INTERNSHIP EXPERIENCE AT
WALTER P. MOORE & ASSOCIATES, CONSULTING ENGINEERS

A Report

by

FRANCISCO XAVIER ARGUELLO CARAZO

Submitted to the College of Engineering
of Texas A & M University
in partial fulfillment of the requirement for the degree of

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ABSTRACT

A report on an Internship Experience at
Walter P. Moore & Associates, Consulting Engineers. (August 1979)
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Chairman of Advisory Committee: Dr. Richard E. Thomas

An internship at Walter P. Moore & Associates, Consulting Engineers was completed over a period slightly in excess of one year. During this time, the intern worked in the structural division and was assigned numerous projects involving the various phases of the structural design of buildings. His involvement in fifty projects enabled him to perform structural analyses and designs ranging from complex multistory structures to simple structures. While contributing with his technical knowledge to the performance of such tasks, he was also in communication with project architects during the design of some of the buildings, and in various occasions had draftpersons working for him. In addition to the experience accumulated as a consulting structural engineer, the intern was involved in other professional development activities such as conducting a seminar for the office staff on earthquake damage.

TO OLGA

ACKNOWLEDGEMENTS

Many individuals assisted me in the completion of my Doctor of Engineering program, with their help I was able to surpass all problems; to all I am greatful.

Special thanks goes to Dr. Richard E. Thomas, who was my committee chairman and who advised and guided me, both in academic and personal matters.

To Dr. Donald McDonald, who as member of my committee and also as my professor, greatly counseled and guided me through the program.

To all the other members of my committee, who provided guidance and timely advise, especially to Mr. Ken Zimmerman.

To Dr. Chi Wu, whose technical expertise and advise, greatly enhanced the quality of my internship.

To Lee Synan, whose constant assistance and cooperation made this report a reality.

To my parents, to my brother Felipe, and to Mr. Julio Arellano, who encouraged and financially supported me throughout my graduate studies; I thank them for their faith.

To my wife and children, who cheerfully supported me throughout my graduate studies, lifting my spirits in troubled days.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

I. Introduction.

When admitted to the Doctor of Engineering program of Texas A & M University, I held the degrees of Civil Engineer and of Master of Science. I also had some work experience related to the design and supervision of structures. This, coupled with the fact that I was currently working for a Houston-based consulting engineering firm, Walter P. Moore & Associates, was decisive in arranging my internship at that firm.

The objectives of the Doctor of Engineering Internship have been well established by the College of Engineering; these are:

> To enable the student to demonstrate his ability to apply his knowledge and technical training by making an identifiable contribution in an area of practical concern to the organization or industry in which the internship is served, and
>
> To enable the student to function in a non-academic environment in a position where he will become aware of the organizational approach to problems in addition to traditional engineering design or analysis. These may include, but are not limited to, problems of management, labor relations, public relations, environmental protection or economics.

In order to establish my contribution to the area of practical concern in which I was involved and also my exposure to the organizational approach to problems in the non-academic environment, it is necessary to outline in detail the basic services offered by a consulting structural engineer as presented by the American Society of Civil Engineers.* The services marked by an asterisk in the enclosed outline, represent those in which I have had some degree of exposure; the ASCE outline of services is as follows:

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* ASCE - Manuals and Reports on Engineering Practice - No. 45, "Consulting Engineering, a Guide for the Engagement of Engineering Services."

Services in the Preliminary Phase

* 1. Conferences with architects, other engineers engaged on the project, owner's representatives, building officials, and regulatory agencies, to establish the scope of the project and requirements of alternate structural systems;

* 2. Participation in the formulation of a soils and foundation investigation, and counseling on data needed;

* 3. Preparation of economic studies of alternate structural systems, including foundations;

* 4. Preparation of preliminary structural designs required to define space needs of the structural elements, as well as to accommodate the space needs of the architectural, mechanical, and electrical facilities;

* 5. Preparing design criteria and outlining specifications for structural aspects of the project; and

* 6. Counseling on building form, materials, and methods of construction as related to the structure, costs suitability to the site foundation conditions, building code requirements, etc.

Services in the Design Phase

* 1. Conferences with the architect and with others to plan and coordinate the structure into the building project;

* 2. Consultation on the need for foundation investigations to supplement those that may have been made in the preliminary phase;

* 3. Preparation of structural calculations in reproducible form for normal design loads;

* 4. Preparation of structural contract drawings (in pencil on tracing paper unless otherwise agreed) in sufficient detail to define the construc-

tion work explicitly, and to keep the professional responsibility for the structural design, including details, with the Consulting Structural Engineer;

* 5. Preparation of structural specifications in a form as agreed, for incorporation in the project specifications;

* 6. Provision of a reasonable number of prints of the work in progress for coordination of the project design; and

7. Participation in establishing the materials testing, fabrication inspection, and construction inspection programs for the project.

Services in the Construction Phase

1. Preparation of structural addenda as may be required during the bid period, and other assistance in the procurement of bids;

2. Provision of consultation and advice on structural aspects of the project construction;

3. Preparation of supplementary structural sketches and details needed to resolve field problems that may be encountered;

* 4. Review of detailed construction drawings and shop and erection drawings submitted by the contractor;

5. Review of laboratory, shop, and mill test reports of materials, fabrication, and equipment, and reports of these reviews in writing to the Prime Professional; and

6. Observations of construction in progress and provision of appropriate reports to the Prime Professional.

In this report through a detailed coverage of my experience at Walter P. Moore & Associates, where my involvement in the above mentioned services was demonstrated, I establish the fulfillment of the internship's objectives.

II. An Internship at Walter P. Moore & Associates

A. Organization of the Firm and Intern's Position

Walter P. Moore & Associates is a consulting engineering firm, presently engaged in both structural and civil engineering projects. Since its creation in 1931, it has grown to occupy a prestigeous position in the nation, being involved in both national and international projects. The firm was listed by Engineering News Record among the top 500 consulting engineering firms in the United States for the year 1977.

With respect to its organization, it is divided into two major divisions: the Project Division, of recent creation, in charge of Civil Engineering projects, and the Structural Division. The Structural Division has been the pillar of the firm through the years; it is further subdivided into self-sufficient design groups, each of which is headed by a group leader and an assistant group leader in charge of a staff of engineers and draftpersons. The projects are assigned by management to the group leaders, who in turn assign them to an engineer or engineers within the group, depending upon the size of the project.

In addition to the design of buildings, having conventional structures, the division has designed numerous outstanding non-typical structures which makes it a highly desirable place for a young engineer to acquire experience.

I was a design engineer under Mr. Larry Griffis and Mr. Chi Wu, group leader and assistant group leader respectively,* both registered professional engineers, in what was known as Group No. 1 of the Structural Divi -

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* In the following sections, when particular projects are described, the name of my immediate supervisor is given if other than Mr. Griffis and Mr. Wu.

sion during the great majority of my internship. My internship supervisor was Mr. Ken Zimmerman, a registered professional engineer and president of the company.

B. Internship Overview

Walter P. Moore & Associates has been heavily involved in the structural design of buildings for the construction industry in the past forty-seven years. In the construction industry, three broad areas of construction can be classified, namely: building construction, engineering construction, and industrial construction. The firm's involvement has been mainly in the building construction area where the bulk of buildings are those to be erected for habitational, institutional, educational and commercial purposes. All these buildings were designed by architectural firms; the relationship with the consulting structural engineer was one wherein he serves the owner indirectly through an architect responsible as the Prime Professional. Walter P. Moore & Associates' major clients throughout the years have been architectural and development firms for whom the firm performs what is known as "Professional-not-prime" type services.

During the period of fifteen months in which I worked for Walter P. Moore & Associates, I was involved, with varying degree of responsibility, in fifty projects which represented a fairly complete cross section of the type of projects in which the firm was involved. I have classified these projects into six distinct categories according to the type of work performed; each project category, with the percentage of time dedicated to it, and the number of projects actually worked, is indicated in the following list:

Project Categories	%	No.
1. Preliminary Structural Design	23	19
2. Complete Structural Design of Buildings	30	4
3. Design of Special Structural Systems	33	8

Project Categories (cont.)	%	No.
4. Field Inspection of Structures	1	1
5. Structural Additions & Remodeling of Existing Buildings	9	16
6. Revision of Design and Shop Drawings	4	2
	100	50

My involvement in the projects classified in the above mentioned categories has broadened my education by providing me with exposure to the actual practice of engineering and by being a positive step in my professional development; one of the implied objectives of the internship.

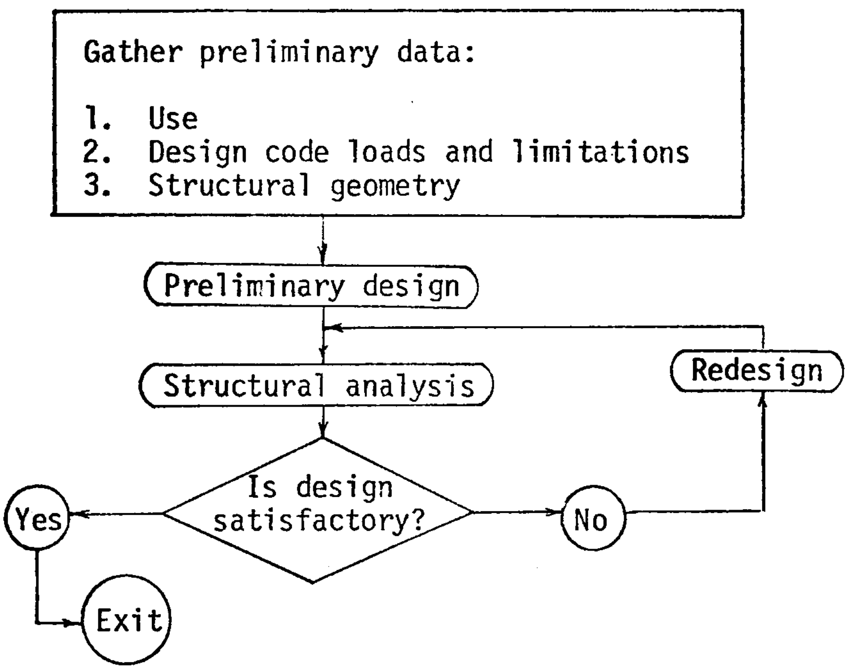
The relevant codes of practice prevalent at the time of my internship were used in the execution of all the projects, these codes were: the American Concrete Institute's ACI 318 - 71, and the American Institute of Steel Construction, Manual of Steel Construction, seventh edition.

In the following sections, a detailed description of relevant projects within each of the six categories mentioned is presented.

III. Projects Performed

A. Preliminary Design

In structural design, the preliminary phase has an important role; it provides the initial description of a real structure with known member sizes and subjected to known loads. The following flow diagram of a structural analysis and design sequence is included here to establish the position of the preliminary phase in the design process.*



From the nature of the preliminary designs in which I was involved, two classifications can be made: a. Preliminary design to establish feasibility and preliminary pricing and, b. Preliminary design as a basis for final design. Among the projects in which I worked I have considered appropriate to include in this section five which are representative of this important phase of structural design. These particular projects are presented in the following list:

* From: "Matrix Structural Analysis", by M.D. Vanderbilt, Quantum Publishers, 1974.

1. Feasibility and Pricing

   a. WEST LOOP OFFICE BUILDING

   b. BAY DESIGN GARAGE

   c. BLOCK 130, HOUSTON CENTER

   d. TEN-TEN GARAGE INVESTIGATION

2. Basis for Final Design: THREE RIVERWAY

1. Feasibility and Pricing

a. WEST LOOP OFFICE BUILDING

Task Description

In this particular assignment I was in charge of preparing the preliminary design for an eight-story office building with a long truncated pyramid-shaped plan, to be constructed in the Houston area and which was being developed by Al Keller, a Houston developer. A sketch of this building's typical floor outline with its dimensions is presented in section a.1 of appendix I.

The objectives to be accomplished is this task were: 1. to establish the general structural layout to fit the functional requirements of the building, and 2. to consider and size the several possible solutions that satisfied the functional requirements. Specificly I was to consider four different schemes combining reinforced concrete and structural steel.

Due to the relatively low-rise nature of this building, wind forces were not considered in this preliminary analysis; for the purpose of establishing the relative advantages of the alternatives considered, a gravity load analysis of a typical floor was considered appropriate.

Task Planning

The first step involved in the execution of the assignment consisted of a careful examination of the set of preliminary architectural plans that were available from the architect's office. After a complete acquaintance with the architectural requirements, the next steps in the planning process were: 1. the establishment of the loading conditions and of the materials' properties, 2. the identification of a representative interior bay of the typical floor to be analyzed, and 3. the review and study of a new construction system which was being introduced in the Houston area and which was to be used as one of the alternatives.

Task Execution

I isolated and analyzed a typical 30' x 100' interior bay extending throughout the width of the building. Four alternatives involving different construction systems and materials were considered, and I carried out a complete structural design for each alternative. The four alternatives considered were (1) Grade 50 steel joists, beams and columns,(2) Grade 50 steel composite beams and steel columns,(3) Reinforced lightweight concrete beams and joists with normal weight reinforced concrete columns, and (4) Grade 50 steel composite joists and beams with grade 50 steel columns. This last alternative, with trade name of "Hambro" system, was being introduced in the Houston area at that time its main feature being the composite action developed both with joists and beams. A set of the relevant calculations for each alternative is included in section a.2. of appendix I.

Once the design was completed, I conveyed all the relevant information to one of the group's draftpersons who was assigned to work with me in this particular job. After agreeing on the format for the drawings, the last step in the task was to prepare the structural specifications for each alternative presented, these were to be included in the drawings.

Task Results

After completion of the design and drafting of the preliminary proposal, I met with my immediate supervisor in order to review the proposal. After I explained the assumptions and procedure used to accomplish the assignment, and after his approval, copies of our drawings were submitted to the firm's client.

The objectives set for this assignment were fully accomplished; an appropriate structural layout, fitting the functional requirements of the building was devised, and a complete design was provided for each of the four alternatives considered.

A copy of the completed drawings with the four different alternatives analyzed, as submitted to the client, is presented in section a.3. of appendix I.

Comments

The information embodied in the drawings, which were being provided by our firm to the client, was of decisive importance in making the decision as to what system of construction to employ in order to minimize the initial cost of the investment. The decision as to which particular scheme would have a least-cost effect was made by the developer after the contractor had reviewed our proposal and had determined, based on availability and prices of materials at that time, which would actually be cheaper to build. It turned out that the scheme chosen was the "Hambro" system.

Several months after I had completed the preliminary analysis for this building, the complete set of architectural plans were submitted to our office in order to proceed with the final design and draft for the structure. At that time, I was heavily involved in another project and couldn't participate in its final design.

Review

I had obtained most of the technical knowledge required to carry-on this assignment from basic reinforced concrete and structural steel design courses. The consideration of a new composite construction system for one of the alternatives, required investigation and study of the new system on my part at that time. This proved to be an interesting learning experience since the new floor system represented, from the design point of view, a definite improvement, by providing composite action with both beams and joists, over the conventional bar joist system. For the sake of completeness, I am enclosing in section a.4. of appendix I a brief description of the "Hambro" system as presented in the manufacturer's brochure.

The contribution of this assignment to the fulfillment of the internship's objectives was: (1) the basic academic knowledge dealing with the analysis and design of reinforced concrete and structural steel elements was applied in the creation of structural systems satisfying the functional requirements of the structure, and (2) the interaction with both the group leader and the draftperson assigned to the project, represented an important aspect of functioning in a non-academic environment.

b. BAY DESIGN GARAGE

Task Description

In this assignment I was to perform the preliminary design of a typical floor for a parking garage structure. The firm's client in this project was Bellows Construction Company, a contractor who was to utilize our design for pricing purposes.

The objective to be accomplished in this task was to provide the client with detailed structural information of three different floor layouts for two different loading conditions in a minimum amount of time.

I was to design three interior bays for a parking garage structure, all with the same column spacing in the longitudinal direction of 30'. The column spacing in the transverse direction varied for each layout: a. 45' - 60' - 45' continuous interior spans with 15' cantilevers at both ends, b. 60' - 60' - 60' continuous spans, and c. 30' - 30' - 30' continuous interior spans with 15' cantilevers at both ends. Layouts "a" and "b" were to be designed with a one-way postentioned lightweight concrete joist system and layout "c" was to be designed with normal weight conventionally reinforced concrete joist system. This last layout was to be analyzed also for a special concentrated loading condition due to an AASHTO HS 20-44 truck loading.

Task Planning

The information provided to me in this particular project was conveyed by the group leader who had obtained it in a telephone conversation with the client. Since a parking garage structure is close to being a "pure" engineering project without architectural requirements, the column spacings and materials' required were about all I needed to get started; this was the information I obtained.

There were two steps involved in the planning process for this project: 1. establishment of the loading conditions and materials' information, and 2. acquaintance with a commercially available computer program which had the capability of analyzing and designing prestressed concrete structures.

Task Execution

I performed a hand analysis and design of the conventional reinforced concrete joist system; the prestressed schemes consisting of postensioned one-way lightweight joists were analyzed and designed by the commercially available "Posten" computer program to which I had to submit the input data only. At the office, we had a computer terminal with operators to whom the engineers would submit the data and they would key-punch it in.

In addition to this "Posten" program I also used to a major extent the "Stress" program, both were available in-house and greatly expanded our capabilities. Typical data sheets with the input for the "Posten" program is presented in section b.1. of appendix I.

Once the design was completed, the next step in the execution of the assignment was to prepare the structural specifications and provide appropriate drawings for the schemes analyzed; since all of the draftpersons in our group were involved in other projects, I personally prepared the required drawings.

Task Results

When I completed both the design and the drafting of the required schemes, I met with my immediate supervisor to review my work. After discussing the procedure employed in carrying out the assignment and reviewing the specifications and drawings, copies of these were sent to the client. The structural drawings with specifications which I prepared for each scheme analyzed, are presented in sections b.2. and b.3. of appendix I.

The objective to be accomplished in this task was fulfilled; the detailed structural information required by the client was provided within a short period of time. In addition, I was introduced to the use of the "Posten" computer program which demonstrated to have powerful capabilities.

Comments

It is worthwhile to note that the firm's client was a contracting company. Based on relatively sketchy information with which to start, we provided information that could be used in a multitude of different building schemes. This demonstrated the fast-pace of the construction industry these days, when structural designs, based on phone requests, are needed to remain competitive.

Review

In the execution of this task, I utilized basic reinforced and prestressed concrete principles learned in school. The utilization of the "Posten" computer program certainly contributed to expand my capabilities as a structural designer.

The main contribution of this assignment to the fulfillment of the internship's objectives is directly related to the application of my technical knowledge in producing an identifiable contribution to the firm's interests.

c. BLOCK 130, HOUSTON CENTER

Task Description

An architectural firm from Houston, Pierce-Goodwin-Alexander, had proposed several schemes for a multi-story building to be constructed in downtown Houston. Our firm was contacted to perform a preliminary estimate of materials required for the structure. There was a very special feature of this task, it was to be completed within forty-eight hours.

This project consisted of designing three different schemes, (1) a twenty-seven - story structure with rectangular plan dimensions of 90' x 240', (2) an eighteen - story structure with rectangular plan dimensions of 90' x 184', and (3) an eighteen - story structure with rectangular plan dimensions of 100' x 184'. All three buildings were to have reinforced concrete structures.

The objective to be attained in this task was to provide estimates of the materials required for the three structures in a minimum amount of time.

Task Planning

I was provided with a standard plan to be modified according to the particular requirements of each scheme. (see section c.1. of appendix I). Since the task demanded rapid action, the time spent in planning it was minimum. It consisted in dividing the project into three phases: (1) the design of the typical floor for gravity loads with minor modifications, (2) the sizing of the lateral load-resisting elements, and (3) an estimate of the materials required for the different schemes.

Task Execution

I carried out the design of the reinforced concrete one-way joist system for the typical floor in a very short period of time; in doing this I utilized the short-cuts available from ACI 318 - 71 in its chapter 8: "Analysis and Design-General Considerations".

The analysis of the lateral force-resisting elements required an oversimplification due to the time constraint. I isolated three levels within the height of each structure, one level close to the roof, one at midheight and the third one at ground level. These isolated substructures were analyzed and designed and the results were used to establish average column and beam sizes. This oversimplified analysis is presented in section c.2. of appendix I for the twenty-seven - story building; the foundation investigation for this building is also included in that section of the appendix.

Task Results

In this project, the review of my work by my supervisor was done on a step-by-step basis; as soon as I had some information, he would discuss its relevance with me and would convey it to the client by telephone.

The objective set for this task was fully accomplished, within the time limits imposed by the client, I was able to supply the relevant information requested.

Comments

By far, the most important aspect of this task was the limitation imposed by the time requirement. This limitation forced me to make a rapid decision as to how to simplify the analysis. The computer programs available were useless under the circumstances because of the relatively long time involved in preparing the input data.

Throughout the period of time in which I worked at Walter P. Moore & Assoc. I could notice the increasing time limitations being imposed by the firm's clients upon each project, but this particular one was certainly the most restricted of all.

Review

The basic knowledge of structural analysis and of concrete design acquired in school was sufficient to carry on this assignment. The relevant aspect of it was the need of applying that knowledge in making a judgement as to simplify the analysis and still provide results within "the ballpark".

The main contribution of this assignment to the fulfillment of the internship's objectives is that in addition to contributing to the firm's interests, it gave me a first-hand view of the ever increasing fast-pace which the construction industry is going through today; this certainly represented a view which could only be obtained outside of the academic world.

d. TEN-TEN GARAGE INVESTIGATION

Task Description

The Tenneco corporation was considering the construction of a twenty-four - story building to be located in the downtown area of Houston, and on the site of an existing seven - story parking garage structure. This project had a very special feature: the parking garage building was not to be demolished and was to remain operational; our firm was contacted to carry out the preliminary design and feasibility study.

In order to comply with such a request, it was proposed to construct a platform 115' high providing a surface of 209' x 240' at the top, and completely independent of the existing garage structure. Such a platform would serve as the supporting structure for the twenty-four - story building that would then be erected on top of it.

In charge of this unususal project was Dr. H.R. Horn, who at the time was vice-president of the firm. He subdivided the project into two different tasks , the preliminary design of the twenty-four - story building and the preliminary design of the supporting platform structure. I was assigned to perform the preliminary design of the tower, while two other engineers worked on the supporting platform. A schematic drawing giving an idea of the proposed structure is presented in section d.1. of appendix I.

Since we had to establish the feasibility of constructing the platform, the main requirement on my assignment was to establish the loading conditions that the twenty-four - story building would impose on the platform.

The specific objectives that I was to accomplish in this task were: 1. to design a complete typical floor for the tower, and 2. to compute the reactions at the transfer level with the platform due to gravity and wind loads.

Task Planning

Once I was informed on the nature of the project and became acquainted with the architectural requirements, I proceeded to establish the floor gravity loads and the wind loads.

At this stage, I was instructed to consider a composite steel and concrete system for the floor structure. Since this was the first "real world" job in which I was to perform a design of such a system, I proceeded to review both my steel design class notes and the current AISC requirements for composite construction presented in the Manual of Steel Construction.

Task Execution

The execution of the assignment was straight-forward; after completing the gravity load analysis and design of the composite floor system, I submitted the design results to the draftperson assigned to the project in order to transfer them to the drawings. A copy of the working drawings for the typical floor plan is included in section d.2. of appendix I as well as a copy of the gravity load calculations. Once the floor design was completed, I proceeded to collect the column loads in order to establish reactions at the base and for future use in the actual column design. The load collection for the columns is also included with the gravity load calculations. It was important at that time because this building was the first multistory structure which I analyzed in actual practice. The standard format employed in the office to record loads proved to be very practical.

The wind loading used in this building was established from the

American National Standards Institute's (ANSI) provisions for a one hundred year storm. The initial lateral load resisting systems proposed for the building consisted in five X-braced systems and two portal frames resisting the wind loading applied to the broad face of the building. The two exterior portals in the longitudinal direction were to resist the wind loading applied to the short face of the building. The wind loading for both faces, as well as the reactions at the base are included in section d.3. of appendix I.

Task Results

After completion of my assignment, I provided the reactions at the base of the building to the team working on the platform, and I also reviewed the typical floor design with the engineer in charge of the project, this had been executed to his satisfaction.

The specific objectives set for this assignment were fully attained; I produced a complete design of the floor system as well as provided the input, in the form of the applied loads, to the design of the platform.

Comments

The critical element of this job was certainly the supporting platform, since the project depended on its feasibility. Once the platform had been geometrically modeled and analyzed for the applied loads, it became apparent that the member sizes required were too large. Our results were submitted to the client and I never heard of the project again.

Review

This project was probably the most unusual one in which I ever participated. From the initial stages I realized that even if we could devise a feasible structure to support the twenty-four - story building, the problems to be encountered in the area of soil mechanics and foundations would have been great; nevertheless it was a great challenge.

To perform this assignment, I utilized basic knowledge obtained from courses in structural analysis and in design of steel structures.

This assignment greatly contributed to my development and understanding of office practices as concerned with practical design and record-keeping of design notes. The contribution of it to the fulfillment of the objectives of the internship is mainly in what is concerned with my practical contribution to the firm's interests, and to the interaction developed with peers while working as a team.

2. Basis for Final Design: THREE RIVERWAY

Task Description

A Houston-based developer: John Hanson Investments, was planning to build a multistory office building for the Houston area which was to have architectural features very similar to the Allied Chemical building, an existing structure which he had also developed in the area. Our firm was to conduct a preliminary design for the new building.

The new building was planned to be twenty-one stories high and to have a hexagonal-shaped floor plan with a first-floor overall longitudinal dimension of 273' with a width of 100' (see the floor plan sketches in section 1 of appendix II). The building had an unusual architectural feature consisting of a series of irregularly patterned stepped-in upper floors which made it necessary to provide a transfer system of load from axially loaded elements to flexural elements at those levels.

Due to the time limitations imposed by the client, the project was divided by Dr. Chi Wu, who was in charge of it, among two additional design engineers including me. The objective of my particular assignment was to perform the preliminary design of the lateral force resisting elements and of the transfer girders for both a structural steel scheme and a reinforced concrete scheme.

The difference of this preliminary design from the others in which I had worked, was that for this particular building the complete final design would follow immediately after a decision was made as to which scheme would be appropriate. The preliminary sizes would then be used as an input to a refined analysis and design process.

Task Planning

In addition to a thorough review of the architectural requirements which by far were the most complex of all the buildings I worked on during my internship, the major item requiring sound judgement and planning was related to the distribution of wind loading among the resisting elements. The wind loading considered for this building was a 100-year storm as provided for by the ANSI (American National Standards Institute) code. To give an idea of the complexity of the resisting system, I am including in section 2 of appendix II, elevations of each of the rigid frames, numbered with reference to the previously presented floor plan sketches, which in conjunction with the shear walls (in the reinforced concrete scheme) or the k-braces (in the structural steel scheme) were providing the lateral resistance.

Task Execution

After I thoroughly reviewed, with the valuable input of Dr. Wu, the structural problem posed both by the shear wall-frame interaction, or the k-brace-frame interaction, and by the geometry of the frames themselves, we came to an agreement as to the wind load distribution. The procedure to be followed was simply to assign percentages of loading according to the relative stiffness of the frames and walls. The distribution of load between the bracing system and the frames was done arbitrarily by intuition and judgement and the distribution of loading among the frames themselves was done according to an approximate portal analysis-type stiffness distribution. It is of interest to mention at this point that, when the complete final design was done by using a sophisticated three dimensional computer analysis, our intuitive base shear distribution came within 10% of the so called "exact" results.

Once the lateral loading was established for this preliminary stage, I proceeded to perform a portal analysis of the frames and a design of the members in both schemes. I also designed the transfer girder system which basically consisted in one and two span girders carrying a concentrated load due to a column at a stepped-in floor.

When working on the structural steel scheme, due to its relative flexibility, I considered the effect of drift due to the wind loading. The application of the method proposed by F. Cheong-Siat-Moy, "Stiffness Design of Unbraced Frames", Engineering Journal/American Institute of Steel Construction, First Quarter 1976, was of great assistance. The method was capable of providing rapid means for modifying member sizes meeting pre-selected story defection constraints which made it a valuable practical design aid. Also of interest to mention here is the fact that, about two months later, while attending an American Institute of Steel Construction Seminar (see section IV, "Other Professional Development Activities", of this report) this particular procedure was very much highlighted as a very recent design aid for the practicing structural consultant; needless to say, I felt very satisfied of just having applied it.

Task Results

After the completion of the design and drafting of the preliminary schemes, the task force working on the project met and discussed the results obtained; these results embodied in the drawings were to the satisfaction of the group leader. Our preliminary drawings as presented to the client for both the structural steel scheme and the reinforced concrete scheme are presented in section 3 of appendix II.

The objectives set for this assignment were fully accomplished; I contributed with my technical knowledge to the preliminary solution of a relatively complex problem. The analysis and design performed was done within the time limitations imposed by the client.

Comments

The information provided in our preliminary drawings was conveyed to the client, who in conjunction with the contractor decided to proceed with the reinforced concrete scheme for the complete final design.

The response by the client was almost immediate, so that I was assigned to work on the complete final design of this building right after the completion of the preliminary proposal. I cover my involvement in that stage of design in section III C; "Design of Special Structural Systems in Major Buildings", of this report.

Review

I had acquired most of the technical knowledge required to conduct this assignment in advanced structural analysis courses and in basic reinforced concrete and structural steel design courses. The input provided by Dr. Wu was extremely valuable in carrying-on the assignment, both when advising as to practical methods of structural analysis and when recommending to review appropriate and recent technical literature.

This assignment contributed greatly to the fulfillment of the internship's objectives by providing me with the opportunity of making an identifiable contribution to the firm's interests in a relatively complex problem. This building certainly was an outstanding non-typical structure and as such, represented an interesting challenge which contributed to my overall professional development. Since the task required a close team work, the interaction with peers in developing the project was of great value, this was reflected in the constant exchange of information among the team members.

B. Complete Structural Design of Buildings

Within the framework of the general flow diagram describing the structural analysis and design sequence, presented earlier in the preliminary design section of this report, the complete design of a structure is likely to involve the following stages*:

1. Establishing the general layout to fit the functional requirements of the structure ,
2. Consideration of the several possible solutions that may satisfy the functional requirements,
3. Preliminary structural design of the various possible solutions,
4. Selection of the most satisfactory solution, and
5. Detailed structural design of the most satisfactory solution.

The final product of the detailed structural design is the complete set of constructive drawings which are to be utilized in the actual construction of the building. These drawings represent the source by which consulting engineers convey information to the contractor who will build the building. In preparing drawings, including framing plans and details, the preparation of structural details are very much the function of the engineer who must be aware of construction practices in order to perform an efficient job.

For inclusion in this section, I chose two representative projects:

a. Science & Mathematics Center/Junior College - COMMONS BUILDING

b. SMITH PARK PAVILION

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* From: "Elementary Structural Analysis" by C.H. Norris and J.B. Wilbur, McGraw-Hill Book Co., 1960.

a. Science & Mathematics Center/Junior College - COMMONS BUILDING

Task Description

In the decade of the 70's the construction industry of the free world experienced an involvement in projects of unparalleled scale in the Middle East. Within a major plan to gain self-reliance, based on ambitious programs of development where education was to play an important role, the kingdom of Saudi Arabia launched a program to develop large educational facilities. In 1976, the Houston-based architectural firm of James M. Sink Associates was contracted by the government of Saudi Arabia to provide programming and design services, in the creation of a Science and Mathematics College to be located in the city of Riyadh.

Walter P. Moore & Associates was contacted by J.M. Sink Associates to provide the civil and structural engineering services for such a facility. The project was divided into two phases, the initial phase would provide facilities for 3500 students with a second phase increasing the facilities to service 6500 students. Our firm was to provide the complete contract drawings for phase 1 effective immediately while phase 2 drawings would be done at a later time. The initial phase of the project was to provide 1.5 million square feet of construction with the capability for expansion to 2.2 million square feet; the phase 1 development plan is included in section a.1. of appendix III.

The facilities to be built were organized into four categories: academic, academic support, housing and campus support. The housing category was subdivided into married student housing and single student housing. Initially, two neighborhoods accommodating a total of 1008 single students were to be built. Each neighborhood consisted of seven halls for 72 students and a one-story Commons building containing all facilities shared by the halls. The single student housing site plan is also included in section a.1. of appendix III.

I was assigned the task of performing the complete structural design, detailing, and drafting of the Commons building which was to be used repetitively. The Commons building locations are highlighted in the single student housing site plan.

The objective set for this task was to provide complete contract drawings reflecting the structural design for the Commons building within the time limitations imposed by the deadlines set by the client.

Task Planning

Of all the projects in which I was involved during my internship, this particular one required the maximum amount of time in the planning stage. I subdivided this stage into three broad phases (1) acquaintance with the conditions prevalent in Saudi Arabia, (2) acquaintance with the overall project, and (3) acquaintance and impact of the particular architectural requirements for the building I was in charge.

Among the information relevant to construction obtained about the conditions prevalent in Saudi Arabia, the following were of interest: the great majority of construction materials were imported; labor was scarce and it was necessary to import labor; ports were so overcrowded that a 1 year duration in line for cargo ships was very common; potable water was a scarce commodity, a gallon of water would sell much higher than a gallon of gasoline; temperature changes of over 100 F in a short period of time made it one of the most inclement environments for construction.

The most outstanding features to consider in the planning of this task with respect to the overall project were: the use of metric dimensioning and reinforcing steel bar sizes, and the standarization and coordination of design specifications and drawings. The coordination was handled rather well by Mr. Lee Jones, the group leader in charge of the overall project; the group held weekly meetings where general information about the project were discussed. All the written communication occurring with the architect's office was kept available to the group's staff.

As far as the Commons building itself, this was a one-story building with three areas having different roof elevations, and with plan dimensions of roughly 140' x 180'. The information available from the architect at the initial stages was still of a preliminary nature; in fact, I started to work on the building with only a preliminary architectural floor plan. Information pertaining to loading and code provisions, and to the structural systems to be utilized, were the items that I investigated in this planning stage.

Task Execution

From the preliminary architectural floor plan, I initially prepared a structural layout for the roof in the form of a roof framing plan. Through almost daily telephone communication, I kept in touch with the architect in charge of the Commons building, with whom I would exchange information. Through this process, and by timely exchange of working drawings we were able to complete the design of the building and to meet the deadlines set for the preliminary reproduction and review of the drawings. The final architectural plan with building sections is included also in section a.1. of appendix III.

The structural system which I designed, consisted in pretensioned precast concrete elements and one-way slabs for the roof system, supported on reinforced concrete walls and columns. The complete design calculations are presented in section a.2. of appendix III.

Task Results

After completion of the design and drafting for the Commons building which I did slightly ahead of schedule, I helped out other engineers within the group, who were also working on the Saudi project, both in the design of structural elements and in preparing structural element's schedules.

While the project was sent out for reproduction, I was transfered to group No. 1 where I remained the rest of my internship. When the full set of drawings were returned to the office for revision, I was temporarily transfered back to my original group to make the appropriate changes; this step proved very useful since my supervisor provided great input with respect to improving and correcting my structural details.

Once all the drawings were in a final form, they were submitted to the architect's office who provided them to the Saudi government for bidding.

The objectives set for this assignment were fully accomplished; I produced a complete set of contract drawings which were the product of a detailed structural design. In addition, I contributed towards meeting the deadlines imposed by the firm's client by helping out in the design and draft of various other buildings within the overall project.

Copies of the complete contract drawings with some of the structural details as submitted to the client are included in section a.3. of appendix IV.

Comments

All of the information which I provided to the client through the contract drawings was a result of careful structural design. These drawings were to be used in the bidding and in the construction process, which made them very important.

In my particular assignment, I had enough time to carry it out, but it was apparent to me that with the overall project the deadline was very restrictive; in order to get the project on time large amounts of overtime were necessary from the group's staff.

Review

While working on this project, I had the great opportunity of getting a first-hand look at the so publiziced large projects being developed in the Middle East, and I also had the opportunity of reviewing the conditions prevalent in that area of the world where the largest engineering projects of modern times are being executed.

I had obtained the technical knowledge required to complete my assignment in basic reinforced and prestressed concrete courses; the organization and coordination required to develop the complete structural drawings were a matter of experience which I had acquired through my previous work at Walter P. Moore. In developing structural details, common sense and consulting with more experienced engineers within the group proved very useful; in school, little attention is given to structural detailing, I believe that greater emphasis should be given to this important area.

The contribution of this assignment to the fulfillment of the internship's objectives is as follows: 1. I was fully responsible for carrying out the complete design of the building, from the initial preliminary phase to the production of complete structural drawings within a time limitation imposed by a deadline, 2. I was in direct contact with the architect in charge of the design of the Commons building, with whom I developed a great professional relationship, 3. the overall task was by all means a group effort, the interaction with peers proved very rewarding as well as the interaction with the group leader, 4. the exposure to such a task, especially in that area of the world gave me a great insight into the execution of a large and complex project. All in all, the involvement in this particular project gave me exposure to the organizational approach to problems in the "real world". My contribution to the firm's interests was certainly a major part of this task.

b. SMITH PARK PAVILION

Task Description

This project consisted in designing, detailing, and drafting a structure for a pavilion to be erected in the city of Jacinto, Texas; our client, the architecture firm in charge of the project, was The Architecture Company from Houston.

The pavilion was a very simple open facility consisting of a 40' x 102' flat roof supported on concrete-encased steel columns, and of a 90' x 94' concrete slab on grade. The roof structure consisted in steel joists supported on steel joist girders.

The objective to be accomplished in this project was to provide the complete contract drawings for the construction of the pavilion.

Task Planning

Since the execution of this project was to be of a straight forward nature, the amount of time spent in the planning of it was limited to the establishment of the loading conditions and to gathering information from the manufacturers of the joist girder systems.

The joist girders are open-web steel flexural elements that are shop-fabricated on a special order basis according to the special loading conditions of each particular job, and that meet the specifications of the American Institute of Steel Construction. They are normally used when long spans are to be cleared in buildings, which was the reason for using them in this job, where a span of 90' had to be cleared.

Task Execution

After establishing the loading conditions for the roof structure, I analyzed and designed it. During the design process, I was in contact with the architect who requested several alternatives for the column design; mainly to check the use of concrete-encased steel sections as opposed to an only-steel section alternative.

When the design of the elements was completed, I proceeded to perform a detailed design of the connections and to write the structural specifications pertaining to the job. Once this was completed, I proceeded to perform the complete drafting of the contract drawings.

Task Results

When the drawings were completed, I met with my supervisor to whom I explained the procedure followed in the execution of the project; after his review I sent out the copies of our plans to the architect's office. Copies of those drawings are enclosed in section b of appendix III.

The objective set for this task was fully accomplished; I had completed the project, which was under my responsibility, and had sent out the contract drawings within the architect's time frame.

Comments

The structural drawings conveyed to the client represented the complete contract plans to be utilized in the construction of the facility. This certainly is the objective of the structural design process; its end result being the drawings from which the building is actually constructed.

Immediately after I had finished working on this project, our firm was contacted to do the design for another facility very similar to this one: Irvington Park Pavilion, I was assigned the project in my last day at the office, before returning to school, and that same day I completed the design of it.

Review

The knowledge required to design the structural members and the connections was obtained in basic structural steel courses.

Even though the execution of this project was straight forward, it contributed to the fulfillment of the internship's objectives due to the fact that I was fully responsible for it, no matter how small, and worked on it from start to finish being in direct contact with the architect.

C. Design of Special Structural Systems in Major Buildings

The design of buildings in today's competitive world has been greatly accelerated due to the time limitations imposed by investors seeking to maximize their returns. Through my involvement in the actual practice of consulting structural engineering at Walter P. Moore & Associates, I experienced this situation on a first-hand basis. Structures which normally could be designed by one engineer had to be broken down into different design tasks and several engineers would be responsible for each task. This section of my report is a reflection of this trend, where I describe my involvement in the design of important structural systems within the overall structure of a building.

As representative of this type of task, I have chosen the Three Riverway project.

THREE RIVERWAY

Task Description

Our firm had submitted a preliminary structural design proposal on a twenty-one story building planned for the Houston area; I had participated in that phase of the design, (refer to section III A.2. of this report), and now that the decision had been made by the developer to proceed with a final design, I was assigned to work with the team who was to perform that task.

In the preliminary proposal, we had presented two alternatives: a structural steel scheme and a reinforced concrete scheme. The reinforced concrete scheme consisting in a one-way joist floor system was chosen by the developer for the actual construction of the building. Some minor architectural changes had been made to the originally proposed building, including a reduction in the number of stories from twenty-one to twenty.

The analysis to be done at this stage in the design process was to be performed by modeling the structure and carrying out a computer-aided analysis of lateral forces by using a commercially available computer program. Due to the complexity of the building it was decided to use a three-dimensional computer model. Dr. Chi Wu, who was in charge of the structural team that was to work on this project, divided it into several well defined tasks.

I was resoponsible for the complete design of the wind-resisting rigid frames, also I was to provide the input of member sizes to the model and was responsible for the revision of the computer model and output. My objective was to do this within the short time-frame available.

Task Planning

With the time limitations imposed by the client; we were to supply the complete set of final drawings in one month, the planning of my particular assignment was performed on a continuous basis. My particular task was clearly divided into an analysis phase and a design phase, the work in both phases was very much interrelated with the work being done by the rest of the team. The first step in the planning process was a thorough review of the new architectural requirements and their impact on the structure.

From these requirements, we established the column locations throughout the height of the building; a plan presenting the column locations is included in section 1. of appendix IV, the architectural elevations of the building are also enclosed in that section.

The next step in the planning of this task was the establishment of the basic assumptions to be made in the generation of the model; namely the floor behavior which we agreed to be rigid in its plane, the establishment of support conditions, and of the loading conditions. The wind loading conditions and the computer-generated geometric display of the modeled structure is presented in section 2. of appendix IV.

Once the analysis phase was completed, the next step in the planning process was to prepare the design procedure to be followed. In order to produce systematic design notes, which were necessary due to the large number of elements to be designed, I devised a simple standard format for the design of the beams. This standard format is presented in section 3. of appendix IV.

Task Execution

The actual task of modeling the structure was done by using the commercially available "ECES 2" computer program being marketed by the McDonnell Douglas Automation company; this task was carried out by a member of the design team who towards the end of the modeling process was transfered to another project leaving me with the task of making some minor adjustments, and doing the complete revision of the output. In carrying out the adjustments to the model, I made several trips to the McDonnell Douglas office in downtown Houston, since our office terminal was not tied-in with their system.

The revision of the output consisted mainly in checking floor displacements at selected locations and loading conditions and verifying the modeled behavior, and of checking the base shears and comparing them to the applied loading. The lateral deformation behavior expected, consisted mainly in a cantilevered beam-type deflection accounting for the strong contribution of the shear walls in resisting the wind load acting on the broad face, and in a shear-type deformation accounting for the strong contribution of the frames in resisting the wind load acting on the narrow face. A copy of the relevant revisions performed is included in section 4. of appendix IV.

After the completion of the analysis phase, including the revision of the computer output, I proceeded with the design phase which was of a straight-forward nature, but extremely lengthy (only the wind beams numbered over 400). At this stage, due to the time limitations, the column design was carried-out by another member of the team while I completed the design of the wind beams and their detailing and scheduling. The general design information for the wind beams is presented in section 5. of appendix IV.

An important aspect of the project execution which was of a non-technical nature was related to the production of the complete set of drawings. Due to the ever-binding time limitations, the design team worked large amounts of overtime, which was certainly to be expected from the engineers; but the crucial point was in using the personal relationships developed with the draftpersons working on the project, in order to have them working also long hours of overtime and complete the project in time.

Task Results

After the completion of the task, I met with Dr. Wu and discussed the results obtained, which were to his satisfaction. Our set of drawings was submitted to the client right on schedule. Copies of some of the relevant floor framing plans and of the beam schedules as presented to the client are enclosed in section 6. of appendix IV.

The objectives set for this assignment were accomplished; I contributed with my technical training to the completion of a major project within the time limitation.

Comments

Our complete set of drawings was sent out to the architect's office for revision and for use by the contractor. After this, I was assigned to a new project and when the revisions were to be made, I was already back in school.

As of today, the Three Riverway building is under construction. The experienced gained in my involvement in its design was very rewarding.

Review

I had obtained the technical knowledge required to conduct this assignment in structural analysis courses and in basic reinforced concrete design. The interaction with the engineers in the design team was very valuable in the execution of my task and in gaining insight into the problems encountered by them in their particular assignments.

This task contributed greatly to the fulfillment of the objectives of the internship by allowing me to contribute, with my technical knowledge, to the solution of a practical problem for the firm. Also of great relevance was my interaction with both the engineers and draftpersons within the design team; with the engineers, by acquiring experience through their involvement in the project and with the draftpersons, by developing friendly relationships which in tight deadline situations were very useful and could count on their assistance in meeting the deadlines.

D. Field Inspection

CARRIAGE PARK APARTMENT COMPLEX

Task Description

Walter P. Moore & Associates was contacted by a Chicago-based company, requesting information concerning the integrity of an existing apartment complex located in the south-east area of Houston. Our firm was to be responsible for a complete survey of the apartment complex, including all building systems and site evaluation.

Since our firm was acting as the Prime Professional in this job, and our responsibility was to perform a complete survey of the complex, the services of two outside consultants were employed to inspect all of the complex's systems, with the exception of the structural systems which we had the capability of inspecting. Jochen & Henderson, Inc. was contracted to inspect the plumbing, electrical, and mechanical systems, while Stewart Construction Consultants, Inc. were contracted to conduct a survey of the site condition and site structures, special purpose buildings, building exteriors and building interiors.

I was assigned the job of performing the structural inspection of the buildings in the complex, and to report back to Mr. Terry Shipman, a registered professional engineer who was my immediate supervisor at that time. The two consultants that our firm had contracted were to report also to him.

The objective of the task entrusted to me, was to perform an inspection of the structural systems of the existing buildings in the apartment complex and to prepare a report on my findings. The on-site coordination with the representatives of the outside consultants was under my responsibility, and was an important item in the attainment of the task objective.

Task Planning

Having had some experience in structural supervision, and in the evaluation of earthquake-damaged buildings in Nicaragua, Central America; I felt well prepared to carry-on the assignment, even though I realized that the construction practice I would be facing would be quite different.

Upon request, I was furnished with a site plan of the apartment complex; from it I could determine the size of the complex which was relatively large. Since no additional plans were available I realized I would have to relay mainly on my field observations.

Since the apartment complex was currently in operation, the inspection of building interiors was the item that required coordination both with the representatives of our two consultants and with the manager of the complex, as to minimize discomfort to the tenants. In our first meeting conducted at the premises, we decided to concurrently perform the inspection of building interiors as the first step in our survey, so that afterwards each inspector could proceed independently. At that time we decided to inspect a representative sample of building interiors which we agreed to be around 10 %.

Task Execution

The apartment complex had a total of 25 buildings, consisting of 22 two-story apartment buildings, 1 three-story apartment building, and 2 one-story mechanical equipment buildings. After the team-inspection of the randomly selected building interiors, I proceeded on my own with the inspection of all building exteriors. Typically all exterior walls at ground level were found to be brick veneer and the second level exteriors were of wood construction.

I was mainly concerned with establishing apparent building distortions and patterns of wall cracking; I found no evidence of structural damage.

Task Results

The objective of this task was fully attained: the survey was conducted with minimum discomfort to tenants, which was due mainly to the on-site coordination with the complex's manager and the firm's consultants' representatives. The task was performed in a minimum amount of time, an important consideration in all projects.

While no evidence of structural damage was found, the major problems observed were wall cracking at ground level and corrosion of metal components. My complete findings are embodied in the report I prepared for my supervisor, which is enclosed in appendix V.

Upon submission of my report to Mr. Terry Shipman, we discussed the reasons and consequences of my findings. We reviewed my report and made a step-by-step analysis of the items listed; from this analysis, explanations for the problems observed were formulated. Wall cracking was determined to be caused both by temperature stresses and by the presence of expansive clays, a prevalent soil condition in the Houston area. The corrosion of metal components in the buildings was most likely caused by the proximity of the complex to the Houston ship channel, an area where air pollution is rather concentrated. After our discussion, a final report was produced and directed to the firm's client; a copy of this is also included in appendix V.

Comments

Among the services that a consulting structural engineering firm is capable of performing, that one of inspection and evaluation of buildings is an important one. The opinion of a structural engineer with respect to the soundness of an existing structure will influence the decision of a potential investor considering its purchase. In this particular case, after the inspection was conducted and the complete reports were submitted to the client, we found out that the Chicago-based company had proceeded with the purchase of the apartment complex.

Review

The task of inspecting the apartment complex was particularly interesting since this type of project was not a common one considering that the firm was acting as the prime professional in charge.

Personally it was of interest to get acquainted with the type of construction widely used in the area for low-rise buildings, namely the use of brick veneer and wood framing. The review with Mr. Shipman of my observations embodied in the report presented to him, proved very rewarding since the causes of the majority of the problems observed were mainly due to prevalent special conditions in the Houston area.

The main contribution of this task to the attainment of the internship objectives, was twofold: the interaction with the consultlants hired by our firm, and the public relation involvement which was an important feature of the task. The knowledge required to perform this task was not obtained from classroom lectures, it was obtained through previous experience both in supervision of construction and in general personal interaction.

E. Structural Additions and Remodeling of Existing Buildings

While large and complex buildings attract the attention of all people involved in their planning and design, very simple additions and remodeling of existing buildings are a fact of life for the practicing structural consultant and consequently deserve attention.

During the period of time in which I worked at Walter P. Moore & Assoc, I had the opportunity of working in numerous additions and remodeling of existing buildings. These type of projects were very small and their coverage in this report will vary in format from all of the ones presented in previous sections.

The different projects in which I worked involved the following tasks: strengthening existing floor structures, eliminating and adding walls, modifying grade beams and foundations, and providing the structure required by mechanical additions. All of these projects required the examination of the drawings available for the existing building and extracting the necessary information from it.

As an example of this, I will mention a project in which I was to provide the structure required by mechanical additions to be made in one of the floors of the One Houston Center building in downtown Houston. The structure required consisted in the framing for two "catwalks" to be located in the mechanical area of a floor system. From the mechanical drawings submitted to our office, I identified the location of the addition and proceeded to revise the plans of the existing structure. From these, I was able to locate existing members to be used as supports for the addition. A copy of my final drawing with the pertinent details as presented to the client is included in section 1. of appendix VI.

From my involvement in these small projects, I gained some insight into the problem of working with existing buildings such as dependence in field measurements for dimensioning, revision of old drawings, and most important, the precautions that should be taken when welding to existing stressed elements. To this effect, I sent a memorandum to Mr. Zimmerman concerning this matter; a copy of it is presented in section 2. of appendix VI, as well as the response I got which is self explanatory.

As can be seen, there are lessons to be learned even from the smallest project. The contribution of my involvement in this type of project to the internship's objectives is related not so much as to my contribution to the firm's interest, but mostly towards the insight gained from exposure to a practical problem.

F. Revision of Design and Shop Drawings

Additional tasks that a consulting structural engineer routinely performs are: revision of design done by other engineers, both outside the firm or within the firm; and the revision of shop drawings.

Due to the simple nature of these tasks, their coverage will be similar in format to the coverage previously presented for the topic of section III E. in this report.

The revision of design performed by others, outside of the consulting engineering firm occurs in many cases involving the use of precast concrete elements in buildings. These elements are normally designed by the precast supplier whom after designing the elements and connections, submitts his drawings and design notes to the consulting structural engineer in charge of the overall structural design, for their revision and approval.

Shop drawings are prepared and used by the contractor as instruments to sequence his work and to facilitate fabrication and erection. These drawings are done by the contractor from the structural drawings prepared by the consulting structural engineer. After preparing the shop drawings, the contractor submitts them back to the structural engineer for their revision. As to their approval, it is of interest to quote the ASCE - Manuals and Reports on Engineering Practice - No. 45, "Consulting Engineering, a Guide for the Engagement of Engineering Services": "Their approval (of the shop drawings) by the Consulting Structural Engineer is not to be construed as a waiver of construction contract requirements or responsibilities unless the contractor has requested a deviation from the contract documents in writing".

I was involved in a project where I had to revise both the design and the shop drawings for a garage structure with a precast concrete system. The building in case was a two-story parking garage facility to be constructed in Greenspoint plaza, Houston. A copy of a working drawing presenting the framing plan and sections is enclosed in section 1 of appendix VII. The objective of the revision of shop drawings is to verify their general conformance with structural requirements and this was my objective in revising these particular ones. My general comments on this revision are enclosed in section 1 of appendix VII. I made a basic revision of the main precast prestressed elements and found them satisfactory, a copy of the revision of the prestressed double tees is also included in section 1 of appendix VII.

The contribution of my involvement in this type of task to the internship's objectives is basically related to the insight gained from my exposure to the way contractors, who after all, are the ones who have the field experience in construction, envision how to "put the building together".

IV. Other Professional Development Activities

What I have termed as "Other Professional Development Activities", encompass those activities in which I was involved during the period of time covered by my internship, but outside of the firm's assignment; that is, professional-related activities in which I was involved on my spare time.

The membership in professional societies is of great importance in the development of a professional engineer; during my internship, I became a member of the following societies: American Society of Civil Engineers, American Concrete Institute, and the Nicaraguan Association of Engineers and Architects. In Nicaragua, the degree of Civil Engineer is a professional degree; having gone directly after graduation into graduate school in the United States, I had not been able to register as such, but while on vacation from the office, I became a registered engineer in Nicaragua.

In addition to the above mentioned involvements, I have considered for inclusion with greater detail in this report two additional professional development actitities: 1. A seminar on earthquake damage which I conducted at the office, and 2. Attendance to a continuing education seminar on steel structures which was conducted by the American Institute of Steel Construction.

A. Earthquake Seminar

The creation at the office of informal in-house seminars; "sack-lunch" seminars, conducted in large by the firm's staff, gave me the opportunity, not only to share in the technical experiences and interests of the various engineers working for the firm, but also I contributed to the in-house seminar program by conducting one myself.

Having been involved in earthquake-resistant structural design and inspection in Nicaragua, Central America, after the December 1972, Managua earthquake, I had interesting information on the subject. The main body of the seminar I conducted, consisted of a slide presentation on some aspects of the structural damage caused by the earthquake. The photographs presented were taken during a survey of damage performed by a team of engineers in January 1973.* I participated as a guide in the team's survey; at the time I was a third-year student of Civil Engineering. Since then, I had had the opportunity to review the vast literature available on the Managua earthquake, and had developed explanations concerning of the damage shown in the photographs.

For inclusion in this report, I have reduced the number of photographs from the ones actually presented in the seminar; close to 150 slides were shown then, only some of the relevant slides are included in this report. Excerpts of the presentation with the photographs are included in this section's appendix.

This presentation to the firm's engineers represented a positive contribution to fulfilling my internship's objectives, not only in providing some insight into seismic problems to my peers, but also it gave me the opportunity to make a semi-formal presentation in a non-academic environment.

B. AISC Seminar

Towards the end of my internship, the American Institute of Steel Construction sponsered a seminar consisting of a 2-day lecture series on practical steel design for buildings from 2 to 20 stories. Since at the time when the seminar was offered in Houston I was heavily involved in the completion of a project at the office and didn't have the spare time, I decid-

* The photographs were furnished to me by Mr. Felipe Arguello, the engineer heading the survey team.

ed to attend the one offered in the Dallas - Fort Worth area offered at a convenient date.

The lectures in the seminar included topics such as braced and unbraced frame design, floor systems, fire protection, earthquake design, special framing systems, and high strength bolting. It was of interest to note that in the unbraced frame design lecture, the speaker highlighted two very recent methods developed in the adjustment for drift control, one of which I had just applied at the office in my last project there.

Upon completion of the lecture series, a certificate of completion with 0.9 continuing education units was awarded to all participants; a copy of my certificate is also included in the appendix to this section.

Attendance to this seminar contributed to the fulfillment of the internship's objectives, mainly because of the exposure it gave me to state-of-the-art in steel design of buildings as viewed by outstanding practicing engineers; it certainly contributed towards my professional development.

V. Conclusion

During my internship at Walter P. Moore & Associates, Consulting Engineers, I fulfilled the objectives of the Doctor of Engineering program. These objectives are:

> To enable the student to demonstrate his ability to apply his knowledge and technical training by making an identifiable contribution in an area of practical concern to the organization or industry in which the internship is served, and
>
> To enable the student to function in a non-academic environment in a position where he will become aware of the organizational approach to problems in addition to traditional engineering design or analysis. These may include, but are not limited to, problems of management, labor relations, public relations, environmental protection or economics.

My involvement in fifty projects which covered a wide range of the services performed by a consulting structural engineer, allowed me to demonstrate my ability in applying my knowledge and technical training, especially when I dealt with complex structures such as the one involved in the Three Riverway project. Also, In several occasions, I had the responsibility of executing a project from the initial conception by the architect to the completion of full contract drawings as was the case in the Commons Building for the Science and Mathematics Center to be constructed in Saudi Arabia. All in all, no matter how simple a project, I made identifiable contributions to the area of practical concern of the firm.

While performing the technical tasks assigned, I was very much functioning in a non-academic environment. Through my involvement with project architects, with peers and supervisors, and with draftpersons working for me in some projects, I became very much aware of the organizational approach to problems.

The time limitations imposed on the consulting structural engineer, which are a reflection of the fast-pace of the construction industry these days and which mainly originate from the investor's economic constraints, was a major non-academic experience to which I was thoroughly exposed. As a direct consequence of this, the search for short-cut methods in the analysis and design of structures as well as the use of judgement and intuition, based on academic knowledge, in order to meet the deadlines, was an important feature of my internship.

In addition to the above mentioned, my involvement in activities such as the earthquake seminar, greatly contributed towards my professional development, an implied objective of the internship.

APPENDIX I

Feasibility and Pricing

a. WEST LOOP OFFICE BUILDING

   1. Typical floor sketch
   2. Design calculations
   3. Preliminary structural proposal
   4. "Hambro" composite floor system

b. BAY DESIGN GARAGE

   1. "Posten" computer input sheets
   2. Postensioned concrete joist scheme
   3. Reinforced concrete joist scheme

c. BLOCK 130, HOUSTON CENTER

   1. Typical floor plan
   2. Design calculations

d. TEN-TEN GARAGE INVESTIGATION

   1. Sketch of proposed system
   2. Floor framing and calculations
   3. Wind reactions

a.1. Typical floor sketch

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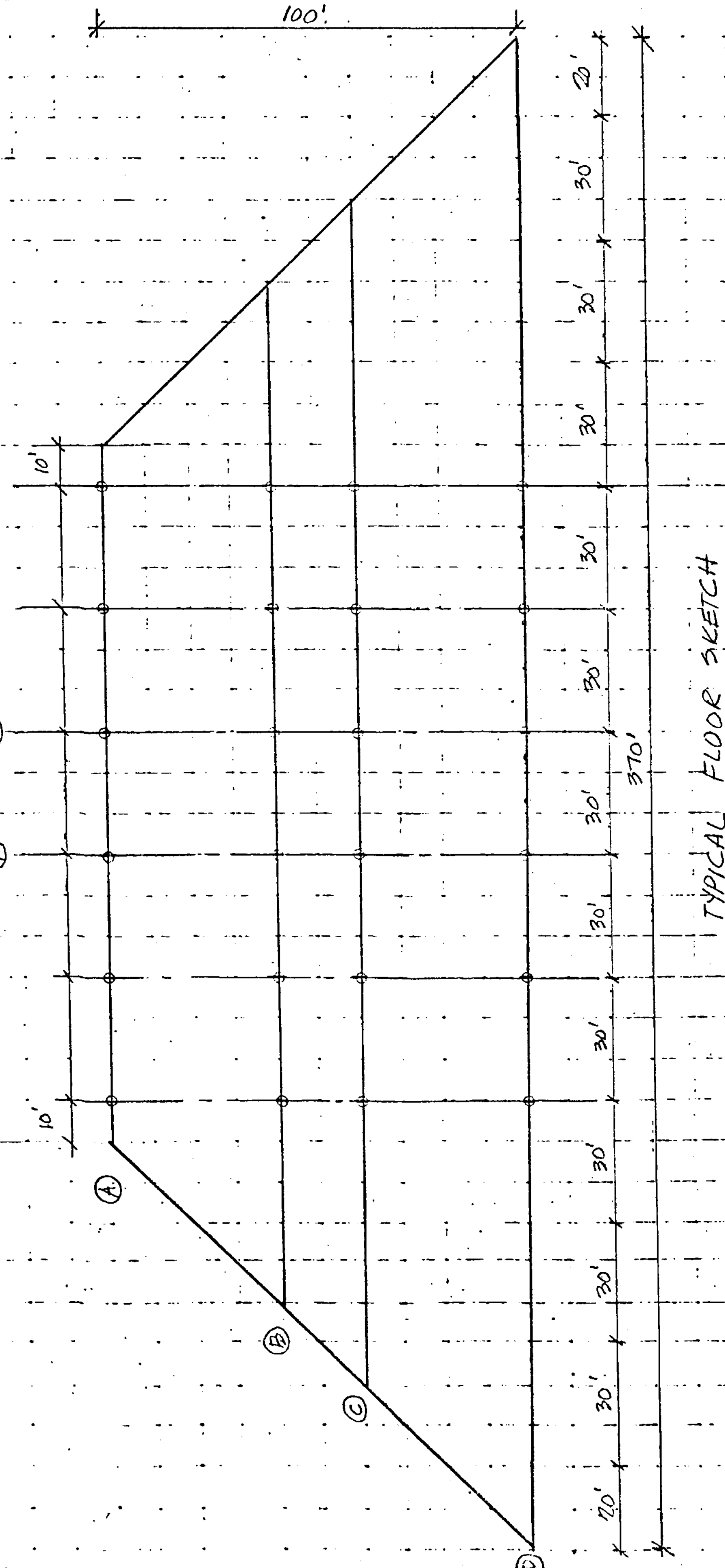
Job Name WEST LOOP OFFICE BLDG.

Architect AL KELLER 59

Job # 10018



a.2. Design calculations

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Job Name WEST LOOP OFFICE BLDG.

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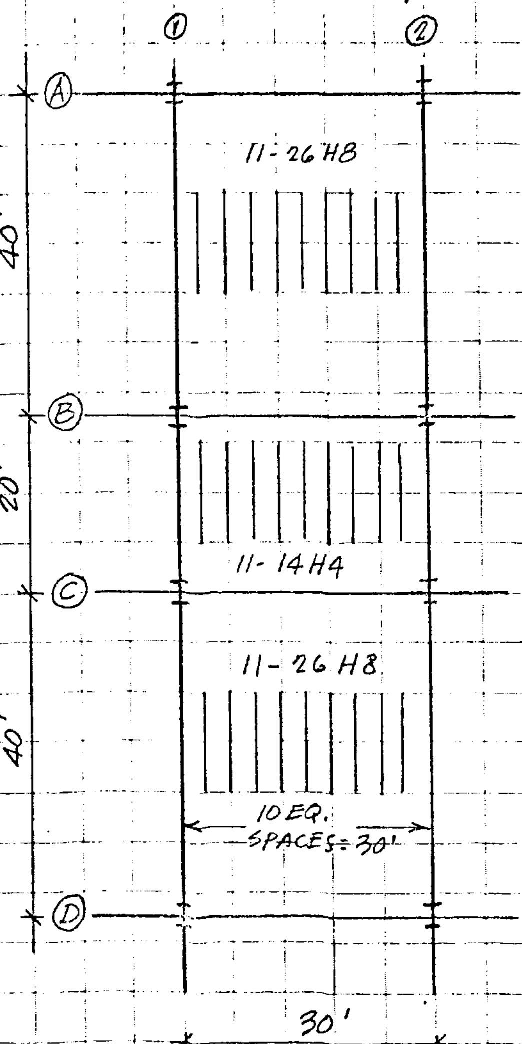
PRELIMINARY TYPICAL FLOOR

Job # 10018

SCHEME 1 ; STEEL BMS. & BAR JOISTS

F_y = 50 ksi



LOADS : (LT.WT.)

LL	Ptn.	2½ DECK	JST.	CLG.	
50	+ 20	+ 25	+ 3	+ 4	L. 50, D. 52 } 102

SPANDRELS : 15 PLF (GLASS WALL)

JOISTS :

SPAN 20', LOAD = 102 PSF × 3 = 306 PLF — 14 H4

SPAN 40', LOAD = 306 PLF — 26 H8

BEAMS :

A, 1-2 ; SPAN : 30', R = 47%, LOAD : D 1040 (Floor) + 15 (Wall) = 1055 ; L (1000)* 530 ; 1585 PLF (2055)* ; TL = 47.6K (61.7)* ; M = 2140 K-"

f_b = 31.3 ksi

W 18 × 40

B, 1-2 ; SPAN : 30', R = 47%, LOAD : D 1560 ; L (1500)* 795 ; 2355 PLF (3060)* ; TL = 70.7K (91.8)* ; M = 3180 K-"

f_b = 28 ksi

W 24 × 55

NOTE : ( )* → UNREDUCED LIVE LOAD

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Job Name WEST LOOP OFFICE BLDG.

62

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SCHEME 1 (CONT.); COLUMN DESIGN

Job # 10018

$F_y = 50$ ksi

MARK

A-1

LEVEL COL. SPTG	DEAD (KIPS)		LIVE (KIPS)		L.L. REDUCT. (%)	RED. LL (KIPS)		D + RED.LL (KIPS)	SIZE
ROOF	13.2	13.2	13.2	13.2	–		13.2	26.4	W8x17
8	34.8	48	33	46.2	47	17.5	24.5	72.5	W8x28
7	34.8	82.8		79.2			42.0	124.8	W8x28
6		117.6		112.2			59.5	177.1	W8x40
5		152.4		145.2			77.0	229.4	W8x40
4		187.2		178.2			94.5	281.7	W10x49
3		222		211.2			112	334.0	W10x49
2		256.8		244.2			129.4	386.2	W12x58
1		291.6		277.2			146.9	433.5	W12x58
									FTG. 9'-6" x 9'-6" t = 28" 8#8 E.W.

BASE PL 20" x 20" x

B-1

LEVEL COL. SPTG.	DEAD (KIPS)		LIVE (KIPS)		L.L. REDUCT. (%)	RED. LL (KIPS)	D+RED.LL (KIPS)	SIZE
ROOF	19.8	19.8	19.8	19.8	–	19.8	39.6	W8x17
8	51.6	71.4	49.5	69.3	47	36.7	108.1	W8x31
7		123		118.8		63	186	W8x31
6		174.6		168.3		89.2	263.8	W12x53
5		226.2		217.8		115.4	341.6	W12x53
4		277.8		267.3		141.7	419.5	W12x72
3		329.4		316.8		167.9	497.3	W12x72
2		381		366.3		194.2	575.2	W12x79
1		432.6		415.8		220.4	653.0	W12x79
								FTG. 11'-6" x 11'-6" t = 33" 9#9 E.W.

BASE PL 24" x 24" x

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Job Name WEST LOOP OFFICE BLDG.

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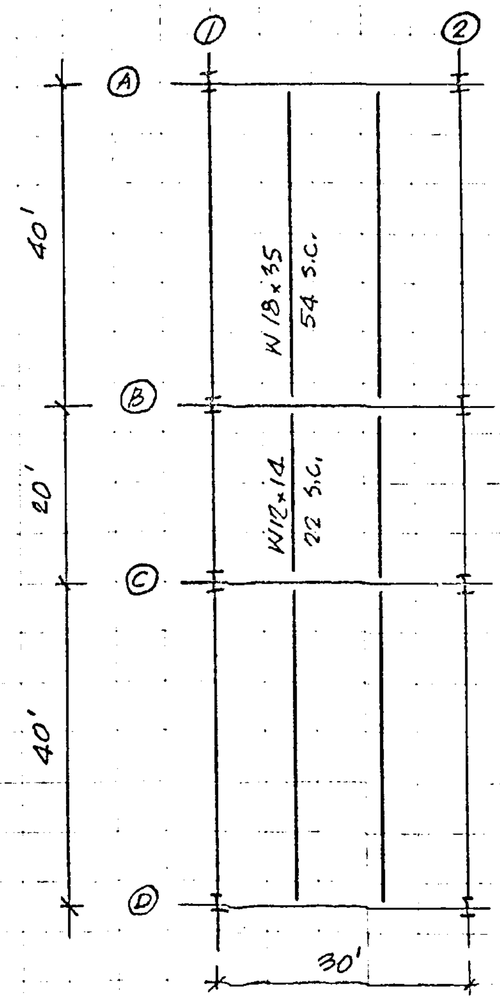
PRELIMINARY TYPICAL FLOOR

Job # 10018

SCHEME 2 ; COMPOSITE BM. 5¼ LTW. CONC.

$F_y = 50$ ksi



LOADS :

LL PTN. 5¼ CONC CLG.
50 + 20 + 45 + 4

L 50
D 45 } 119 PSF
SD 24

Check deck to span 10' ; USE 3 SPAN CONDITION.

$M = 0.1\,w\ell^2$

$\Delta_{max} = 0.0069\, w\ell^4/EI$

$\Delta = 0.0069 \times 45 \times \dfrac{10^4 \times 1728}{29\times10^6 \times 0.419} = 0.442"$

$L/180 = 0.67"$; $0.442 < 0.67$ O.K. ✓

$+f_b = \dfrac{(0.96 \times 45 \times 10^2) + (485.2)(10)}{0.397} = 23\,100$ psi ✓

$-f_b = \dfrac{(1.2 \times 45 \times 10^2) + (246.33)(10)}{0.363} = 21{,}662$ psi ✓

$-f_b = \dfrac{1.2 \times 65 \times 10^2}{0.363} = 21{,}488$ psi

PURLIN A-B

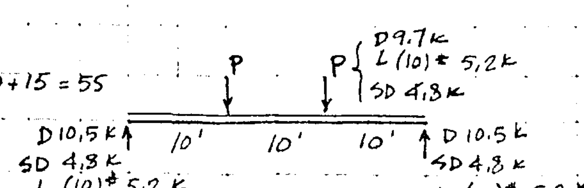
SPAN 40'-0" LOAD D 450 + 35 = 485 ; L 500 ; SD 240 ; 1225 #/' , TL = 49 K $M_T = 2940$ K-" $f_b = 31$ ksi $\Delta_L = 1¾"$ 54 S.C. W18x3[illegible]

PURLIN B-C

SPAN 20'-0" LOAD D 470 ; L 500 ; SD 240 ; 1210 #/' , TL = 24.2 K $M_T = 726$ K-" $f_b = 25$ ksi $\Delta_L = ½"$ 22 S.C. W12x1[illegible]

GIRDER A-(1-2)

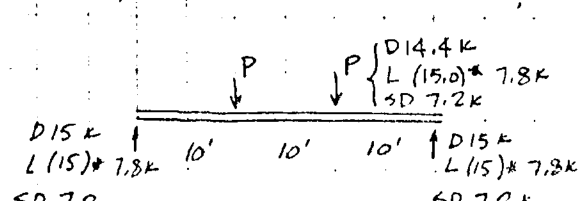
SPAN 30'-0" R = 48% LOAD D 40 + 15 = 55



$M_T = 2434$ K-"
$f_b = 32.5$ ksi
31 [illegible] W16x[illegible]

GIRDER B-(1-2)

SPAN 30'-0" R = 48% LOAD D 40



$M_T = 3582$ K-"
$f_b = 32.5$ ksi
62 [illegible] W18[illegible]

SCHEME 2 (CONT.); COLUMN DESIGN Job # 10018

F_y = 50 KSI

MARK

A-1

LEVEL COL. SPTG.	DEAD (KIPS)	LIVE (KIPS)	L.L. REDUC. (%)	RED. LL (KIPS)	D+RED LL (KIPS)	SIZE
ROOF	32 / 32	12 / 12	–	12	44.0	W8x17
8	45.1 / 77.1	30 / 42	60	16.8	93.9	W8x31
7	122.2	72	↓	28.8	151.0	
6	167.3	102		40.8	208.1	W12x45
5	212.4	132		52.8	265.2	
4	257.5	162		64.8	322.3	W12x58
3	302.6	192		76.8	379.4	W12x58
2	347.7	222		88.8	436.5	W12x65
1	392.8	252		100.8	493.6	
						FTG. 10'-0" x 10'-0" x 29" 9 #8 E.W.

BASE Ⓟ 21" x 21" x 2

B-1

LEVEL COL. SPTG.	DEAD	LIVE	LL REDUC.	RED LL	D+ RED LL	SIZE
ROOF	47 / 47	18 / 18	–	18	65	W8x20
8	66 / 113	45 / 63	60	25.2	138.2	
7	179	108	60	43.2	222.2	W8x40
6	245	153	60	61.2	306.2	
5	311	198	59	79.2	390.2	W12x53
4	377	243	59	97.2	474.2	
3	443	288	58	115.2	553.2	W14x78
2	509	333	58	133.2	642.2	
1	575	378	58	151.2	726.2	W14x87
						FTG. 12'-0" x 12'-0" x 34" 10 #9 E.W.

BASE Ⓟ 25" x 25" x C

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Job Name WEST LOOP OFFICE BLDG.

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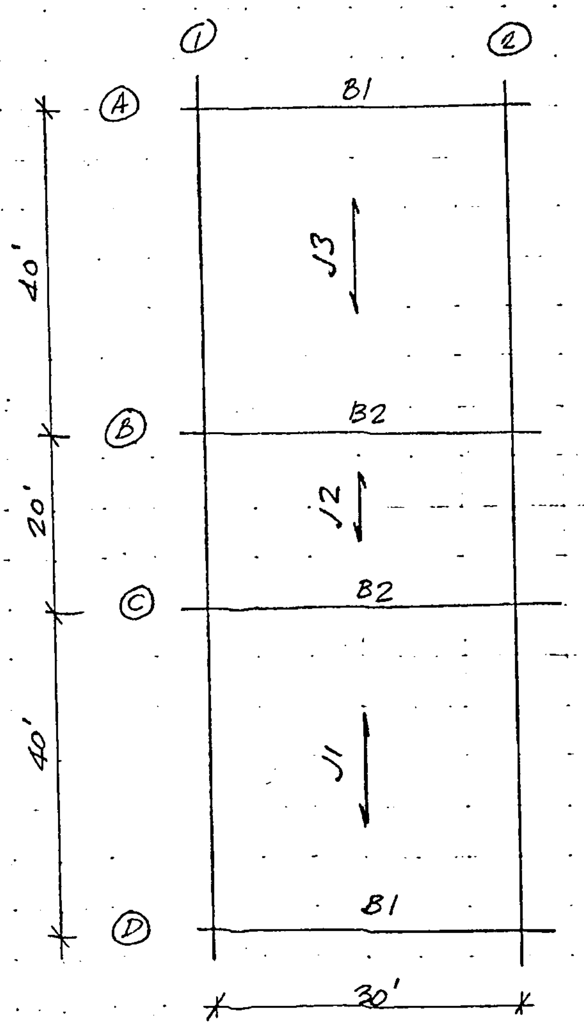
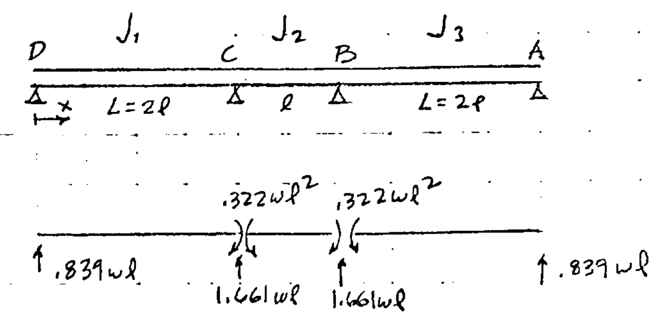
SCHEME 3 LT. WT. CONC. PAN JOISTS $f_c' = 3\,ksi$ Job # 10018



LOADS:

LL	PTN.	JST & BRDG.	SLAB	CLG.	
50 +	20 +	40 +	48 +	4	L 50, D 112 } 162

JOIST:



FOR DC: $M_x = .839\,wl\,x - \frac{wx^2}{2}$

$\frac{dM_x}{dx} = .839wl - wx = 0 \therefore x = .839l$

$+M_{max} = 0.2844wl^2 = 0.0711wL^2$

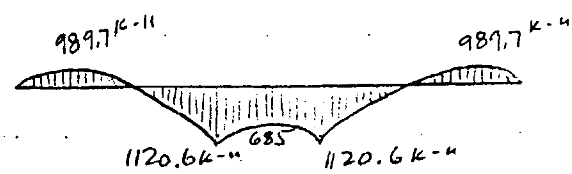
$C \simeq 14 \quad (wl^2/14)$

FOR CB:

$x = 0.5l$

$+M_{max} = 0.25wl^2 - 0.322wl^2 - .125w$

$M_{max} = -0.197\,wl^2$



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Job Name WEST LOOP OFFICE BLDG.

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SCHEME 3 (CONT.)

LW. CONC. $f'_c = 3$ ksi $f_y = 60$ ksi Job # 10018

J1, 20 3/4, d = 19 3/8"

Span – 40'-0" Load = D 336, L 150 — ULT. D 470.4, L 255 — 725 PLF

V = 14720# (at d from face)

+M = 0.0711 × .725 × 40² × 12 = 990 k-in
TAPER INTERIOR END, 5' FROM FACE OF SUPPORT

(D 7.9 k, L 4.3 k; D 10.9 k, L = 5.9 k; 1120.6 k-in)

−M = 1120.6 k-in

b = 15" k = 176 ρ = 0.33% ; k = 498 ρ = 1.5%

v = 104 Psi
A_s = 0.96 in² — 1 #6 BOT
$-A_s$ = 1.74 in² — 1 #7 BOT.

J2, 20 3/4, d = 19 3/8"

Span – 20'-0" Load = D 336, L 150 — ULT. D 470.4, L 255 — 725 PLF

V = 7250#

(1120 k-in; D 4.7 k, L 2.5 k; D 4.7 k, L 2.5 k; 1120 k-in)

−M = 1120.6 k-in

k = 498 ρ = 1.5%

v = 54 psi — 2 #9 × 43' T
min A_s = 0.38 in² — 1 #6 BOT
$-A_s$ = 1.74 in²

B1, 24" × 20 3/4", d = 18.75"

R = 48%

Span – 30'-0" Load = FLOOR + WALL + BM: D 2240, 15, 480 = 2735; L 1000 (1000)* — ULT. D 3829, L 884 — 4713 PLF

V = 70700#

M = wl²/16 = 4713 × 30² × 12/16 = 3182 k-in — b = 51" k = 176 ρ = .33%

STIRRUPS 50 – #3, 10@4 / 14@7 / 1@36 /

−M = wl²/11 = 4629 k-in — k = 549 ρ = 1.18%

v = 157 psi — 2 #11 TOP
A_s = 3.16 in² — 2 #9 BOT
$-A_s$ = 5.31 in² — 1 #10 BOT

B2, 30 × 20 3/4", d = 18.75"

R = 60%

Span – 30'-0" Load = FLOOR + BM: D 3360 + 519 = 3879; L 1500 (1500)* — ULT D 5430, L 1020 — 6450 PLF — 2 #10 TOP

V = 96754#

M = 6450 × 30² × 12/16 = 4354 k-in — b = 70" k = 176 ρ = 0.33%

STIRRUPS 46 – #3, 19@6 / 3@9 / 1@36 /

−M = wl²/11 = 6333 k-in — k = 600 ρ = 1.37%

v = 172 Psi — 2 #10 TOP
A_s = 4.33 in² — 2 #11 BOT
$-A_s$ = 7.43 in² — 1 #11 BOT

Span – Load =
v =
A_s =
$-A_s$ =

Span – Load =
v =
A_s =
$-A_s$ =

Span – Load =
v =
A_s =
$-A_s$ =

Span – Load =
v =
A_s =

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SCHEME 3 (CONT.), COLUMNS $f'_c = 4^{ksi}$

MARK

A-1

LEVEL COL. SPTG.	DEAD (KIPS)	LIVE (KIPS)	LL RED, %	RED LL (KIPS)	D+RED LL (KIPS)	SIZE	REINF.	TIES
ROOF	72×1.4= 101	13×1.7=22 22	–	22	123	14"×14"	4#7	#3@14"
8	87.7×1.4=122.8 223.8	32.5×1.7=55.3 77.3	60	30.9	254.7	14"×14"	4#7	#3@14"
7	346.6	132.6		53.0	399.6	14"×14"	4#7	#3@14"
6	469.4	187.9		75.0	544.4	18"×18"	8#6	#3@12"
5	592.2	243.2		97.3	689.5	18"×18"	8#6	#3@12"
4	715.0	298.5		120.0	835.0	20"×20"	8#7	#3@14"
3	837.8	353.8		141.5	979.3	20"×20"	8#9	#3@18"
2	960.6	409.1		163.6	1124.2	20"×20"	8#11	#4@20"
1	1083.4	464.4		186.0	1269.2			
						FTG. 13'-6"×13'-6" ×38" 10#10 EW		

B-1

LEVEL COL. SPTG.	DEAD (KIPS)	LIVE (KIPS)	LL RED %	RED LL (KIPS)	D+RED LL (KIPS)	SIZE	REINF.	TIES
ROOF	104.8×1.4= 146.7	20×1.7=34	–	34	180.7	16"×16"	4#8	#3@16"
8	127.6×1.4=178.7 325.4	50×1.7= 85 119	60	47.6	373	16"×16"	4#8	#3@16"
7	504.1	204		81.6	585.7	16"×16"	4#8	#3@16"
6	682.8	289		115.6	798.4	20"×20"	4#9	#3@20"
5	861.5	374		149.6	1011.1	20"×20"	8#10	#3@18"
4	1040.2	459		183.6	1223.8	24"×24"	8#10	#3@18"
3	1218.9	544		217.6	1436.5	24"×24"	8#11	#4@22"
2	1397.6	629		251.6	1649.2	24"×24"	12#11	#4@22"
1	1576.3	714		285.6	1861.9			
						FTG. 17'-0×17'-0 ×46" 16#10 EW		

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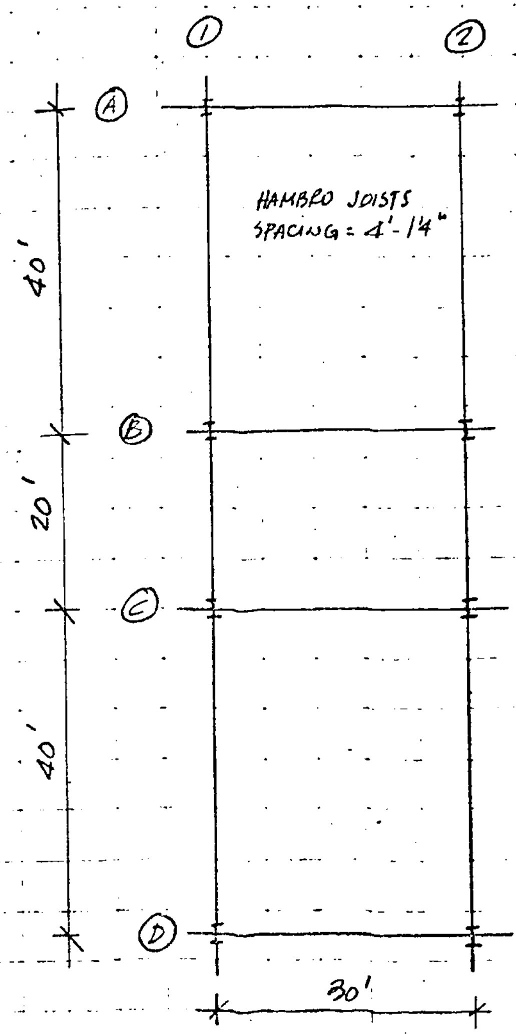
Job Name WEST LOOP OFFICE BLDG.

Architect AL KELLER

SCHEME 4 ; HAMBRO SYSTEM

Job # 10018

$F_y = 50$ ksi



LOADS : LW.

LL	PTN.	3" SLAB	JST	CLG		
50 +	20 +	30 +	2 +	4 =	L 50 / D 56	106

CONSTR. STAGE :

14 + 30 + 11 = L 14 / D 41 } 55

JOISTS :

SPAN : 20', LOAD = 106 × 4.1' = 435 PLF H 1206

SPAN : 40', LOAD = 106 × 4.1' = 435 PLF RH2415

BMS :

A, 1-2 ; SPAN : 30' R=48% LOAD : D 640+35=675 ; L (1000)* 520 ; SD 480 ; 1675 PLF TL = 50.3 (64.7)* ; M = 2261.3 K-"
f_b = 29.8 ksi S.C. 20 W18×35

B, 1-2 ; SPAN : 30' R=53% LOAD : D 960+44=1004 ; L (1500)* 705 ; SD 720 ; 2429 PLF TL = 72.9K (96.7)* ; M = 3279.2 K-"
f_b = 29.0 ksi S.C. 44 W21×44

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Job Name WEST LOOP OFFICE BLDG.

Architect AL KELLER

SCHEME 4 (CONT.): COLUMN DESIGN

Job # 10018

F_y = 50 ksi

MARK

A-1

LEVEL COL. SPTG.	DEAD (KIPS)	LIVE (KIPS)	L.L. REDUC. (%)	RED. LL (KIPS)	D+RED LL (KIPS)	SIZE
ROOF	27.8 27.8	13.7 13.7	–	13.7	41.5	W8x17
8	39.2 67.0	34.1 47.8	60	19.1	86.1	W8x28
7	106.2	81.9		32.8	139.0	
6	145.4	116.0		46.4	191.8	W8x40
5	184.6	150.1		60.0	244.6	
4	223.8	184.2		73.7	297.5	W10x54
3	263.0	218.3		87.3	350.3	
2	302.2	252.4		101	403.2	W10x60
1	341.4	286.5		114.6	456.0	
						FTG. 9'-6" x 9'-6" x 28" 8 #8 EW

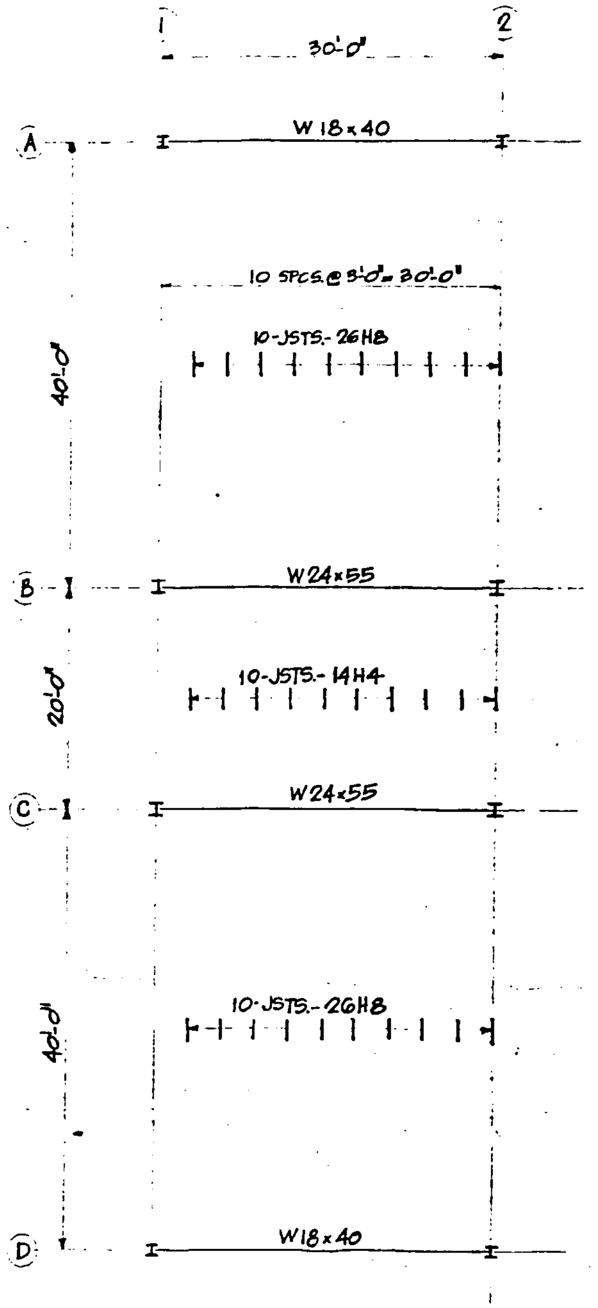
BASE PL 20" x 20" x 2

B-1

LEVEL COL. SPTG.	DEAD (KIPS)	LIVE (KIPS)	LL REDUC. (%)	RED. LL	D+RED LL	SIZE
ROOF	41.8 41.8	20.4 20.4	–	20.4	62.2	W8x20
8	58.7 100.5	51.1 71.5	60	28.6	129.1	W8x35
7	159.2	122.6		49	208.2	
6	217.9	173.7		69.5	287.4	W14x61
5	276.6	224.8		90.0	366.6	
4	335.3	275.9		110.4	445.7	W14x78
3	394	327		130.8	524.8	
2	452.7	378.1		151.2	603.9	W14x84
1	511.4	429.2		171.7	683.1	
						FTG. 12'-0 x 12'-0 x 34 10 #9 EW

BASE PL 24" x 24" x

a.3. Preliminary structural proposal



PLAN - TYPICAL BAY
SCALE: 1/8" = 1'-0"

SCHEME 1

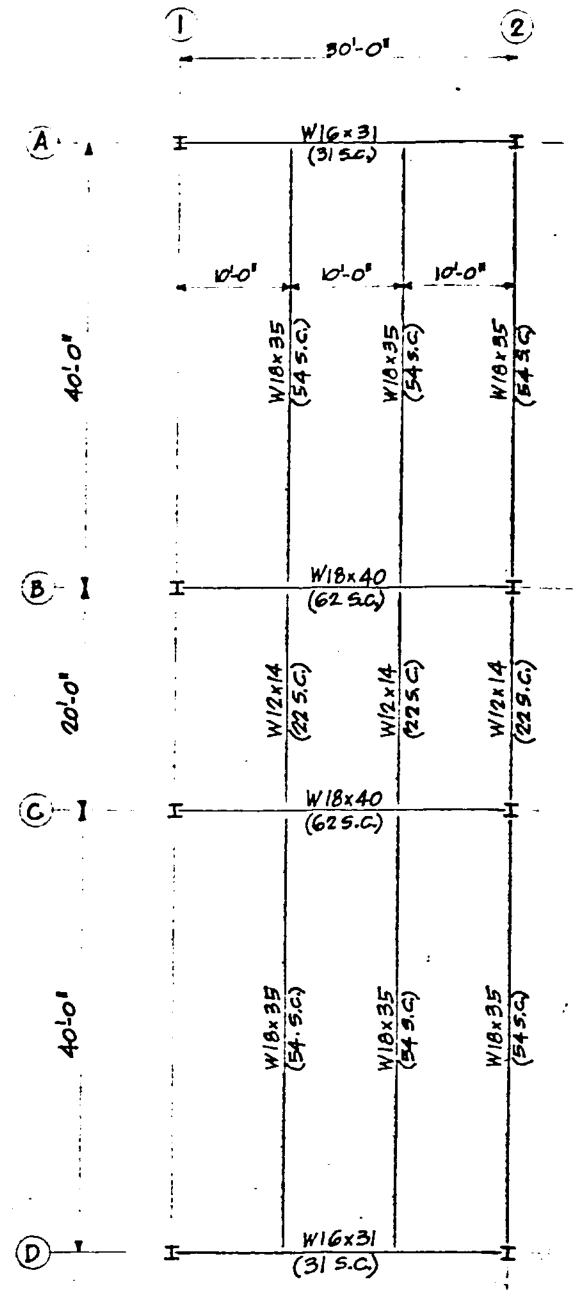
STEEL BEAMS, BAR JOISTS, 2½" LT.WT.CONC.SLAB

COLUMN SCHEDULE

COL. SPTG. \ MARK	A-1, A-2, D-1, D-2	B-1, B-2, C-1, C-2
ROOF – 1ST FL. (columns, bottom to top)	W12x58, W10x49, W8x40, W8x28, W8x17	W12x79, W12x72, W12x53, W8x31, W8x17
COLUMN BASE PL.	PL 2"x20"x1'-8"	PL 2½"x24"x2'-0"
FOOTING SIZE	9'-6"x9'-6"x28"	11'-6"x11'-6"x33"
FOOTING REINF.	8-#8 E.W.	9-#9 E.W.

NOTES:

1. ALL STEEL SHALL BE A572-GRADE 50.
2. FLOOR CONSTRUCTION SHALL BE 2½" CONCRETE ON CORRUGATED METAL DECK (MIN. Sx=.032 IN³)
3. REINFORCE SLAB WITH 6"x6"-#10x#10 W.W.F. - ASTM A-185
4. CONCRETE SHALL BE LIGHT WEIGHT CONC.-TESTING 3000 P.S.I. AT 28 DAYS. EXCEPT AS OTHERWISE NOTED BELOW FOR FOOTINGS.
5. ALL BEAM CONNECTIONS SHALL BE STANDARD WEB CONNECTIONS.
6. CONCRETE FOR FOOTINGS SHALL BE STONE CONC. TESTING 3,000 P.S.I. AT 28 DAYS.



PLAN - TYPICAL BAY
SCALE: 1/8" = 1'-0"

SCHEME 2

STEEL-COMPOSITE BEAMS, 5¼" LT.WT. CONC. SLAB

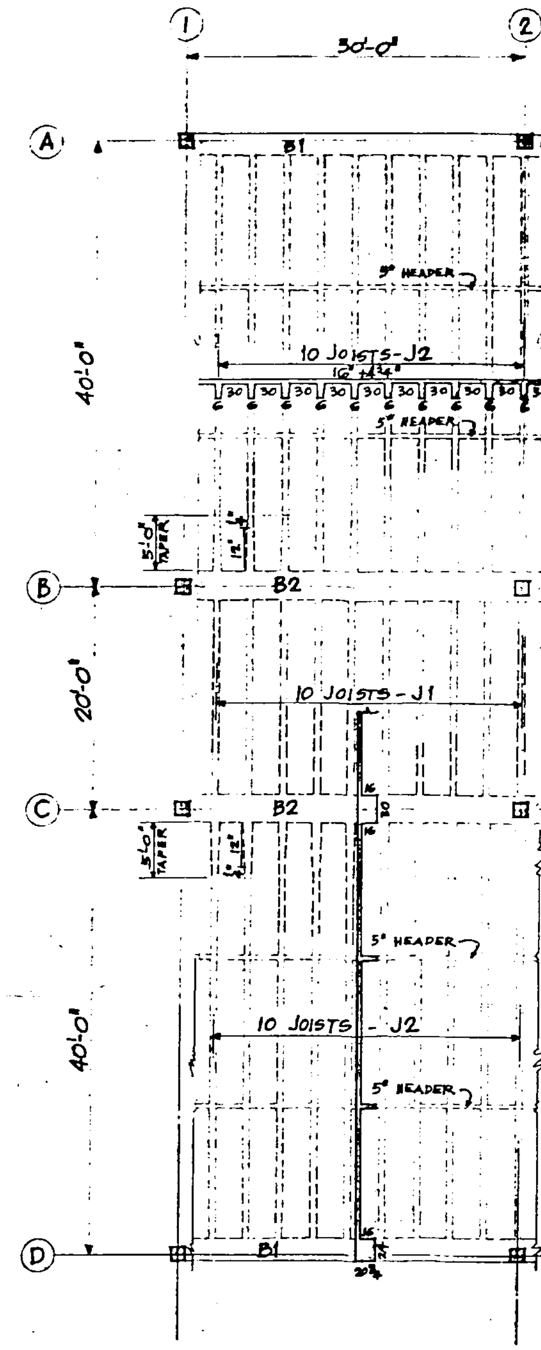
COLUMN SCHEDULE

COL. SPTG. \ MARK	A-1, A-2, D-1, D-2	B-1, B-2, C-1, C-2
ROOF – 1ST FL. (columns, bottom to top)	W12x65, W12x58, W8x45, W8x31, W8x17	W14x87, W14x78, W12x58, W8x40, W8x20
COLUMN BASE PL.	PL 2"x21"x1'-9"	PL 2¾"x25"x2'-1"
FOOTING SIZE	10'-0"x10'-0"x29"	12'-0"x12'-0"x34"
FOOTING REINF.	9-#8 E.W.	10-#9 E.W.

NOTES:

1. ALL STEEL SHALL BE A572, GRADE 50.
2. FLOOR CONSTRUCTION SHALL BE 3¼" CONCRETE SLAB ON 2" DEEP, QL99 18GA. METAL COATED STEEL DECK AS MANUFACTURED BY H.H. ROBERTSON CO., OR EQUAL. (TOTAL 5¼").
3. REINFORCE SLAB WITH 6"x6"-#10x#10 W.W.F. IN TOP - AST.M. A185.
4. CONC. (EXCEPT FOR FOOTINGS) TO BE LT.WT. CONC., TESTING 3,000 P.S.I. AT 28 DAYS.
5. (S.C.) SHEAR CONNECTORS SHALL BE ¾"x4 3/16" B.W.
6. CONCRETE FOR FOOTINGS SHALL BE STONE CONC. TESTING 3,000 PSI. AT 28 DAYS.

—PRELIMINARY—
WEST LOOP
OFFICE BUILDING
FOUR FRAMING SCHEMES
DATE 10-4-77



CONCRETE BEAM AND JOIST SCHEDULE

	MARK	SIZE W"	SIZE D"	REINF. TOP	REINF. TOP	REINF. TOP	REINF. BOT.	REINF. BOT.	STIRRUPS NO	STIRRUPS SIZE	STIRRUPS TYPE	STIRRUPS SPACING EA. END
BEAMS	B1	24	20¾	2-#7		4-#8	2-#8	2-#8	50	#3	⊔	1@4/14@7/1@36/
BEAMS	B2	30	20¾	2-#8		6-#8	3-#9	2-#8	46	#3	⊔⊔	1@6/5@9/1@36/
JOISTS	J1	6	20¾				1-#7	1-#6				
JOISTS	J2	6	20¾	5-#7*				1-#6				

* TOP BARS 40'-0" LONG

PLAN - TYPICAL BAY
SCALE: 1/8" = 1'-0"

SCHEME 3

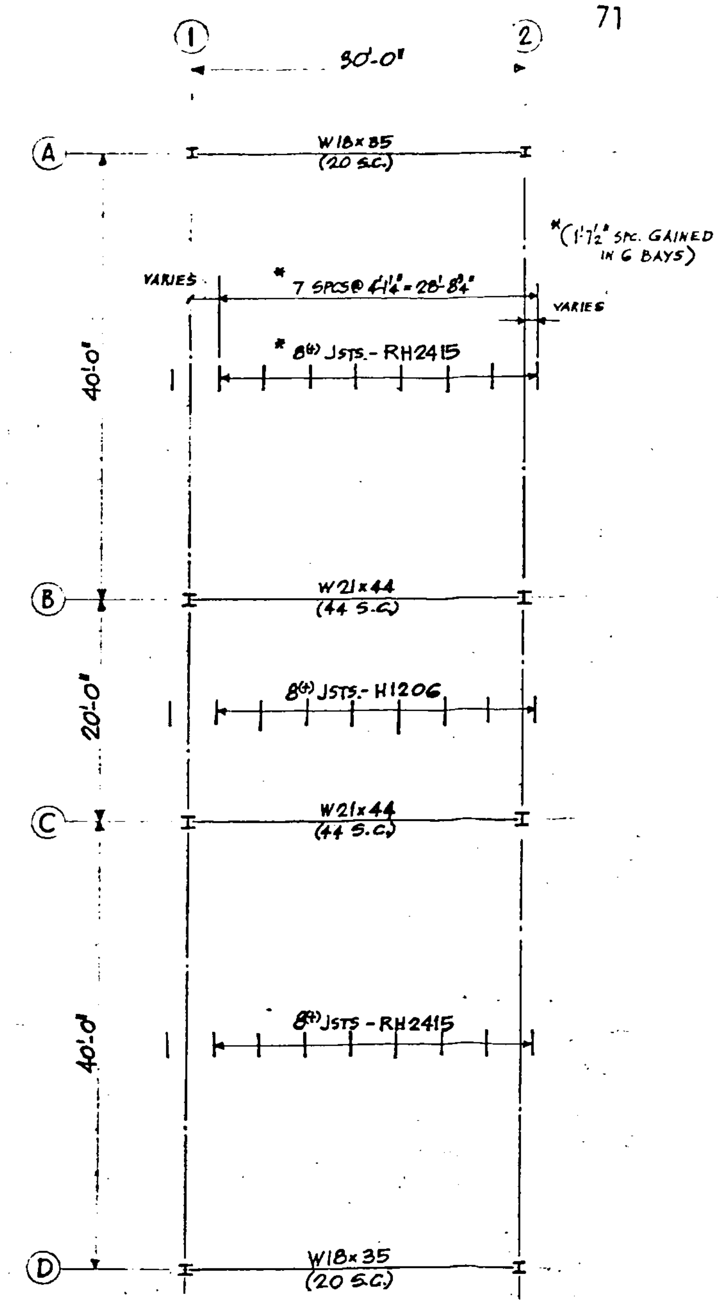
CONCRETE COLUMNS, BEAMS AND JOISTS

COLUMN SCHEDULE

COL. SPTG.	MARK	A-1, A-2, D-1, D-2	B-1, B-2, C-1, C-2
8	SIZE	14"x14"	16x16
	REINF.	4-#7	4-#8
	TIES	#3@14"	#3@16
7	SIZE	14"x14"	16x16
	REINF	4-#7	4-#8
	TIES	#3@14"	#3@16
6	SIZE	14x14	16x16
	REINF	4-#7	4-#8
	TIES	#3@14"	#3@16
5	SIZE	18x18	20x20
	REINF	8-#6	4-#9
	TIES	#3@12	#3@20
4	SIZE	18x18	20x20
	REINF	8-#6	8-#10
	TIES	#3@12"	#3@18
3	SIZE	20x20	24x24
	REINF	8-#7	8-#10
	TIES	#3@14	#3@18
2	SIZE	20x20	24x24
	REINF	8-#9	8-#11
	TIES	#3@18	#4@22
1	SIZE	20x20	24x24
	REINF.	8-#11	12-#11
	TIES	#4@20	#4@22
PLINTH	SIZE	20x20	24x24
	REINF	8-#11	12-#11
	TIES	#4@20	#4@22
FOOTING	SIZE	13'-6"x13'-6"x38"	17'-0"x17'-0"x46"
	REINF.	10-#10 E.W.	16-#10 E.W.

NOTES:

1. ALL REINFORCING BARS SHALL BE GRADE 60 (EXCEPT #3, GRADE 40)
2. SLAB SHALL BE 4¾" CONCRETE OVER 16" DEEP PANS, USING LIGHT WEIGHT CONC. TESTING 3,000 P.S.I. AT 28 DAYS.
3. ALL CONCRETE COLUMNS SHALL BE STONE CONC., TESTING 4,000 P.S.I. AT 28 DAYS.
4. SLAB REINFORCING SHALL BE 4"x8"-W2.1xW1.4 (4"x8"-#8x#10) W.W.F. IN TOP
5. HEADER JOISTS SHALL BE 5" WIDE x 20¾" DEEP AND SHALL BE REINFORCED WITH 1-#5 TOP & BOTTOM. PLACE HEADERS AT 3RD POINTS OF 40'-0" SPANS.
6. CONCRETE FOR FOOTINGS SHALL BE STONE CONC. TESTING 3,000 P.S.I. AT 28 DAYS.



PLAN - TYPICAL BAY
SCALE: 1/8" = 1'-0"

SCHEME 4

"HAMBRO" (COMPOSITE JOISTS)

COLUMN SCHEDULE

COL. SPTG. \ MARK	A-1, A-2, D-1, D-2	B-1, B-2, C-1, C-2
ROOF – 1ST FL. (columns, bottom to top)	W10x60, W10x54, W8x40, W8x28, W8x17	W14x84, W14x78, W14x61, W8x35, W8x20
COLUMN BASE PL.	PL 2"x20"x1'-8"	PL 2½"x24"x2'-0"
FOOTING SIZE	9'-6"x9'-6"x28"	12'-0"x12'-0"x34"
FOOTING REINF.	8-#8 E.W.	10-#9 E.W.

1. ALL STEEL SHALL BE A572, GRADE 50
2. FLOOR CONSTRUCTION SHALL BE 3" CONCRETE SLAB OVER COMPOSITE JOIST - MANUFACTURED BY HAMBRO. REINFORCE WITH 6"x6"-#6x6 W.W.F., ASTM A-185.
3. ALL CONCRETE SHALL BE LIGHT WEIGHT CONC., TESTING 3,000 P.S.I. IN 28 DAYS, EXCEPT AS NOTED BELOW.
4. ALL BEAM CONNECTIONS SHALL BE STANDARD WEB CONNECTIONS.
5. (S.C.) SHEAR CONNECTORS SHALL BE ½"x2" STUDS.
6. CONCRETE FOR FOOTINGS SHALL BE STONE CONC., TESTING 3,000 P.S.I. AT 28 DAYS.

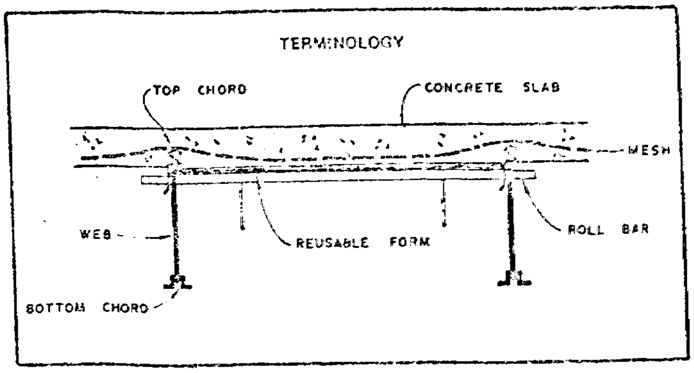
WALTER P. MOORE & ASSOCIATES, INC.
CONSULTING ENGINEERS
2905 SACKETT ST. HOUSTON, TEXAS
PH. (713) 526-5641

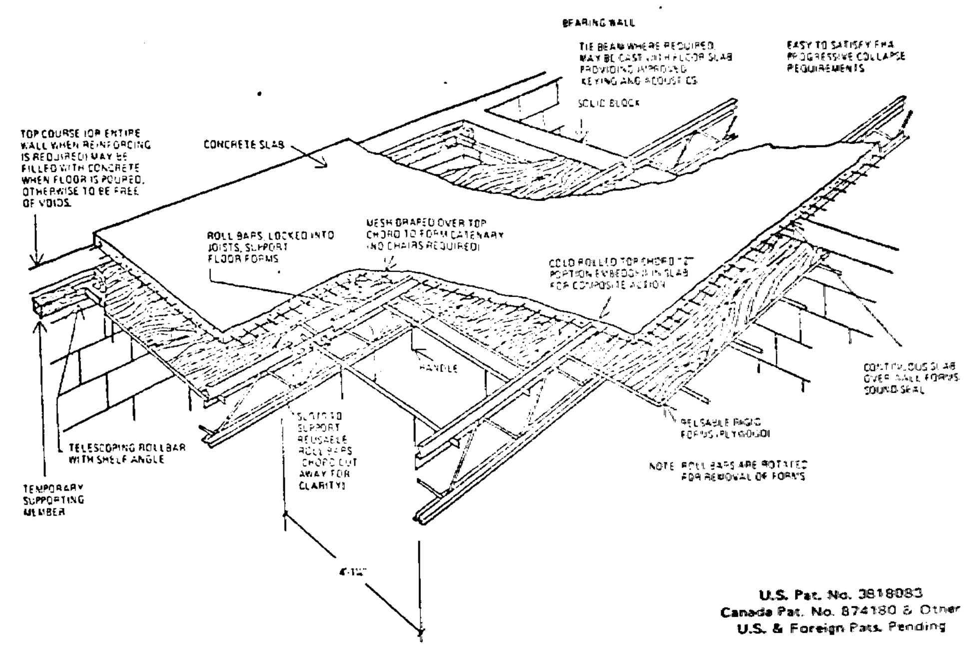
a.4. "Hambro" composite floor system

5.4/Ca

A SIGNIFICANT DEVELOPMENT IN FLOOR CONSTRUCTION

- ☐ NO STEEL DECK
  Thus eliminating the source of vibration and noise transmission
- ☐ NO BRIDGING
  Thus eliminating a continuous connection, a major source of sound and vibration transmission
- ☐ NO ON-SITE WELDING
- ☐ NO HIGH-CHAIRS





U.S. Pat. No. 3818083
Canada Pat. No. 874180 & Other
U.S. & Foreign Pats. Pending

Composite action with this system is achieved automatically along the entire length of the Hambro top chord. Increased stiffness normally in the order of three times greater than conventional joists and 1/3 the deflection.

b.1. "Posten" computer input sheets

DATA SHEET FORM NO. 1 — LEAVE YELLOW BLANK FOR PROGRAM CNCGRD

USER: XAVIER DATE 10/31/77 PAGE 1 OF 2

NOTE: INSERT DATA ON LINES 1, 2, 3, & 4 ONLY ONCE. LEAVE LINES 1, 2, 3, & 4 BLANK FOR ALL SUBSEQUENT CONTINUOUS SPAN BENTS IN THE SAME JOB.

DO NOT OMIT ANY OF LINES 5 TO 29 BELOW. FOR TELETYPE INPUT INSERT ZERO VALUES. FOR CARD INPUT, ALL BLANK SPACES ARE INTERPRETED AS ZERO VALUES. THEREFORE A BLANK CARD MAY BE USED.

PERMANENT OPTIONS (SEE MANUAL FOR DETAILS)

A: SEC. 18.B.5. LONG OUTPUT, VAR. 1
BOND: BONDED TENDONS
B: LIMITED STEEL STRESS (PSI)
C: LAT. LOAD MOMS., FRAME CONSTANTS
D: BOT. COVER - END SPANS (IN)
E: INITIAL COMP. STRESS (PSI)
F: U FOR TOP CRACKING
G: U FOR BOT CRACKING
H: SHRINKAGE FACTOR (IN/IN)
I: ARBITRARY STRESS LOSS
J: ELIM. BOT. REBAR
K1: MOM. REDIS. (AREAS BEFORE & AFTER)
K2: MOM. REDIS. (AREAS AFTER ONLY)
L: LOAD FACTORS

Line	Field	Entry
1	JOB NAME AND USER'S FIRM NAME. (May be Alphabetic or Numeric)	BAY DESIGN GARAGE 1
2	A	2
2	BOND	0
2	B	0
2	C	0
2	D	0.
2	E	0.
2	F(TOP)	0.
2	G(BOT)	0.
2	H (SHRINK FACT)	0.
2	I, J, K1, K2	0, 0, 0, 0
2	"L" (DL) (LL)	0. 0.
3	DEGREE OF LL SKIP LOADING △1	0
3	SPLITTING TENSILE STRENGTH, PSI △2	0.
3	f'c PSI	4000.
3	ALLOWABLE TENSILE STRESS IN CONCRETE (PSI) TOP △3	380
3	ALLOWABLE TENSILE STRESS IN CONCRETE (PSI) BOTTOM △3	380.
3	ALLOWABLE TENSILE STRESS IN CONCRETE (PSI) INIT. CONDS.	165.
3	WEIGHT OF CONCRETE (PCF)	120.
4	ULTIMATE STR. TENDONS (PSI)	270000.
4	YIELD STR. TENDONS (PSI)	240000.
4	YIELD STR. DEF. BARS (PSI)	60000.
4	YIELD STR. STIRRUPS (PSI)	10000.
4	ALPHA (DECIMAL FRAC.) △4	.083
4	IF "SAND-LIGHTWEIGHT" CONCR. IS USED INSERT 1	0
5	TEMPORARY OPTIONS (SEE MANUAL FOR DETAILS) — AUTO DEPTH L, R, FTMIN	0, 0, 0
5	AXIAL FORCE (KIPS) "M"	0.
5	BAY WIDTH (FT.) "N"	0.
5	MIN. AVG. PRESTRESS (FMIN) (PSI) "O"	200
5	"P" OMIT SPANDREL LEFT, RIGHT △16	0, 0
5	MULTIPLE JOBS "Q"	0
5	ABREVIATED INPUT "R"	0
5	BALANCING LOAD DESIGN △1 SPAN NO.	0
5	BALANCING LOAD DESIGN LOAD (PLF)	0.
6	MISCELLANEOUS DESIGN DATA — NO. OF SPANS △5	3
6	NO. OF LEFT CANTLV. △6	1
6	NO. OF RIGHT CANTLV. △6	1
6	EXTRA PRESTRESS ALLOWED LEFT 1-YES 0-NO	0
6	EXTRA PRESTRESS ALLOWED RIGHT 1-YES 0-NO	[illegible]
6	CONCRETE COVER TO C.G. TENDONS TOP (IN.) BOTT. (IN.)	[illegible]
6	CONCRETE COVER TO C.G. DEF. BARS TOP (IN.) BOTT. (IN.)	2.0, 2.5
6	INSERT 1 IF SLAB OR CONCRETE JOIST CONSTRUCTION	1
6	INSERT 1 IF FLAT PLATE SPANNING 2 WAYS △17	0
6	FILL IN ONLY IF AVG. PRESTRESS FOR 1 SPAN IS SPECIFIED △1 — SPAN NO. △14, EFF. PRESTR. (P.S.I.)	[illegible]

Line	SPAN NUMBERS	1	2	3	4	5	6	7	8	9
7 △8	SPAN NAMES	J1	J2	J3						
8	SPAN (FEET)	45.0	60.	45.						
9	TOTAL DEPTH (Inches)	23.	23.	23.						
10	BOTTOM WIDTH B (Inches)	6.	6.	6.						
11	TOP WIDTH BT (Inches)	36.	36.	36.						
12	FLANGE THICKNESS T (In.)	3.	3.	3.						
13	SHOULDER G (Inches)	0.	0.	0.						
14	BOTTOM NOTCH HEIGHT HB (In.)	0.	0.	0.						
15	SLOPE WIDTH SW (In.)	1.67	1.67	1.67						
16 △9	UNIFORM LOAD LBS/FT.	372.	372.	372.						
17 △10	RATIO L.L. TO TOT. LOAD	0.403	0.403	0.403						
18 △11	INITIAL TOTAL LOAD	[illegible]	[illegible]	[illegible]						
19 △12	FRACTION OF LIVE LOAD FOR DEFLECTION ONLY	1.0	1.0	1.0						
20 △10	[illegible]	[illegible]	[illegible]	[illegible]						
21	NO. OF CONC. LOADS	0	0	0						
22	NO. PARTIAL UNIF. LOADS	0	0	0						
23	NO. PARTIAL TRIAG. LOADS	0	0	0						

(Lines 9–20: OPTION 8)

FILL OUT LINES 24 AND 25 ONLY IF IT IS DESIRED TO ARBITRARILY SPECIFY GROSS DRAPES AND PRESTRESS. IF REDESIGN OPTION IS NOT USED, INSERT ZEROS ON LINES 24 AND 25. (OR INSERT BLANK CARDS IF CARD INPUT IS USED)

Line		1	2	3	4	5	6	7	8	9
24 △13	DRAPE (Inches)	0.	0.							
25 △13	[illegible]									

Line	COLUMN NUMBERS	1	2	3	4	5	6	7	8	9	10
26 △14	NET HEIGHT OF COLUMN (FT.)	9000.0	9000.0	9000.0	1000.0						
27	WIDTH PARALLEL TO SPAN (In.)	18.	48.	48.	4[illegible]						
28	WIDTH PERPENDICULAR TO SPAN (In.)	12.	12.	12.	1[illegible]						
29 △15	COLUMN HEAD SIZE (In.)	0.	0.	0.							

OMIT DATA FOR THE TWO LINES BELOW UNLESS OPTIONS C1, C3, SHORTENING OPTIONS OR REDESIGN 1 ARE USED

△1 1.0 PRODUCES FULL SKIP LOADING (WORST L.L. PLACEMENTS FOR SHEAR, MOMENT, ETC.). 0.0 PLACES FULL D.L.+L.L. ON ALL SPANS SIMULTANEOUSLY. △2 INSERT ZERO IF NOT KNOWN. △3 TO DESIGN FOR THESE STRESSES INSERT ZEROS FOR ITEMS △7 AND △13.
△4 ALPHA IS THE FRACTION OF THE SPAN FROM CENTER OF COLUMN TO THE POINT OF INFLECTION OF THE TENDON (POINT OF REVERSE CURVATURE). △5 EXCLUSIVE OF CANTILEVERS. △6 INSERT 1 OR 0 △8 MAY BE ALPHABETIC OR NUMERIC. △9 TOTAL LOAD INCLUDING SELF-WEIGHT OF MEMBER. △10 DECIMAL FRACTION. △11 FOR INITIAL CONDITIONS. △12 L.L. REDUCING MULTIPLIER FOR DEFLECTION COMPUTATION. △13 REDESIGN OPTION-PREDETERMINED DRAPES AND PRESTRESS. MAKE ITEMS △7 ZEROS IF REDESIGN OPTION IS USED. △14 THIS VALUE MUST BE GREATER THAN ZERO. △15 DIMENSION PARALLEL TO SPAN (HAVING INFINITE MOMENT OF INERTIA): INSERT ALL ZEROS IF ALWAYS THE SAME WIDTH AS COLUMN. OTHERWISE FILL IN ALL VALUES. △16 INSERT 10 FOR OPT. TEN OR 11 THRU 14 FOR SHORTENING OPTNS.
△16 INSERT 1 WHEN END OF FLAT PLATE IS NOT CONTINUOUSLY SUPPORTED BY SPANDREL OR BEARING WALL. △17 INSERT 2 FOR WAFFLE, 3 FOR FLAT SLAB WITH DROP PANELS (OPTION A4 OR A5).

DATA SHEET FORM NO. 4

89107 JOB NO.	10/31/77 DATE	PAGE 2 OF 2
USER XAVIER		

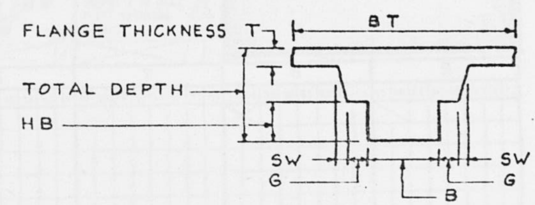
NOTE: OMIT THIS PAGE IF THERE ARE NO CANTILEVERS.

[FILL IN COMPLETELY ANY OF THE 4 FOLLOWING LINES FOR WHICH THERE IS INPUT DATA BY INSERTING ZEROS FOR ZERO QUANTITIES]

		SPAN (FT) (cols 1–7)	TOTAL DEPTH (inches) (cols 8–14)	BOTTOM WIDTH B (inches) (cols 15–21)	FLANGE WIDTH BT (inches) (cols 22–28)	FLANGE THICKNESS T (inches) (cols 29–35)	SHOULDER G (inches) (cols 36–42)	BOTTOM NOTCH HEIGHT HB (cols 43–49)	SLOPE WIDTH SW (inches) (cols 50–56)
1	LEFT CANTILEVER	15.00	23.	6.	36.	3.	0.	0.	1.67
2	RIGHT CANTILEVER	15.00	23.	6.	36.	3.	0.	0.	1.67

		UNIFORM LOAD (lbs/lin.ft.) (cols 1–7)	NUMBER OF CONCENTRATED LOADS (cols 8–14)	RATIO L.L. TO TOTAL LOAD * (cols 15–21)	FRACTION OF L.L. (For deflection only) * (cols 22–28)
3	LEFT CANTILEVER	372	1	0.403	1.0
4	RIGHT CANTILEVER	372	1	0.403	1.0

*Decimal Fraction



SW AND G MAY BE NEGATIVE

CONCENTRATED LOADS, P, (pounds.) INSERT ACTUAL LOADS AND DISTANCES ONLY. LEAVE OTHER SPACES BLANK.

		P_1 (1–7)	P_2 (8–14)	P_3 (15–21)	P_4 (22–28)	P_5 (29–35)	P_6 (36–42)	P_7 (43–49)	P_8 (50–56)	P_9 (57–63)	P_{10} (64–70)
5	LEFT CANTILEVER	900									
6	RIGHT CANTILEVER	900									

DISTANCES FROM CENTER OF END COLUMN TO CONCENTRATED LOADS (Ft.)

		C_1 (1–7)	C_2 (8–14)	C_3 (15–21)	C_4 (22–28)	C_5 (29–35)	C_6 (36–42)	C_7 (43–49)	C_8 (50–56)	C_9 (57–63)	C_{10} (64–70)
7	LEFT CANTILEVER	15.0									
8	RIGHT CANTILEVER	15.0									

FOR REDESIGN ONLY (Omit if not a redesign)

9	LEFT CANTILEVER
10	RIGHT CANTILEVER

DATA SHEET FORM NO. 1 — LEAVE YELLOW BLANK FOR PROGRAM CNCGRD

USER: XAVIER | DATE 10/31/77 | PAGE 1 OF 1

NOTE: INSERT DATA ON LINES 1, 2, 3, & 4 ONLY ONCE. LEAVE LINES 1, 2, 3, & 4 BLANK FOR ALL SUBSEQUENT CONTINUOUS SPAN BENTS IN THE SAME JOB.

DO NOT OMIT ANY OF LINES 5 TO 29 BELOW. FOR TELETYPE INPUT INSERT ZERO VALUES. FOR CARD INPUT, ALL BLANK SPACES ARE INTERPRETED AS ZERO VALUES. THEREFORE A BLANK CARD MAY BE USED.

1 JOB NAME AND USER'S FIRM NAME. (May be Alphabetic or Numeric): PAY DE [illegible] CAFAFE 2

2 A — BOND — B — C — D — E — F(TOP) — F(BOT) — H (SHRINK FACT) — I — J — K1 — K2 — (DL) "L" (LL): 0 .0 1.0

3 DEGREE OF LL SKIP LOADING: 1.0 — SPLITTING TENSILE STRENGTH, PSI: [illegible] — f'c PSI: 4000 — WEIGHT OF CONCRETE (PCF): 120

4 YIELD STR. DEF. BARS (PSI): 60000 — YIELD STR. STIRRUPS, (PSI): 40000 — IF "SAND-LIGHTWEIGHT" CONCR. IS USED INSERT 1: 0

PERMANENT OPTIONS (SEE MANUAL FOR DETAILS)

- A: SEC. 18.8.5, LONG OUTPUT, VAR. 1
- BOND: BONDED TENDONS
- B: LIMITED STEEL STRESS (PSI)
- C: LAT. LOAD MOMS. FRAME CONSTANTS
- D: BOT. COVER - END SPANS (IN)
- E: INITIAL COMP. STRESS (PSI)
- F: U FOR TOP CRACKING
- G: U FOR BOT CRACKING
- H: SHRINKAGE FACTOR (IN IN)
- I: ARBITRARY STRESS LOSS
- J: ELIM. BOT. REBAR
- K1: MOM. REDIS. (AREAS BEFORE & AFTER)
- K2: MOM. REDIS. (AREAS AFTER ONLY)
- L: LOAD FACTORS

5 TEMPORARY OPTIONS (SEE MANUAL FOR DETAILS) — BAY WIDTH (FT.) "N": 0 — "P" OMIT SPANDREL (16) LEFT: 0 RIGHT: 0 — MULTIPLE JOBS "O": 0 — ABREVIATED INPUT "R": 0

6 MISCELLANEOUS DESIGN DATA (5) — CONCRETE COVER TO C.G. DEF. BARS TOP (IN.): 2.0 BOTT. (IN.): 2.5 — INSERT 1 IF SLAB OR CONCRETE JOIST CONSTRUCTION: 1 — INSERT 1 IF FLAT PLATE SPANNING 2 WAYS (17): 0

Line	SPAN NUMBERS	1	2	3	4–9
7 (8)	SPAN NAMES	J1	J2	J3	
8	SPAN (FEET)	60.0	60.	60.	
9	TOTAL DEPTH (Inches)	23.	23.	23.	
10	BOTTOM WIDTH B (Inches)	6.	6.	6.	
11	TOP WIDTH BT (Inches)	36.	36.	36.	
12	FLANGE THICKNESS T (In.)	3.	3.	3.	
13	SHOULDER G (Inches)	0.	0.	0.	
14	BOTTOM NOTCH HEIGHT NB (In.)	0.	0.	0.	
15	SLOPE WIDTH SW (In.)	1.67	1.67	1.67	
16 (9)	UNIFORM LOAD LBS FT.	372.	372.	372.	
17 (10)	RATIO L.L. TO TOT. LOAD	0.403	.403	.403	
18 (4)					
19 (12)	FRACTION OF LIVE LOAD FOR DEFLECTION CALC.	1.0	1.0	1.0	
20 (10)					
21	NO. OF CONC. LOADS	0	0	0	
22	NO. PARTIAL UNIF. LOADS	0	0	0	
23	NO. PARTIAL TRIAG. LOADS	0	0	0	

Lines 9–20: OPTION R

FILL OUT LINES 24 AND 25 ONLY IF IT IS DESIRED TO ARBITRARILY SPECIFY GROSS DRAPES AND PRESTRESS. IF REDESIGN OPTION IS NOT USED, INSERT ZEROS ON LINES 24 AND 25. (OR INSERT BLANK CARDS IF CARD INPUT IS USED)

24 (7)

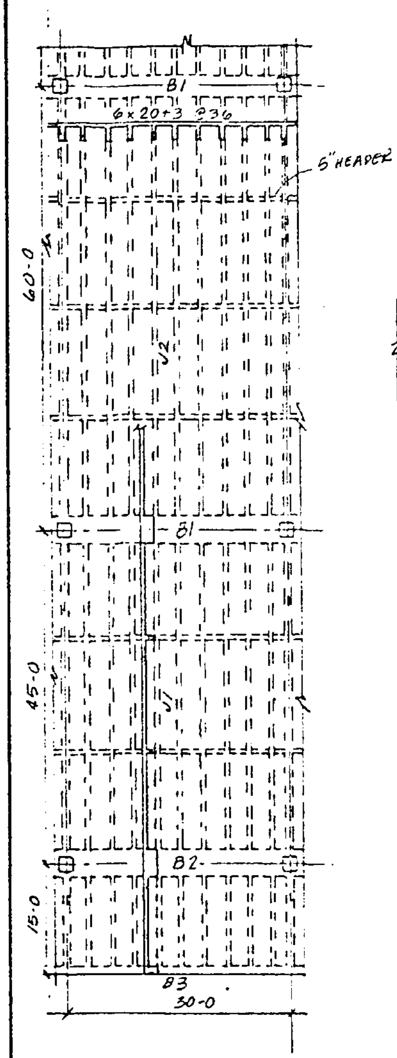
25 (13)

Line	COLUMN NUMBERS	1	2	3	4	5–10
26 (11)	NET HEIGHT OF COLUMN (FT.)	1000.	1000.	1000.	1000.	
27	WIDTH PARALLEL TO SPAN (In.)	16.	43.	43.	43.	
28	WIDTH PERPENDICULAR TO SPAN (In.)	12.	12.	12.	12.	
29 (15)	COLUMN HEAD SIZE (In.)	0.	0.	0.	2 (?).	

OMIT DATA FOR THE TWO LINES BELOW UNLESS OPTIONS C1, C3, SHORTENING OPTIONS OR REDESIGN 1 ARE USED

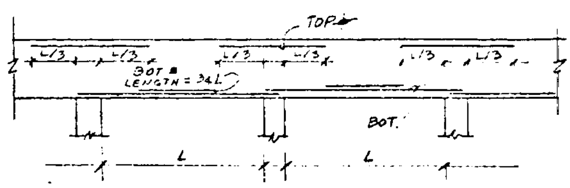
(1) 1.0 PRODUCES FULL SKIP LOADING (WORST L.L. PLACEMENTS FOR SHEAR, MOMENT, ETC.). 0.0 PLACES FULL D.L.+L.L. ON ALL SPANS SIMULTANEOUSLY. (2) INSERT ZERO IF NOT KNOWN. (3) TO DESIGN FOR THESE STRESSES INSERT ZEROS FOR ITEMS (7) AND (13). (4) ALPHA IS THE FRACTION OF THE SPAN FROM CENTER OF COLUMN TO THE POINT OF INFLECTION OF THE TENDON (POINT OF REVERSE CURVATURE). (5) EXCLUSIVE OF CANTILEVERS. (6) INSERT 1 OR 0 (8) MAY BE ALPHABETIC OR NUMERIC. (9) TOTAL LOAD INCLUDING SELF-WEIGHT OF MEMBER. (10) DECIMAL FRACTION. (11) FOR INITIAL CONDITIONS. (12) L.L. REDUCING MULTIPLIER FOR DEFLECTION COMPUTATION. (13) REDESIGN OPTION-PREDETERMINED DRAPES AND PRESTRESS. MAKE ITEMS (7) ZEROS IF REDESIGN OPTION IS USED. (14) THIS VALUE MUST BE GREATER THAN ZERO. (15) DIMENSION PARALLEL TO SPAN (HAVING INFINITE MOMENT OF INERTIA): INSERT ALL ZEROS IF ALWAYS THE SAME WIDTH AS COLUMN, OTHERWISE FILL IN ALL VALUES. (16) INSERT 1 WHEN END OF FLAT PLATE IS NOT CONTINUOUSLY SUPPORTED BY SPANDREL OR BEARING WALL. (17) INSERT 2 FOR WAFFLE, 3 FOR FLAT SLAB WITH DROP PANELS (OPTION A4 OR A5). (18) INSERT 10 FOR OPT. TEN OR 11 THRU 14 FOR SHORTENING OPTNS

b.2. Postensioned concrete joist scheme



MARK	SIZE		REINF. STEEL				STIRRUPS			
	W"	D"	TOP ⌀	BOT.	BOT. ⌀		No	SIZE	TYPE	SPACING EA. END
B1	48	23	6#11	2#11	2#10		34	#3	⊔⊔	@3/15@7.5/1@4.3
B2	48	23	6#10	2#11	1#11		34	#3	⊔⊔	@3/15@7.5/1@4.3

Table: CONCRETE BEAM SCHEDULE



BEAM BAR PLACING DIAGRAM

NOTES:

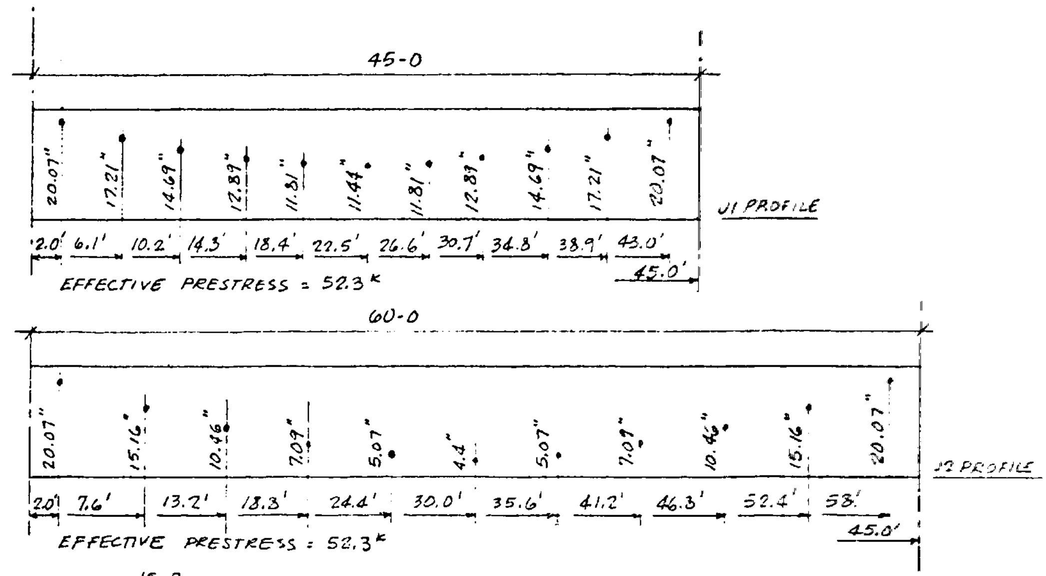
1. ALL REINFORCING BARS SHALL BE GRADE 60 (EXCEPT #3, GRADE 40)
2. SLAB SHALL BE 3" CONCRETE OVER 20" DEEP PANS, USING LIGHT WEIGHT CONCRETE TESTING 4000 PSI AT 28 DAYS, AND SHALL WEIGH NOT MORE THAN 120 POUNDS PER CU. FT.
3. SLAB REINFORCING SHALL BE 6 x 6" W4 x W4 (6 x 6 #4 x #4) WWF IN TOP.
4. CONCRETE HEADER JOISTS SHALL BE PROVIDED SUCH THAT A PAN LENGTH DOES NOT EXCEED 15 FEET BETWEEN HEADERS. HEADERS SHALL BE 5" WIDE AND REINFORCED WITH 1 #5 CONTINUOUS TOP AND BOTTOM.
5. BEAM B3 SHALL BE 12" WIDE, 23" DEEP AND SHALL BE REINFORCED WITH 2 #5 CONT. TOP & BOT. USE #3 STIRRUPS (2) @ 6".

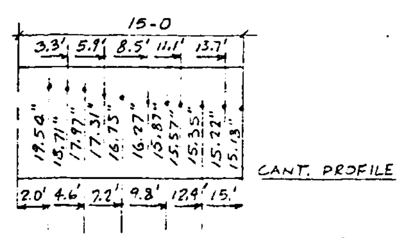
WALTER P. MOORE

TITLE	REVISION	DATE	BY
SCHEME 1 BAY DESIGN - GARAGE			

WALTER P. MOORE & ASSOCIATES, INC.
CONSULTING ENGINEERS
2905 SACKETT STREET HOUSTON, TEXAS 77006

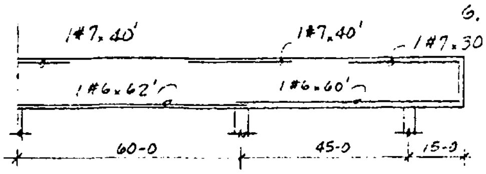
DRAWN	SHEET NO.
CHECKED	1
APPROVED	
DATE	





POST-TENSIONED CONC. NOTES

1. FORCES SHOWN ARE EFFECTIVE AFTER ALL LOSSES.
2. ALL TENDONS SHALL HAVE PARABOLIC DRAPE.
3. C.G.T. IS THE CENTER OF GRAVITY OF THE TENDONS MEASURED FROM THE MEMBER SOFFIT.
4. ALL TENDONS SHALL BE UNBONDED
5. TENDONS FOR PRESTRESSING SHALL CONFORM TO ASTM A 416 AND SHALL BE 270K GRADE WITH A MINIMUM ULTIMATE STRENGTH OF 270000 PSI. AND A YIELD STRENGTH OF 240000 PSI.
6. MINIMUM STRENGTH AT TRANSFER SHALL BE 3000 PSI.



JOIST MILD STEEL PLACING DIAGRAM

WALTER P. MOORE

TITLE	REVISION	DATE	BY
SCHEME 1 BAY DESIGN - GARAGE			

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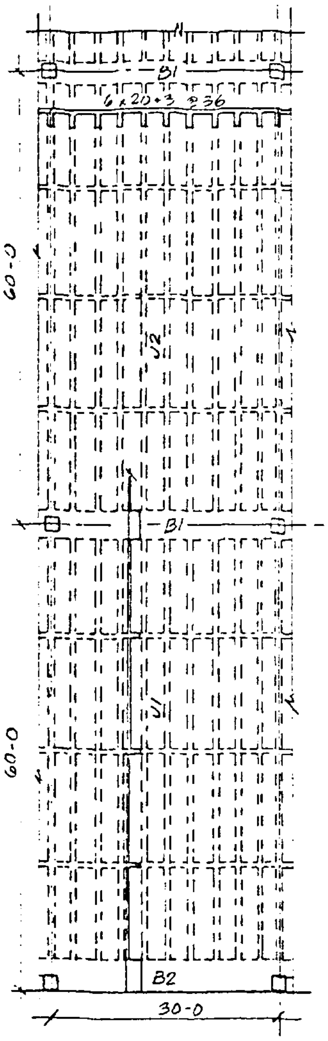


CONCRETE BEAM SCHEDULE										
MARK	SIZE		REINF. STEEL			STIRRUPS				
	W"	D"	TOP	BOT.	BOT.		No	SIZE	TYPE	SPACING EA. END
B1	43	23	8#10	2#11	2#11		36	#3	[illegible]	@3.5/16@7/1@43
B2	48	23	6#10	2#11	1#11		34	#3	[illegible]	@3.5/15@7.5/1@48

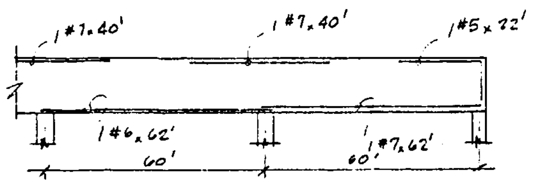
NOTE: SEE SHEET 1 FOR BEAM BAR PLACING DIAGRAM & NOTES.

POST-TENSIONED CONC. JOISTS :

J1 EFFECTIVE PRESTRESS 77.1 K PER JOIST

J2 EFFECTIVE PRESTRESS 77.1 K PER JOIST

NOTE: SEE SHEET 2 FOR POST-TENSIONED CONC. NOTES.



JOIST MILD STEEL PLACING DIAGRAM

TITLE	REVISION	DATE	BY
SCHEME 2 BAY DESIGN - GARAGE			

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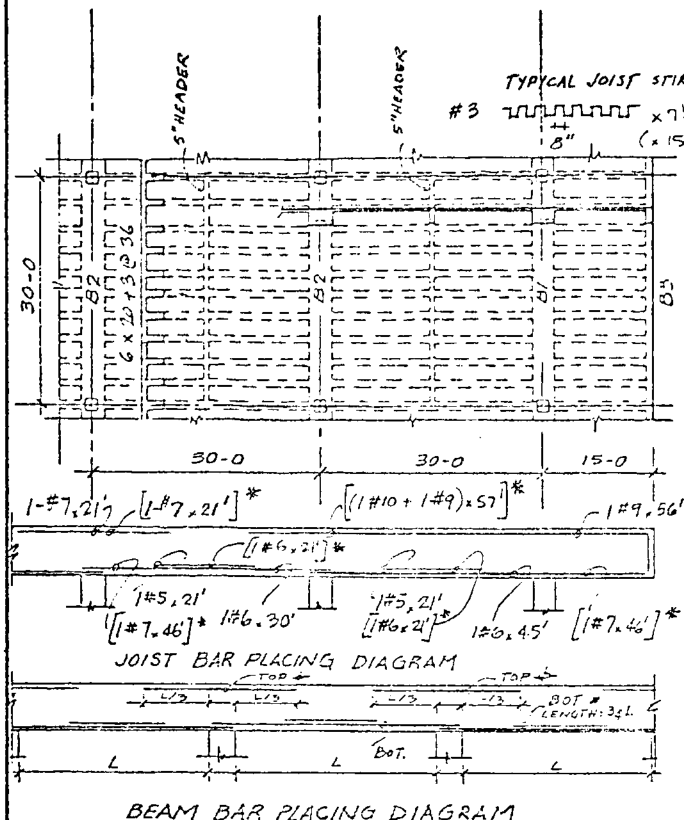
b.3. Reinforced concrete joist scheme



* WITH 20 TON TRUCK LOAD

CONCRETE BEAM SCHEDULE

MARK	SIZE W"	SIZE D"	REINF. STEEL TOP ½	REINF. STEEL BOT.	REINF. STEEL BOT. @	STIRRUPS No.	STIRRUPS SIZE	STIRRUPS TYPE	STIRRUPS SPACING EA. END
B1	36	23	3#10	2#11	2#10	38	#3	⊓⊓	5@6/13@7.5/1@24
B2	36	23	6#10	2#11	2#10	38	#3	⊓⊓	5@6/13@7.5/1@24

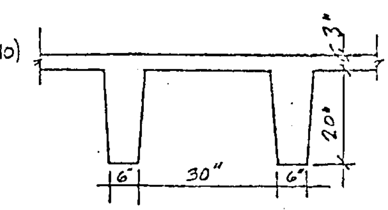
CONCRETE BEAM SCHEDULE *

MARK	SIZE W"	SIZE D"	REINF. STEEL TOP ½	REINF. STEEL BOT.	REINF. STEEL BOT. @	STIRRUPS No.	STIRRUPS SIZE	STIRRUPS TYPE	STIRRUPS SPACING EA. END
B1	36	23	8#11	1#11	3#11	40	#4	⊓⊓	8@6/11@7.5/1@24
B2	36	23	1#11	1#11	3#10	40	#4	⊓⊓	8@6/11@7.5/1@24

[ ]* JOIST REINF. FOR TRUCK LOAD.

NOTES:

1. ALL REINFORCING BARS SHALL BE GRADE 60 (EXCEPT #3, GRADE 40). (EXCEPT #4 STIRRUPS, G 40)
2. SLAB SHALL BE 3" CONCRETE OVER 20" DEEP PANS, USING NORMAL WEIGHT CONC. TESTING 3,000 PSI AT 28 DAYS
3. SLAB REINFORCING SHALL BE 6"x6" W4xW4 (6x6 #4x#4) WWF IN TOP.
4. HEADER JOISTS SHALL BE 5" WIDE x 23" DEEP AND SHALL BE REINFORCED WITH 1-#5 TOP & BOT.
5. BEAM B3 SHALL BE 12" WIDE x 23" DEEP AND SHALL BE REINFORCED WITH 2#5 CONT. TOP & BOT. USE #3 STIRRUPS (⊓) @ 6".



WALTER P. MOORE
115
REGISTERED

TITLE	REVISION	DATE	BY
BAY DESIGN - GARAGE			

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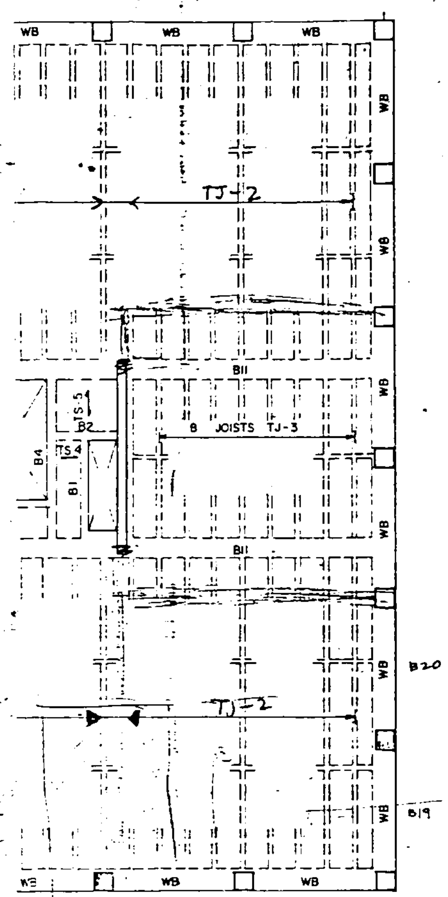
c.1. Typical floor plan

MA…	…PS OR REMARKS
	SPACING EA. END
B…	6/9 at 11/3 at 15/
B…	6/9 at 11/3 at 15/
B…	4 at 6/4 at 9/9 at 11/2 at 18/
B…	6/3 at 9/8 at 11/2 at 15/
B…	
B…	
B7	

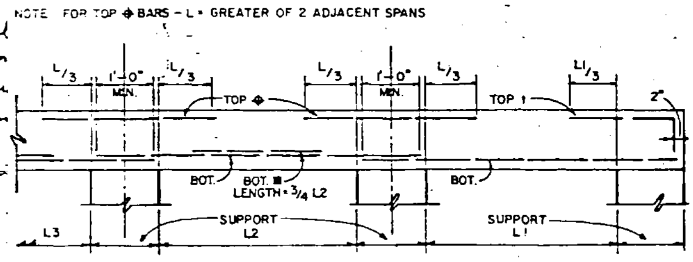
	…PS OR REMARKS
B…	SPACING EA END
B…	
B…	
B…	
B…	

SLAB SCHEDULE					
MARK	THICKNESS	REINFORCING STEEL			
		TOP	TOP 1	TOP ◆	BOT
TS-1	6"		#3 at 12"		#4 at 18"
TS-2	6"		#3 at 12"	#4 at 18"	#4 at 18"
TS-3	5"	#3 at 11"			#3 at 11"
TS-4	5"	#3 at 11"			#3 at 11"
TS-5	5"	#3 at 11"			#3 at 11"
TS-6	6"		#3 at 12"		#4 at 15"



22 story:

NOTE FOR TOP ◆ BARS – L = GREATER OF 2 ADJACENT SPANS



ELEVATION

RAMS

RECEIVED
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SYSTEM 1

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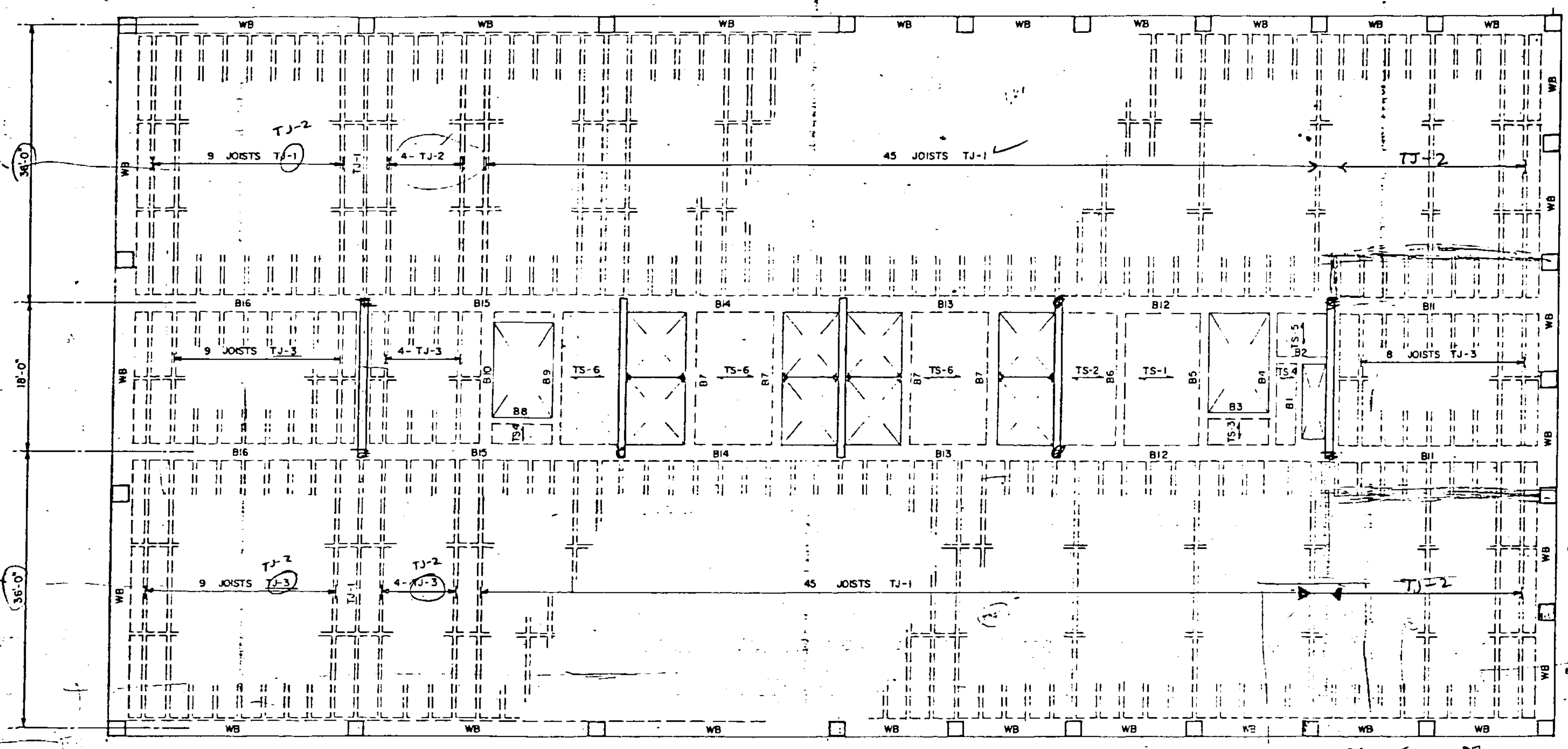
CONC…
P… et · Houston Texas 77019 · (713) 528-6321

BEAM SCHEDULE											
MARK	SIZE W"	SIZE D"	REINFORCING STEEL TOP	TOP †	TOP ◆	BOT ■	BOT.	STIRRUPS OR REMARKS NO	SIZE	TYPE	SPACING EA. END
B1	8"	16"		2-#5			2-#5	8	#3	▢	6/12/2 at 18/
B2	8"	16"	2-#5				2-#5	6	#3		6/12/16/
B3	8"	16"	2-#5				2-#5	8	#3		6/3 at 12/
B4	8"	16"		2-#5			2-#5	20	#3		7 at 6/2 at 12/1 at 18/
B5	10"	20"		2-#5			2-#5	18	#3		6/6 at 9/2 at 12/
B6	10"	20"		2-#5			2-#7	18	#3		6/6 at 9/2 at 12/
B7	10"	20"		2-#5			2-#5	18	#3		6/6 at 9/2 at 12/
B8	8"	16"	2-#5				2-#5	8	#3		6/3 at 12/
B9	10"	20"		2-#5			2-#5	18	#3		6/6 at 9/2 at 12/
B10	10"	24¾"		2-#5			2-#6	12	#3		6/2 at 12/3 at 18/
B11	24"	24¾"		2-#8	3-#10	2-9	3-#9	28	#4		6/3 at 9/8 at 11/2 at 15/
B12	24"	24¾"			6-#10	2-9	5-#9	38	#4		4 at 6/4 at 9/9 at 11/2 at 18/

BEAM SCHEDULE											
MARK	SIZE W"	SIZE D"	REINFORCING STEEL TOP	TOP †	TOP ◆	BOT ■	BOT	STIRRUPS OR REMARKS NO	SIZE	TYPE	SPACING EA. END
B13	24"	24¾"			4-#10	1-#9	2-#9	26	#4	▢	6/9 at 11/3 at 15/
B14	24"	24¾"			4-#10	1-#9	2-#9	26	#4		6/9 at 11/3 at 15/
B15	24"	24¾"			6-#10	2-#9	3-#9	38	#4		4 at 6/4 at 9/9 at 11/2 at 18/
B16	24"	24¾"		2-#8	3-#10	2-#9	3-#9	28	#4		6/3 at 9/8 at 11/2 at 15/

SLAB SCHEDULE					
MARK	THICKNESS	REINFORCING STEEL TOP	TOP †	TOP ◆	BOT
TS-1	6"		#3 at 12"		#4 at 18"
TS-2	6"		#3 at 12"	#4 at 18"	#4 at 18"
TS-3	5"	#3 at 11"			#3 at 11"
TS-4	5"	#3 at 11"			#3 at 11"
TS-5	5"	#3 at 11"			#3 at 11"
TS-6	6"		#3 at 12"		#4 at 15"

JOIST SCHEDULE									
MARK	SIZE W" D"	REINFORCING STEEL TOP	TOP †	TOP ◆	BOT. ■	BOT.	STIRRUPS OR REMARKS NO	SIZE	TYPE	SPACING EA END
TJ-1	6"x20"+4¾"		1-#6		1-#7	1-#7				
TJ-2	6"x20"+4¾"		1-#5			1-#9				
TJ-3	6"x20"+4¾"	3-#5				1-#5				

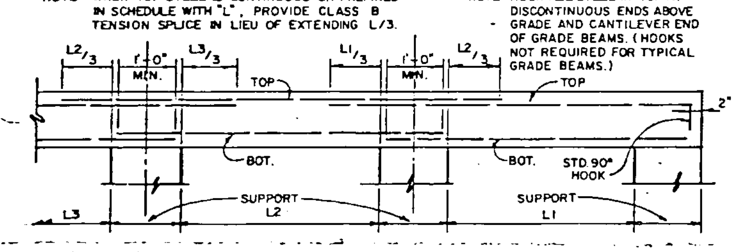


29 story:
[illegible]

NOTES:
1. DESIGN LIVE LOADS
FLOOR: 65# P.S.F.
CORE AREA: 100# P.S.F.
2. FLOOR FRAMING SHALL BE OF LIGHTWEIGHT CONCRETE TESTING 4000 P.S.I. AND SHALL WEIGH NOT MORE THAN 120# P.C.F.
3. ALL REINFORCING STEEL SHALL BE GRADE 60 (#3 BARS SHALL BE GRADE 40) AND SHALL CONFORM TO THE ASTM SPECIFICATION A615
4. 5-WIND FRAMES APPLICABLE TO STRUCTURES EXCEEDING 10 FLOORS ONLY. PROVIDE 3-WIND FRAMES OTHERWISE.

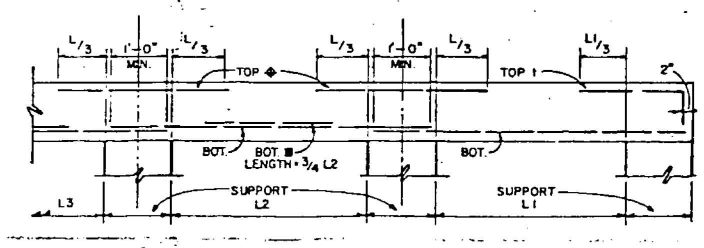
NOTE: WHEN TOP STEEL IS CONTINUOUS OR PREFIXED IN SCHEDULE WITH "L", PROVIDE CLASS B TENSION SPLICE IN LIEU OF EXTENDING L/3.

NOTE: HOOK ALL STEEL IN TOP AT DISCONTINUOUS ENDS ABOVE GRADE AND CANTILEVER END OF GRADE BEAMS. (HOOKS NOT REQUIRED FOR TYPICAL GRADE BEAMS.)



ELEVATION

NOTE: FOR TOP ◆ BARS - L = GREATER OF 2 ADJACENT SPANS



ELEVATION

BAR PLACEMENT DIAGRAMS

RECEIVED
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SYSTEM 1

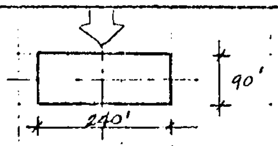
Typical Floor Framing Plan

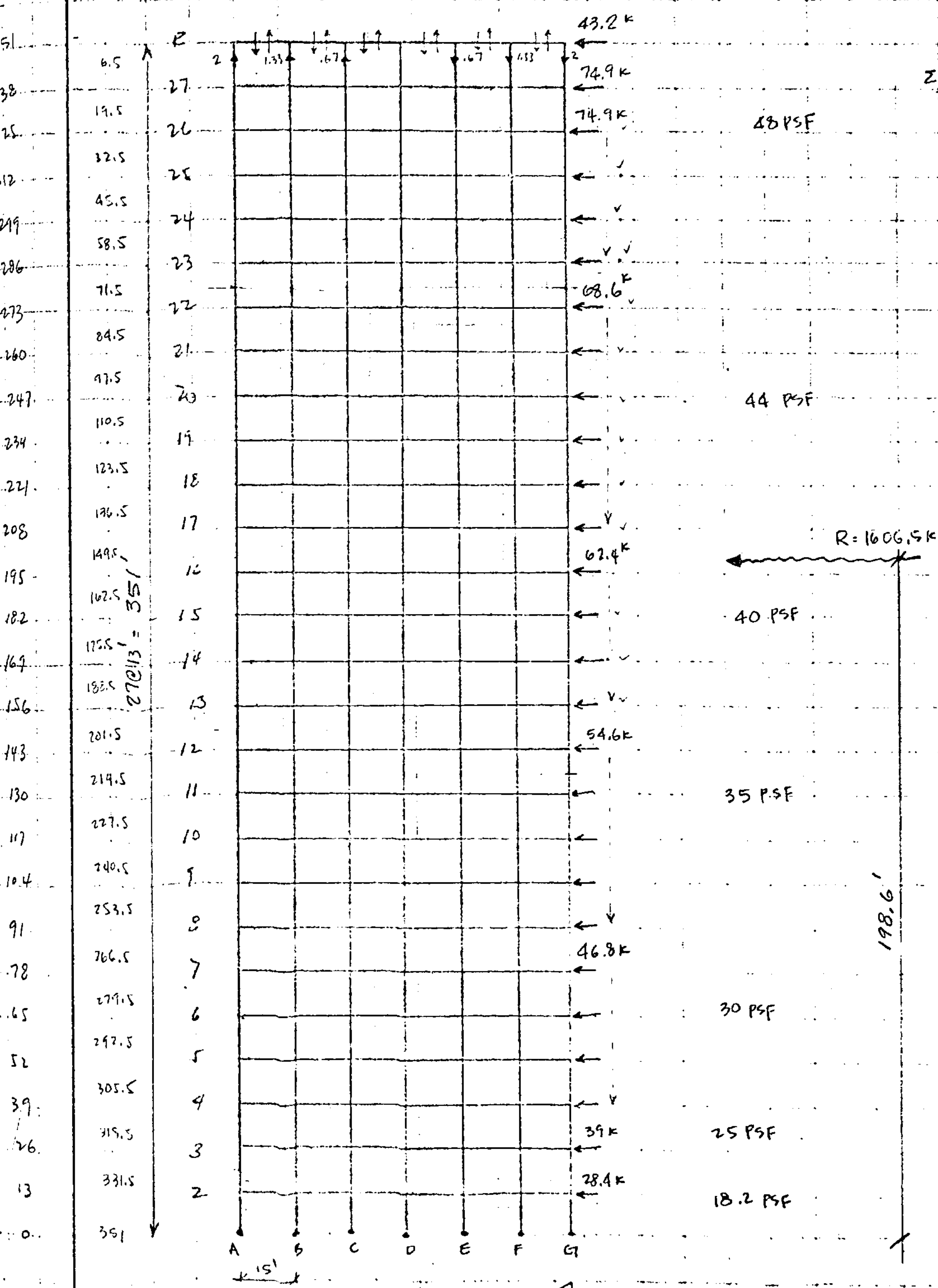
CONCRETE CONSTRUCTION CORE D

PGA ARCHITECTURE-ENGINEERING - A DIVISION OF PIERCE GOODWIN ALEXANDER - 2217 Welch Street - Houston Texas 77019 - (713) 528-6321

c.2. Design calculations

27 STORY BLDG.





$R = 1606.5\ K$

$\frac{\Sigma F_i d_i}{R} = d_i ; \quad \frac{319077.2^{K-'}}{1606.5\ K} = 198.6$

$F_A = -F_G$

$F_B = \frac{30}{45} F_A = -F_F$

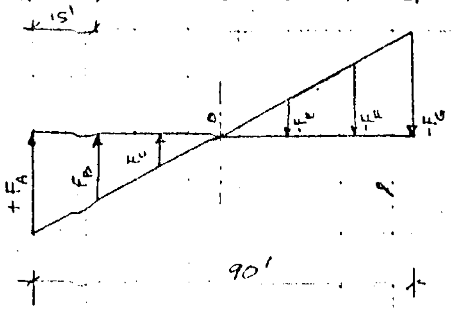
$F_C = \frac{15}{45} F_A = -F_E$

$\Sigma M_A = 0 \therefore$

$-1606.5^K \times 198.6' + \left(\frac{30}{45} F_A\right) \times 15' + \left(\frac{15}{45} F_A\right) \times 30' - \left(\frac{15}{45} F_A\right) \times 60' - \left(\frac{30}{45} F_A\right) \times 75' - F_A \times 90' =$

$F_A = 2279\ K$

$\Sigma M_o : 2(F_A \times 45) + \left(\frac{30}{45} F_A \times 30\right) 2 + \left(\frac{15}{45} F_A \times 15\right) 2 = 140 F_A$



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Houston, Texas 77006

Job Name BLOCK 130 HSTN, CTR.

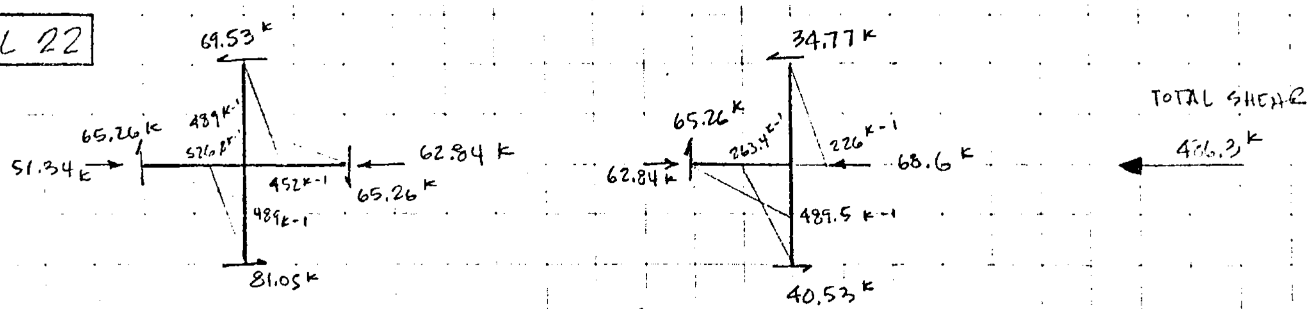
Architect P.G.A.

27 STORY BLDG.

Job #

PORTAL ASSUMPTIONS FOR MOMENTS & SHEARS

LEVEL 22



0.9D + 1.3W

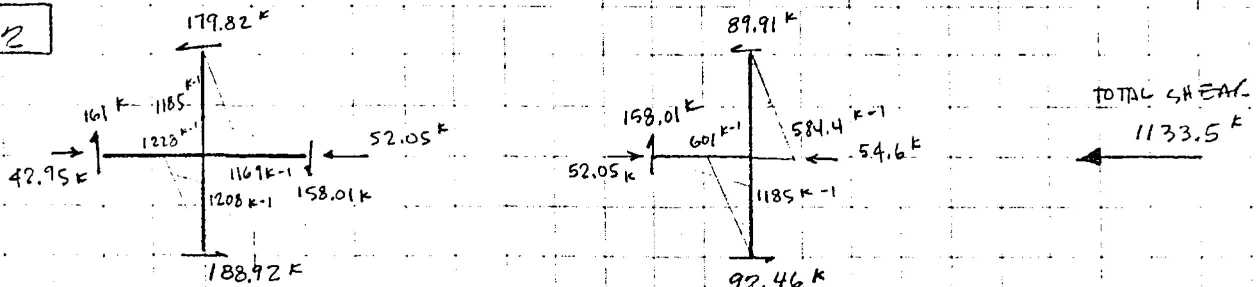
BM. DESIGN: M = 5875 k-' ; Mu = 7880 k-'

b = 12"   k = 603

d = 33"   ρ = 1.26%

As = 5 sq in

LEVEL 12



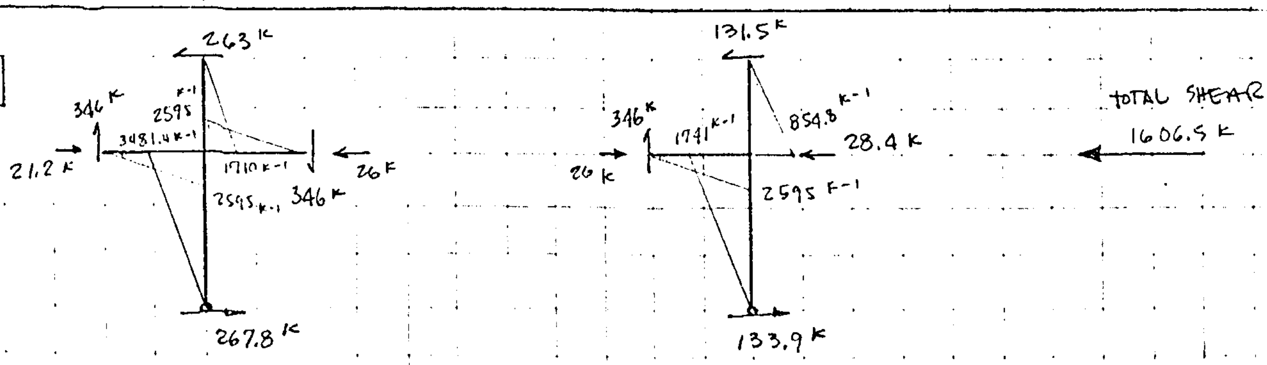
BM. DESIGN: M = 14496 k-' , Mu = 14496 × 1.3 + 269 × 0.9 = 19087 k-'

b = 30"   k = 584

d = 33"   ρ = 1.21%

As = 12 sq in

LEVEL 2



BM DESIGN: M = 31140 k-' ; Mu = 31140 × 1.3 + 269 × 0.9 = 40724 k-'

b = 48"   k = 780

d = 33"   ρ = 1.7%

As = 27 sq in

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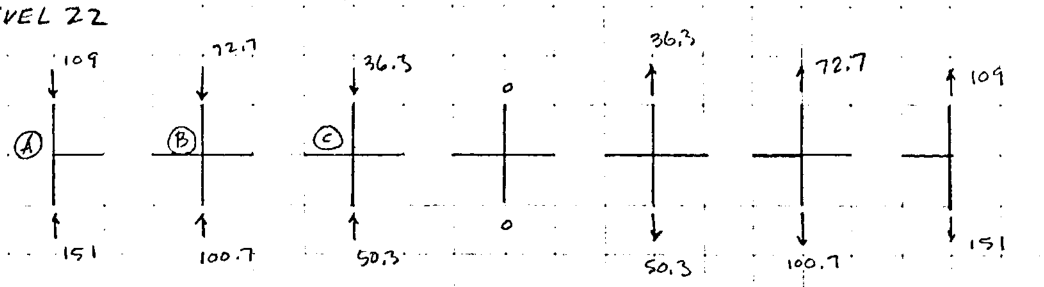
Architect P.G.A.

27 STORY BLDG. $f'_c = 5$ ksi

Job #

CANTILEVER ASSUMPTIONS FOR AXIAL LOAD IN COLUMNS:

LEVEL 22



23-22 ; M = 15260.05 ;
$F_A = 109^k$; $F_B = 72.7^k$; $F_C = 3$...
22-21 M = 21136 ;
$F_A = 151^k$, $F_B = 100.7^k$, $F_C = 50.$...

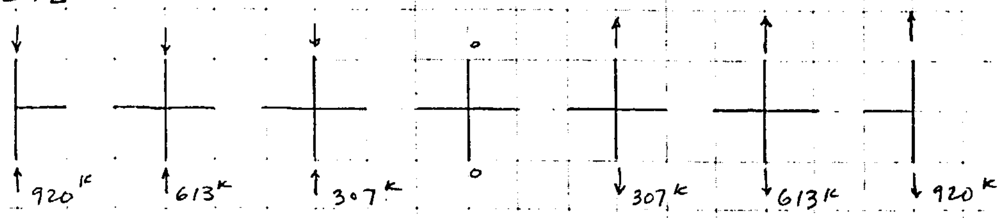
$M_u = 8218^{k-ft}$

$P_u = (466.2^k + 100.7^k \times 1.7)\,0.75 = 478^k$

e = 17.2"

24" x 24" - 8 #11

LEVEL 12



12-11 M = 128778.7
$F_A = 920^k$; $F_B = 613.2^k$; F_C 3...

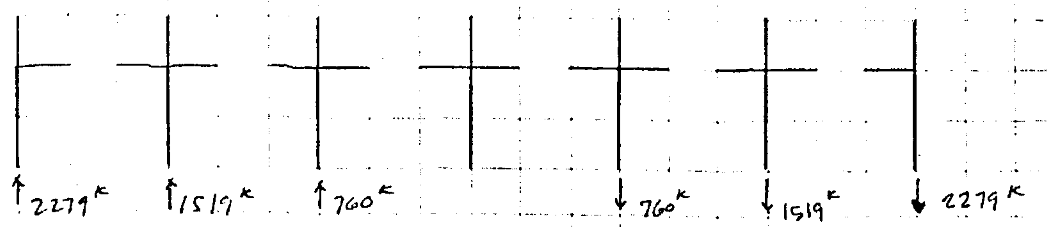
$M_u = (14736) \times 1.3 = 19157^{k-ft}$

$P_u = (1243^k + 613 \times 1.7)\,0.75 = 1714^k$

e = 11.2"

30" x 30" - 20 #14

LEVEL 2



$M_u = 41777 \times 1.3 = 54310^{k-ft}$

$P_u = (2098^k + 1519 \times 1.7)\,0.75 = 3510^k$

e = 15.5"

40" x 40" - 32 #14

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90

Architect P.G.A.

27 STORY BLDG. (90' x 240')

Job #

INTERIOR COLUMN : AREA : 756 sq FT.

f'_c = 5000 PSI

		SIZE	REINF
6 FLOORS	918 K	16 x 16	- 8 #11
5 FLOORS	1683 K	18 x 18	- 8 #18
8 FLOORS	2907 K	26 x 26	- 12 #18
8 FLOORS	4131 K	34 x 34	- 12 #18

AVG. COL. SIZE : 24" x 24"

AVG. COL. REINF : 126 POUNDS PER LINEAR FT. OF COLUMN

2.2 POUNDS PER SQUARE FOOT OF FLOOR AREA (REINF.)

$v_c = 4\sqrt{f'_c} = 219\ psi = 31.54\ k/sq\ FT$

$b_o = 4(34/12 + d) = 11.33 + 4d$

$V_u = 4131\ k - 8\ ksf\ (34/12 + d)^2 = 4131 - 8(2.83 + d)^2$

$$31.54 = \frac{4131 - 8(2.83+d)^2}{0.85(11.33+4d)\,d} \quad \therefore$$

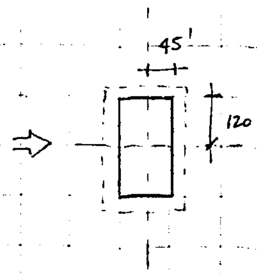
$26.8\,(11.33d + 4d^2) = 4131 - 8\,(8 + 5.66d + d^2)$

$303.6\,d + 107.2\,d^2 = 4131 - 64 - 45.28d - 8d^2$

$115.2\,d^2 + 348.88\,d - 4067 = 0$

$d^2 + 3.03\,d - 35.3 = 0$

$$\frac{-3.03 \pm \sqrt{9.18 + 141.2}}{2} = 4.61' = \boxed{55.4''} \rightarrow t = 60''$$



4 INT. COL. + (W+L+D)

$10327.5^k + 9803\ k = 19606\ k$ (W.L.)

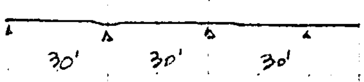
$A = \frac{19606\ k}{5\ KSF} = 3922\ sq\ FT.$

$(45' \times 120' = 5400\ sq\ FT)$

CONSIDER INT. COL. STRIP AS CRITICAL :

$f'_c = 3\ ksi$

$f_y = 60\ ksi$



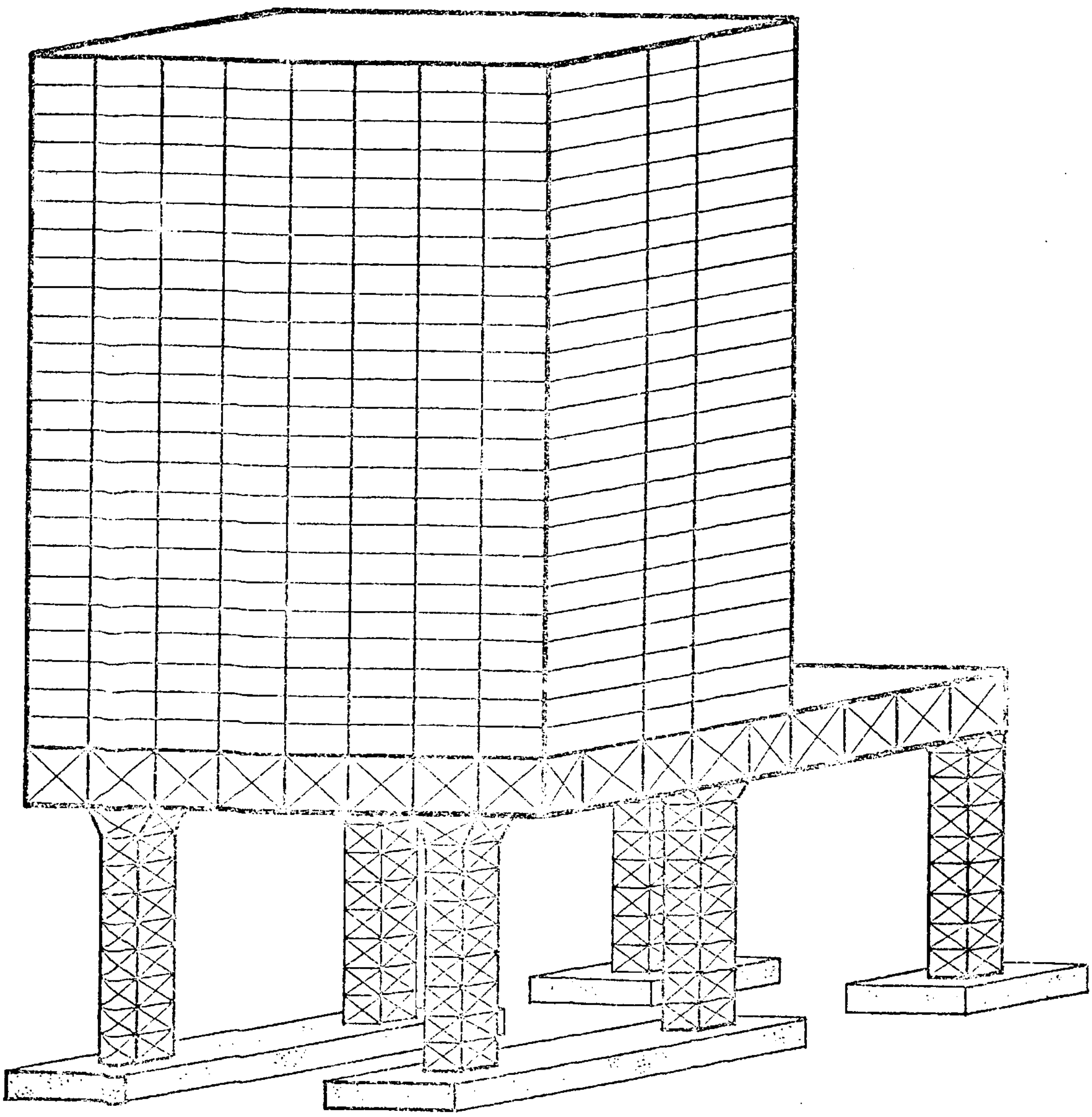
$M_+ = \frac{wl^2}{15} = 8 \times 30^2 \times 12/15 = 5760\ k\text{-}"$ b = 12", d = 56", K = 153 $\rho = .30\%$ $A_s = 2\ in^2/FT$

$M_- = \frac{wl^2}{10} = 8 \times 30^2 \times 12/10 = 8640\ k\text{-}"$ b = 12", d = 56", K = 230 $\rho = .45\%$ $A_s = 3.0\ in^2/FT$

REINF :

3.4 POUNDS OF REINF. STEEL PER CU. FT. OF CONC.

d.1. Sketch of proposed system



PROPOSED SYSTEM

TEN-TEN GARAGE

d.2. Floor framing and calculations

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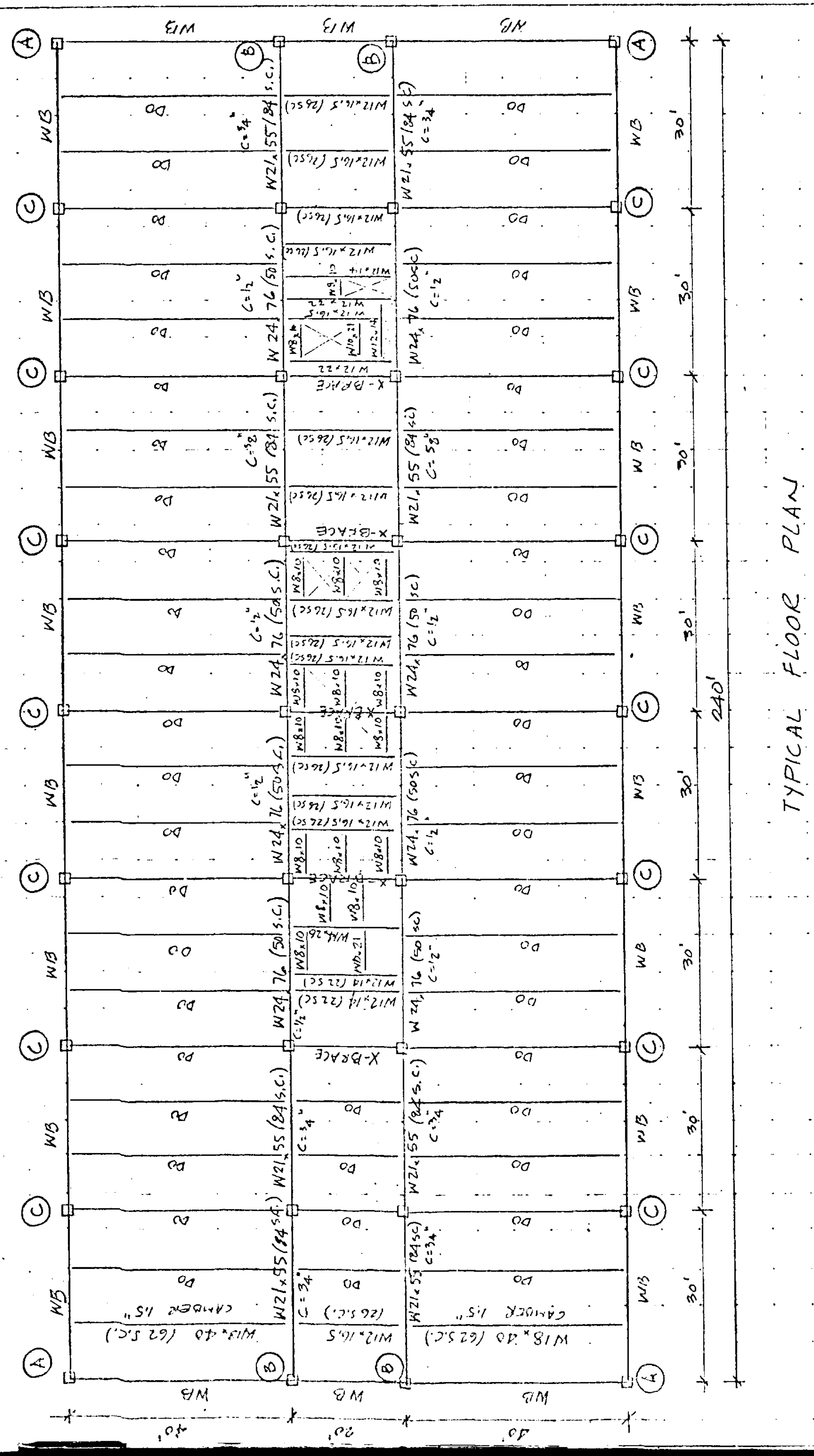
Job Name TEN-TEN GARAGE INV.

Architect TENNECO REALTY

Job #



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GRAVITY LOADS

LOAD:

	LL	LW 5¼" CONC.	PAVER	PART'N, CLG.	TOTAL	
GROUND	100 +	42 +	20		= 162	D 62, L 100 #/□'
TYPICAL GIRDERS =	50 +	42 +	20 +	6	= 118	D 68, L 50
TYPICAL PURLINS =	65 +	42 +	20 +	6	= 133	D 68, L 65
CORE & MECH. =	100 +	42 +		+ 6	= 148	D 48, L 100 (PURLINS & BMS.)
ROOF =	50 +	42 +	20 +	6	= 118	D 68, L 50

BLDG. FACE:

4" BRICK + WINDOW USE 50 PSF

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Job Name [illegible]

Architect [illegible]

Job # [illegible]

TYP. FLOOR $F_y = 50$ ksi

Purlin — SPAN 40'-0" Ld = D 680 / L 650 + BH 35 = D 715 / L 650 1365 #/' TL = 54.6k D 28.6 / L 26.0 f_s = 29.1 ksi M = 3264 "k camber = 1.5" W18x40

Purlin — SPAN 20'-0" Ld: D 715 / L 650 1365 #/' TL = 27.3k D 14.3 / L 13.0 M = 820 "k W12x16.5 f_s = 23.5

Left Str. — SPAN 20'-0" Ld = D 336 / L 700 + 14 = D 350 / L 700 1050 #/' TL = 21k D 7.0 / L 14.0 M = 630 "k W12x14 f_s = 23.3

Left Mech. — X BRACE SPAN 20'-0" Ld = D 580 / L 825 + 14 = D 594 / L 825 1419 #/' TL = 28.4 D 11.9 / L 16.5 M = 852 "k W12x16.5 f_s = 24.4

Left Mech. — SPAN 20'-0" Ld = D 384 / L 800 + 14 = D 398 / L 800 1198 #/' TL = 24.0 D 8.0 / L 16.0 M = 719 "k W12x14 f_s = 24.0

Left Str. — SPAN 20'-0" Ld = D 408 / L 850 + 14 = D 422 / L 850 1272 #/' TL = 25.4 D 8.4 / L 17.0 M = 763 "k W14x26 f_s = 21.7

Right Stair — SPAN 13'-0" Ld = D 288 / L 600 + wall 200 + BH 14 = D 502 / L 600 1102 #/' TL = 14.6 D 8.4 / L 10.7 M = 536 "k W12x16.5 f_s = 30.5

Right Chase — SPAN 20'-0" Ld = D 144 / L 300 + WALL 200 + BH 14 = D 358 / L 300 658 #/' TL = 13.1 D 7.1 / L 6.0 M = 395 "k W12x14 f_s = [illegible]

Rt. Stair — SPAN 12'-0" Ld = WALL 200 + BH 14 = 214 — 8' D 4.5 / L 5.4, 4'; D 2.8 / L 1.8; D 4.3 / L 3.6 M = 357 "k W12x14 f_s = 24.0

OPG. — SPAN 20'-0" Ld = D 144 / L 300 + WALL 200 + BH 14 = D 358 / L 300 658 #/' TL = 13.1 D 7.1 / L 6 M = 395 "k W12x14 22

Lobby — SPAN 20'-0" Ld = D 288 / L 600 + 14 = D 302 / L 600 902 #/ft TL = 18 D 6 / L 12 M = 541.2 "k W12x14 22

Ticket — SPAN 20'-0" Ld = D 384 / L 800 + 14 = D 398 / L 800 1198 #/' TL = 24 D 8 / L 16 M = 719 "k W12x14 22

of Rt. Stair — SPAN 20'-0" Ld = D 240 / L 500 + wall 200 + BH 14 = D 454 / L 500 — 3' D 2.8 / L 1.8, 17'; D 7.0 / L 6.5; D 5.0 / L 5.3 M = 654 "k f_s = 25.9 W12x22

of Rt. Chase — SPAN 20'-0" Ld = D 168 / L 350 + wall 200 + BH 14 = D 382 / L 350 — 3' D 4.3 / L 3.6, 17'; D 7.5 / L 6.7; D 4.5 / L 4.0 M = 740 "k f_s = 29.3 W12x22

of Right Girder — SPAN 30'-0" Ld: BH 50 — D 21.5 / L 19.5, D 21.5 / L 19.5; 12', 6', 12'; D 22.3 / L 19.5; D 22.3 / L 19.5 M = 4990 "k f_s = 29.9 camber 0.74" W21x55 84

Stair Girder — SPAN 30'-0" Ld: BH 50 — D 7 / L 6.5, D 14.3 / L 13.0, D 7.5 / L 6.5, D 3.6 / L 3.0, D 14.3 / L 13.0, D 7.1 / L 6.5; 2', 3', 3', 3', 3', 3', 7'; D 28.0 / L 23.6; D 25.8 / L 23.3 M = 5675 "k b/t = 4 f_s = 24.5 camber 0.5 W21x76 50

Mech. Girder — SPAN 30'-0" Ld: BH 50 — D 21.5 / L 19.5, D 3.5 / L 3.0, D 14.3 / L 13, D 14.2 / L 16.5; 10', 3.5', 6.5', 1.5', 8.5'; D 22.2 / L 23.6; D 21.3 / L 24.4 M = 5643 "k camber W21x76 50

of MECH. PURLINS — SPAN 20'-0" Ld D 480 / L 1000 1480 #/' TL = 29.6k D 9.6 / L 20 M = 888 "k f_s = 25.4 ksi W12x16.5

girders, of Right Stair — SPAN 30'-0" Ld BH 50 — D 19.1 / L 23, D 19.1 / L 23; 10', 10', 10'; D 20 / L 23; D 20 / L 23 M = 5120 "k f_s = 31 ksi camber W21x55 84

girders in bay — SPAN 30'-0" Ld BM 50 — D 4.8 / L 10, D 14.3 / L 13.0, D 4.8 / L 10.0, D 14.3 / L 13, D 4.8 / L 10; 3.5, 1.5, 6, 4, 1.5, 3.5; D 21.4 / L 27.7; D 21.7 / L 28.0 M = 6053 "k f_s = 26 camber W21x76 50

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Job Name TEN-TEN GARAGE INVESTIGATION

Architect TENNECO REALTY

Job # [illegible]

COL. MARK (A) K=1

COL. SPTG. LEVEL	Lux Luy	DEAD LOAD (KIPS)	LIVE LOAD (REDUCED) (KIPS)	DL + LL	COL SIZE
ROOF	13'	30.3	20.8	51.1	
	13'	30.3	20.8	51.1	
24th	13'	30.3	20.8	51.1	
	13'	60.6	41.6	102.2	
23th	13'	30.4	20.8	51.2	
	13'	91.0	62.4	153.4	
22	13'	30.4	20.8	51.2	
	13'	121.4	83.2	204.6	
21	13'	30.5	20.8	51.3	
	13'	151.9	104	255.9	
20	13'	30.5	20.8	51.3	
	13'	182.4	124.8	307.2	
19	13'	30.6	20.8	51.4	
	13'	213	145.6	358.6	
18	13'	30.6	20.8	51.4	
	13'	243.6	166.4	410	
17	13'	30.7	20.8	51.5	
	13'	274.3	187.2	461.5	
16	13'	30.7	20.8	51.5	
	13'	305	208	513	
15	13'	30.8	20.8	51.6	
	13'	335.8	228.8	564.6	
14	13'	30.8	20.8	51.6	
	13'	366.6	249.6	616.2	
13	13'	30.9	20.8	51.7	
	13'	397.5	270.4	667.9	
12	13'	30.9	20.8	51.7	
	13'	428.4	291.2	719.6	
11	13'	31.0	20.8	51.8	
	13'	459.4	312	771.4	
10	13'	31.0	20.8	51.8	
	13'	490.4	332.8	823.2	
9	13'	31.1	20.8	51.9	
	13'	521.5	353.6	875.1	
8	13'	31.1	20.8	51.9	
	13'	552.6	374.4	927	

COL MARK (A) (CONT.)

7	13'	31.2	20.8	52.0	
	13'	583.8	395.2	979	
6	13'	31.2	20.8	52.0	
	13'	615	416	1031	
5	13'	31.3	20.8	52.1	
	13'	646.3	436.5	1083.1	
4	13'	31.3	20.8	52.1	
	13'	677.6	457.6	[illegible]	
3	13'	31.4	20.8	52.2	
	13'	709	478.4	1187.4	
2	13'	31.4	20.8	52.2	
	13'	740.4	499.2	1239.6	
GROUND		31.5	20.8	52.3	
		772	520	1292	

d.3. Wind reactions

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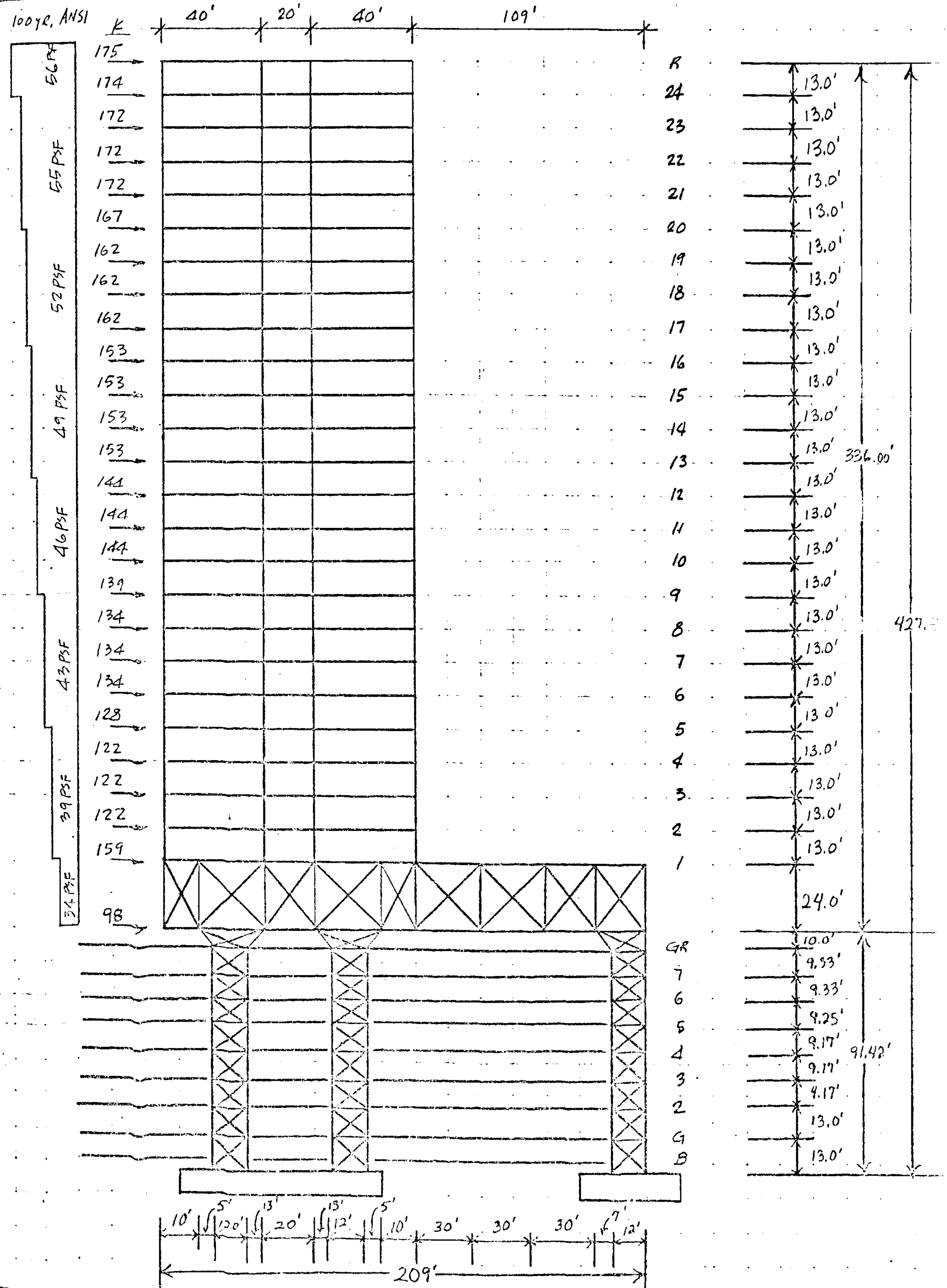
Job Name TEN-TEN GARAGE INVESTIGATION
100
Architect TENNECO REALTY

Job # 14016



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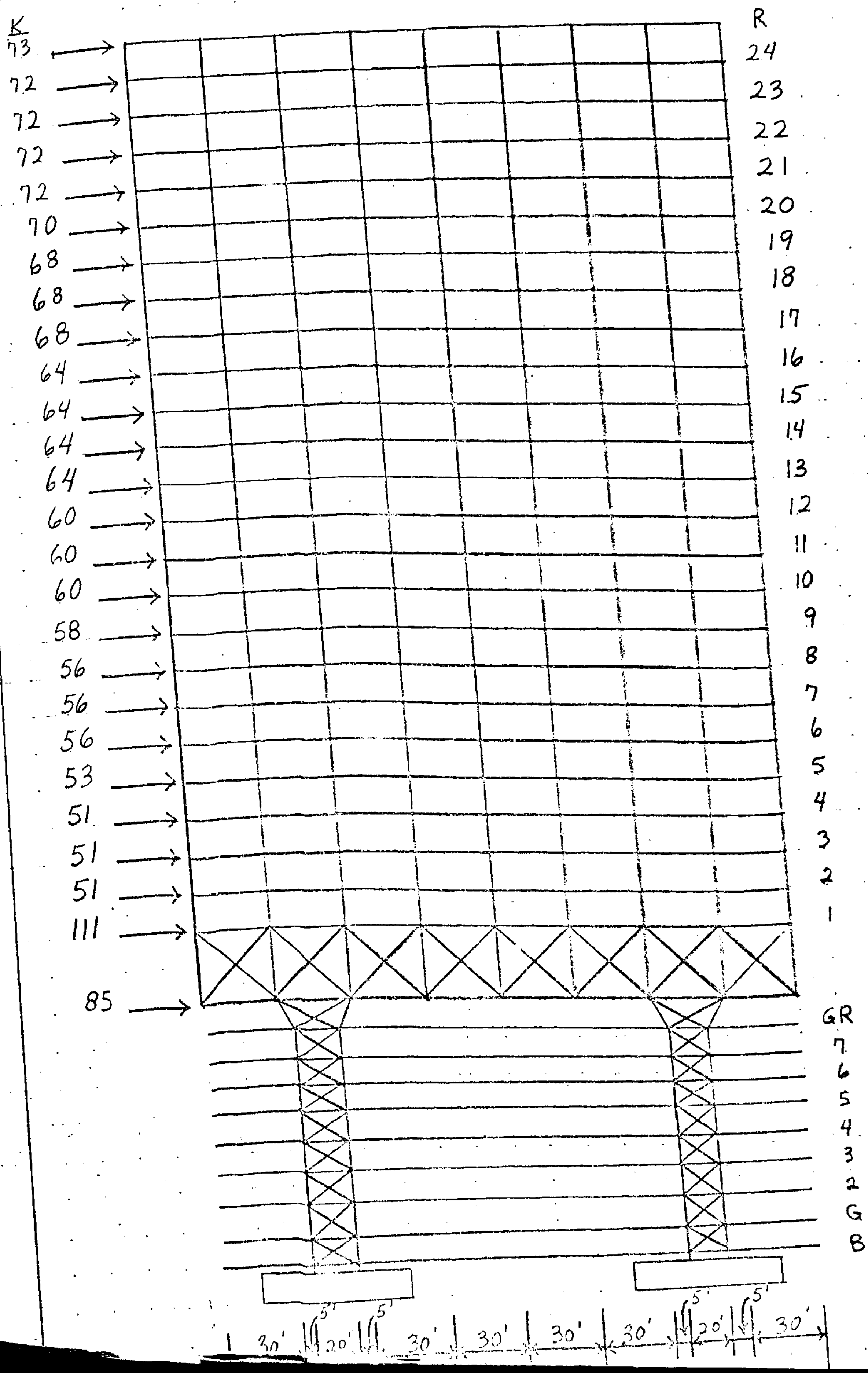
Houston, Texas 77006

Job Name TEN-TEN GARAGE INV.

Architect TENNECO REALTY 101

Job #



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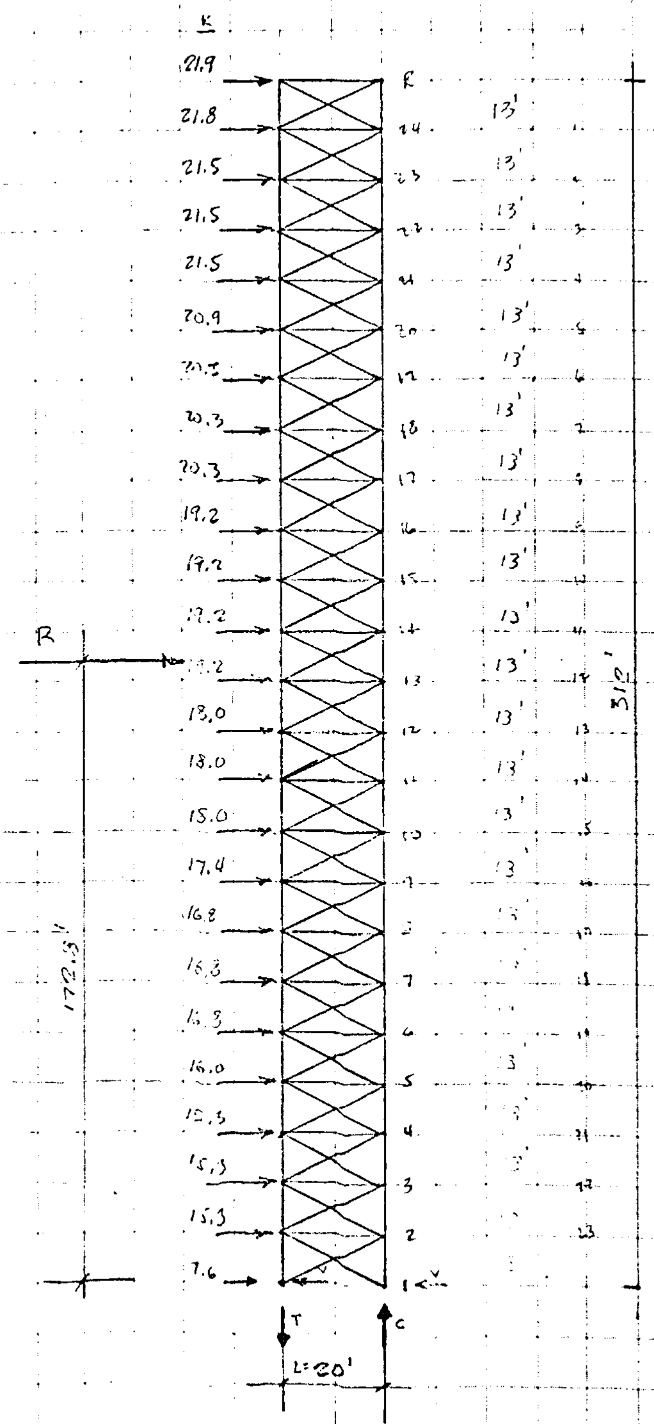
Job Name: TEN-TEN GARAGE [illegible]

Architect: [illegible]

Job #

TYP. X-BRACE



$R = 450.5^k$

$\frac{\Sigma F_i d_i}{R} = d$; $\frac{77845.3^{k'}}{450.5^k} = 172.8'$

$T = C$

$Rd = TL$

$\frac{(450.5^k)(172.8')}{20'} = T = C = 3892.3^k$

$V = \frac{R + 7.6}{2} = 229^k$

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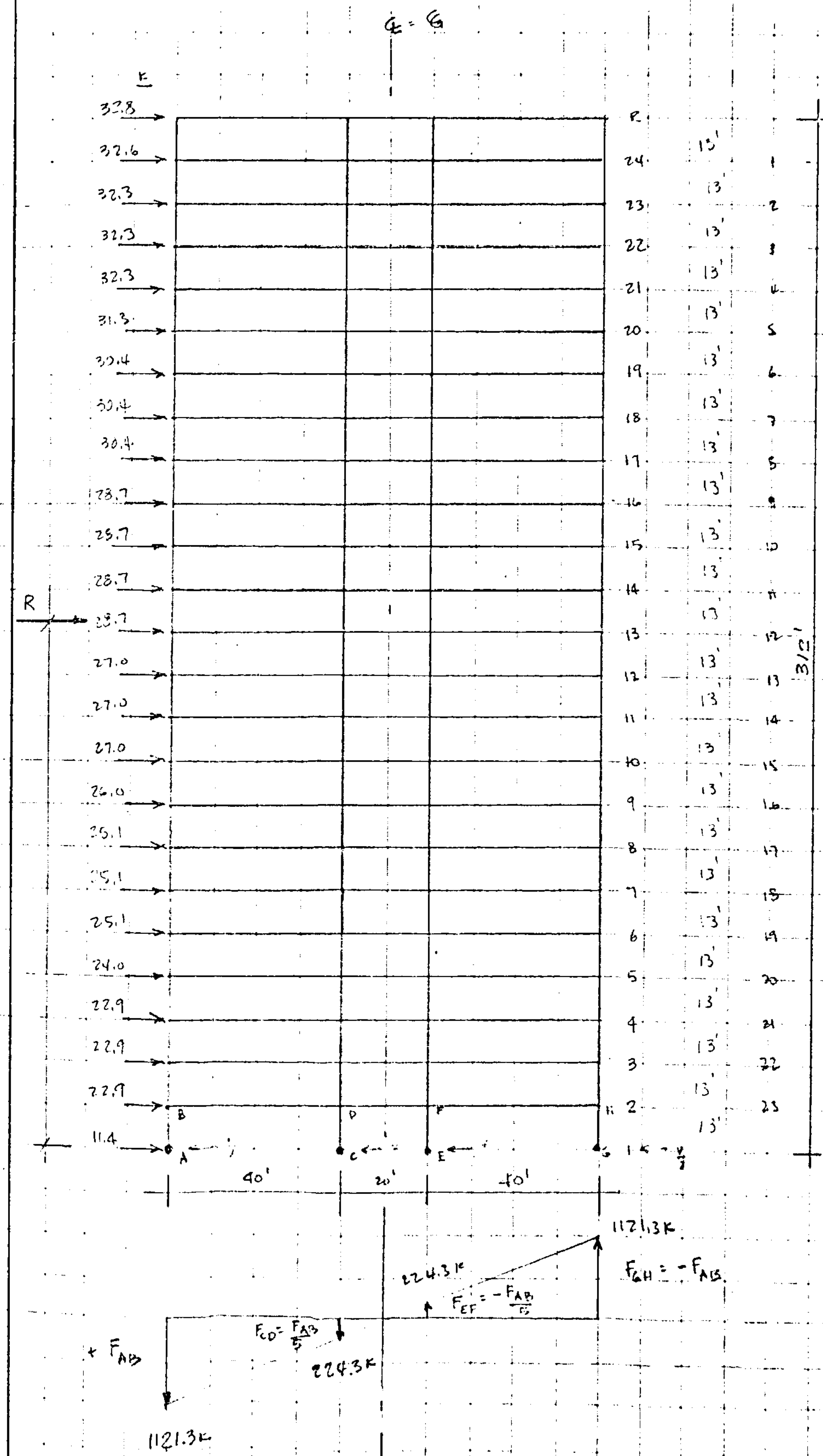
Job Name [illegible]

Architect [illegible]

TYP. WEAK AXIS PORTAL

Job #



R = 677.6 K

$\frac{\Sigma F_i d_i}{R} = d$; $\frac{116610^{K\cdot'}}{677.6^K} = 17$

$\Sigma M_A = 0$

$(677.6)(172.1) + \frac{F_{AB}}{5} \times 40$

$- \frac{F_{AB}}{5} \times 60 - 100 F_{AB} = 0$

$F_{AB} = \frac{116610}{104} = 1121.3$

3V = R + 11.4

V = 229.7K

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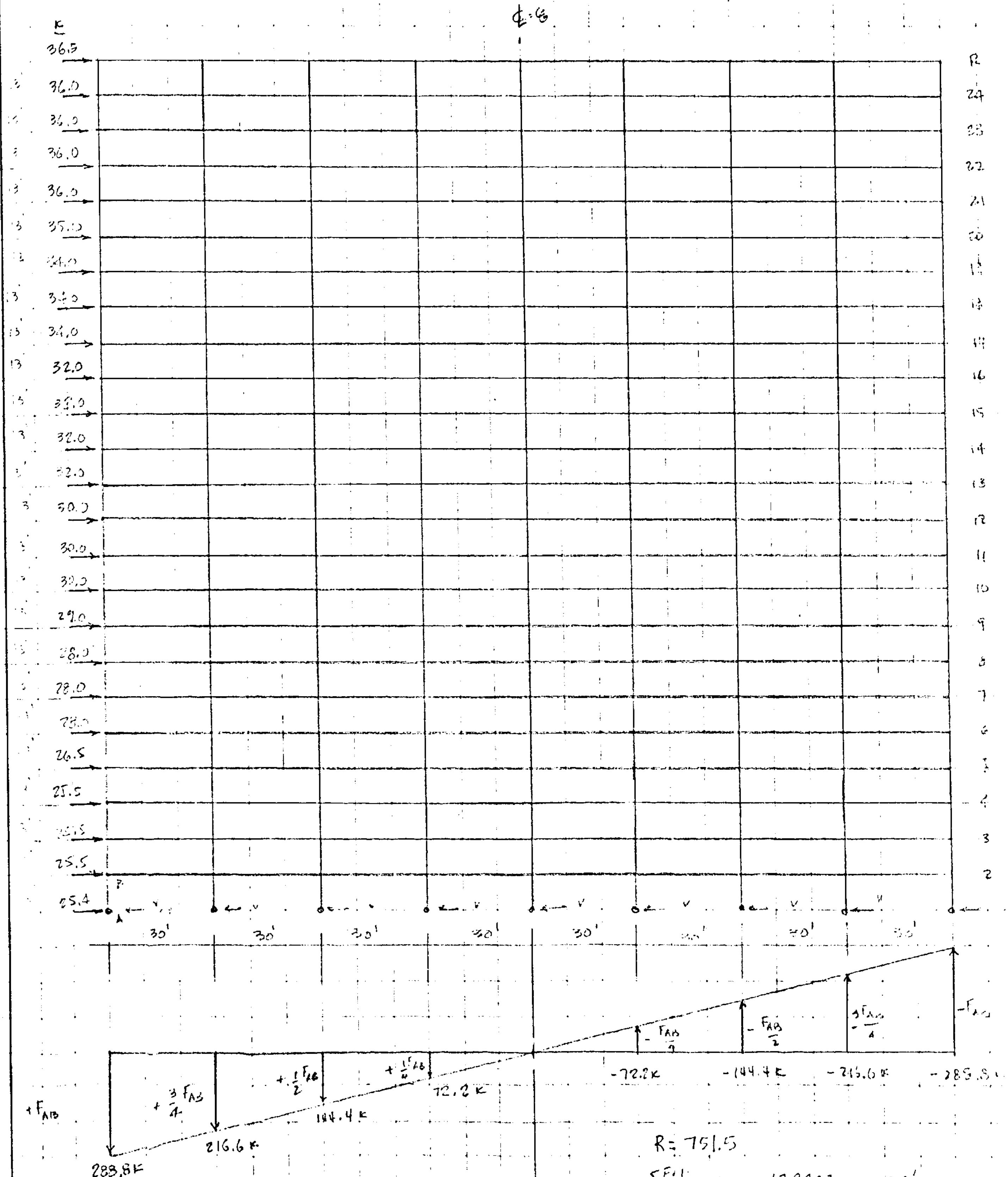
Job Name [illegible]

Architect [illegible]

Job #

TYP. STRONG AXIS PORTAL



R = 751.5

$\frac{\Sigma F_i d_i}{R} = d$; $\frac{129922}{751.5} = 172.9'$ ✓

$\Sigma M_A = 0$; $(751.5)(172.9) + \left(\frac{3F_{AB}}{4}\right)(30) + \left(\frac{F_{AB}}{2}\right)(60) + \left(\frac{F_{AB}}{4}\right)(90) - \left(\frac{F_{AB}}{4}\right)(150) - \left(\frac{F_{AB}}{2}\right)(180) - \left(\frac{3F_{AB}}{4}\right)(210) - (F_{AB})(240) = 0$

$F_{AB} = 288.8$ k

$8V = 751.5 + 25.4$

$V = 97.1$ k

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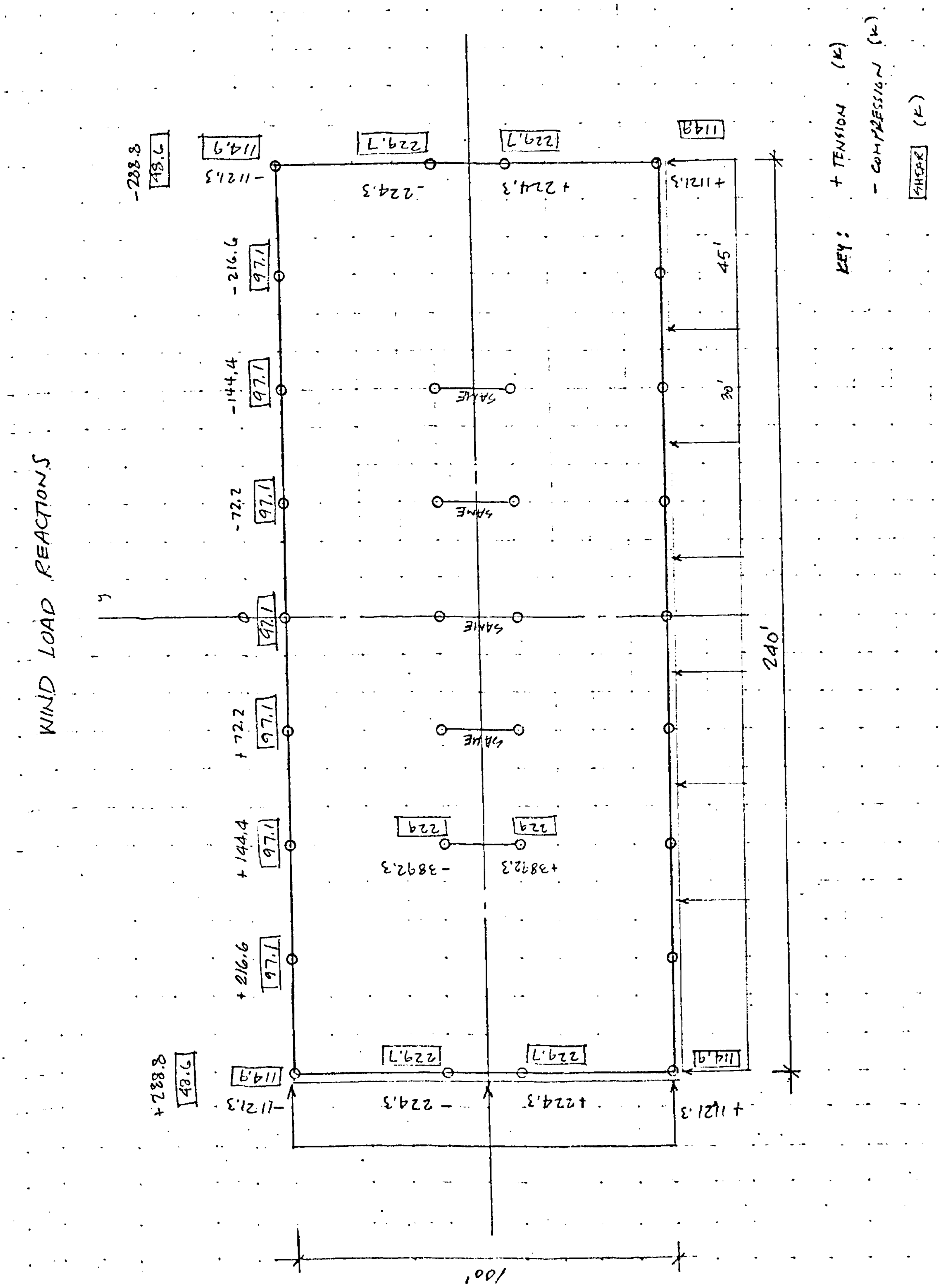
Job Name TEN-TEN GARAGE INV.

Architect TENNECO REALTY

105

Job #



APPENDIX II

Basis for Final Design: THREE RIVERWAY

1. Typical floor plan sketches
2. Rigid frame elevations
3. Preliminary proposals

1. Typical floor plan sketches

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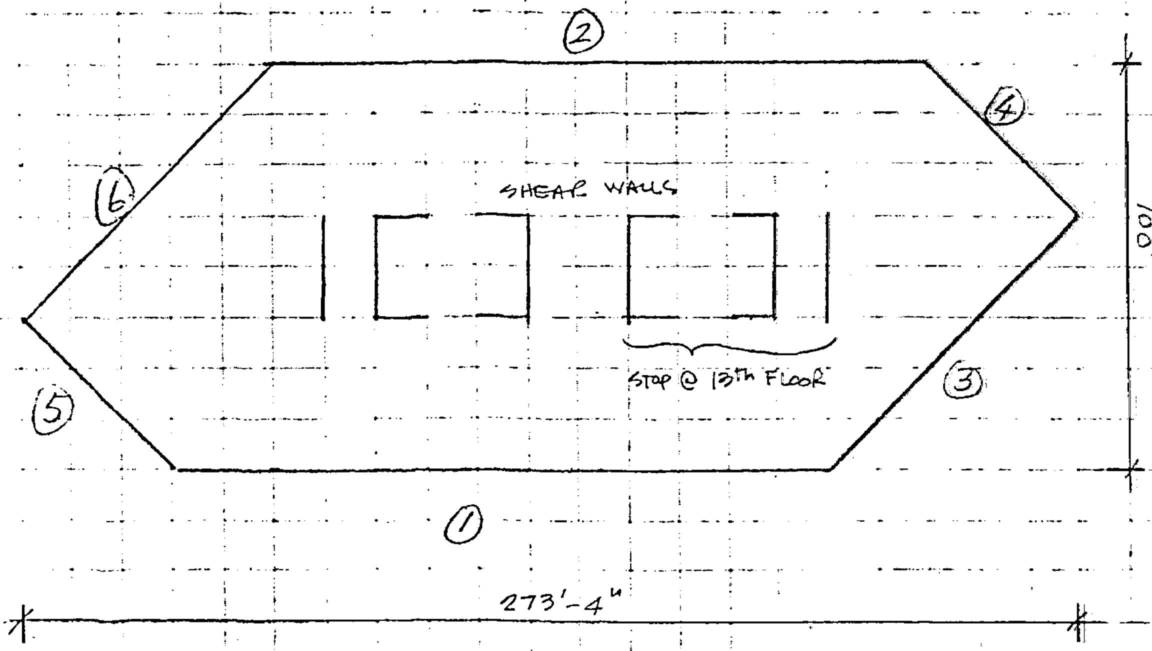
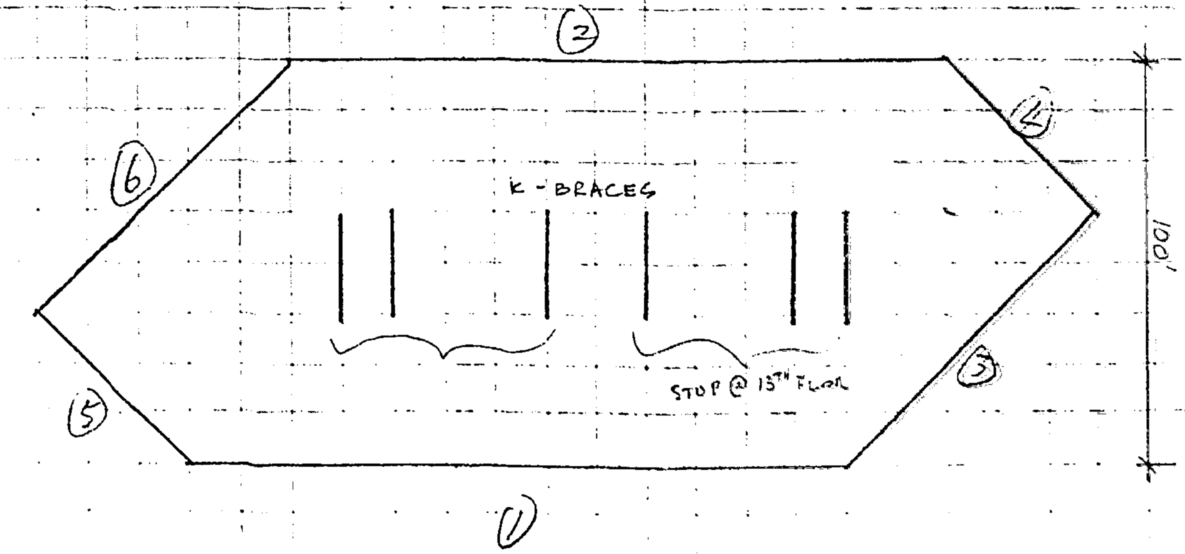
Job Name THREE RIVERWAY
Architect S. I. MORRIS

TYPICAL FLOOR PLANS
Job #

CONCRETE SCHEME



STEEL SCHEME



2. Rigid frame elevations

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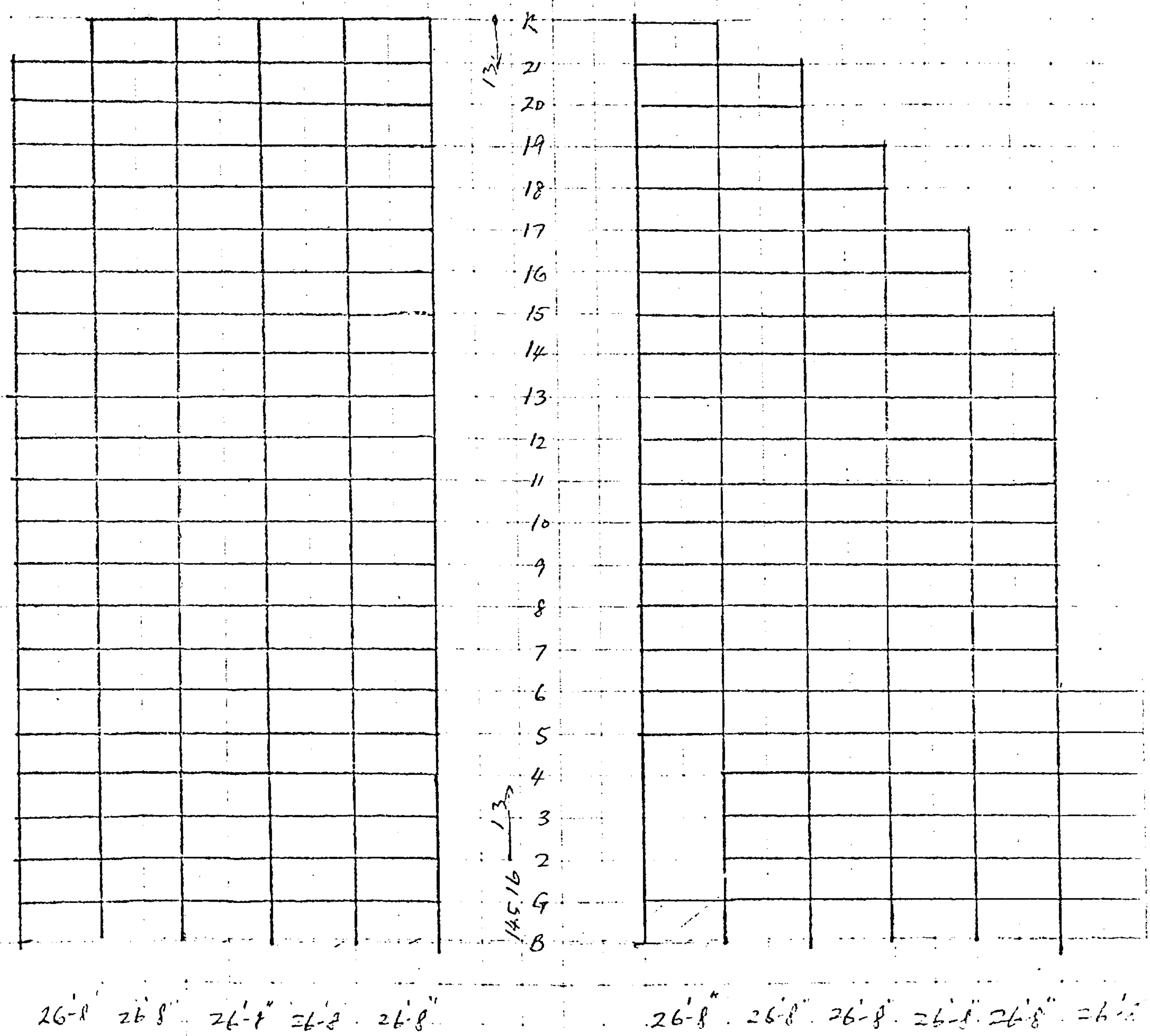
Job Name THREE RIVERWAY

Architect S. I. MORRIS 110

Job #

APPROX. SAME RELATIVE STIFFNESS
(WIND IN NARROW FACE)

FRAME ① FRAME ②



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Job Name THREE RIVERWAY

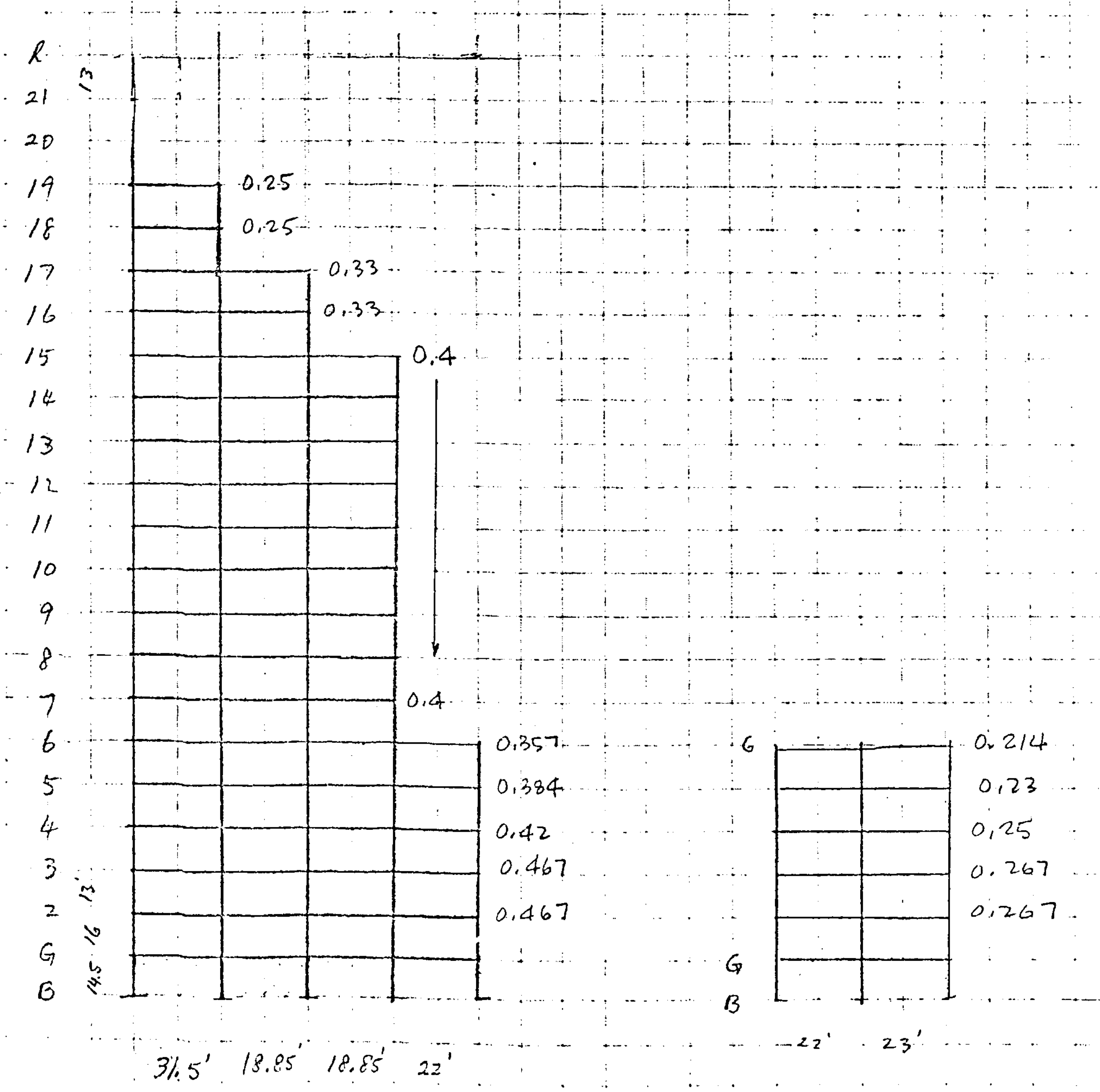
Architect S. I. MORRIS 111

Job #

FRAME RELATIVE STIFFNESS

(WIND APPLIED IN BROAD FACE)

FRAME (3) FRAME (4)



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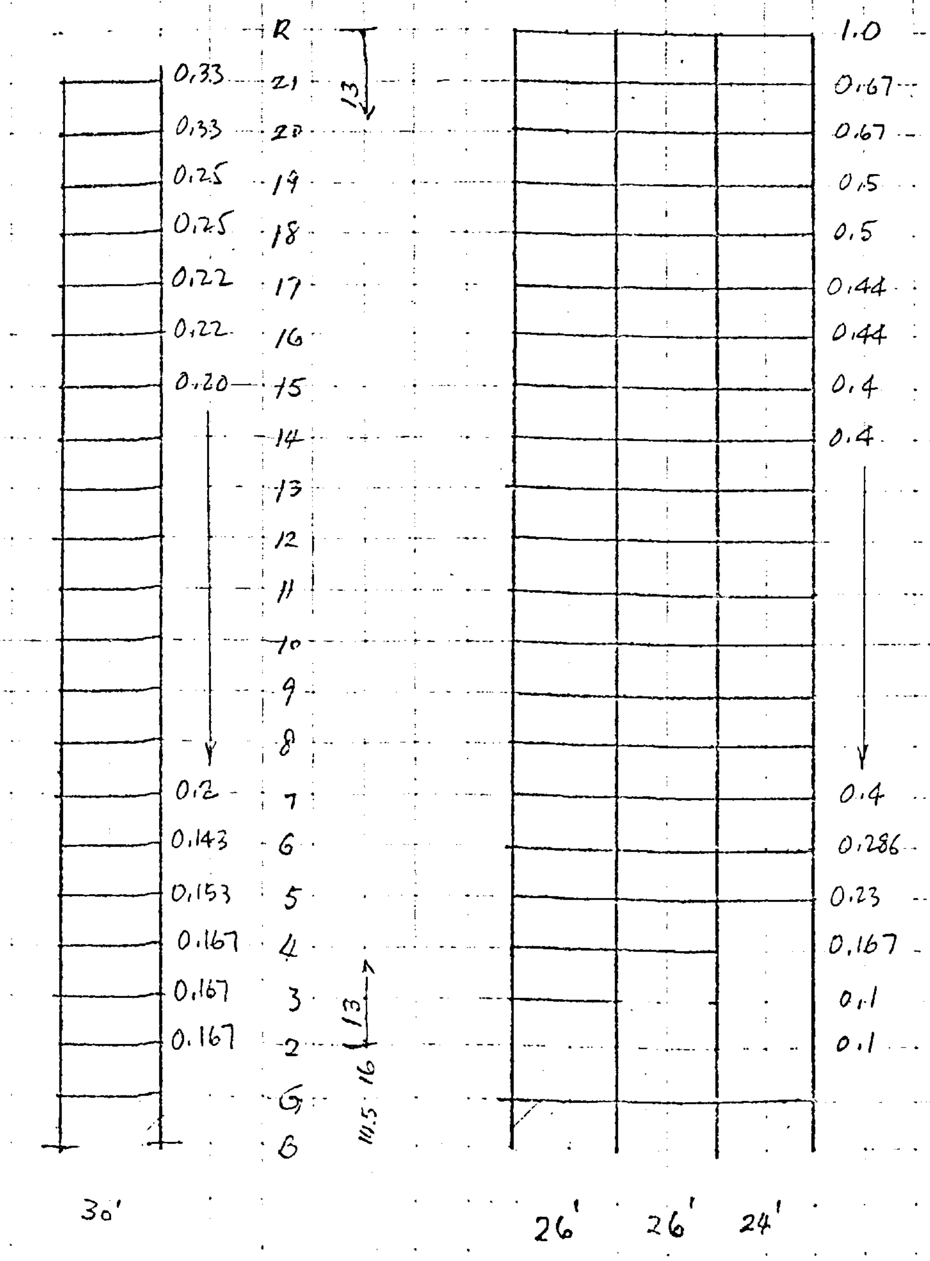
Job Name THREE RIVERS [illegible]

Architect S.I. MORRIS

Job #

FRAME RELATIVE STIFFNESS
(WIND APPLIED IN BROAD FACE)

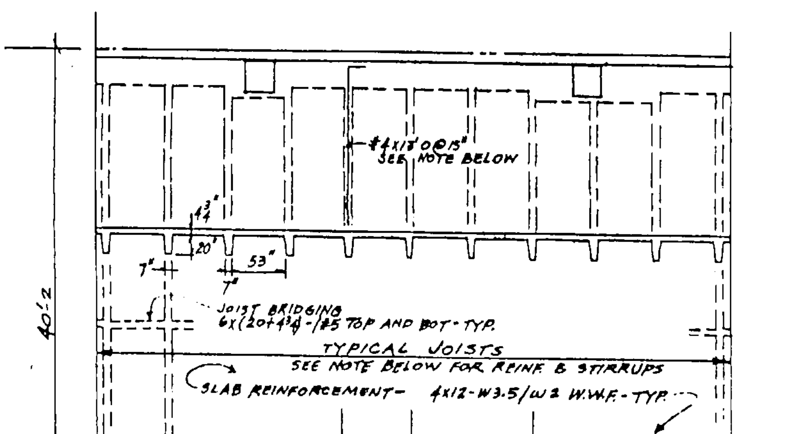
FRAME (5) FRAME (6)



Preliminary proposals

TRANSFER GIRDER SCHEDULE

FLOOR	SPAN (℄ TO ℄)	BEAM SCHEDULE SIZE	REINF #/ft.
21ST FL.	38-0	30x36	20.2#/ft.
	24-6	30x36	22.0#/ft.
	29-0	30x36	20.6#/ft.
	32-0	36x42	25.7#/ft.
	35-0	36x42	31.3#/ft.
20TH FL.	28-0	36x42	24.7#/ft.
	30-0	36x42	29.7#/ft.
	27-0	30x36	21.6#/ft.
	20-0	30x36	15.9#/ft.
19TH FL.	29-0	36x42	22.3#/ft.
	38-0	30x36	25.9#/ft.
	20-0	30x36	22.8#/ft.
	25-0	36x42	31.3#/ft.
18TH FL.	27-0	30x36	19.1#/ft.
17TH FL.	19-0	24x36	13.1#/ft.
	38-0	36x42	33.8#/ft.
16TH FL.	28-0	36x42	22.3#/ft.
15TH FL.	38-0	36x42	33.2#/ft.
6TH FL.	25-0	60x42	98#/ft.
	30-0	60x42	112#/ft.

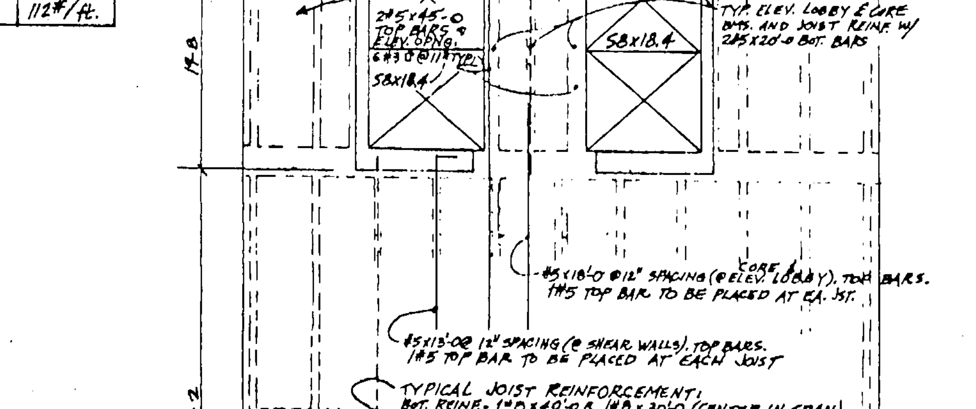


NOTE:
TOP BAR ————
BOTTOM BAR — — — —
LENGTHS INDICATED DO NOT INCLUDE ACI STD. HOOKS, WHERE HOOKS ARE SHOWN

SCHEME 1

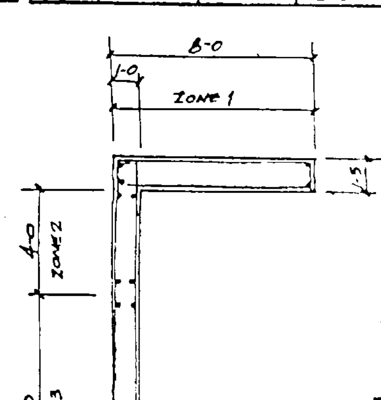
· CONCRETE SYSTEM

LIGHTWEIGHT CONCRETE FOR FLOOR (120 PCF MAX) SHALL TEST 4000 lbs/in² at 28 DAYS. ALL REINFORCING STEEL SHALL BE GRADE 60 (#3 BARS AND ALL STIRRUPS AND TIES SHALL BE GRADE 40) AND CONFORM TO THE ASTM SPEC. A615.



CONCRETE SCHEME 1 SCHEDULE

Floor	Ht.	Item	COL. #4	COL. #2	Item	SHEAR WALL ZONE 1	SHEAR WALL ZONE 2	SHEAR WALL ZONE 3
COL. SUPTG. ROOF	13-0	SIZE	24x24	24x24	VERT.	#5@12EF	#4@16EF	#4@16EF
		VERT. STL.	4-#11	4-#11	HORIZ.	#4@16	#4@16	#4@16
		TIES	#4@22	#4@22				
COL. SUPTG. 21ST	13-0	SIZE	↑	↑	VERT.	↑	↑	↑
		VERT. STL.			HORIZ.			
		TIES						
COL. SUPTG. 20TH	13-0	SIZE	24x24	24x24	VERT.	#5@12EF	#4@16EF	#4@16EF
		VERT. STL.	4-#11	4-#11	HORIZ.	#4@16	#4@16	#4@16
		TIES	#4@22	#4@22				
COL. SUPTG. 19TH	13-0	SIZE	↑	↑	VERT.	#6@12EF	#4@16EF	#4@16EF
		VERT. STL.			HORIZ.	#4@16	#4@16	#4@16
		TIES						
COL. SUPTG. 18TH	13-0	SIZE	↑	↑	VERT.	↑	↑	↑
		VERT. STL.			HORIZ.			
		TIES						
COL. SUPTG. 17TH	13-0	SIZE	24x24	24x24	VERT.	#6@12EF	#4@16EF	#4@16EF
		VERT. STL.	4-#11	4-#11	HORIZ.	#4@16	#4@16	#4@16
		TIES	#4@22	#4@22				
COL. SUPTG. 16TH	13-0	SIZE	24x24	24x24	VERT.	#8@12EF	#4@16EF	#4@16EF
		VERT. STL.	4-#11	8-#10	HORIZ.	#4@12	#4@12	#4@12
		TIES	#4@22	#4@20				
COL. SUPTG. 15TH	13-0	SIZE	↑	↑	VERT.	↑	↑	↑
		VERT. STL.			HORIZ.			
		TIES						
COL. SUPTG. 14TH	13-0	SIZE	24x24	24x24	VERT.	#8@12EF	#4@16EF	#4@16EF
		VERT. STL.	4-#11	8-#10	HORIZ.	#4@12	#4@12	#4@12
		TIES	#4@22	#4@20				
COL. SUPTG. 13TH	13-0	SIZE	30x30	30x30	VERT.	#8@12EF	#5@16EF	#4@16EF
		VERT. STL.	8-#11	8-#10	HORIZ.	#4@12	#4@12	#4@12
		TIES	#4@22	#4@20				
COL. SUPTG. 12TH	13-0	SIZE	↑	↑	VERT.	↑	↑	↑
		VERT. STL.			HORIZ.			
		TIES						
COL. SUPTG. 11TH	13-0	SIZE	↑	↑	VERT.	#8@12EF	#5@16EF	#4@16EF
		VERT. STL.			HORIZ.	#4@12	#4@12	#4@12
		TIES						
COL. SUPTG. 10TH	13-0	SIZE	30x30	30x30	VERT.	#8@10½EF	#5@16EF	#5@16EF
		VERT. STL.	8-#11	8-#10	HORIZ.	#4@12	#4@12	#4@12
		TIES	#4@22	#4@20				
COL. SUPTG. 9TH	13-0	SIZE	↑	↑	VERT.	↑	↑	↑
		VERT. STL.			HORIZ.			
		TIES						
COL. SUPTG. 8TH	13-0	SIZE	30x30	30x30	VERT.	#8@10½EF	#5@16EF	#5@16EF
		VERT. STL.	8-#11	8-#10	HORIZ.	#4@12	#4@12	#4@12
		TIES	#4@22	#4@20				
COL. SUPTG. 7TH	13-0	SIZE	30x30	30x30	VERT.	#8@6EF	#5@8EF	#5@12EF
		VERT. STL.	16-#11	8-#11	HORIZ.	#5@12	#5@12	#5@12
		TIES	#4@22	#4@22				
COL. SUPTG. 6TH	13-0	SIZE	↑	↑	VERT.	↑	↑	↑
		VERT. STL.			HORIZ.			
		TIES						
COL. SUPTG. 5TH	13-0	SIZE	30x30	30x30	VERT.	#8@6EF	#5@8EF	#5@12EF
		VERT. STL.	16-#11	8-#11	HORIZ.	#5@12	#5@12	#5@12
		TIES	#4@22	#4@22				
COL. SUPTG. 4TH	13-0	SIZE	30x30	30x30	VERT.	#11@6¼EF	#6@8EF	#6@12EF
		VERT. STL.	20-#14	8-#11	HORIZ.	#5@12	#5@12	#5@12
		TIES	#4@24	#4@22				
COL. SUPTG. 3RD	13-0	SIZE	↑	↑	VERT.	↑	↑	↑
		VERT. STL.			HORIZ.			
		TIES						
COL. SUPTG. 2ND	16-0	SIZE	↑	↑	VERT.	↑	↑	↑
		VERT. STL.			HORIZ.			
		TIES						
COL. SUPTG. 1ST	14-6	SIZE	30x30	30x30	VERT.	#11@6¼EF	#6@8EF	#6@12EF
		VERT. STL.	20-#14	8-#11	HORIZ.	#5@12	#5@12	#5@12
		TIES	#4@24	#4@22				



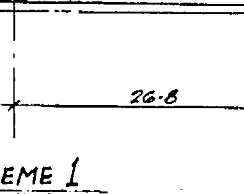
TYPICAL SHEARWALL

WINDFRAME SCHEDULE

FLOOR LOCATION	SIZE N	SIZE O	REINFORCING STEEL lb. Per Foot
WINDFRAME #1			
20,21,ROOF 17,18,19	30	24½	19.2#/ft.
14,15,16	do	do	21.8#/ft.
11,12,13	do	do	23.1#/ft.
8,9,10	do	do	24.9#/ft.
5,6,7	do	do	26.4#/ft.
2,3,4	do	do	28.5#/ft.
WINDFRAME #2			
20,21,Roof	30	24½	25.3#/ft.
17,18,19	do	do	28.4#/ft.
14,15,16	do	do	33.7#/ft.
11,12,13	do	do	42.4#/ft.
8,9,10 5,6,7	do	do	47.1#/ft.
2,3,4	do	do	52.4#/ft.

MAT CONSTRUCTION

MAT AREA. = 26284 Sq.ft.
CONCRETE VOLUME = 4717 cu.yd
REINFORCING = 307 TONS
4000 PSI STONE CONCRETE



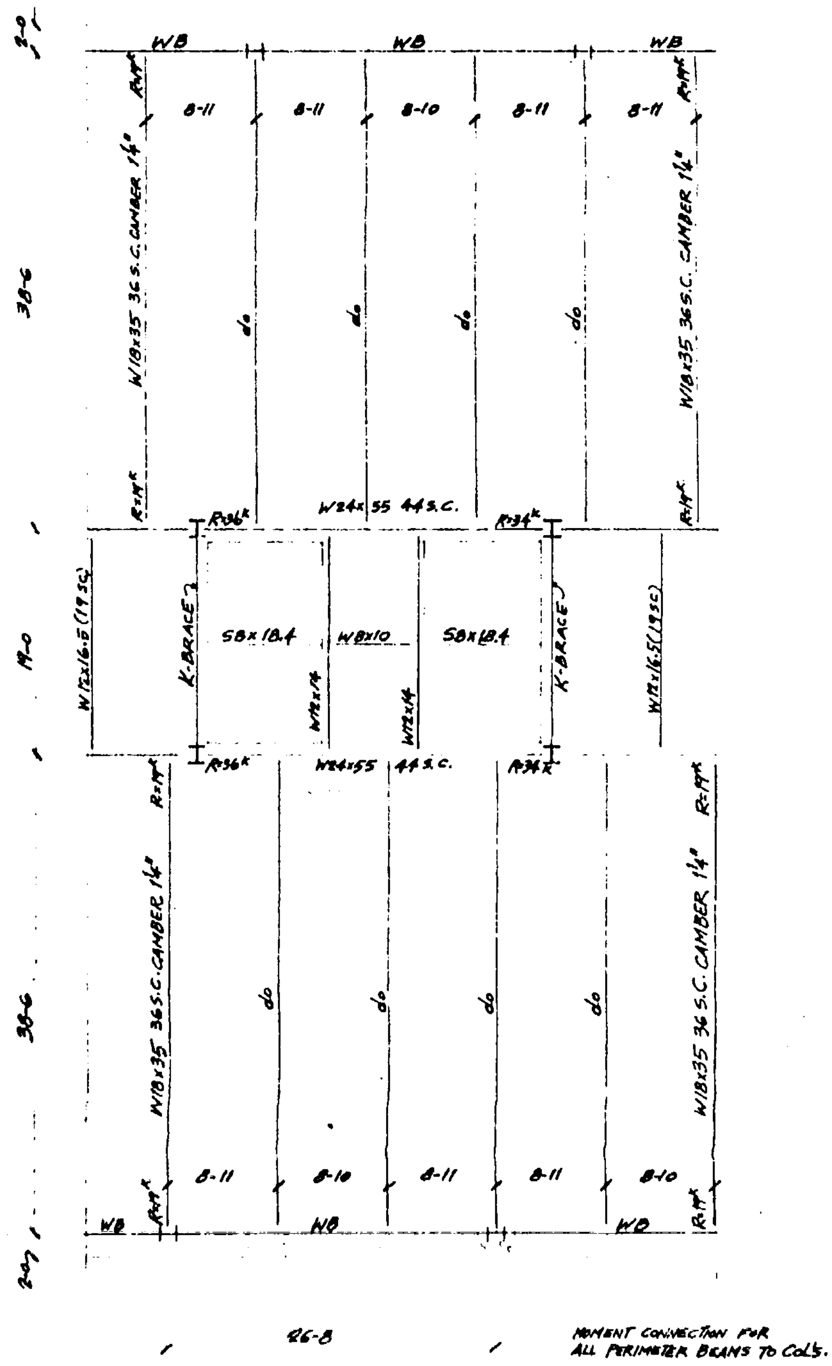
TYPICAL MAT SECTION

3 RIVERWAY - S.I. MORRIS
SIMA No. 77152
SCHEME 1 (CONCRETE)
ISSUED FOR REF ...
WALTER P. MOORE & ASSOCIATES, INC.
CONSULTING ENGINEERS
2905 SACKETT STREET HOUSTON, TEXAS
PRELIMINARY
S1
114

3 RIVERWAY - S.I. MORRIS

TRANSFER GIRDERS

FLOORS	BEAMS SPAN	BEAMS SIZE
21ST FL.	38-0	W30X99
	24-6	W27X84
	29-0	W27X84
	32-0	W27X94
	35-0	W30 x 108
20TH FL.	28-0	W33 x 118
	30-0	W33x 118
	21-0	W27x 84
	20-0	W24x 61
19TH	29-0	W30x116
	38-0	W33x141
	20-0	W24x76
	25-0	W33 x130
18TH	27-0	W27x84
17TH	19-0	W24 x55
	38-0	W36x150
16TH	28-0	W30x99
15TH	38-0	W36x160
6TH	25-0	W36 x 300
	30-0	42" PL GIRDER 312 #/ft.



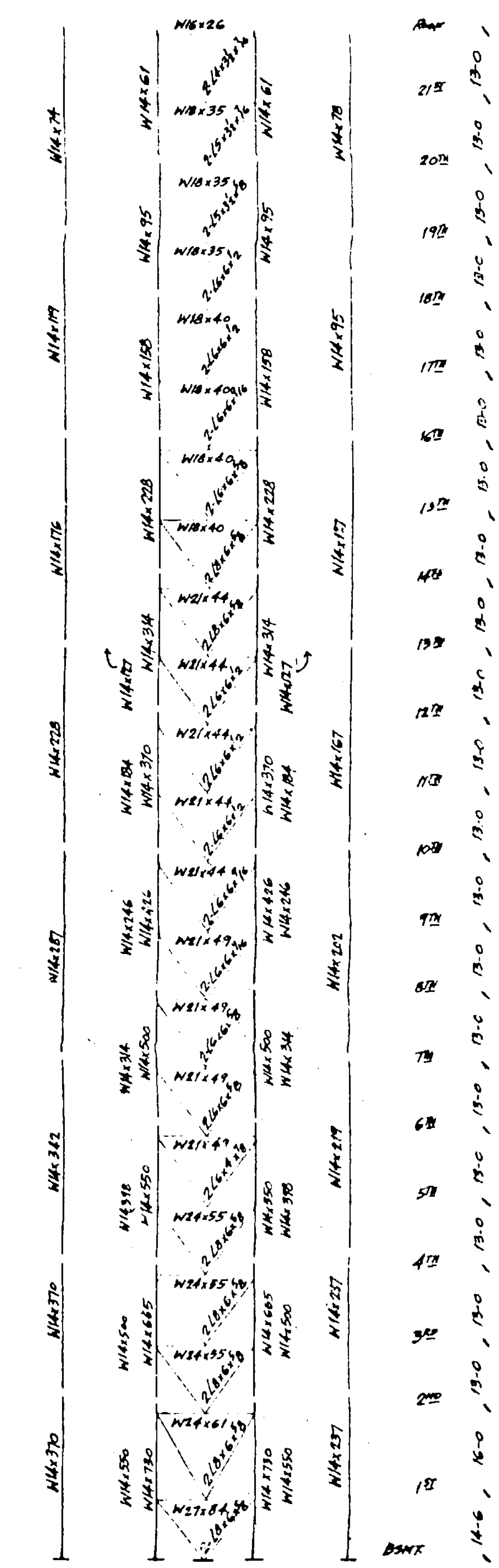
SCHEME 2

· STEEL SYSTEM

A36 STEEL

FLOOR CONSTRUCTION:
METAL DECK FOR FLOORS SHALL BE 2" QL-99 20 GA.
AS MANUFACTURED BY H. H. ROBERTSON CO., OR EQUAL.
CONCRETE OVER METAL DECK SHALL BE LIGHT WEIGHT (MAX. DENSITY 120 lbs/ft³) AND TEST 3000 lbs/in² at 28 DAYS. TOTAL THICKNESS OF LIGHTWEIGHT CONCRETE AND METAL DECK TO BE 5¼".
REINFORCE SLAB w/ 6x6-W1.4xW1.4 (6"x6", #10x#10) WELDED WIRE MESH LAPPED ONE MESH AT ENDS AND SIDES. SHEAR CONNECTOR QUANTITIES SHOWN ON PLAN ARE FOR A ¾" ⌀ x 3⅞ LONG (B W) HEADED STUD w/ AN ALLOWABLE CONNECTION CAPACITY OF 9.5 KIPS PER CONNECTOR.

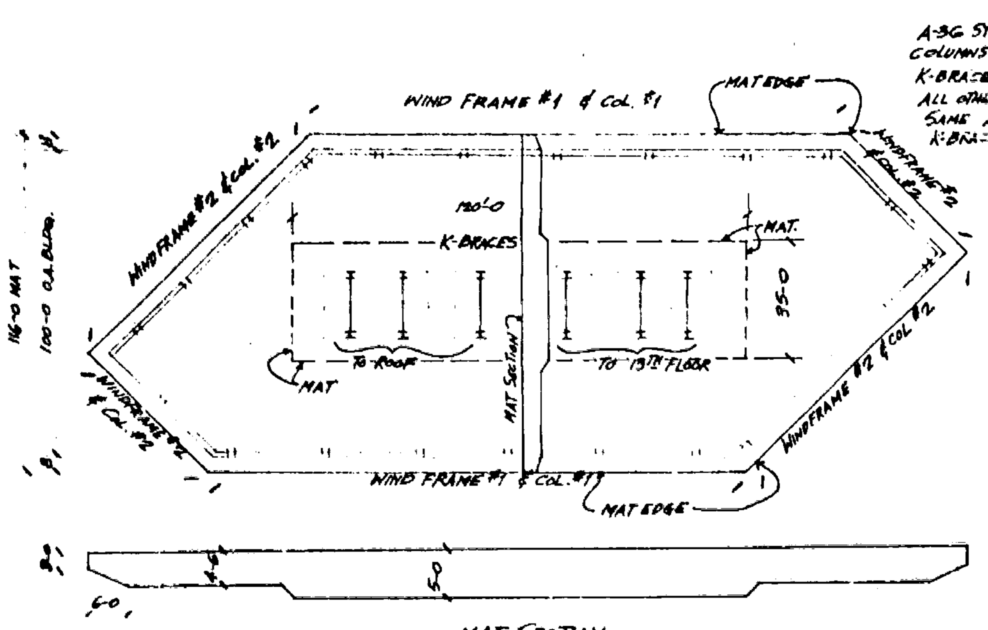
STEEL SCHEME 2 SCHEDULE (A-36 STEEL)



A-36 STEEL
COLUMNS MARKED W14-- ARE FOR K-BRACE TO 13TH FLOOR ONLY.
ALL OTHER MEMBERS REMAIN THE SAME AS MARKED FOR BOTH K-BRACES.

WINDFRAME SCHEDULE (A-36 STEEL)

MARK. LOCATION	WINDFRAME #1	WINDFRAME #2
ROOF, 21ST, 20TH	W24x55	W24x68
19TH, 18TH, 17TH	W24x55	W24x76
16TH, 15TH, 14TH	W24x61	W27x94
13TH, 12TH, 11TH	W24x76	W30x99
10TH, 9TH, 8TH, 7TH, 6TH, 5TH,	W27x84	W30x108
4TH, 3RD, 2ND	W27x94	W30x116



MAT CONSTRUCTION

AREA = 26284 Sq.ft.
CONCRETE VOLUME = 4346 Cu.Yd.
REINFORCING = 282 TONS
4000 PSI STONE CONCRETE

3 RIVERWAY - S.I. MORRIS SCHEME 2 (STEEL)
SIMA No 77152 ISSUED FOR RFP No 1, ITEM 1.02
115
PRELIMINARY
S-2

APPENDIX III

Complete Structural Design of Buildings

a. Science and Mathematics Center/Junior College - COMMONS BUILDING

   1. Development, site, and architectural plans

   2. Design calculations

   3. Structural drawings

b. SMITH PARK PAVILION: Structural drawings a.1. Development, site, and architectural plans

KINGDOM OF SAUDI ARABIA

MINISTRY OF EDUCATION

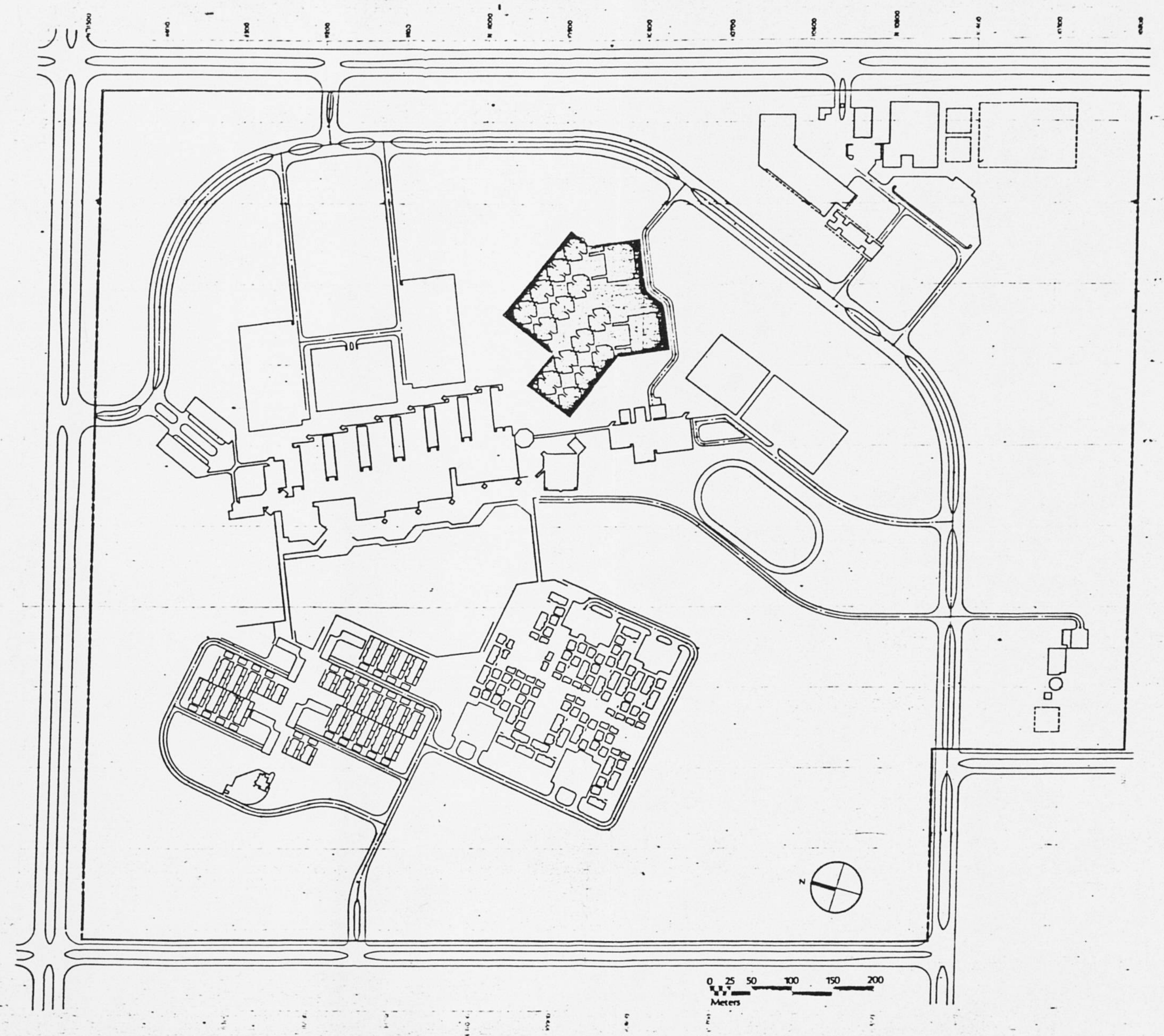
المملكة العربية السعودية

وزارة المعارف

SCIENCE AND MATHEMATICS CENTER / JUNIOR COLLEGE

Riyadh — Phase One

مركز العلوم و الرياضيات / الكلية المتوسطة



INDEX OF DRAWINGS

ARCHITECTURAL

A7-2-1	Key Plan	1:500
A7-2-2	Site Plan — Sector No. 1	1:200
A7-2-3	Site Plan — Sector No. 2	1:200
A7-2-4	Site Plan — Exterior Courts	1:100
A7-3-1	Floor Plans — Dormitory	
A7-3-2	Floor Plan/Building Sections — Commons	
A7-3-3	Reflected Ceiling Plan/Floor Plans/Interior Elevations — Commons	
A7-3-4	Roof Plan/Floor Plans/Interior Elevation — Commons	
A7-4-1	Exterior Elevations/Building Sections — Dormitory	
A7-4-2	Exterior Elevations/Floor Plan/Interior Elevations — Commons	
A7-5-1	Building Sections — Commons	
A7-6-1	Wall Sections — Dormitory	
A7-6-2	Wall Sections — Dormitory	
A7-6-3	Wall Sections — Dormitory	
A7-6-4	Wall Sections — Commons	
A7-6-5	Wall Sections — Commons	
A7-6-6	Wall Sections — Commons	
A7-8-1	Floor Plans/Interior Elevations — Dormitory	

STRUCTURAL

S7-1-1	General
S7-2-1	Key Plan
S7-2-2	Foundation/Framing Plans — Dormitory
S7-2-3	Framing Plan — Foundation/Ground Level — Commons
S7-2-4	Framing Plan — Roof — Commons
S7-3-1	Sections — Dormitory
S7-3-2	Sections — Dormitory
S7-3-3	Sections — Commons
S7-4-1	Schedules

MECHANICAL

M7-1-1	Legends/Symbols/Abbreviations	
M7-1-2	Schedules	
M7-2-1	Site Plan — Dormitory Complex — Sector 1	1:200
M7-2-2	Site Plan — Dormitory Complex — Sector 2	1:200
M7-3-1	Floor Plans — Typical Dormitory	
M7-3-2	Floor Plans — Typical Commons	
M7-3-3	Floor Plans — Mechanical Rooms — Commons/Dormitory	

ELECTRICAL

E7-1-1	Legends/Symbols	
E7-1-2	Distribution Diagram/Schedules	
E7-2-1	Site Plan — Dormitory Complex — Sector 1	1:200
E7-2-2	Site Plan — Dormitory Complex — Sector 2	1:200
E7-3-1	Floor Plans — Typical Dormitory	
E7-3-2	Floor Plan — Typical Commons	
E7-3-3	Power Plan — Commons Kitchen/Serving Area	

PLUMBING

P7-1-1	Legends/Schedules
P7-3-1	Floor Plan — Typical Dormitory
P7-3-2	Floor Plan — Typical Commons
P7-3-3	Floor Plan — Typical Commons Kitchen

CIVIL

C7-2-1	Site Plans — Paving/Grading/Structures — Sector 1	1:200
C7-2-2	Site Plans — Paving/Grading/Structures — Sector 2	1:200

LANDSCAPE

L7-2-1	Site Plans — Plant Material — Sector 1	1:200
L7-2-2	Site Plans — Plant Material — Sector 2	1:200
L7-3-1	Site Plans — Irrigation System — Sector 1	1:200
L7-3-2	Site Plans — Irrigation System — Sector 2	1:200

FOOD SERVICE

K7-1-1	Legend/Symbols/General Notes/Equipment Schedule — Floor Plan
K7-3-1	Equipment Elevations

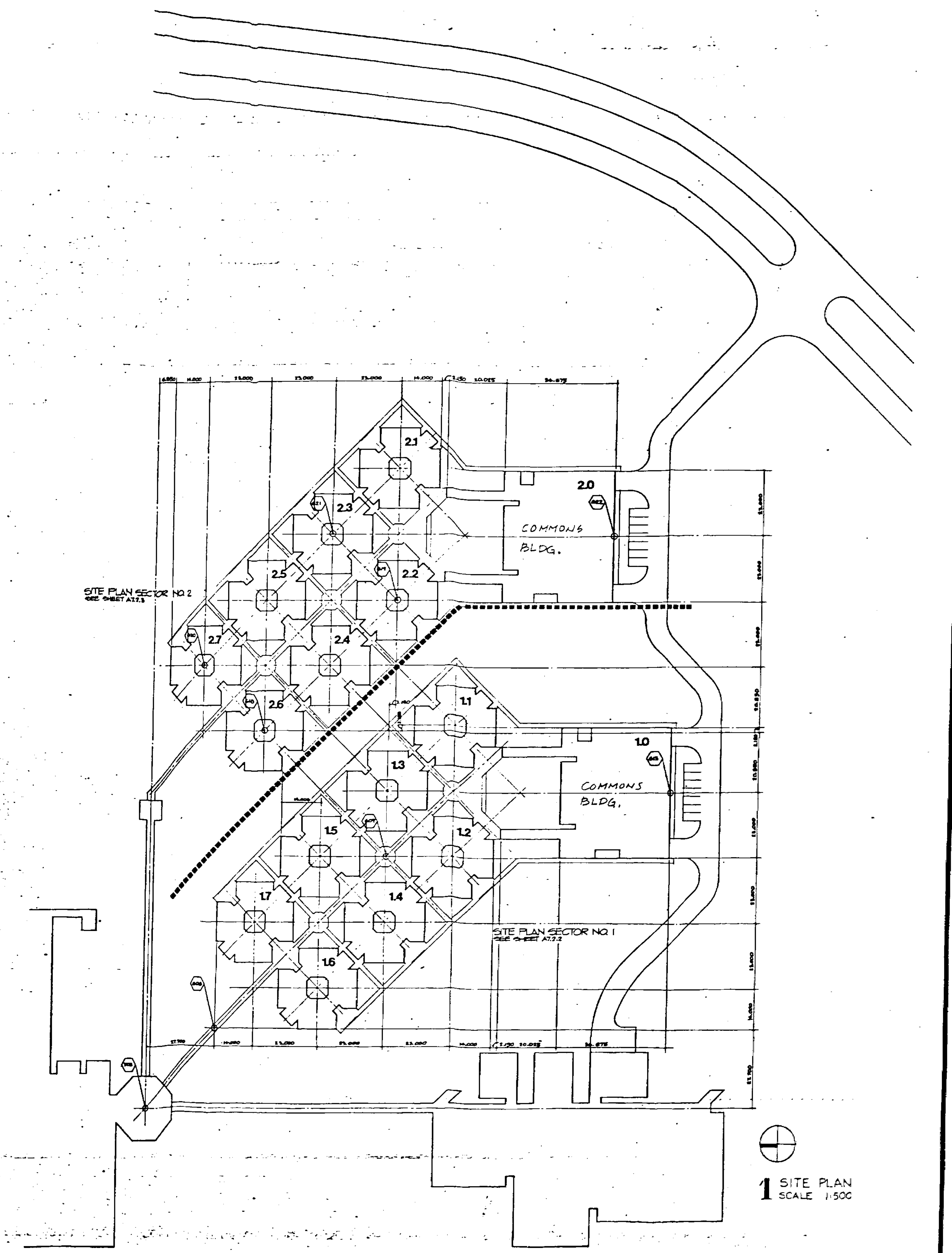
7

SINGLE STUDENT HOUSING

JAMES M. SINK ASSOCIATES
Planners and Architects

June 1977

JAMES H. BINE ASSOCIATES
PLANNERS & ARCHITECTS



1 SITE PLAN
SCALE 1:500

MINISTRY OF EDUCATION • SCIENCE & MATHEMATICS CENTER / JUNIOR COLLEGE PROJECT

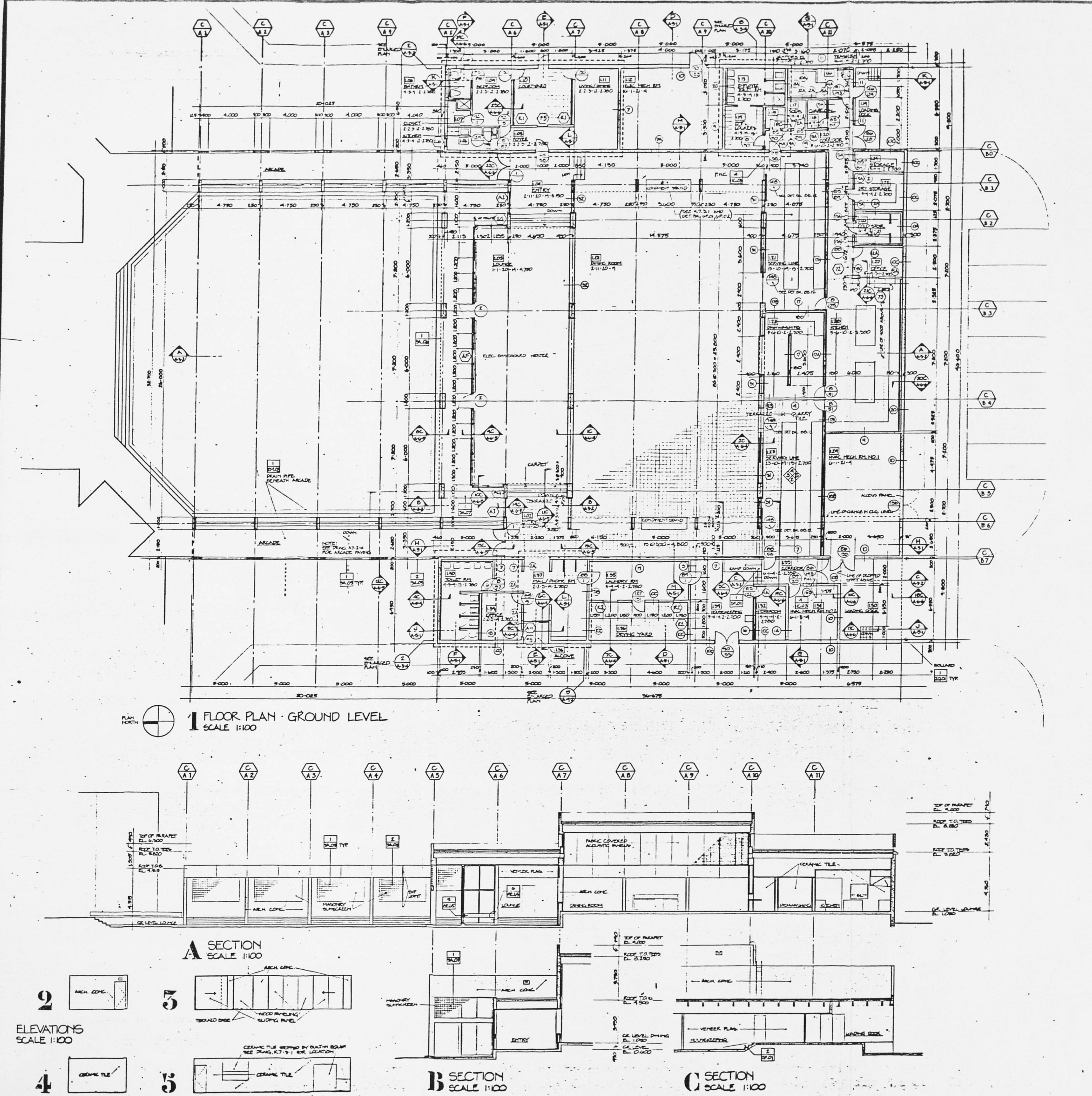
RIYADH • KINGDOM OF SAUDI ARABIA

SINGLE STUDENT HOUSING

KEY PLAN

JUNE 5, 1977

A7·2·1



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RIYADH · KINGDOM OF SAUDI ARABIA

120

JAMES M. SINK ASSOCIATES
PLANNERS & ARCHITECTS

DAR-AL-RIYADH CONSULTANTS
PROJECT ASSOCIATES

WALTER P. MOORE & ASSOCIATES, INC.
STRUCTURAL & CIVIL ENGINEERS

COOK & HOLLE INC.
MECHANICAL & ELECTRICAL ENGINEERS

REVISIONS
SUBMISSION JULY 17, 1977

KEY

SINGLE STUDENT HOUSING

FLOOR PLAN
BLDG. SECTIONS

COMMONS BLDG.

ISSUE DATE JUNE 3, 1977

A7·3·2

a.2. Design calculations

WALTER P. MOORE & ASSOCIATES, INC.
CONSULTING ENGINEERS
2905 Sackett
Houston, Texas 77006

Job Name SMC/JC

Architect JAMES M. SINK[122] ASSOC.

COMMONS ROOF FRAMING

Job # 130[illegible]

✓

ΠΠ1 (14.94m)
Span – 49'-0" Load = 30 + 77 + 35 + 40 = 182 PSF (LIVE + Π + TOPPING + ROOFING)
SUPERIMP. LOAD = 70 PSF
v =
2.400 ΠΠ 760 C 5 D (WIDTH (m), DEPTH (mm), # OF ½" Ø STRANDS, DEFLECTED, COMPOSITE)
A_s =
$-A_s$ =

ΠΠ2 (14.94m)
Span – 49'-0" Load = 30 + 77 + 35 + 40 = 182 PSF (LL + Π + TOPPING + ROOFING)
SUPERIMP. LOAD = 70 PSF
v =
2.300 ΠΠ 760 C 5 D
A_s =
$-A_s$ =

ΠΠ3 (11.3m)
Span – 37'-0" Load = 30 + 54 + 35 + 40 = 159 PSF (LL + Π + TOPPING + ROOFING)
SUPERIMP. LOAD = 70 PSF
v =
2.400 ΠΠ 460 C 4 D
A_s =
$-A_s$ =

ΠΠ4 (11.3m)
Span – 37'-0" Load = 30 + 54 + 35 + 40 = 159 PSF (LL + Π + TOPPING + ROOFING)
SUPERIMP. LOAD = 70 PSF
v =
2.300 ΠΠ 460 C 4 D
A_s =
$-A_s$ =

ΠΠ5 (10.0m)
Span – 33'-0" Load = 30 + 54 + 35 + 40 = 159 PSF (LL + Π + TOPPING + ROOFING)
SUPERIMP. LOAD = 70 PSF
v =
2.400 ΠΠ 460 C 5 S
A_s =
$-A_s$ =

ΠΠ6 (6.7m)
Span – 22'-0" Load = 30 + 54 + 35 + 40 = 159 PSF (LL + Π + TOPPING + ROOFING)
SUPERIMP. LOAD = 70 PSF
v =
2.400 ΠΠ 460 C 2 S
A_s =
$-A_s$ =

ΠΠ7 (6.7m)
Span – 22'-0" Load = 30 + 54 + 35 + 40 = 159 PSF (LL + Π + TOPPING + ROOFING)
SUPERIMP. LOAD = 70 PSF
v =
A_s =
2.275 ΠΠ 460 C 2 S
$-A_s$ =

ΠΠ8 (6.7m)
Span – 22'-0" Load = 30 + 54 + 35 + 40 = 159 PSF (LL + Π + TOPPING + ROOFING)
SUPERIMP. LOAD = 70 PSF
v =
2.200 ΠΠ 460 C 2 S
A_s =

Houston, Texas 77006

Architect JAMES M. SINK ASSOC.

Job # 1303

7π9

COMMONS ROOF FRAMING

Span – (6.7m) 22'-0" Load = 30 (LL) + 54 (π) + 35 (TOPPING) + 40 (ROOFING) = 159 PSF

SUPERIMP. LOAD = 70 PSF

2.075 π460C25

V =

A_s =

$-A_s$ =

Span – Load =

V =

A_s =

$-A_s$ =

Span – Load =

V =

A_s =

$-A_s$ =

Span – Load =

V =

A_s =

$-A_s$ =

Span – Load =

V =

A_s =

$-A_s$ =

Span – Load =

V =

A_s =

$-A_s$ =

Span – Load =

V =

A_s =

$-A_s$ =

Span – Load =

V =

A_s =

$-A_s$ =

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CONSULTING ENGINEERS
2905 Sackett
Houston, Texas 77006

Job Name SMC / JC
124
Architect J.M. SINK ASSOC.
COMMONS ROOF FRAMING f'_c = 4000 psi Job # 13025

Span — Load =
v =
A_s =
$-A_s$ =

251 | d: 5.0" (2.95 m) LIVE ROOFING SLAB
Span — 9.66' Load = 30 + 40 + 75 = 145 PSF D 115 L 30 ULT 212 PSF D 161 L 51
V = D 778 PLF L 246 PLF v = v TOP 12@300
$wl^2/8$ M_u = 212 x 9.66² x 12/8 = 29700# -" K=99 MIN A_s = .178 IN²/FT (3.77 cm²/m) 12@300
6" (150 mm) $-A_s$ =

252 | d = 5.0" (2.7 m) LIVE ROOFING SLAB
Span — 8.9' Load = 30 + 40 + 75 = 145 PSF D 115 L 30 ULT 212 PSF D 161 L 51
V = D 717 PLF L 227 PLF v = v TOP 12@300
$wl^2/11$ M_u = 212 x 8.9² x 12/11 = 18,320 #-" K = 61 MIN A_s = .178 IN²/FT (3.77 cm²/m) 12@300
6" (150 mm) $-M$ = $wl^2/9$ = 18,000 #-" K = 60 ρ = .17% $-A_s$ = .102 IN²/FT (2.16 cm²/m)

253 | d = 5.0" (2.1 m) LIVE ROOFING SLAB
Span — 6.9' Load = 30 + 40 + 75 = 145 PSF D 115 L 30 ULT 212 PSF D 161 L 51
V = D 556 PLF L 176 PLF v = v TOP 12@300
$wl^2/11$ M_u = 212 x 6.9² x 12/11 = 11,000 #-" K = 37 MIN A_s = .178 IN²/FT (3.77 cm²/m) 12@300
6" (150 mm) $-A_s$ =

SLAB-BM BETWEEN 253-254 & 257-258 | d = 5.0" (4.7 m) LIVE DEAD
Span — 15.4' Load = 237 + 910 = 1147 PLF ; ULT 1677 PLF D 1274 L 403
V = D 9810 # L 3100 # v = 66 PSI
$wl^2/8$ M_u = 1677 x 15.4² x 12/8 = 596,576 #-" K = 519 ρ = 1.7% A_s = 3.68 IN² (24 cm²) 8-20
(1070 x 150) 42" x 6" $-A_s$ =

254 | d = 5.0" (3.2 m) LIVE ROOFING SLAB
Span — 10.5' Load = 30 + 40 + 75 = 145 PSF D 115 L 30 ; ULT 212 PSF D 161 L 51 TOP 12@300
V = D 844 PLF L 267 PLF v = v TOP 12@300
$wl^2/11$ M_u = 212 x 10.50² x 12/11 = 25,500 #-" K = 85 MIN A_s = 0.178 IN²/FT (3.77 cm²/m) 12@300
6" (150 mm) $-M$ = $wl^2/9$ = 23300 #-" K = 96 ρ = .27% $-A_s$ = 0.162 IN²/FT (3.43 cm²/m)

255 | d = 5.0" (2.95 m) LIVE ROOFING SLAB
Span — 9.66' Load = 30 + 40 + 75 = 145 PSF D 115 L 30 ; ULT 212 PSF D 161 L 51
V = D 778 PLF L 246 PLF v = v TOP 12@300
$wl^2/11$ M_u = 212 x 9.66² x 12/11 = 21600 #-" K = 72 MIN A_s = 0.178 IN²/FT (3.77 cm²/m) 12@300
6" (150 mm) $-A_s$ =

256 | d = 5.0" (2.5 m) LIVE ROOFING SLAB
Span — 8.2' Load = 30 + 40 + 75 = 145 PSF D 115 L 30 ; ULT 212 PSF D 161 L 51
V = D 660 PLF L 210 PLF v = v TOP 12@300
$wl^2/11$ M_u = 212 x 8.2² x 12/11 = 15600 #-" K = 52 MIN A_s = 0.178 IN²/FT (3.77 cm²/m) 12@300

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Houston, Texas 77006

Job Name SMC / JC

125

Architect JAMES M. SINK ASSOC.

COMMONS ROOF FRAMING f'_c = 4000 PSI   Job # 13025

257 — d = 5.0" (2.7m)
Span – 8.86' Load = 30 (LIVE) + 40 (ROOFING) + 75 (SLAB) = 145 PSF; D 115, L 30; ULT 212 PSF; D 161, L 51
V = D 713 PLF, L 226 PLF; v = ✓
$wL^2/16$: M_u = 212 × 8.86² × 12 / 16 = 12500 #-" K = 42 MIN A_s = .178 in²/ft (3.77 cm²/m) 12@300
6" (150mm): –M = $wL^2/10$ = 15500 #-" K = 52 –A_s = .06 in²/ft (1.27 cm²/m)

258 — d = 5.0" (2.0m)
Span – 6.56' Load = 30 (LIVE) + 40 (ROOFING) + 75 (SLAB) = 145 PSF; D 115, L 30; ULT 212 PSF; D 161, L 51
V = D 528 PLF, L 167 PLF; v = ✓ TOP 12@300
$wL^2/11$: M_u = 212 × 6.56² × 12 / 11 = 9953 #-" K = 33 MIN A_s = .178 in²/ft (3.77 cm²/m) 12@300
6" (150mm): –A_s =

281 — d = 26" (4.7m)
Span – 15.4' Load = D 477 (ROOF) + 383 (BM + PARAPET) = 860 PLF; L 143; ULT 1447 PLF; D 1204 PLF, L 243 PLF
V = D 9271 #, L 1871 #; v = 54 psi TOP 2∅20mm
$wL^2/11$: M_u = 1447 × 15.4² × 12 / 11 = 375,000 #-" K = 70 MIN A_s = 0.7 in² (4.52 cm²) 2∅24mm
(200×750) 8"×29.5": 18-10MM@50/6@165/2@600/ –M = $wL^2/10$ = 412650 #-" K = 76 MIN A_s = 0.62 in² (4.0 cm²)

282 — d = 26" (4.7m)
Span – 15.4' Load = D 860 PLF, L 143 PLF; ULT 1447 PLF; D 1204 PLF, L 243 PLF
V = D 9271 #, L 1871 #; v = 54 psi TOP 2∅20mm
$wL^2/16$: M_u = 1447 × 15.4² × 12 / 16 = 258, #-" K = 43 MIN A_s = 0.7 in² (4.52 cm²) 2∅24mm
(200, 750) 8"×29.5": 18-10MM@50/6@165/2@600/ –A_s =

283 — d = 27" (5.0m) EXTEND ALL REINF. TO END OF CANTILIVER
Span – 16.4' Load = D 860 PLF, L 143 PLF; ULT 1447 PLF; D 1204 PLF, L 243 PLF $V_{cant.}$ 51 psi
v = 72 psi TOP 2∅20mm
(sketch notes: 1447 #/I; 8.2' D 9373 L 1993 / D 12341 L 2491; 16.4'; D 7405 # L 1495 #)
$wL^2/8$: M_u = 1447 × 24.6² × 8.2² × 12 / 8 × 16.4² = 329,000 #-" K = 31 MIN A_s = 0.7 in² (4.52 cm²) 2∅24mm
(300×765) 11.5"×30": 18-10MM@50/6@165/2@600/ –M = 504,000 #-" K = 55 –A_s = 0.44 in² (2.82 cm²)

284 — d = 54" (4.7m)
Span – 15.4' Load = D 397 PLF (ROOF) + 1960 PLF (BM & WALL) = 2357; L 104 PLF; ULT 3477; D 3300 PLF, L 177 PLF
V = D 25410 #, L 1363 #; v = 42 psi 2∅24 TOP
$wL^2/8$: M_u = 3477 × 15.4² × 12 / 8 = 1,237,0 #-" K = 36 MIN A_s = 2.12 in² (13.7 cm²) 2∅30mm
(300×1470) 11.5"×58": 16-10MM@50/6@240/1@600/ –A_s =

285 — d = 36.4" (5.0m)
Span – 16.4' Load = D 556 (ROOF) + 492 (BM) + 853 (WALL) = 1900; L 145; ULT 2910 PLF; D 2662 PLF, L 247 PLF
V = D 21830 #, L 2025 #; v = 56 psi TOP 2∅24mm
$wL^2/11$: M_u = 2910 × 16.4² × 12 / 11 = 854,000 #-" K = 55 MIN A_s = 1.5 in² (9.65 cm²) 2∅30mm
(300×975) 11.5"×38.4": 16-10MM@50/6@240/1@600/ –M = $wL^2/10$ = 939,300 #-" K = 60 MIN A_s = 0.62 in² (4 cm²)

286 — d = 36.4" (5.0m)
Span – 16.4' Load = D 1900 PLF, L 145 PLF; ULT 2910 PLF; D 2662 PLF, L 247 PLF
V = D 21830 #, L 2025 #; v = 56 psi TOP 2∅24mm
$wL^2/16$ (300×975): M_u = 2910 × 16.4² × 12 / 16 = 587,000 #-" K = 52 MIN A_s = 1.5 in² (9.65 cm²) 2∅30mm

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CONSULTING ENGINEERS
2905 Sackett
Houston, Texas 77006

Job Name SMC / JC 126
Architect JAMES M. SINK Assoc.

COMMONS ROOF FRAMING $f'_c = 4000$ psi Job # 13025

2B7 d=52.5" (5.0m)
Span = 16.4' Load = D 1402 PLF ; L 145 PLF ; ULT 2210 PLF D 1963 PLF L 247 PLF
V: D 16100 # L 2015 #
v = 30 psi Top L 2φ29
wl²/11 M_u = 2210 × 16.4² × 12 / 11 = 648,500 #-in K=20 MIN A_s = 2.07 in² (13.4 cm²) 2φ30
(350×1410) 11.8', 55"
16-10MM @50/6@300/1@500/ −M = wl²/9 = 1,046,000 #-in K=32 MIN A_s = 0.62 in² (4 cm²)

2B8 d=52.5" (6.4m)
Span = 21.0' Load = ROOF D 556 + BM 676 + PARAPET 170 = 1402 PLF ; L 145 ; ULT 2210 PLF D 1963 PLF L 247 PLF
V: D 23205 # L 2594 #
v = 42 psi Top 2φ29
wl²/11 M_u = 2210 × 21² × 12 / 11 = 1,064,000 #-in K=33 MIN A_s = 2.07 in² (13.4 cm²) 2φ30
(350×1410) 11.8', 55"
18-10MM @50/6@100/2@600/ −A_s =

2B9 d=21.6" (7.2m)
Span = 23.6' Load = ROOF D 2116 + BM & PARAPET 823 L 492 ULT 4951 PLF D 4114 PLF L 837 PLF
V: D 45500 # L 9377 #
v = 153 psi Top L 2-φ26mm
wl²/11 M_u = 4951 × 23.6² × 12 / 11 = 3,008,200 K=364 ρ=.72% A_s = 2.75 in² (17.8 cm²) 4-φ24mm
(450×600) 17.7', 23.6"
24-10MM @50/6@140/5@500/ −M = wl²/10 = 3,310,000 K=401 ρ=.8% −A_s = 3.06 in² (19.73 cm²)

2B10 d=21.6" (7.2m)
Span = 23.6' Load = D 2939 L 492 ULT 4951 PLF D 4114 PLF L 837 PLF
V: D 45500 # L 9377 #
v = 153 psi Top L 2-φ26
wl²/16 M_u = 4951 × 23.6² × 12 / 16 = 2,069,000 #-in K=250 ρ=.43% A_s = 1.84 in² (11.8 cm²) 4-φ20mm
(450×600) 17.7', 23.6"
24-10MM @50/6@140/5@500/ −A_s =

2B11 d=36" (1.5m)
Span = 5.0' Load = D BM + PARAPET 400 PLF ULT 560 PLF
V = 1400 #
v = ✓ Top L 2-20mm
wl²/8 M_u = 560 × 5² × 12 / 8 = 21000 #-in MIN A_s = 1.18 in² (7.6 cm²) 2-24mm
(350×975) 9.3', 38.4"
10-10MM @50/4@170/ −A_s =

2B12 d=37" (1.5m)
Span = 5.0' Load = D BM 400 PLF + WALL 1230 PLF = 1630 PLF ULT 2300 PLF
V = 5750 #
v = 16 psi 2φ20 TOP
wl²/8 M_u = 2300 × 5² × 12 / 8 = 87000 #-in K=6.5 MIN A_s = 1.21 in² (7.8 cm²) 2φ24mm
(350×975) 9.3', 33.4"
10-10MM @50/4@170/ −A_s =

2B13 d=21.6" (7.2m)
Span = 23.6' Load = ROOF D 2116 + BM 456 L 492 ULT 4410 PLF D 3572 PLF L 837 PLF
V: D 42150 # L 9380 #
v = 136 psi Top 2-φ24
wl²/11 M_u = 4410 × 23.6² × 12 / 11 = 2,680,000 #-in K=325 ρ=.64% A_s = 2.45 in² (15.8 cm²) 3-φ26
(350×600) 17.7', 23.6"
24-10MM @50/6@140/5@550/ −M = wl²/10 = 2,948,000 #-in K=357 ρ=.71% −A_s = 2.71 in² (17.52 cm²)

2B14 d=21.6" (7.2m)
Span = 23.6' Load = D 2552 L 492 ULT 4410 PLF D 3572 PLF L 837 PLF
V: D 42150 # L 9380 #
v = 136 psi Top 2-φ24
wl²/16 M_u = 4410 × 23.6² × 12 / 16 = 1,843,000 #-in K=224 ρ=.45% A_s = 1.65 in² (10.7 cm²) 3-φ24

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Job Name SMC/JC

127

Architect JAMES M. SINK ASSOC.

COMMONS ROOF FRAMING f'_c = 4000 psi Job # 13025

2B15 d = 21.6" (7.2 m)

Span – 23.6' Load = ROOF D 2433 + BM 436, L 566 ULT 4980 PLF D 4017 PLF, L 963 PLF

V = D 47400 #, L 11364 # v = 154 psi TOP 2-φ26 mm

$wl^2/11$ M_u = 4980 × 23.6² × 12 / 11 = 3,026,000 #-", K = 366 ρ = .73% A_s = 2.8 in² (18 cm²) 4φ24 mm

(450×600) 17.7" × 23.6" 24-10MM @50/6@140/5@550 / $-M = wL^2/10$ = 3,330,000 #-", K = 403, ρ = .8% $-A_s$ = 3.06 in² (19.74 cm²)

2B16 d = 21.6" (7.2 m)

Span – 23.6' Load = D 2869, L 566 ULT 4980 PLF D 4017 PLF, L 963 PLF

V = D 47400 #, L 11364 # v = 154 psi TOP 2-φ26 mm

$wl^2/16$ M_u = 4980 × 23.6² × 12 / 16 = 2,081,000 #-", K = 252, ρ = .49% A_s = 1.87 in² (12.1 cm²) 3φ24

(450×600) 17.7" × 23.6" 24-10MM @50/6@140/5@550 / $-A_s$ =

2B17 d = 21.6" (7.2 m)

Span – 24' Load = D BM 300 PLF + GLASS 100 PLF = 400 PLF ULT 560 PLF

V = D 6720 # v = 27 psi TOP 2φ20 mm

$wl^2/11$ M_u = 560 × 24² × 12 / 11 = 352,000 #-", K = 64 MIN A_s = .85 in² (5.5 cm²) 2φ20 mm

(300×615) 11.8" × 23.6" 24-10MM @50/6@140/5@550 / $-M = \frac{wL^2}{10}$ = 388,000 #-" K = 71 $-A_s$ = .4 in² (2.3 cm²)

2B18 d = 21.6" (7.2 m)

Span – 24' Load = D BM 300 PLF + GLASS 100 PLF = 400 PLF ULT 560 PLF

V = D 6720 # v = 27 psi BOT 2φ20 mm

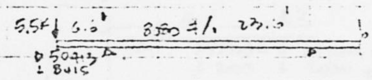
$l^2/16$ M_u = 560 × 24² × 12 / 16 = 242,000 #-", K = 44 MIN A_s = .85 in² (5.5 cm²) 2φ20 mm

(300×615) 11.8" × 23.6" 24-10MM @50/6@140/5@550 / $-A_s$ =

2B19 d = 37" (7.2 m) (SEE TORSION DESIGN) EXTEND ALL REINF. TO END OF CANTILEVER

Span – 23.6' Load = ROOF D 3300 + BM & PARAPET 1060, L 750 ULT. 8030 PLF D 6805 PLF, L 1275 PLF $V_{cant.}$ = 133 psi

V = D 82000 #, L 15300 # v = 220 psi TOP 3-φ24 mm



$wl^2/14$ M_u = 8030 × 23.6² × 12 / 14 = 3,830,000 #-" K = 235 ρ = .46% A_s = 2.04 in² (13.2 cm²) 3-φ26 mm

(300×1000) 12×39 STIRRUPS 40-φ12 @50/19@180 / $-M$ = 2550,000 #-" K = 155 ρ = .33% $-A_s$ = 1.48 in² (9.55 cm²)

2B20 d = 37" (7.2 m) (SEE TORSION DESIGN)

Span – 23.6' Load = D 4860, L 750 ULT 8080 PLF D 6305 PLF, L 1275 PLF

V = D 82000 #, L 15300 # v = 220 psi TOP 2-φ24 mm

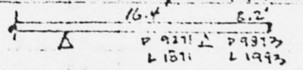
$wl^2/16$ M_u = 8080 × 23.6² × 12 / 16 = 3,376,000 #-" K = 205 ρ = .39% A_s = 1.8 in² (11.5 cm²) 3-φ24 mm

(300×1000) 12×39 STIRRUPS 40-φ12 @50/19@180 / $-M_{14} = \frac{wL^2}{11}$ = 4,912,000 #-", K = 299, ρ = .59% A_s = 2.62 in² (16.9 cm²)

2B21 d = 26" (5.0 m) EXTEND ALL REINF. TO END OF CANTILEVER

Span – 16.4' Load = D 360 PLF, L 143 PLF ULT 1447 PLF D 1204 PLF, L 243 PLF $V_{cant.}$ = 57 psi

V = D 9271 #, L 1871 # v = 54 psi TOP 2-φ20 mm



$wl^2/16$ M_u = 1447 × 16.4² × 12 / 16 = 292,000 #-" K = 54 MIN A_s = 0.71 in² (4.52 cm²) 2-φ20 mm

(200×750) 8" × 29.5" 18-10MM @50/6@160/2@600 / $-M$ = 584,000 #-" K = 103 ρ = .21% $-A_s$ = 0.44 in² (2.82 cm²)

CANTILEVER AT EXPANSION JOINT d = 26" (2.0 m)

Span – 6.56' Load = D 360 PLF, L 143 PLF ULT 1447 PLF D 1204 PLF, L 243 PLF

V = 4800 # v = 23 psi TOP 2-φ20 min

(200×750) A_s = 2-φ20 min

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Architect JAMES M. SINK ASSOC.

COMMONS ROOF FRAMING

$f'_c = 4000$ psi

Job # 13025

B22 $d = 21.6"$ (4.5m)

Span – 14.76' Load = BM D 300 PLF + PARAPET 733 = 1038 PLF ULT 1454 PLF

V = 10,730 #   v = 63 PSI   2-20 TOP

$WL^2/8$ $M_u = 1038 \times 14.76^2 \times 12/8 = 340,000$ #-"   K = 98   MIN $A_s = 0.35 in^2 (5.5 cm^2)$ 2-ϕ20 mm

(200, 580) 7.9" x 22.8"   18 - 10MM @ 50/6 @ 130/2 @ 600/ $-A_s =$

B23 $d: 40"$ (5.0m)

Span – 16.4' Load = BM D 590 PLF + PARAPET 345 PLF = 935 PLF   ULT 1310 PLF

V = 10,750 #   v = 23 PSI   2-20 TOP

$WL^2/8$ $M_u = 935 \times 16.4^2 \times 12/8 = 378,000$ #-"   K = 20   MIN $A_s = 1.77 in^2 (11.42 cm^2)$ 3-ϕ24 mm

(300 x 1070) 11.8" x 42"   16 - 10MM @ 50/6 @ 250/1 @ 600/ $-A_s =$

2B24 $d: 27"$ (4.7m)

Span – 15.4' Load = ROOF D 547 L 143 + BM + PARAPET 525 = 1072 PLF, 143 PLF   ULT 1743 PLF   D 1500 L 243

V = D 11550 # L 1371 #   v = 42 psi   TOP L 2-20 MM

$WL^2/11$ $M_u = 1743 \times 15.4^2 \times 12/11 = 451000$ #-"   K = 53   MIN $A_s = 1.06 in^2 (6.85 cm^2)$ 2-24 MM

(300 x 765) 11.8" x 30"   18 - 10MM @ 50/6 @ 170/2 @ 600/ $- M = \frac{WL^2}{10} = 496,000$ #-"   K = 53 $-A_s = 0.62 in^2 (4.0 cm^2)$

2B25 $d = 27"$ (4.7m)

Span – 15.4' Load = D 1072 L 143   ULT 1743 PLF   D 1500 L 243

V = D 11550 # L 1871 #   v = 42 psi   TOP L 2-20 MM

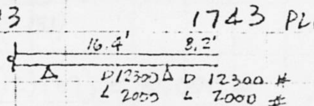
$WL^2/16$ $M_u = 1743 \times 15.4^2 \times 12/16 = 310000$ #-"   K = 36   MIN $A_s = 1.06 in^2 (6.85 cm^2)$ 2-24 MM

(300 x 765) 11.8" x 30"   18 - 10MM @ 50/6 @ 170/2 @ 600/ $-A_s =$

2B26 $d = 27"$ (5.0m)   EXTEND ALL REINF. TO END OF CANTILEVER

Span – 16.4' Load = D 1072 L 143   ULT 1743 PLF   D 1500 PLF L 243 PLF $V_{CANT} = 45$ psi

V = D 12300 # L 2000 #   v = 45 psi   TOP L 2-20 MM



$WL^2/16$ $M_u = 1743 \times 16.4^2 \times 12/16 = 352,000$ #-"   K = 41   MIN $A_s = 1.06 in^2 (6.85 cm^2)$ 2-24 MM

(300 x 765) 11.8" x 30"   18 - 10MM @ 50/6 @ 170/2 @ 600/ $- M = 586,000$ #-"   K = 63 $-A_s = 0.62 in^2 (4 cm^2)$

2B27 $d = 36.4"$ (2.75m)

Span – 9.0' Load = D 400 PLF   ULT D 560 PLF

V = D 2520 #   v = 7 PSI   2-20 TOP

$WL^2/8$ $M_u = 560 \times 9^2 \times 12/8 = 68000$ #-"   MIN $A_s = 1.2 in^2 (7.7 cm^2)$ 2-24 MM

(250, 950) 9.8" x 30"   18 - 10MM @ 50/5 @ 230/ $-A_s =$

Span – Load =

v =

$A_s =$

$-A_s =$

Span – Load =

v =

$A_s =$

COMMONS ROOF FRAMING

(7.2m) COMBINED SHEAR AND TORSION DESIGN $f'_c = 4000$ psi

SPAN = 24'

CONTINUOUS BM., SUPPORTING 2.400 TT 760

TORQUE : D 50000 #-l; L 11800 #-l; ULT. 61800 #-l

CHECK LEDGE:

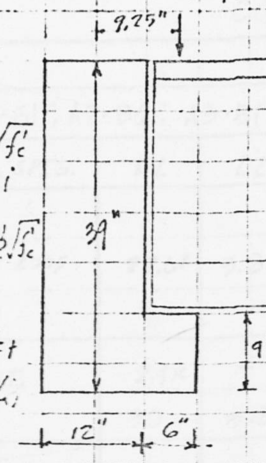
$v_u = \frac{6600}{12 \cdot 7}$ # $= 79$ psi $< 2\phi\sqrt{f'_c} = 108$ psi

$v_u = \frac{6600 \cdot 4}{36 \times 7} = 105$ psi $< 4\phi\sqrt{f'_c} = 215$ psi

$M_u = 6600 \times 6 = 39600$ #-"/Ft

$A_s = 0.15$ in²/Ft (318 mm²/m)

USE ϕ10 @200 mm



T_u at "d" FROM FACE OF SUPPORT : $61800 \times \frac{7.0}{12} = 36050$ #-l

$v_{tu} = \frac{3 T_u}{\phi \sum x^2 y}$; $\sum x^2 y = (12)^2 (39) + (6)^2 (9) = 5940$ in³

$v_{tu} = \frac{3 \times 36050 \cdot 12}{0.85 \times 5940} = 257$ psi $> 1.5\sqrt{f'_c} = 95$ psi

V_u at "d" : $97300 \cdot \frac{7.0}{12} = 57000$ #

$v_u = \frac{57000}{0.85 \times 37 \times 12} = 151$ psi

MAX. ALLOW. $v_{tu} = \frac{12\sqrt{f'_c}}{\sqrt{1 + \left(\frac{1.2 v_u}{v_{tu}}\right)^2}} = \frac{12\sqrt{4000}}{\sqrt{1 + \left(\frac{1.2 \cdot 151}{257}\right)^2}} = 620$ psi > 257 psi ✓

$v_{tc} = \frac{2.4\sqrt{f'_c}}{\sqrt{1 + \left(\frac{1.2 v_u}{v_{tu}}\right)^2}} = \frac{2.4\sqrt{4000}}{\sqrt{1 + \left(\frac{1.2 \times 151}{257}\right)^2}} = 124$ psi < 257 psi STIRRUPS REQUIRED

$v_c = \frac{2\sqrt{f'_c}}{\sqrt{1 + \left(\frac{v_{tu}}{1.2 v_u}\right)^2}} = \frac{2\sqrt{4000}}{\sqrt{1 + \left(\frac{257}{1.2 \cdot 151}\right)^2}} = 73$ psi < 151 psi STIRRUPS REQUIRED

$V_u = (v_u - v_c) b_w d = (151 - 73)(12)(37) = 35000$ # ; $\frac{A_v}{s} = \frac{V_u}{d f_y} = \frac{35000}{37 \times 40000} = 0.024$ sq in/in

max $s = \frac{d}{2} = 18.5$"

TORSIONAL WEB REINF. REQ:

$A_t = \frac{(v_{tu} - v_{tc})(s \sum x^2 y)}{3 \alpha_t x_1 y_1 f_y}$; $x_1 = 8.5$", $y_1 = 35.5$", $\alpha_t : 0.66 + 0.33\left(\frac{y_1}{x_1}\right)$ but not > 1.5

$\alpha_t = 2.04$, USE 1.5

$\frac{A_t}{s} = \frac{(257 - 124)\,5940}{3 \times 1.5 \times 8.5 \times 35.5 \times 40000} = 0.015$ sq in/in ; max $s = \frac{x_1 + y_1}{4} = 11$"

COMBINE TORSION & SHEAR REINF. : $\frac{A_t}{s} + \frac{1}{2}\frac{A_v}{s} = 0.015 + \frac{0.024}{2} = 0.027$ sq in/in

TRY #3 ; $s_d = \frac{0.20}{0.027} = 7.4$" ;

CLOSED STIRRUPS : 40 ϕ12 mm @ 50/19 @ 180/

TORSIONAL LONGITUDINAL REINF. $A_l = 2A_t\left(\frac{x_1 + y_1}{s}\right) = 2 \times 0.015 \times 7.4 \times \frac{8.5 + 35.5}{7.4} = 1.32$ sq in

DISTRIBUTE A_l AROUND PERIMETER OF STIRRUPS, PROVIDING LONGITUDINAL BARS AT EACH CORNER, MAX BAR SPACING : 12 in. #3 MIN. BAR SIZE. COMBINE A_l WITH A_s FOR FLEXURE.

DISTRIBUTE : $\frac{1.32}{4}$ at top ; $\frac{1.32}{4}$ at bottom ; the REST IN MIDDLE OF SECTION ; 4-ϕ12

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Job Name SMC / JC

Architect JAMES M. SINK ASSOC.

COLUMNS: $f_c' = 4000$ PSI
FOOTINGS: $f_c' = 3000$ PSI

Job # 13025

COMMONS COLUMN & FOOTING

A2-B1; A2-B6; A3-B1; A3-B6

COL. SPTG.	DL	LL	TL	COL & FTG.
LOW ROOF	27.6K	3.8K	31.4K	(250 x 1000) 10" x 39" 8 φ 20 mm
1 ST.	2.4K 30	— 3.8	2.4K 33.8	
WORK. TO FTG.	21.5	2.27	24 K	(450 x 1.200) 1.5' x 4.0' 3-φ16 mm long 5-φ16 mm short

t = 450

A6-B1; A6-B6

COL. SPTG.	DL	LL	TL	COL & FTG.
LOW ROOF	18.0 K	1.5	19.5	(250 x 1000) 10" x 39" 8 φ 20 mm
1 ST.	2.4K 20.4K	— 1.5	2.4 21.9	
WORK. TO FTG.	14.6	0.9	15.5	(450 x 1.200) 1.5' x 4.0' 3 φ16 mm long 5 φ16 mm short

t = 450

A4-B1; A4-B6

COL. SPTG.	DL	LL	TL	COL & FTG.
LOW ROOF	28 K	3.9 K	30 K	(250 x 1000) 10" x 39" 8 φ 20 mm
1 ST	2.4K 30.4	— 3.9	2.4K 34.3	
WORK. TO FTG.	21.7	2.3	24	(450 x 1.200) 1.5' x 4.0' 3-φ16MM LONG 5-φ16MM SHORT

t = 450

A7-B1; A7-B6

COL. SPTG.	DL	LL	TL	COL & FTG.
LOW ROOF	36.5K	2.1K	38.6K	(250 x 1000) 10" x 39" 8 φ 20 mm
1 ST.	2.4K 38.9	— 2.1	2.4K 41 K	
WORK. TO FTG.	27.8	1.24	29 K	(450 x 1.200) 1.5' x 4.0' 3 φ16 mm long 5 φ16 mm short

t = 450

A5-B1; A5-B6

COL. SPTG.	DL	LL	TL	COL & FTG.
LOW ROOF	31.0K	4.5K	35.6K	(250 x 1000) 10" x 39" 8 φ 20 mm
1 ST	2.4K 33.4	— 4.5	2.4K 38.0	
WORK. TO FTG.	24	2.7	26.7	(450 x 1.200) 1.5' x 4.0' 3-φ16MM LONG 5-φ16MM SHORT

t = 450

A8-B1; A8-B6; A9-B1; A9-B6

COL. SPTG.	DL	LL	TL	COL & FTG.
LOW ROOF	52.5	4.10	56.6	(250 x 1000) 10" x 39" 8 φ 20 mm
1 ST.	2.4 54.9	— 4.1	2.4K 59.0	
WORK. TO FTG.	39.2	2.42	41.7	(650 x 1.400) 2.13' x 4.6' 3-φ16 MM LONG 5-φ16 MM SHORT

t = 450

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Job Name JMC / JC

Architect JAMES M. SINK ASSOC.

131

COLUMNS: $f'_c = 4000$ psi
FOOTINGS: $f'_c = 3000$ psi

COMMONS COLUMN & FOOTING

Job # 13025

A10-B1 ; A10-B6				
COL. SPTG.	DL	LL	TL	COL. & FTG.
LOW ROOF	52.53	4.1	56.7	(250 x 1000) 10" x 39" 8 ϕ 20mm
1ST.	2.9	–	2.9	
	55.4	4.1	59.6	
WORK. to FTG.	40.0	2.42	42.42	(650 x 1400) 2.13' x 4.6' 3-ϕ16mm LONG 5-ϕ16mm SHORT

t = 450

A11-B1 ; A11-B6				
COL. SPTG.	DL	LL	TL	COL. & FTG.
LOW ROOF	48.2	4.7	52.9	(250 x 1000) 10" x 39" 8 ϕ 20mm
1ST.	2.9	–	2.9	
	51.1	4.7	55.8	
WORK to FTG.	36.5	2.8	39.3	(650 x 1400) 2.13' x 4.6' 3-ϕ16mm LONG 5-ϕ16mm SHORT

t = 450

A7-B2 , A7-B5				
COL. SPTG.	DL	LL	TL	COL. & FTG.
HIGH ROOF	161.5K	23.8K	185.3K	(450 x 1200) 17.7" x 47.2" 8 ϕ 30mm
MIDDLE	6.72K	–	6.72	
	168.22	23.8	192.0	
LOW	73.31	11.30	84.61	
	241.62	35.1	276.7	
1ST.	16.7	–	16.7	
	258.3	35.1	293.42	
WORK to FTG.	184.5K	20.7	205.2K	(1.700 x 2.500) 5.6' x 8.2' 6-ϕ20mm LONG 8-ϕ20mm SHORT

t = 650

A10-B2, A10-B5				
COL. SPTG.	DL	LL	TL	COL. & FTG.
HIGH ROOF	161.5K	23.8K	185.3K	(450 x 1200) 17.7" x 47.2" 8 ϕ 30mm
MIDDLE	6.72K	–	6.72	
	168.22	23.8	192.0	
LOW	53.2K	11.4K	64.6	
	221.4	35.2	256.6	
1ST.	16.7	–	16.7	
	238.1	35.2	273.3	
WORK to FTG.	170.1K	20.7K	190.8K	(1.700 x 2.500) 5.6' x 8.2' 6-ϕ20mm LONG 8-ϕ20mm SHORT

t = 650

A7-B3, A7-B4, A10-B3, A10-B4				
COL. SPTG.	DL	LL	TL	COL. & FTG.
HIGH ROOF	194K	30.6K	224.6	(450 x 1200) 17.7" x 47.2" 8 ϕ 30mm
MIDDLE	13.44K	–	13.44	
	207.5K	30.6K	238K	
LOW	84.3K	19.8K	104K	
	292K	50.4K	342K	
1ST	16.7	–	16.7	
	308.7	50.4	359K	
WORK TO FTG.	221K	30K	251K	(1.700 x 2.500) 5.6' x 8.2' 6-ϕ20mm LONG 8-ϕ20mm SHORT

t = 650

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Job Name SMC / JC

Architect JAMES M. SINK ASSOC.

COLUMNS: f'_c = 4000 PSI
FOOTINGS: f'_c = 3000 PSI

COMMONS COLUMN & FOOTING

Job # 13025

A5-B2 ; A5-B5				
COL. SPTG.	DL	LL	TL	COL. & FTG.
				(450 x 1,200)
ROOF	79.4k	9.9k	89.3k	17.7" x 47.2"
				8 φ 30mm
1ST.	19.0k	-	19.0k	
	98.4k	9.9k	108.3k	
WORK. to				(1,000 x 2,000)
FTG.	70.3k	5.9k	76.2k	3.28' x 6.6'
				3-φ16MM LONG
				5-φ16MM SHORT

t = 650

A6-B2 ; A6-B5				
COL. SPTG.	DL	LL	TL	COL. & FTG.
				(250 x 1,200)
ROOF	45.0k	1.4k	46.4k	10" x 47.2"
				6 φ 26mm
1ST.	2.4k	-	2.4k	
	47.4k	1.4k	48.8k	
WORK. to				(650 x 1,400)
FTG.	33.9k	1k	34.9k	2.13' x 4.6'
				3-φ16MM LONG
				5-φ16MM SHORT

t = 500

A5-B3 ; A5-B4				
COL. SPTG.	DL	LL	TL	COL. & FTG.
				(450 x 1,200)
ROOF	117.2k	19.8k	137k	17.7" x 47.2"
				8 φ 30mm
1ST.	19.0k	–	19.0	
	136.2k	19.8k	156k	
WORK. to				(1,000 x 2,000)
FTG.	97.3k	11.7k	109k	3.28' x 6.6'
				3-φ16MM LONG
				5-φ16MM SHORT

t = 650

A2-B0 ; A3-B0 ; A4-B0 ; A2-B7 ; A3-B7 ; A4-B7				
COL. SPTG.	DL	LL	TL	COL. & FTG.
				(200 x 1,100)
ROOF	24.4k	9.0k	33.4k	7.9" x 43.3"
				8 φ 20mm
1ST	23.5k	-	23.5	
	47.9k	4.0k	51.9k	
WORK. TO				(650 x 1,400)
FTG.	34.0k	2.4k	36.4k	2.13' x 4.6'
				3-φ16MM LONG
				5-φ16MM SHORT

t = 450

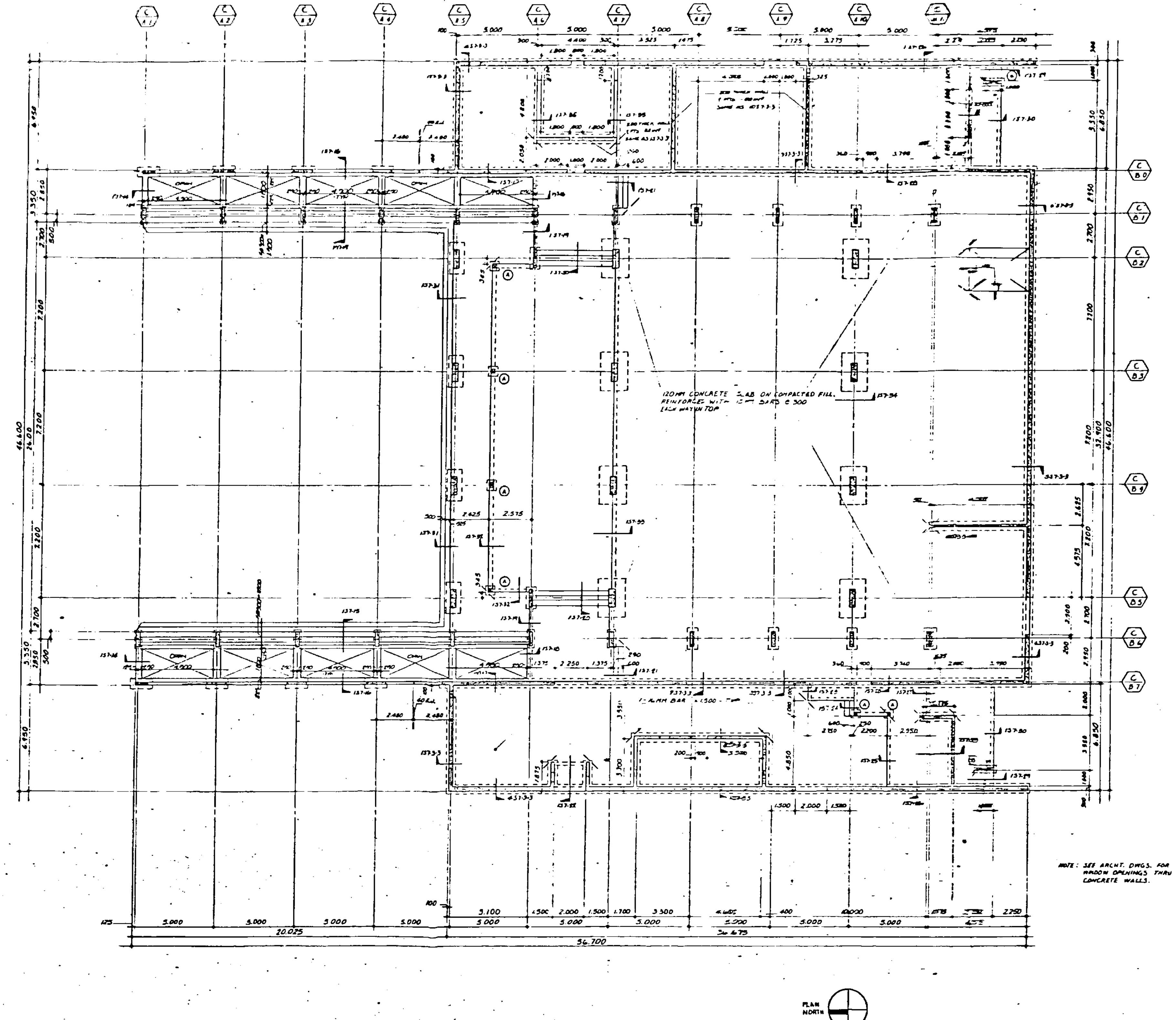
A1-B1 ; A1-B6				
COL. SPTG.	DL	LL	TL	COL. & FTG.
				(250 x 1,000)
ROOF	14.4k	1.9	16.3	10" x 39"
				8 φ 20mm
1ST.	2.4k	-	2.4k	
	16.8k	1.9k	18.7k	
WORK. to				(450 x 1,200)
FTG.	12. k	1.1k	13.1k	1.5' x 4.0'
				3 φ 16MM LONG
				5 φ 16MM SHORT

t = 450

A1-B0 ; A1-B7				
COL. SPTG.	DL	LL	TL	COL. & FTG.
				(200 x 725)
ROOF	11.4k	1.9	13.3	7.9" x 28.5"
				8 φ 16MM
1ST.	9.5	–	9.5	
	21k	1.9	22.8	
WORK. TO				(450 x 1,000)
FTG.	15k	1.22k	16.22k	1.5' x 3.3'
				3 φ 16MM LONG
				3 φ 16MM SHORT

t = 450

a.3. Structural drawings



1 FRAMING PLAN-FOUNDATION AND GROUND LEVEL
SCALE 1:100

134

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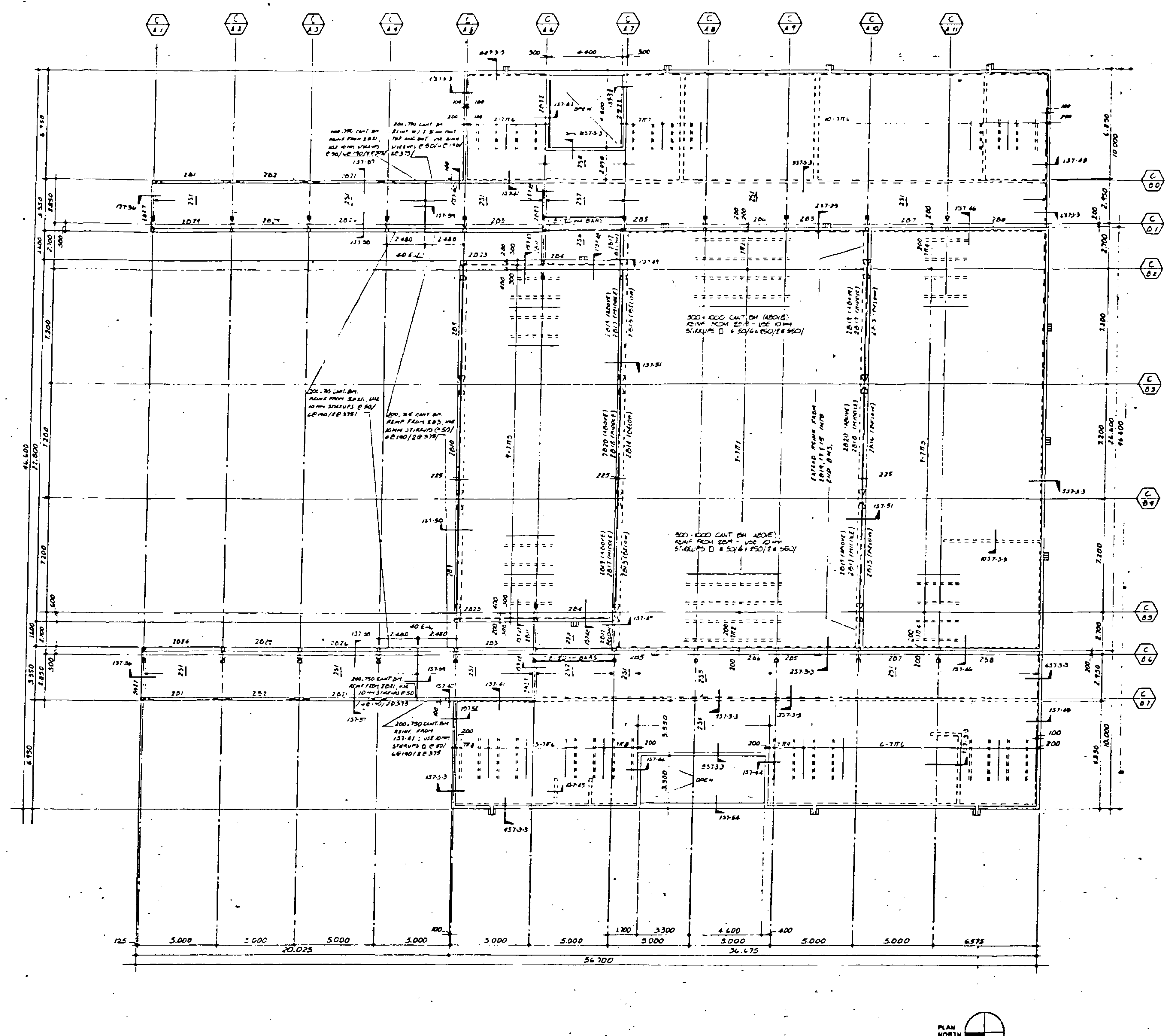
SINGLE STUDENT HOUSING
FRAMING PLAN-FOUNDATION / GROUND LEVEL-COMMONS

JUNE 5, 1977

S7·2·3



1 FRAMING PLAN - ROOF
SCALE 1:100

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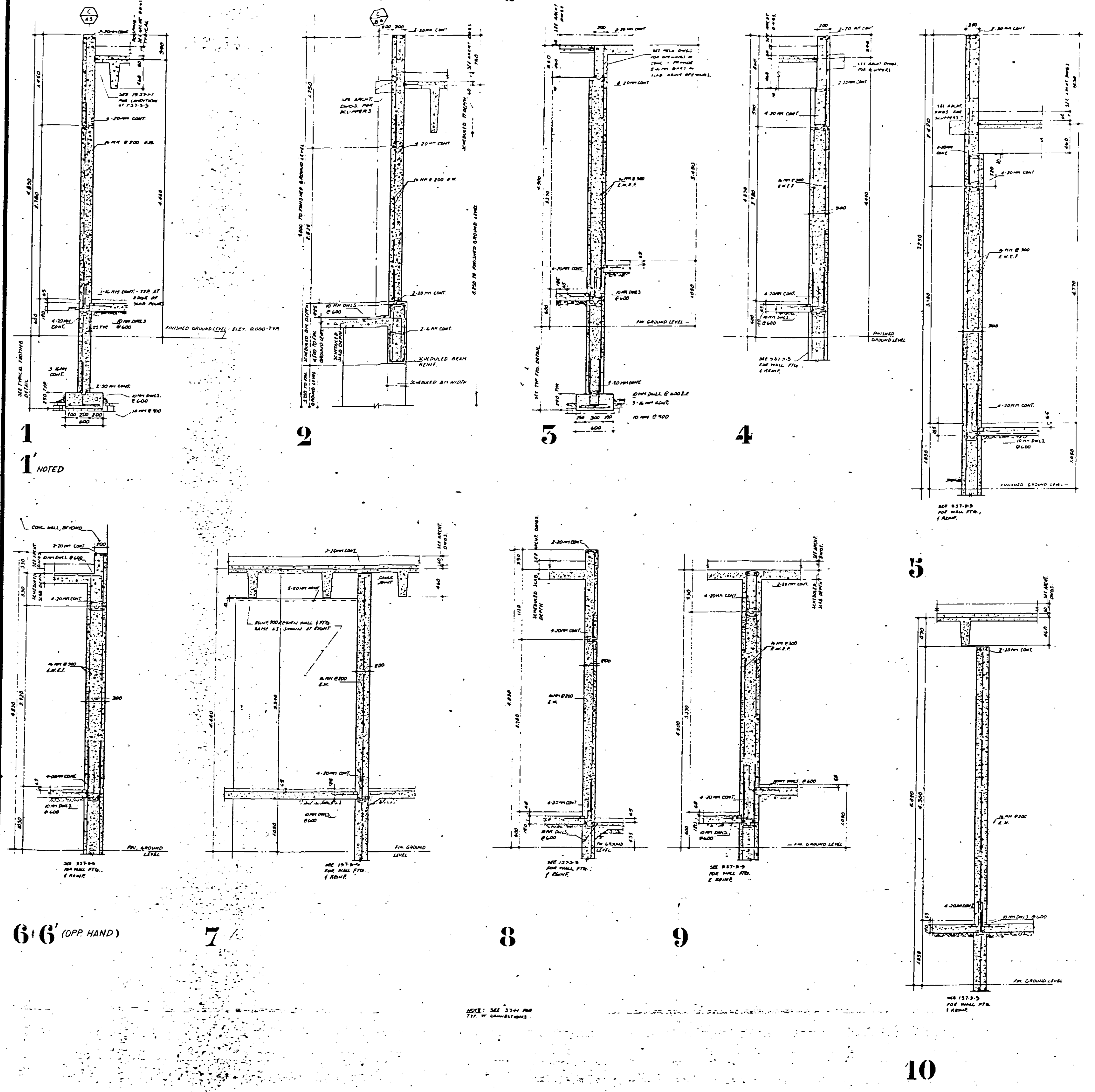
SINGLE STUDENT HOUSING
FRAMING PLAN - ROOF -
COMMONS

ISSUE DATE JUNE 3, 1977

S7·2·4



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136
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SINGLE STUDENT HOUSING
SECTIONS
COMMONS

JUNE 3, 1977

S733

SINGLE STUDENT HOUSING — DORMITORY SLAB SCHEDULE

MARK	THICKNESS (MM)	REINFORCING STEEL TOP	TOP ◇	TOP ◆	BOT	REMARKS
FOURTH LEVEL						
4S1	150		12@300		12@300	
4S2	150			12@250	12@300	
4S3	150		12@300		12@300	
4S4	150		12@300		12@300	
4S5	150		12@300		12@300	
4S6	150	12@300			12@300	
4S7	150	12@300			12@300	
4S8	150		12@300		16@275	
4S9	150	12@300			12@300	
4S10	150				12@300	
THIRD LEVEL						
3S1	150		12@300		12@300	
3S2	150			12@300	12@300	
3S3	150		12@250 / 8@300		12@250	
3S4	150		12@300		12@300	
3S5	150		12@300		12@300	
3S6	150	12@300			12@300	
3S7	150	12@300			12@300	
3S8	150		12@300		16@300	
SECOND LEVEL						
2S1	150		12@300		12@300	
2S2	150			12@300	12@300	
2S3	150		12@250 / 8@300		12@250	
2S4	150		12@300		12@300	
2S5	150		12@300		12@300	
2S6	150	12@300			12@300	
2S7	150	12@300			12@300	
2S8	150		12@300		16@250	

SINGLE STUDENT HOUSING — DORMITORY BEAM SCHEDULE

MARK	SIZE W (MM)	D (MM)	REINFORCING STEEL TOP			BOT	STIRRUPS NO	SIZE	TYPE	SPACING EA END
FOURTH LEVEL										
4B1	[illegible]	600	2-16			2-16	2	10	☐	150/
4B2	200	600	2-16			2-16	2	2		150/
4B3	200	600	2-16			2-20	36	10		50/4@75/11@150/2@600/
4B4	200	600	2-16			2-16	4	10		150/1000/
4B5	177	600	2-16			2-16	4	10		150/475/
4B6	250	600	2-16			2-16	20	10		50/4@75/5@475/
4B7	200	600	L2-16			2-16	8	10		150/3@575/
4B8	200	600	L2-16			2-16	8	10		150/3@575/
4B9	250	600	L2-16			2-16	8	10		150/3@575/
4B10	250	600	L2-16			2-16	8	10		150/3@575/
4B11	200	600	2-16			2-16	6	10		150/2@525/
THIRD LEVEL										
3B1	[illegible]	600	2-16			2-16	2	10	☐	150/
3B2	200	600	2-16			2-16	2	10		150/
3B3	200	600	2-16			2-20	36	10		50/4@75/9@150/2@575/
3B4	200	400	2-16			2-16	10	10		75/2@150/2@450/
3B5	177	385	2-16			2-16	4	10		150/475/
3B6	250	385	2-16			2-16	20	10		50/4@75/5@475/
3B7	200	400	L2-16			2-16	8	10		150/3@575/
3B8	200	400	L2-16			2-16	8	10		150/3@575/
3B9	250	400	L2-20			2-16	8	10		150/3@575/
3B10	250	400	L2-16			2-16	8	10		150/3@575/
3B11	200	400	2-16			2-16	12	10		75/3@150/2@375/
SECOND LEVEL										
2B1	[illegible]	600	2-16			2-16	2	10	☐	150/
2B2	200	600	2-16			2-16	2	10		150/
2B3	200	600	2-16			2-20	36	10		50/4@75/10@150/2@575/
2B4	200	600	2-16			2-16	12	10		75/3@150/2@775/
2B5	177	385	2-16			2-16	4	10		150/475/
2B6	250	385	2-16			2-16	20	10		50/4@75/5@475/
2B7	200	400	L2-16			2-16	8	10		150/3@575/
2B8	200	400	L2-16			2-16	8	10		150/3@575/
2B9	250	400	L2-16			2-16	8	10		150/3@575/
2B10	250	400	L2-16			2-16	8	10		150/3@575/
2B11	200	400	L2-16			2-16	12	10		75/3@150/2@375/
2B12	200	600	2-16			2-16	8	10		125/250/2@450/
2B13	200	400	2-16			2-16	18	10		75/5@150/450/

SINGLE STUDENT HOUSING — COMMONS SLAB SCHEDULE

MARK	THICKNESS (MM)	REINFORCING STEEL TOP	TOP ◇	TOP ◆	BOT	REMARKS
SECOND LEVEL						
2S1	150		12@300		12@300	
2S2	150		12@300		12@300	
2S3	150	12@300			12@300	
2S4	150		12@300	12@300	12@300	
2S5	150		12@300		12@300	
2S6	150	12@300			12@300	
2S7	150				12@400	
2S8	150	12@300			12@300	

SINGLE STUDENT HOUSING — COMMONS BEAM SCHEDULE

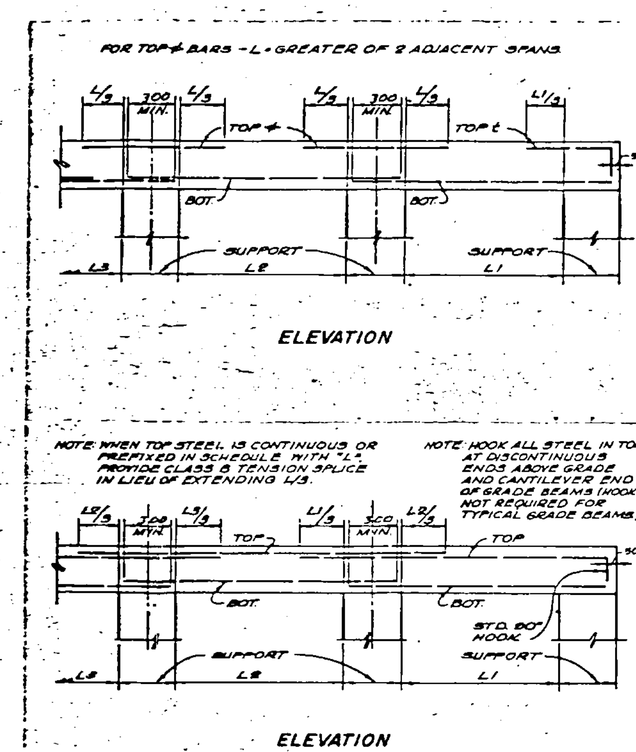
MARK	SIZE W (MM)	D (MM)	REINFORCING STEEL TOP			BOT	STIRRUPS NO	SIZE	TYPE	SPACING EA END
ROOF										
2B1	200	750	L2-20			2-24	18	10	☐	50/6@165/2@600/
2B2	200	750	L2-20			2-24	18	10		50/6@165/2@600/
2B3	400	765	2-20			2-24	18	10		50/6@165/2@600/
2B4	300	1410	2-24			2-30	18	10		50/6@240/600/
2B5	300	975	L2-24			2-30	18	10		50/6@240/600/
2B6	300	975	L2-24			2-30	18	10		50/6@165/2@600/
2B7	300	1600	L2-24			2-30	18	10		50/6@300/500/
2B8	300	1410	L2-24			2-30	18	10		50/6@300/2@400/
2B9	450	600	L2-26			4-26	24	10		50/6@140/5@500/
2B10	450	600	L2-26			4-20	24	10		50/6@140/5@500/
2B11	250	975	L2-20			2-24	10	10		50/4@170/
2B12	250	975	2-20			2-26	10	10		50/4@170/
2B13	450	600	2-24			3-26	24	10		50/6@140/5@550/
2B14	450	600	2-24			3-24	24	10		50/6@140/5@550/
2B15	450	600	2-26			4-24	24	10		50/6@140/5@550/
2B16	450	600	2-26			3-24	24	10		50/6@140/5@550/
2B17	400	615	L2-20			2-20	24	10		50/6@140/5@550/
2B18	300	615	L2-20			2-20	24	10		50/6@140/5@550/
2B19	300	1000	3-24			3-26	40	12		50/19@180/
2B20	300	1000	2-24			3-24	40	12		50/19@180/
2B21	200	750	L2-20			2-20	18	10		50/6@160/2@600/
2B22	200	580	2-20			2-20	18	10		50/6@130/2@600/
2B23	300	1070	2-20			3-24	16	10		50/6@250/600/
2B24	300	765	L2-20			2-24	18	10		50/6@170/2@600/
2B25	300	765	L2-20			2-24	18	10		50/6@170/2@600/
2B26	300	765	L2-20			2-24	18	10		50/6@170/2@600/
2B27	250	750	2-20			2-26	12	10		50/5@230/

SINGLE STUDENT HOUSING — COMMONS COLUMN & FOOTING SCHEDULE

MARK		A2-B1, A2-B6, A3-B1, A3-B6, A4-B1, A4-B6, A5-B1, A5-B6, A6-B1, A6-B6, A7-B1, A7-B6, A8-B1, A8-B6	A8-B1, A8-B6, A9-B1, A9-B6, A10-B1, A10-B6, A11-B1, A11-B6	A7-B2, A7-B5, A8-B2, A8-B5, A7-B3, A7-B4, A10-B3, A10-B4	A5-B2, A5-B5, A5-B3, A5-B4	A6-B2, A6-B5	A2-B0, A3-B0, A4-B0, A5-B7, A2-B7, A4-B7	A1-B0, A1-B7
COLUMN	SIZE	250×1000	250×1000	450×1200	450×1200	250×1200	200×1250	200×725
	VERT. REINF	8-20	8-20	5-30	8-30	6-26	8-20	8-16
	TIES	10@250	10@250	10@450	10@450	10@250	10@200	10@200
FOOTING	SIZE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	REINF. STEEL	3-16 LONGWAY 5-16 SHORTWAY	3-16 LONGWAY 5-16 SHORTWAY	[illegible]	3-16 LONGWAY 5-16 SHORTWAY	3-16 LONGWAY 5-16 SHORTWAY	3-16 LONGWAY 5-16 SHORTWAY	3-16 LONGWAY 5-16 SHORTWAY

SINGLE STUDENT HOUSING — COMMONS LET. FTG. SCHED

MARK		A	B
PLINTH	SIZE	300×300	300×1000
	VERT REINF	4-16	8-16
	TIES	10@300	10@300
FOOTING	SIZE	600×600×300	600×[illegible]×300
	REINF STEEL	3-16 EA. WAY	3-16 LONG WAY 6-16 SHORT WAY



BAR PLACEMENT DIAGRAMS

SCHEDULE NOTES

1. BARS MARKED THUS ◆ SHALL BE PLACED IN TOP OF SLAB CENTERED OVER INTERIOR SUPPORT. SEE DIAGRAM. IF SLAB IS CONTINUOUS AT BOTH ENDS, BARS AT INDICATED SPACING SHALL BE CENTERED OVER EACH SUPPORT.
2. BARS MARKED THUS ◇ SHALL BE PLACED IN TOP OF SLAB AT DISCONTINUOUS END. SEE DIAGRAM. IF SLAB IS DISCONTINUOUS AT BOTH ENDS, BARS AT INDICATED SPACING SHALL BE PLACED AT EACH END.
3. STIRRUPS SHALL BE SPACED FROM FACE OF SUPPORT.

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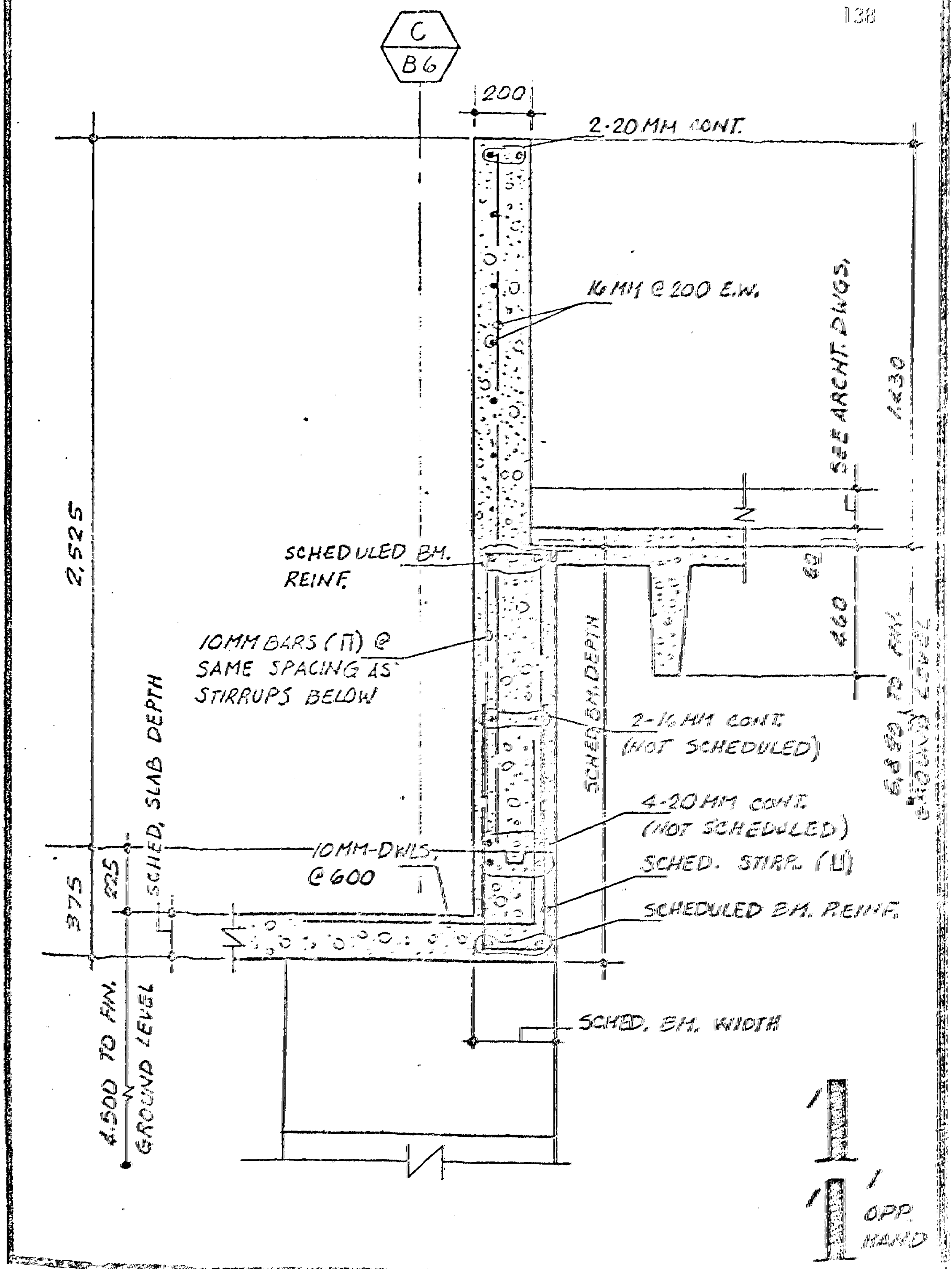
SINGLE STUDENT HOUSING

SCHEDULES

JUNE 3, 1977

S7·41



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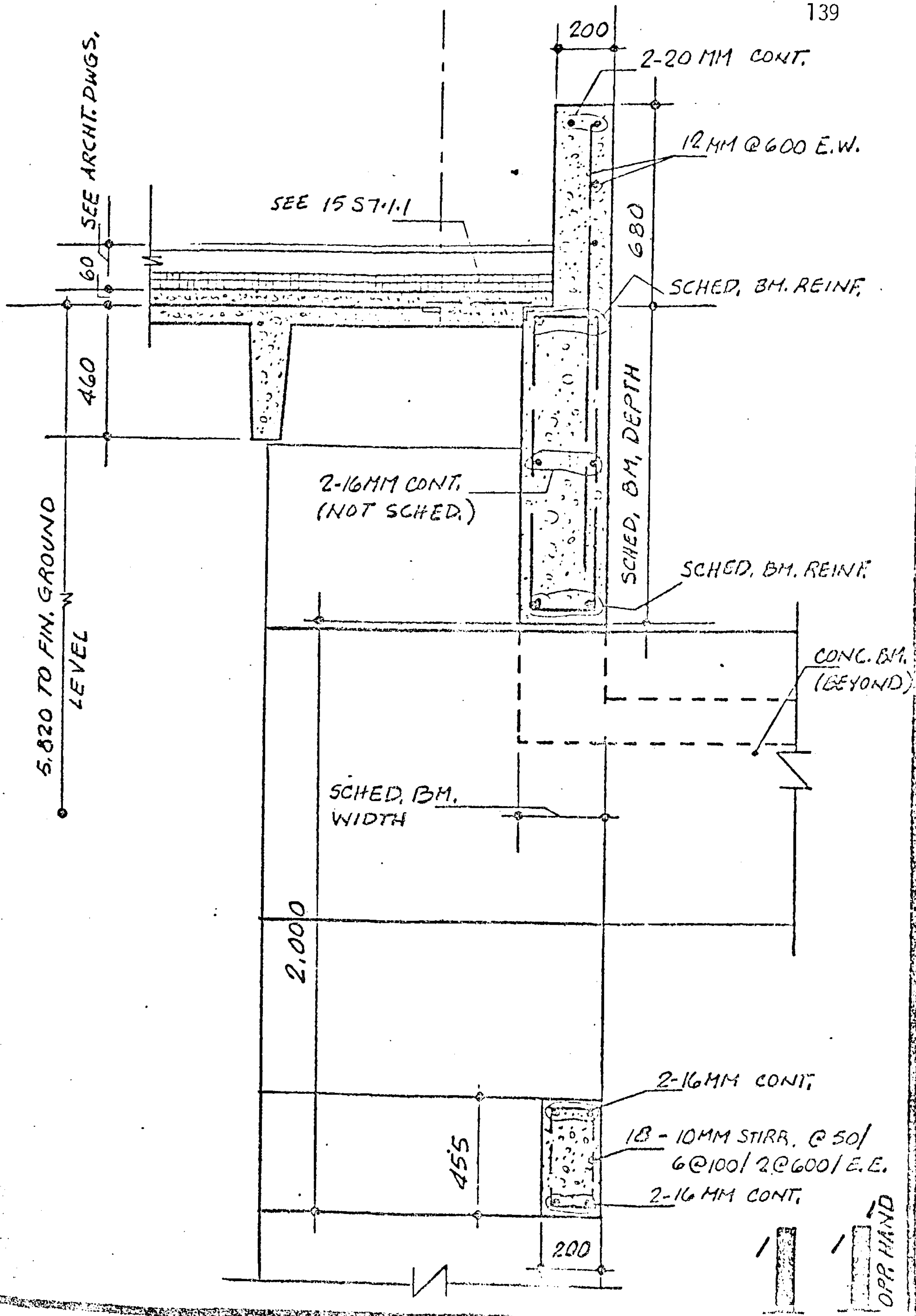
JULY 12, 1977

STRUCTURAL DETAILS

ST-4



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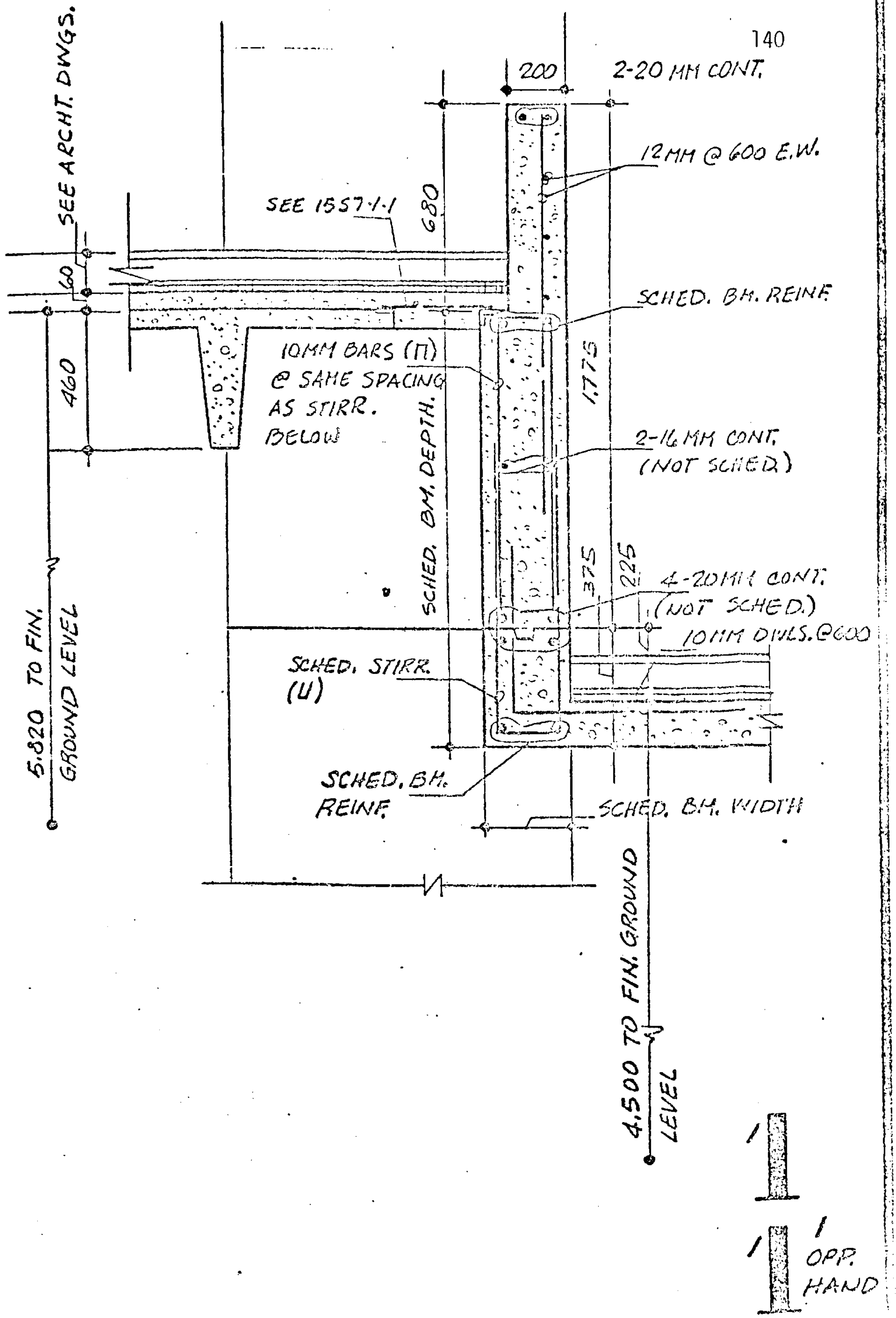
JAMES H. SINK ASSOCIATES PLANNERS & ARCHITECTS	REVISIONS JULY 17, 1977	PROJECT 7515 STRUCTURAL DETAILS	DATE ISSUED 6-9-77 S7.47



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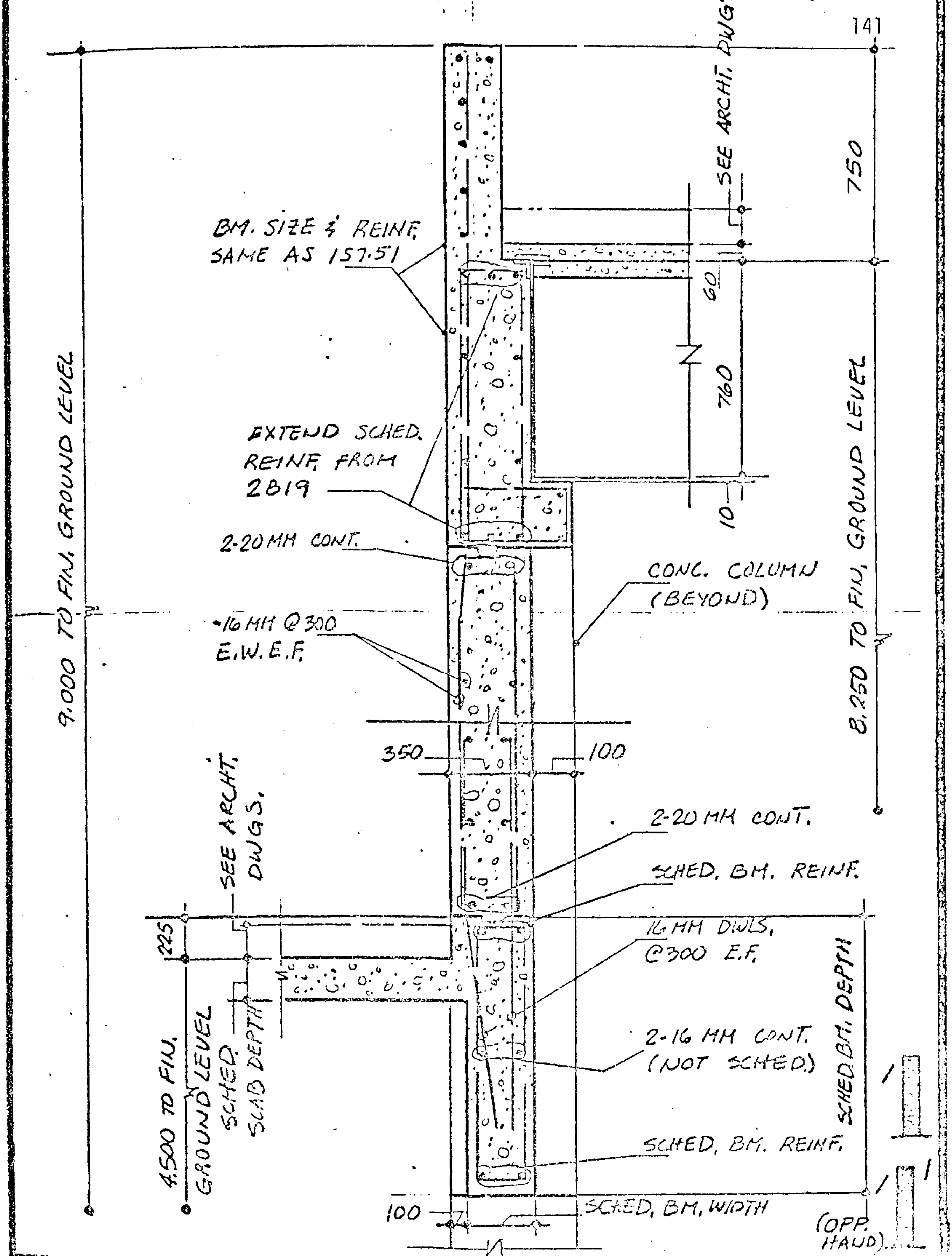
JAMES M. SINK ASSOCIATES PLANNERS & ARCHITECTS	REVISIONS JULY 17, 1977	PROJECT 7513 STRUCTURAL DETAILS	DATE ISSUED -6-77 S7-48



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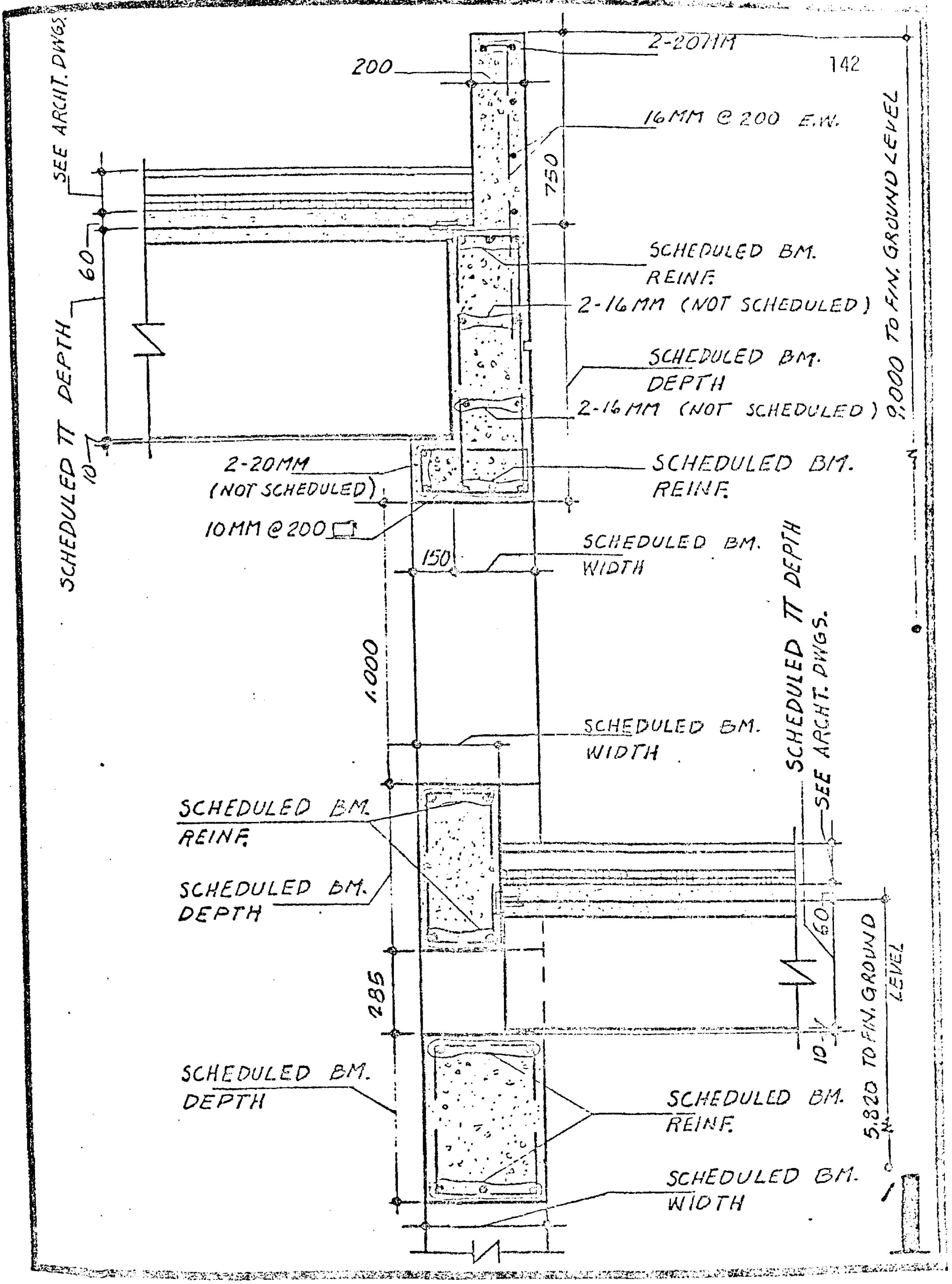
JAMES M. SINK ASSOCIATES PLANNERS & ARCHITECTS	REVISIONS JULY 17, 1977	PROJECT 7316 STRUCTURAL DETAILS	DATE ISSUED 6-5-77 S7.49



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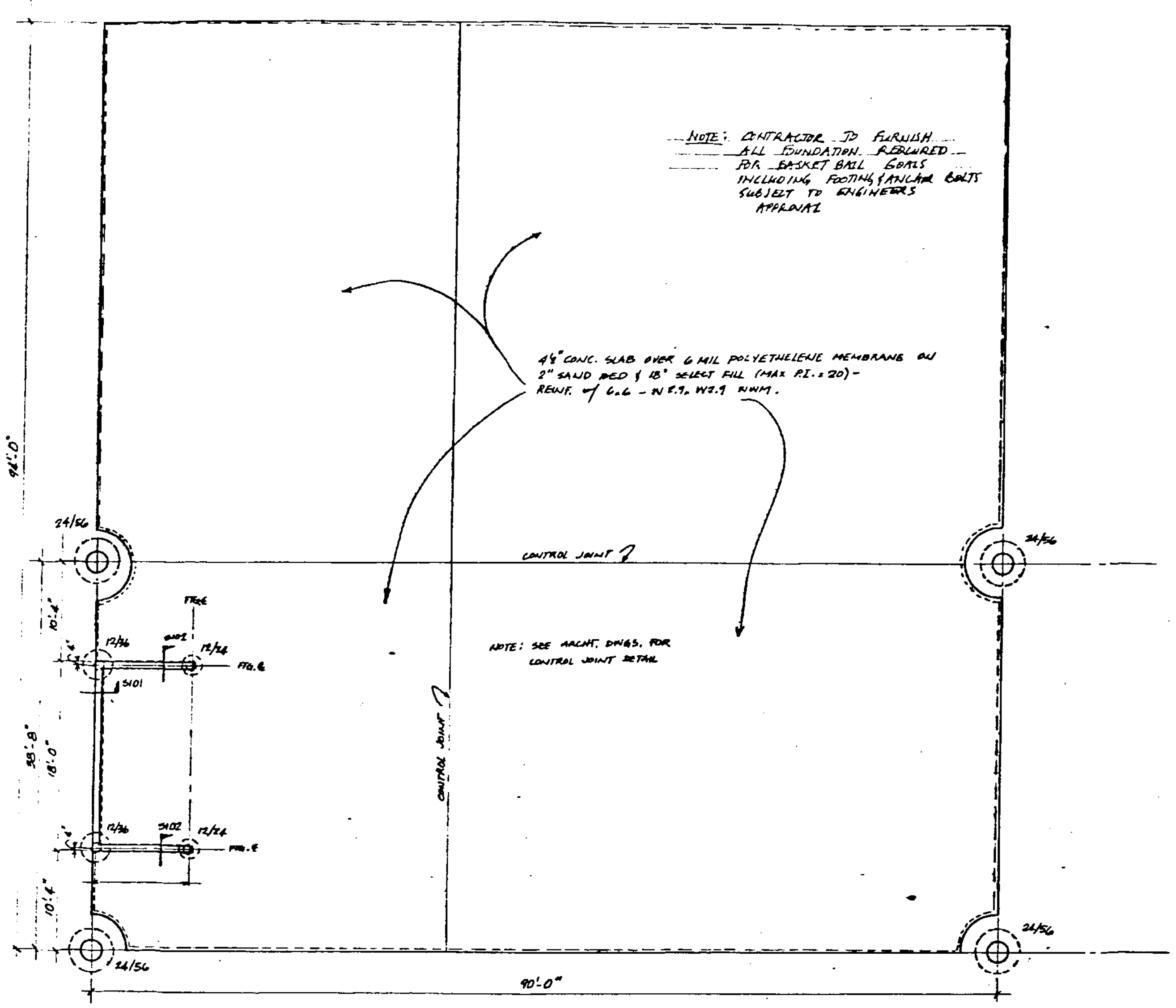
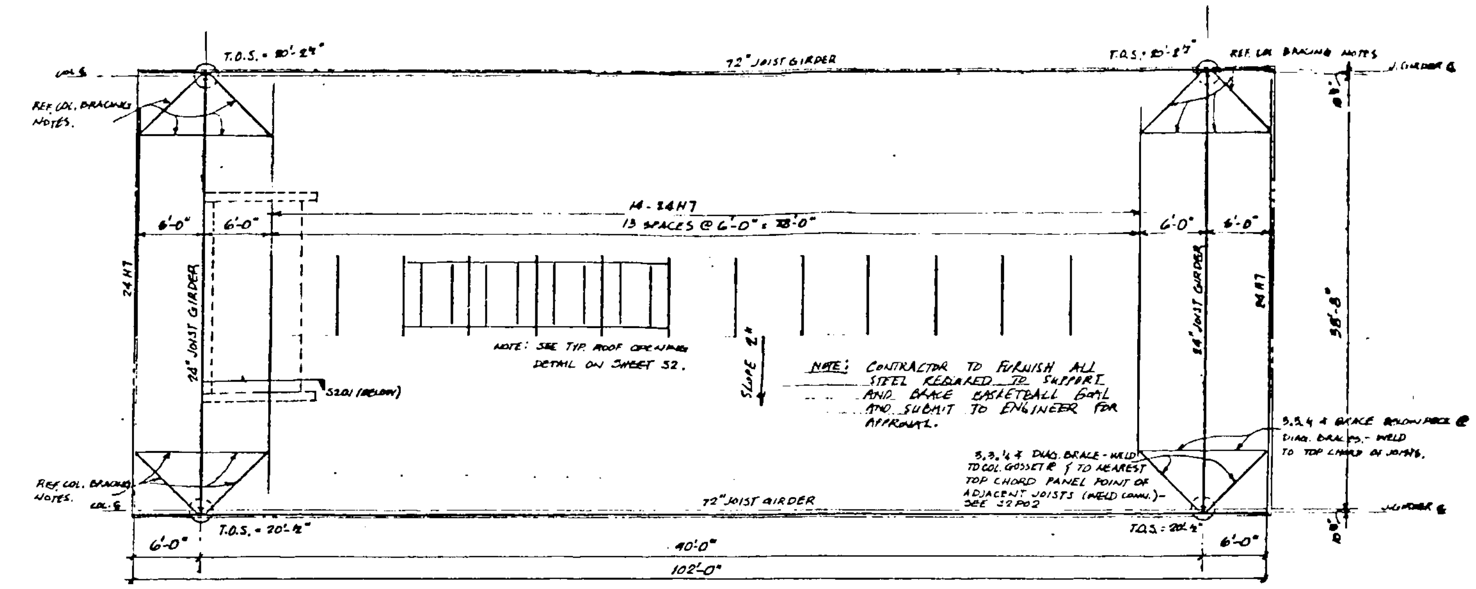
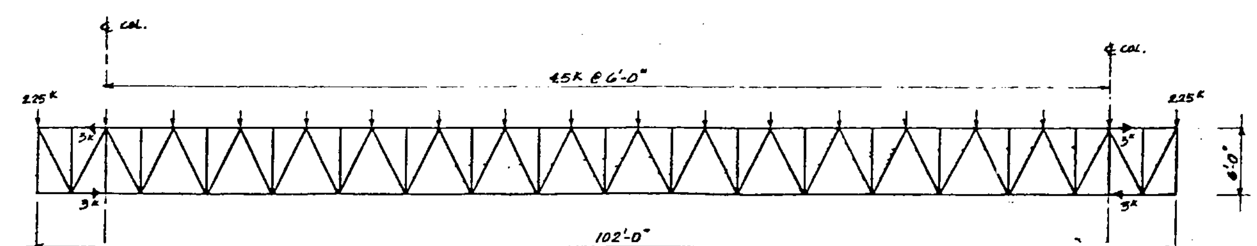
b. SMITH PARK PAVILION: Structural drawings



FOUNDATION FRAMING PLAN SCALE: 1/8" = 1'-0"

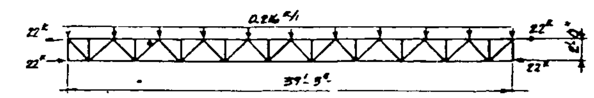


ROOF FRAMING PLAN SCALE: 1/8" = 1'-0"



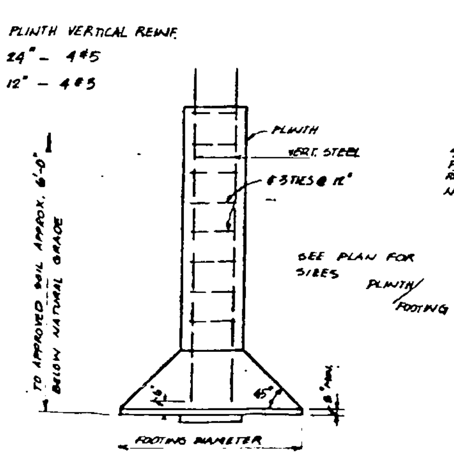
72" JOIST GIRDER

NOTE: END MOMENTS SHOWN MAY ACT IN EITHER DIRECTION

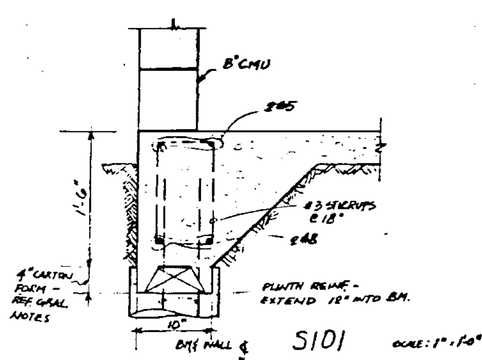


24" JOIST GIRDER

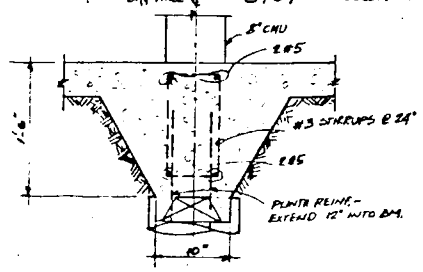
NOTE: END MOMENTS SHOWN MAY ACT IN EITHER DIRECTION



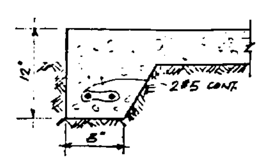
TYPICAL REAMED FOOTING DETAIL



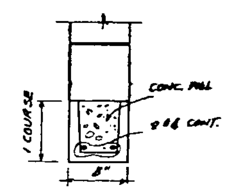
S101 SCALE: 1" = 1'-0"



S102 SCALE: 1" = 1'-0"



TYPICAL EDGE OF SLAB DETAIL



OPENING LESS THAN 5'-0" WIDE

TYPICAL BLOCK LINTEL DETAIL SCALE: 1" = 1'-0"

NOTE: SEE ARCHITECTURAL DWG'S FOR SIZE AND LOCATION OF OPENINGS. PROVIDE 8" MIN. BEARING AT EACH END.

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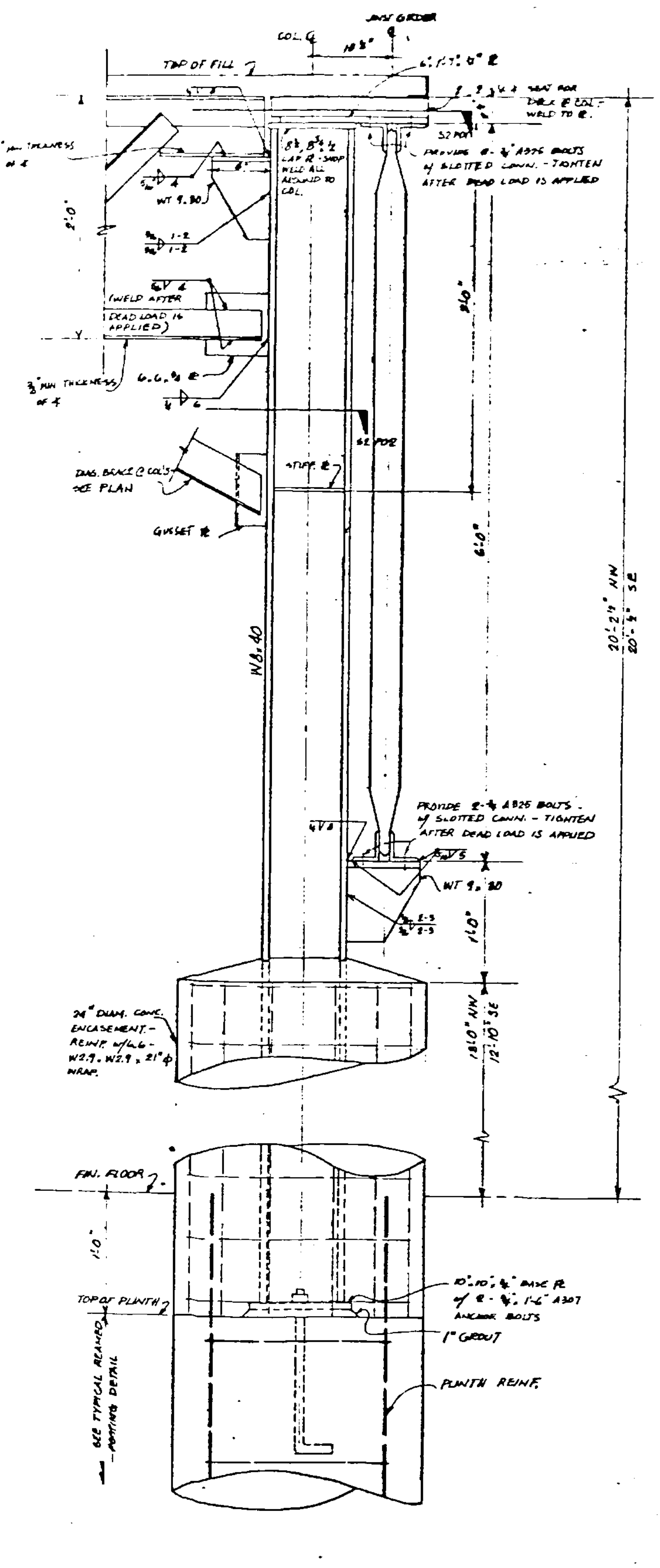
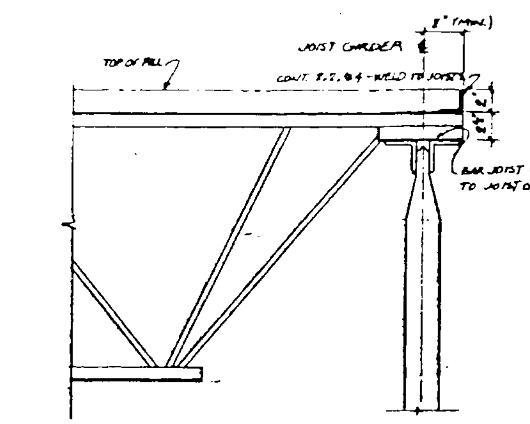
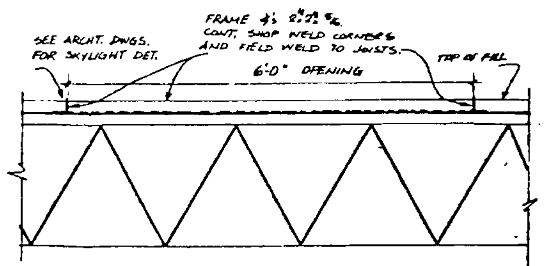
date: sheet: S1
job no: of: 2



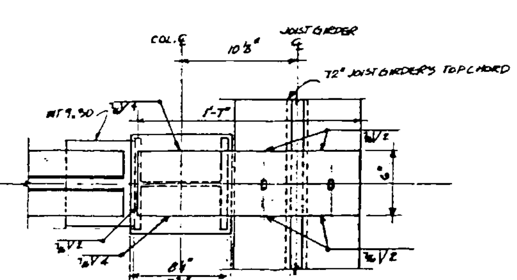
TYPICAL COLUMN-GIRDER CONNECTION



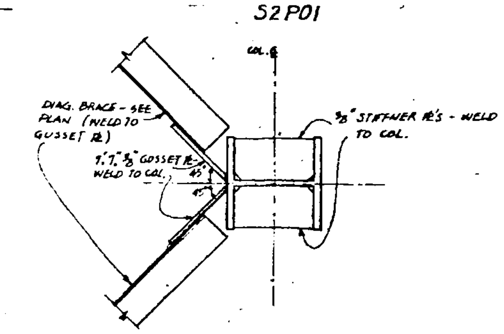
TYPICAL JOIST-GIRDER CONNECTION



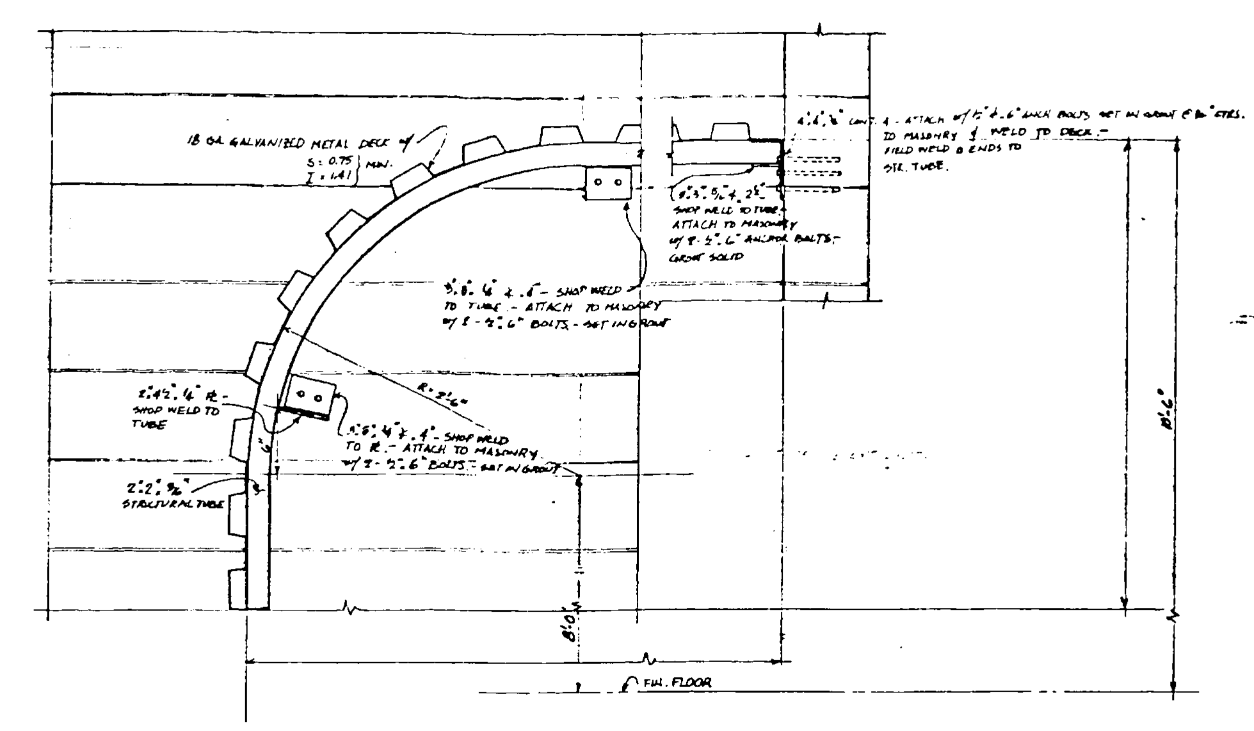
TYPICAL ROOF OPENING DETAIL



S2P01



S2P02



S201

GENERAL NOTES

DESIGN LIVE LOADS

ROOF - 20 P.S.F.

CONCRETE

ALL CONCRETE SHALL TEST 2500 POUNDS PER SQUARE INCH AT 28 DAYS.

REINFORCING STEEL

ALL REINFORCING STEEL SHALL BE GRADE 60 (#2 AND #3 BARS AND ALL STIRRUPS AND TIES SHALL BE GRADE 40) AND SHALL CONFORM TO THE ASTM SPECIFICATION A615. DETAILING OF REINFORCING STEEL SHALL CONFORM TO THE AMERICAN CONCRETE INSTITUTE DETAILING MANUAL. PROVIDE 1-#6 X 4'-0" ┌ TOP AND BOTTOM IN EXTERIOR FACE OF GRADE BEAMS AT CORNERS.

WELDED WIRE FABRIC SHALL CONFORM TO ASTM SPECIFICATION A185.

PROVIDE STANDARD BAR CHAIRS AND SPACERS AT 5'-0" CTRS. FOR ALL SLABS AND BEAMS ABOVE GRADE.

PROVIDE 3" X 6" X 20 GAUGE SHEET METAL BAR CHAIRS AT 4'-0" MAXIMUM CTRS. EACH WAY FOR ALL TOP REINFORCING FOR SLABS ON GRADE. DEPTH OF CHAIRS SHALL PROVIDE FOR 1" TOP COVER TO REINFORCING.

LAP CONTINUOUS UNSCHEDULED REINFORCING BARS AS FOLLOWS: BOTTOM BARS IN MEMBERS SUPPORTED BY COLUMNS OR FOOTINGS - 12" AT SUPPORTS ONLY; ALL OTHERS - 50 BAR DIAMETERS.

REINFORCING STEEL COVERAGE SHALL BE AS FOLLOWS:
- COLUMNS - 1½"
- GRADE BEAMS - 1½" TOP, 3" BOTTOM, 2" SIDES
- FOOTINGS - 3"

STRUCTURAL STEEL

ALL STRUCTURAL STEEL SHALL CONFORM TO ASTM SPECIFICATION A-36. STRUCTURAL STEEL DETAILS AND CONNECTIONS SHALL CONFORM TO THE STANDARDS OF THE AISC. FIELD CONNECTIONS SHALL BE EQUIVALENT TO STANDARD BOLTED CONNECTIONS USING 3/4" ASTM A307 BOLTS UNLESS OTHERWISE SHOWN. IF CONNECTION BOLTS ARE IN SINGLE SHEAR, BOLTS SHALL BE PLACED IN TWO VERTICAL ROWS. CONNECTIONS SHALL BE BOLTED OR WELDED - SEE DETAILS. SPLICING OF STRUCTURAL STEEL MEMBERS IS PROHIBITED WITHOUT PRIOR APPROVAL OF THE ENGINEER AS TO LOCATION AND TYPE OF SPLICE TO BE MADE. ANY MEMBER HAVING SPLICE NOT SHOWN AND DETAILED ON SHOP DRAWINGS WILL BE REJECTED. ALL WELDING SHALL CONFORM TO THE AMERICAN WELDING SOCIETY CODE. WHEN CAMBER OF STEEL MEMBERS IS REQUIRED BY THE DRAWINGS, THE GENERAL CONTRACTOR SHALL VERIFY THE REQUIRED CAMBER IN THE FIELD PRIOR TO ERECTION OF EACH MEMBER.

EXPOSED FASCIA CONNECTIONS ARE TO BE WELDED AND ABRASIONS GROUND SMOOTH; ERECTION MATERIAL USED IN FIELD CONNECTIONS SHALL BE REMOVED, HOLES FILLED, AND ABRASIONS GROUND SMOOTH.

EXAMINE THE ARCHITECTURAL AND STRUCTURAL DRAWINGS FOR ALL ITEMS REQUIRED TO BE HOT-DIP GALVANIZED AFTER FABRICATION.

STEEL JOISTS

OPEN WEB STEEL JOISTS SHALL CONFORM TO THE STANDARDS OF THE STEEL JOIST INSTITUTE. TOP CHORDS OF JOISTS SHALL BE ANGLES OR TEES. BRIDGING SHALL BE HORIZONTAL RODS IN ACCORDANCE WITH PARAGRAPH 5.4 OF THE STEEL JOIST INSTITUTE SPECIFICATIONS. BRIDGING SHALL BE CONTINUOUS THROUGH STRUCTURAL STEEL PURLINS AND ANCHORED TO SPANDREL MEMBERS. PROVIDE CEILING EXTENSIONS AT CONTACT CEILINGS - SEE ARCHITECTURAL DRAWINGS. JOISTS SHALL BE CAMBERED FOR DEAD LOAD.

JOISTS SHALL BE WELDED TO SUPPORTING STEEL MEMBERS.

PROVIDE FLAT BEARING FOR ALL JOISTS.

STEEL ROOF CONSTRUCTION

ROOF DECK OVER STEEL JOISTS SHALL BE A 2" MINIMUM INSULATING FILL SLAB OF PERLITE OR VERMICULITE AGGREGATE CONCRETE CONSISTING OF A 1:6 MIX, HAVING A MAXIMUM DENSITY OF 30 POUNDS PER CUBIC FOOT. ROOF DECK OVER STEEL JOISTS SHALL BE GALVANIZED, 26 GAUGE 1-5/16" DEEP, MIN. SECTION MODULUS = 0.11 $IN.^3$ AND A MINIMUM YIELD STRENGTH OF 80,000 PSI. LAP ENDS OF DECK 2" AT SUPPORTS AND WELD TO SUPPORTS AT 12" CTRS. TO CONFORM TO U.L. WIND UPLIFT CLASS 90. PROVIDE VENT CLIPS AT MID SPAN AT EACH SIDE LAP OF CORRUGATED METAL DECK UNLESS DECK IS PREVENTED.

MISCELLANEOUS

FOOTINGS SHALL BE POURED IMMEDIATELY AFTER EXCAVATION.

GRADE BEAMS SHALL BE POURED ON WAX IMPREGNATED CORRUGATED FIBER CARTON FORMS (JAY-VOIDS AS MANUFACTURED BY THE LAWRENCE PAPER CO.). BEAM FORMS SHALL BE 4" DEEP. BEAM CARTON FORMS SHALL BE 2" LESS THAN BEAM WIDTH AND CENTERED UNDER BEAM.

SEE ARCHITECTURAL DRAWINGS FOR FLOOR ELEVATIONS, SLOPES, AND THE LOCATION OF DEPRESSED FLOOR AREAS.

THE CONTRACTOR SHALL COMPARE STRUCTURAL SECTIONS WITH ARCHITECTURAL SECTIONS AND REPORT ANY DISCREPANCY TO THE ARCHITECT PRIOR TO FABRICATING OR INSTALLING STRUCTURAL MEMBERS.

REPRODUCTION NOTE

JOIST GIRDERS

STEEL JOIST GIRDERS SHALL BE DESIGNED IN ACCORDANCE WITH THE STEEL JOIST INSTITUTE SPECIFICATIONS. JOIST GIRDER DEPTHS, NUMBER OF PANEL POINTS AND LOADS ARE INDICATED ON THE PLANS. JOIST GIRDERS SHALL BE CAMBERED FOR DEAD LOADS AND SHALL BE WELDED TO SUPPORTING STEEL. GIRDERS SHALL CONFORM TO THE VULCRAFT JOIST GIRDER SPECIFICATIONS, OR EQUAL. MEMBER SIZES SHALL BE INDICATED ON THE SHOP DRAWINGS. DESIGN CALCULATIONS SHALL BE SUBMITTED TO THE STRUCTURAL ENGINEER UPON REQUEST.

THERE SHALL BE NO HORIZONTAL CONSTRUCTION JOINTS IN CONCRETE POURS. ALL CONSTRUCTION JOINTS SHALL BE MADE IN THE CENTER OF SPANS WITH VERTICAL BULKHEADS. THE LOCATION OF CONSTRUCTION JOINTS SHALL BE APPROVED BY THE STRUCTURAL ENGINEER.

STATE OF TEXAS — WALTER P. MOORE — 116 — REGISTERED PROFESSIONAL ENGINEER

WALTER P. MOORE & ASSOC., INC.
CONSULTING ENGINEERS
HOUSTON TEXAS

SMITH PARK
PAVILION
JACINTO CITY, TEXAS

the architecture company
brown & mason 713 524-0200
4513 caroline houston, texas 77004

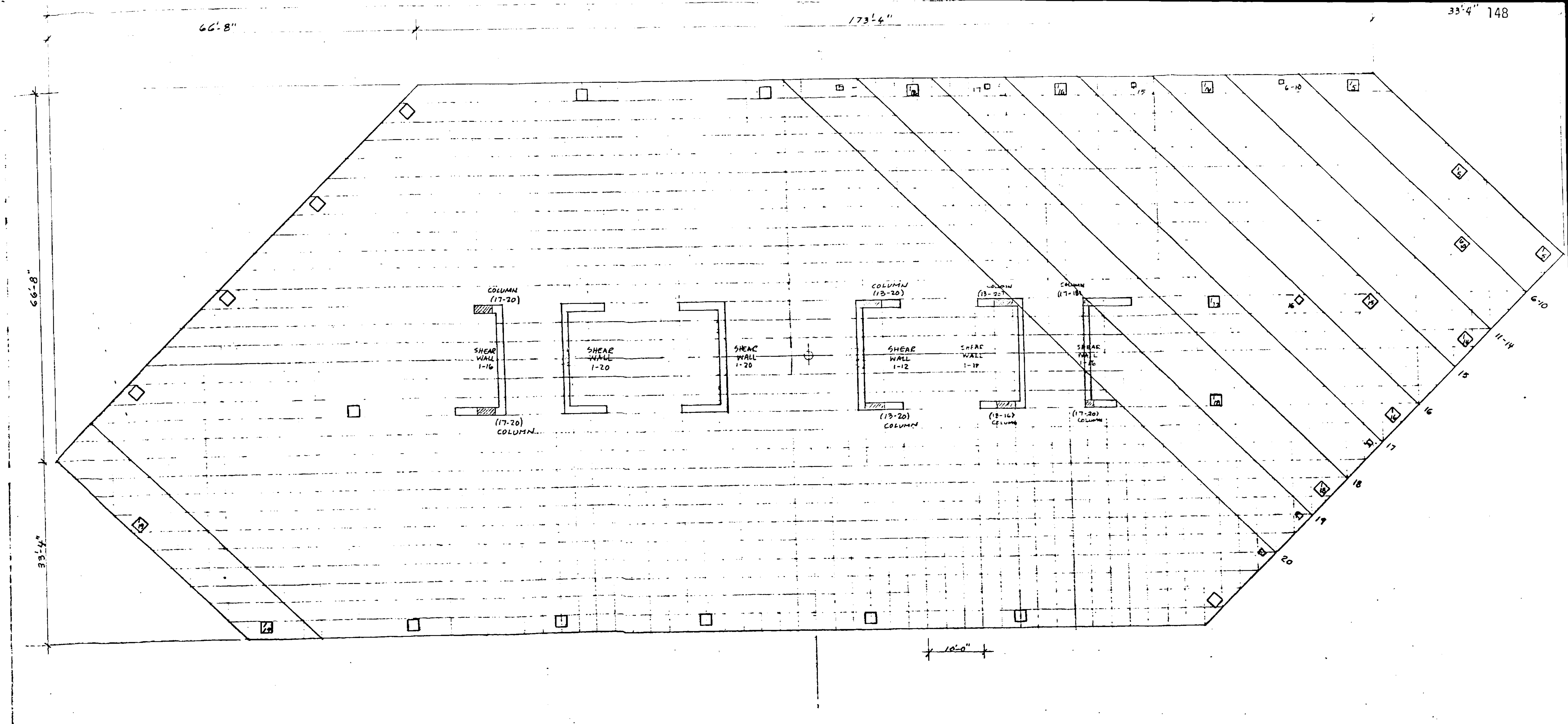
date: sheet S2
job no: of: 2

APPENDIX IV

Design of Special Structural Systems in Major Buildings:
THREE RIVERWAY

1. Column location and architectural elevations
2. Wind loading and computer-generated display
3. Standard format for wind beam design
4. Computer output revision
5. Wind beam design information
6. Structural floor plans and beam schedules

1. Column location and architectural elevations

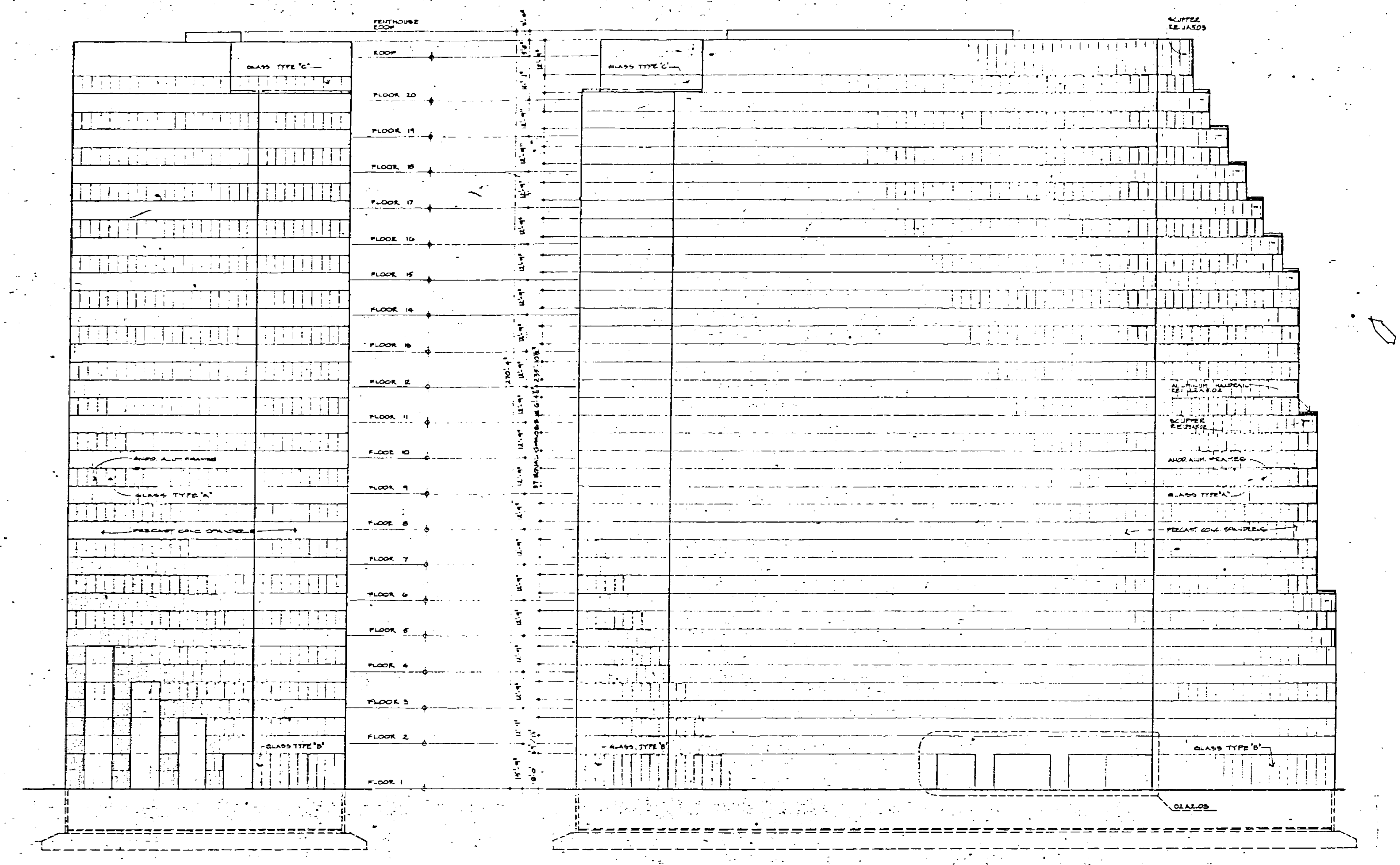


COLUMN LOCATION

THREE RIVERWAY

W. P. MOORE ENGINEERS
S. I. MORRIS ARCHITECTS

APRIL 20, 1978



WEST ELEVATION 1/8"=1'-0" 22

SOUTH ELEVATION 02

REVIEW DRAWINGS

NOT FOR CONSTRUCTION
S. I. Morris Associates

S. I. Morris Associates
ARCHITECTS 3465 WEST ALABAMA HOUSTON, TEXAS

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STRUCTURAL ENGINEERS HOUSTON

Chenault & Associates, Inc.
CONSULTING ENGINEERS HOUSTON

THREE RIVERWAY

JOHN HANSEN
INVESTMENT BUILDER

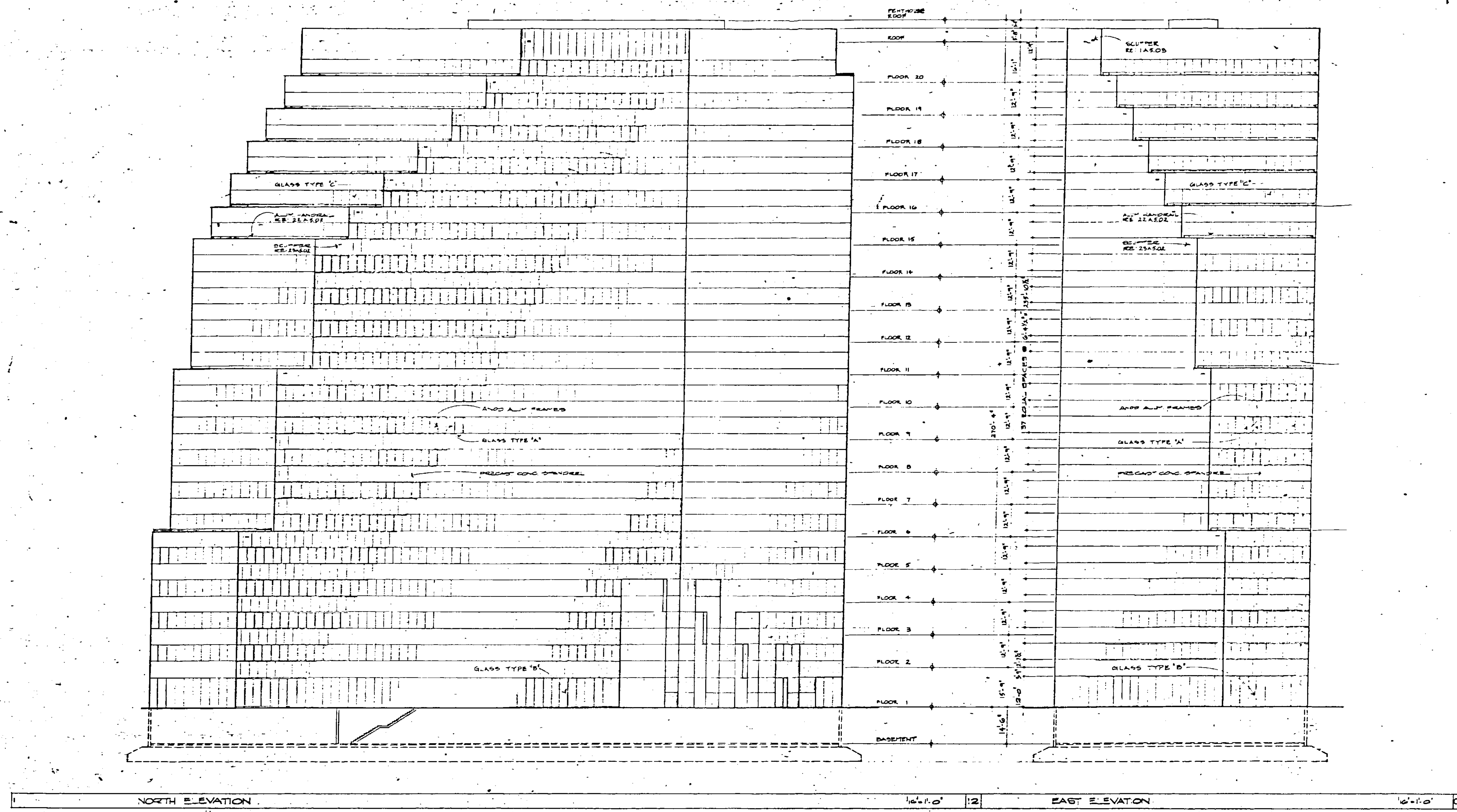
BUILDING ELEVATIONS

RECEIVED
MAY 1 1978

COMM. NO. 77152

DRAWING NO. A-2.01

150



REVIEW DRAWINGS
NOT FOR CONSTRUCTION
S. I. Morris Associates

S. I. Morris Associates
ARCHITECTS 3465 WEST ALABAMA HOUSTON, TEXAS

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THREE RIVERWAY

JOHN HANSEN
INVESTMENT BUILDER

BUILDING ELEVATIONS

RECEIVED
MAY 1 1978

DATE

DRAWING NO.

COMM. NO.

A-2.02

2. Wind loading and computer-generated display

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CONSULTING ENGINEERS
2905 Sackett
Houston, Texas 77006

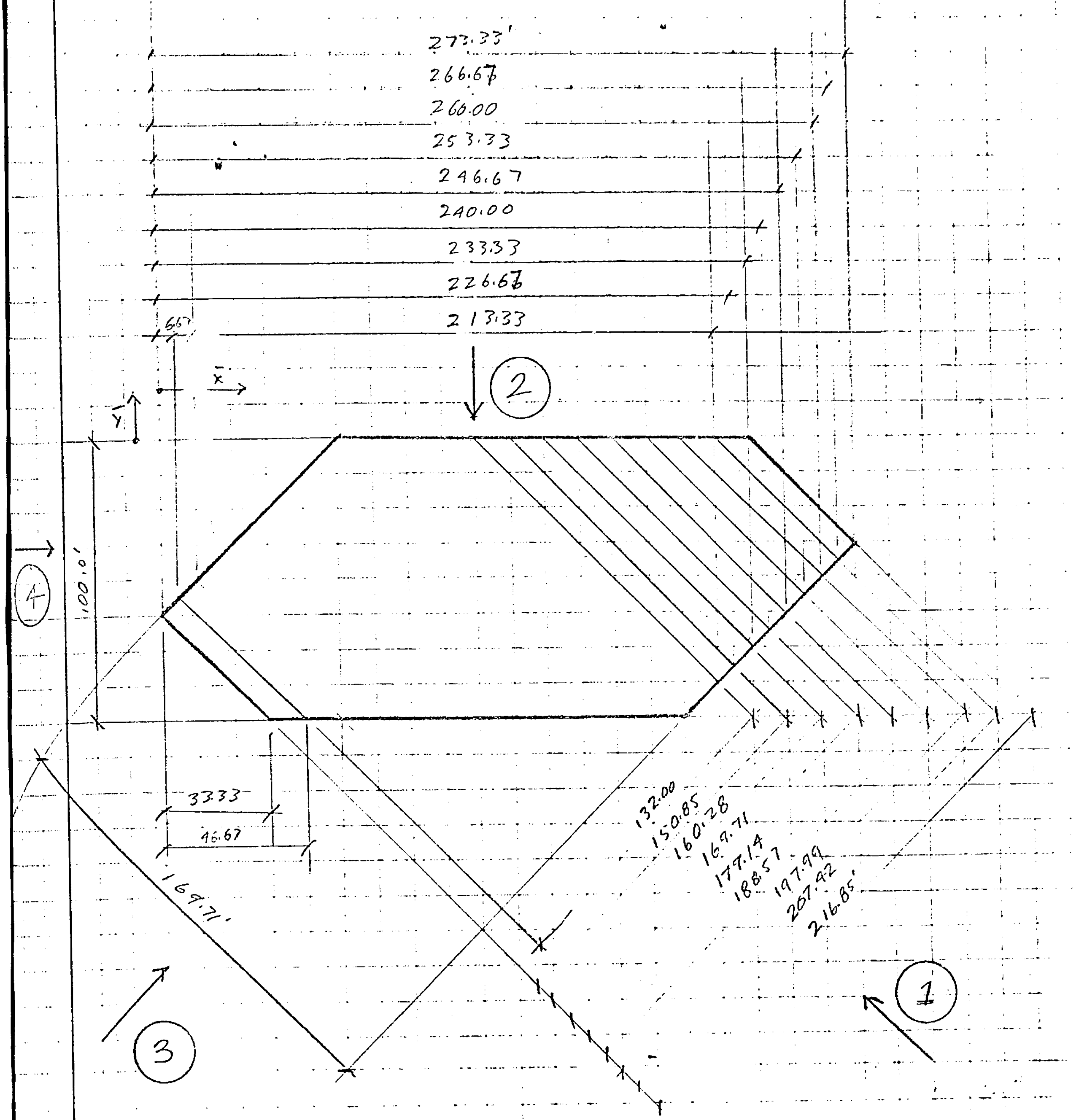
Job Name THREE RIVERWAY

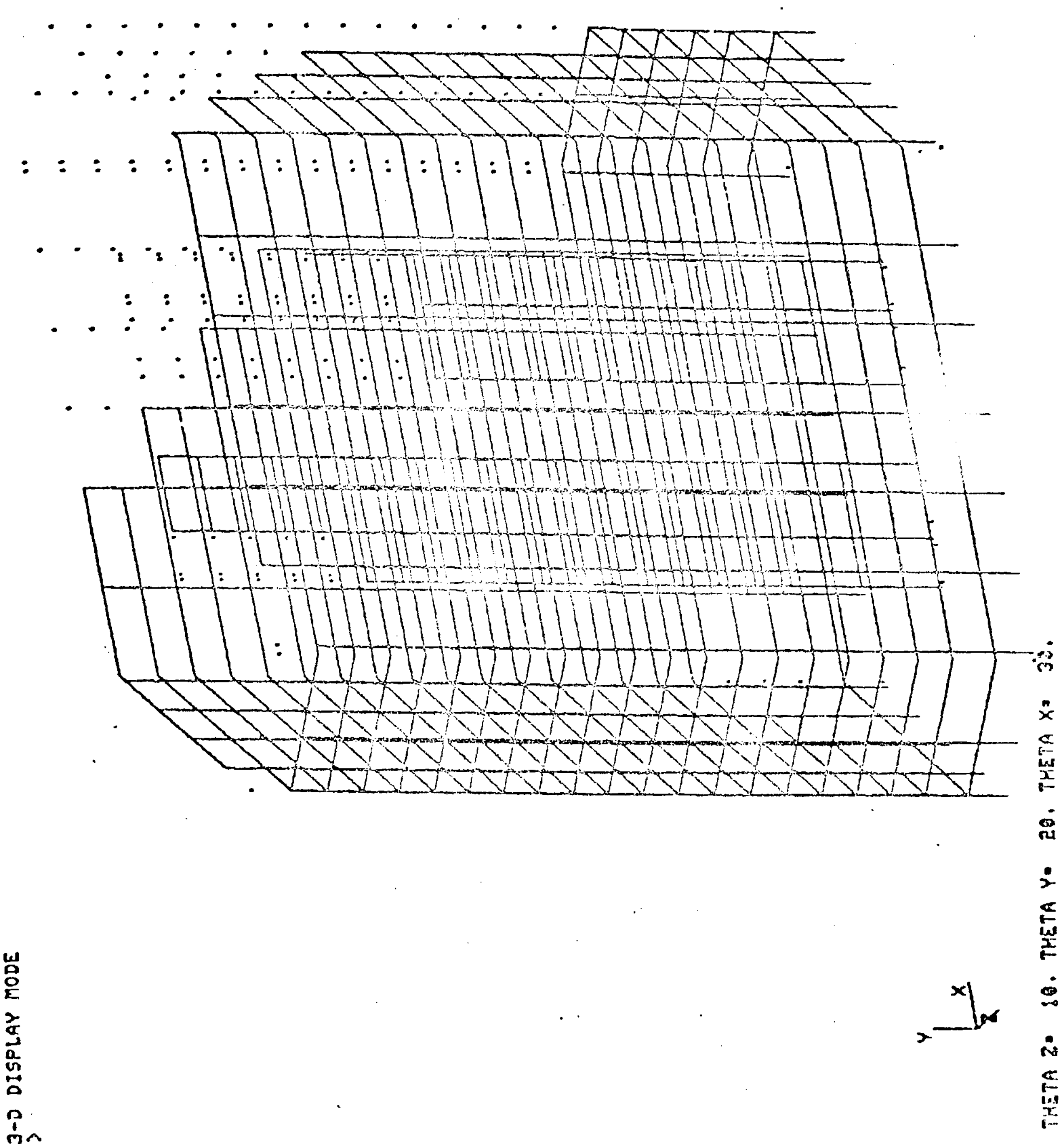
Architect SI MORRIS

X

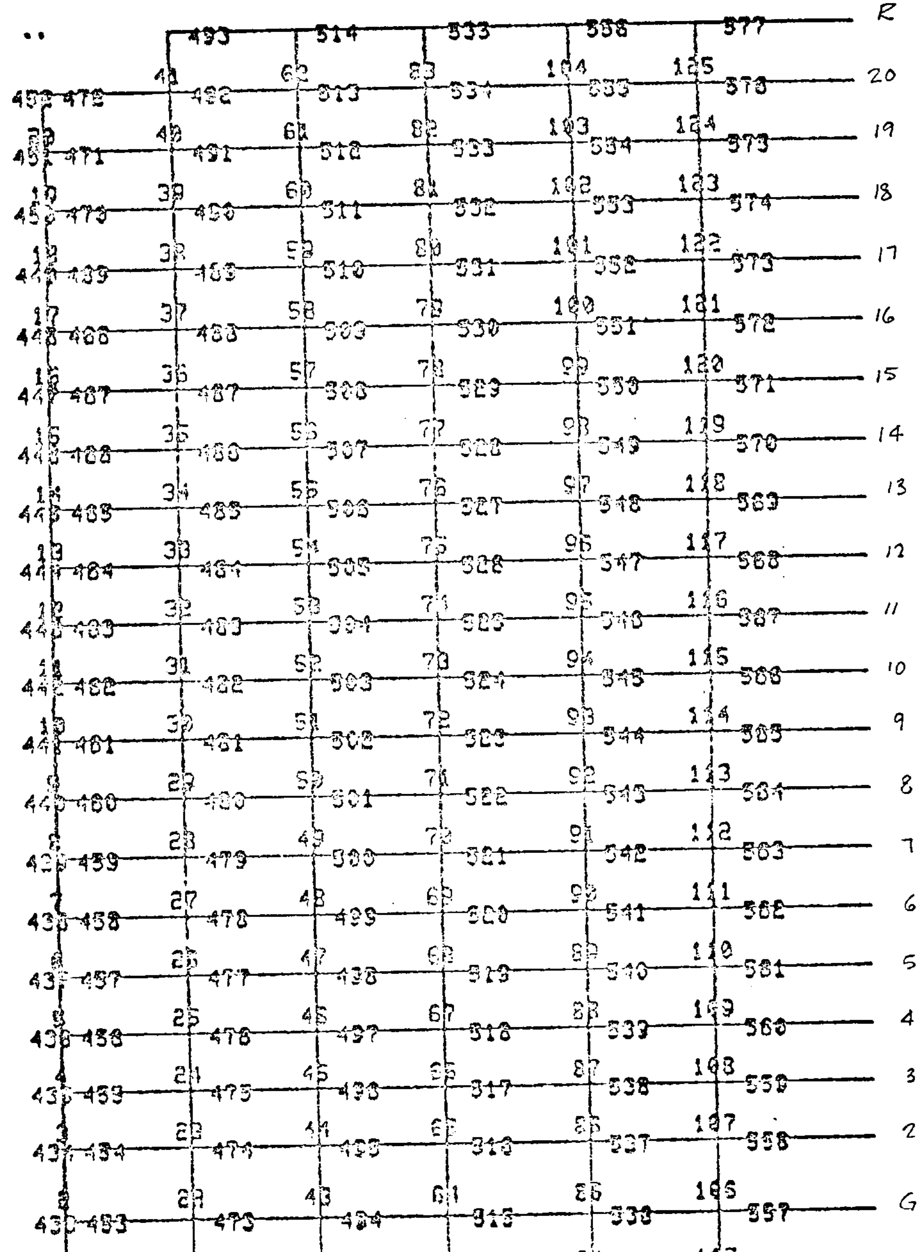
WIND LOADING CONDITIONS

Job #




3-D DISPLAY MODE
>
THETA Z= 10. THETA Y= 20. THETA X= 30.
X
Y

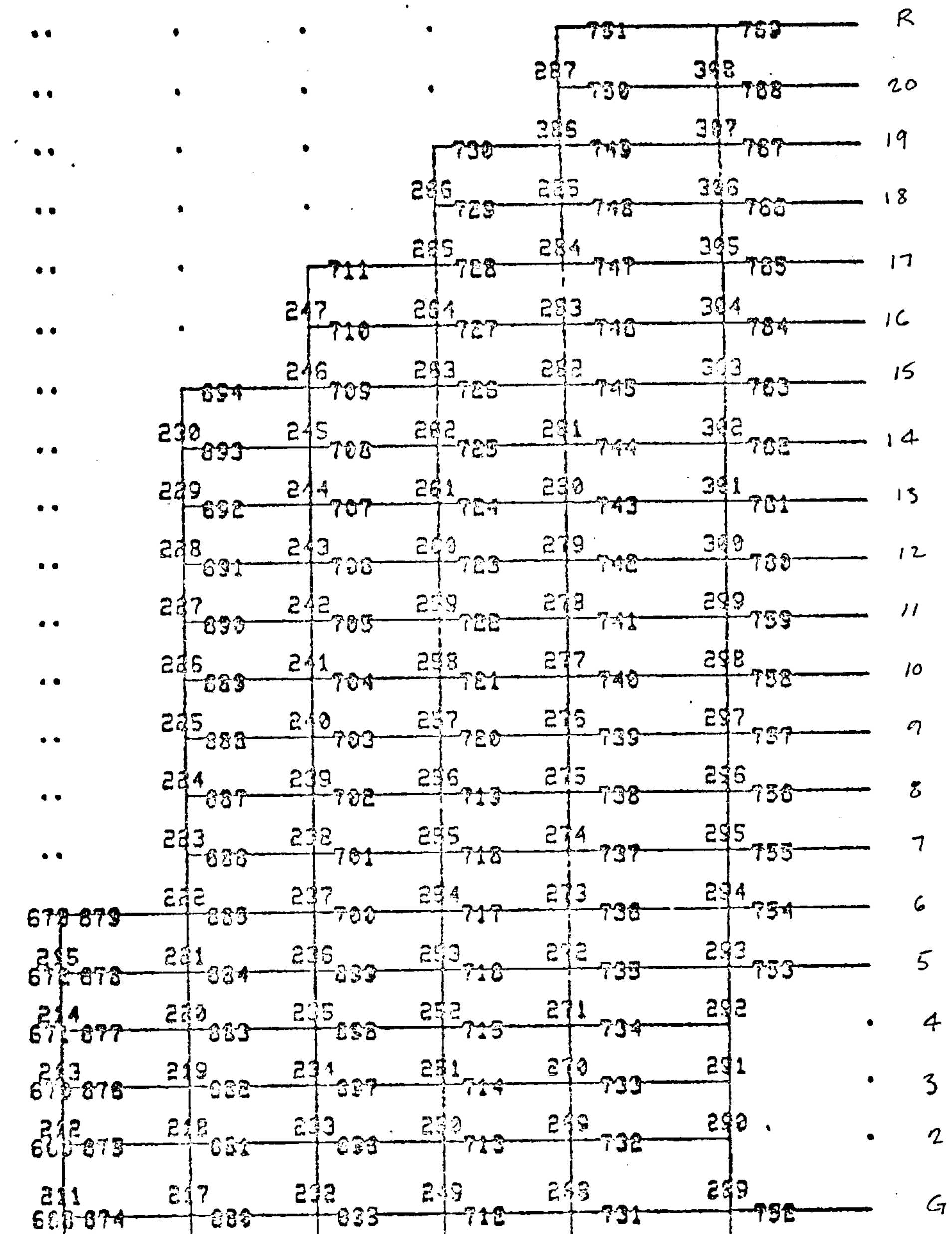
2-D DISPLAY MODE
DEFINED PLANE
>LAB E
>FACE ONE



THETA Z= 0. THETA Y= 0. THETA X= 0.

FRAME 1

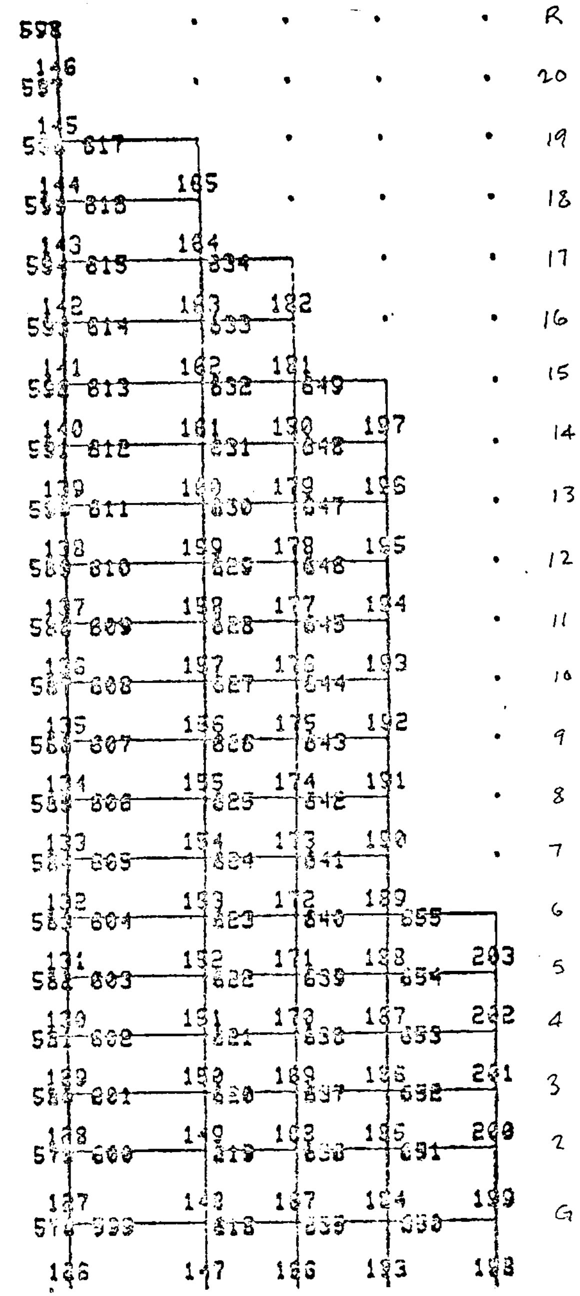
2-D DISPLAY MODE
DEFINED PLANE
>LAB E
>FACE 4



THETA Z= 180. THETA Y= 0. THETA X= 180.

FRAME 2

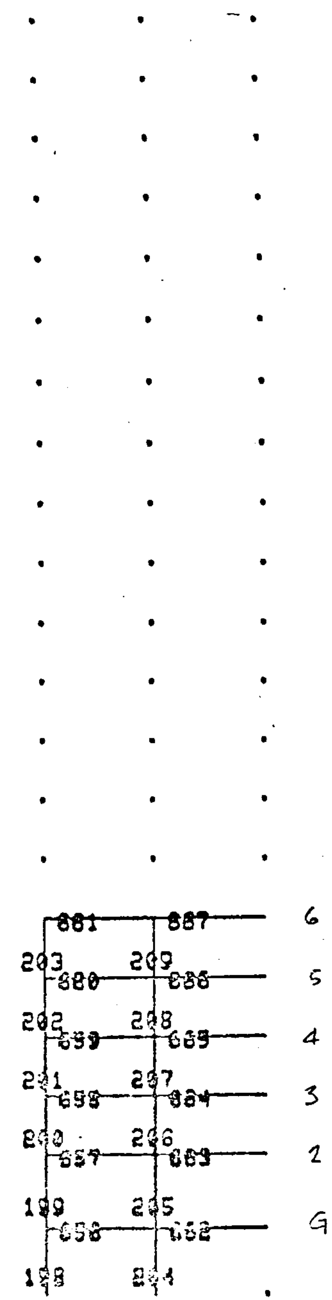
2-D DISPLAY MODE
DEFINED PLANE
>LAB E
>FACE TWO



THETA Z= 0. THETA Y= -45. THETA X= -0.

FRAME 3

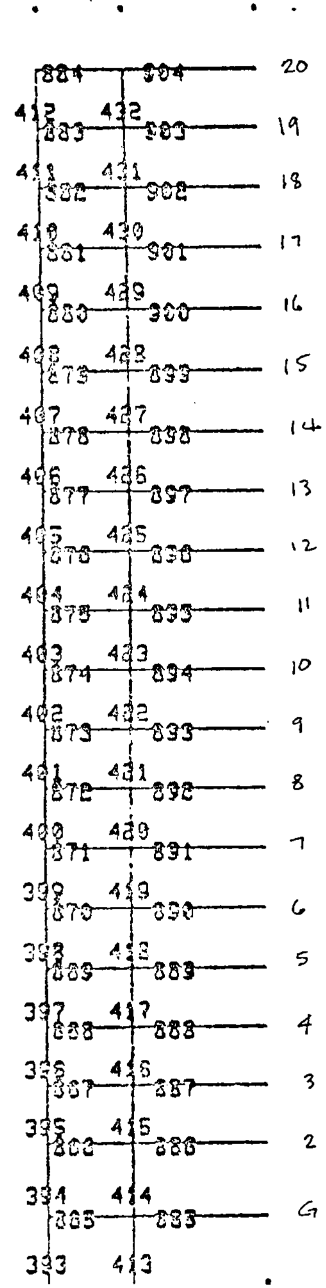
2-D DISPLAY MODE
DEFINED PLANE
>LAB E
>FACE THREE



THETA Z= 180. THETA Y= -38. THETA X=-180.

FRAME 4

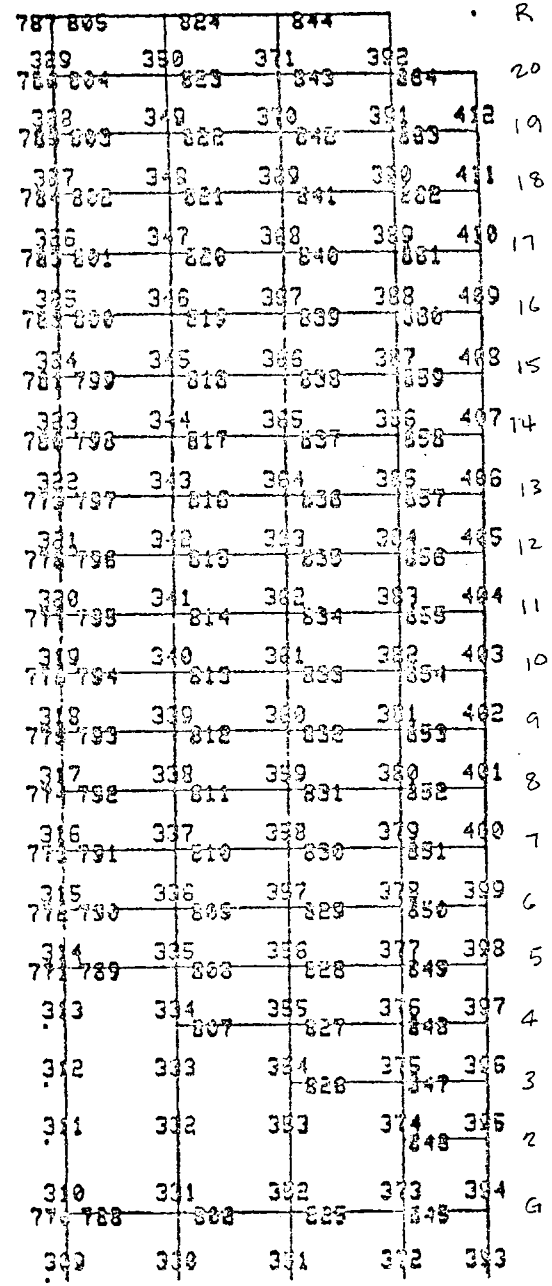
```
2-D DISPLAY MODE
DEFINED PLANE
>C8B E
FIRST CHAR IS BAD DELIM
>LAB E
>FACE SIX    COLS 393 TO 412 ARE DUMMY
```



```
THETA Z=   0. THETA Y=  90. THETA X=   0.
```

FRAME 5

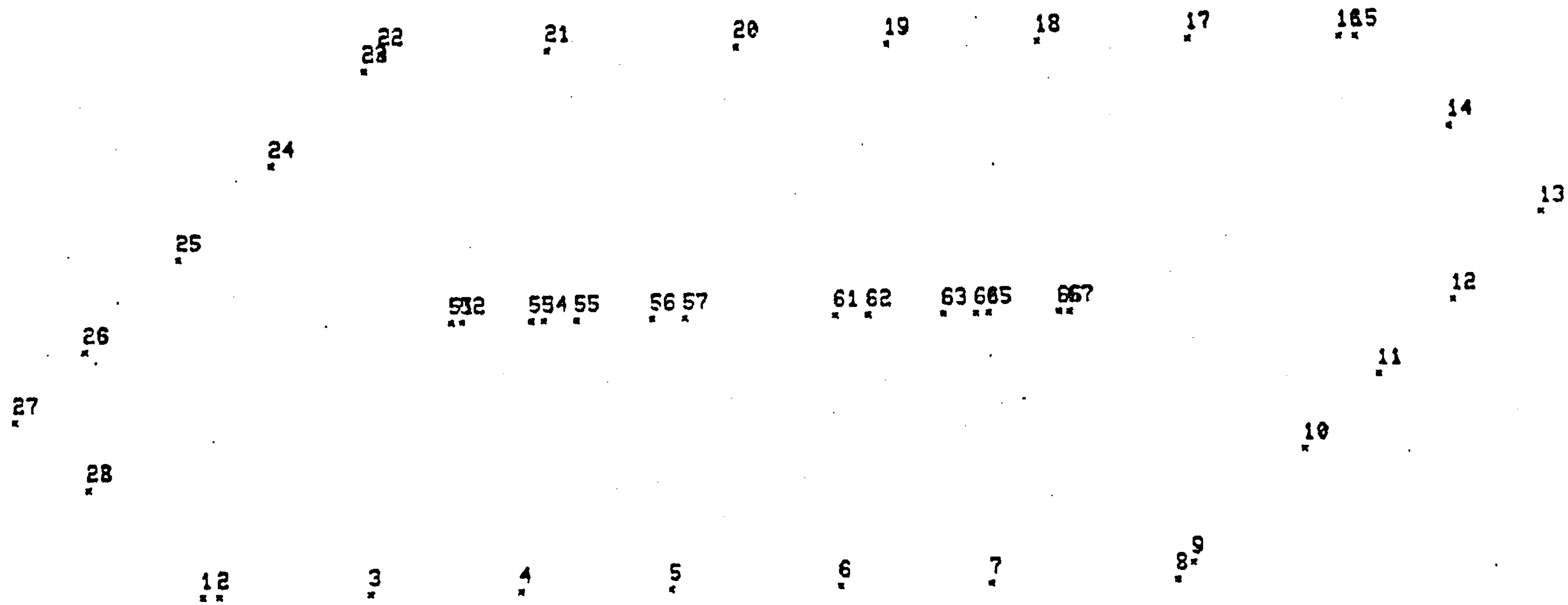
2-D DISPLAY MODE
DEFINED PLANE
>LAB E
>FACE FIVE COLS 393 TO 412 ARE DUMMY



THETA Z= 180. THETA Y= 143. THETA X= 180.

FRAME 6

2-D DISPLAY MODE
DEFINED PLANE
>LAB P
>BASEMENT COLUMN LOCATIONS
UNKNOWN COMMAND
>



THETA Z= 0. THETA Y= 0. THETA X= 90.

3. Standard format for wind beam design

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Architect ______________ 163

WIND BEAMS

Job #

Span – Load =

MAX (+M) ON SPAN		MAX (−M) @ SUPPORT		MAX (+M) @ SUPPORT	
1.7L + 1.4D	$\frac{3}{4}$(1.7L+1.4D+1.7W)	1.7L + 1.4D	$\frac{3}{4}$(1.7L+1.4D+1.7W)	0.9D + 1.3W	

$+M_D = w_D l^2/$ =
$+M_L = w_L l^2/$ =
$-M_D = w_D l^2/$ =
$-M_L = w_L l^2/$ =
$+M_W$ =
$-M_W$ =

v =
A_s =
$-A_s$ =

Span – Load =

MAX (+M) ON SPAN		MAX (−M) @ SUPPORT		MAX (+M) @ SUPPORT	
1.7L + 1.4D	$\frac{3}{4}$(1.7L+1.4D+1.7W)	1.7L + 1.4D	$\frac{3}{4}$(1.7L+1.4D+1.7W)	0.9D + 1.3W	

$+M_D = w_D l^2/$ =
$+M_L = w_L l^2/$ =
$-M_D = w_D l^2/$ =
$-M_L = w_L l^2/$ =
$+M_W$ =
$-M_W$ =

v =
A_s =
$-A_s$ =

Span – Load =

MAX (+M) ON SPAN		MAX (−M) @ SUPPORT		MAX (+M) @ SUPPORT	
1.7L + 1.4D	$\frac{3}{4}$(1.7L+1.4D+1.7W)	1.7L + 1.4D	$\frac{3}{4}$(1.7L+1.4D+1.7W)	0.9D + 1.3W	

$+M_D = w_D l^2/$ =
$+M_L = w_L l^2/$ =
$-M_D = w_D l^2/$ =
$-M_L = w_L l^2/$ =
$+M_W$ =
$-M_W$ =

v =
A_s =
$-A_s$ =

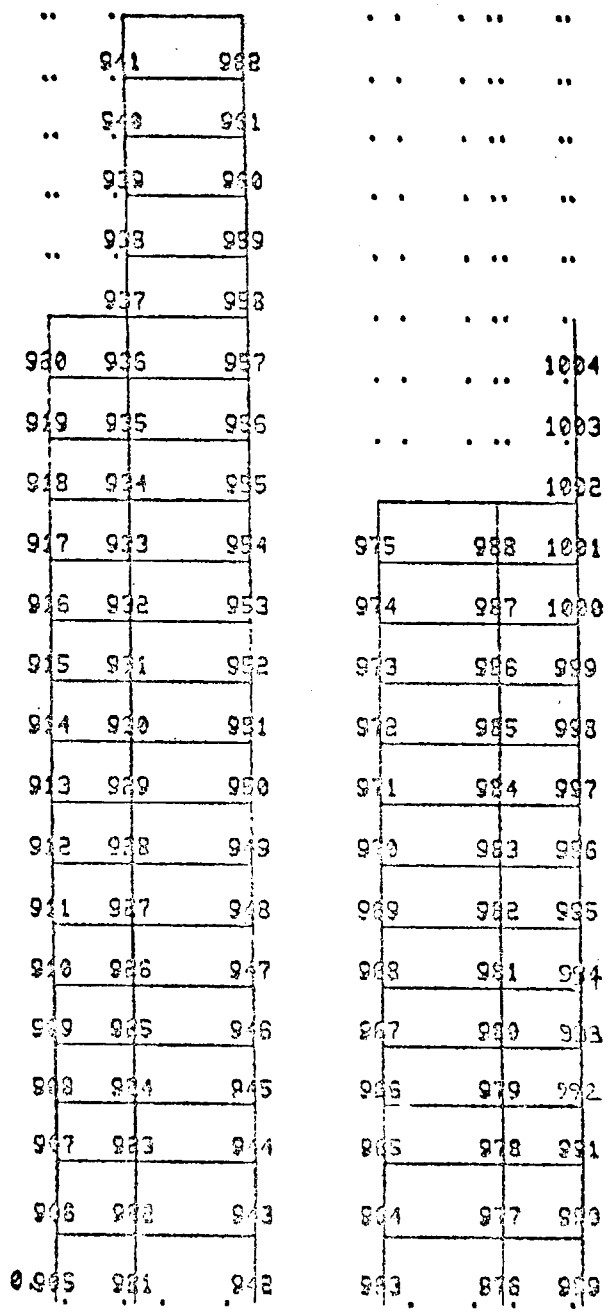
Span – Load =

MAX (+M) ON SPAN		MAX (−M) @ SUPPORT		MAX (+M) @ SUPPORT	
1.7L + 1.4D	$\frac{3}{4}$(1.7L+1.4D+1.7W)	1.7L + 1.4D	$\frac{3}{4}$(1.7L+1.4D+1.7W)	0.9D + 1.3W	

$+M_D = w_D l^2/$ =
$+M_L = w_L l^2/$ =
$-M_D = w_D l^2/$ =
$-M_L = w_L l^2/$ =
$+M_W$ =
$-M_W$ =

v =
A_s =
$-A_s$ =

2-D DISPLAY MODE
DEFINED PLANE
SLAB E



THETA Z= 0. THETA Y= 0. THETA X= 0.

SHEAR WALLS

4. Computer output revision

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Job Name 3 RIVERWAY

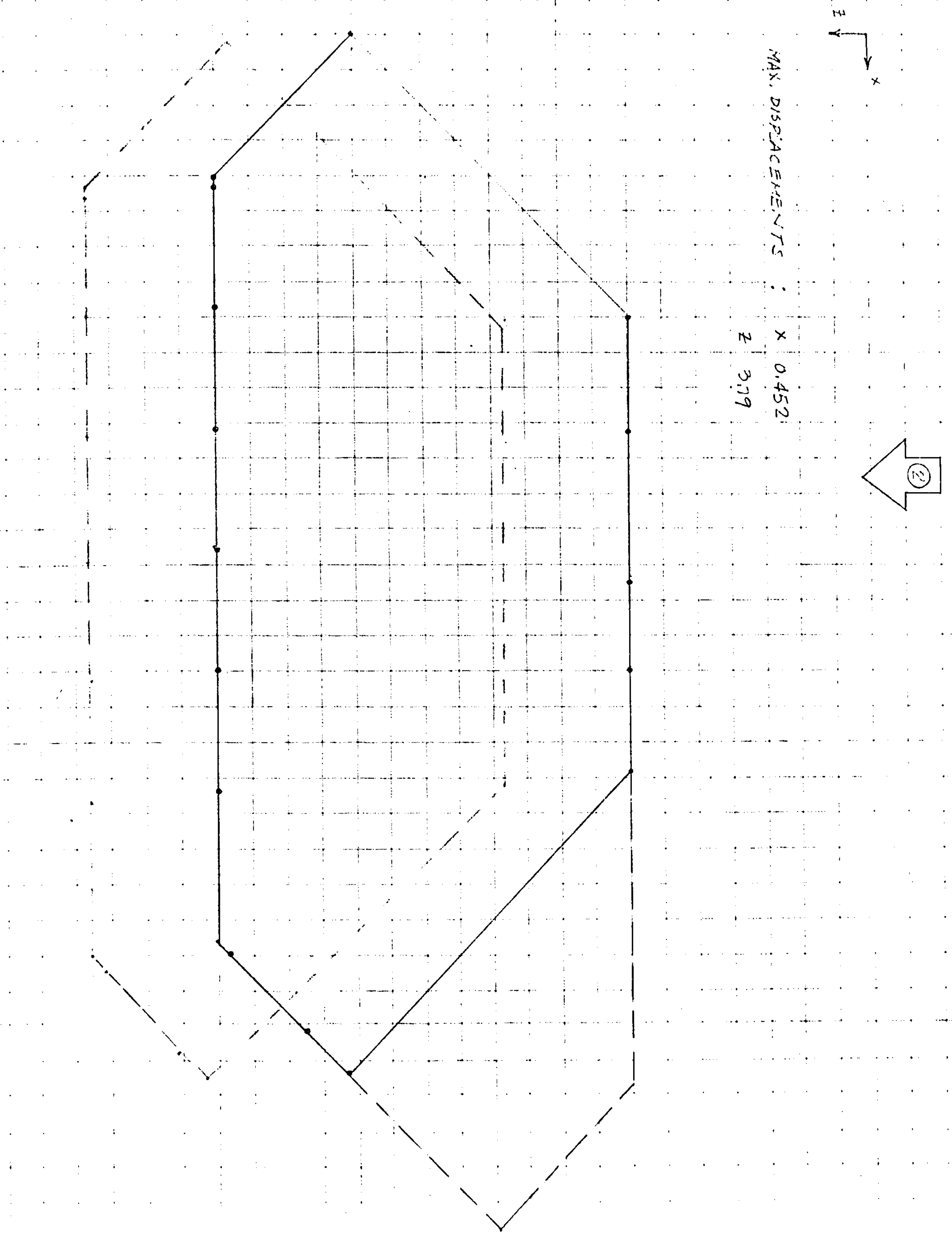
Architect SI MORRIS

3rd RUN CHECK

Job #

WIND BLOWING SOUTH (LOADING CASE 2)

LEVEL 15



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Job Name [illegible]

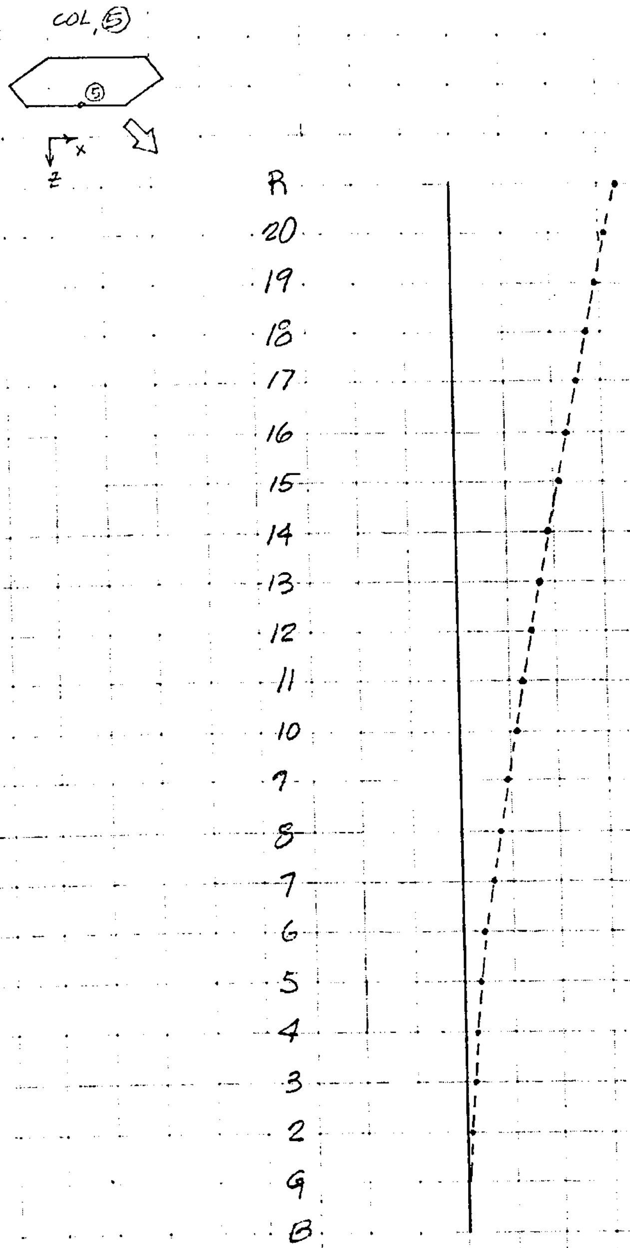
166

Architect [illegible]

Job #

3d RUN CHECK

LOADING CASE 1 .– DEFLECTION   Z DISPLACEMENT



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Job Name ______

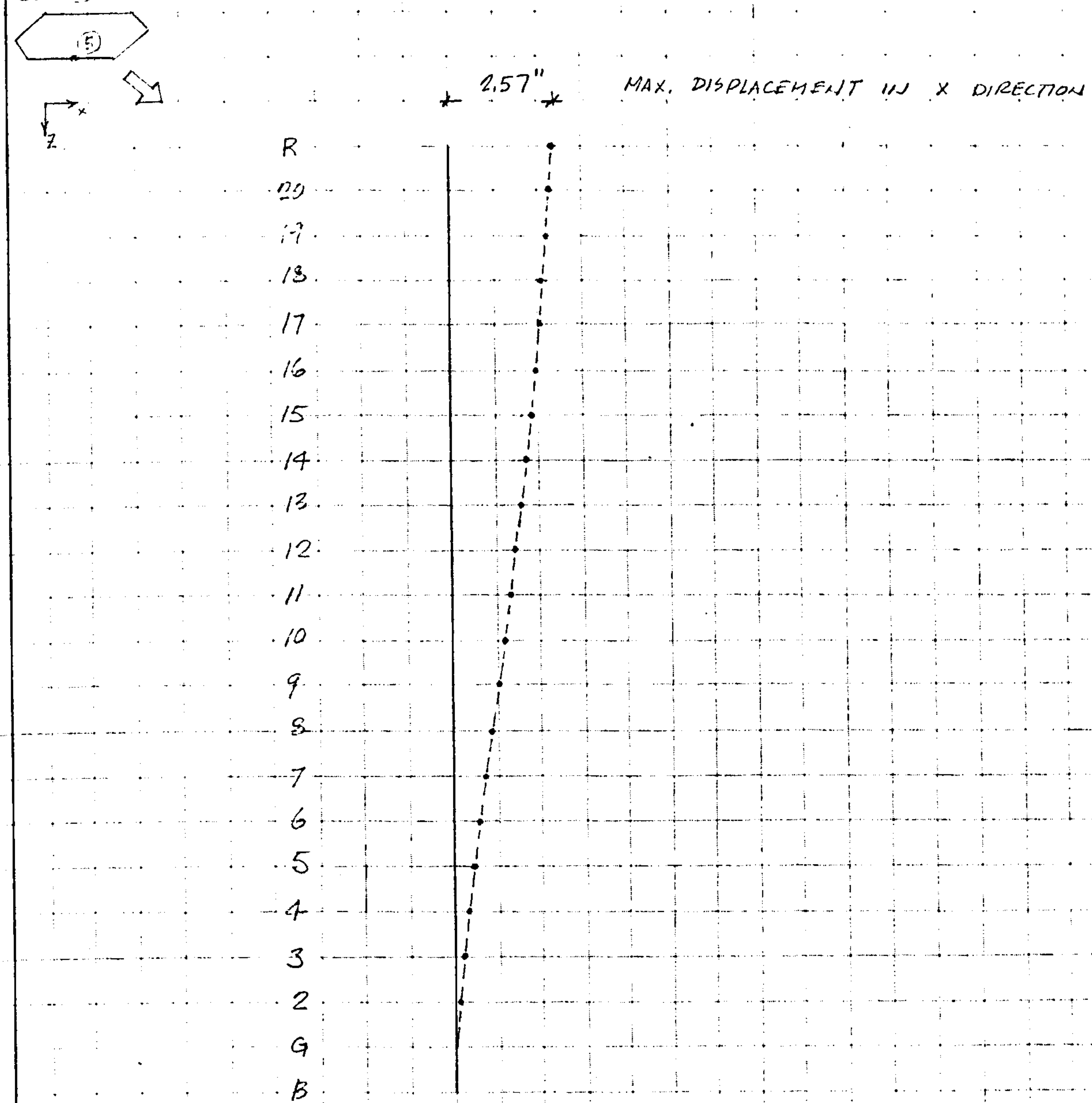
Architect ______

Job # ______

167

LOADING CASE I.T DEFLECTION X DISPLACEMENT

COL (5)



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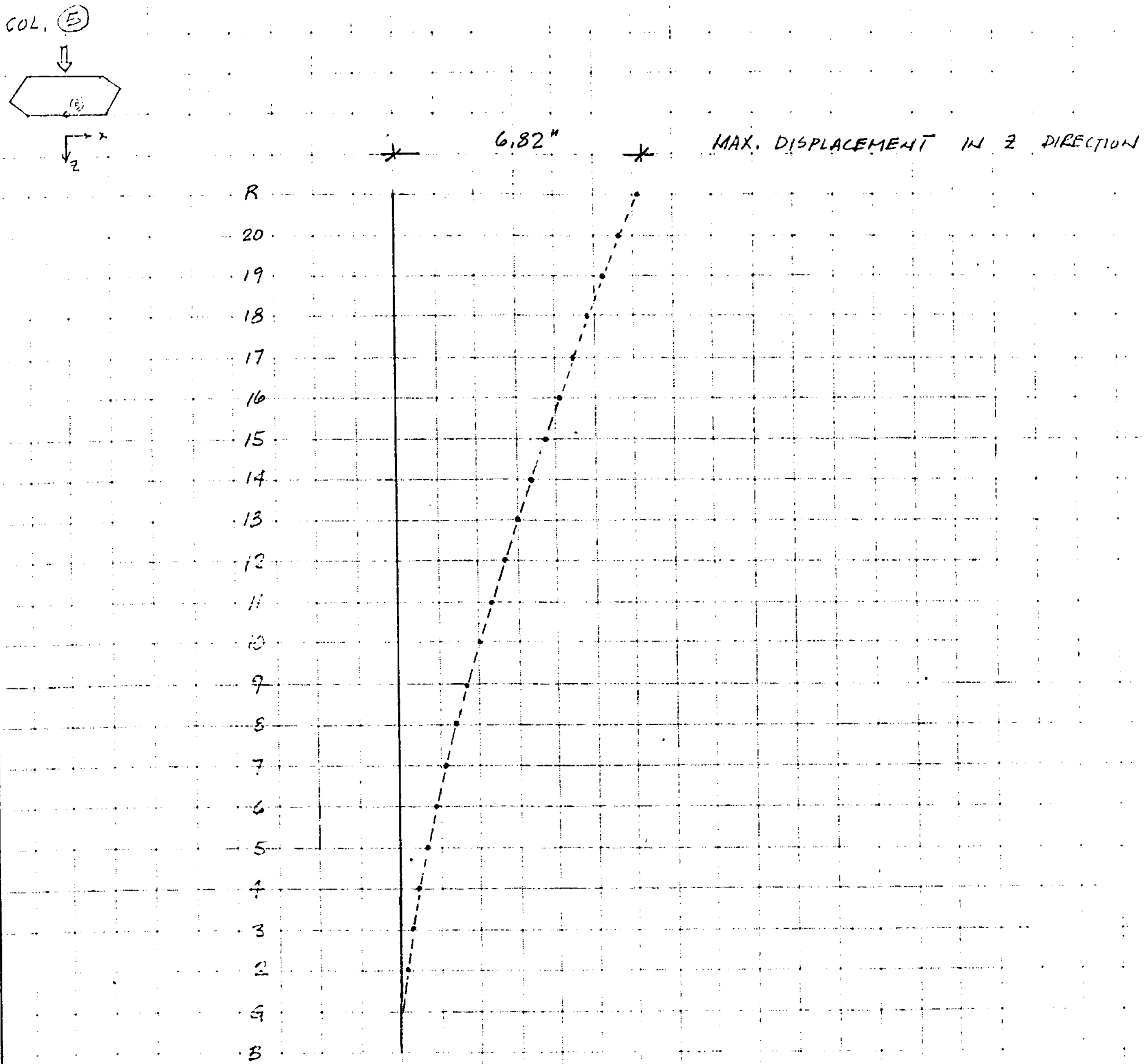
Job Name

Architect

3rd RUN CHECK

Job #

LOADING CASE 2 - DEFLECTION Z DISPLACEMENT



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Houston, Texas 77006

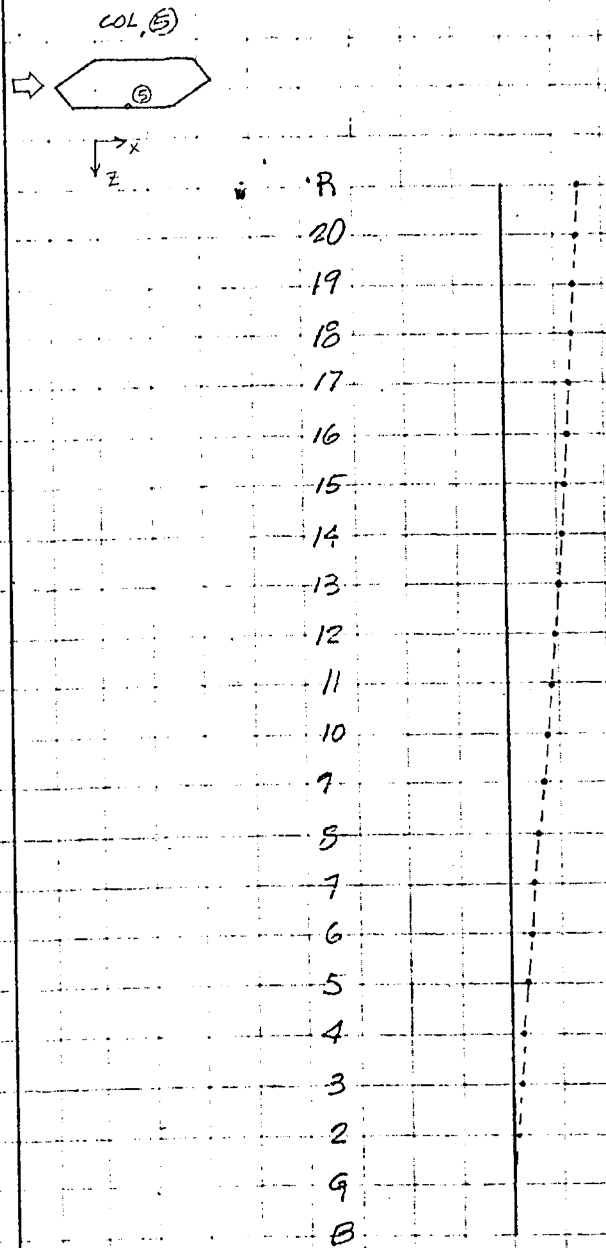
Job Name 3 RIVERWAY

Architect 3D MORRIS

3D RUN CHECK

Job #

LOADING CASE 4 - DEFLECTION   X DISPLACEMENT



5. Wind beam design information

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2905 Sackett
Houston, Texas 77006

Job Name 3 RIVERWAY

Architect SI MORRIS

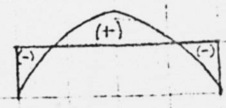
Job #

WIND FRAME DESIGN:

BEAMS

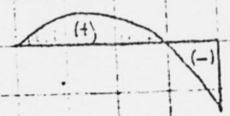
GRAVITY MOMENTS : (TYPICAL)

INTERIOR SPANS $+M = \frac{wl^2}{16}$



$-M = \frac{wl^2}{11}$

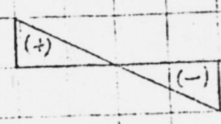
END SPANS $+M = \frac{wl^2}{12}$



$-M = \frac{wl^2}{10}$

WIND MOMENTS:

FROM COMPUTER OUTPUT



COMBINATIONS :

$1.7L + 1.4D$

$\frac{3}{4}(1.7L + 1.4D + 1.7W)$

$0.9D + 1.3W$ → (FOR POSITIVE MOMENT OVER SUPPORT)

NOTE : CHECK MAX. POSITIVE MOMENT @ END SPANS

LIMITING WIND MOMENT:

a) NEGATIVE MOMENT: $\frac{3}{4}(1.7L + 1.4D + 1.7W) = 1.7L + 1.4D$

MAKE : $(1.7L + 1.4D) = K$

$0.75K + 1.275W = K$

$W = \frac{0.25K}{1.275} = 0.196K$

FOR $W > 0.196K$ ⇒ $\frac{3}{4}(1.7L + 1.4D + 1.7W)$ CONTROLS

b). POSITIVE MOMENT @ SUPPORT:

$-0.9D + 1.3W = 0$ ∴ $1.3W = 0.9D$

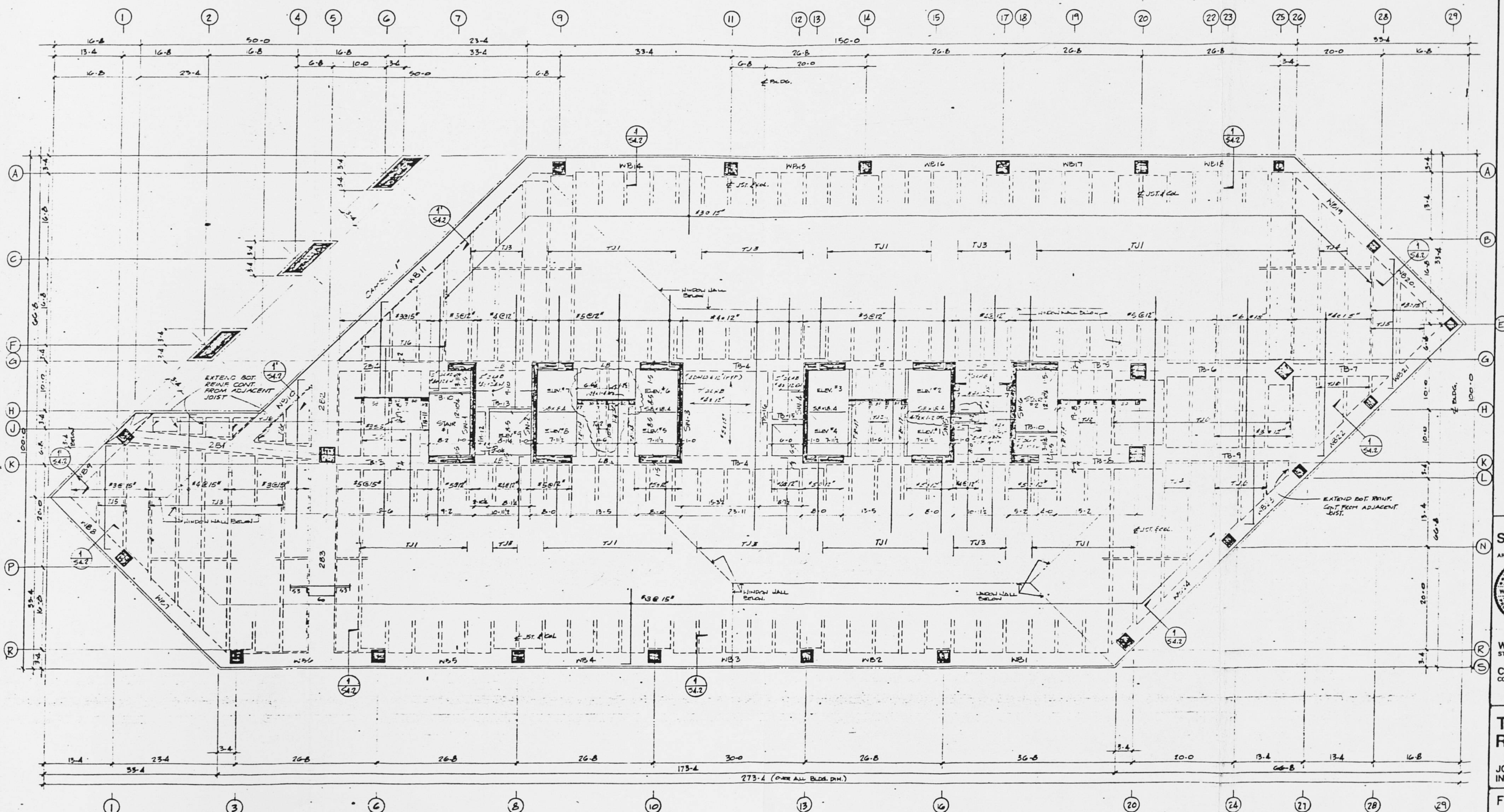
$W = 0.692D$

FOR $W > 0.692D$ → (+) MOMENT OCCURS @ SUPPORT

6. Structural floor plans and beam schedules

REVISIONS		
NO.	DATE	DESCRIPTION
1	5-15-78	ISSUED FOR ... #2
2	JUNE 78	ISSUED FOR REV. #& TO ...

173



S. I. Morris Associates
ARCHITECTS 3465 WEST ALABAMA HOUSTON, TEXAS

STATE OF TEXAS · WALTER P. MOORE · 116 · REGISTERED PROFESSIONAL ENGINEER

NO. 545

REGISTERED ARCHITECT · STATE OF TEXAS

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Chenault & Associates, Inc.
CONSULTING ENGINEERS HOUSTON

THREE RIVERWAY

JOHN HANSEN
INVESTMENT BUILDER

FLOOR 2

DATE	DRAWING NO.
COMM. NO. 77152	S3.3

REVISIONS		
NO.	DATE	DESCRIPTION
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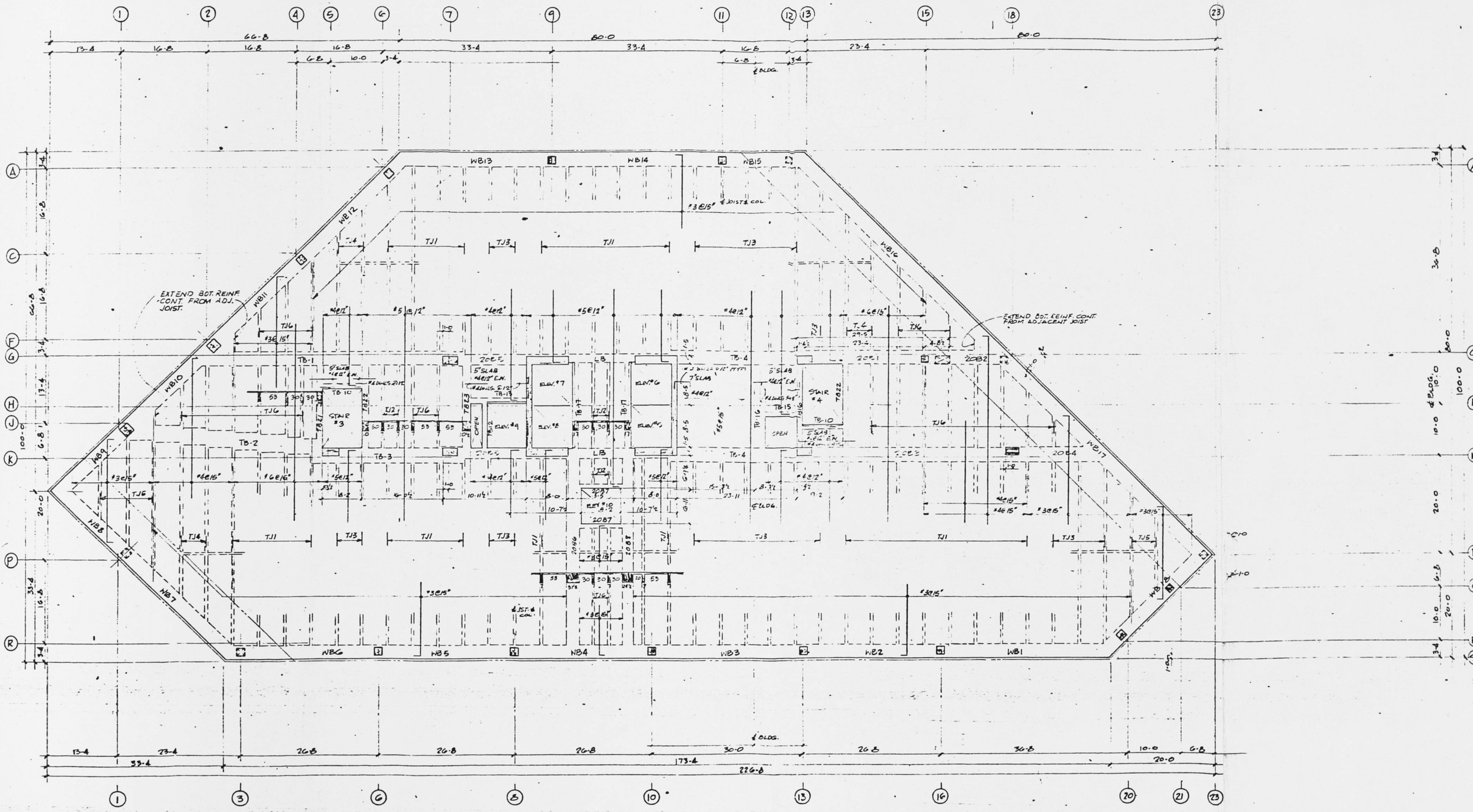
2	[illegible] JUNE [illegible]	[illegible] FOR [illegible]

174



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Chenault & Associates, Inc.
CONSULTING ENGINEERS HOUSTON

THREE RIVERWAY

JOHN HANSEN
INVESTMENT BUILDER

FLOOR 20

DATE	DRAWING NO.
COMM. NO. 77152	S3.15

BEAM SCHEDULE WB-, CB-, B

REVISIONS		
NO	DATE	DESCRIPTION
1	5-5-78	ISSUED FOR [illegible]
2	[illegible] 78	ISSUED FOR [illegible]

175

Column headings (all panels): REMARKS | MARK | SIZE: W" , D" | REINFORCING STEEL: TOP (TOP C / TOP ◆ / TOP ■), TOP, TOP◆, BOT■, BOT, (C BOT / L BOT) | STIRRUPS: NO, SIZE, TYPE, SPACING EA END

ROOF

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
	WB1	30	24¾	2-#9		2-#11	1-#11	1-#10	L2-#11	30	#4	□	[illegible]
	WB2	30	24¾	2-#9			1-#9		L2-#9	18			6/12 @ 10/
	WB3	30	24¾	2-#7			1-#9		L2-#9	22			6/10 @ 10/
	WB4	30	24¾	2-#9		2-#9	1-#9		L2-#7	18		□	6/12 @ 10/
	WB5	30	33	2-#7			1-#9		L2-#9	26	#4	□	6/12 @ 10/
	WB6	30	33	2-#11		2-#11	2-#11		L2-#11	30	#5	□	15 @ [illegible]/
	WB7	30	33	3-#11			4-#10		L3-#11	24	#4	III	6/21 @ 10/
	WB8	30	33	2-#11	2-#10C		2-#11		L3-#11	22	#5	□	11 @ 4/
	WB9	30	33	2-#[illegible]			1-#9		L2-#9	26	#4	⊏	6/9 @ 15/
	WB10	30	33	2-#7		2-#7	1-#9		L2-#[illegible]	26	#4	III	6/9 @ 15/
	WB11	30	24¾	2-#7			1-#9		L2-#7	30	#4		6/14 @ 10/
	WB12	30	24¾	2-#10	2-#9K		2-#11		L2-#11	40	#4	□	6/12 @ 10/
	WB13	30	33	2-#9			2-#11		L2-#10	24	#4	III	6/12 @ 15/
	WB14	30	33	3-#9			2-#10		L2-#12	26	#4	III	6/22 @ 15/
	WB15	30	33	2-#9		2-#9	1-#9		L2-#9	30			6/16 @ 10/
	WB16	30	33	2-#7			1-#9		L2-#9	30			6/14 @ 5/
	WB17	30	33	2-#9			1-#9		L2-#9	20	'	'	6/9 @ 15/

FLOOR 20, 19 (UNLESS NOTED IN REMARKS)

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
	WB1	30	24¾	2-#11		2-#11	2-#11		L2-#11	32	#4	□	6/4 @ 10/
	WB2	30	24¾	2-#9		2-#7			L2-#10	18			6/8 @ 10/
	WB3	30	24¾	2-#8			1-#9		L2-#9	22			6/10 @ 10/
	WB4	30	24¾	2-#11		2-#10	3-#11		L2-#10	44			5@4/7 @ 10/
	WB5	30	24¾	2-#8					L2-#10	18			6/8 @ 10/
	WB6	30	24¾	2-#9			1-#10		L2-#10	28			6/13 @ 10/
	WB7	30	24¾	2-#8		2-#8	2-#10		L2-#10	32			6/16 @ 10/
	WB8	30	24¾	3-#10					L3-#10	26			13 @ 8/
	WB9	30	24¾	3-#10					L3-#10	26			13 @ 8/
	WB10	30	24¾	2-#8					L2-#10	28			6/13 @ 10/
	WB11	30	24¾	2-#8					L2-#10	18			6/8 @ 10/
	WB12	30	24¾	2-#8					L2-#10	18			6/8 @ 10/
	WB13	30	24¾				2-#10		L2-#10	30			6/14 @ 10/
FLR. 19TH	WB14	30	24¾	3-#10			2-#10		L2-#10	30	'	'	6/14 @ 10/
FLR. 20TH	WB14	36	33	2-#11		2-#9	2-#8		L2-#9	22	#4	□	6/10 @ 15/
FLR. 19TH	WB15	36	33	3-#11			2-#9		L2-#9	22			6/10 @ 15/
FLR. 20TH	WB15	36	33	2-#11		2-#11	2-#11		L2-#11	34			7 @ 6/
FLR. [illegible]	WB16	36	33	4-#11			2-#11		L4-#11	22			6/17 @ 15/2 @ 24/
FLR. 20TH	WB16	36	33	4-#11			2-#11		L5-#11	44			6/19 @ 15/2 @ 24/
FLR. 19TH	WB17	36	33	3-#11			2-#10		L4-#11	26			6/11 @ 15/24/
FLR. 20TH	WB17	36	33	4-#11			2-#11		L5-#11	44			6/19 @ 15/2 @ 24/
FLR. 19TH	WB18	36	33	2-#9			2-#9		L2-#8	16			6/7 @ 15/
FLR. 20TH	WB18	36	33	4-#9					L4-#9	[illegible]			6/8 @ 15/
FLR 20TH	WB19	36	33	2-#10	3-#10K		2-#9		L2-#8	22	'	'	6/9 @ 15/24/

FLOOR 18, 17, 16 (U.N.)

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
	WB1	30	24¾	2-#10		2-#9	2-#11		L2-#11	34	#4	□	6/14 @ 10/2 @ 24/
	WB2	30	24¾	2-#10		2-#10			L2-#10	22			6/8 @ 10/2 @ 24/
	WB3	30	24¾	2-#7			1-#9		L2-#9	26			6/10 @ 10/2 @ 24/
FLR. 16TH	WB4	30	24¾	2-#10		2-#10			L2-#10	22	#4		6/8 @ 10/2 @ 24/
FLR. 17TH, 18TH	WB4	30	24¾	2-#11		2-#11	2-#11		L2-#11	32	#5		6/15 @ 10/
	WB5	30	24¾	2-#6					L2-#10	22	#4		6/8 @ 10/2 @ 24/
	WB6	30	24¾	2-#9		2-#9			L3-#10	30			6/13 @ 10/15/
	WB7	30	24¾	2-#6					L3-#10	34			6/16 @ 10/
	WB8	30	24¾	3-#11					L3-#11	26			13 @ 8/
	WB9	30	24¾	3-#11					L3-#10	26			13 @ 8/
	WB10	30	24¾	2-#6					L2-#10	28			6/13 @ 10/
	WB11	30	24¾	2-#10		2-#10			L2-#10	22			6/8 @ 10/2 @ 24/
	WB12	30	24¾	2-#8					L2-#10	22			6/9 @ 10/24/
	WB13	30	24¾	2-#9		2-#9	2-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB14	30	24¾	2-#9			1-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB15	30	24¾	2-#9		2-#9			L2-#10	22	#4	□	6/7 @ 10/24/
FLR. 16TH	WB16	36	33	2-#10		2-#[illegible]		2-#8	L2-#[illegible]	20	#4	III	6/7 @ 15/2 @ 24/
FLR 17TH	WB16	36	[illegible]	[illegible]		2-#9	2-#10		L2-#[illegible]	50	#5	[illegible]	25 @ 6/

FLOORS 18, 17, 16 (U.N.) - CONTINUED

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
FLR. 18TH	WB16	36	33	2-#7			2-#9		L2-#8	12	#4	□	6/5 @ 15/
FLR. [illegible]	WB17	36	33	4-#9					L4-#9	12			6/5 @ 15/
FLR. 17TH	WB17	36	33	4-#11		2-#11	3-#11		L4-#11	44			6/19 @ 15/2 @ 24/
FLR. 18TH	WB17	36	33	3-#11	2-#9K		3-#11		L4-#11	44			6/19 @ 15/2 @ 24/
FLR. 16TH	WB18	36	33	3-#11			3-#11		L4-#11	44			6/19 @ 15/2 @ 24/
FLR. 17TH	WB18	36	33	4-#9			2-#9		L2-#8	20			6/7 @ 15/2 @ 24/
FLR. 18TH	WB18	36	33	2-#9		2-#11	2-#9		L2-#8	28			6/11 @ 15/2 @ 24/
FLR. 16TH	WB19	36	33	3-#10					L4-#9	12			6/5 @ 15/
FLR. 17TH	WB19	36	33	2-#9			2-#9		L2-#8	16	'		6/7 @ 15/
FLR 18TH	WB19	30	24¾	2-#7			1-#7		L2-#8	16		□	6/7 @ 10/
FLR 16TH	WB20	36	33	3-#9					L2-#9	18		III	9 @ 8/
FLR. 17TH	WB20	36	33	2-#8			2-#9		L2-#8	20			6/7 @ 15/2 @ 24/
FLR. 18TH	WB20	30	24¾	3-#10			2-#9		L2-#8	26		□	6/12 @ 10/2 @ 24/
FLR. 16TH	WB21	36	33	2-#10			2-#9		L2-#8	14		III	6/5 @ 15/24/
FLR. 16TH	WB22	36	33	3-#10			2-#9		L2-#8	20	'	III	6/7 @ 15/2 @ 24/

FLOORS 15, 14, 13

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
	WB1	30	24¾	2-#11			2-#11		L2-#11	34	#4	□	6/14 @ 10/2 @ 24/
	WB2	30	24¾	2-#11		2-#10			L2-#10	22			6/8 @ 10/2 @ 24/
	WB3	30	24¾	2-#6			1-#9		L2-#9	26			6/10 @ 10/2 @ 24/
	WB4	30	24¾	2-#10		2-#9			L2-#10	22			6/8 @ 10/2 @ 24/
	WB5	30	24¾	2-#6					L2-#10	22			6/8 @ 10/2 @ 24/
	WB6	30	24¾	2-#11		2-#11			L3-#10	30			6/13 @ 10/15/
	WB7	30	24¾	2-#6					L3-#11	34			6/16 @ 10/
	WB8	30	24¾	3-#11					L3-#11	26			13 @ 8/
	WB9	30	24¾		3-#11C2				L3-#11	26			13 @ 8/
	WB10	30	24¾	2-#6					L2-#10	28			6/13 @ 10/
	WB11	30	24¾	2-#9		2-#9			L2-#10	22			6/8 @ 10/2 @ 24/
	WB12	30	24¾	2-#9					L2-#10	22			6/9 @ 10/24/
	WB13	30	24¾	2-#10		2-#10	2-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB14	30	24¾	2-#9			1-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB15	30	24¾	2-#10					L2-10	22			6/9 @ 10/24/
FLR 13 & 14	WB16	30	24¾	2-#9					L2-#10	22			[illegible] 24/
FLRS 13TH & 14TH	WB17	36	33	2-#11			1-#10		L2-#10	20		III	[illegible] 15/2 @ 24/
FLR. 15TH	WB17	36	33	3-#11				2-#10	L3-#11	22		III	[illegible] @ 15
FLR 13 & 14	WB18	36	33	4-#11			3-#11		L3-#11	36		III	[illegible] 14 @ 15/3 @ 24/
FLR. 15TH	WB18	36	33	4-#11		2-#9	3-#11		L3-#11	36		III	[illegible] 14 @ 15/3 @ 24/
FLR 13 & 14	WB19	36	33	3-#10			2-#10		L3-#11	16			[illegible] 2 @ 24/
FLR 15TH	WB19	36	33	3-#10			2-#10		L3-#10	16			[illegible] 2 @ 24/
FLR 13 & 14	WB20	36	33	2-#9			1-#10		L2-#10	14			6/6 @ 15/
FLR. 15TH	WB20	36	33	2-#9			1-#10		L2-#10	14			6/6 @ 15/
FLR 13 & 14	WB21	36	33	3-#10			1-#10		L2-#10	14			6/6 @ 15/
FLR. 15TH	WB21	36	33	3-#10			1-#10		L2-#10	14		III	6/6 @ 15/
FLR 13 & 14	WB22	30	24¾	2-#10	2-#9K				L2-#10	26		□	6/10 @ 10/2 @ 24/
FLR 15TH	WB22	30	24¾	2-#10	2-#9K				L2-#10	26		III	6/10 @ 10/2 @ 24/
FLR 15TH	WB16	30	24¾	2-#10					L2-#10	22		□	6/9 @ 10/24/

FLOORS 12, 11, 10

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
	WB1	30	24¾	2-#11			2-#11		L2-#11	34	#4	□	6/14 @ 10/2 @ 24/
	WB2	30	24¾	2-#8					L2-#10	22			6/8 @ 10/2 @ 24/
	WB3	30	24¾	2-#10		2-#10			L2-#11	26			6/10 @ 10/2 @ 24/
	WB4	30	24¾	2-#7					L2-#10	22			6/8 @ 10/2 @ 24/
	WB5	30	24¾	2-#10		2-#10			L2-#10	22			6/8 @ 10/2 @ 24/
	WB6	30	24¾	2-#8					L3-#10	30			6/13 @ 10/1 @ 15/
	WB7	30	24¾	2-#10					L3-#10	34			6/16 @ 10/
	WB8	30	24¾	3-#11					L3-#11	26			13 @ 8/
	WB9	30	24¾	3-#11					L3-#11	26			13 @ 8/
	WB10	30	24¾	2-#9					L2-#10	28			6/13 @ 10/
	WB11	30	24¾	2-#11					L2-#10	22			6/8 @ 10/2 @ 24/
	WB12	30	24¾	2-#11					L2-#10	22			6/9 @ 10/1 @ 24/
	WB13	30	24¾	2-#10		2-#10	2-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB14	30	24¾	2-#9			1-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB15	30	24¾	2-#10					L2-#10	22			6/9 @ 10/1 @ 24/
	WB16	30	24¾	2-#9					L2-#10	22		'	6/9 @ 10/1 @ 24/
FLRS. 10TH & 11TH	WB17	36	33	2-#10			1-#10		L2-#10	22	'		6/10 @ 15/

FLOORS 12, 11, 10 (U.N.) - CONTINUED

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
FLR 12TH	WB17	36	33	2-#11			1-#10		L2-#10	20	#4	III	6/7 @ 15/2 @ 24/
FLRS 10TH, 11TH	WB18	36	33	4-#11			3-#11		L3-#11	30		⊏	6/4 @ 15/3 @ 24/
FLR 12TH	WB18	36	33	4-#[illegible]			3-#11		L3-#11	30			6/14 @ 15/3 @ 24/
FLR 12TH	WB19	36	33	3-#10			2-#10		L3-#11	16		'	6/6 @ 15/2 @ 24/
FLRS 10TH, 11TH	WB20	36	33	2-#9					L3-#10	16		II	8 @ 10/
FLR 12TH	WB20	36	33	2-#[illegible]			[illegible]-#10		L2-#10	14		III	6/6 @ 15/
FLRS 10TH, 11TH	WB21	36	33	3-#[illegible]			1-#10		L2-#10	14		III	6/5 @ 10/1 @ 24/
FLR 12TH	WB21	36	33	3-#10			[illegible]-#10		L2-#10	14		III	6/6 @ 15/
FLRS 10TH, 11TH	WB22	30	24¾	2-#9	2-#9K				L2-#10	[illegible]		⊏	6/10 @ 10/2 @ 24/
FLR 12TH	WB22	30	24¾	2-#10	2-#9K				L2-#10	[illegible]		□	6/10 @ 10/2 @ 24/
FLRS [illegible]	WB23	30	24¾	2-#[illegible]		[illegible]	1-#10		L2-#10	[illegible]		□	6/10 @ 10/2 @ 24/
FLRS 10TH, 11TH	WB19	36	33	2-#9					L3-#10	16	'	III	8 @ 10/

FLOORS 9, 8, 7 (U.N.)

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
	WB1	30	24¾	2-#11			2-#11		L2-#11	34	#4	□	6/14 @ 10/2 @ 24/
	WB2	30	24¾	2-#11		2-#11			L2-#10	22			6/8 @ 10/2 @ 24/
	WB3	30	24¾	2-#9			1-#9		L2-#9	26			6/10 @ 10/2 @ 24/
	WB4	30	24¾	2-#10		2-#10			L2-#10	22			6/8 @ 10/2 @ 24/
	WB5	30	24¾	2-#9					L2-#10	22			6/8 @ 10/2 @ 24/
	WB6	30	24¾	2-#11		2-#11			L3-#10	30			6/13 @ 10/1 @ 15/
	WB7	30	24¾	2-#10					L3-#11	34			6/16 @ 10/
	WB8	30	24¾	3-#11					L3-#11	26			13 @ 8/
	WB9	30	24¾	3-#11					L3-#11	26			13 @ 8/
	WB10	30	24¾	2-#9					L2-#10	28			6/13 @ 10/
	WB11	30	24¾	2-#11					L2-#10	22			6/8 @ 10/2 @ 24/
	WB12	30	24¾	2-#11					L2-#10	22			6/9 @ 10/1 @ 24/
	WB13	30	24¾	2-#10		2-#10	2-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB14	30	24¾	2-#11			1-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB15	30	24¾	2-#9					L2-#10	22			6/9 @ 10/1 @ 24/
	WB16	30	24¾	2-#11					L2-#10	22		□	6/9 @ 10/1 @ 24/
	WB17	36	33	2-#[illegible]			1-#10		L2-#10	22		III	6/10 @ 15/
	WB18	36	33	6-#[illegible]			3-#11		L4-#11	36		III	6/14 @ 15/3 @ 24
	WB20	36	33	2-#9				2-#11	L3-#10	16		III	8 @ 10/
	WB21	36	33	3-#10				2-#11	L2-#10	14		III	6/6 @ 10/1 @ 24/
	WB22	30	24¾	2-#11					L2-#10	14		III	6/6 @ 10/1 @ 24/
	WB23	30	24¾	2-#10		2-#10	1-#10		L2-#10	26		□	6/10 @ 10/2 @ 24/
→	WB19	36	33	2-#7					L3-#10	16		III	8 @ 10/

FLOOR 6

REMARKS	MARK	W"	D"	TOP	TOP	TOP◆	BOT■	BOT	C BOT / L BOT	NO	SIZE	TYPE	SPACING EA END
	WB1	30	24¾	2-#11			2-#11		L2-#11	34	#4	□	6/4 @ 10/2 @ 24/
	WB2	30	24¾	2-#11			2-#11		L2-#10	22			6/8 @ 10/2 @ 24/
	WB3	30	24¾	2-#9			1-#9		L2-#9	22			6/10 @ 10/2 @ 24/
	WB4	30	24¾	2-#10		2-#10			L2-#10	22			6/8 @ 10/2 @ 24/
	WB5	30	24¾	2-#9					L2-#10	22			6/8 @ 10/2 @ 24/
	WB6	30	24¾	2-#11		2-#11			L3-#10	30			6/13 @ 10/1 @ 15/
	WB7	30	24¾	2-#10					L3-#11	34			6/16 @ 10/
	WB8	30	24¾	3-#11					3-#11	26			13 @ 8/
	WB9	30	24¾	3-#11					3-#11	26			13 @ 8/
	WB10	30	24¾	2-#9					L2-#10	28			6/13 @ 10/
	WB11	30	24¾	2-#11					L2-#10	22			6/8 @ 10/2 @ 24/
	WB12	30	24¾	2-#11					L2-#10	22			6/8 @ 10/2 @ 24/
	WB13	30	24¾	2-#10		2-#10	2-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB14	30	24¾	2-#11			1-#10		L2-#10	34			6/14 @ 10/2 @ 24/
	WB15	30	24¾	2-#9					L2-#10	22			6/9 @ 10/1 @ 24/
	WB16	30	24¾	2-#11		2-#11			L2-#10	22			6/9 @ 10/1 @ 24/
	WB17	30	24¾	2-#11		2-#11			L2-#10	22			6/9 @ 10/1 @ 24/
	WB18	30	24¾	2-#10		2-#10	2-#10		L2-#11	30		Y	6/13 @ 10/1 @ [illegible]
	WB19	30	33	2-#9					L3-#9	24		⊏	6/11 @ 10/
	WB20	30	33	2-#9					L3-#9	24			6/11 @ 10/
	WB21	30	33	3-#9					L3-#9	26			6/12 @ 10/
	WB22	30	33	2-#11		2-#11			L3-#9	22		Y	6/10 @ 10/
	WB23	30	24¾	2-#7					L2-#10	16		□	6/6 @ 10/1 @ 24/
	WB24	30	24¾	3-#10		2-#10	1-#10		L2-#10	26	'	□	6/10 @ 10/2 @ 24/

S. I. Morris Associates
ARCHITECTS 3465 WEST ALABAMA HOUSTON, TEXAS

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NO. 346

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STRUCTURAL ENGINEERS HOUSTON

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THREE RIVERWAY

JOHN HANSEN
INVESTMENT BUILDER

BEAM SCHEDULE

DATE

DRAWING NO. S1.4

COMM. NO. 77152

BEAM SCHEDULE

MARK	SIZE W"	SIZE D"	TOP	TOP HOOK	TOP◆	BOT■	BOT	C BOT	STIRRUPS NO	SIZE	TYPE	SPACING EA END
FLOORS 12, 13, 14 NOTED												
13-14 B1	30	24¾		3-#7t	2-#8		5-#11		24	#3		6@11/
12 B2	30	24¾			2-#9		5-#8		10	#3		6/4@11/
13-14 B2	30	24¾			6-#?		5-#8		6	#3		6/26,24/
12-14 B3	60	33		3-#10t			6-#11		24	#4		6/11@12/
12-14 B4	60	33	10-#11				6-#11		18	#4		6/8@12/
13 B5	30	24¾			4-#9		3-#7		8	#8		6/11/11/38/
14 B5	30	24¾			2-#9		4-#9		22	#3		6/3@6,7@11/
14 B6	30	24¾			[illegible]	3-#11	3-#10		46	#3		5@5/12@11/
12 B5	30	24¾	2-#7				2-#10		16	#3		5/12@11/
12 B6	30	24¾	2-#9				2-#10		20	#3		6/12@11/
13 B6 / 14 B7	30	24¾			6-#9		3-#8		10	#3		6/4@11/
FLOORS 7 THRU 11												
7-11 B1	30	24¾			4-#10	1-#8	2-#9		6	#3		6 3@11/24/
FLOOR 6												
6B1	84	39	25-#11	20-#10t			50-#11		90	#5		6/44@8/
6B2	30	33	2-#11		3-#11		7-#11		38	#4		19@7/
6B3	30	33			2-#11		4-#11		18	#4		6/5@15/3@36/
FLOORS 3, 4												
3B1	36	33	4-#11	4-#11t	4-#11	6-#11	6-#11		68	#4		6/33@8/
4B1	56	33	9-#11			4-#11	5-#11		34	#4		6/16@11/
FLOOR 2												
2B1	36	33	2-#11	2-#11t	3-#10		2-#11	2-#10	32	#4		6/11@12/4@24/
2B2	60	33	20-#11				10-#11		20	#4		10@12/
2B3	60	33		3-#7t			4-#11		40	#4		6/19@12/
2B4	24	24¾		2-#6t	2-#9		3-#7		20	#3		6/9@11/
FLOOR FIRST												
1B1	36	24¾		5-#11t	2-#11	4-#11	3-#11		44	#3		10@5/11@11/20/
1B2	52	24¾		4-#8t	4-#10	3-#9	4-#9		44	#3		16@6/5@11/40
1B3	30	24¾			4-#10		2-#7		14	#3		6/4@11/2@46/
1B4	30	24¾	2-#9			2-#9	3-#9		28	#3		5@5/3@8/6@11/
1B5	30	24¾			4-#8		2-#8		12	#3		6/2@11/2@28
1B6	30	24¾			4-#8		4-#8		20	#3		6/3@8/8@11/
1B7	30	24¾		2-#8t	3-#8		3-#7		16	#3		6/7@11/
1B8	30	24¾			4-#7		2-#9		12	#3		6/4@11/2@41/
1B9	30	24¾		2-#10t	3-#9	4-#9	4-#9		26	#3		5/9@5/11/11/
1B10	17	24¾	2-#5				2-#5		8	#3		6/38/38/
1B11	11½	24¾	2-#5				2-#5		6	#3		6/38/38/
1B12	10	24¾	2-#5				2-#5		4	#3		6/30/
1B13	12	24¾	2-#5				2-#5		4	#3		6/40/
1B14	17	24¾	2-#5				2-#6		6	#3		6/38/38/
1B15	42	24¾	2-#5				2-#5		6	#3		6/38/38/
1B16	24	24¾	2-#6	2-#6t	3-#8		5-#8		30	#3		6/11@7/21/31/
1B17	24	24¾	2-#6				3-#8		28	#3		6/11@7/27/27/
1B18	24	24¾	2-#5		6-#8		4-#8		34	#3		6/15@7/34/
1B19	17	24¾					2-#6		12	#3		6/2@11/3@34/
1B20	17	24¾	2-#6	2-#6t			3-#7		16	#3		6/5@11/3@31/
1B21	12	24¾	2-#5				3-#5		6	#3		6/9/9/
1B22	30	24¾	2-#7				4-#9		54	#3		4/5@4/6@8/[illegible]
1B23	30	24¾	5-#10				3-#8		8	#3		6/14/14/30/
1B24	20	36	2-#5	2-#7t			5-#11		36	#3		[illegible]
1B25	18	24¾	2-#5				2-#8		14	#3		4/6@9/
1B26	8	24¾	2-#5				2-#6		10	#3		6/4@11/
1B27	8	24¾	2-#5				2-#6		10	#3		6/4@11/
1B28	8	24¾	2-#5				2-#6		2	#3		6/
1B29	24	36	4-#10				3-#9		22	#3		4/10@7/
1B30	24	36	2-#5	2-#8t			5-#10		78	#3		3/13@3/15@7/
1B31	14	36	2-#5	4-#6t			4-#7		26	#3		6/4@6/2@8/
1B32	32	36	5-#10				5-#8		6	#3		4/15/15/
1B33	32	36	2-#7				6-#10		34	#4		6/11@7/5@8/
1B34	32	36	2-#7		2-#9		6-#8		34	#4		[illegible]/28/
1B35	32	36	2-#7				5-#9		36	#4		4/11@4/6@4/27/27
1B36	30	36	4-#9				4-#9		4	#3		6/32/
1B37	18	24¾	2-#5	1-#5t			3-#7		4	#3		6/41/
1B38	54	24¾		4-#7t			5-#9		38	#3		6/18@7/
1B39	8/48	24¾		2-#7t			3-#7		4	#3		6/41/
1B40	12	24¾		4-#7t			5-#9		46	#3		5/14@5/18@9/
1B41	12	36	2-#5				3-#8		12	#3		3/4@4/[illegible]
1B42	[illegible]	[illegible]		4-#7t			[illegible]		16	#3		6/7@11/

MARK	SIZE W"	SIZE D"	TOP	TOP HOOK	TOP◆	BOT■	BOT	C BOT	STIRRUPS NO	SIZE	TYPE	SPACING EA END
ROOF BEAMS												
RB1	30	24¾		3-#9t		4-#10	6-#11		58	#3		28@6/11@8/5@11/
RB2	30	24¾			10-#11	2-#6	3-#6		8	#3		6/2@11/39/
RB3	30	24¾			10-#11	2-#6	3-#7		20	#3		6,5@11/39,
RB4	30	24¾		3-#10t		3-#9	3-#10		8	#3		6/3@36/
RB5	30	24¾		3-#8t			3-#7		20	#3		6/13@11/29,
RB6	30	24¾			6-#11		3-#9		12	#3		6,4@11/20/
RB7	30	24¾			4-#11	3-#8	3-#8		24	#3		[illegible]@11/2@30/
RB8	30	24¾		3-#11t		4-#10	5-#10		56	#3		14@5/5@6/9@11/
RB9	30	36	2-#7				2-#10		8	#3		6 2@17/41/
RB10	[illegible]	24¾	2-#6				3-#6		16	#3		6/7@12/
RB11	12	24¾	2-#6				3-#6		12	#3		6/4@11/34/
RB12	6	24¾	2-#5				2-#7		12	#3		6/4@11/34/
RB13	30	36	6-#9				3-#10		20	#3		6/9@11/
FLOOR 20												
20B1	30	24¾			4-#10		3-#11		36	#4		6/16@4@9/6@10/
20B2	30	24¾	2-#9				3-#8		8	#3		6/3@12/
20B3	30	24¾	3-#11		5-#11		4-#11		24	#3		9@6/12@11/28/
20B4	30	24¾	2-#11				2-#11		20	#3		6/9@8/
20B5	17	24¾					3-#11		10	#3		6,3@11/30/
20B6	31½	24¾	4-#9				4-#9		12	#3		6/5@40/
20B7	2	24¾	2-#5				2-#6		4	#3		6,32/
20B8	24½	24¾	4-#9				4-#9		12	#3		6/5@40/
FLOOR 19												
19B1	30	24¾				1-#7	2-#8		14	#3		6/5@11/33/
19B2	30	24¾		2-#9t	4-#9	1-#7	2-#8		24	#4		5/6@5/5@11/
19B3	30	24¾			6-#10	3-#10	3-#10		40	#3		6.7@6/12@11/
19B4	30	24¾					3-#8		10	#3		6/3@11/42/
19B5	30	24¾	2-#10 C1				2-#10		26	#3		6/11@8/
19B6	48	24¾						L4-#9	18	#3		6/8@11/
19B7	48	24¾	7-#11 C1				4-#11		10	#3		6/3@11/
19B8	30	24¾			6-#10 TOTAL TO SHEAR WALL	1-#8	2-#8		6	#3		6,28/28/
19B9	31½	24¾	4-#9				4-#9		12	#3		6,5@40
19B10	12	24¾	2-#5				2-#6		4	#3		6,32/
19B11	24½	24¾	4-#9				4-#9		24	#3		6/8@11/3@36/
FLOOR 18												
18B1	30	24¾			6-#10 TOTAL TO SHEAR WALL	1-#8	2-#8		6	#3		6/28 28/
18B2	30	24¾					4-#11		14	#3		6/5@11, 33/
18B3	30	24¾			3-#8	1-#8	2-#8		10	#3		6 2@11/34/34/
18B4	30	24¾		3-#8t		1-#8	2-#8		8	#3		6,2@11/40/
18B5	30	24¾			6-#10	3-#10	3-#10		40	#3		6,7@6/12@11/
18B6	18½	24¾	4-#9				4-#9		30	#3		6,12@11/36,36/
FLOOR 17												
17B1	30	24¾					4-#11		[illegible]	#3		6,6@11/24/
17B2	30	24¾			6-#11		3-#8		12	#3		6,4@11/30/
17B3	30	24¾					3-#8		12	#3		6/4@11/24/
17B4	30	24¾		2-#6t	2-#8		3-#8		6	#3		6/34/34/
17B5	30	24¾			6-#9	3-#9	4-#9		56	#3		6,26/12@11,
17B6	30	24¾			6-#9		3-#8		12	#3		6,4@11/38/
17B7	30	24¾		3-#8t	3-#8		3-#11		24	#3		6,11@11,
17B8	30	24¾			6-#10 TOTAL TO SHEAR WALL	1-#8	2-#8		6	#3		6,28/28/
17B9	67	24¾	4-#10	6-#8t		2-#11	4-#10					
FLOOR 16												
16B1	30	24¾				1-#8	2-#9		18	#3		6,8@11/
16B2	30	24¾	3-#8			1-#8	2-#8		8	#3		6/3@21/
16B3	30	24¾	3-#8			1-#8	2-#8		16	#3		6/6@11/30/
16B4	48	24¾	2-#10	4-#11t	2-#10	3-#11	4-#10		32	#3		6/6@8/9@11/
16B5	30	24¾			4-#10	3-#10	4-#10		42	#3		6/8@6/12@11/
16B6	30	24¾	3-#9			1-#8	2-#8		10	#3		6/2@11/32/32/
16B7	30	24¾		3-#9t		1-#10	2-#9		20	#3		6/8@11/24/
FLOOR 15												
15B1	30	24¾				1-#8	2-#9		18	#3		6,8@11/
15B2	30	24¾	3-#8			1-#8	2-#8		8	#3		6 3@21/
15B3	30	24¾	3-#9			1-#8	2-#9		8	#3		6 6@11/36,36/
15B4	30	24¾			6-#10	3-#10	3-#10		34	#3		6,5@7,11@11,
15B5	30	24¾		3-#8t		1-#8	2-#9		18	#3		6,6@11/36,36,
15B6	60	33		3-#10t			6-#11		24	#4		6/11@12/
15B7	60	33	10-#11				6-#11		18	#4		6/8@12/

REMARKS	MARK	SIZE W"	SIZE D"	TOP	TOP HOOK	TOP◆	BOT■	BOT	C BOT	STIRRUPS NO	SIZE	TYPE	SPACING EA END
	FLOORS 5, 4, 3, 2 UNLESS NOTED IN REMARKS												
	WB1	30	24¾	2-#11			2-#11		L2-#11	34	#4		6/14@10/2@24/
	WB2	30	24¾	2-#11		2-#11			L2-#10	22			6/5@10/2@24/
	WB3	30	24¾	2-#9			1-#9		L2-#9	20			6/10@10/2@24/
	WB4	30	24¾	2-#10		2-#10			L2-#10	22			6/8@10/2@24/
	WB5	30	24¾	2-#9					L2-#10	22			6/8@10/2@24/
FL. 2nd	WB6	36	33	2-#9	2-#9t	2-#10	2-#9		L2-#9	22			6/10@15/
FL. 3,4,5	WB6	30	24¾	2-#11		2-#11			L3-#10	30			6/13@10/1@15/
	WB7	30	24¾	2-#10					L3-#11	34			6/16@10/
	WB8	30	24¾	3-#11					L3-#11	26			13@9/
FLR 2nd	WB9	30	24¾	3-#11					L3-#11	26			13@9/ NOTE: REINF. @ COLS.
FLR. 3,4,5	WB9	30	24¾	3-#11					L3-#11	26			13@9/
FLR 2nd	WB10	36	33	2-#9					L4-#9	16			6/5@15/2@24/
FLR 3	WB10	30	24¾	2-#10					L3-#11	34			6/16@10/
FLR 4,5	WB10	30	24¾	2-#9					L2-#10	28			6/13@10/
FLR. 2nd	WB11	36	33	3-#11	7-#11t				L6-#11	38			6/15@15/3@24/
FLR 3	WB11	36	33	3-#11		2-#10	3-#10		L4-#11	36			6/13@15/4@24/
FLR 4	WB11	30	24¾	2-#11					L2-#10	22			6/9@10/1@24/
FLR 5	WB11	30	24¾	2-#11					L2-#10	22			6/9@10/1@24/
FLR 4	WB12	36	33	5-#11			4-#11	3-#11	L3-#11	38			6/7@15/4@24/
FLR 5	WB12	30	24¾	2-#11					L2-#10	22			6/9@10/1@24/
FLR. 2,3	WB14	36	33	2-#9		2-#11			L4-#9	24			6/7@15/4@24/
FLR. 4	WB14	30	24¾	2-#11		2-#11	2-#10		L2-#10	34			6/14@10/2@24/
	WB15	30	24¾	2-#9					L2-#10	22			6/9@10/1@24/
	WB16	30	24¾	2-#11		2-#11			L2-#10	22			6/9@10/1@24/
	WB17	30	24¾	2-#11		2-#11			L2-#10	22			6/9@10/1@24/
	WB18	30	24¾	2-#10		2-#10	2-#10		L2-#11	30			6/13@10/1@15/
	WB19	30	24¾	2-#11					L2-#11	22			6/8@10/2@24/
	WB20	30	24¾	2-#11					L2-#10	20			6/8@10/1@24/
	WB21	30	24¾	2-#11		2-#11			L4-#11	30			3@6/12@10/
	WB22	30	24¾	2-#11		2-#11			L4-#11	30			3@6/10@10/
	WB23	30	24¾	2-#7					L2-#10	16			6/6@10/1@24/
	WB24	30	24¾	[illegible]		1-#10	1-#10		L2-#10	26			6/10@10/2@24/
→FLR 4	WB13	30	24¾	2-#9			1-#10		L2-#10	22			6/8@10/2@24/
→FLR. 5	WB13	30	24¾	2-#10		2-#10	2-#10		L2-#10	34			6/14@10/2@24/
→FLR 5	WB14	30	24¾	2-#11			1-#10		L2-#10	34			6/14@10/2@24/
	FLOOR FIRST												
	AB1	35 1/16	24¾	3-#10	2-#7t			4-#11		24	#3		6/11@11/39/
	AB2	35 1/16	24¾	2-#?				3-#8		16	#3		6/5@11/2@33/
	AB3	35 1/16	24¾	2-#9				3-#9		18	#3		6/7@11/2@31/
	AB4	35 1/16	24¾	2-#8				3-#8		16	#3		6/5@11/2@33/
	PENTHOUSE ROOF BEAMS												
	PB1	24	14	3-#7				2-#9		24	#3		11@6/43/
	PB2	24	14					2-#7		10	#3		4@6,46/
	PB3	24	14		2-#5t			2-#7		6	#3		2@6,46/
	PB4	24	14	3-#7			1-#7	2-#8		30	#3		14@6/44/
	PB5	24	14					2-#7		4	#3		6/24/
	PB6	24	14	2-#5				2-#7		10	#3		3@6,2@38/
	PB7	24	[illegible]					2-#7		4	#3		6/24/
	PB8	24	14	5-#7				2-#9		32	#3		15@6/40,
	PB9	24	14		2-#6t			2-#7		10	#3		4@6 38/
	PB10	24	14		2-#6t			2-#7		14	#3		5@6 38/
	PB11	24	14	2-#7				3-#8		26	#3		12@6/39/
	FLOOR FIRST (CONT.)												
	1B43	12	24¾	2-#7				2-#7		8	#3		6/3@11/
	1B44	24	24¾	2-#7	2-#9t			7-#10		60	#3		3/15@3/13@5/20/
	1B45	18	24¾	2-#7		2-#9		5-#7		5	#3		6/4@11/
	1B46	30	36		2-#10t			15-#11▲		42	#4		6/6@6/10@8/6@17
	1B47	30	36		2-#10t			22-#11▲		60	#4		4/14@4/11@6/4@17
	1B48	30	36		2-#10t			17-#11▲		60	#4		4/4@4/[illegible]
	1B49	30	24¾					3-#10		10	#3		6/2@11, 35,38/
	LOADING DOCK ROOF BEAMS												
	DRB1	15½	24¾	2-#5				3-#5		8	#3		6/3@40/
	DRB2	18	20¾	2-#5				3-#8		12	#3		6/10/10/36 36/

REVISIONS

NO	DATE	DESCRIPTION
	[illegible]	[illegible]
	[illegible]	ISSUED FOR [illegible]

176

S. I. Morris Associates
ARCHITECTS 3465 WEST ALABAMA HOUSTON, TEXAS

WALTER P. MOORE 216 REGISTERED PROFESSIONAL ENGINEER
NO. 846

Walter P. Moore & Associates, Inc.
STRUCTURAL ENGINEERS HOUSTON

Chenault & Associates, Inc.
CONSULTING ENGINEERS HOUSTON

THREE RIVERWAY

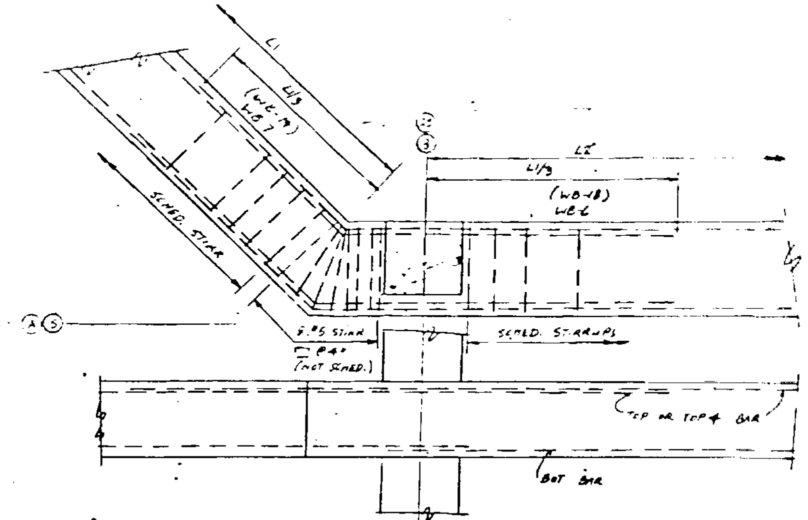
JOHN HANSEN
INVESTMENT BUILDER

BEAM SCHEDULE

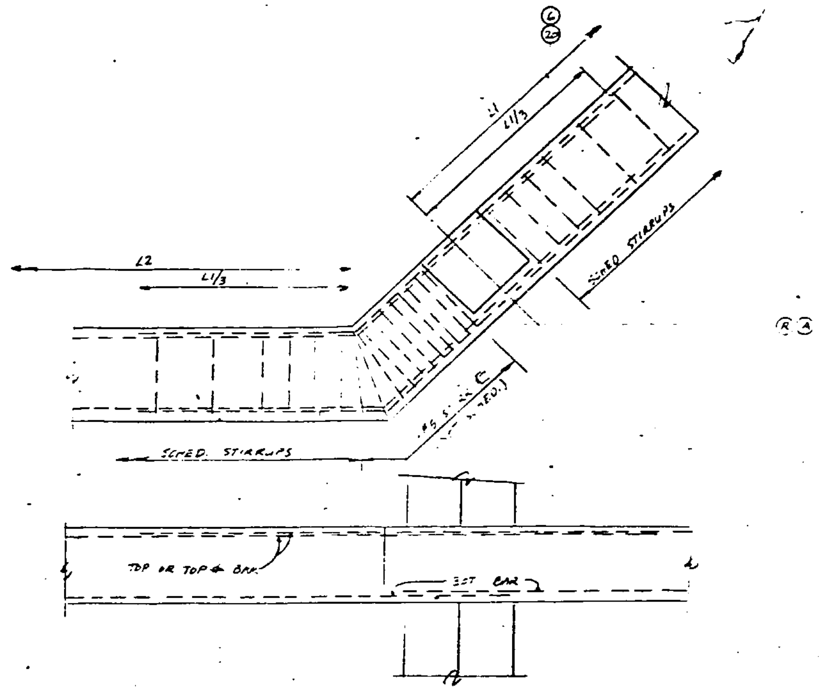
DATE

DRAWING NO. S1.5

COMM. NO. 77152



BAR PLACEMENT DIAGRAM
SPANDREL BEAMS AT GRID S3
SPANDREL BEAMS AT GRID A25 (OPP. HAND)



BAR PLACEMENT DIAGRAM
SPANDREL BEAMS AT GRID R20
SPANDREL BEAMS AT GRID A6 (OPP. HAND)

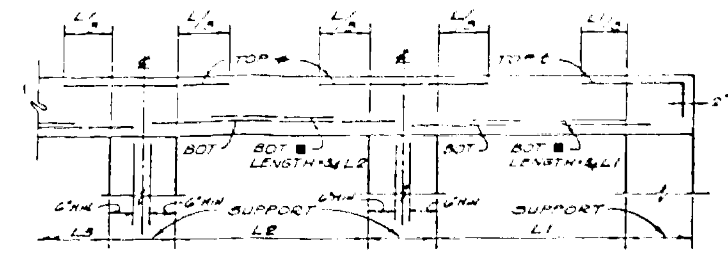
BEAM SCHEDULE (TB)

MARK	SIZE W"	SIZE D"	REINFORCING STEEL TOP	TOP L	TOP ✦	BOT ■	BOT		STIRRUPS OR REMARKS NO	SIZE	TYPE	SPACING EA END
TB1	16	24½	6-#11		10-#11	5-#11	5-#11		72	#4	[illegible]	2/12@4/5@9/2@54/
TB2	30	24½		4-#10	6-#10	5-#9	5-#9		42	#3		3/9@6/6@11/6@31/
TB3	30	24½			4-#10	1-#7	8-#7		30	#3		2/13@5/16@25/
TB4	30	24½			6-#9	1-#8	3-#8		42	#3		2/14@5/16@31/
TB5	30	24½			4-#8	1-#6	3-#7		24	#3		2/10@5/12@20/
TB6	30	24½			4-#8	2-#6	4-#6		44	#3		2/20@5/16@38/
TB7	30	24½		2-#6	2-#9	1-#6	3-#7		34	#3		2/15@5/33/
TB8	30	24½			4-#10	1-#7	6-#7		28	#3		2/12@5/28/
TB9	30	24½		3-#10	2-#10	1-#8	5-#8		56	#3		2/25@5/2@30/
TB10	12	22½	2-#5				2-#5		4	#3		6/28/
TB11	11½	24¾	2-#5				2-#6		10	#3		6/3@11/40/
TB12	10	24¾	2-#5				2-#6		4	#3		6/30/
TB13	12	22½	2-#5				2-#5		4	#3		6/40/
TB14	17	24¾	2-#5				2-#6		6	#3		6/2@38/
TB15	10	24¾	2-#5				2-#5		4	#3		6/20/
TB16	12	24¾	2-#5				2-#6		6	#3		6/2@38/
TB17	17	22½	2-#5				2-#6		6	#3		6/2@38/
TB18	14½	24¾	2-#5				2-#6		6	#3		6/2@38/
TB19	23	24¾	2-#5				3-#6		6	#3		6/2@38/
TB20	23	24¾	2-#5				2-#8		6	#3		6/2@38/
TB21	19	24¾	2-#5				3-#6		6	#3		6/2@38/
TB22	10	24¾	2-#5				2-#7		6	#3		6/2@38/
TB23	10½	24¾	2-#5				2-#7		12	#3		6 4@11/34/

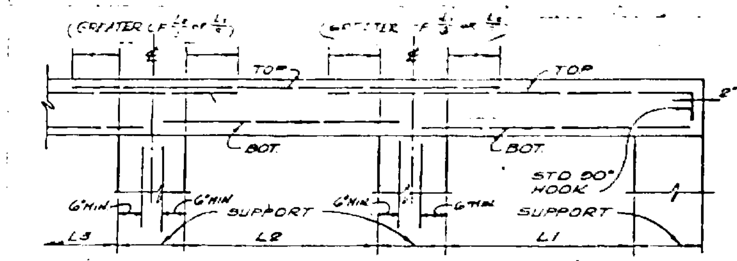
JOIST SCHEDULE

MARK	SIZE W"	SIZE D"	REINFORCING STEEL TOP	TOP L	TOP ✦	BOT ■	BOT		STIRRUPS OR REMARKS NO	SIZE	TYPE	SPACING EA END
JJ1	7	20-4½					2-#10		8	#3	[	6,3@10/
JJ2							1-#7					
JJ3							2-#9					
JJ4							2-#7					
JJ5				2-#5c			2-#5					
JJ6				2-#5c			2-#5					
JJ7				2-#6c			2-#6					
JJ8				2-#5c			2-#8		26	#3		6/12@6/
JJ9				2-#5c		1-#6	1-#6					
JJ10				1-#5c	2-#7	1-#5	1-#5					
JJ11						1-#5	1-#5					
JJ12					1-#9	1-#6	1-#7		20	#3		6/9@10/
JJ13					2-#9	1-#8	1-#8		20	#3		6/9@10/
JJ14				1-#6c	1-#8	1-#8	1-#8		34	#3		6/16@10/
JJ15				1-#6c	1-#7	1-#6	1-#7		14	#3		6,6@10/
JJ16				1-#5c		1-#5	1-#5					
JJ17				1-#5c			1-#7					
JJ18				1-#5c			1-#7					
TYPICAL FLOOR JOISTS												
TJ1	7	20-4½					2-#8		6	#3	[	6,5@10/
TJ2							1-#6					
TJ3							2-#9					
TJ4							2-#7					
TJ5							2-#6					
TJ6							1-#7					
TJ7							2-#8					
LOADING DOCK ROOF JOISTS												
DJ1	7	20-4½		2-#5			2-#6					

FOR TOP✦ BARS - L - GREATER OF 2 ADJACENT SPANS

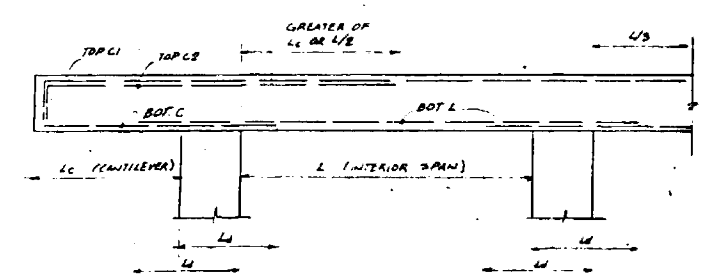


ELEVATION NOTE HOOK ALL STEEL IN TOP AT DISCONTINUOUS



ELEVATION

BAR PLACEMENT DIAGRAMS



ELEVATION

SCHEDULE NOTES

1. BARS MARKED THUS ✦ SHALL BE PLACED IN TOP OF BEAM OR JOIST CENTERED OVER INTERIOR SUPPORT. IF CONTINUOUS AT BOTH ENDS, HALF OF BARS SHALL BE CENTERED OVER EACH SUPPORT.
2. TOP BARS MARKED K SHALL BE PLACED IN TOP OF BEAM CENTERED OVER CORNER SUPPORT. IF CORNER AT BOTH ENDS, HALF OF BARS SHALL BE CENTERED OVER EACH CORNER SUPPORT.
3. BARS MARKED THUS † SHALL BE PLACED IN TOP OF BEAM, JOIST OR SLAB AT DISCONTINUOUS END. IF BEAM OR JOIST IS DISCONTINUOUS AT BOTH ENDS, HALF OF BARS SHALL BE PLACED IN THE TOP AT EACH END. IF SLAB IS DISCONTINUOUS AT BOTH ENDS TOTAL BARS, OF BARS AT INDICATED SPACING, SHALL BE PLACED IN THE TOP AT EACH END.
4. BARS MARKED THUS ■ SHALL BE PLACED IN BOTTOM OF BEAM, JOIST OR SLAB AND CENTERED IN THE SPAN. ALTERNATE LONG AND SHORT BARS IN SLABS.
5. STIRRUPS SHALL BE SPACED FROM FACE OF SUPPORTS.
6. BOTTOM BARS MARKED THUS ▲ SHALL BE PLACED IN TWO LAYERS.

REVISIONS

NO	DATE	DESCRIPTION
	[illegible]	[illegible]
	[illegible]	[illegible]

177

S. I. Morris Associates
ARCHITECTS 3465 WEST ALABAMA HOUSTON, TEXAS

STATE OF TEXAS — WALTER P. MOORE — 136 — REGISTERED PROFESSIONAL ENGINEER
NO. 845

Walter P. Moore & Associates, Inc.
STRUCTURAL ENGINEERS HOUSTON

Chenault & Associates, Inc.
CONSULTING ENGINEERS HOUSTON

THREE RIVERWAY

JOHN HANSEN
INVESTMENT BUILDER

BEAM & JOIST SCHEDULE

DATE
DRAWING NO. S1.6
COMM NO.

APPENDIX V

Field Inspection

CARRIAGE PARK APARTMENT COMPLEX

1. Inter-office report to T. Shipman from X. Arguello
2. Report to R.A. Tash, Ltd. from Walter P. Moore & Assoc.

1. Inter-office report to T. Shipman from X. Arguello

WALTER P. MOORE & ASSOCIATES, INC.
CONSULTING ENGINEERS
2905 Sackett
Houston, Texas 77006

Job Name APARTMENT INSPECTION
180
Architect RONALD A. TASH, LTD.

Job # 78056

TO: TERRY SHIPMAN
FROM: XAVIER ARGUELLO
SUBJECT: REPORT ON STRUCTURAL SURVEY PERFORMED AUGUST 4th AND 5th, 1977 AT CARRIAGE PARK APARTMENT COMPLEX.

THE COMPLEX HAS A TOTAL OF 25 BUILDINGS, INCLUDING 22 TWO-STORY APARTMENT BUILDINGS, 1 THREE-STORY APARTMENT BUILDING, AND 2 ONE-STORY MECHANICAL ROOMS. IT IS DIVIDED INTO NORTH CARRIAGE PARK (16 BLDGS.) AND SOUTH CARRIAGE PARK (9 BLDGS.).

THE EXTERIOR OF ALL BUILDINGS AND SOME OF THE INTERIORS WERE INSPECTED. TYPICALLY ALL EXTERIOR WALLS AT GROUND LEVEL ARE BRICK VENEER, THE SECOND LEVEL EXTERIORS ARE OF WOOD CONSTRUCTION.

OBSERVATIONS:

A. WALLS

NORTH SIDE: MODERATE CRACKING IS VISIBLE IN MOST OF THE BRICK WALLS; THE CRACKS ARE BASICALLY OF TWO TYPES:

1. VERTICAL CRACKING LOCATED IN MIDDLE OF WALL.
2. DIAGONAL AND HORIZONTAL CRACKS AT WINDOW OPENINGS EXTENDING TO NEAREST CORNER.

ONE OF THE BUILDINGS PRESENTS A RELATIVELY LARGE NUMBER OF THESE CRACKS (10). THE REST HAVE AN AVERAGE OF 2 CRACKS PER BUILDING.

SOUTH SIDE: TWO BUILDINGS PRESENT MODERATE CRACKS AT THE LOCATION OF ELECTRICAL PANELS.

IN THE THREE-STORY BUILDING, VERTICAL MODERATE CRACKS ARE VISIBLE IN WALLS AROUND ELEVATOR AND STAIRS.

B. SLABS

NORTH SIDE: MODERATE CRACKING OBSERVED AT

CORNERS OF SLABS ON GRADE.
IN FEW PLACES EROSION DUE TO RAINFALL WAS OBSERVED ON THE GROUND, EXPOSING BOTTOM OF SLAB ON GRADE.

SOUTH SIDE: GENERAL CRACKING (MODERATE) IN SLABS AT CORRIDORS IN THE THREE-STORY BUILDING WERE OBSERVED.

NO VISIBLE CRACKING OF SLABS ON GRADE.

C. STAIRS

ALL STAIRS ARE OF THE LIGHT METAL AND CONCRETE TYPE THROUGHOUT THE COMPLEX; ALL STAIRS EXPOSED TO WEATHER PRESENT A HIGH LEVEL OF CORROSION.

POOR WORKMANSHIP WAS OBSERVED AT PIPE COLUMN SUPPOR[illegible]

D. ROOF

EVIDENCE OF LEAKING WAS FOUND IN ALMOST ALL INTERIORS INSPECTED. THE EXTENT OF POSSIBLE DAMAGE TO THE WOODEN STRUCTURE SUPPORTING THE ROOF COULD NOT BE DETERMIN[illegible] DUE TO ITS CONCEALED NATURE.

E. GENERAL

PIPE COLUMNS SUPPORTING CORRIDORS IN THE THREE-STORY BUILDING AND COOLING TOWER IN NORTH MECHANICAL ROOM ARE HEAVILY CORRODED AT BASE.

RETAINING WALL AT DRIVEWAY, WEST OF NORTH SIDE SWIMMING POOL WAS OBSERVED IN POOR CONDITION.

CONCLUSION:

ALL CRACKS OBSERVED IN WALLS AND SLABS ARE OF NON-STRUCTURAL CHARACTER.

FROM WHAT COULD BE OBSERVED, THE BUILDINGS ARE STRUCTURALLY SAFE.

PRESENCE OF TERMITES WAS REPORTED, BUT NO EVIDENCE OF STRUCTURAL DAMAGE WAS FOUND.

2. Report to R.A. Tash, Ltd from Walter P. Moore & Assoc.

...TER P. MOORE AND ASSOCIATES INC. *CONSULTING ENGINEERS 2905 SACKETT STREET HOUSTON, TEXAS 77098 (713) 526-5641*

TO: Ronald A. Tash, Ltd.

SUBJECT: Report on Structural Survey Performed August 4th and 5th, 1977 at Carriage Park Apartment Complex, Houston, Texas

The complex has a total of 25 buildings, consisting of 22 two-story apartment buildings, 1 three-story apartment building, and 2 one-story mechanical buildings. It is divided into North Carriage Park (16 buildings) and South Carriage Park (9 buildings).

The exterior of all buildings and some of the interiors were inspected. Typically all exterior walls at ground level are brick veneer.

The following observations were made:

1. Walls

   A. Northside - Moderate cracking is visible in most of the brick walls. The cracks are basically vertical cracks located in the middle of the wall, and diagonal and horizontal cracks at window openings. One of the buildings has a relatively large number of these cracks (10). The remainder have an average of two cracks per building.

   B. Southside - Two buildings have moderate cracks at the location of the electrical panels. The three-story building has cracks in the walls around the elevator and stairs.

   The cracks in the brick indicate some foundation movement. These cracks are probably caused by expansion of the clay soils due to seasonal changes in the moisture content of the soil. This condition is quite prevalent in many parts of Houston that have expansive clays. The cracks could also be due in part to temperature stresses.

   The cracks do not indicate any serious structural damage and are only cosmetic in nature. The cracks should be patched to prevent moisture penetration and can be done at a small cost. In general, the brick and mortar appear to be in good condition.

2. Slabs and Grade Beams

   A. Northside - Moderate cracking was observed at the corners of slab on grade and grade beams. These cracks are due to the placement of the reinforcing bars. They are cosmetic in nature and do not affect the structural integrity of the foundation system. They can be repaired at a small cost.

In a few locations, erosion due to rainfall has exposed the bottom of the grade beam. This does not affect the grade beam but should be filled in to prevent further erosion.

B. Southside - In the three-story building, moderate cracks in the slab on grade were observed in the corridors. The corridors are exposed to the weather, and these cracks are only cosmetic in nature and do not present any serious structural consequence.

3. Stairs
All stairs are of the light metal and concrete type. Stairs exposed to the weather exhibit a high level of corrosion. This is quite normal for areas of Houston where air pollution tends to be a little more concentrated than normal. The project is in such an area because of its proximity to the ship channel. The stairs should be repaired and probably can be done by the maintenance staff.

4. Roof
Evidence of leaking was found in almost all interiors inspected. The extent of possible damage to the wooden structure supporting the roof could not be determined due to its concealed nature. It is our opinion that any structural damage would be minor.

5. General
Some pipe columns supporting the corridors in the three-story building and the cooling tower in the North Mechanical Room are corroded. This could be repaired by the maintenance staff.

The presence of termites was reported in six buildings, but there was no evidence of structural damage.

6. Conclusion
In general, the buildings are structurally sound and should not present any major structural problems in the near future. The stairs and pipe columns that are corroded should be repaired.

Submitted by:

WALTER P. MOORE AND ASSOCIATES, INC.

Terry G. Shipman

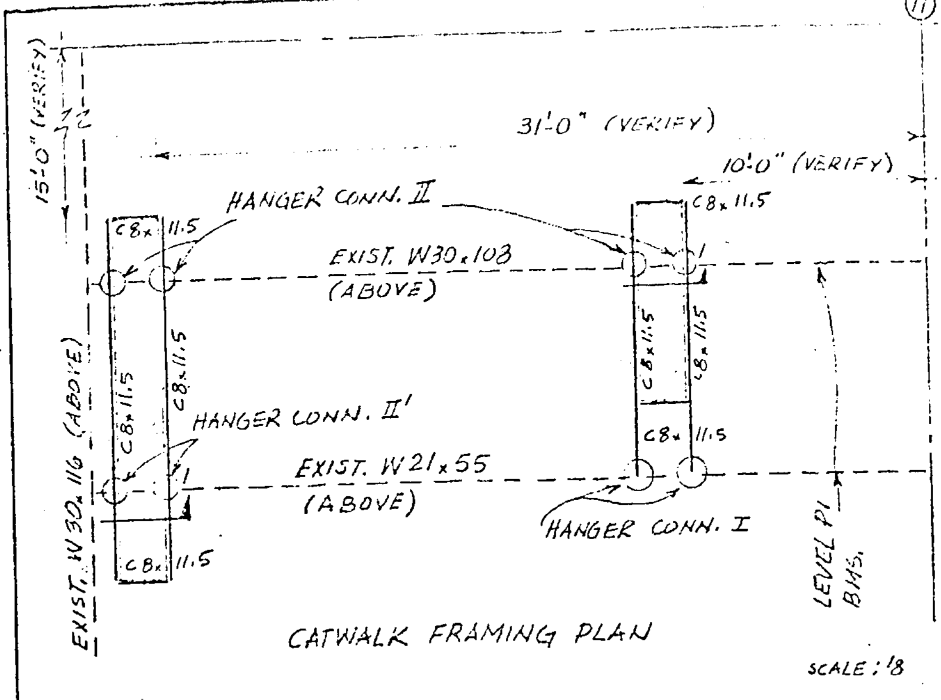
Terry G. Shipman, P.E.

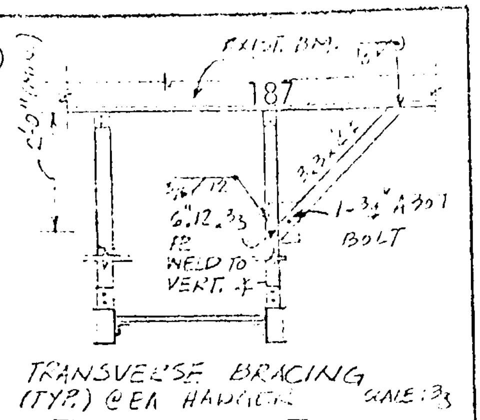
APPENDIX VI

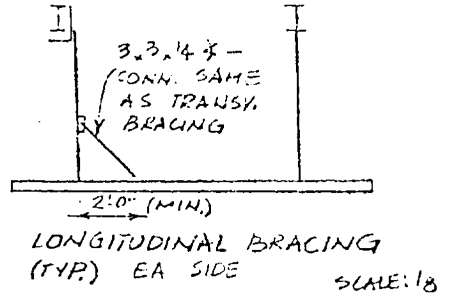
Structural Additions and Remodeling of Existing Buildings

1. Structural drawings
2. Memorandum to K. Zimmerman and response

1. Structural drawings



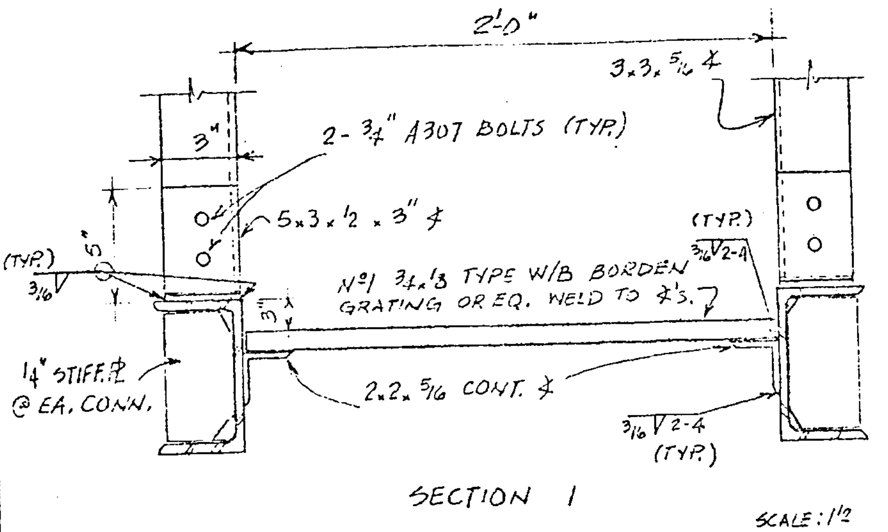


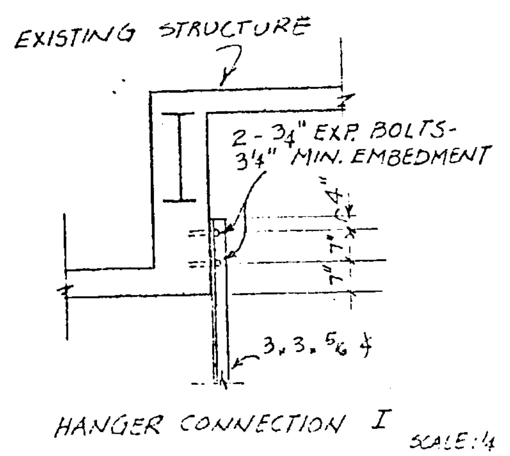


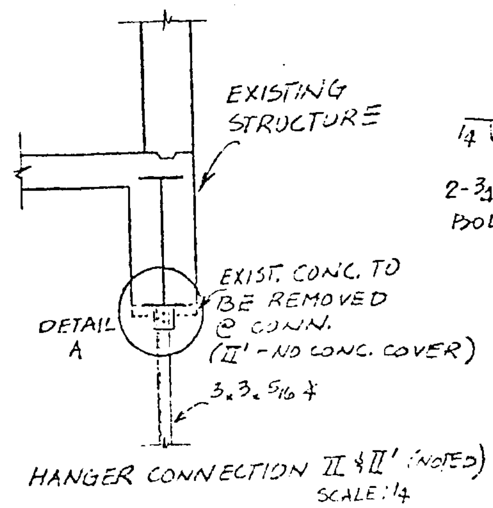
NOTES :

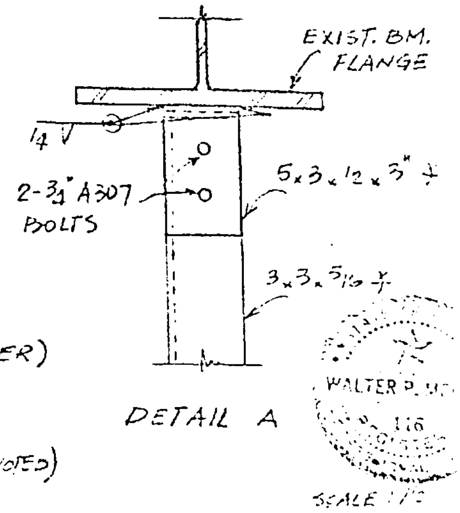
1.- ALL STR. STEEL SHALL BE A36

2.- ALL DIMENSIONS SHALL BE FIELD-VERIFIED









TITLE CATWALK FRAMING - WINE & CHEESE VILLA LEVEL M1 IHC	REVISION / DATE / BY
WALTER P. MOORE & ASSOCIATES, INC. CONSULTING ENGINEERS	DRAWN XAC; CHECKED LG; APPROVED; DATE 2/13/75 — SHEET NO. S1
2905 SACKETT STREET HOUSTON, TEXAS 77006	

2. Memorandum to K. Zimmerman and response

MEMORANDUM

May/2/78

TO: Ken Zimmerman

FROM: Xavier Arguello

RE: Suggestions for improvement in our methods of design and detailing.

A. The number of jobs involving additions, repairs and revisions of existing structures represent not a small percentage of the total jobs our firm gets. I would like to present a suggestion derived from my involvement in several jobs of this type: It is quite common to specify in our drawings, welding of cover plates, hangers, stiffner plates, connection plates, etc. to existing structural elements that are stressed. We should include in our "Check List of Problem Items" a provision calling to the attention of our engineers the potential problems that may occur due to the reduction in effective area caused by welding temperatures in the stressed member. (i.e. welding stiffner plates on midspan of a simply supported beam could create a collapse mechanism). Connections to existing stressed members can be performed without problems if one is aware of this and applies sound engineering judgement.

B. In our typical stick-on detail: "Typical Block Lintel Details", the note for the two course block lintel reads: "openings 5 ft. wide or greater". I recommend including in the note an upper bound limiting the opening length. I feel that this will clarify our detail preventing misinterpretations.

Walter P. Moore and Associates, Inc.
Consulting Engineers and Planners

K. E. Zimmerman, P.E.
Vice Chairman of the Board

May 19, 1978

Mr. Xavier Arguello
2905 Sackett Street
Houston, Texas 77098

Dear Xavier:

Your suggestions of May 2 were presented to the Executive Committee on May 10 and discussed. While the content of your suggestions are items that have heretofore been orally brought to the attention of our group leaders, your comments suggested that if it really gets effective it should be put in written form. Lee Jones will have a memorandum regarding the items out shortly.

The Committee appreciated your concern regarding the items mentioned, and thanks you for submitting them. The enclosed check is a token of appreciation for your thoughtfulness.

Yours very truly,

WALTER P. MOORE AND ASSOCIATES, INC.

K. E. Zimmerman

KEZ:md

Walter P. Moore and Associates, Inc.
Consulting Engineers and Planners

MEMO

DATE: MAY 25, 1978

TO: ALL STRUCTURAL PERSONNEL

FROM: LEE W. JONES

Xavier Arguello has made several suggestions that all of us should have been aware of, but they are worthy reminders.

1. Caution should be used when welding to existing steel members. Sound engineering judgement should be exercised when welding to stressed members since the welding temperatures may reduce the member capacity.

2. Our typical two course block lintel detail reads "For openings 5 Ft. wide or greater." With various loading conditions it is not appropriate to set an upper span limit for this lintel. We should however insure that the larger openings on each project are provided with adequate lintels.

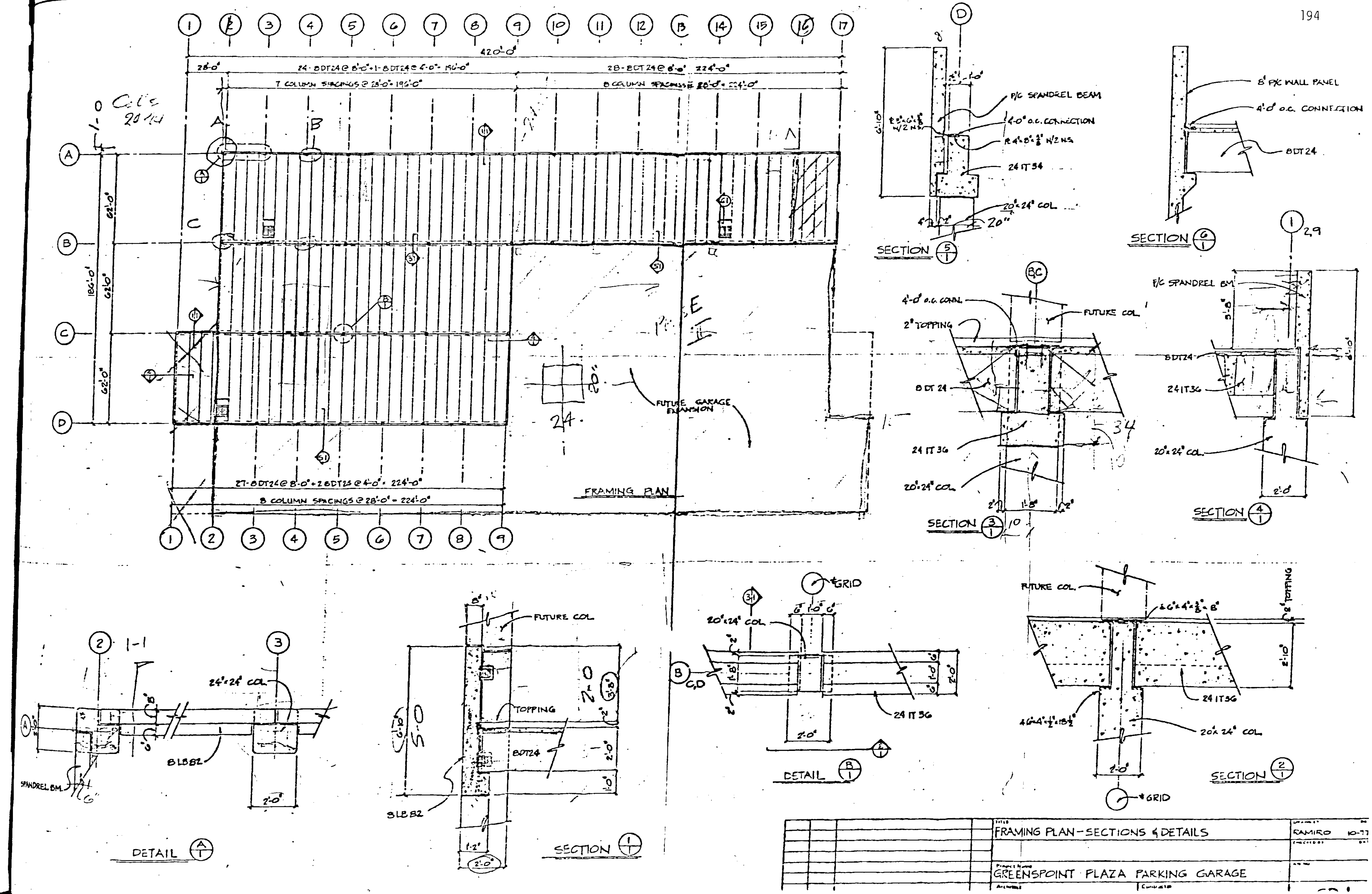
3203 West Alabama, Houston, Texas 77098 • (713) 525-7300 • TWX 910-881-4827

APPENDIX VII

Revision of Design and Shop Drawings

1. Framing plan and sections
2. Revision of precast system

1. Framing plan and sections


420'-0"
28'-0"
24-8DT24 @ 8'-0" + 1-8DT24 @ 4'-0" = 196'-0"
28-8DT24 @ 8'-0" = 224'-0"
7 COLUMN SPACINGS @ 28'-0" = 196'-0"
8 COLUMN SPACINGS @ 28'-0" = 224'-0"
186'-0"
62'-0"
FUTURE GARAGE EXPANSION
27-8DT24 @ 8'-0" + 2-8DT24 @ 4'-0" = 224'-0"
8 COLUMN SPACINGS @ 28'-0" = 224'-0"
FRAMING PLAN
P/C SPANDREL BEAM
4'-0" o.c. CONNECTION
24 IT 34
20"x24" COL
SECTION 5/1
8" P/C WALL PANEL
4'-0" o.c. CONNECTION
8DT24
SECTION 6/1
4'-0" o.c. CONN.
2" TOPPING
FUTURE COL
8DT24
24 IT 36
20"x24" COL
SECTION 3/1
P/C SPANDREL BM
8DT24
24IT36
20"x24" COL
SECTION 4/1
24"x24" COL
8LB82
SPANDREL BM.
DETAIL A/1
FUTURE COL
TOPPING
8DT24
8LB82
SECTION 1/1
GRID
20"x24" COL
24 IT 36
DETAIL B/1
FUTURE COL.
2" TOPPING
24 IT36
20"x24" COL
SECTION 2/1
GRID
FRAMING PLAN - SECTIONS & DETAILS
RAMIRO 10-77
GREENSPOINT PLAZA PARKING GARAGE

2. Revision of precast system

WALTER P. MOORE & ASSOCIATES, INC.
CONSULTING ENGINEERS
2905 Sackett
Houston, Texas 77006

PRECAST DESIGN - REVISION

- USE LIGHTWEIGHT TOPPING ON DOUBLE TEE ✓ O.K.

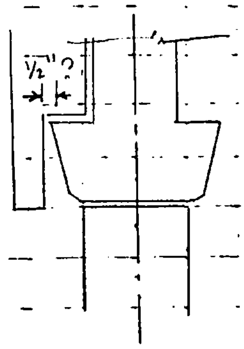
DL 20PSF

- f'_c = 5500 psi WAS USED IN DESIGN FOR DT'S (OUR NOTES CALL FOR 5000) ✓

Notes:

① IT SHIFTED 1/2"

② IT SHIFTED 2½" ✓O.K. (SEE ①)

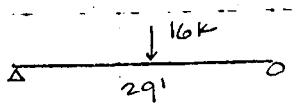


- DIMENSIONS O.K. ✓

- DIFFERENT ARRANGEMENT OF DT'S O.K. ✓

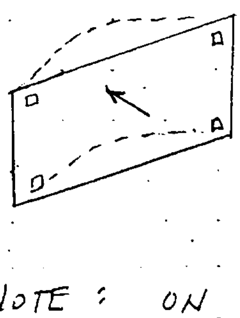
- STAIRWELL DIMENSIONS AND LOCATION O.K. ✓

- NOTE: PANELS SUPPORTED ON IT NOT SHOWN ON SHOP DRAWINGS AS DESIGNED, PLATES AT ENDS ONLY: WHEN BUMPER LOAD ACTS, THE FLEXURAL ACTION WILL BEHAVE WITH $d \simeq 7"$

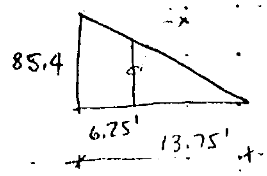


$M = 16^k \times 29 \times 12 / 4 = 1392^{k\text{-}in}$ K = 418 ρ = .82% $A_s = 3.91 \, in^2$

STEEL PROVIDED:
(0.1)(5.67) = 0.57 in^2 NO GOOD



- NOTE: ON L BEAM, SHEAR STRESS DUE TO TORSION & TO DIRECT SHEAR WERE NOT COMPUTED PROPERLY



$x = \frac{85.4 \times 7.5}{13.75} = 47$ psi

WALTER P. MOORE & ASSOCIATES, INC.
CONSULTING ENGINEERS
2905 Sackett
Houston, Texas 77006

Job Name: GREENSPOINT GARAGE
197

Architect:

Job #

DOUBLE TEE REVISION

$L = 60.83'$

(A) INITIAL PRESSTRES : (AT MIDDLE)

loss due to elastic shortening

$$\sigma_{TOP} = \frac{(2)(173460)}{401} - \frac{(2)(173460) \times 12.68}{3063.5} = (-570.8 \text{ psi})(0.9) = -513.7 \text{ (TENSION)}$$

$$\sigma_{BOT} = \frac{(2)(173460)}{401} + \frac{(2)(173460) \times 12.63}{1223.6} = 4460 \text{ psi} \times 0.9 = 4014.0 \text{ (compression)}$$

(B) INITIAL PRESSTRES PLUS BM WEIGHT :

$$M_{Dw} = 418 \times 60.83^2 \times 12/8 = 2{,}320{,}000 \text{ \#-in}$$

$$\sigma_{TOP} = -513.7 + \frac{2320000}{3063.5} = 243.6 \text{ psi (compression)}$$

$$\sigma_{BOT} = 4014.0 - \frac{2320000}{1223.6} = 2118 \text{ psi (compression)}$$

Allowable compression (ACI 18.4.1) :

$0.6 f'_{ci} = 0.6 \times 3500 = 2100$ ok.

(C) STRESSES AFTER 22% losses + WEIGHT OF TOPPING

$M_{TOPPING} = 160 \times 60.83^2 \times 1\ldots = 888{,}070$

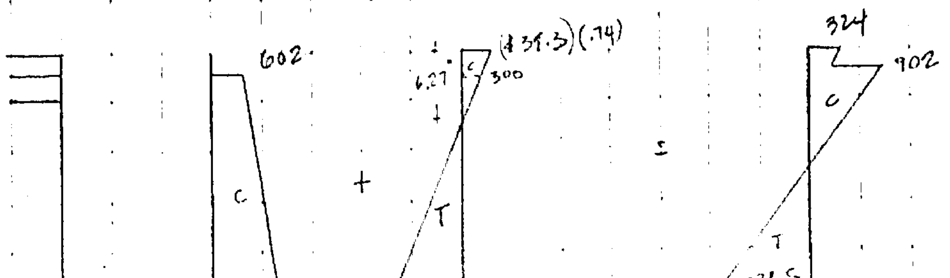
$$\sigma_{top} = (-570.8)(0.78) + \left[2320000 / 3063.5\right] + \left[888070 / 3063.5\right] = 602 \text{ psi}$$

$$\sigma_{BOT} = (4460)(0.78) - \left[2320000 / 1223.6\right] - \left[888070 / 1223.6\right] = 857 \text{ psi}$$

(D) STRESSES DUE TO L.L. (composite section)

$$\sigma_{TOP(composite)} = \frac{M_L}{S_{TOP(comp)}} = \frac{320 \times 60.83^2 \times 12/8}{4042.1} = 439.3 \text{ psi}$$

$$\sigma_{BOT(composite)} = \frac{M_L}{S_{BOT(comp)}} = \frac{1776200}{1431.8} = 1240.5 \text{ psi}$$



APPENDIX VIII

Other Professional Development Activities

A. Excerpts of a seminar conducted at Walter P. Moore & Assoc.

B. AISC seminar, certificate of completion

A. Excerpts of a seminar conducted at Walter P. Moore & Assoc.

Some Aspects of the Structural Damage Caused by the 1972 Managua, Nicaragua Earthquake

The Structural Engineers Association of California (SEAOC), establishes provisions for earthquake-resistant structures in their "Recommended Lateral Force Requirements and Commentary", which are adopted by most of the major building codes in the Western Hemisphere. They state that: "With regard to earthquakes, structures designed in conformance with the provisions and principles set forth herein should, in general, be able to: 1. Resist minor earthquakes without damage, 2. Resist moderate earthquakes without structural damage, but with some non-structural damage, and 3. Resist major earthquakes, of the intensity of severity of the strongest experienced in California, without collapse, but with some structural as well as non-structural damage."

The 1972 Managua earthquake can be classified as a moderate earthquake. The intensity of shaking in the city was established to be around VII to VIII in the Modified Mercalli scale with high shaking zones of IX to X (out of a maximum of XII). Maximum accelerations recorded were of 0.39 g East-West, 0.34 g North-South, and 0.33 g vertical; it was established that at least in one zone the vertical acceleration reached the value of gravity (1 g.) (see: Saint-Amand, Pierre; "The Seismicity and Geologic Structure of the Managua, Nicaragua Area"; Managua, Nicaragua earthquake of December 23, 1972 Earthquake Engineering Research Institute conference proceedings).

It was established that the total damage caused by the earthquake amounted to about 30% of the nation's gross national product. Around 8000 people were killed, 20,000 injured, and the property damage exceeded a billion U.S. dollars (see: Duke, Martin C.; "Impact of Managua on Earthquake Engineering"; Managua, Nicaragua earthquake of December 23, 1972, Earthquake Engineering Research Institute, conference proceedings).

Damage in Managua was related to the type and quality of construction, to the intensity of shaking, and to fault lines. In Photos 1, 2, and 3, we can appreciate obvious examples of neglect of provisions for resistance to lateral forces.

In Photos 4 and 5 permanent deformations are observed due entirely to first floor distortions beyond the elastic limit. The upper floors are undistorted due to the fact that once the strength of the "weak" first floor is reached, the upper floors are isolated to a great extent from the ground-induced forces. Notice in Photo 4 that the failure actually occurred in the direction of the weak axis of the portal frames. In photo 5, notice how the second and third floors are intact, even the glass pa es are in place!

Weak parts of a structure may be attributable to underdesign of that part of the structure, and/or overdesign of other parts of the structure. In earthquake-prone areas, danger exists both from understrong and overstrong elements. Photo 6 presents a close-up of one of the failed first floor columns of the building shown in photo 5. The effective length of this column has been reduced by the presence of the masonry walls, confining its lower half portion, this creates an unnoticed stiffer element which attracts greater forces and which doesn't have the strength to resist them; notice the far spacing of the stirrups and their size.

The occurrance of the type of failure caused by understrong elements in structures has been thoroughly studied, a proposed design taking advantage of the weak first floor has been set forth by M. Fintel and

F. Khan: "Shock-Absorbing Soft Story Concept for Multistory Earthquake Structures", Portland Cement Association.

The author had the opportunity of participating in the structural inspection of the repairs performed on the building shown on Photo 5; it consisted basically of carrying reinforced concrete piers from the foundation to the roof in the same location of existing columns. This way the structure was strengthend without creating additional weak spots.

Photo 7 presents the damage caused to a building which had been repaired from previous earthquake damage (1968). The new damage occurred at the abrupt change in stiffness in the second floor level, up to where strengthening had been carried when repairing the 1968 damage. After the 1968 earthquake, the first floor which was damaged then, was strengthened by forming reinforced concrete piers carried to the second floor; and thus inadvertedly transfering the original weakness to that floor. Photo 8 shows a close-up of the abrupt change of stiffness and the damage concentrated there.

In Photo 9, overturning failure in the strong axis of the portals can be observed, this view presents the failed tension-side, Photo 10 shows a crushed column on the failed compression-side. This building obviously had no provision for resistence of large lateral forces.

An example of damage due to inadverted stiffness provided by infills in frames, without the sufficient strength to resist the forces induced, is presented in Photo 11. The main structure of this building, a reinforced concrete frame system did not suffer major damage but the "non-structural" damage was rather high. In seismic areas, due consideration has to be given to the behavior and interaction of non-structural elements, as well of course to the structural elements.

Conditions such as the one presented in Photo 12 are quite prevalent in building-congested downtown areas; in this particular case an adjacent building stiffened the bottom story levels of the six story building causing damage at the externally-originated abrupt change in stiffness.

Photo 13 presents an example of poor detailing and/or poor workmanship. The connections of the heavy precast concrete roof slabs failed in each and every dwelling of this housing project; upon close examination of the failed slabs, only tack welds were observed to have been provided as connection to the walls.

Finally, Photo 14 presents two medium-rise buildings, both of reinforced concrete but the one to the left, the "Banco de America" building withstood the earthquake very well while the one to the right, the "Banco Central" building fared poorly. The "Banco de America" building had a much stiffer structure which relied on shear wall-frame interaction for the resistance to lateral forces, in addition to having a sysmmetric plan. The "Banco Central" building had a flexible frame system resisting lateral forces, when the frames deformed, most of the "non-structural" partitions were damaged; in fact damage was so heavy that even though the main structure was undamaged it was determined that the cost involved in its repair would exceed the benefits of putting it back in operation. This building also had an unsymetric distribution of stiffness in-plan; as of today it has already been demolished.

Photo 1

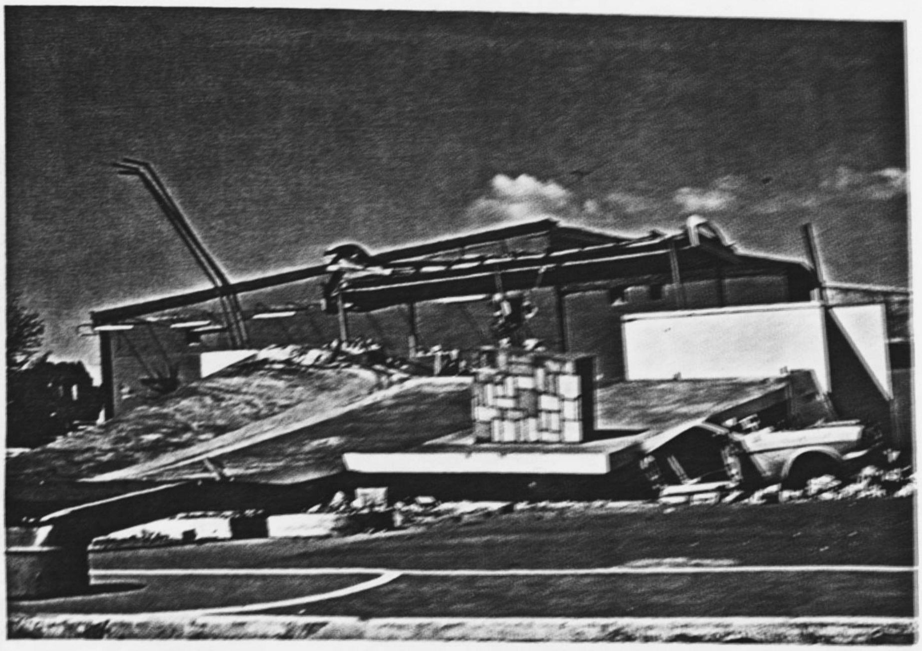


Photo 2

Photo 3

Photo 4

Photo 5

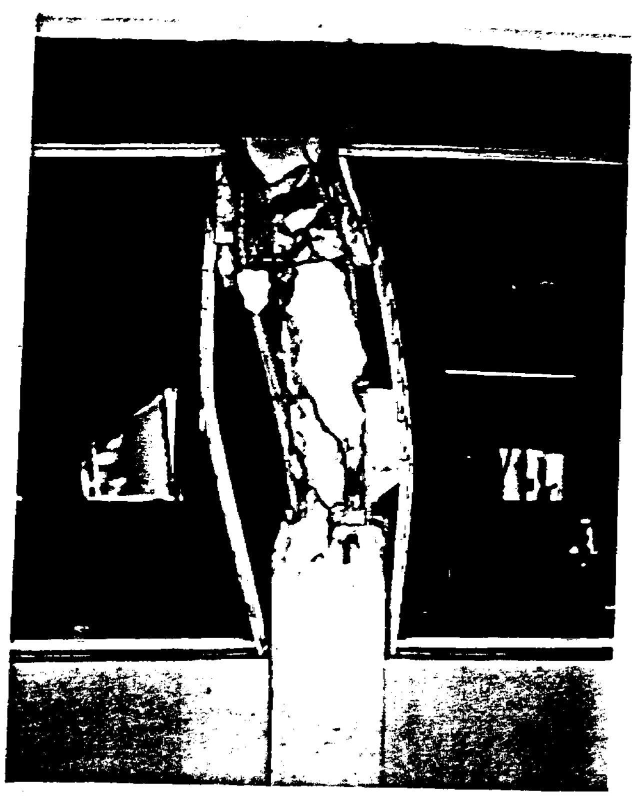


Photo 6

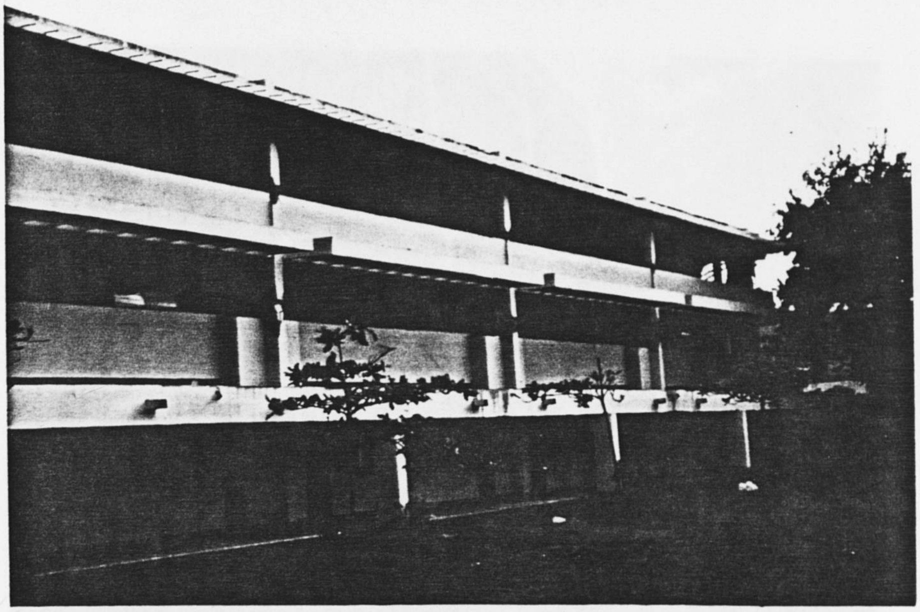


Photo 7

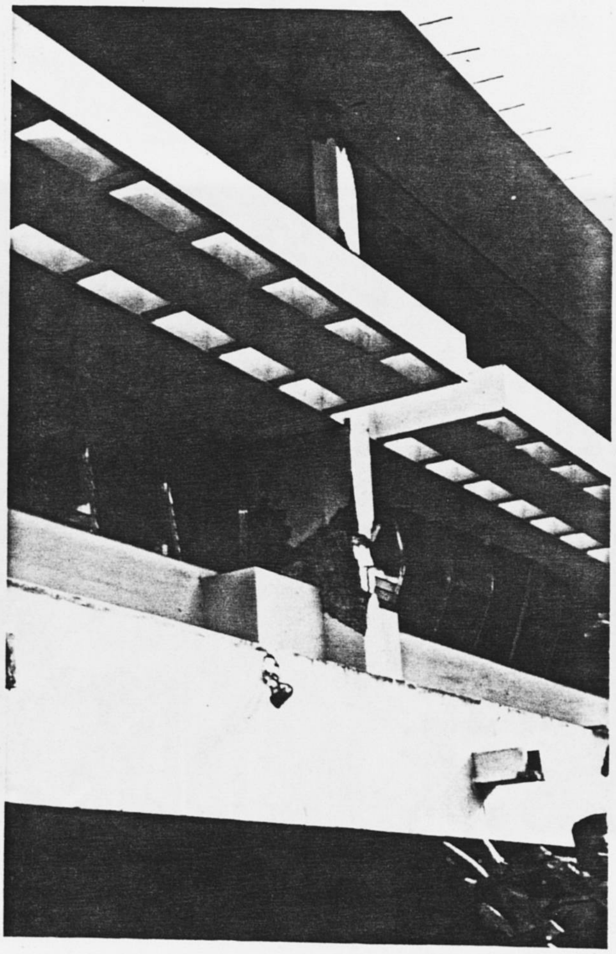


Photo 8

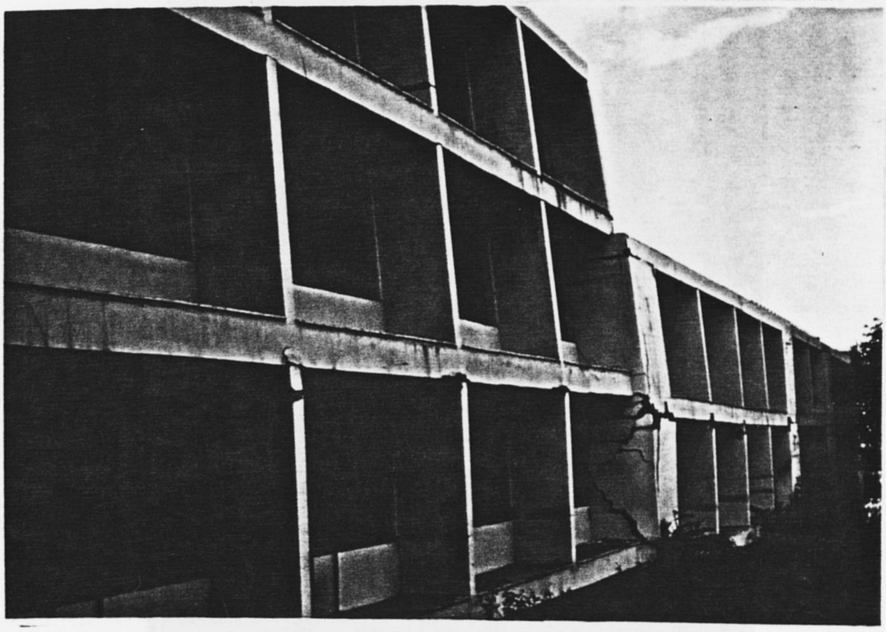


Photo 9

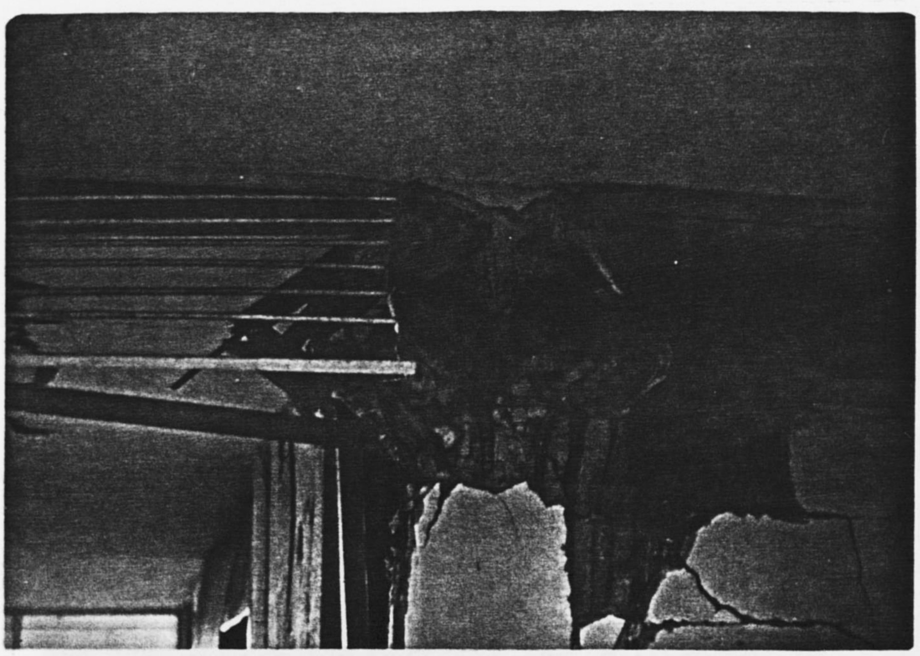


Photo 10

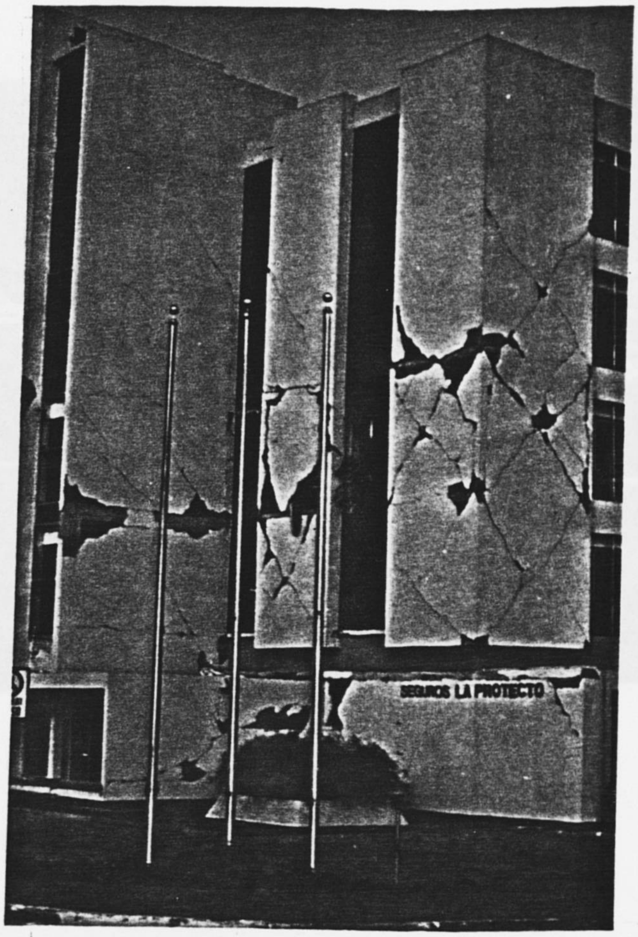


Photo 11

Photo 12

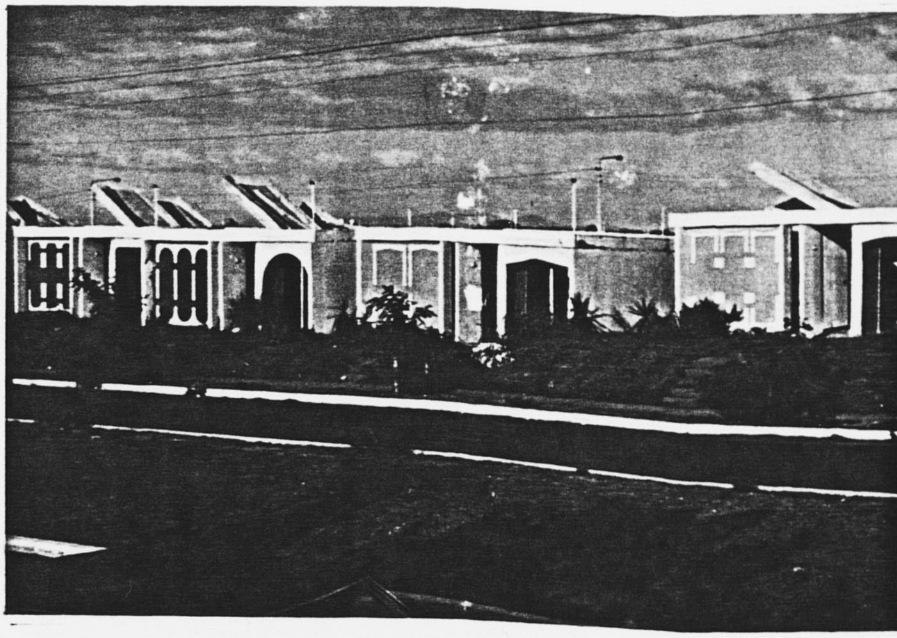


Photo 13

Photo 14

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Regional Engineer

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Date

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VII. Vita

Francisco Xavier Arguello Carazo was born on August 6, 1953 in Guatemala, Central America; his parents being Felipe and Lola Arguello Bolanos, he is married to Olga A. Arguello and has four children. He received the degree of Civil Engineer in August of 1975 from the National University of Nicaragua, Central America, and a Master of Science degree in May of 1977 from Rice University in Houston, Texas, with a major emphasis in structural engineering. While in Nicaragua, he acquired three years of experience in engineering, working one and a half years for a consulting engineering firm: Federico Fiedler & Assoc., and one and a half years for an agricultural development firm: Arrocera Venllano S.A. He has fifteen months consulting engineering experience at Walter P. Moore & Associates, in Houston, Texas. His permanent mailing address is: P.O. Box 645, San Pedro Sula, Honduras, Central America.

The typist for this report was Olga A. Arguello.