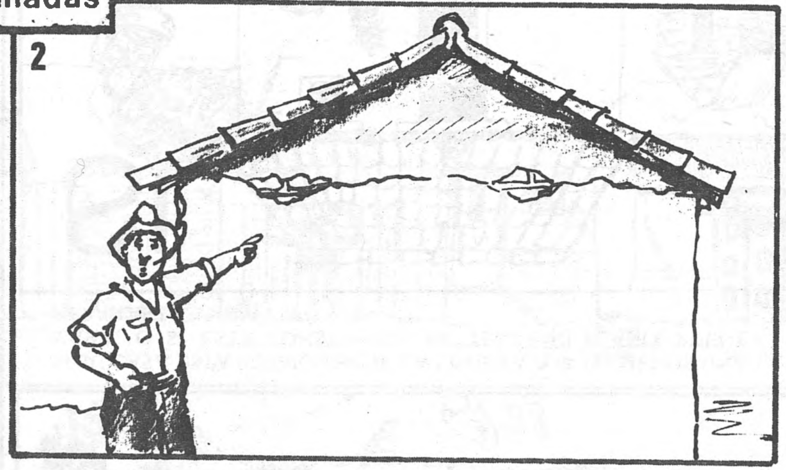
CHARLA Nº 1 Inspección De Las Casas Dañadas

1



UNA CASA DAÑADA CON TECHO PESADO.

2



UNA CASA DAÑADA CON MOJINETE PESADO.

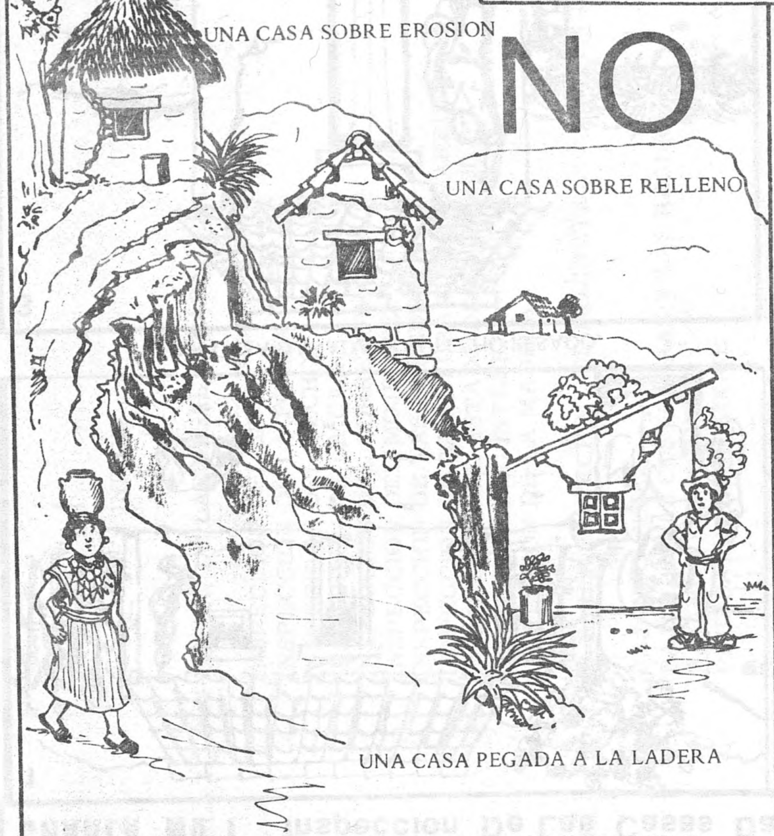
3

UNA CASA DAÑADA CON PAREDES MUY ALTAS.

4

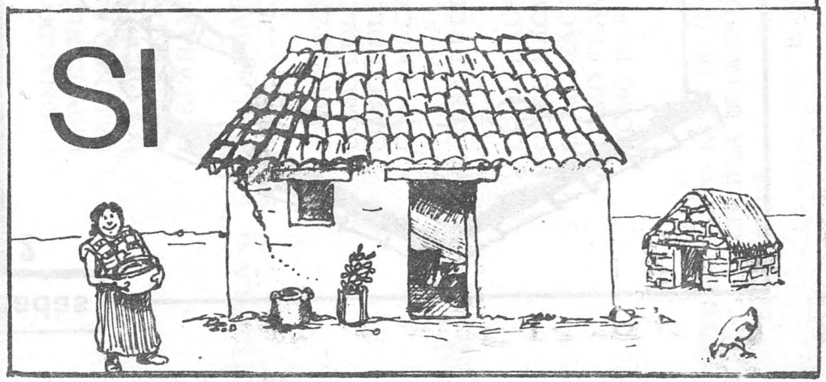
UNA CASA DAÑADA CON PUERTA QUE ABRE HACIA ADENTRO.

Inspección del Sitio



NO REPARAR UNA CASA EN ESTA FORMA PORQUE EL SITIO ES PELIGROSO.

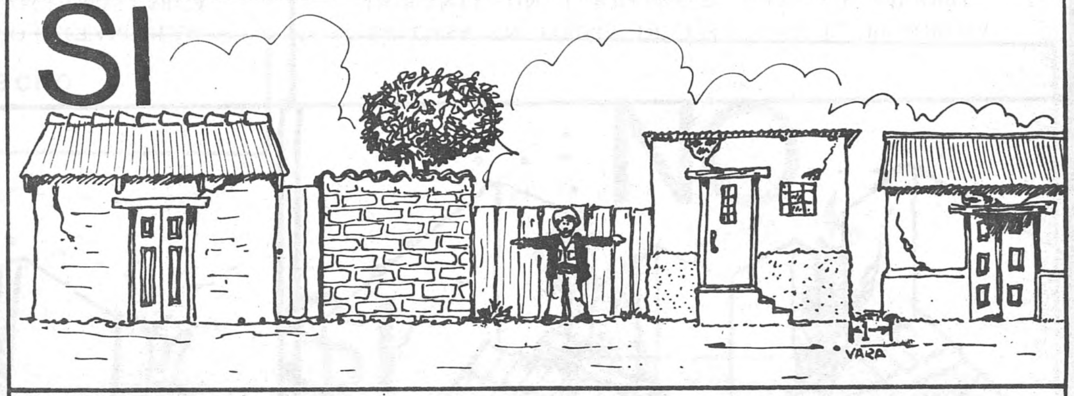
SI SU CASA ESTA SEPARADA DE LA LADERA POR LO MENOS UNA VARA, O SI ESTA CONSTRUIDA EN TERRENO PLANO, PUEDE REPARARLA.



Inspección Del Sitio

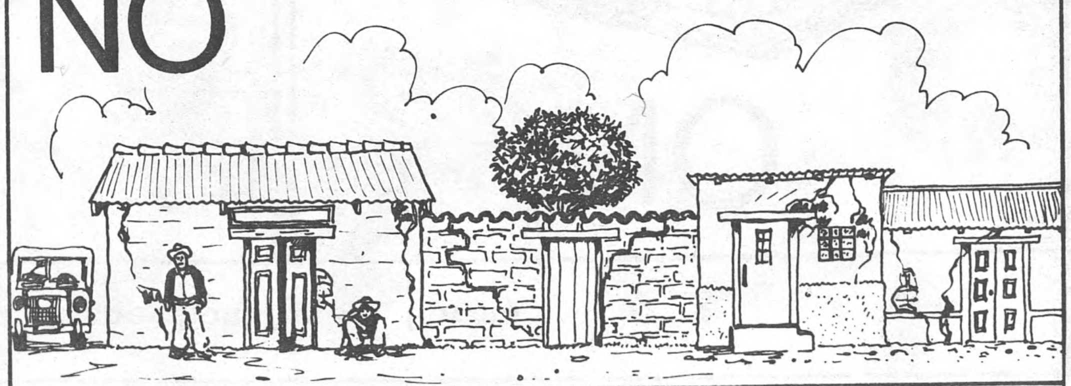
LAS CASAS SEPARADAS SE PUEDEN REPARAR. HAGA UN PASILLO DE POR LO MENOS UNA VARA.

SI



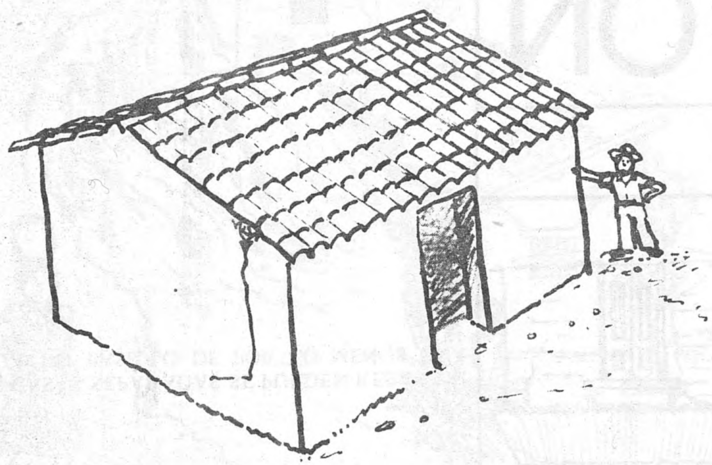
ANTES DE REPARAR UNA CASA PEGADA CON LAS DEMAS, SEPARELA SI ES POSIBLE.

NO

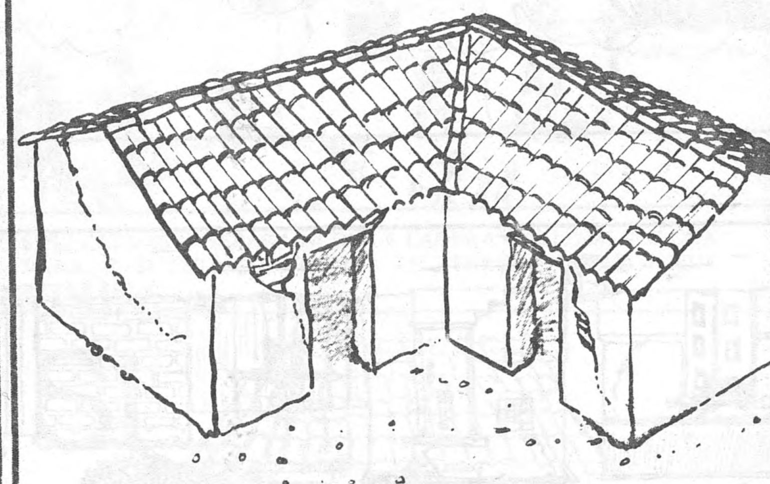


Inspección De La Forma

SI



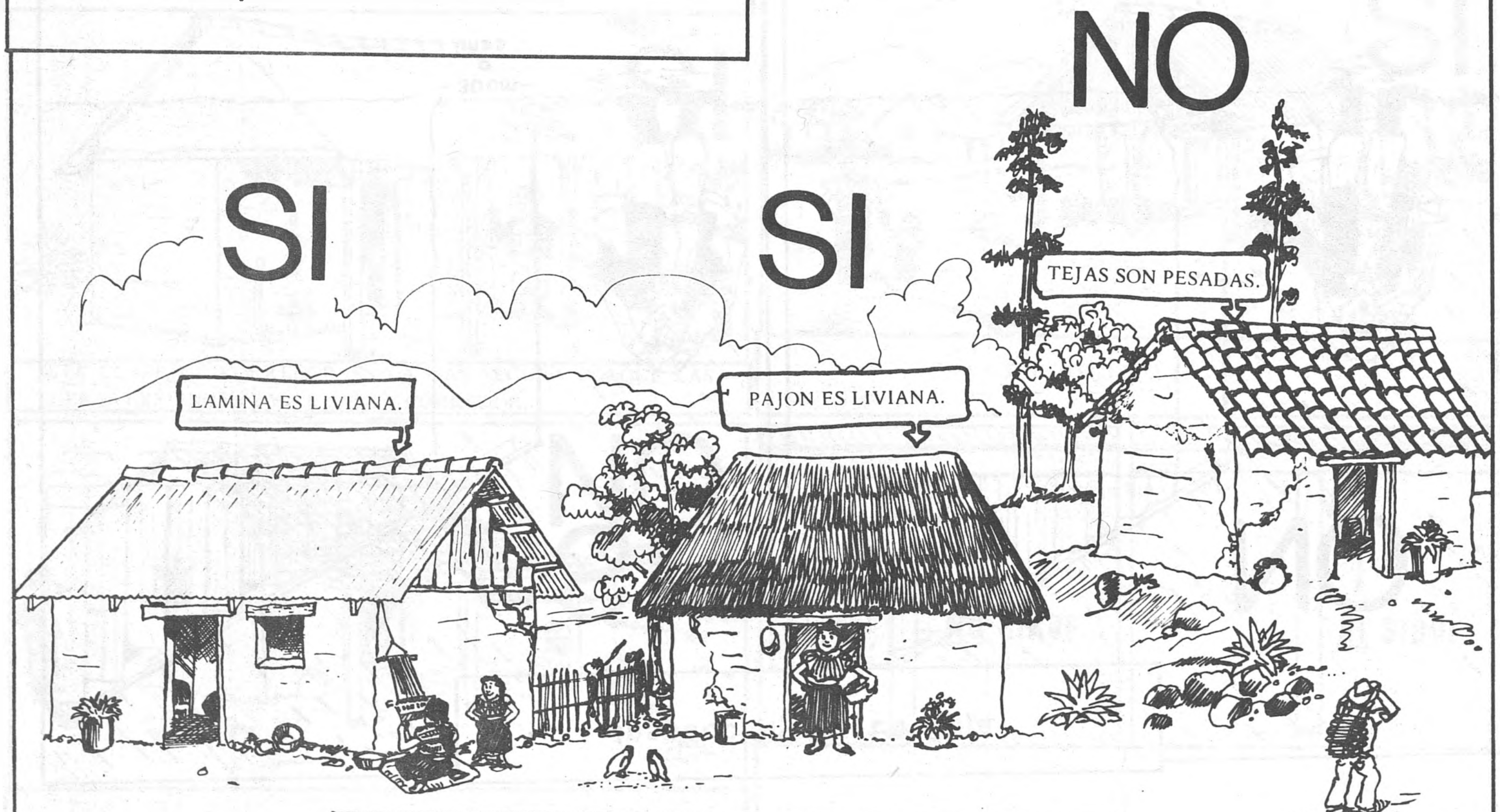
NO



LA CASA MAS SEGURA ES CUADRADA O RECTANGULAR. LA CASA NO DEBE SER MAS QUE DOS VECES MAS LARGA QUE EL ANCHO DE LA CASA.

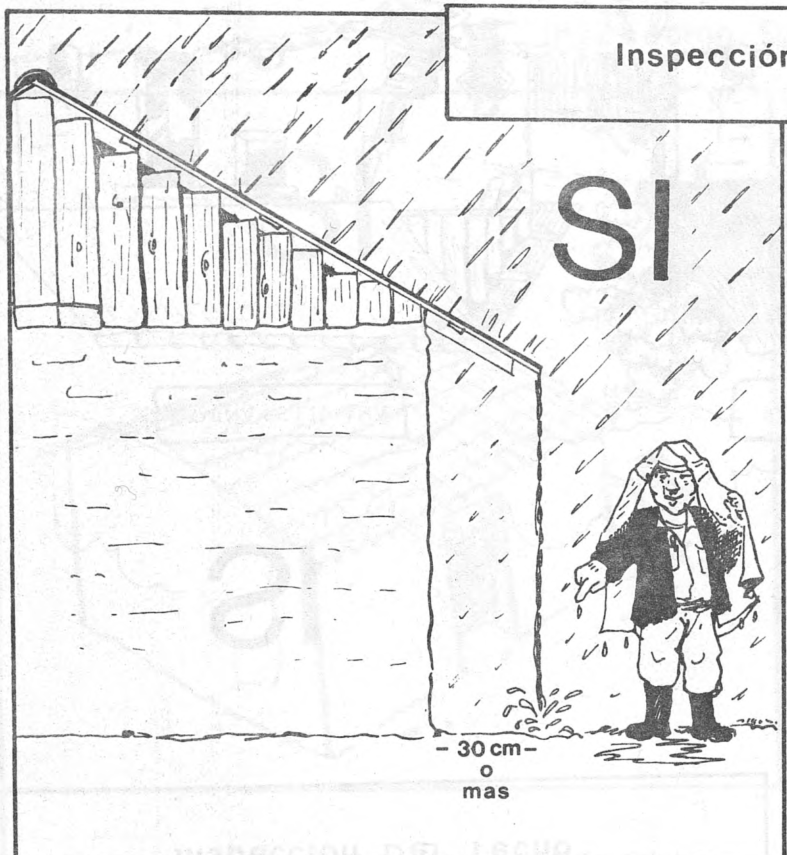
LA CASA EN FORMA DE ESCUADRA ES PELIGROSA DURANTE UN TERREMOTO. HAY QUE DIVIDIRLA SEPARANDO LAS DOS PARTES POR UNA VARA.

Inspección Del Techo



HAY QUE CAMBIAR UN TECHO PESADO POR UN TECHO LIVIANO.

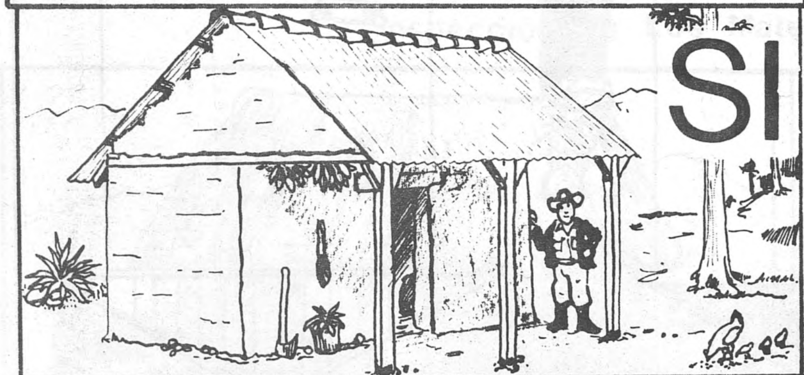
Inspección De La Ceja



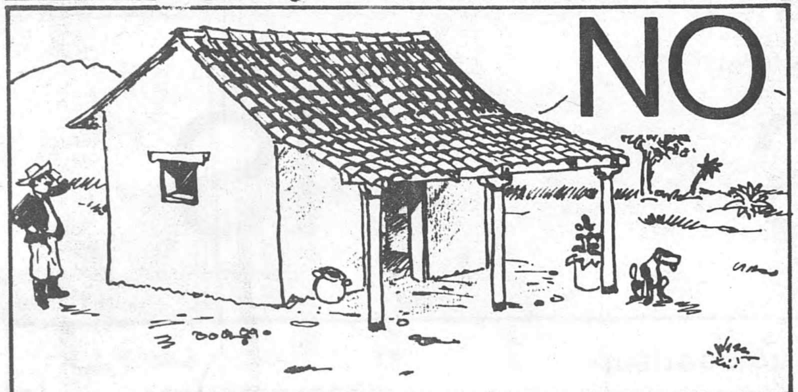
CUANDO LA CEJA TIENE UNA DISTANCIA DE 30 CENTIMETROS O MAS DE LA CASA, NO HACE MUCHO DAÑO EL AGUA.

CUANDO LA CEJA ESTA DEMASIADA CERCA DE LA PARED, EL AGUA HACE MUCHO DAÑO AL CIMIENTO Y LA PARED. EN ESTE CASO HAY QUE EXTENDER LA CEJA.

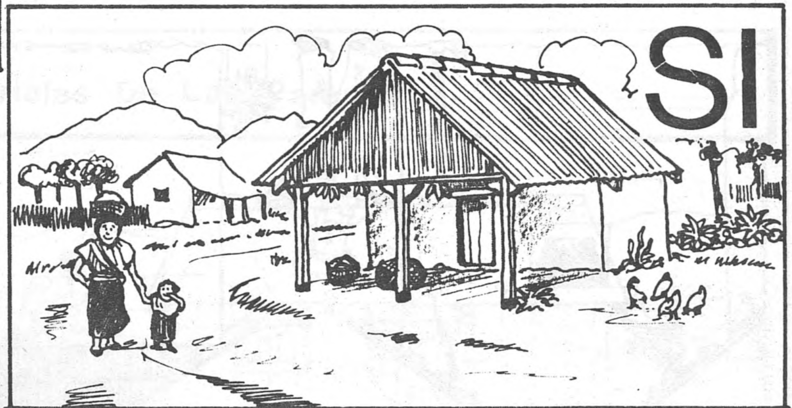
Inspección De Los Corredores



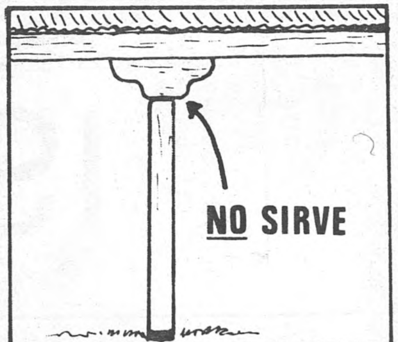
ESTA CLASE DE CORREDOR ES LA MAS SEGURA PORQUE LAS TIJERAS EXTIENDEN SOBRE CASA Y CORREDOR.



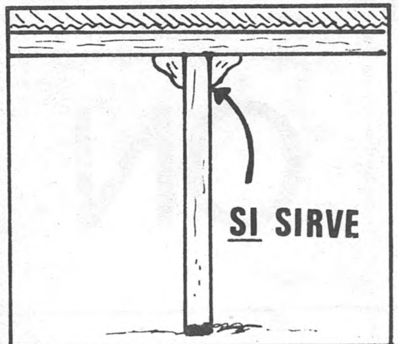
ESTA CLASE DE CORREDOR ES MENOS SEGURO PORQUE LAS TIJERAS DE LA CASA Y LAS VIGAS DEL CORREDOR SON APARTE.



ESTE ESTILO ES SEGURO.



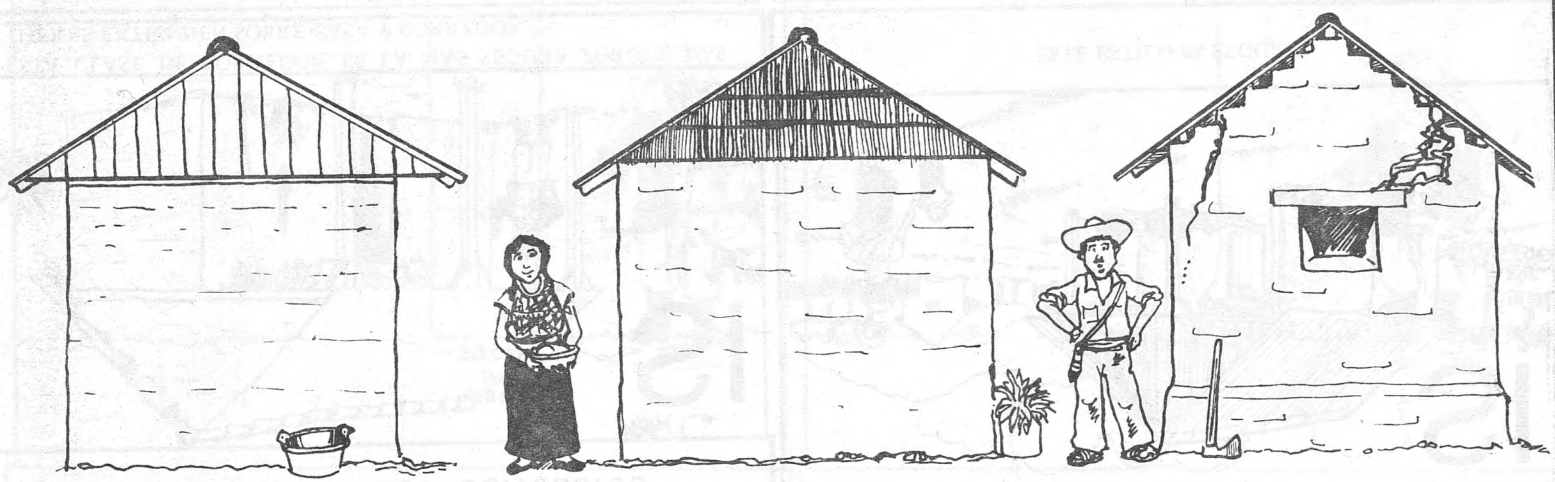
ESTA MANERA NO SIRVE.



ESTA MANEA ES MEJOR.

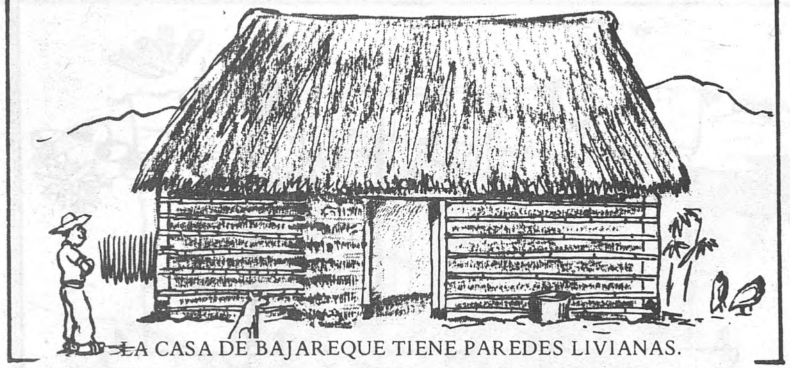
Inspección Del Mojinete

SI	SI	NO
EL MOJINETE DE MADERA ES LIVIANO	EL MOJINETE DE CAÑA ES LIVIANO	EL MOJINETE DE ADOBE ES PESADO



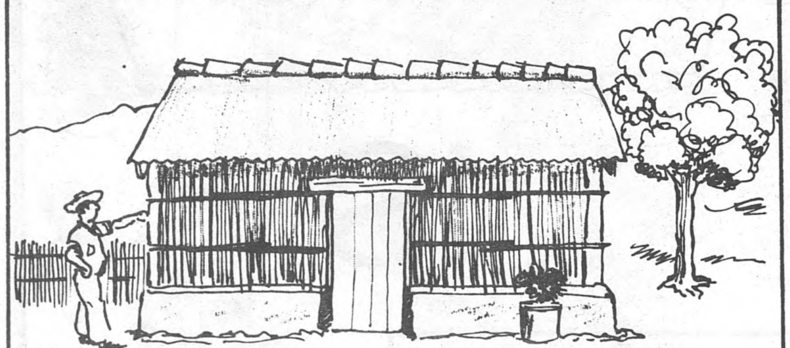
HAY QUE CAMBIAR LOS MOJINETES PESADOS POR MOJINETES DE MATERIAL LIVIANO.

Inspección De Los Materiales De Las Paredes

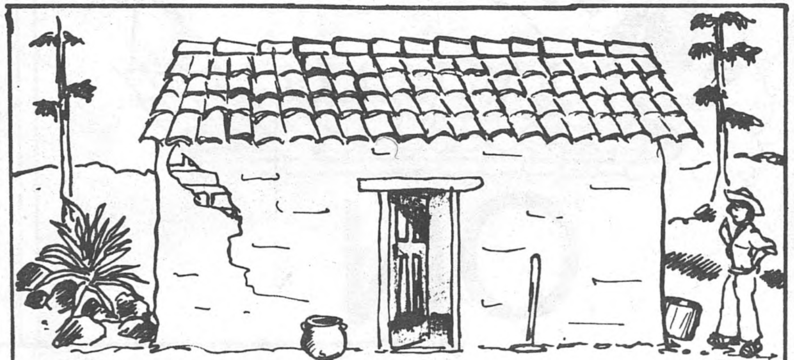


LA CASA DE BAJAREQUE TIENE PAREDES LIVIANAS.

LA CASA DE MADERA TIENE PAREDES LIVIANAS.



LA CASA DE CAÑA TIENE PAREDES LIVIANAS.



LA CASA DE ADOBE TIENE PAREDES PESADAS.

LA CASA DE ADOBE TIENE PAREDES PESADAS. LAS PAREDES DE ADOBE SON PESADAS Y REQUIEREN REFORZAMIENTO PARA AGUANTAR UN TERREMOTO.

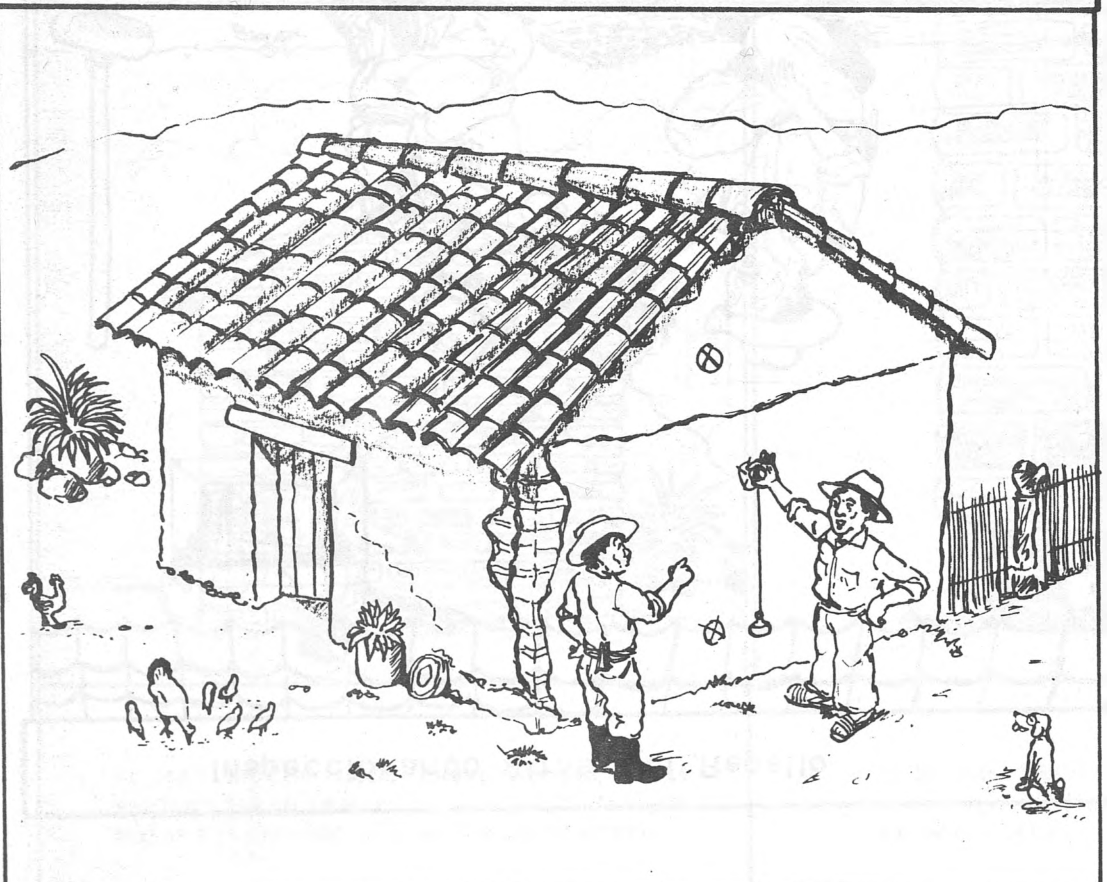
Inspección De La Altura De Las Paredes

LA CASA CON PAREDES DE DOS METROS.

LA CASA CON PAREDES MUY ALTAS.

LA MEJOR ALTURA PARA UNA CASA ES CUANDO SE PUEDE ALCANZAR EL MACHIEMBRE. SI PASAN LAS PAREDES DE DOS METROS, HAY QUE BAJARLAS.

Inspección Del Estado De Las Paredes

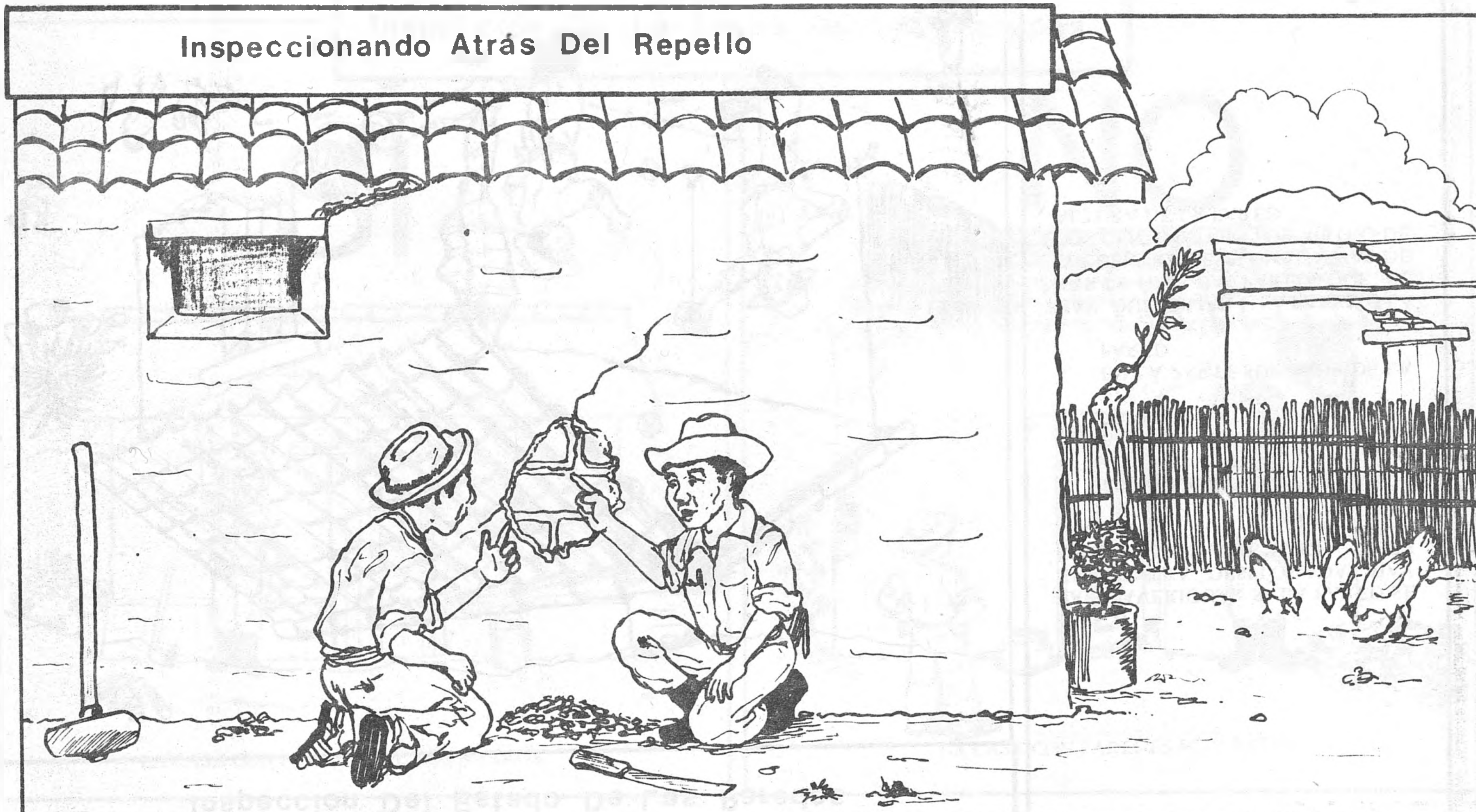


PARA AVERIGUAR SI LA PARED SE ENCUENTRA DESPLOMADA, HAY QUE PLOMARLA EN TRES LUGARES:

1. EN LA BASE DE LA PARED.
2. A MEDIA ALTURA DE LA PARED.
3. EN LA PARTE SUPERIOR DE LA PARED.

HAY QUE BAJAR LA PARED O LA PARTE DE LA PARED QUE SE ENCUENTRE DESPLOMADA MAS DE DOS CENTIMETROS POR METRO DE ALTURA DE LA PARED.

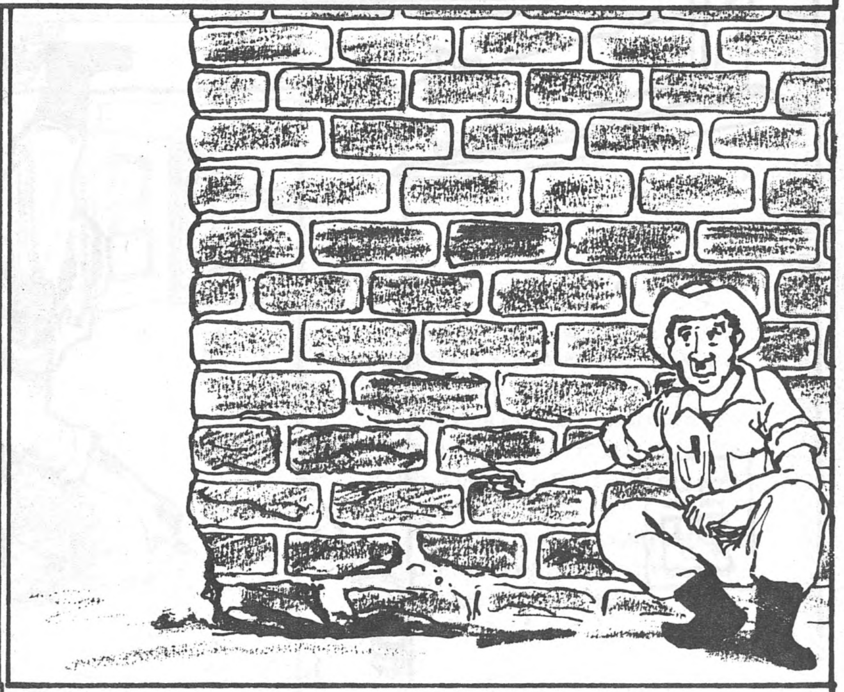
Inspeccionando Atrás Del Repello



HAY QUE QUITAR UNA PARTE DEL REPELLO PARA INSPECCIONAR LAS PAREDES DONDE SE ENCUENTRAN GRIETAS

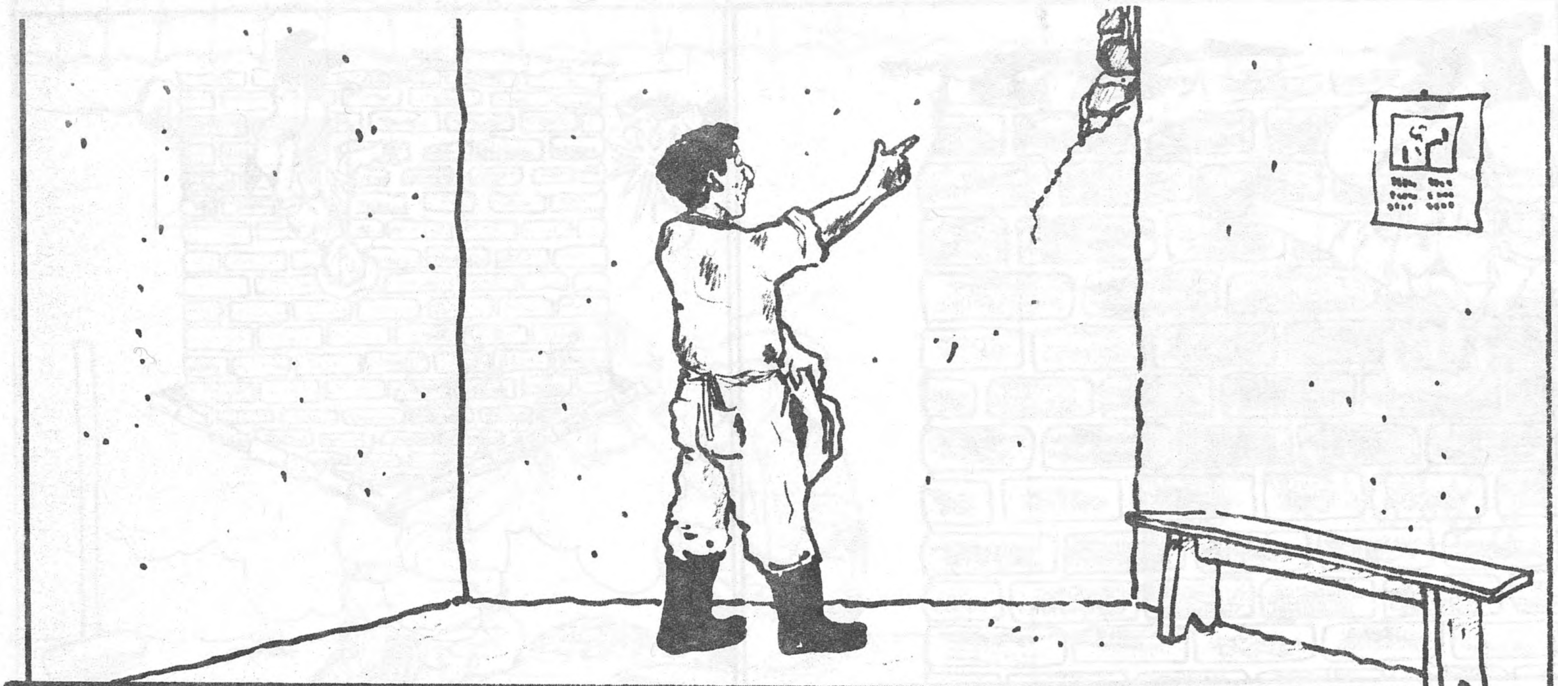
Inspección Del Estado Del Adobe

SI HAY MUCHO LODO ENTRE ADOBES, ESTAS PAREDES SERAN DEBILES. SI ES POSIBLE, HAY QUE BOTAR LAS PAREDES Y LEVANTARLAS DE NUEVO.



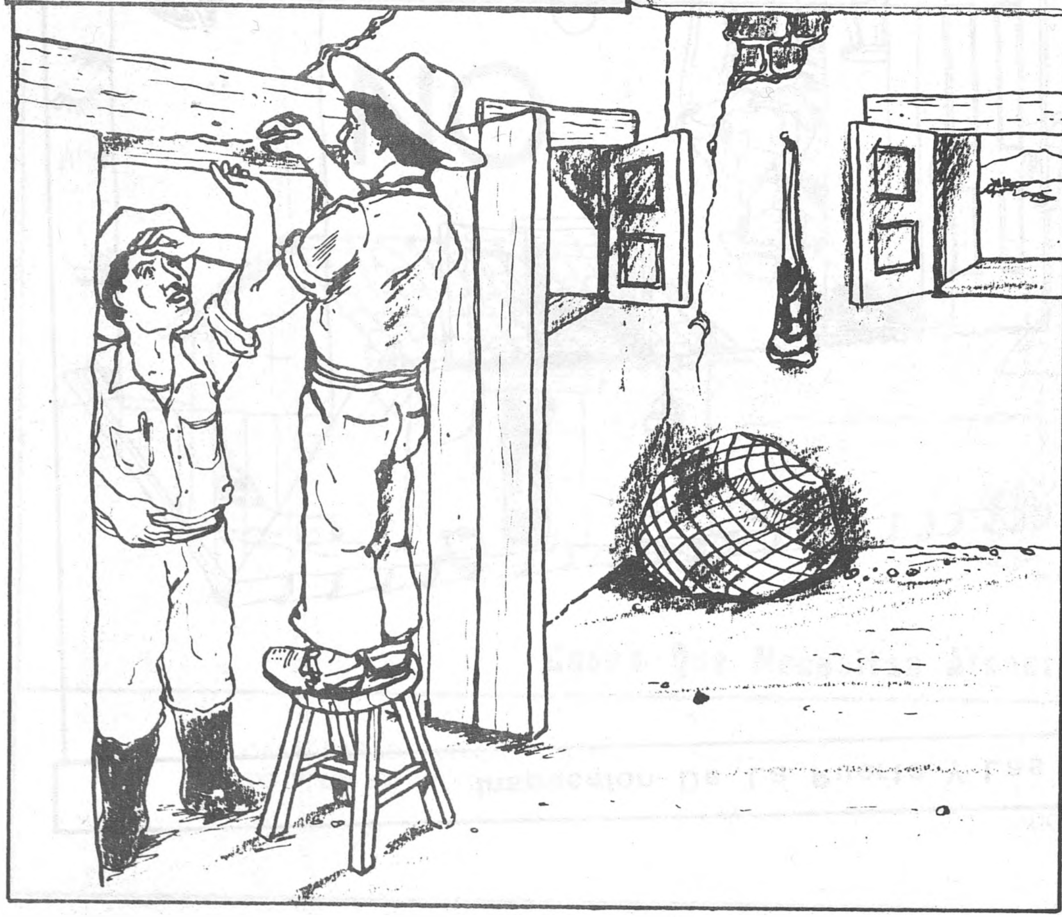
SI SE HAN DESHECHO MUCHO LOS ADOBES POR HUMEDAD U OTROS DAÑOS, HAY QUE REEMPLAZARLAS.

Inspección Del Interior



EN EL INTERIOR, HAY QUE INSPECCIONAR PARA VER SI HAY GRIETAS; EN LAS ESQUINAS, EN LA BASE, A MEDIA ALTURA Y EN LA PARTE SUPERIOR DE LAS PAREDES. SI SE ENCUENTRAN GRIETAS, HAY QUE REPARARLAS, SIEMPRE SEGUN LA CONDICION DE LAS PAREDES EXTERIORES.

Inspección De La Madera



REVISE LA MADERA POR POLILLA Y HUMEDAD CADA AÑO DESPUES DEL INVIERNO. INSPECCIONE LA MADERA EN LOS UMBRALES Y LOS MARCOS DE LAS PUERTAS Y LAS VENTANAS.

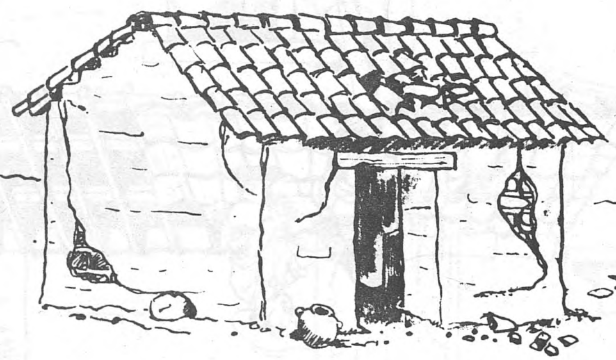
SI SE PUEDE ROMPER LA MADERA CON EL DEDO PULGAR, HAY QUE CAMBIARLA.

Inspección De La Puerta Y Las Ventanas

SI LA PUERTA Y LA VENTANA NO SE ABREN HACIA AFUERA, HAY QUE CAMBIARLAS.

CHARLA Nº2 Como Bajar El Techo Y El Mojinete

NO



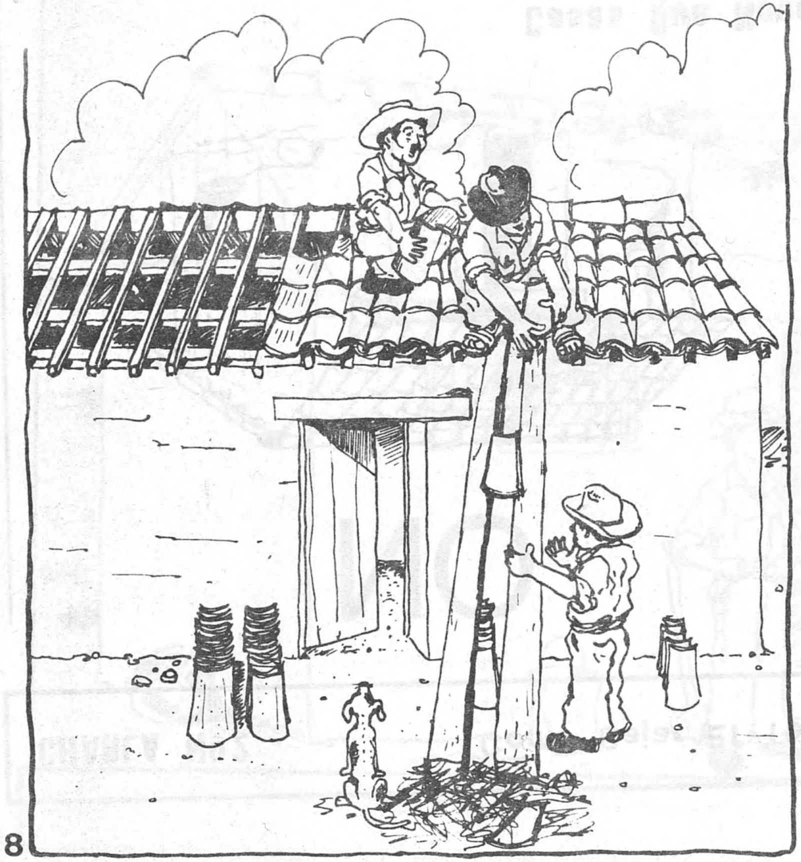
NO

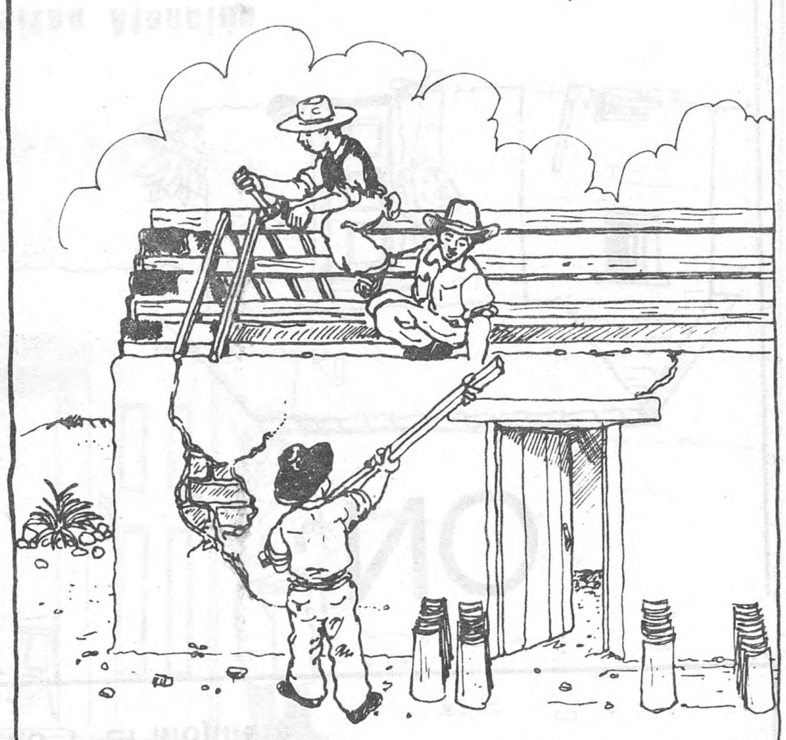
Casas Que Necesitan Atención

LA CASA DAÑADA CON UN TECHO PESADO Y LOS MOJINETES DE ADOBE.

LA CASA SIN DAÑO CON UN TECHO LIVIANO CON LOS MOJINETES DE ADOBE.

Bajando Las Tejas

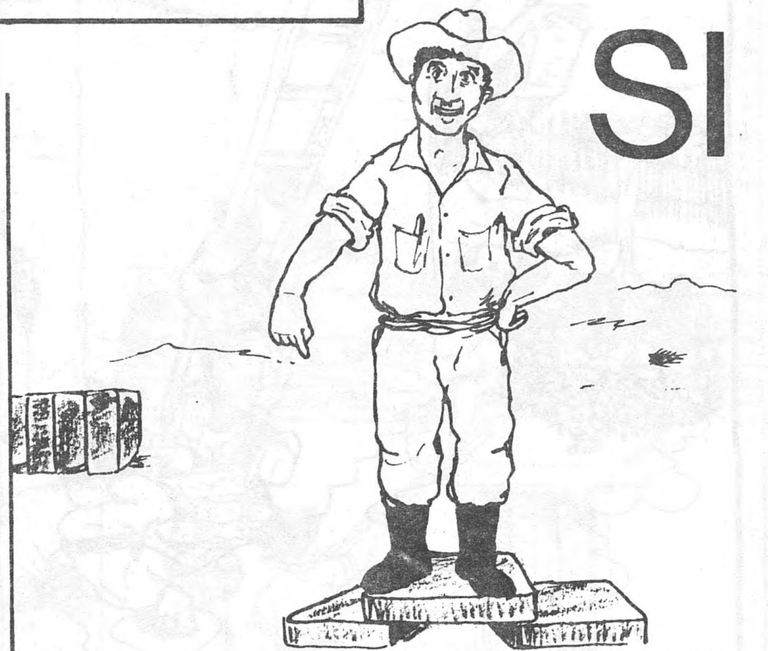




Bajando La Madera

Bajando El Mojinete

Como Escoger Adobe



HAGA PRESION O FUERZA CON EL PIE SOBRE EL ADOBE. SI SE ROMPE EL ADOBE, SIGNIFICA QUE NO SIRVE.

SI RESISTE EL PESO DE UN HOMBRE COMPLETO, EL ADOBE ESTA BUENO.

CHARLA Nº3 Como Bajar Y Reparar Paredes

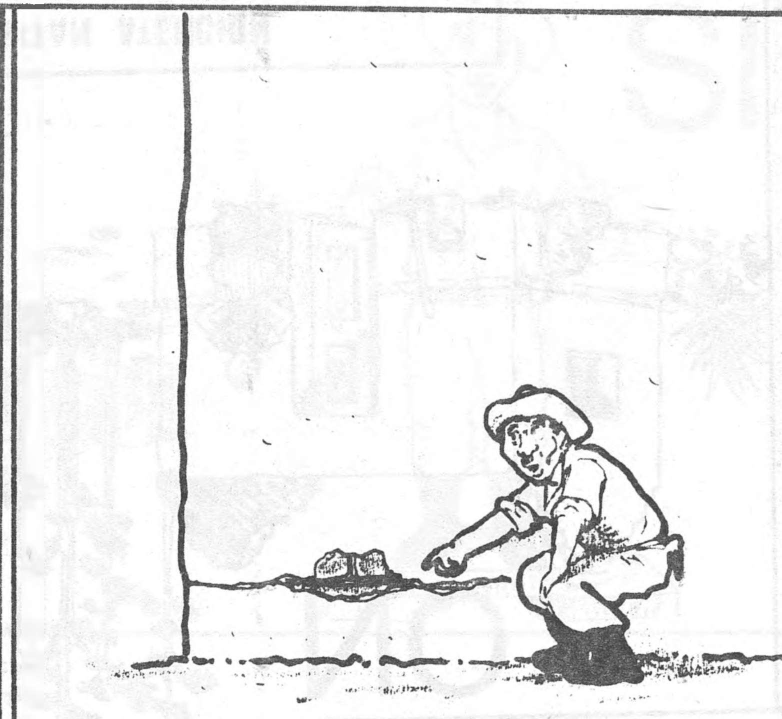
CASAS QUE NECESITAN ATENCION

UNA CASA DAÑADA, CON UNA PARED DESPLOMADA Y CON GRIETAS.

UNA CASA SIN DAÑO, CON PAREDES EN BUENA CONDICION, PERO DEMASIADO ALTAS.

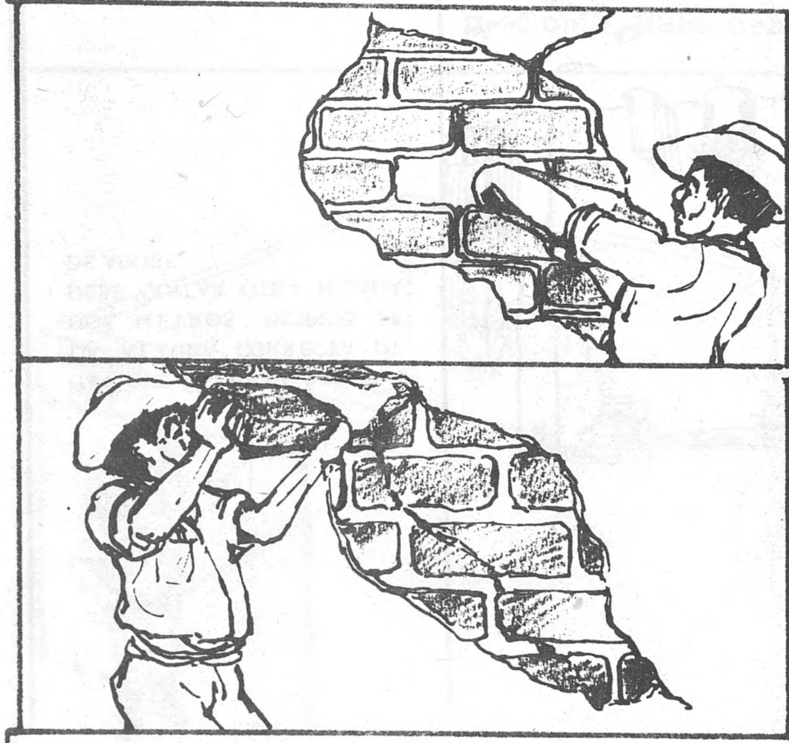
Como Examinar Paredes Dañadas

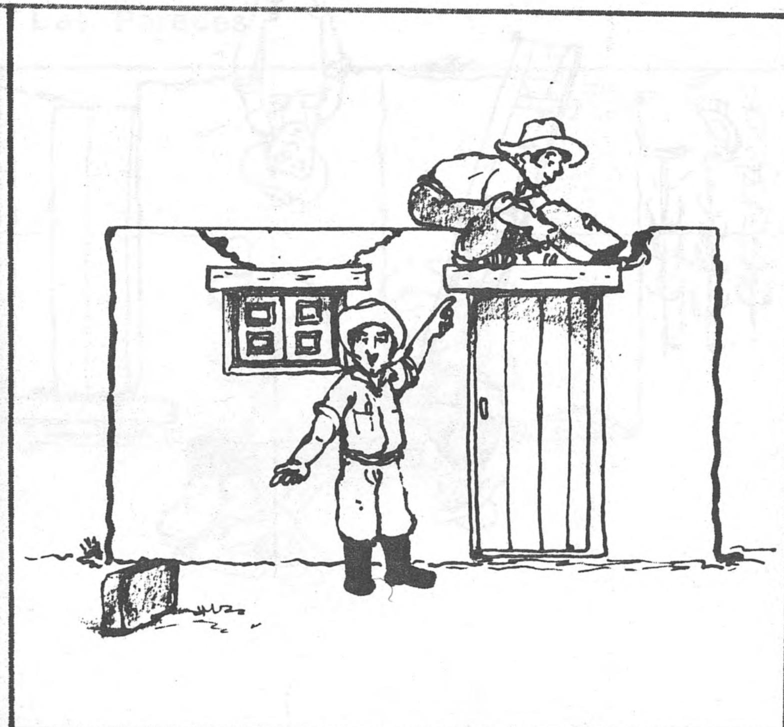
Cuando hay una grieta vertical cerca de una esquina, normalmente es porque la otra pared se ha desplomado durante el movimiento de tierra. Hay que bajar la pared, si se ha desplomado más que 2 centímetros por cada metro de altura de la pared. Alrededor de la grieta, hay que bajar y volver a sentar los adobes para que se agarren de nuevo.



Toda la pared arriba de una grieta horizontal debe de quitarse y volver a construir.

Reparando Las Grietas



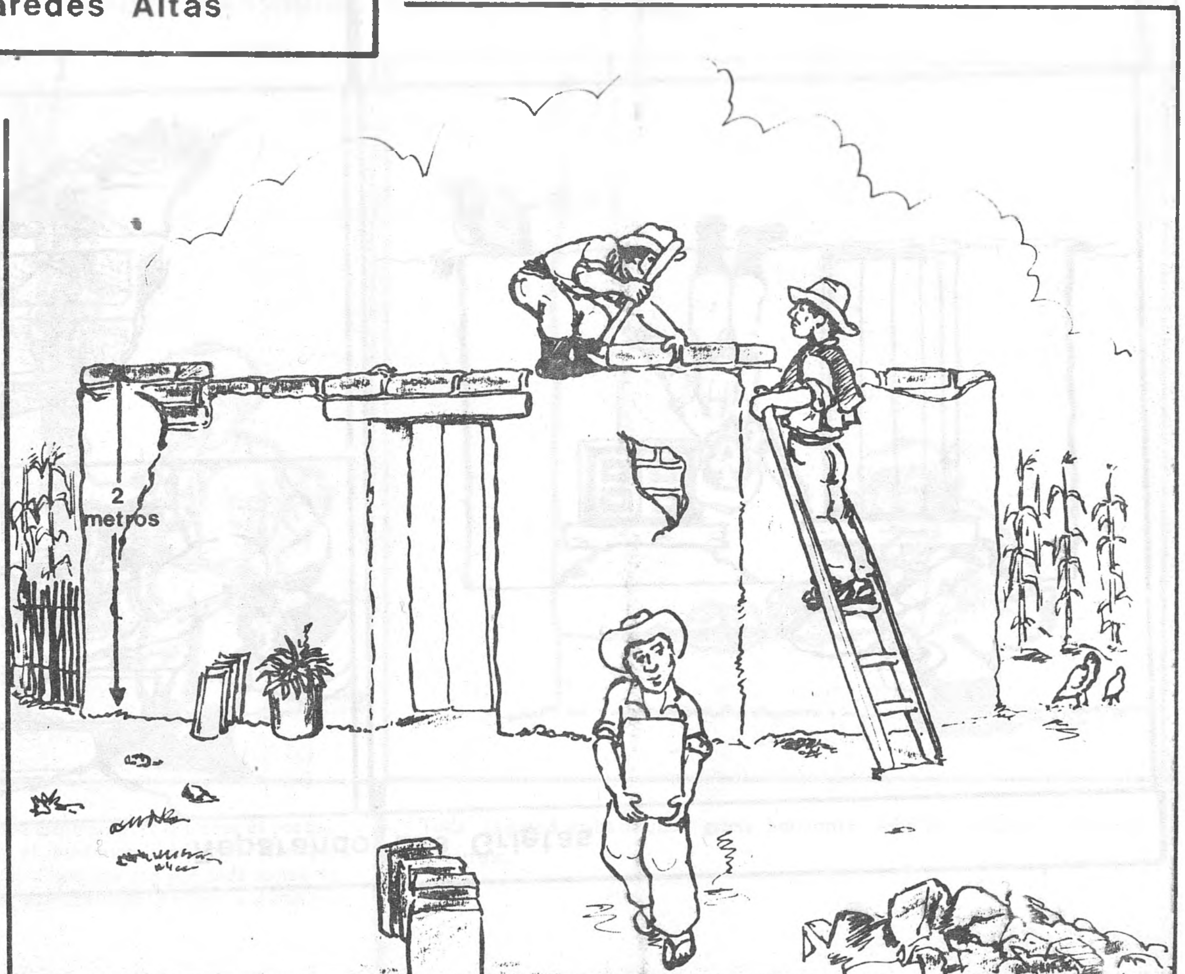


Cuando hay una grieta diagonal, hay que quitar el adobe de los dos lados de la grieta y reemplazarlo con nuevo adobe de la misma clase.

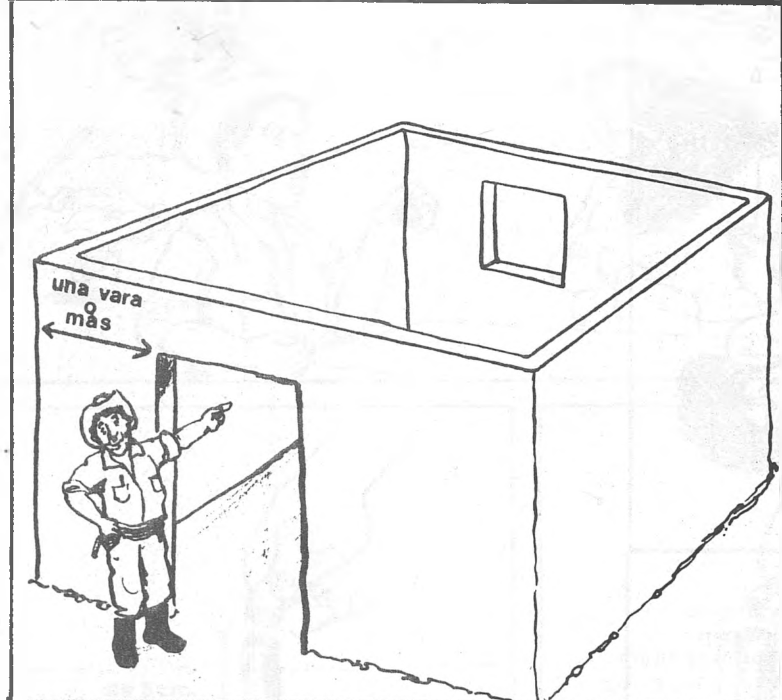
Para reparar grietas sobre la puerta o la ventana, hay que quitar las hiladas dañadas de adobe y volver a ponerlas de nuevo.

Bajando Paredes Altas

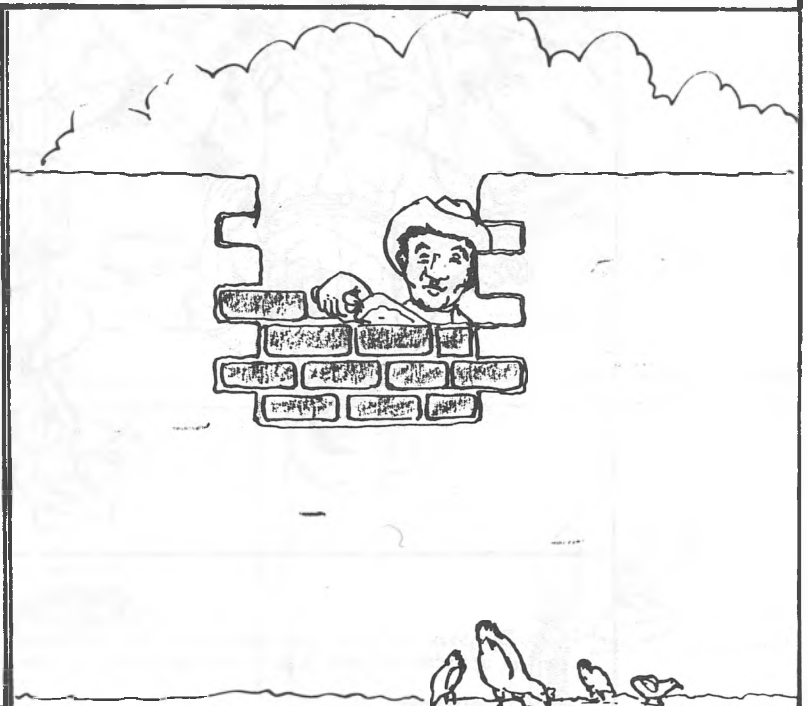
HAY QUE BAJAR LA PARED A LA ALTURA CORRECTA DE DOS METROS. DESPUES SE DEBE QUITAR OTRA HILADA DE ADOBE.



Como Balancear Las Paredes



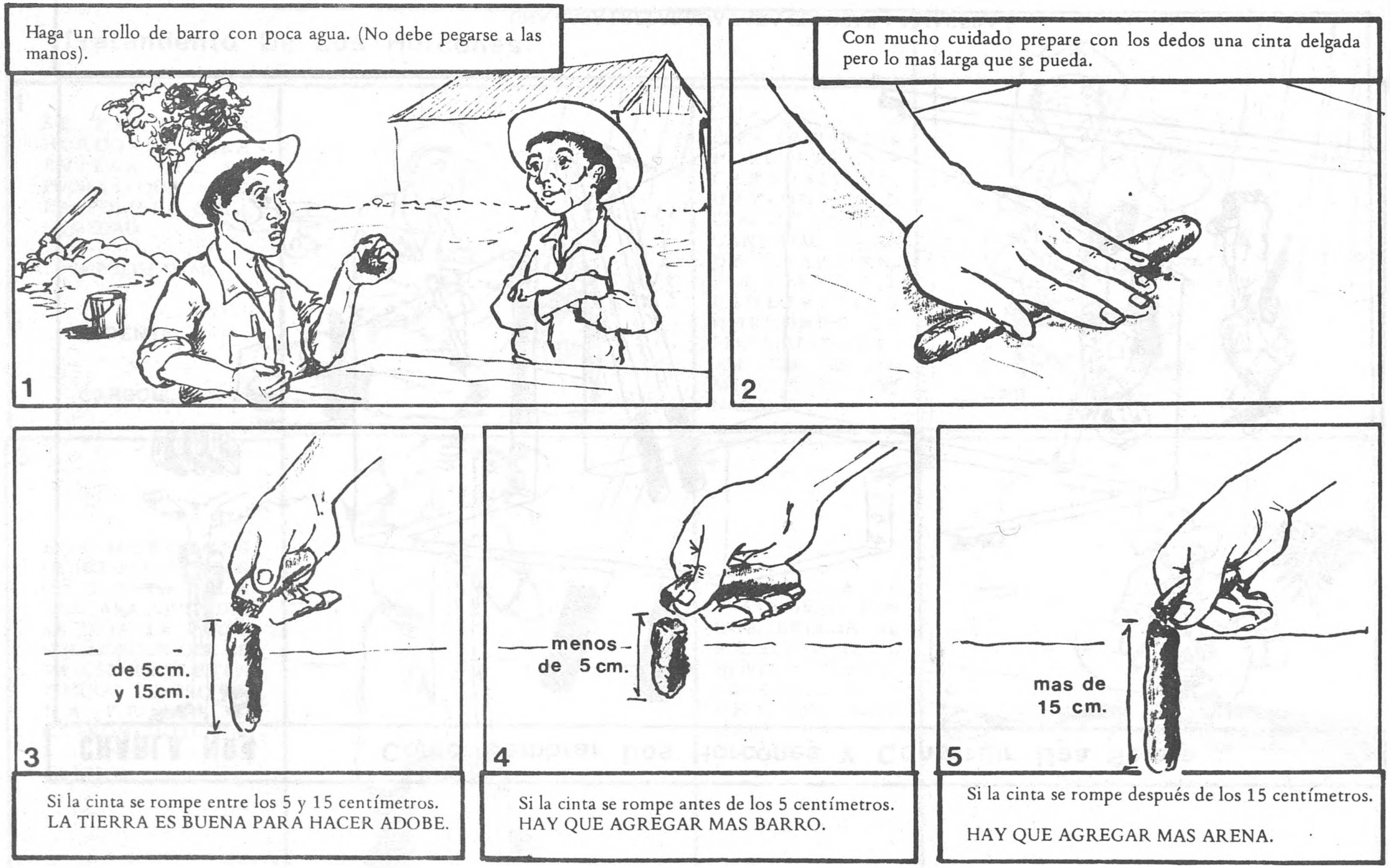
Hay que balancear las puertas y las ventanas para que las paredes pesen aproximadamente lo mismo. Hay que dejar una vara o más entre las puertas y las esquinas.



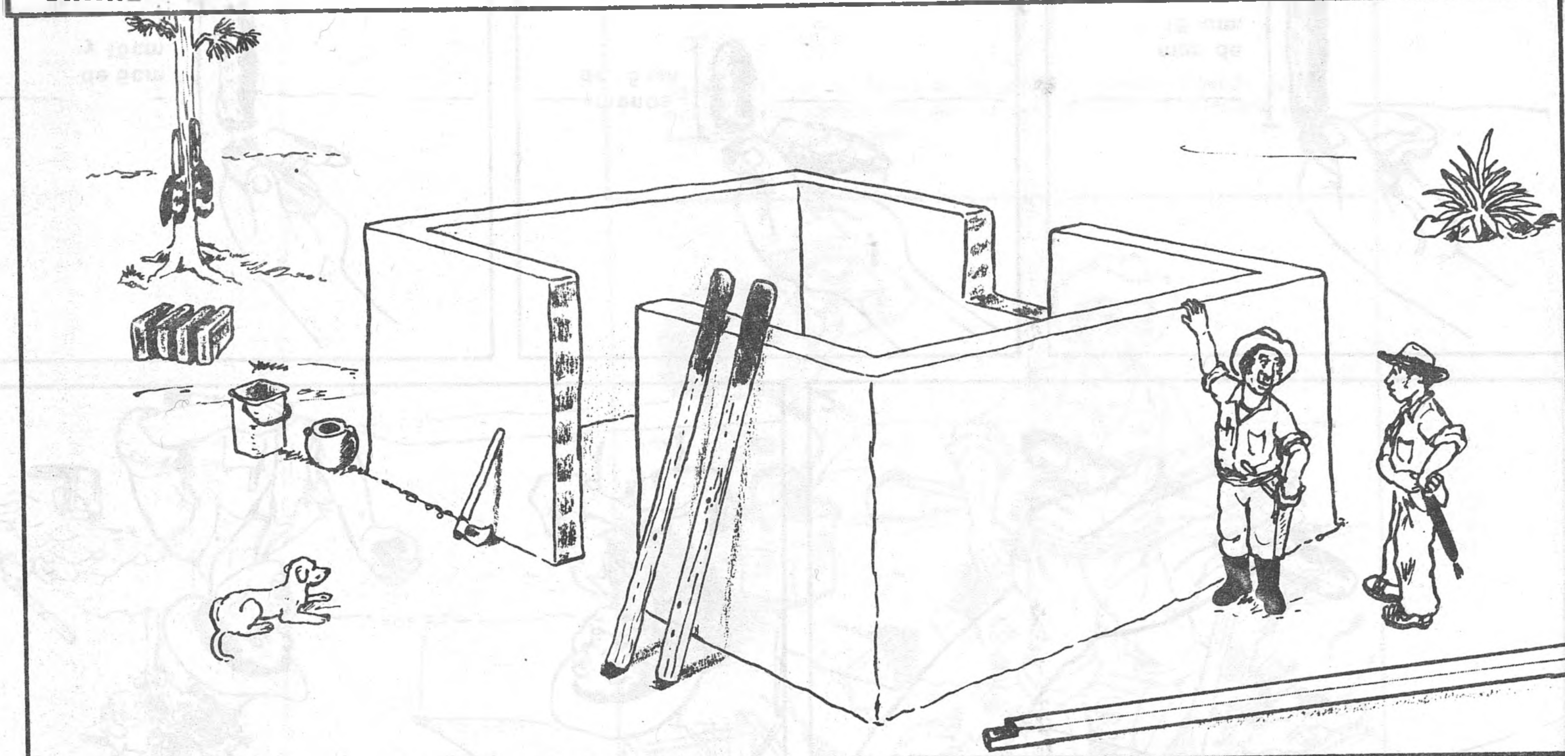
Si las paredes no están balanceadas con puertas y/o ventanas opuestas, será necesario en ciertos casos abrir o llenar puertas y/o ventanas. También si una puerta o ventana queda a menos de una vara de una esquina hay que llenarla y abrirla de nuevo en el mejor lugar.

Preparando Bueñ Adobe

Recuérdese que la fuerza de las paredes también depende en la calidad de los adobes. Hay que escoger lodo bueno y mezclarlo con bastante hoja de pino seco.


Haga un rollo de barro con poca agua. (No debe pegarse a las manos).
1
Con mucho cuidado prepare con los dedos una cinta delgada pero lo mas larga que se pueda.
2
de 5cm.
y 15cm.
3
Si la cinta se rompe entre los 5 y 15 centímetros.
LA TIERRA ES BUENA PARA HACER ADOBE.
menos
de 5 cm.
4
Si la cinta se rompe antes de los 5 centímetros.
HAY QUE AGREGAR MAS BARRO.
mas de
15 cm.
5
Si la cinta se rompe después de los 15 centímetros.
HAY QUE AGREGAR MAS ARENA.

CHARLA Nº4 Como Sembrar Los Horcónes Y Construir Una Solera



UNA CASA PREPARADA PARA COLOCAR LA MADERA.

Tratamiento De Los Horcones

1

SE TRATA LOS HORCONES PARA EVITAR QUE SE PUDRA O QUE ENTRE LA POLILLA O LA HUMEDAD.

SE PUEDE USAR:

PENTA

O

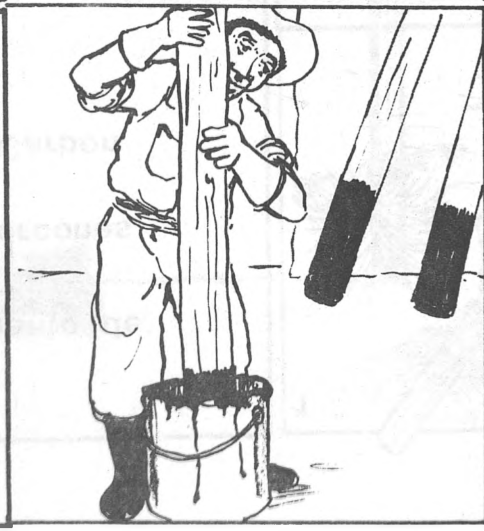
CARBONLINEO

2

PARA TRATAR LOS HORCONES CON CARBONLINEO, HAY QUE MEZCLARLO CON UNA CANTIDAD IGUAL DE GASOLINA. PARA QUE PENETRE LOS HORCONES. LA PENTA SE UTILICE, ASI COMO ES, SIN MEZCLARLA CON NADA.

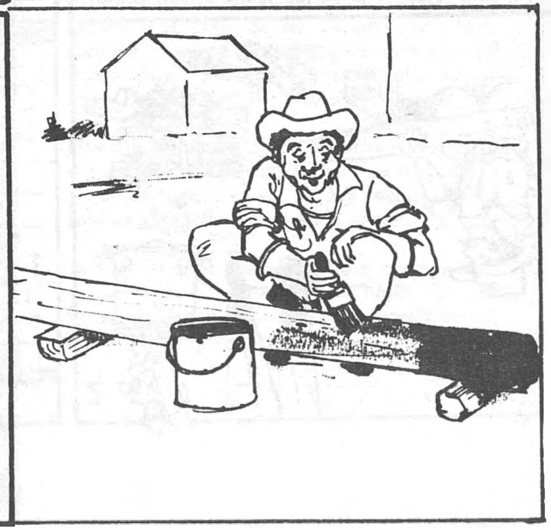
3

LOS HORCONES DEBEN ESTAR SECOS CON TODA LA CASCARA QUITADA. SE DEJA LA PARTE DEL HORCON QUE SE VA A SEMBRAR EN LA TIERRA, DENTRO DE LA PENTA O CARBONLINEO POR LO MENOS 15 MINUTOS..



4

SE APLICA EL TRATAMIENTO CON UNA BROCHA AL RESTO DEL HORCON. CUANDO SE SEQUE DELE UNA SEGUNDA MANO.

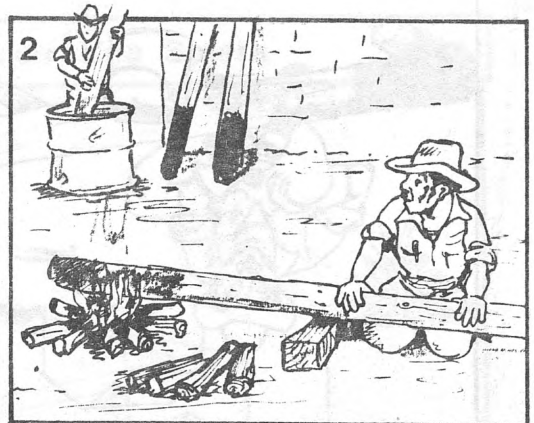


Tratamiento de Los Horcones por Carbon

1

Los horcones deben de estar secos y si tienen cáscara, se quita, menos el último metro.

2



Introduzca la punta del horcón con cáscara dentro del fuego, dándole vuelta hasta que esté quemada y se carbonice.

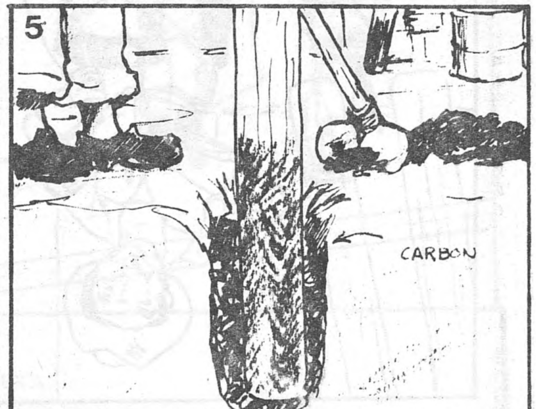
3

Cuando esté quemado con uniformidad, introduzca la punta del horcón en agua para apagar el fuego.

4

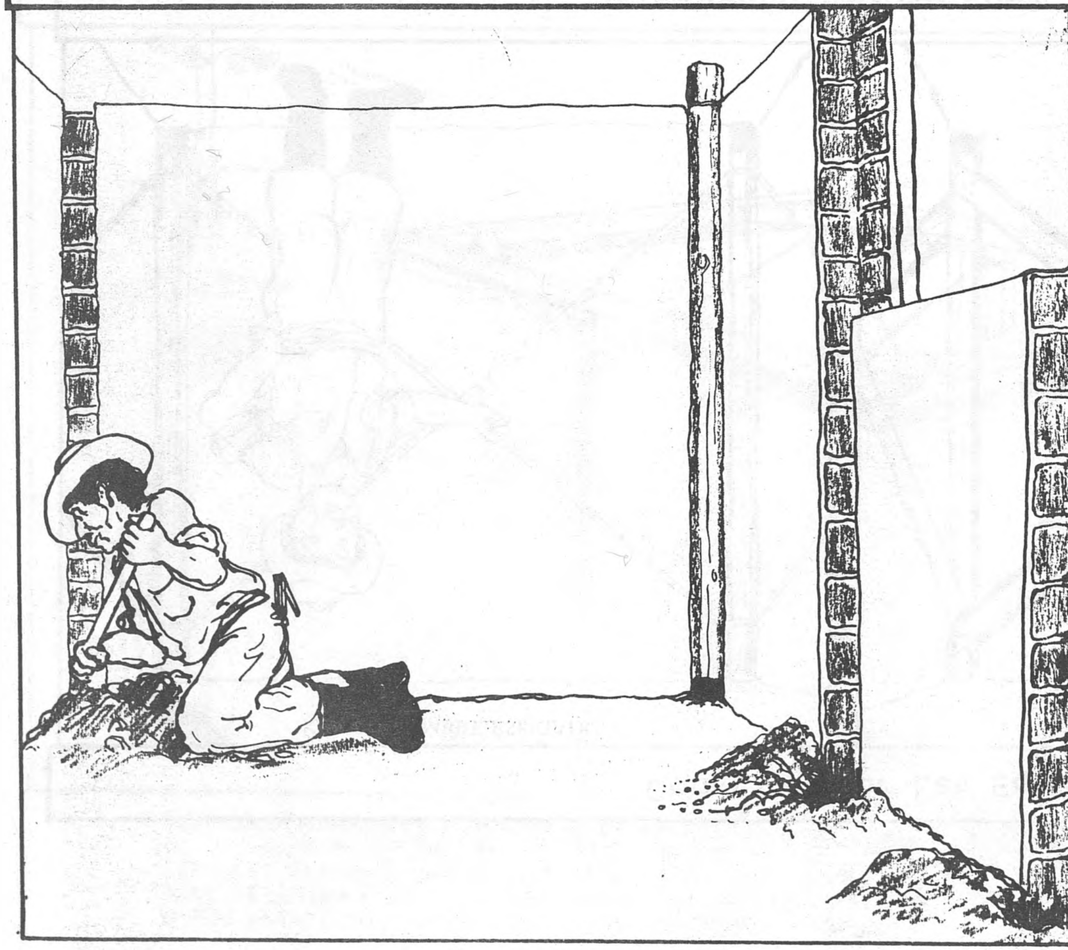
Ponga la ceniza del carbón adentro del hoyo preparado para el horcón.

5



Introduzca el horcón en el hoyo y añada más carbón.

Como Colocar Los Horcónes En Las Paredes



Para colocar los horcones en las paredes se debe hacer canales en las esquinas y a los lados de las puertas y las ventanas para meter los horcones dentro de las paredes. También a cada 2 metros a 2 1/2 metros en las paredes más largas donde no hay puertas o ventanas.

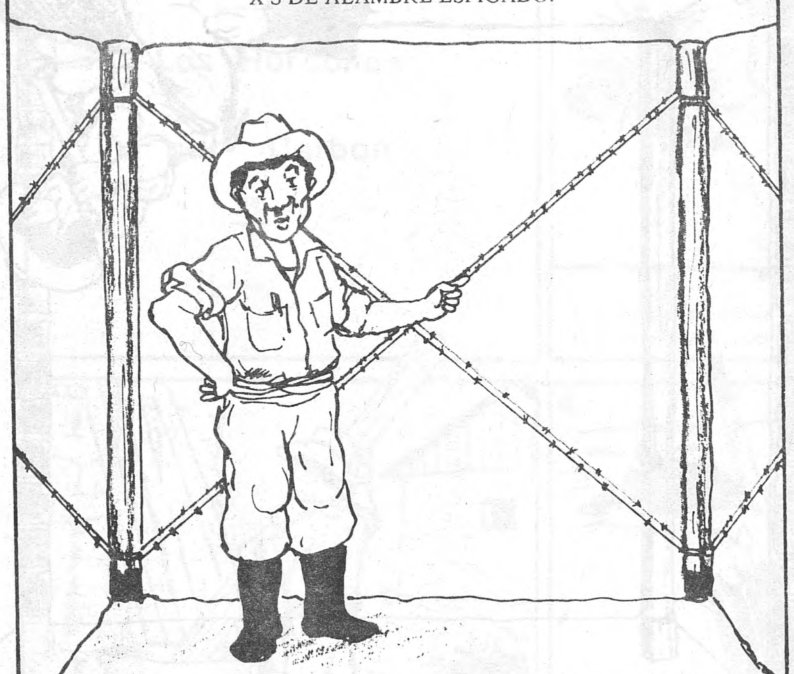
El horcón debe ser de 6" X 6" o más, para aguantar el peso de las paredes. Se puede emplear las vigas quitadas anteriormente del techo para este propósito, ya que no se necesitan para el techo nuevo más liviano.

Hay que meter los horcones hasta tres cuartos del ancho de la pared para que sea más seguro y que dé lugar a clavar las X's encima que no se vean al repellar de nuevo la pared.

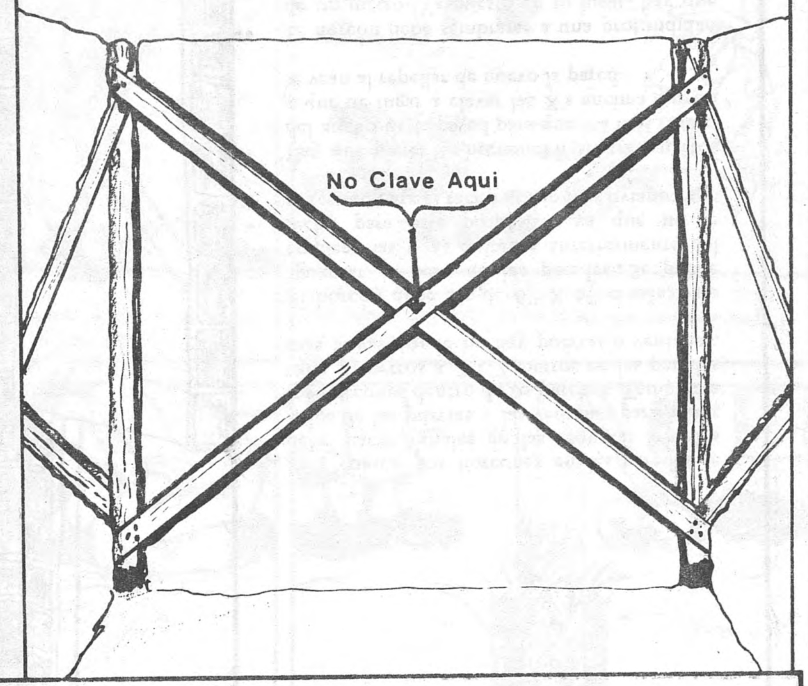
El horcón debe sembrarse a una profundidad de un metro. Ya puesto en su lugar, hay que llenar alrededor del horcón con mezcla de cal, arena, y lodo para que pegue bien.

Como Colocar Las Equis

X'S DE ALAMBRE ESPIGADO.



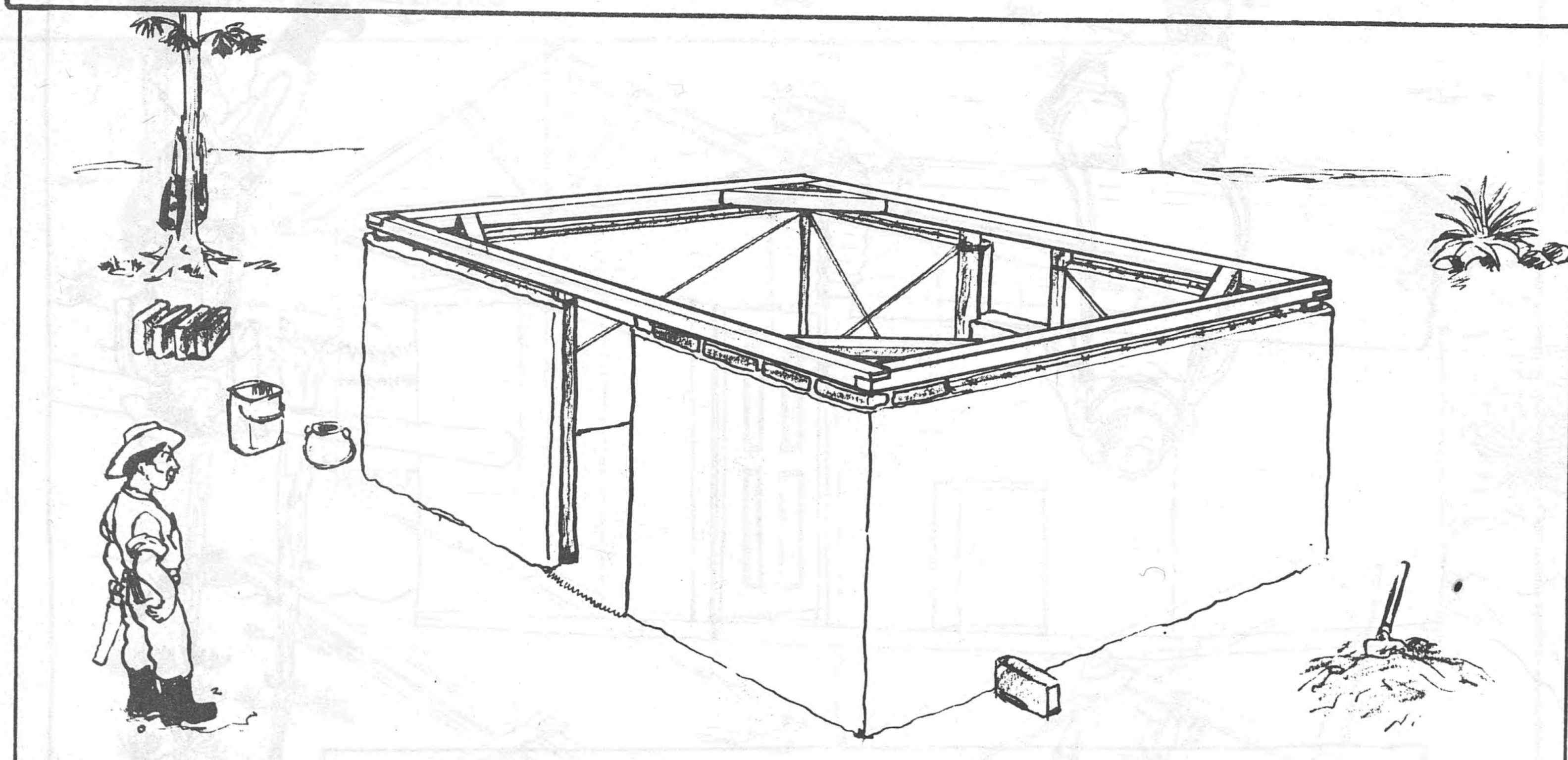
X'S DE MADERA.



Hay que cortar canales en la pared para meter X'S abajo del repello. Si X'S son de madera, las reglas deben ser por lo menos 2 1/2" x 1 1/2". Se pueden emplear las reglas quitadas anteriormente del techo para este propósito, ya que no las necesitan para el nuevo techo liviano.

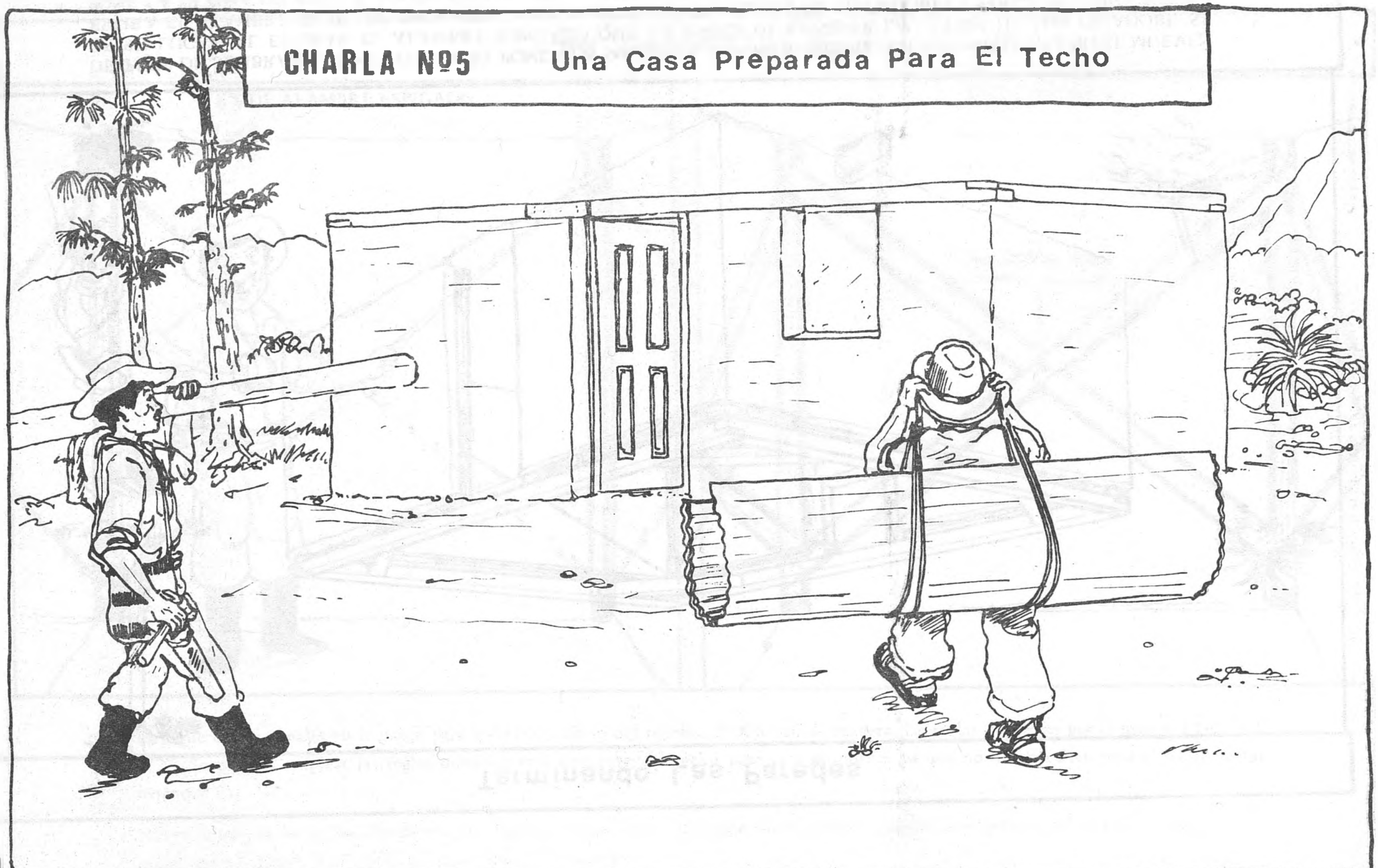
Nunca se clavan las reglas donde cruzan. También no se clavan las reglas o el alambre espigado directamente al nivel del suelo ni a la solera, sino a unas 6" a 8" arriba del suelo y abajo de la solera.

Terminando Las Paredes

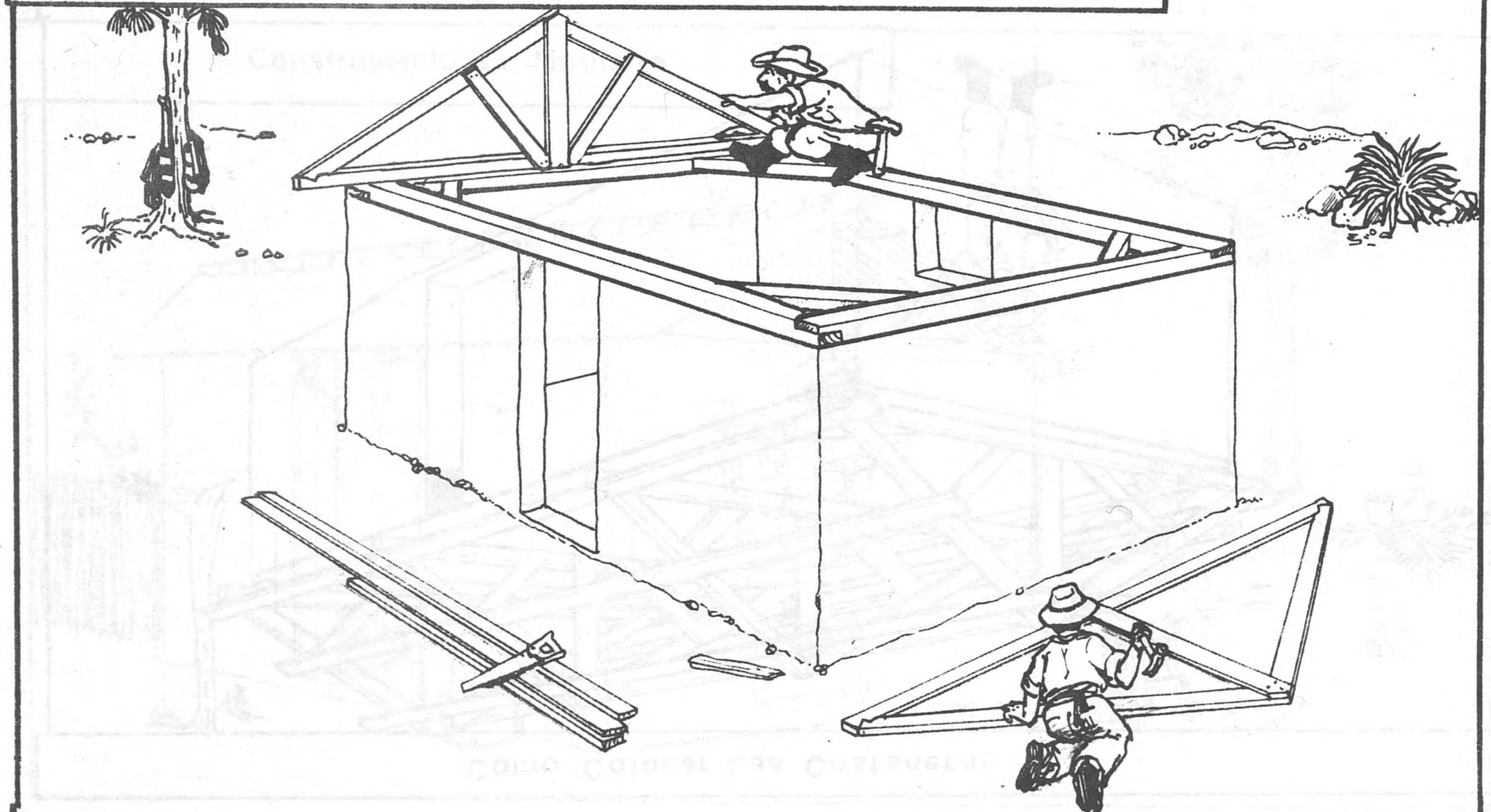


DESPUES DE SEMBRAR LOS HORCONES, SE PONEN LA SOLERA Y LAS ESQUINERAS. ASI LOS HORCONES NO SE MUEVEN DE SU LUGAR AL ESTIRAR EL ALAMBRE ESPIGADO QUE VA ANTES DE REPONER LA ULTIMA HILADA DE ADOBE. SE ESTIRA EL ALAMBRE ESPIGADO BIEN APRETADO DIRECTAMENTE ENCIMA DE LOS ADOBES ENTRE LOS HORCONES. SE PONE LA ULTIMA HILADA DE ADOBE ENCIMA DEL ALAMBRE ESPIGADO, LLENANDO BIEN CON LODO EL ESPACIO QUE QUEDE ABAJO DE LA SOLERA Y ENTRE LOS HORCONES Y LA PARED.

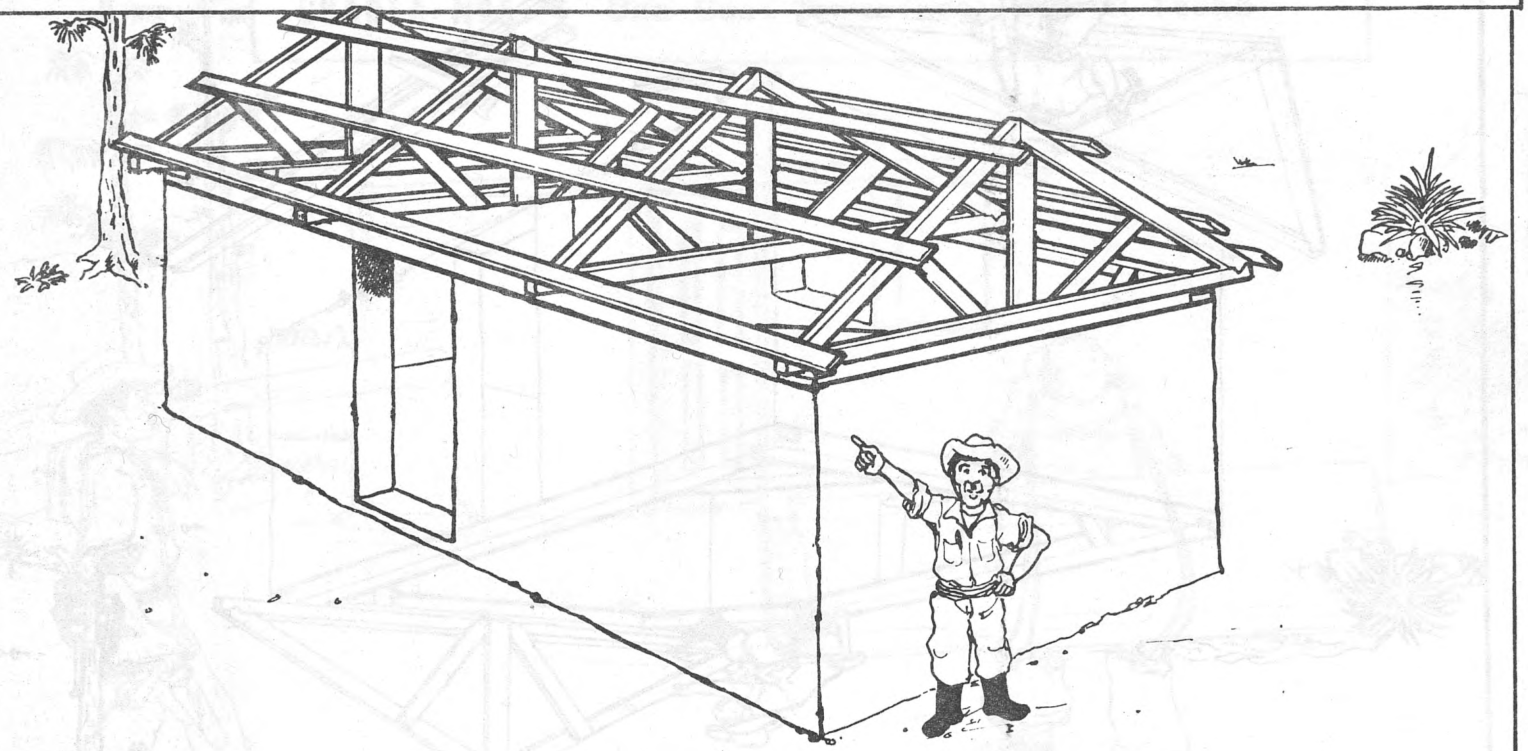
CHARLA Nº5 Una Casa Preparada Para El Techo



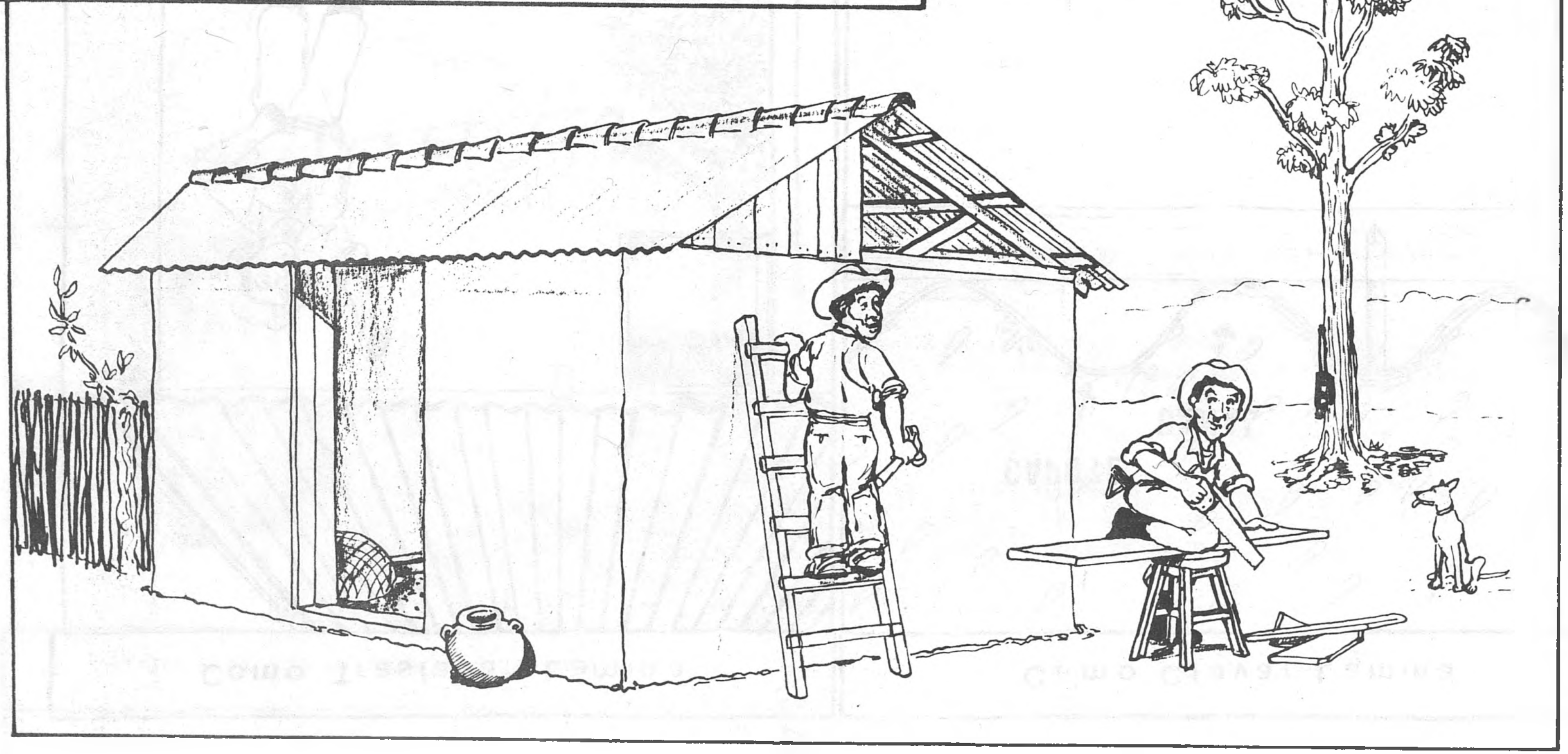
Como Hacer Las Tijeras



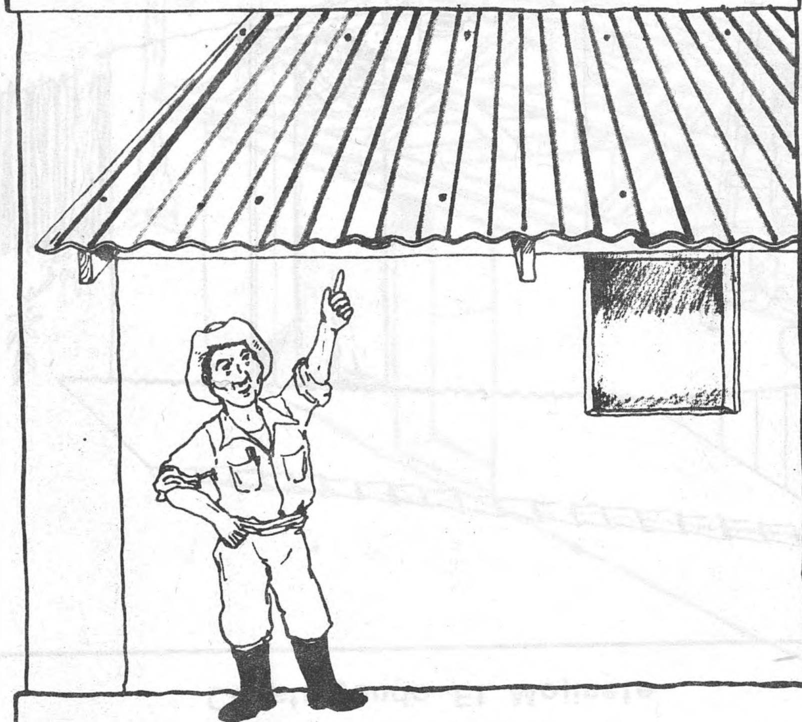
Como Colocar Las Costaneras



Construyendo El Mojinete

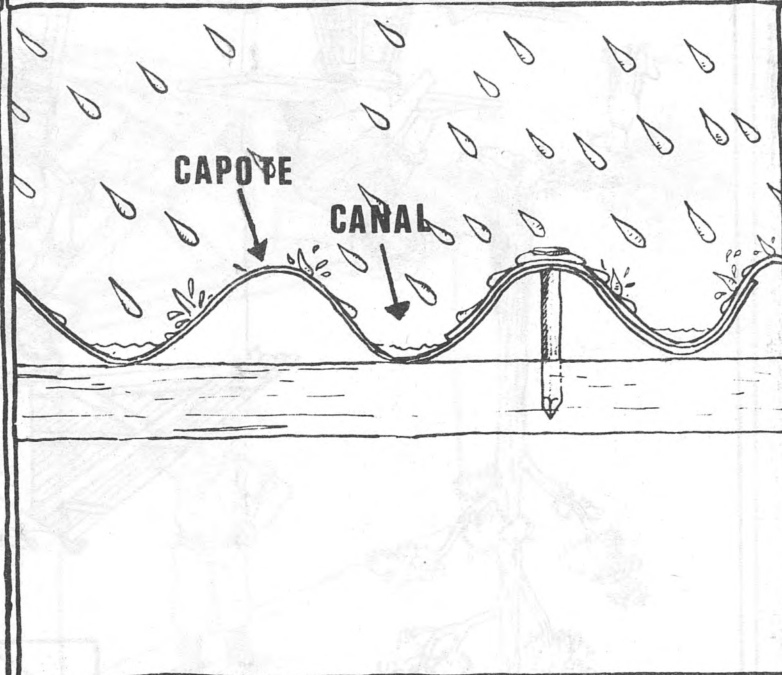


Como Traslapar Lámina

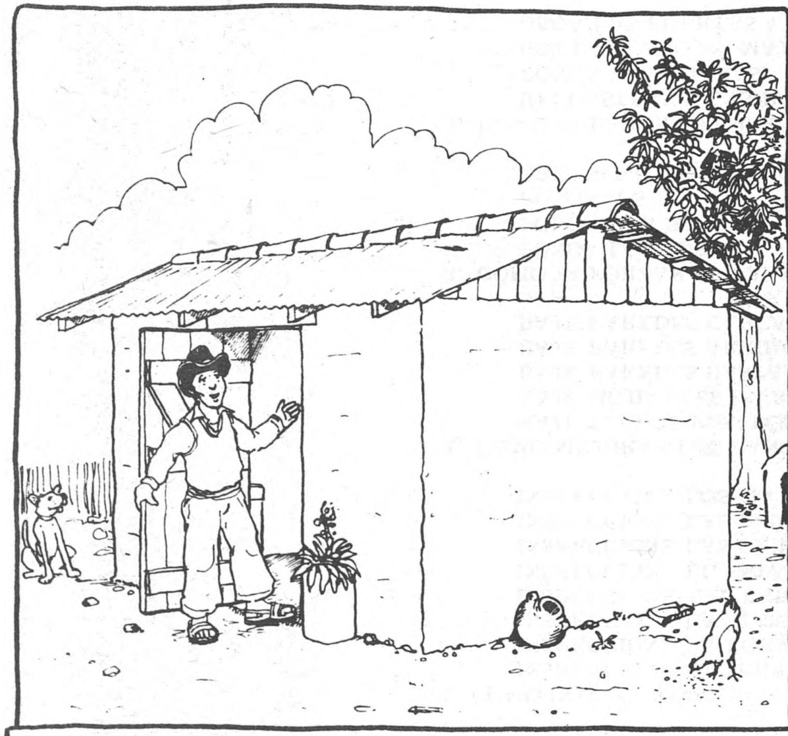


TRASLAPE SU LAMINA UN CANAL Y MEDIO.

Como Clavar Lámina



HAY QUE CLAVAR LA LAMINA EN EL CAPOTE. NO LA CLAVE EN EL CANAL.



HAY QUE ARREGLAR LAS PUERTAS Y LAS VENTANAS.

LA CASA ESTA BIEN REPARADA.

Como Cambiar Puertas y Ventanas

HAY DOS MANERAS DE CAMBIAR LAS PUERTAS Y LAS VENTANAS PARA QUE ABRAN HACIA AFUERA.

1. SE PUEDE QUITAR LA PUERTA CON SUS BISAGRAS TODAVIA PUESTAS, Y DESPUES PONER LA PUERTA DE BOCA ABAJO. AL ARMAR LAS BISAGRAS, DE NUEVO LA PUERTA YA ABRE HACIA AFUERA.

2. SE PUEDEN QUITAR COMPLETAMENTE LAS BISAGRAS Y LUEGO VOLVER A PONERLAS PARA QUE LA PUERTA ABRA HACIA AFUERA.

Recuérdese

1. COMO INSPECCIONAR SU CASA POR DAÑOS DEL TERREMOTO.
   - INSPECCIONE SU TERRENO.
   - INSPECCIONE LA FORMA DE LA CASA.
   - INSPECCIONE LA ALTURA DE LAS PAREDES.
   - INSPECCIONE LAS PAREDES Y EL TECHO POR ADENTRO.
   - INSPECCIONE EL ESTADO DE LA MADERA.
   - INSPECCIONE LAS PAREDES Y EL TECHO POR AFUERA.
   - INSPECCIONE LAS POSICIONES DE LAS PUERTAS Y LAS VENTANAS.
   - INSPECCIONE LOS MATERIALES DE CONSTRUCCION.

2. COMO MEJORAR LOS DAÑOS EN SU CASA.
   - BAJE TECHOS PESADOS.
   - BAJE MOJINETES DE ADOBE.
   - BAJE PAREDES HASTA NO MAS DE 2 METROS.
   - BAJE PAREDES ARRIBA DE GRIETAS HORIZONTALES.
   - BAJE PAREDES CERCA DE GRIETAS VERTICALES Y DIAGONALES.

3. COMO REFORZAR SU CASA.
   - PONGA LOS POSTES.
   - PONGA UNA SOLERA.
   - PONGA X'S
   - BALANCEE LAS PAREDES.

4. COMO REPARAR SU CASA.
   - RECONSTRUYA LAS PAREDES CON REFUERZOS.
   - PONGA LAS TIJERAS.
   - USE LAMINA O UN MATERIAL LIVIANO PARA EL TECHO.
   - HAGA LAS PUERTAS Y LAS VENTANAS ABRIR HACIA AFUERA.

Si todavia tiene Ud. preguntas sobre el contenido de este folleto, pongase en contacto con La Alianza Para Desarrollo Juvenil Comunitario, Oficina Regional, Chiche, Departamento del Quiche, Guatemala, C.A.

Empalmes

CONTENIDO

PRIMERA PARTE:

EMPALMES PARA UNIR DOS PIEZAS DE MADERA PARA HACER UNA PIEZA MAS LARGA.

SEGUNDA PARTE:

EMPALMES PARA LAS UNIONES DE PIEZAS DIFERENTES.

ESTE FOLLETO FUE "EMPALMADO" DEL PROGRAMA DE RECONSTRUCCION DE"ALIANZA PARA DESARROLLO JUVENIL COMUNITARIO" EN JOYA-BAJ POR LAS SIGUIENTES PERSONAS:

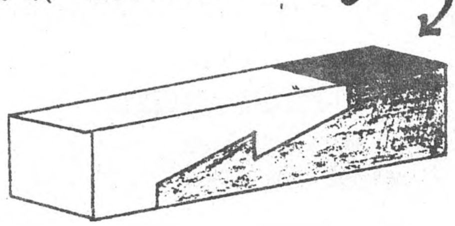
Alberto Quezada Manuel Lorenzo Domingo Larios	COORDINACION DE INSTRUCCION
Rebeca Hammond Adelso Ramos	LOS ARTISTAS
Fred Cuny	ASESOR TECNICO
Nancy Lorence	PLANIFICACION Y EVALUACION

EMPALMES PARA UNIR DOS PIEZAS DE MADERA PARA HACER UNA PIEZA MAS LARGA

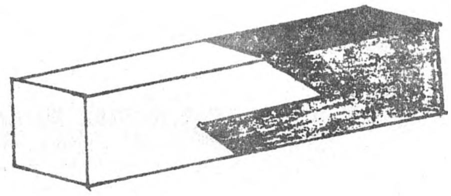
¿EN GENERAL, QUE TIPO DE EMPALME SERA MAS ACONSEJABLE PARA UNIR DOS PIEZAS DE MADERA PARA HACER UNA PIEZA MAS LARGA?

El mejor es el de "<u>cadena</u>" porque no se puede jalar ni empujar la madera. Los empalmes de "<u>doble tacón</u>" de "<u>45</u>" y de "<u>escuadra</u>" son buenos. El empalme "<u>falso</u>" no es recomendable.

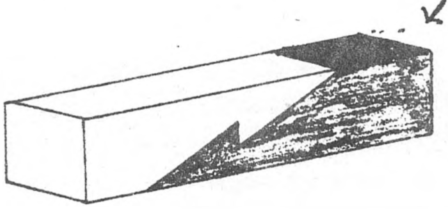
A. CADENA - LO MEJOR



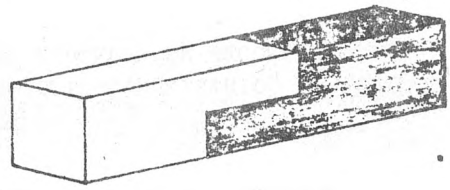
C. 45 - BUENO



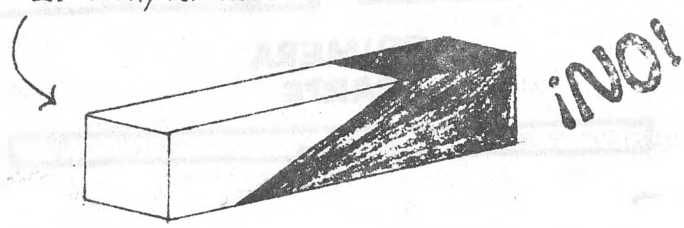
B. Doble TACÓN - BUENO



D. Escuadra - BUENO

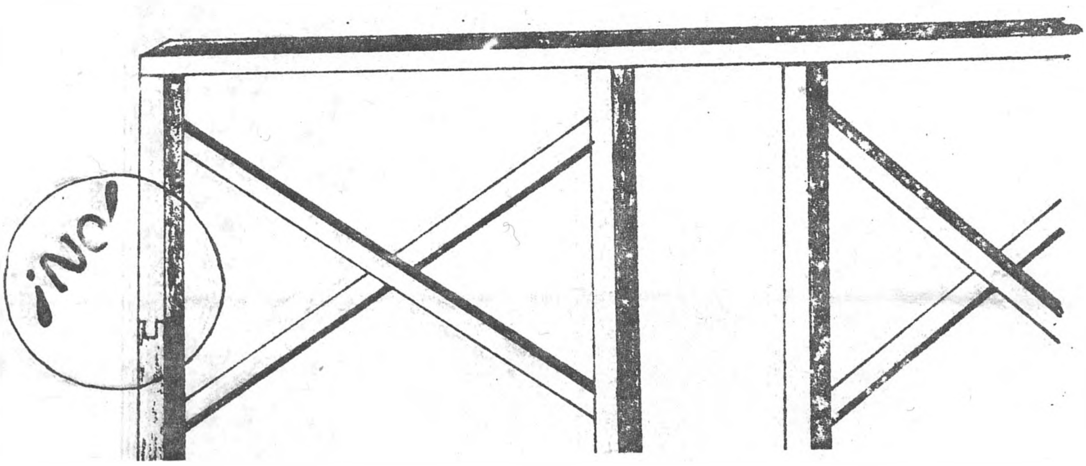


E. Empalme Falso - No ES RECOMENDABLE



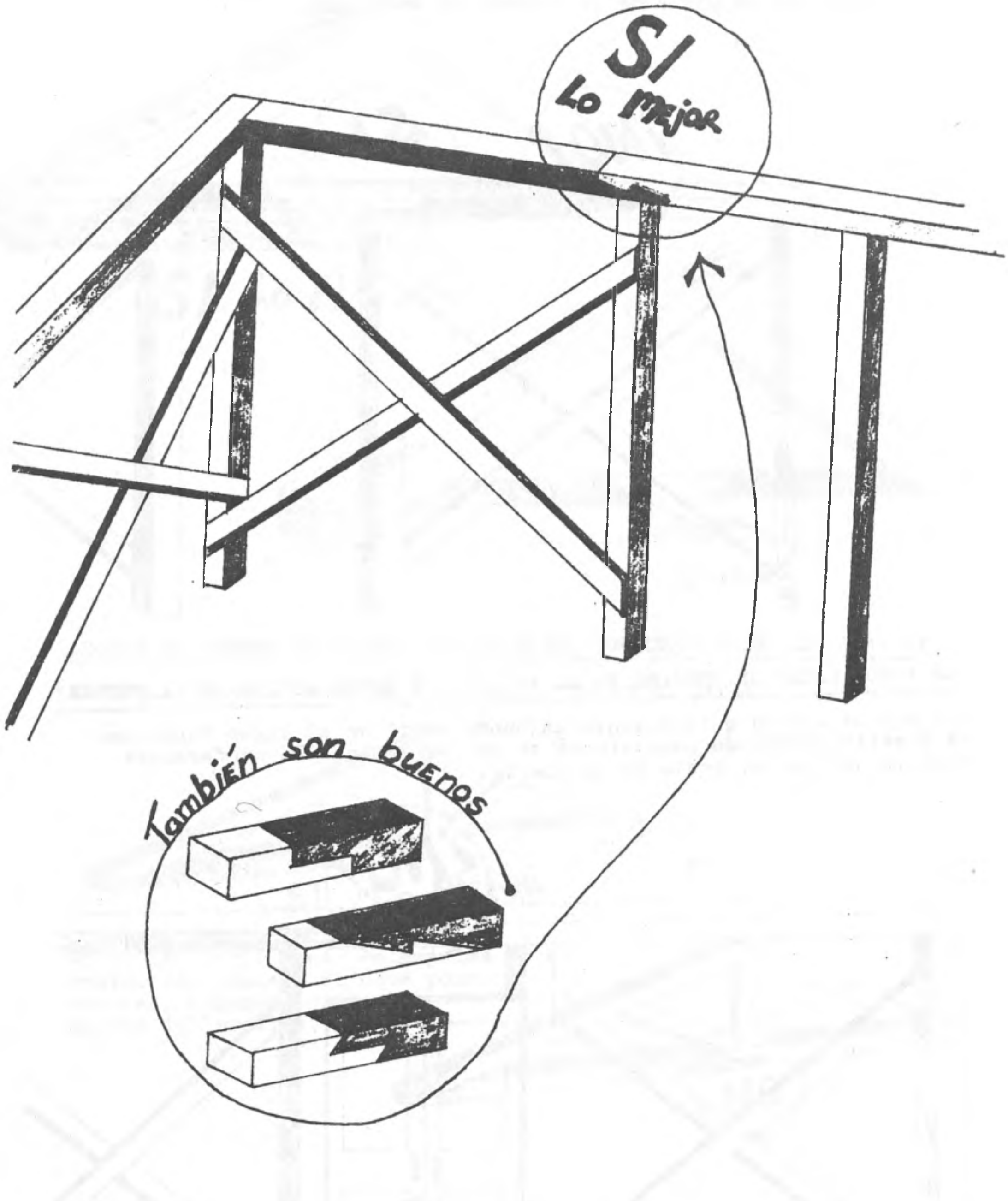
¿QUE TIPO DE EMPALME PUEDE USAR PARA HORCONES O POSTES?

No debe empalmar los horcones o postes porque se debilita mucho al cortarlo. Los horcones o postes sirven de base para todo el cajón de la casa, entonces tienen que tener mucha fuerza.



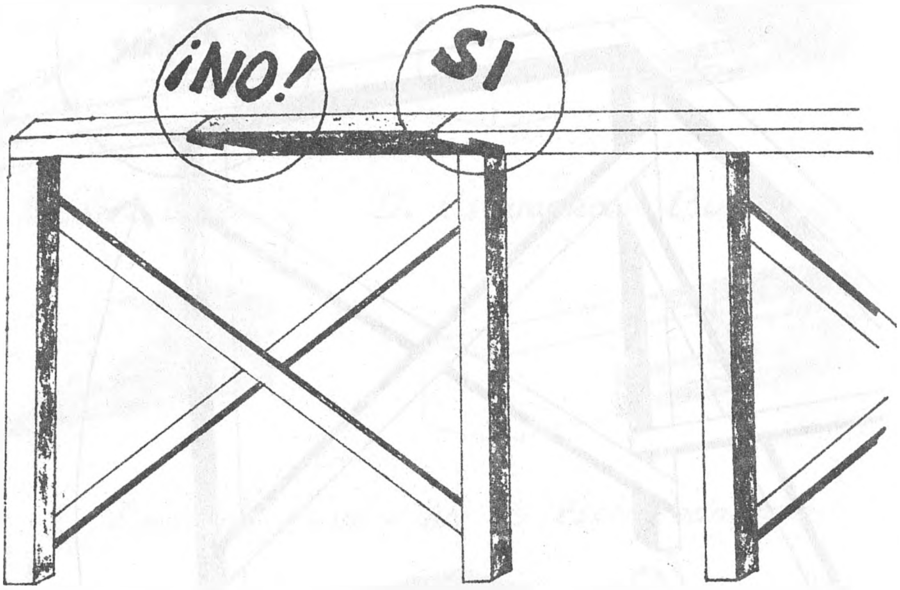
¿QUE TIPO DE EMPALME SERA MEJOR PARA EL ANILLO O SOLERA?

El tipo de cadena es mejor, pero de plan. Los de doble tacón o de 45 o de escuadra son buenos.



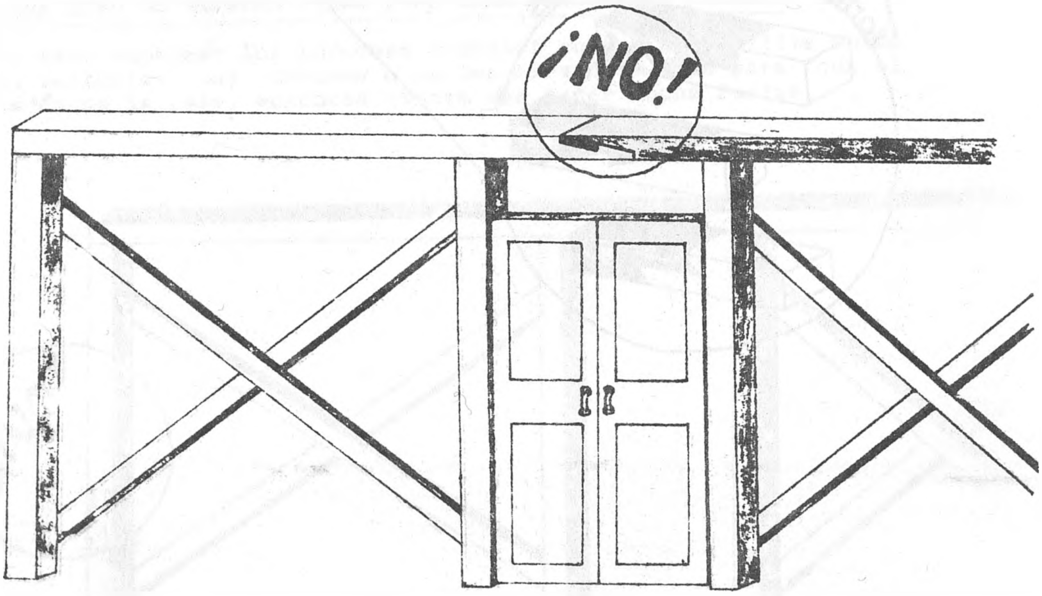
¿SE PUEDE PONER UN EMPALME EN EL ANILLO O SOLERA QUE QUEDA EN EL AIRE?

No se aconseja . Siempre debe ir sobre un poste para darle más fuerza al anillo. Si queda en el aire, queda más débil por el peso de la pieza de la solera que va encima.



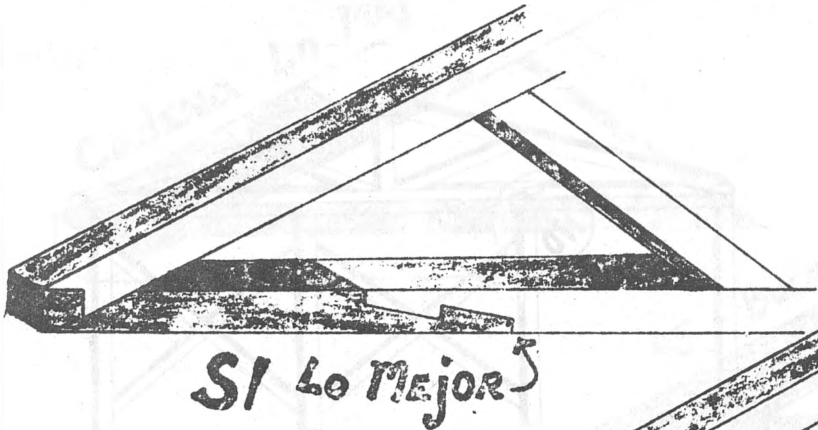
¿SE PUEDE HACER UN EMPALME EN EL ANILLO QUE QUEDE ARRIBA DE LA PUERTA?

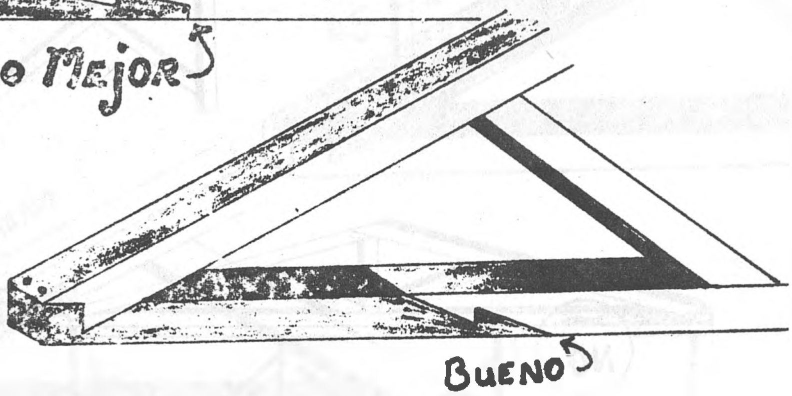
No, porque uno no quiere tener un punto débil en el lugar donde uno va a salir corriendo para afuera en un terremoto. De preferencia debe ir encima del poste de la puerta.



¿QUE TIPO DE EMPALME ES EL MEJOR PARA LOS TENDALES?

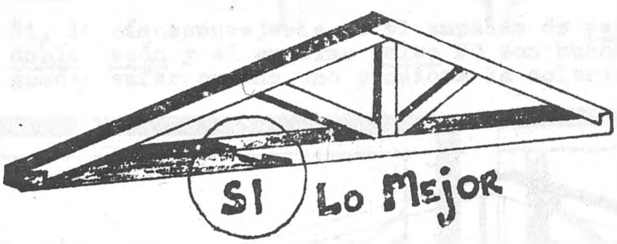
El empalme de cadena es el mejor, y el de doble tacón es muy bueno.



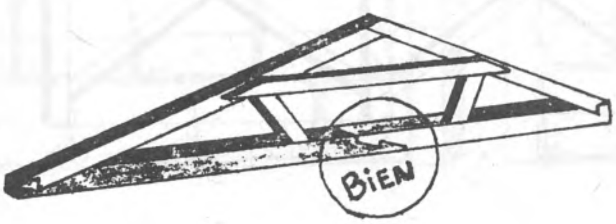


¿DONDE SE PUEDEN EMPALMAR LOS TENDALES, EN MEDIO O EN LAS PUNTAS?

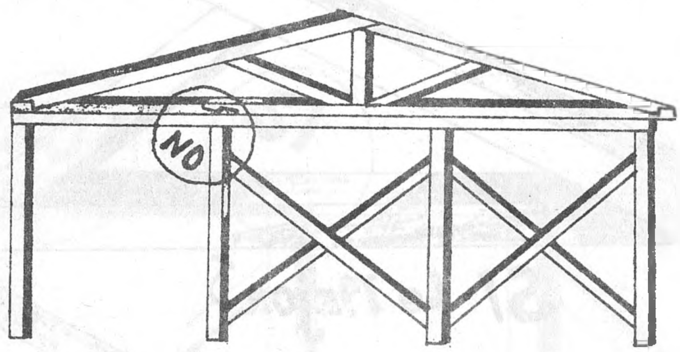
Es mejor poner el empalme a un lado y no en el centro.

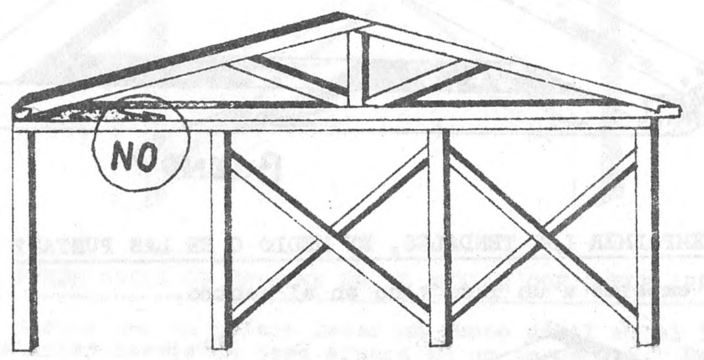


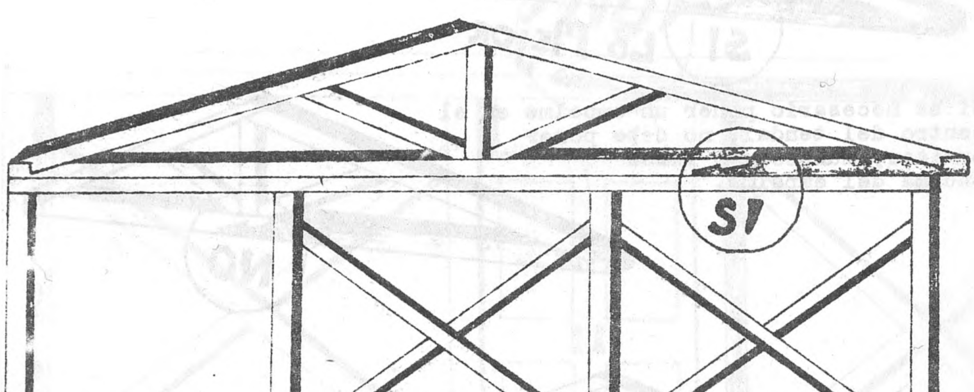
Si es necesario poner un empalme en el centro del tendal, no debe poner breisas, muñecos, o pines encima del empalme.



Si la tijera sirve también para el corredor, es MUY importante poner cualquier empalme sobre el espacio del cuarto, NO encima de la solera, ni en la parte del corredor.

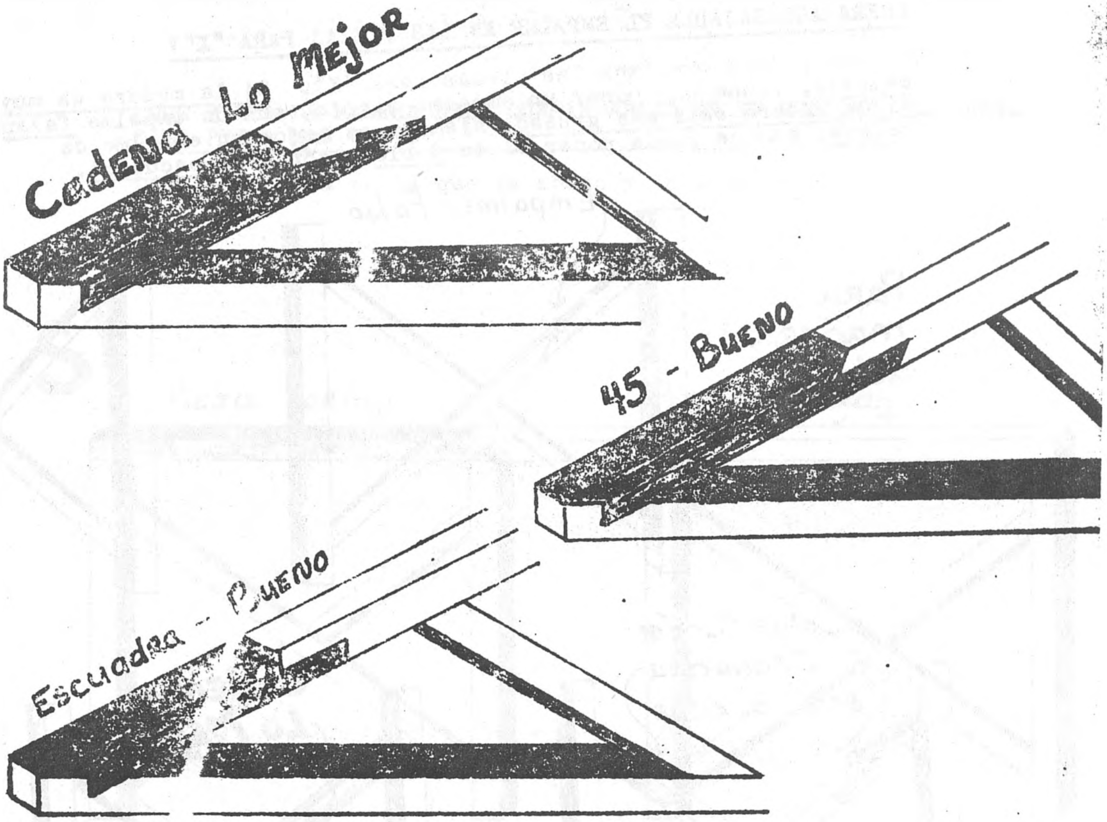






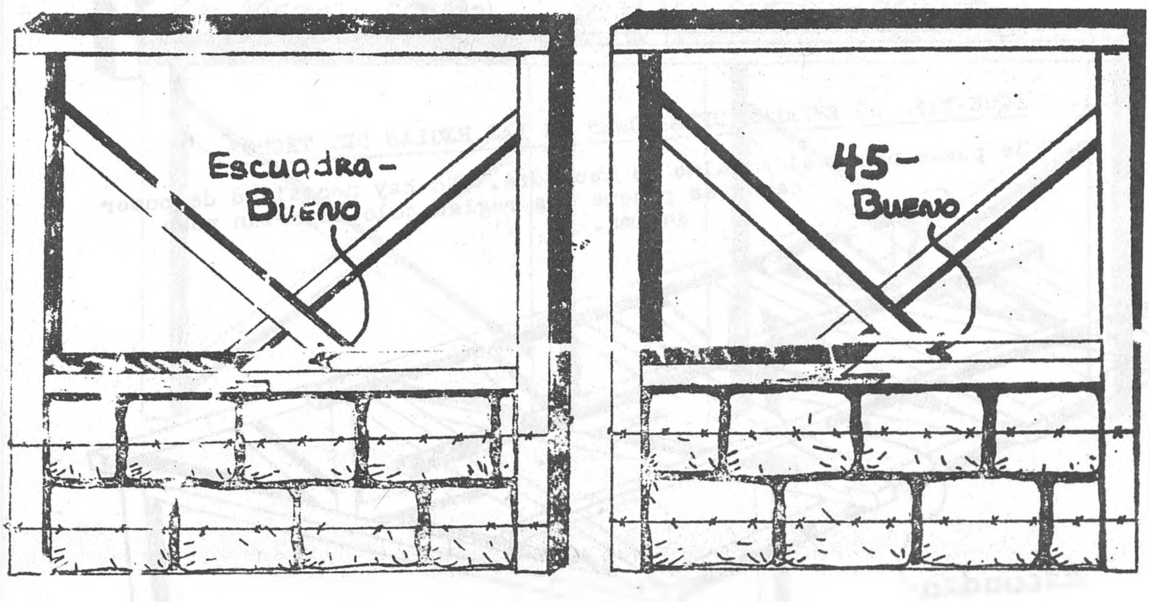
[illegible]

El empalme de <u>cadena</u> es mejor y los de <u>escuadra</u> o de <u>45</u> son buenos, pero de canto. El empalme de <u>doble tacón</u> NO es bueno para la péndula.



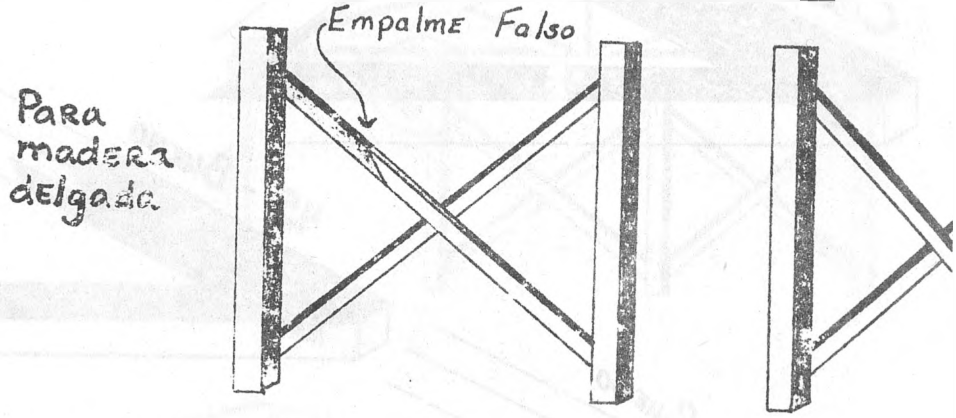
¿SE LE PUEDE HACER EMPALMES A LAS SOLERAS DE ENTRE LOS ADOBES?

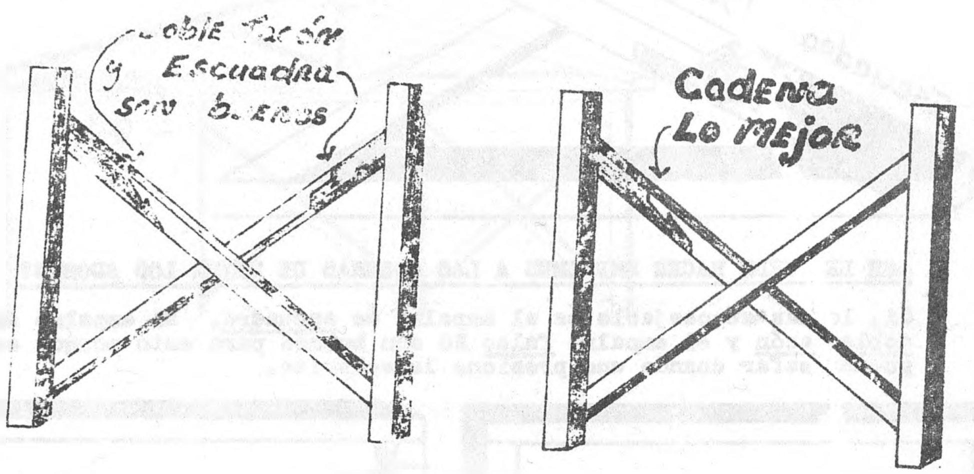
Si, lo más aconsejable es el empalme de <u>escuadra</u>. El empalme de <u>doble tacón</u> y el empalme <u>falso</u> NO son buenos para esto porque se pueden zafar cuando uno presiona la solerita.



¿SERA ACONSEJABLE EL EMPALME EN LAS PIEZAS PARA "X"?

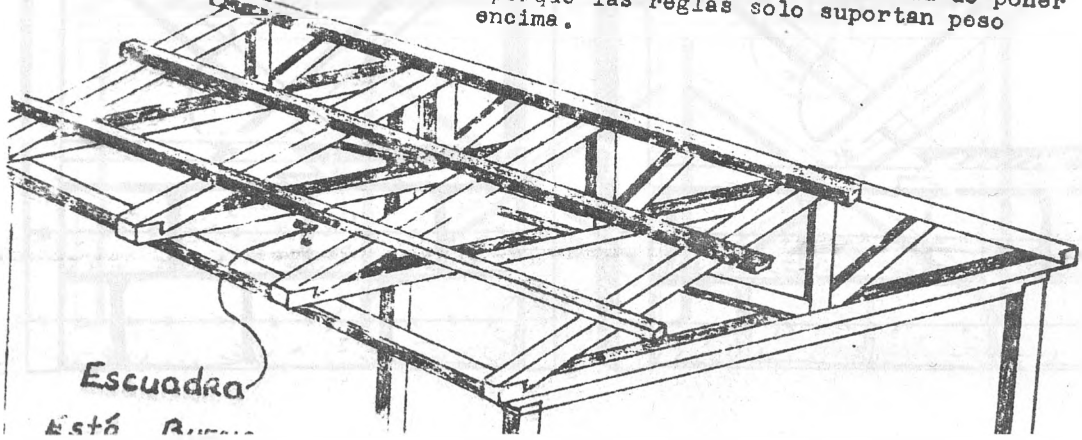
Si, se pueden empalmar las piezas para "X". Si la madera es muy delgada, tiene que poner un empalme simple, aún un empalme falso. Si la madera está más grueso, siempre es mejor un empalme de cadena, aunque puede poner el de doble tacón o de escuadra.





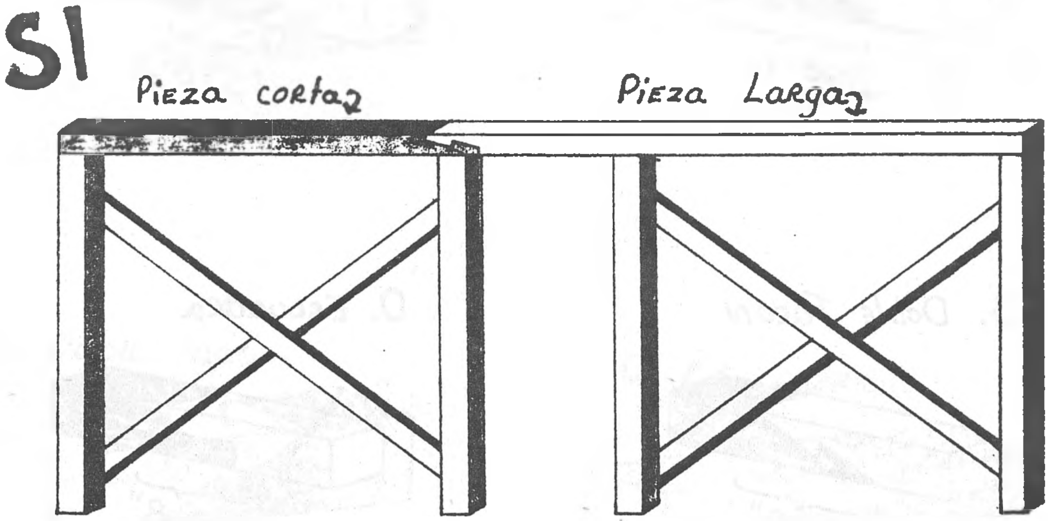
¿QUE TIPO DE EMPALME DEBE PONER EN LAS REGLAS DEL TECHO?

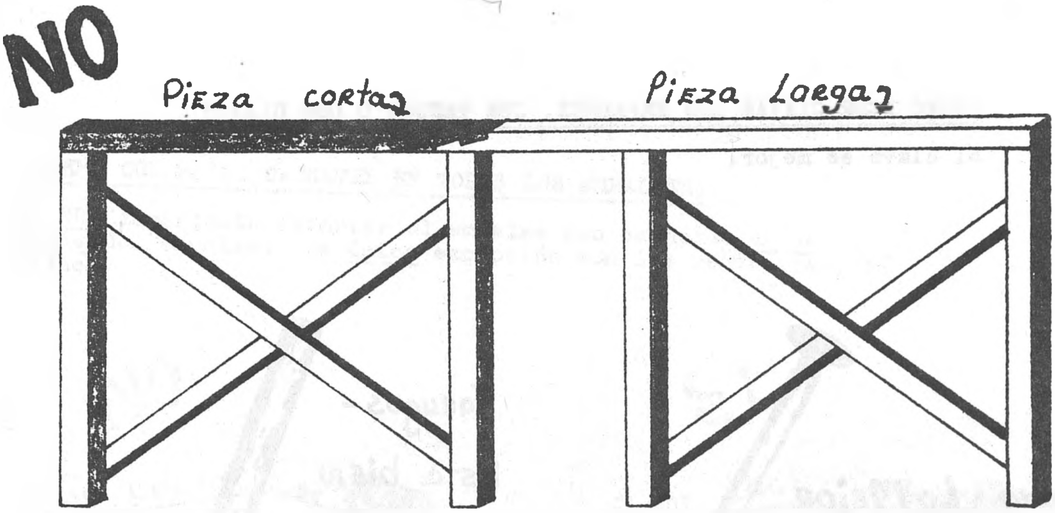
Se puede poner el empalme de escuadra. No hay necesidad de poner cachetes porque las reglas solo suportan peso encima.



¿QUE PIEZA DE MADERA DEBE QUEDAR ABAJO EN UN EMPALME, LA LARGA O LA PIEZA MAS CORTA?

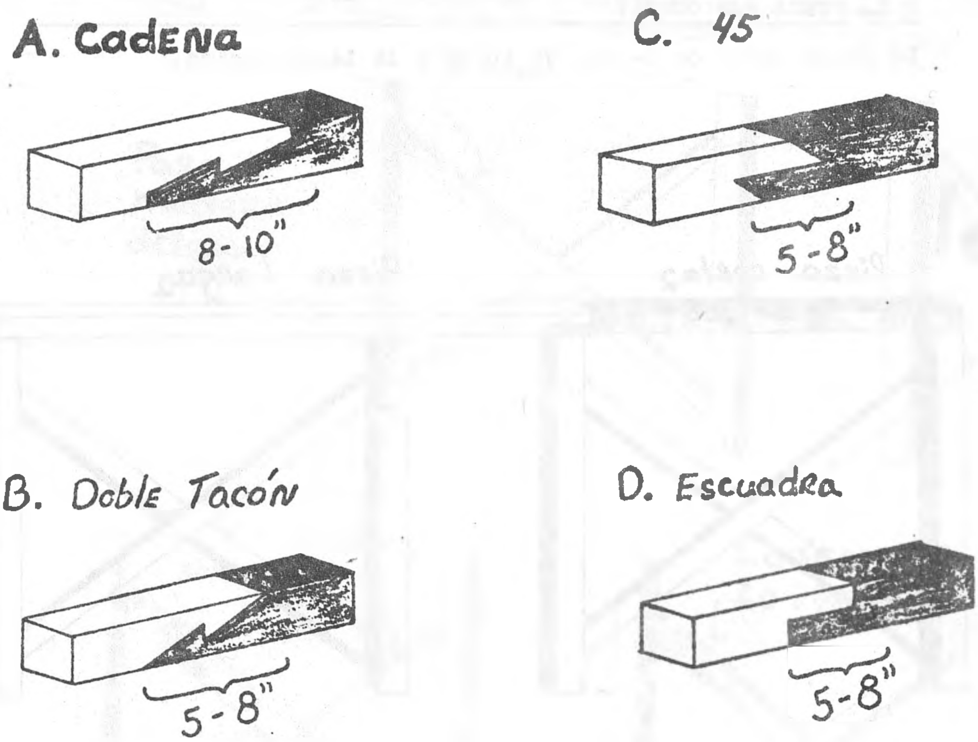
La pieza corta es la que va abajo y la larga encima.





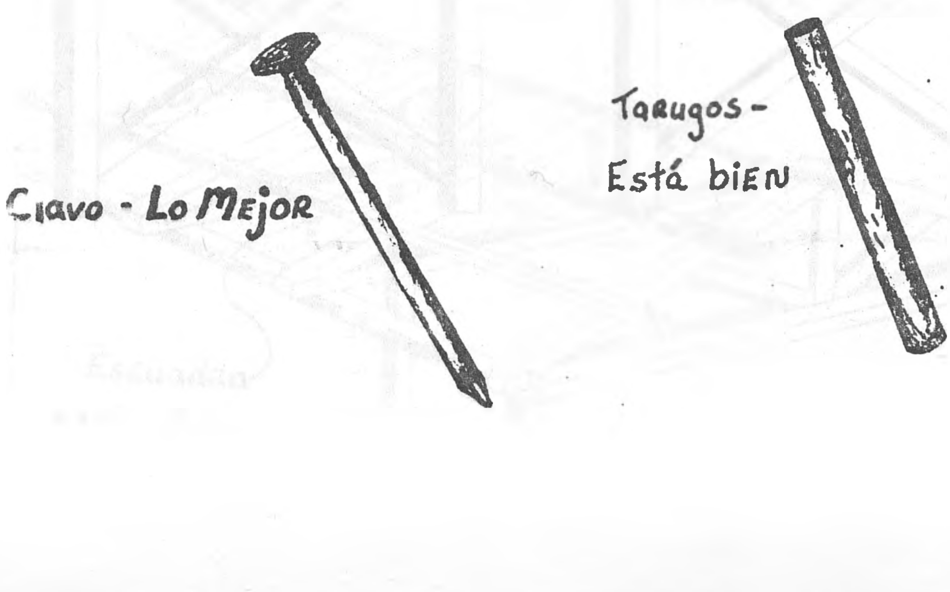
¿QUE LARGO DEBEN TENER LOS EMPALMES?

Depende en el grueso y ancho de la madera y en el tipo de empalme. Para piezas gruesos (de solera, tendal, o péndula) el empalme de cadena o el de doble tacón debe ser de 8 a 10 pulgadas, mientras que los empalmes más sencillos deben ser de 5 a 8 pulgadas.



¿COMO DEBE CLAVAR LOS EMPALMES, CON TARUGO O CON CLAVO?

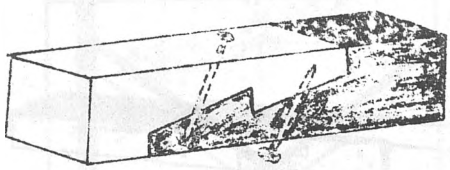
El clavo es mejor.



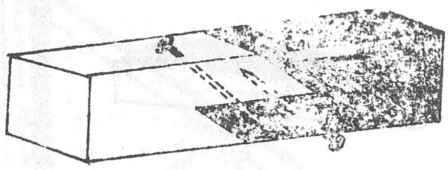
¿CUAL ES LA MEJOR MANERA DE CLAVAR CADA TIPO DE EMPALME?

Los clavos NO deben pasar de un lado al otro de la madera - esto debilita la madera. Y es mejor ponerlos inclinados.

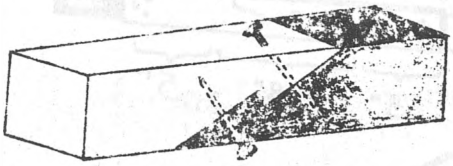
A. Cadena



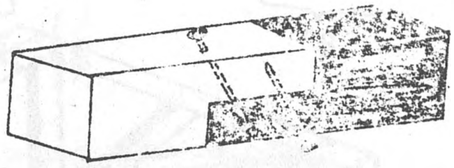
C. 45



B. Doble Tacón



D. Escuadra

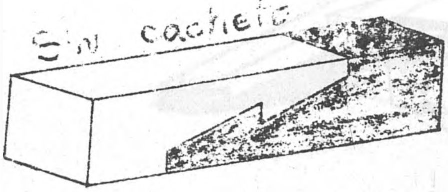


¿TIENE QUE PONER CACHETES EN TODOS LOS EMPALMES?

Es MUY importante reforzar el empalme con cachetes en los dos lados del empalme. La única excepción son las reglas para el techo.

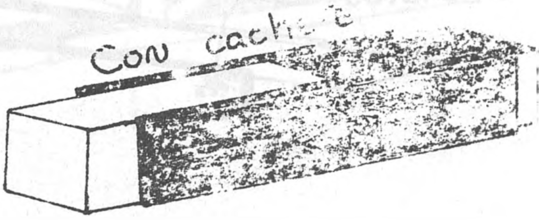
NO

Sin cachete



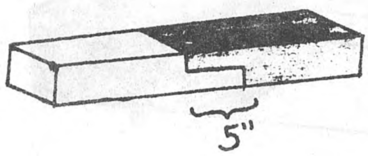
SI

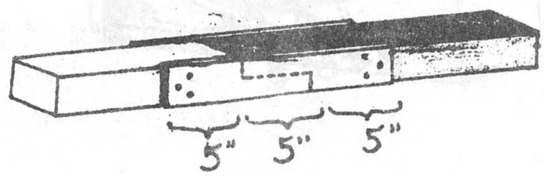
Con cachete

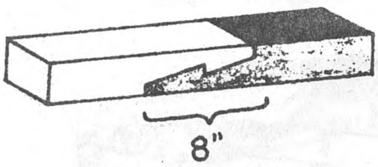


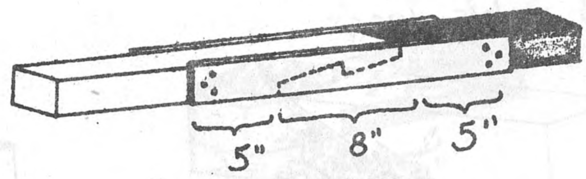
¿QUE LARGO DEBEN TENER LOS CACHETES?

Los cachetes deben tener 5 pulgadas de cada lado del empalme. Si el empalme es de 5 pulgadas, los cachetes deben ser de 15 pulgadas. Si el empalme es de 8 pulgadas, los cachetes tienen q ue tener 18 pulgadas.



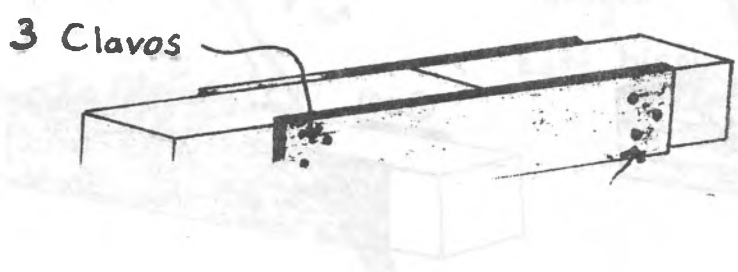






¿CUANTOS CLAVOS DEBEN PONER EN LOS CACHETES?

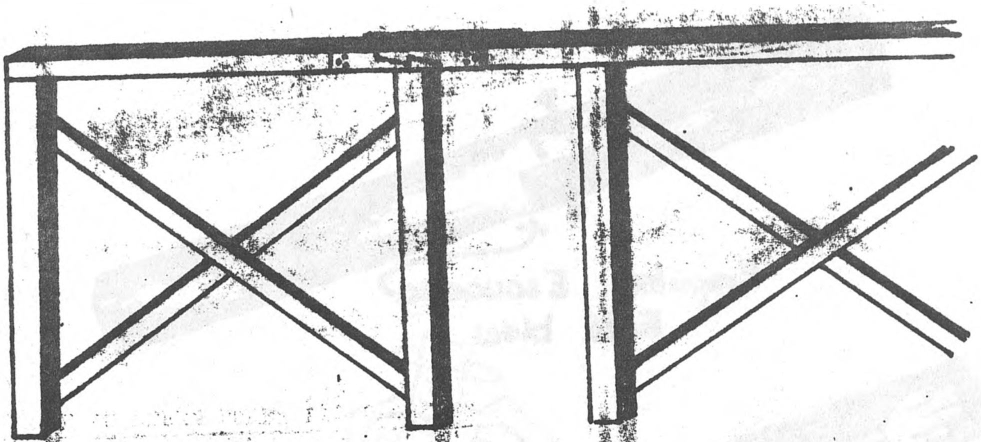
Deben poner tres clavos en cada lado, <u>en forma de triangulo</u> para no rajar la madera.

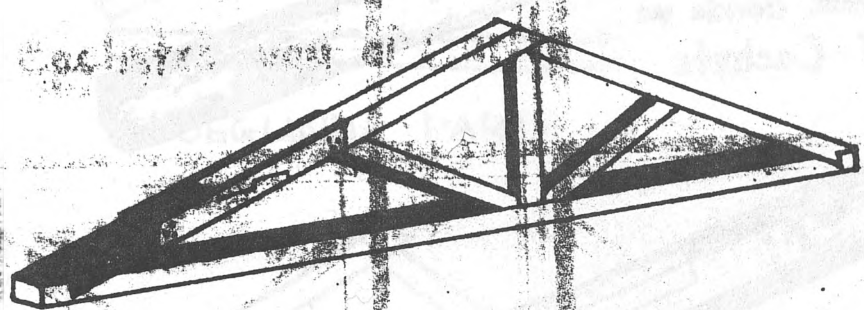


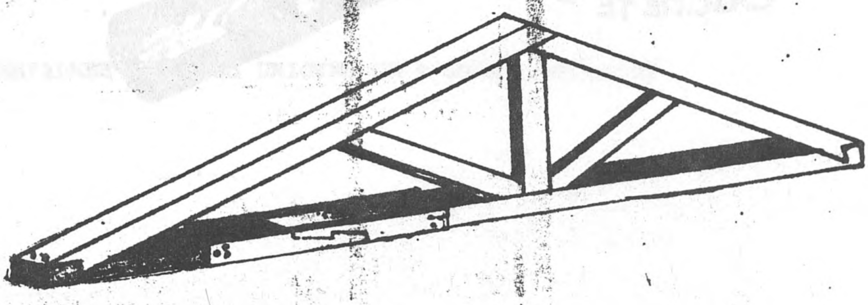
¿DONDE SE DEBEN PONER LAS CACHETES?

Las cachetes van en el canto de la pieza.

Los Cachetes van al Canto



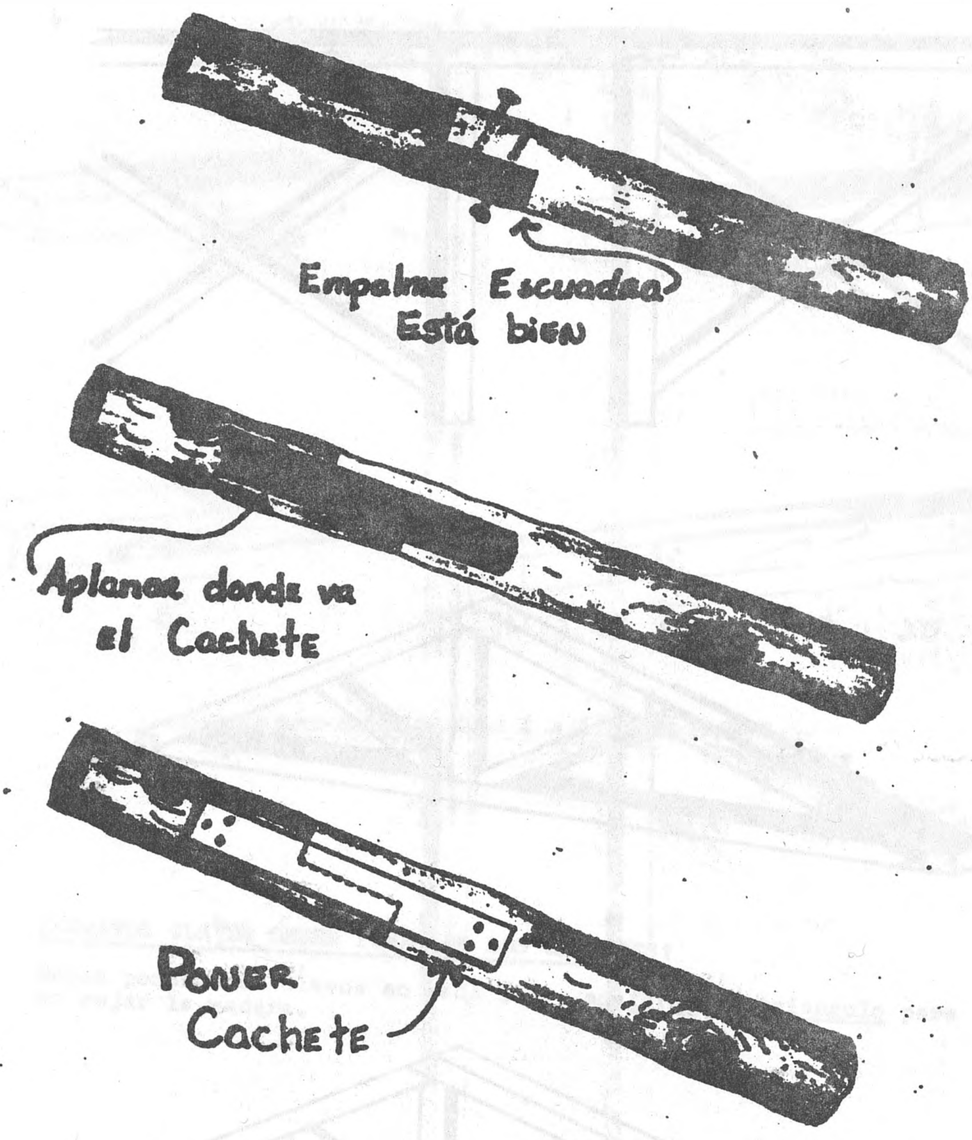


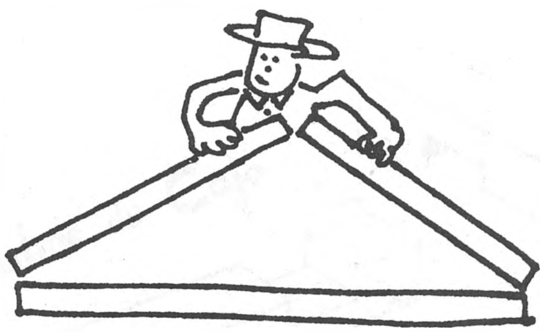


¿COMO SE PUEDE HACER EMPALMES CON PALO ROLLIZO?

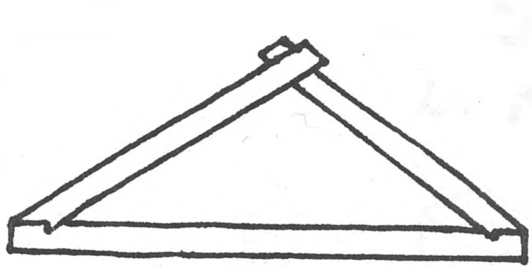
Como los carpinteros tienden hacer empalmes sencillos con palo rollizo, es muy importante que hacen un buen cachete.

Tiene que planear los lados del palo rollizo para cachetear la pieza.





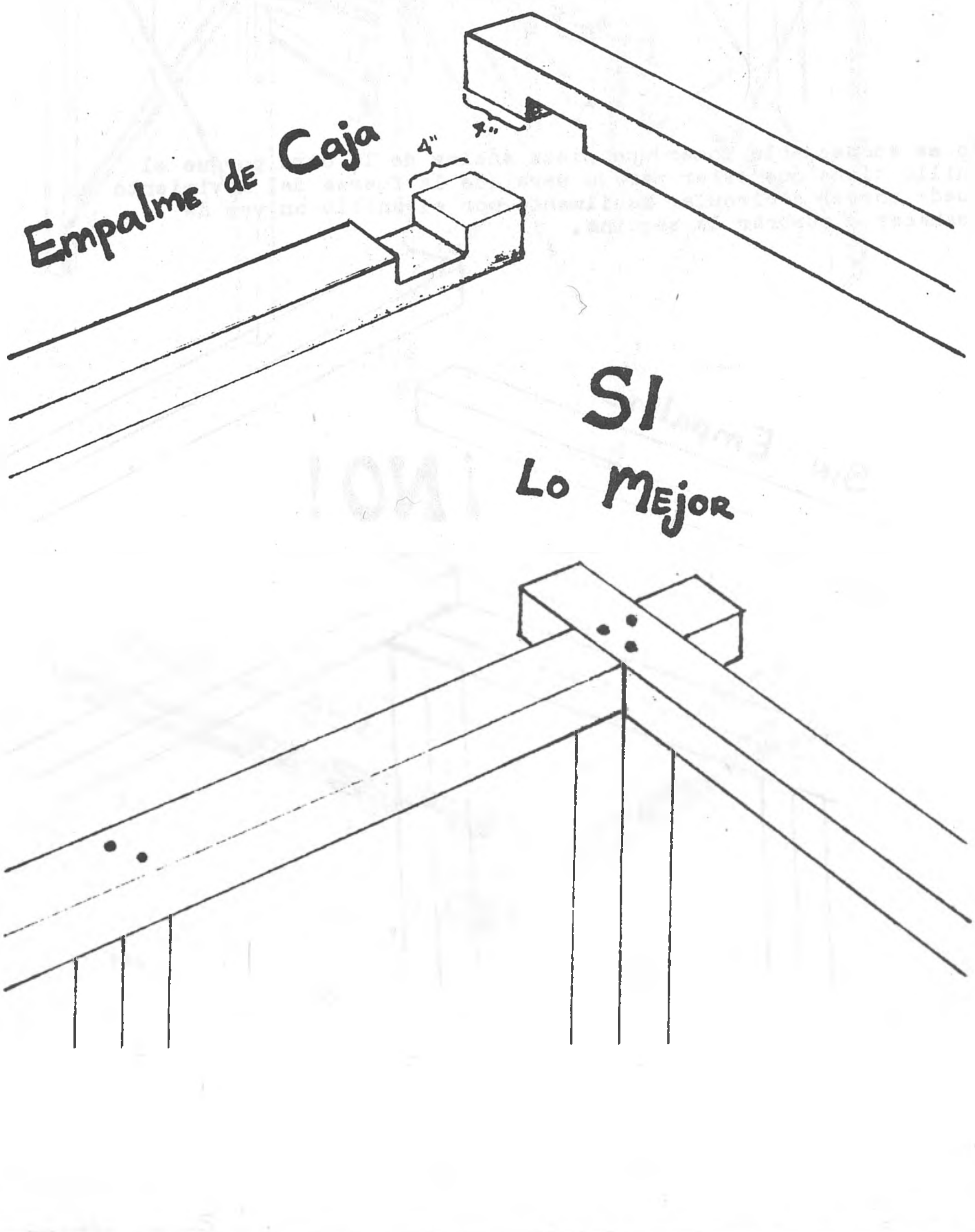
SEGUNDA PARTE

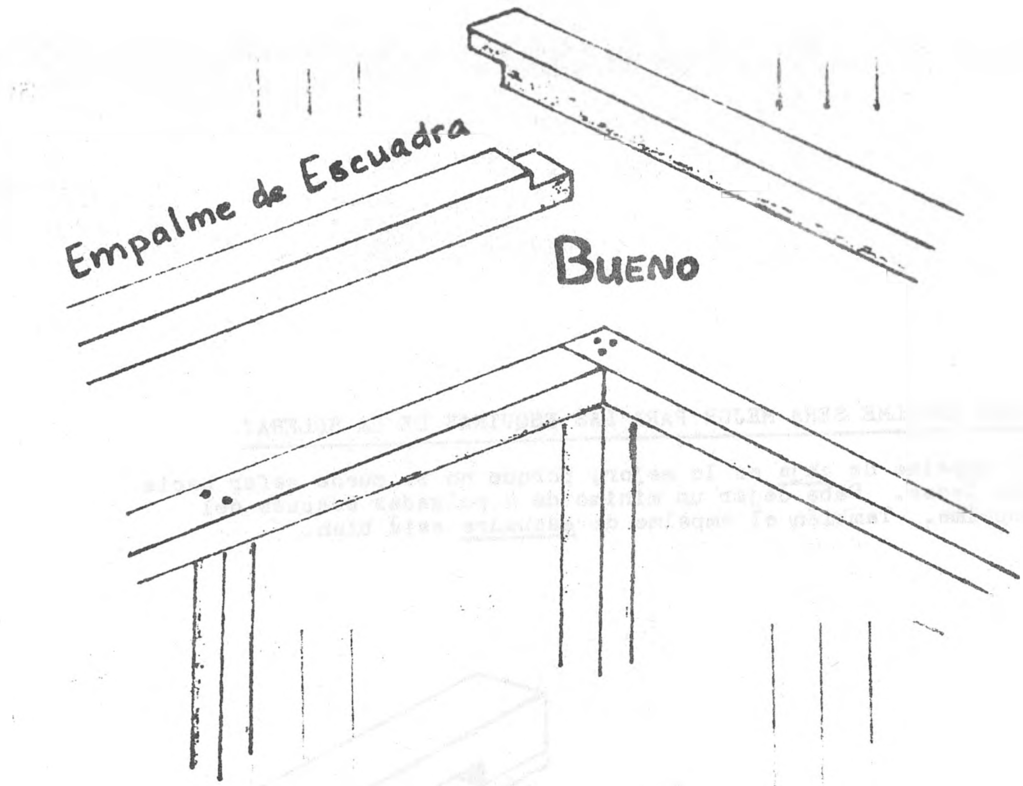


EMPALMES PARA LAS UNIONES DE PIEZAS DIFERENTES

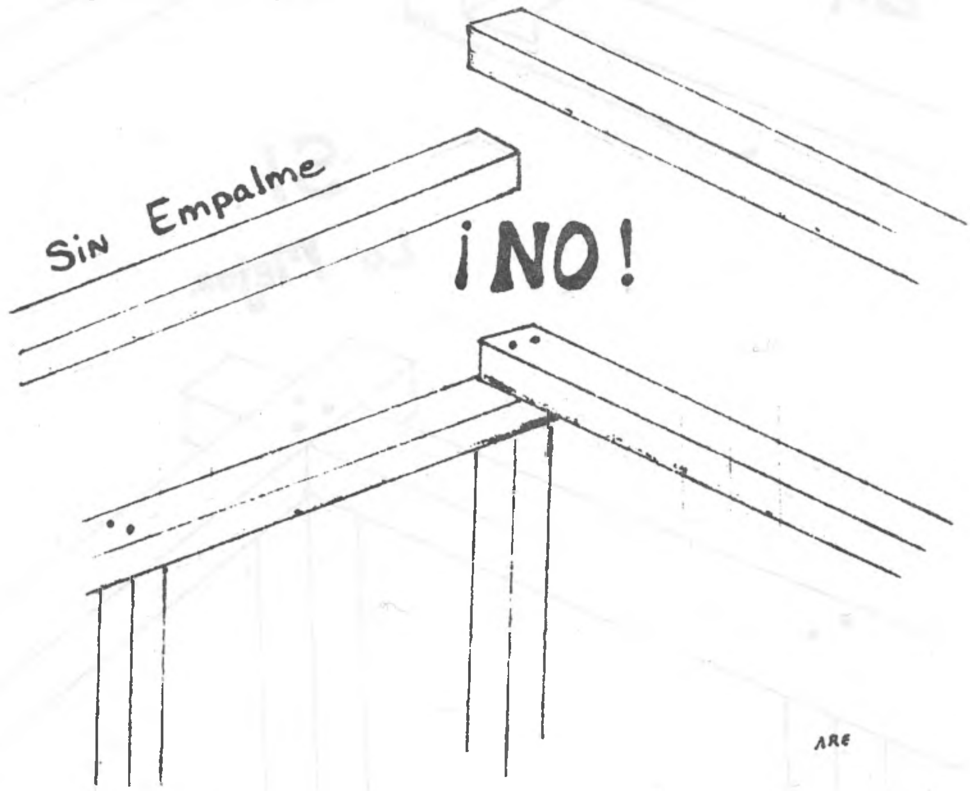
¿QUE EMPALME SERA MEJOR PARA LAS ESQUINAS DE LA SOLERA?

El empalme de caja es lo mejor, porque no se puede zafar hacia los lados. Debe dejar un minimo de 4 pulgadas después del empalme. También el empalme de escuadra está bien.



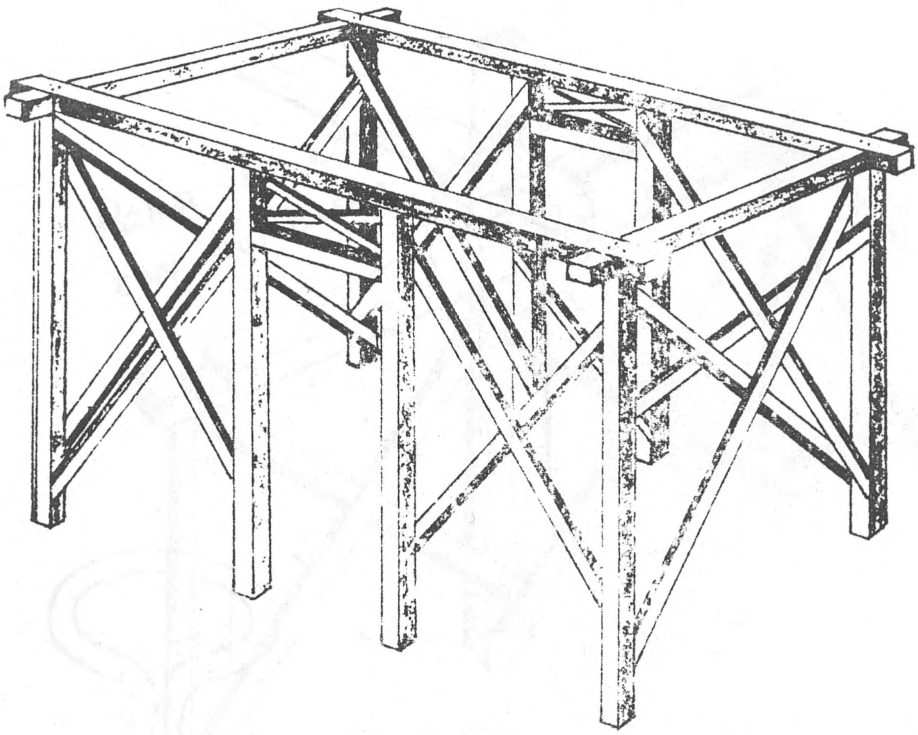


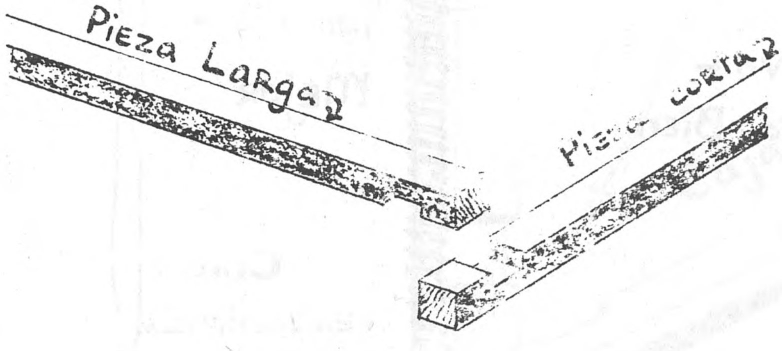
No es aconsejable poner una pieza encima de la otra porque el anillo tiene que estar parejo para que la fuerza del movimiento pueda correr o circular facilmente por el anillo en vez de deshacer o quebrar la esquina.



¿EN LA UNION DE LA ESQUINA, QUE PIEZA VA DEBAJO, LA PIEZA LARGA O LA PIEZA CORTA?

Como en todos los empalmes, es mejor que la pieza corta vaya debajo.

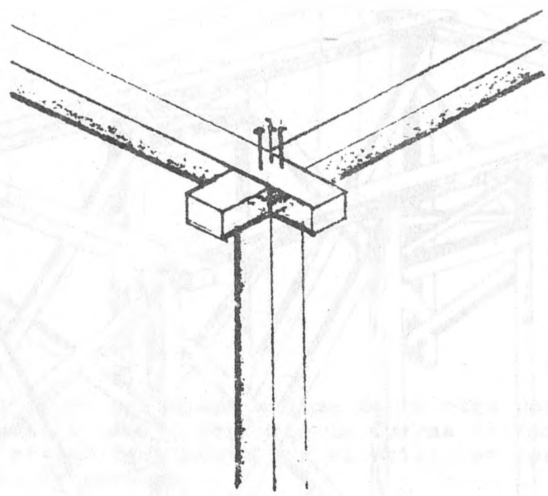


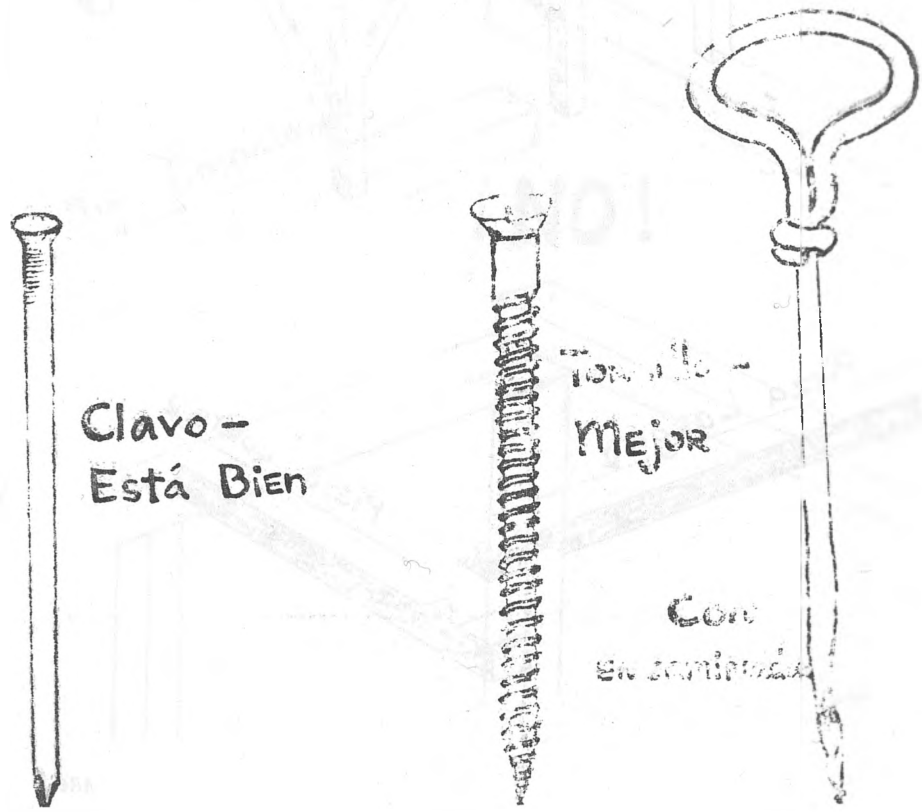


ARE

¿COMO ES MUY IMPORTANTE QUE LAS ESQUINAS DE UNA ARMASON SEAN LO MAS FUERTE POSIBLE, NO SERA ACONSEJABLE USAR TORNILLOS EN VEZ DE CLAVOS EN LAS ESQUINAS DE LA SOLERA O ANILLO?

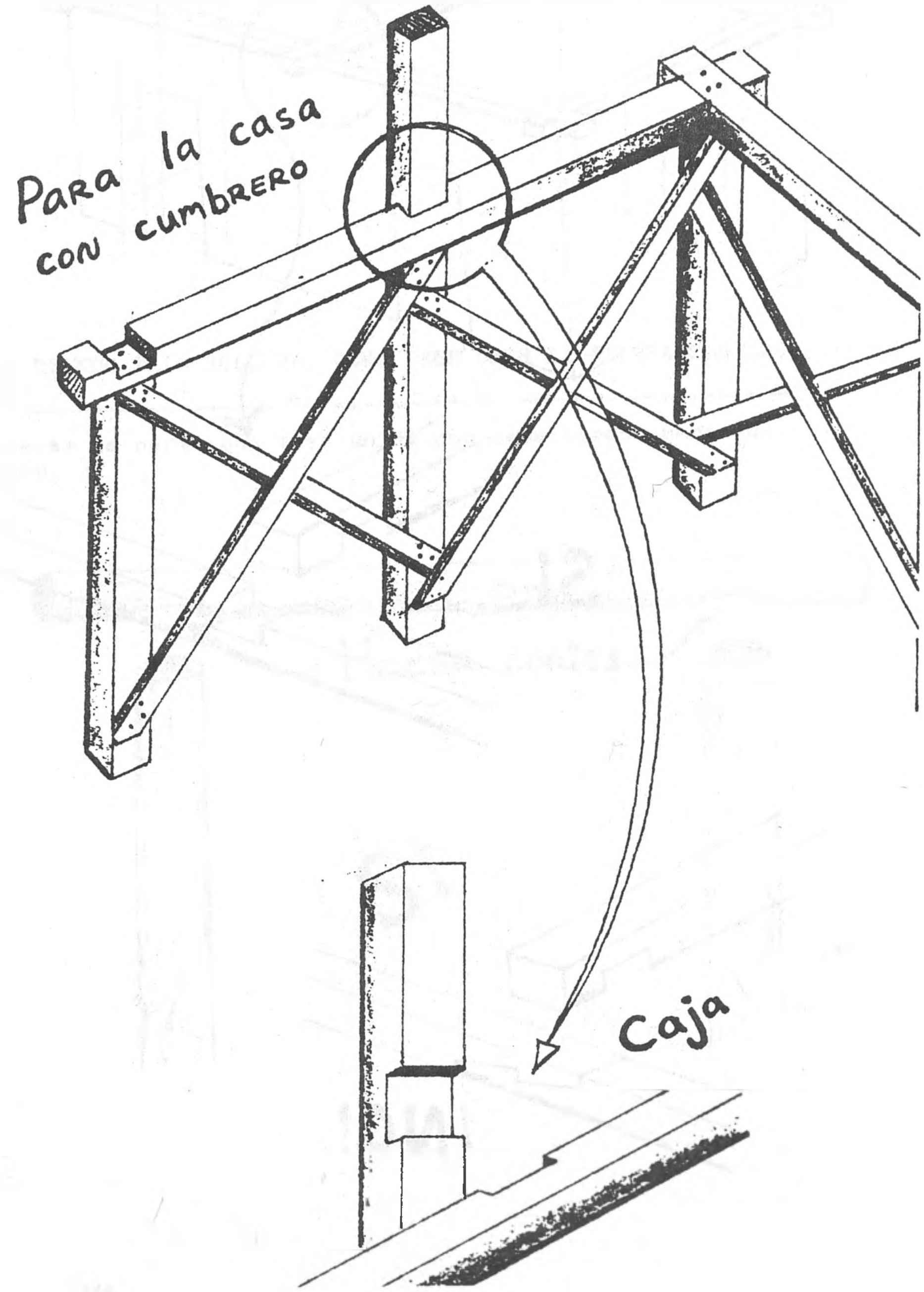
Si, si es posible. Un tornillo de 6 pulgadas es mucho mejor, pero tiene que tener cuidado de usar un encaminador para evitar que se raje la madera.





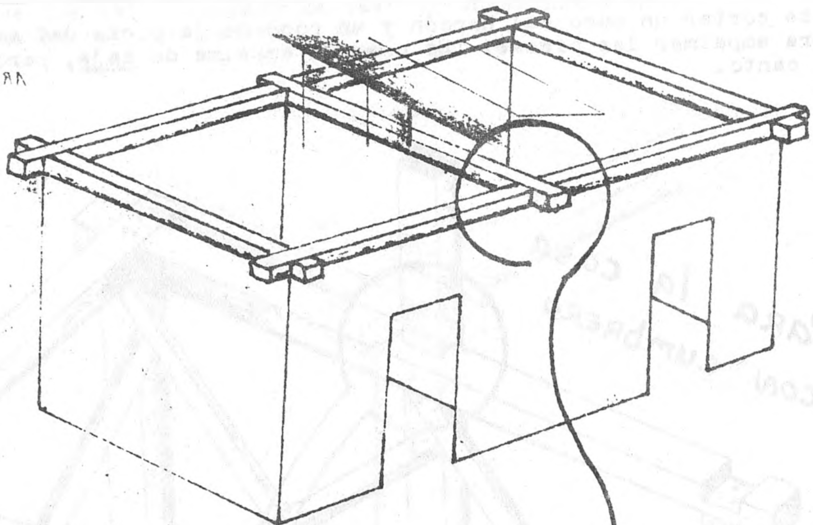
¿SI EL CAJON DE LA CASA LLEVA CUMBRERO EN VEZ DE TIJERAS, COMO DEBE HACER EL ANILLO EN EL ANCHO DE LA CASA? DEBE CORTAR EL ANILLO PARA EMPALMARLO AL HORCON, O DEBE CORTAR EL ANILLO EN DOS PIEZAS Y CLAVARLO AL HORCON?

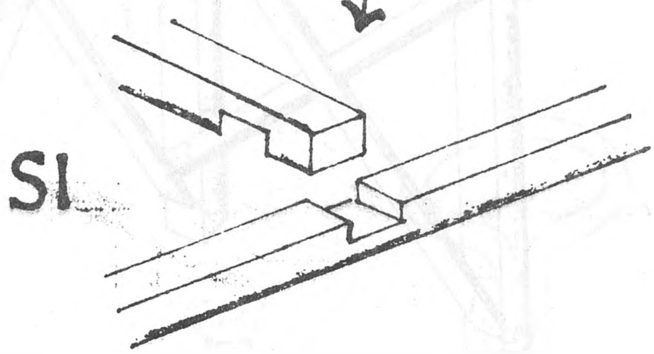
Debe cortar un poco del horcón y un poco de la pieza del anillo para empalmar las piezas. Es como un empalme de caja, pero de canto.

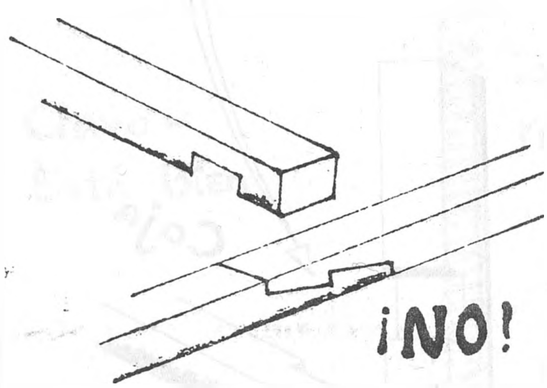


¿SI UNO VA A HACER UNA PARED INTERIOR, CUAL ES LA MANERA DE UNIR LA SOLERA DE LA PARED INTERIOR A LA SOLERA DE LAS PAREDES EXTERIORES?

Lo mejor es unirla con el empalme de caja, tomando el cuidado de no empalmar la solera exterior en la punta donde se une con la solera interior.



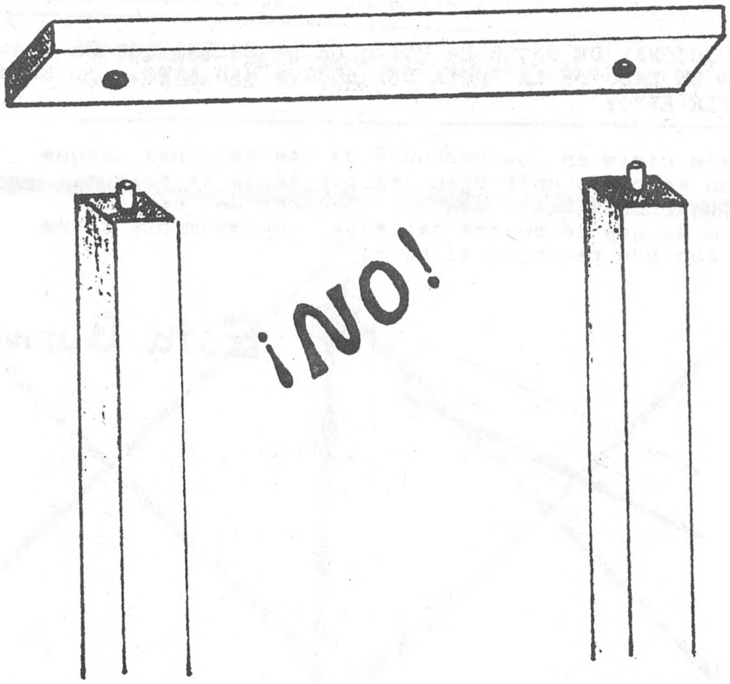




ARE

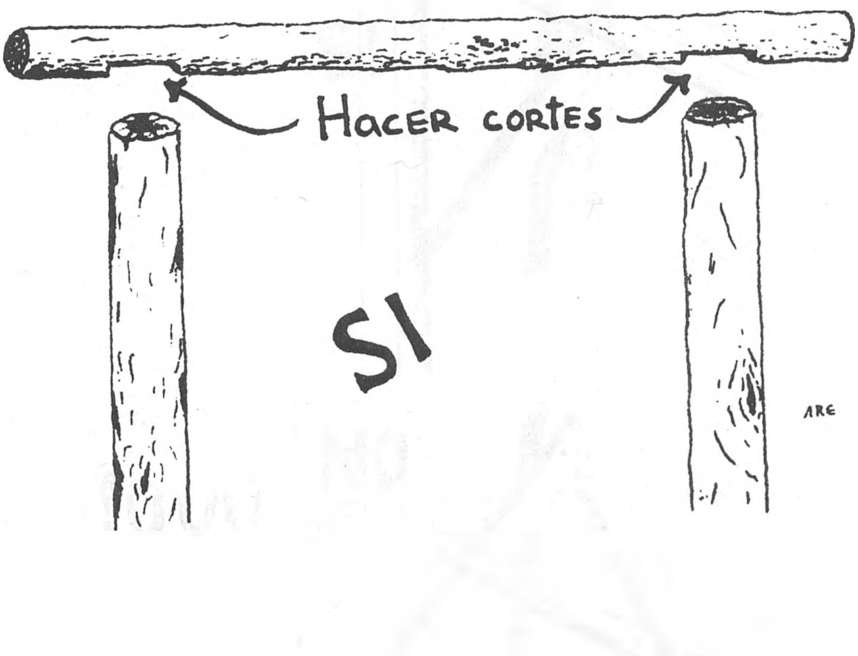
¿SE LE PUEDE EMPALMAR EL HORCON A LA SOLERA, [illegible] HORCON LLEVE ESPIGA?

No, no se puede porque se debilita la solera y la espiga se puede quebrar con la fuerza de un movimiento.



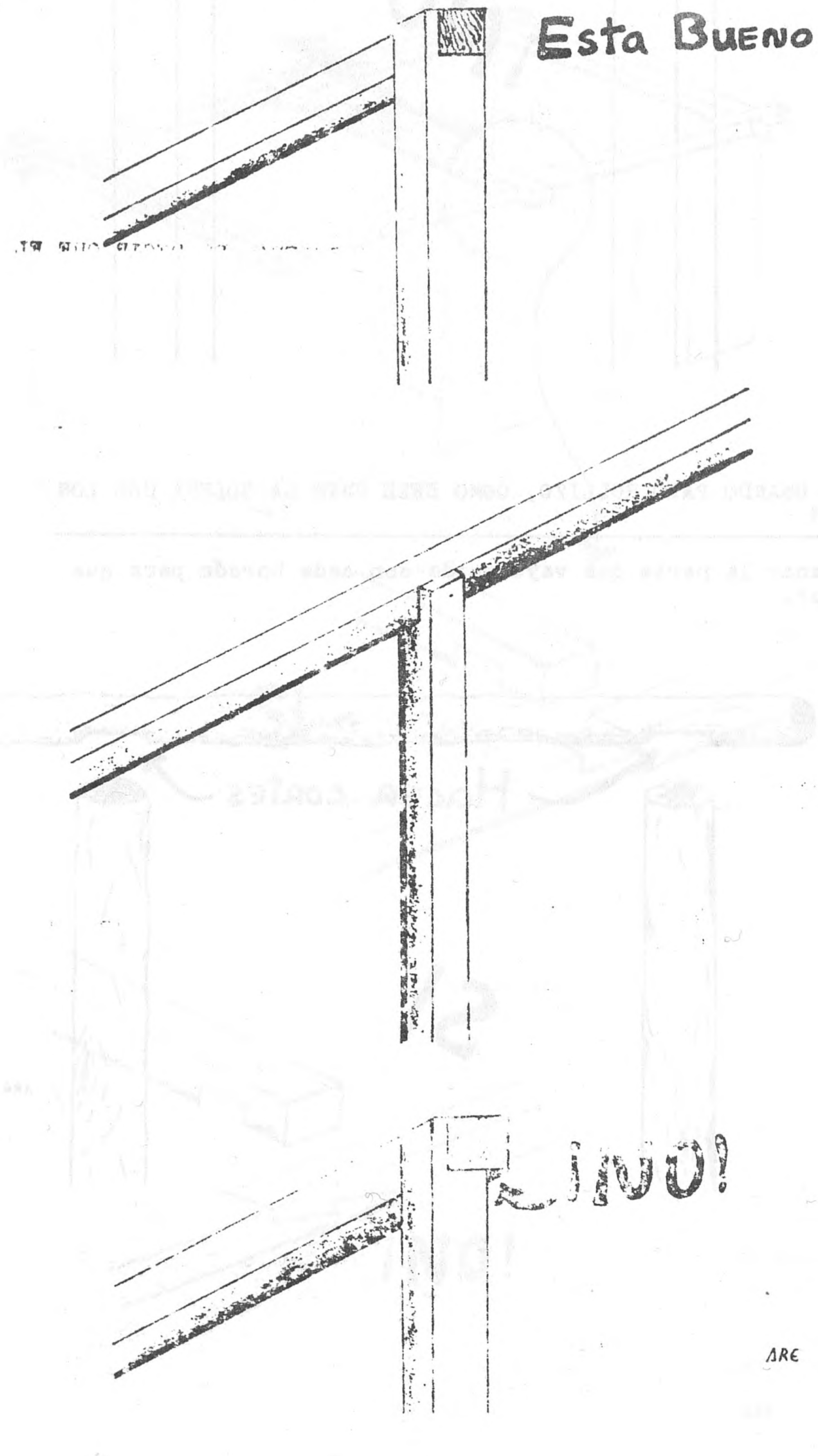
¿SI ESTA USANDO PALO ROLLIZO, COMO DEBE UNIR LA SOLERA CON LOS HORCONES?

Debe aplanar la parte que vaya unida con cada horcón para que case mejor.



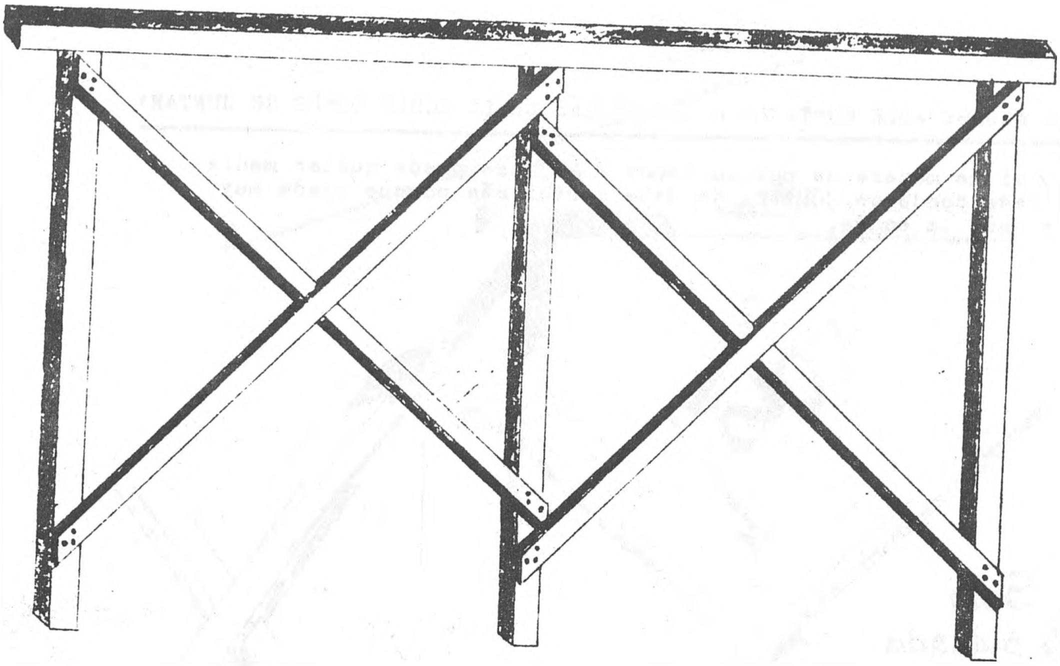
UNA MANERA TRADICIONAL DE HACER LA UNION DE LA SOLERA CON EL HORCON ES DEJAR UN LADO DE LA PUNTA DEL HORCON MAS ALTO. ¿SERA ACONSEJABLE ESTO?

No debe usar este corte en los horcones de las esquinas porque significa que no se puede unir bien las piezas de la solera. Pero está bien usar esta union con los horcones del centro, teniendo cuidado de que la solera descanse completemente sobre el horcón y no con una parte en el aire.



¿CUAL ES LA MEJOR MANERA DE UNIR LAS EQUIS A LOS HORCONES?

Para que tenga suficiente lugar para clavar bien los clavos es mejor ponerlas una encima de la otra.



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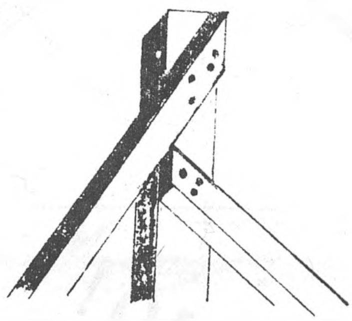

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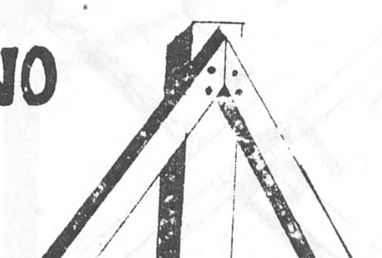
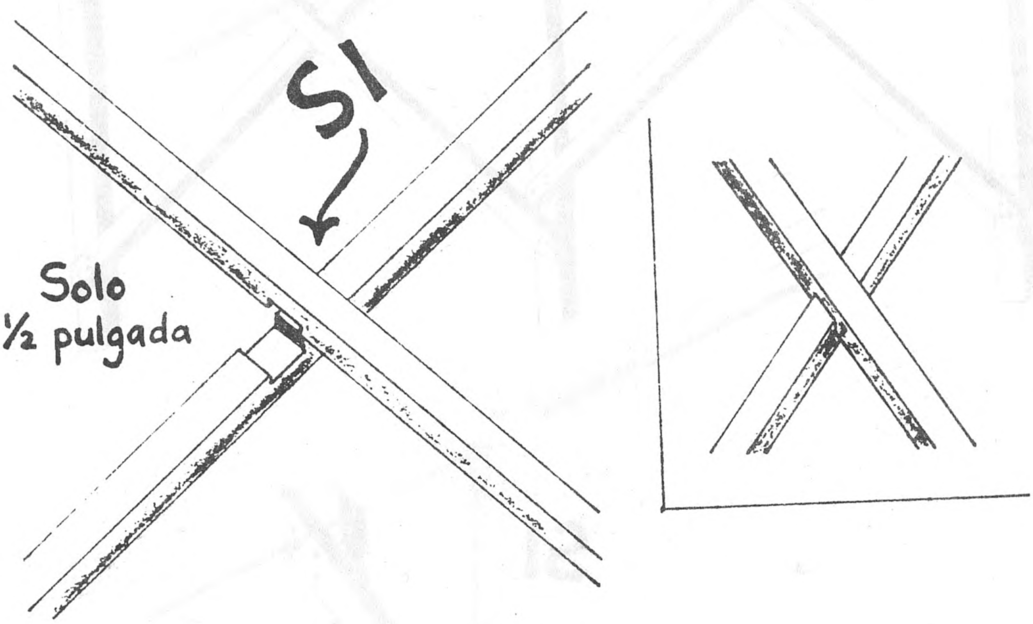
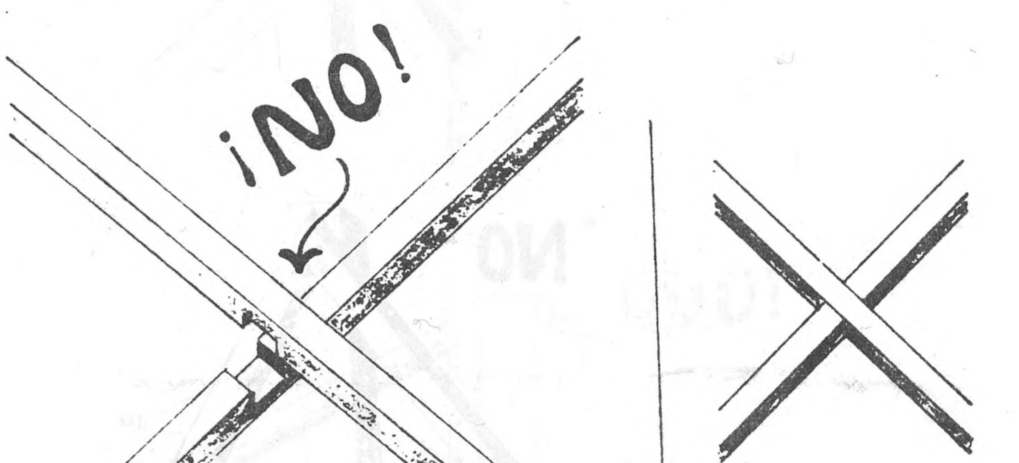


¿ES ACONSEJABLE CORTARLE A LAS PIEZAS DE LA EQUIS DONDE SE JUNTAN?

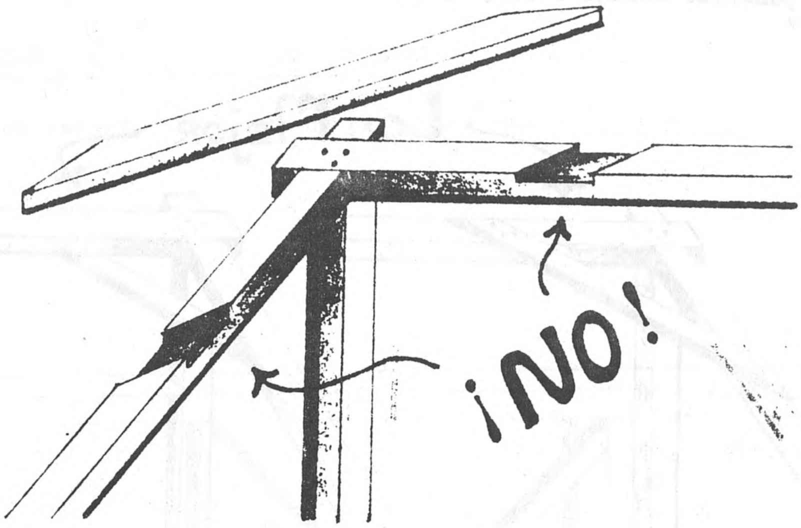
Si, si la madera es por lo menos 2 X 3, se puede quitar media pulgada donde se junten. No debe cortar más porque queda muy delgada la equis.

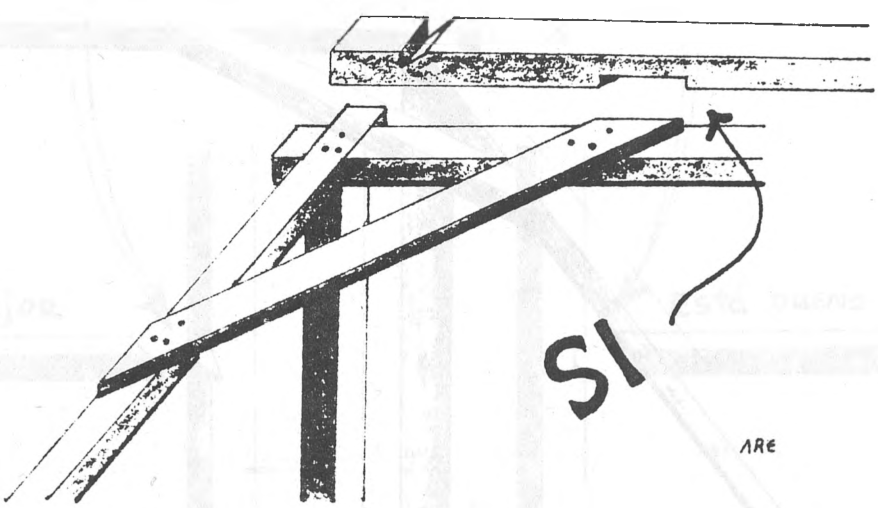




¿SE LE PUEDE CORTAR AL ANILLO PARA COLOCAR LA ESQUINERA ENCIMA?

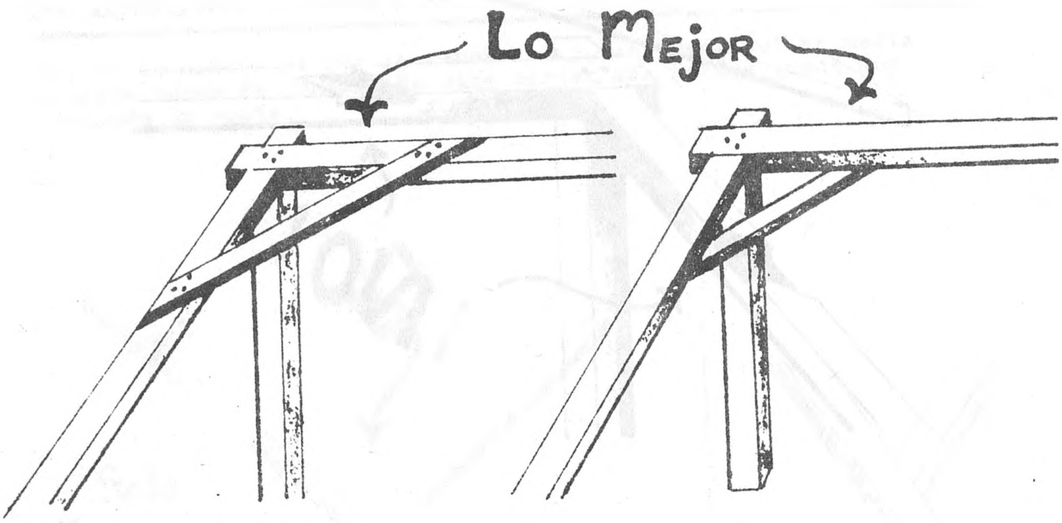
No. Es mejor no cortar el anillo. En este caso habría que cortar el tendal para que quede bien la esquinera.

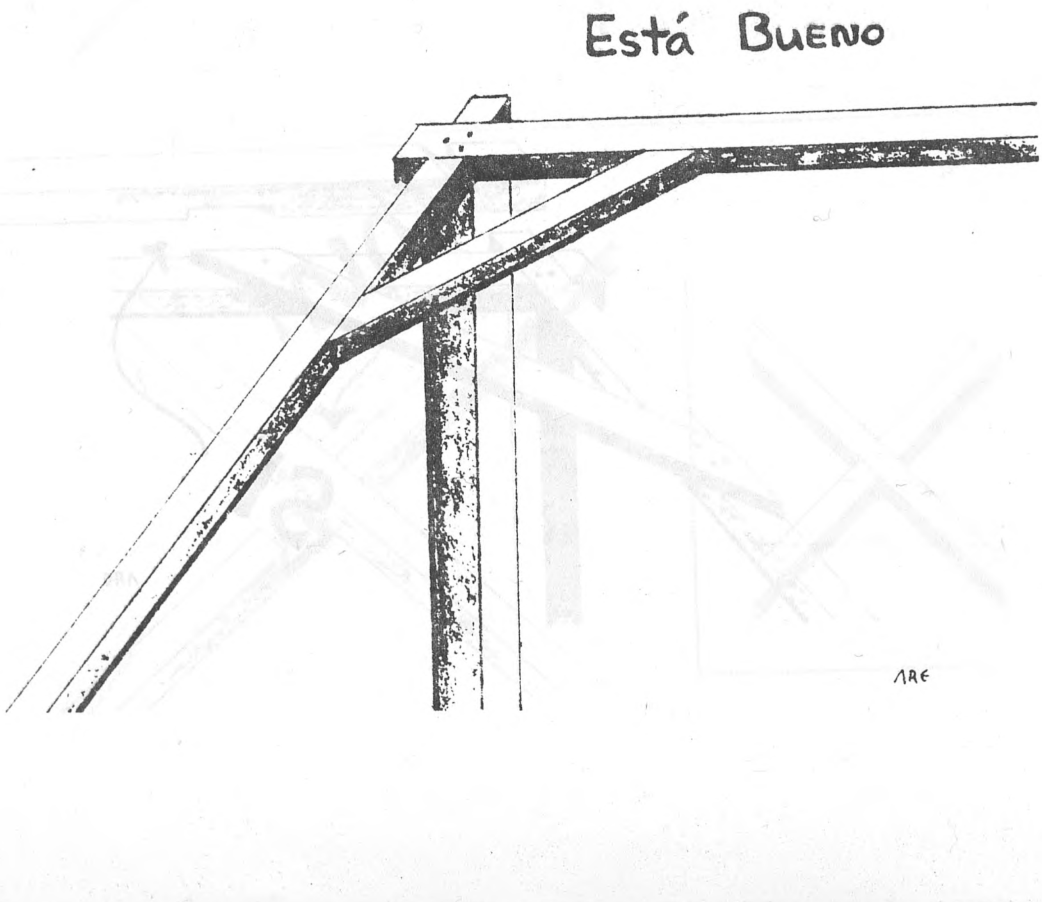




¿QUE ES MEJOR - PONER LAS ESQUINERAS ADENTRO DE LA SOLERA O PONERLAS ENCIMA O ABAJO?

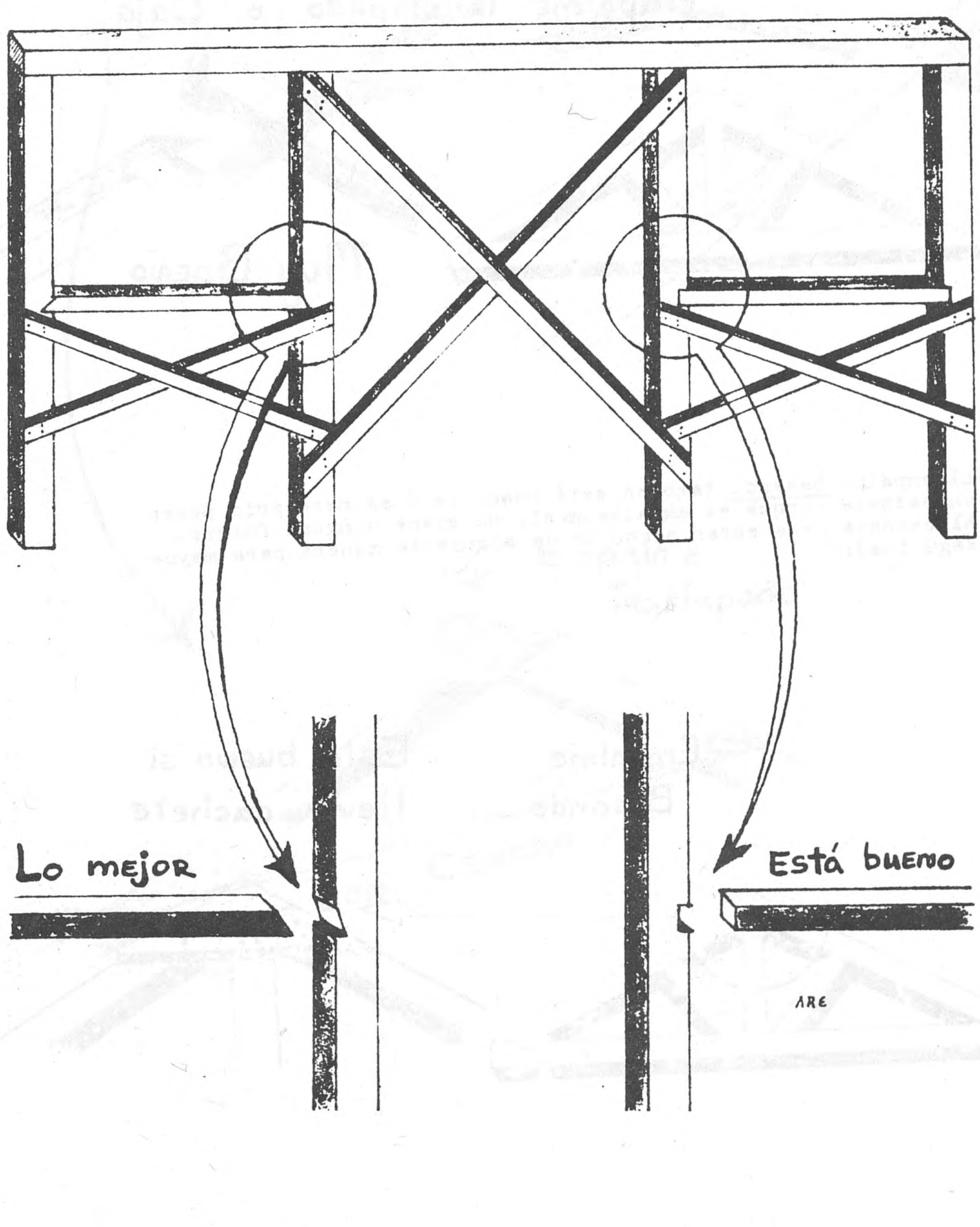
Es mejor ponerlas encima o abajo para ayudar a que la esquina no se abra.





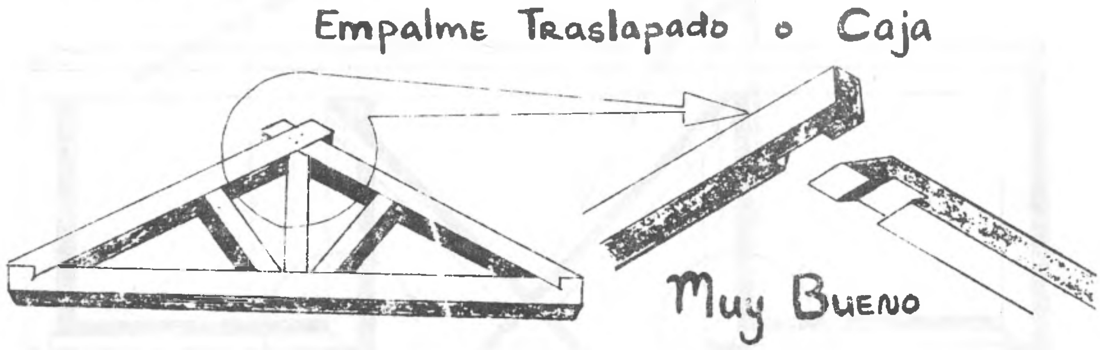
¿DEBE EMPALMAR EL LUMBRAL DE LA VENTANA?

Si, es mejor hacerlo, haciendo un pequeño corte en el horcon.

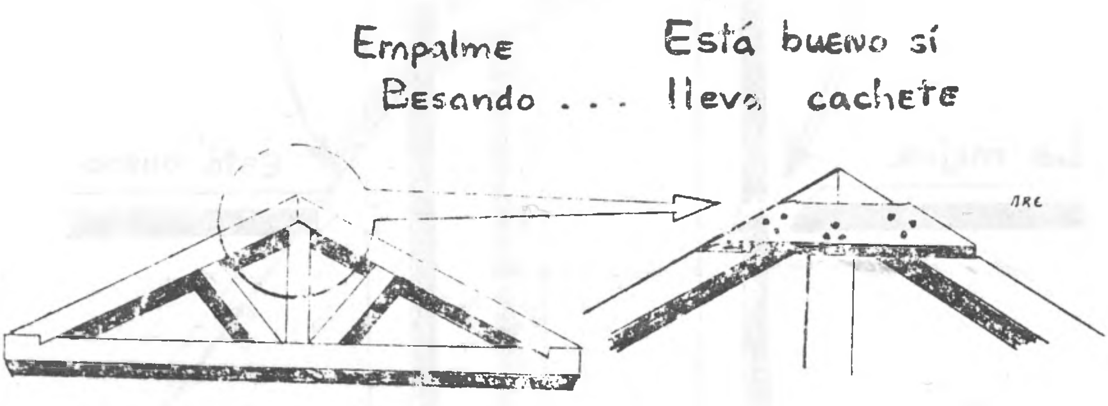


¿QUE EMPALME SERA MEJOR PARA LA UNION DE LAS DOS PENDULAS?

El traslapado es muy bueno, porque la unión no va a depender solo en los clavos del empalme, tambien tiene fuerza del empalme. Realmente es mejor hacerlo como el empalme de caja, dejando un poco de madera en las puntas para que no se puedan zafar las piezas.
El traslape no lleva cachete, se debilita demasiado la unión poniendo tantos clavos.

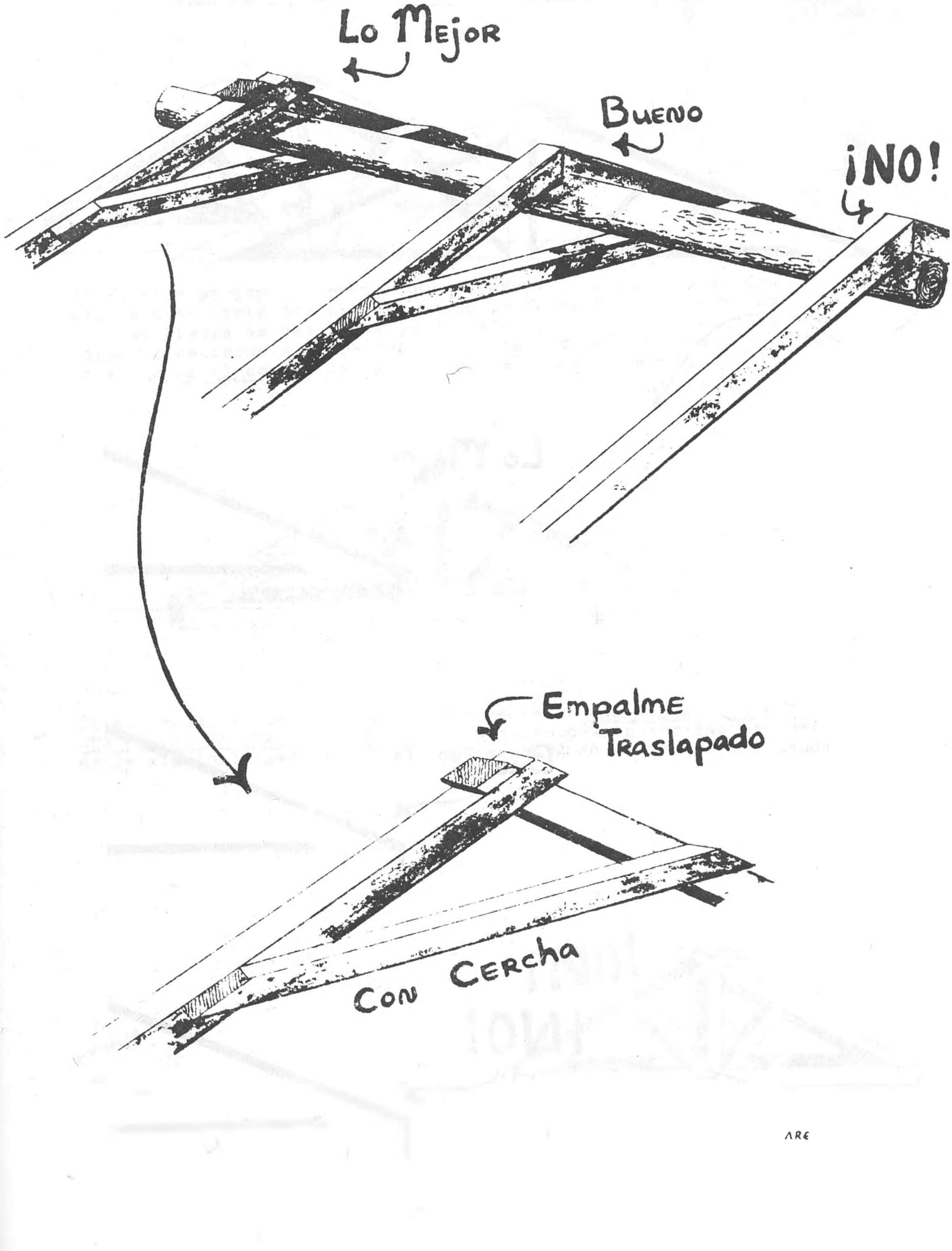


El empalme besando tambien está bueno pero es necesario poner un cachete porque el empalme en si, no tiene ninguna fuerza. El cachete debe estar hecho de la siguiente manera para mayor seguridad:



¿ES NECESARIO EMPALMAR LAS PENDULAS CUANDO UNO ESTA USANDO CUMBRERO?

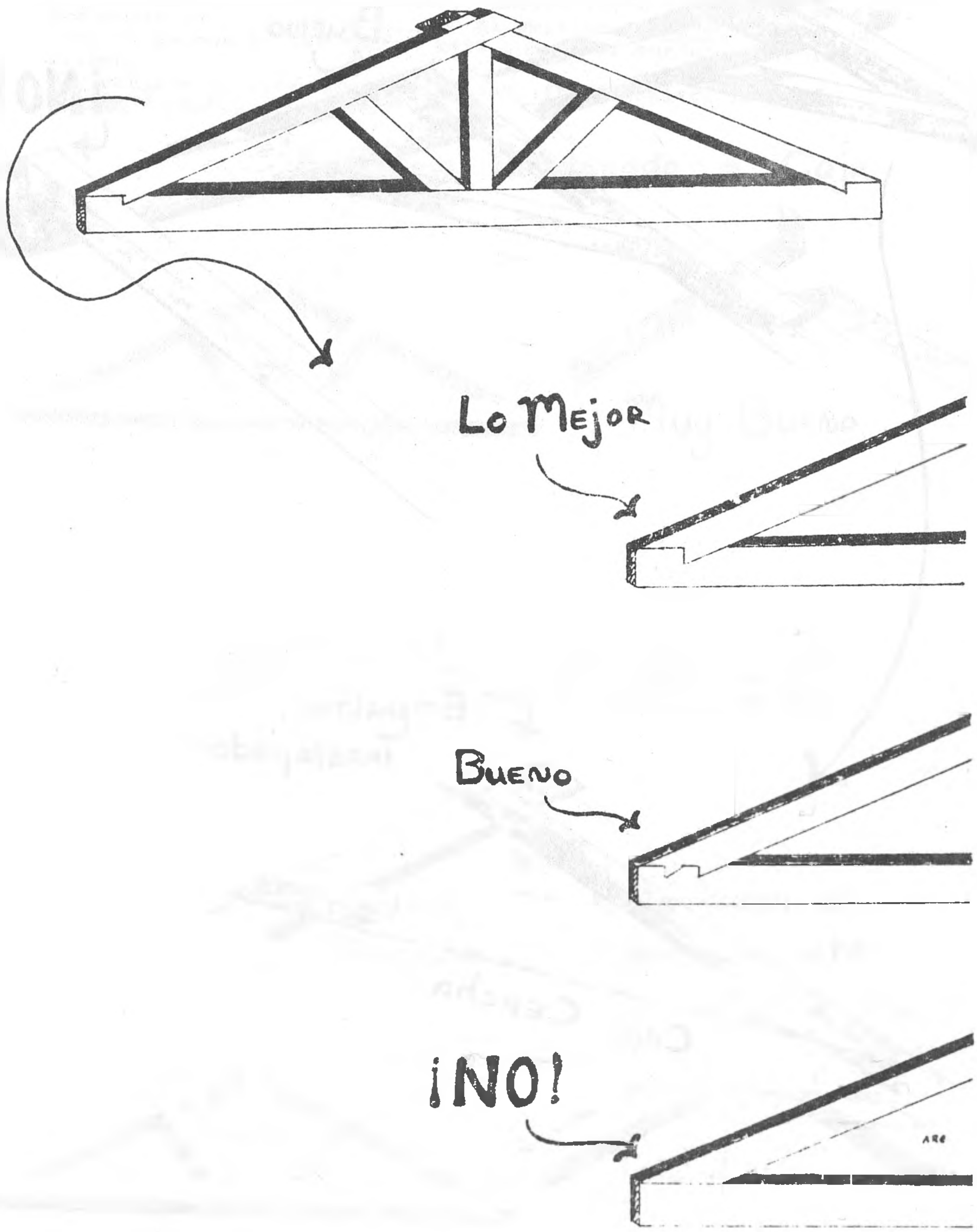
Si, es mucho más seguro hacer un empalme traslapado (abrazando). El empalme besando no es aconsejable cuando uno está usando cumbrero, porque no se puede cachetear.



ARE

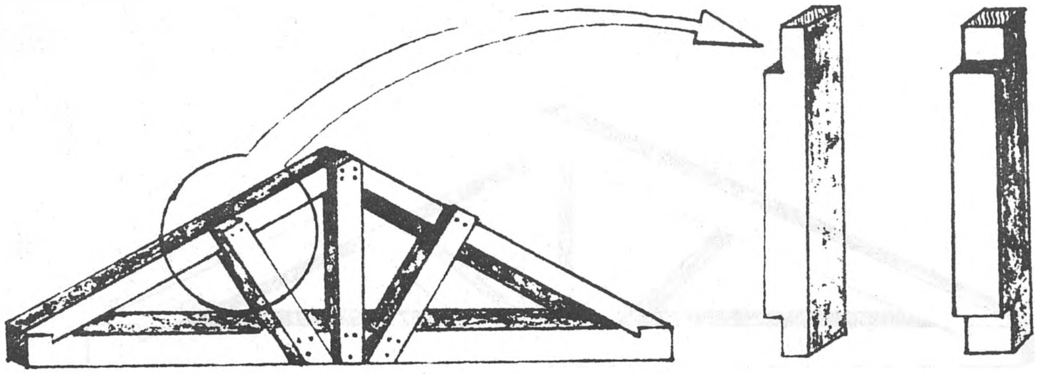
¿ES NECESARIO EMPALMAR LA UNION DE LAS PENDULAS AL TENDAL CUANDO UNO ESTA HACIENDO TIJERAS?

Como toda la fuerza de las péndulas va hacia las puntas de la tijera, es muy importante poner un empalme que sea bueno para la compresión. Por eso es muy aconsejable poner el empalme de tacón en las puntas de las tijeras. Si no lo pone , a la hora de un movimiento, se zafará el clavo. El tacón no deja que se zafe la péndula.

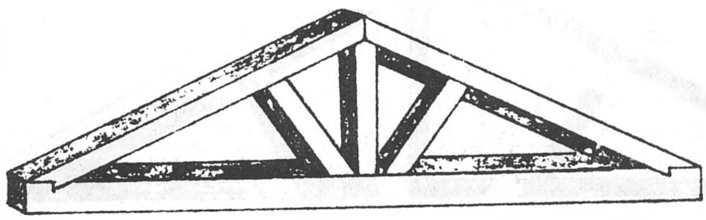


¿CUANDO SE PONEN LAS BREISAS EN LAS TIJERAS DEBE EMPALMARLAS?

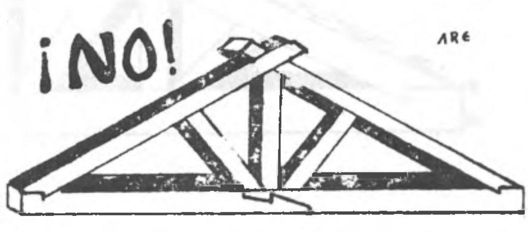
Si se clavan las breisas a los lados de la tijera, se puede cortar un poco (1/2 pulgada) de cada breisa para empalmarla con la péndula y el tendal. Esto solo si la madera tiene por lo menos 2 (dos) pulgadas.



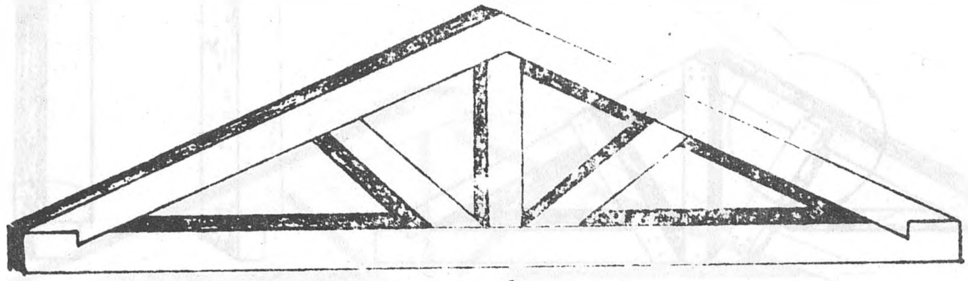
Si se pone el tipo de breisa que va adentro de la tijera, uno simplemente corta las breisas segun la forma de la tijera. Este tipo de breisa es recomendable si la unión de las péndulas es besando. Recuerde siempre que las breisas deben tener sus puntas de abajo en el centro de la tijera, para mayor fuerza.



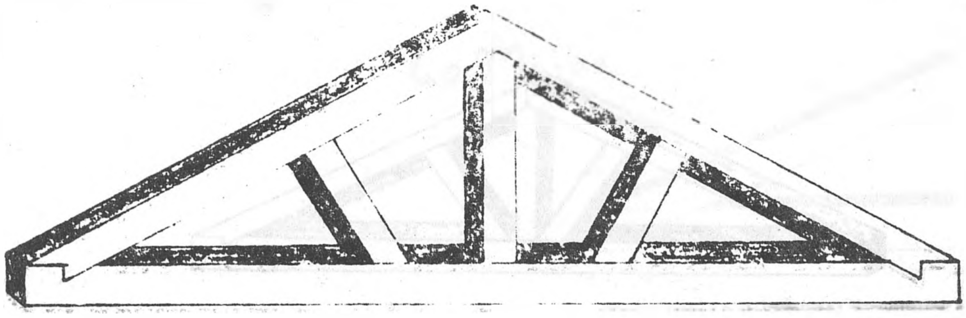
Si el tendal tiene un empalme debe recordar QUE NUNCA DEBE PONER UNA BREISA ENCIMA DE UN EMPALME. Entonces debe poner las breisas de la siguiente manera, si el empalme está en el centro del tendal:



Cuando el tendal no tiene empalme, es importante tomar el cuidado de poner las breisas juntas en el centro para que vayan formando triángulos en la tijera.



← Lo Mejor



Si la tijera es muy larga, puede agregar otras breisas - siempre manteniendo las formas de triángulo.