AUSTIN'S ADOPTION OF ASHRAE S.P. #41 INTO THE LOCAL ENERGY CODE

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ABSTRACT

The City of Austin amended the local Energy Code in December 1984 to incorporate the principal recommendations of ASHRAE Standard Project #41. Revisions to the Code were recommended by a special Task Force appointed by the City Council; Task Force members represented major elements of the construction industry and local community. The Code revisions were reviewed and supported by numerous local City boards and commissions after nearly a year's work by the Task Force.

Principal changes effecting commercial construction involved deleting OTTV criteria and adding three new criteria:

1. Wall heating criteria
2. Wall cooling criteria
3. Peak cooling criteria

The new envelope criteria makes adjustments for building geometry, orientation, shading, insulation, lighting power and controls. A performance index encourages good design by increased awareness of what factors make a difference. The new lighting code methodology is based upon specified watts per square foot for different tasks and gives credit for ceiling height and room size. Cooling equipment efficiencies were increased by 5 to 15%. Pipe and tank insulation levels were raised and a variety of minor control modifications were added.

This paper discusses the code changes related to commercial building envelopes and lighting system.

INTRODUCTION

In April 1983, the Austin City Council set a goal of reducing the energy use by 50% in new buildings by 1985. The new building code provisions represent the only mandatory aspect of a multi-facet program that includes rebates and incentives. Analysis of the proposed changes indicate approximately 20-25% savings over the old energy code (ASHRAE 90A-1980) for typical commercial buildings. While several significant changes were made to the residential code, this paper will only address changes impacting commercial buildings. The commercial sub-committee's goal was to take the best thinking and recommendations on a national level and have the changes put in place locally in a timely manner.

APPROACH

The commercial sub-committee of the Building Code Task Force investigated the work underway on a national level to update ASHRAE Standard 90. Draft copies of the ASHRAE Standard Project #41 were obtained from Battelle Pacific Northwest Laboratory, the prime contractor for DOE. Eight months were spent reviewing the revisions chapter by chapter during weekly meetings. Substantially all of the changes in the S.P. #41 draft documents were incorporated into the committee's recommendations. Several public hearings were held to receive public comments. After the public hearings, presentations were made to all relevant City boards and commissions in addition to many professional and trade associations.

The time table for amending ASHRAE standards and National model codes moves very slowly. The 1983 recommendations in the Battelle report will most likely be incorporated in the Uniform Building Code in 1988 and therefore not be enforced on a local level until 1989. With the rapid growth of the Austin area, four years of code enforcement will have a major impact on the energy efficiency of the local building stock.

A variety of minor changes to the energy code were implemented including increasing the required air conditioning equipment efficiencies, and increasing insulation of piping and hot water tanks. This paper will only address the two major areas of change:

1. Building Envelope
2. Lighting

Principal changes to the envelope section of the Code involved deleting the Overall Thermal Transfer Value (OTTV) criteria and adding three new criteria:

1. Wall heating compliance
2. Wall cooling compliance
3. Peak cooling compliance

The new envelope criteria considers building geometry orientation, shading, insulation, lighting power and controls. Each of the three criteria are evaluated by calculating three sub-components that impact energy efficiency:

1. Conduction Loss/gain
2. Solar gain
3. Lighting load

Proceedings of the Second Symposium on Improving Building Systems in Hot and Humid Climates, College Station, TX, September 24-26, 1985

The compliance values for the three required envelope criteria are calculated by using three variables:

1. Lighting power diversity (watts/sq.ft.)
2. Faction of wall glazed
3. Ratio of wall to floor sq. ft.

Nomagraphs are provided in the code to allow a quick graphical lookup of the compliance criteria.

The impacts of varying the building geometry and orientation are shown in the following example.

The example building is a small lease space in a strip center. The building thermal characteristics can be described by the following wall areas and insulation levels.

	Area Sq. Ft.	U_o	Shading Factor
North Wall	175	.026	
North Glass	375	1.1	-.69
East Wall	600	.001	
East Glass	0	N/A	
South Wall	450	.026	
South Glass	100	1.1	.69
West Wall	600	.001	
West Glass	0		

The example building is 60 feet by 55 feet or 3,300 square feet. The east and west wall are common to other lease space and therefore have no glass and very high effective insulation levels.

To demonstrate the impact of the code on alternative building configurations, Table 1 has been developed with the following changes:

1. Base Case
2. 90 degree rotation
3. Aspect ratio adjustment to allow 40 foot depth. Same square footage, but change the length to width ratio from 1.09 to 2.06
4. Rotated plus aspect ratio changed

If the building fails to meet any of the three compliance criteria, it has to be redesigned or be submitted under Chapter 4, the annual energy analysis alternative compliance section of the code.

In the example problem, the base case passes all the criteria. When the building is rotated 90 degrees clockwise, the project fails to meet the wall cooling or peak cooling critera.

In the third case, the base case was changed to increase the aspect ratio (length/width) from 1.09 to 2.06 by decreasing the depth to 40 feet. The same ratio of window to wall area was maintained. The results compare favorably with the Base Case; however, the project fails to meet the wall heating and wall cooling criteria. The failures are modest and this building concept could be slightly modified to reach compliance. By noting which of the conduction, solar and lighting components govern any specific design, the designer can direct attention at a specific area to gain compliance. The fourth case shows the example building rotated 90 degrees with an elongated aspect ratio. This is clearly the worst design with the building failing in the wall cooling and peak cooling categories by a large margin.

TABLE 1
COMPARISON OF ENVELOPE CRITERIA
AS BUILDING DESIGN CHANGES

BASE CASE

COMPLI CATEG.	CONDUC.	SOLAR	LIGHT		BLDG. CODE COMPLI VALUE		CODE COMPLI CRITER. VALUE	PASS FAIL
Wall Heating	4.65	-0.71	-1.87	=	2.07	≤	2.91	PASS
Wall Cooling	7.16	10.23	18.84	=	36.23	≤	36.25	PASS
Peak Cooling	4.83	8.01	7.04	=	19.88	≤	25.54	PASS

ROTATE 90 DEGREES

COMPLI CATEG.	CONDUC.	SOLAR	LIGHT		BLDG. CODE COMPLI VALUE		CODE COMPLI CRITER. VALUE	PASS FAIL
Wall Heating	3.73	-1.00	-1.88	=	0.85	≤	2.91	PASS
Wall Cooling	9.93	21.23	18.84	=	50.00	≤	36.25	FAIL
Peak Cooling	8.07	15.82	7.04	=	30.92	≤	25.54	FAIL

ASPECT RATIO CHANGED

COMPLI CATEG.	CONDUC.	SOLAR	LIGHT		CODE COMPLI VALUE		COMPLI CRITER. VALUE	PASS FAIL
Wall Heating	6.54	-1.00	-1.89	=	3.65	≤	3.11	FAIL
Wall Cooling	10.07	14.42	18.84	=	43.33	≤	38.75	FAIL
Peak Cooling	6.79	11.29	7.04	=	25.12	≤	27.57	FAIL

ROTATE 90 DEGREES PLUS ASPECT RATIO CHANGED

COMPLI CATEG.	CONDUC.	SOLAR	LIGHT		CODE COMPLI VALUE		COMPLI CRITER. VALUE	PASS FAIL
Wall Heating	5.24	-1.41	-1.85	=	1.98	≤	3.11	PASS
Wall Cooling	13.98	29.92	18.84	=	62.74	≤	38.75	FAIL
Peak Cooling	11.36	22.29	7.04	=	40.68	≤	27.57	FAIL

The lighting code was changed by deleting the IES lumen method and replacing it with a simplified lighting power budget utilizing watt/sq. ft. budgets for different types of areas. The old method was too complex for most people in the construction trades and subject to abuse in interpretation of subjective items regarding lighting quality and color. The new power density standard is simple for contractors and building managers. The new standard has adjustments for room size and ceiling height. The simple procedure is particularly valuable for speculative building with future lease finish out because the lighting systems are typically not engineered.

Table 2 shown below compares the allowable lighting for the example Branch Library project.

The new lighting code provides for higher lighting wattage for exterior areas; however, interior lighting is reduced by 10-15%. In the Branch Library example the total lighting power allowed is approximately 10% less for the new procedure. The greater simplicity in evaluating code compliance and checking implementation in the field should greatly increase the effectiveness of the new lighting code.

SUMMARY

The new energy code in Austin offers the designers new flexibility and performance index guidelines for new buildings. The recommendations from ASHRAE Standards project #41 is being field tested by the City of Austin and should provide valuable experience for other communities that adopt energy codes based upon future revisions of ASHRAE Standard 90.

TABLE 2

COMPARISON OF LIGHTING POWER BUDGETS
BRANCH LIBRARY EXAMPLE 8,540 SQ. FT.

	OLD CODE WATTS	OLD CODE WATTS /SQ. FT.	NEW CODE WATTS	NEW CODE WATTS/ SQ. FT.	PERCENT REDUCED
INTERIOR	15,048	1.76	13,246	1.55	11.9%
EXTERIOR	3,025	.35	3,320	.39	-9.7%
TOTAL	18,373	2.11	16,566	1.94	9.8%