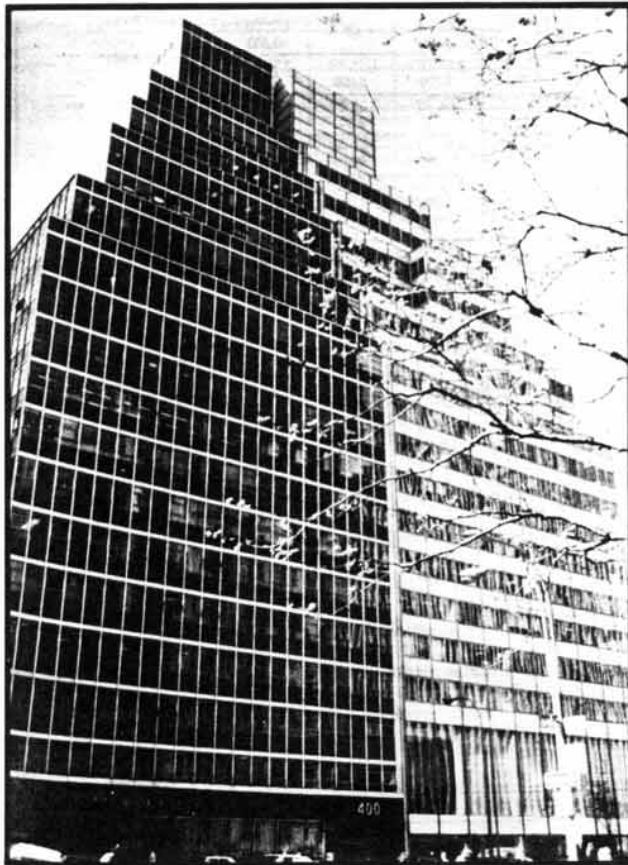


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Chapter 7

BUILDING CODES AND ZONING ORDINANCES



In a complex society, regulation is one of the facts of life. The buildings in which people live, work, and play are subject to many controls. Local and regional government agencies have been established to protect the public and the environment from dangerous and undesirable conditions that sometimes occur when man-made structures are erected, and the result is innumerable building codes and zoning ordinances. In the United States, these rules and regulations can vary from community to community, but all are based on fundamental construction methods necessary to protect public safety and welfare.

BUILDING CODES

Building codes not only affect the selection of the materials that an architect uses to build a structure; they can influence the size and shape of the building as well. For example, depending upon how fire-resistant the selected construction materials are, the codes will permit different maximum areas per floor and different total numbers of floors for the building.

The impact of the relationship between building materials and the size of a building can be most easily demonstrated by an example. Assume that an architect is planning to design a resort. He wishes to use exposed, laminated-wood beams and other wood construction in order to create a rustic atmosphere. Chart 1, reproduced from the National Building Code, known as BOCA, lists hotels under the use-group R-1. When R-1 is intersected with construction type 4 (heavy timber), the chart shows that the maximum height permitted for a structure of this type is 4 stories or 50 feet, whichever is greater. The chart also indicates that no more than 14,400 square feet of space is permitted on each floor. If the client's needs can be accommodated within these height and area limitations, then all is fine. If not, a different type of framing system will have to be considered—one that permits either more height or more area.

Chart 2 provides specific information regarding the amount of fire protection that is required for each particular part of a building. The information differs based on the variations in construction types listed in Chart 1. The building code can also be referred to for further explanation, and indeed the chart often refers the reader to the code. For example, under type 4 construction, Chart 2 shows that bearing walls require a two-hour rating (see 1 under Structure Element).

Park Avenue, New York, New York.

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CHART 1

Table 501
HEIGHT AND AREA LIMITATIONS OF BUILDINGS
 Height limitations of buildings (shown in upper figure as stories and feet above grade), and area limitations of one or two story buildings facing on one street or public space not less than 30 feet wide (shown in lower figure as area in square feet per floor). See Note a.

NP — Not permitted
 NL — Not limited

Use Group	Type of construction									
	Noncombustible					Noncombustible/Combustible			Combustible	
	Type 1		Type 2			Type 3		Type 4	Type 5	
	Protected Note b		Protected		Unprotected	Protected	Unprotected	Heavy timber	Protected	Unprotected
Note a	1A	1B	2A	2B	2C	3A	3B	4	5A	5B
A-1 Assembly, theaters	NL	NL	5 St. 65' 19,950	3 St. 40' 13,125	2 St. 30' 8,400	3 St. 40' 11,550	2 St. 30' 8,400	3 St. 40' 12,600	1 St. 20' 8,925	1 St. 20' 4,200
A-2 Assembly, nightclubs and similar uses	NL	NL 7,200	3 St. 40' 5,700	2 St. 30' 3,750	1 St. 20' 2,400	2 St. 30' 3,300	1 St. 20' 2,400	2 St. 30' 3,600	1 St. 20' 2,550	1 St. 20' 1,200
A-3 Assembly Lecture halls, recreation centers, terminals, restaurants other than night clubs	NL	NL	5 St. 65' 19,950	3 St. 40' 13,125	2 St. 30' 8,400	3 St. 40' 11,550	2 St. 30' 8,400	3 St. 40' 12,600	1 St. 20' 8,925	1 St. 20' 4,200
A-4 Assembly, churches	Note d	NL	5 St. 65' 34,200	3 St. 40' 22,500	2 St. 30' 14,400	3 St. 40' 19,800	2 St. 30' 14,400	3 St. 40' 21,600	1 St. 20' 15,300	1 St. 20' 7,200
B Business	NL	NL	7 St. 85' 34,200	5 St. 65' 22,500	3 St. 40' 14,400	4 St. 50' 19,800	3 St. 40' 14,400	5 St. 65' 21,600	3 St. 40' 15,300	2 St. 30' 7,200
E Educational	Note c,d	NL	5 St. 65' 34,200	3 St. 40' 22,500	2 St. 30' 14,400	3 St. 40' 19,800	2 St. 30' 14,400	3 St. 40' 21,600	1 St. 20' 15,300	1 St. 20' 7,200 Note e
F-1 Factory and industrial, moderate	Note i	NL	6 St. 75' 22,800	4 St. 50' 15,000	2 St. 30' 9,600	3 St. 40' 13,200	2 St. 30' 9,600	4 St. 50' 14,400	2 St. 30' 10,200	1 St. 20' 4,800
F-2 Factory and industrial, low	Note i	NL	7 St. 85' 34,200	5 St. 65' 22,500	3 St. 40' 14,400	4 St. 50' 19,800	3 St. 40' 14,400	5 St. 65' 21,600	3 St. 40' 15,300	2 St. 30' 7,200
H High hazard	Note f	5 St. 65' 16,800	3 St. 40' 14,400	3 St. 40' 11,400	2 St. 30' 7,500	1 St. 20' 4,800	2 St. 30' 6,600	1 St. 20' 4,800	2 St. 30' 7,200	1 St. 20' 5,100 NP
I-1 Institutional, residential care	NL	NL	9 St. 100' 19,950	4 St. 50' 13,125	3 St. 40' 8,400	4 St. 50' 11,550	3 St. 40' 8,400	4 St. 50' 12,600	3 St. 40' 8,925	2 St. 35' 4,200
I-2 Institutional, incapacitated	NL	8 St. 90' 21,600	4 St. 50' 17,100	2 St. 30' 11,250	1 St. 20' 7,200	1 St. 20' 9,900	NP	1 St. 20' 10,800	1 St. 20' 7,650	NP
I-3 Institutional, restrained	NL	6 St. 75' 18,000	4 St. 50' 14,250	2 St. 30' 9,375	1 St. 20' 6,000	2 St. 30' 8,250	1 St. 20' 6,000	2 St. 30' 9,000	1 St. 20' 6,375	NP
M Mercantile	NL	NL	6 St. 75' 22,800	4 St. 50' 15,000	2 St. 30' 9,600	3 St. 40' 13,200	2 St. 30' 9,600	4 St. 50' 14,400	2 St. 30' 10,200	1 St. 20' 4,800
R-1 Residential, hotels	NL	NL	9 St. 100' 22,800	4 St. 50' 15,000	3 St. 40' 9,600	4 St. 50' 13,200	3 St. 40' 9,600	4 St. 50' 14,400	3 St. 40' 10,200	2 St. 35' 4,800
R-2 Residential, multiple-family	NL	NL	9 St. 100' 22,800	4 St. 50' 15,000 Note g	3 St. 40' 9,600	4 St. 50' 13,200 Note g	3 St. 40' 9,600	4 St. 50' 14,400	3 St. 40' 10,200	2 St. 35' 4,800
R-3 Residential, one- and two-family	NL	NL	4 St. 50' 22,800	4 St. 50' 15,000	3 St. 40' 9,600	4 St. 50' 13,200	3 St. 40' 9,600	4 St. 50' 14,400	3 St. 40' 10,200	2 St. 35' 4,800
S-1 Storage, moderate	NL	NL	5 St. 65' 19,950	4 St. 50' 13,125	2 St. 30' 8,400	3 St. 40' 11,550	2 St. 30' 8,400	4 St. 50' 12,600	2 St. 30' 8,925	1 St. 20' 4,200
S-2 Storage, low	Note h	NL	7 St. 85' 34,200	5 St. 65' 22,500	3 St. 40' 14,400	4 St. 50' 19,800	3 St. 40' 14,400	5 St. 65' 21,600	3 St. 40' 15,300	2 St. 30' 7,200
U Utility, miscellaneous	NL	NL								

Note a. See the following sections for general exceptions to Table 501:
 Section 501.4 Allowable area reduction for multistory buildings.
 Section 502.2 Allowable area increase due to street frontage.
 Section 502.3 Allowable area increase due to automatic sprinkler system installation.
 Section 503.1 Allowable height increase due to automatic sprinkler system installation.
 Section 504.0 Unlimited area one-story buildings.

Note b. Buildings of Type 1 construction permitted to be of unlimited tabular heights and areas are not subject to special requirements that allow increased heights and areas for other types of construction (see Section 501.5).

Note c. For tabular area increase in buildings of Use Group E, see Section 502.4.

Note d. For height exceptions for auditoriums in buildings of Use Groups A-4 and E, see Section 503.2.

Note e. For height exceptions for day care centers of Type 5 construction, see Section 503.3.

Note f. For exceptions to height and area limitations for buildings of Use Group H, see Article 6 governing the specific use. For other special fire-resistive requirements governing specific uses, see Section 904.0.

Note g. For exceptions to height of buildings for Use Group R-2 of Types 2B and 3A construction, see Section 904.2.

Note h. For height and area exceptions for open parking structures, see Section 607.0.

Note i. For exceptions to height and area limitations for special industrial uses, see Section 501.1.1.

Note j. 1 foot = 304.8 mm; 1 square foot = 0.093 m².

CHART 2

**Table 401
FIRERESISTANCE RATINGS OF STRUCTURE ELEMENTS (IN HOURS)**

Structure element Note a		Type of construction Section 401.0											
		Noncombustible					Noncombustible/Combustible			Combustible			
		Type 1 Section 402.0		Type 2 Section 403.0			Type 3 Section 404.0		Type 4 Section 405.0	Type 5 Section 406.0			
		Protected	Protected	Unprotected	Protected	Unprotected	Protected	Unprotected	Heavy timber Note c	Protected	Unprotected		
1A	1B	2A	2B	2C	3A	3B	4	5A	5B				
1 Exterior walls	Loadbearing	4	3	2	1	0	2	2	2	1	0	Not less than the rating based on fire separation distance (see Section 905.2)	
	Nonloadbearing	Not less than the rating based on fire separation distance (see Section 905.2)											
2 Fire walls and party walls (Section 907.0)		4	3	2	2	2	2	2	2	2	2	Not less than the rating required by Table 907.1	
3 Fire separation assemblies (Section 909.0)	Fire enclosure of exits (Sections 817.11, 909.0 and Note b)	2	2	2	2	2	2	2	2	2	2	2	2
	Shafts (other than exits) and elevator hoistways (Sections 909.0, 915.0 and Note b)	2	2	2	2	2	2	2	1	1			
	Mixed use separation (Section 313.0)	Fire resistance rating corresponding to the rating required by Table 313.1.2											
	Other separation assemblies (Note i)	1	1	1	1	1	1	1	1	1	1	1	1
4 Fire partitions (Section 910.0)	Exit access corridors (Notes f, g)	1	1	1	1	1	1	1	1	1	1	1	1
	Tenant spaces separations (Note f)	1	1	1	1	0	1	0	1	1	0	1	0
5 Dwelling unit separations (Sections 910.0, 913.0 and Notes f and j)		1	1	1	1	1	1	1	1	1	1	1	1
6 Smoke barriers (Section 911.0 and Note g)		1	1	1	1	1	1	1	1	1	1	1	1
7 Other nonbearing partitions		0	0	0	0	0	0	0	0	0	0	0	0
8 Interior bearing walls, bearing partitions, columns, girders, trusses (other than roof trusses) and framing (Section 912.0)	Supporting more than one floor	4	3	2	1	0	1	0	see Sec. 405.0	1	0		
	Supporting one floor only or a roof only	3	2	1½	1	0	1	0	see Sec. 405.0	1	0		
9 Structural members supporting wall (Section 912.0 and Note g)		3	2	1½	1	0	1	0	1	1	0	Not less than fire resistance rating of wall supported	
10 Floor construction including beams (Section 913.0 and Note h)		3	2	1½	1	0	1	0	see Sec. 405.0 Note c	1	0		
11 Roof construction, including beams, trusses and framing, arches and roof deck (Section 914.0 and Notes e, i)	15' or less in height to lowest member	2	1½	1	1	0	1	0	see Sec. 405.0 Note c	1	0		
	More than 15' but less than 20' in height to lowest member	1	1	1	0	0	0	0	see Sec. 405.0	1	0		
	20' or more in height to lowest member	0	0	0	0	0	0	0	see Sec. 405.0	0	0		

Note a. For fire resistance rating requirements for structural members and assemblies which support other fire resistance rated members or assemblies, see Section 912.1.

Note b. For reductions in the required fire resistance rating of exit and shaft enclosures, see Sections 817.11 and 915.3.

Note c. For substitution of other structural materials for timber in Type 4 construction, see Section 1703.1.1.

Note d. Fire-retardant-treated wood permitted, see Sections 904.3 and 1702.4.

Note e. For permitted uses of heavy timber in roof construction in buildings of Types 1 and 2 construction, see Section 914.4.

Note f. For reductions in required fire resistance ratings of exit access corridors, tenant separations and dwelling unit separations, see Section 810.4 and 810.4.1.

Note g. For exceptions to the required fire resistance rating of construction supporting exit access corridor walls, tenant separation walls in covered mall buildings, and smoke barriers, see Sections 911.4 and 912.2.

Note h. For buildings having habitable or occupiable stories or basements below grade, see Section 807.3.1.

Note i. Not less than the rating required by code.

Note j. For Use Group R-3, see Section 309.4.

Note k. 1 foot = 304.8 mm.

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Upon further investigation, to determine the required fire rating for columns supporting more than one floor (intersect line 8 under Structure Element with Type 4 construction), Chart 2 refers the reader to the building code because the information is too detailed to be included in a chart. The text of the code under that section states that columns supporting floor loads cannot be less than 8 inches by 8 inches in cross-section or less than 6 inches by 8 inches when supporting roofs.

Building codes are concerned with innumerable items and often run to hundreds and even thousands of pages. Every section of the code obviously has some impact on a building, but not every section has a major impact of a form-giving nature. The list that follows notes code items that often affect a building's overall design. The list is selective; individual architects might include different items or omit some of the items on this list.

1. Total permitted area as a function of construction materials.
2. Total permitted height as a function of construction materials.
3. Number and location of required stairs and exits.
4. Required amount of natural and/or artificial light.
5. Required amount of natural and/or artificial ventilation.
6. Required number and types of plumbing fixtures (for washrooms).
7. Pipe spaces required for plumbing and storm-drainage systems.
8. Heating equipment.
9. Air-conditioning equipment.
10. Elevator machine rooms and shafts.
11. Electric-equipment spaces and shafts.
12. Fire-protection systems.
13. Fire-extinguishing equipment.
14. Total building size as a function of building use.

ZONING ORDINANCES

While building codes tend to tell an architect how a structure can be built, zoning regulations tell him or her where the structure can be built and how bulky it can be. They define the areas of a community in which

buildings intended for certain specific uses can be constructed. For example, manufacturing is often allowed only in a particular area, which is usually some distance from residential areas. Zoning ordinances can also limit the overall bulk of buildings and the percentage of the ground they can cover. In addition, they may mandate such things as how many parking spaces must be provided; the amount of open space; yards and plaza sizes; and, in major cities, the type of vertical setbacks that are required.

Among the major items covered by most zoning ordinances are the following:

1. Building use permitted in each area of the community.
2. Lot-area regulations.
3. Yard-size regulations.
4. Building height and setback requirements.
5. Distances between buildings.
6. Parking and truck-dock requirements.
7. Ratio of floor area to total building size.
8. Ratio of open space on the ground to the maximum height of the structure.

RELATIONSHIP BETWEEN CODES AND ZONING ORDINANCES

Apparent jurisdictional overlap may occur between zoning ordinances and building codes. For example, they could conflict over minimum side-yard requirements. A zoning ordinance may specify the size of a yard or set back from a property line that must be provided for a particular type of building, while the building code may establish a minimum yard dimension that is required in order to provide adequate light and ventilation for a window facing onto a yard. Often these requirements are not the same, and since both requirements must be met, the stricter of the two prevails.

Another type of conflict can occur when a building code does not limit a building's height provided proper fire rated materials are used in its construction, but the town zoning ordinance states that no building can be more than, for example, eight stories high. Or the reverse situation might apply: that is, a town zoning ordinance might permit an eight-story hotel while the building code specifies that hotels may not be more than four stories high if they are of heavy-timber con-

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struction. In either case, a solution must be found that satisfies all requirements, and the decisions that result from such conflicts inevitably influence the design of the building.

Apart from building codes and zoning ordinances, the requirements of special-interest agencies can also affect a building. For example, the Board of Health sets up rules for restaurants and hospitals, and the Department of Labor has requirements to protect workers such as mandating guardrails or window ledges to protect window washers. Many of these types of rules will affect the design of buildings. The list of special-interest requirements is enormous, but fortunately their effect on the design of a building is relatively minor, especially when compared with the requirements of the building codes and zoning ordinances. Occasionally, though, a special-interest agency regulation does influence the design of a building.

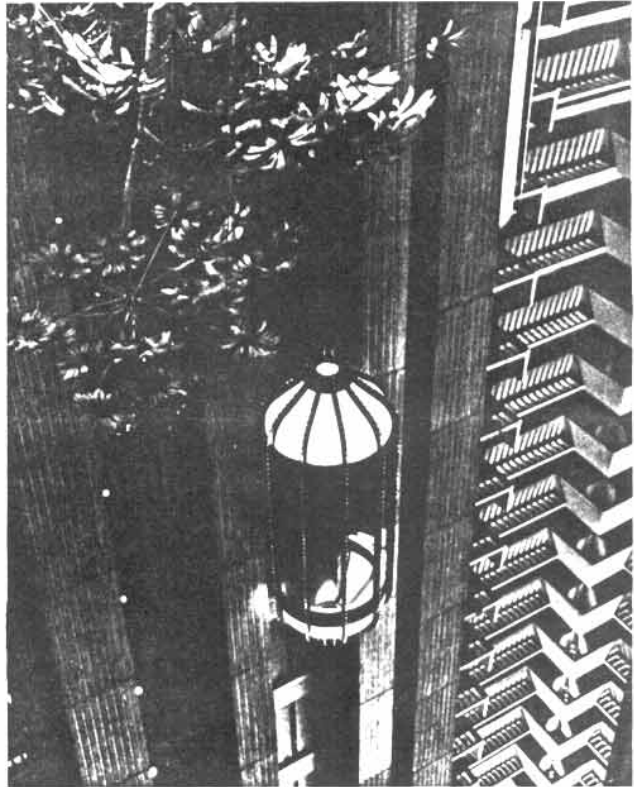
EXIT REQUIREMENTS

One of the decisive form-givers in any major building is the location of its required means of egress. This is a separate problem from the location of decorative or ceremonial stairs, which codes refer to as "convenient" or "ornamental" stairs.

Although building codes go into minute detail describing exit requirements and the way in which exiting enclosures must be constructed, the five points that follow have a major impact on the overall building design.

1. Use of the building, for example, as an office, store, or school.
2. Total number of people in the building as a determinant of the required number of separate exits.
3. Limitations on the maximum travel distance permitted to reach an exit enclosure.
4. Provision for a choice of paths to an exit, and a choice of exits in case one exit is blocked.
5. Provision that exits must lead the occupants to a safe area.

Items 1, 2, and 5 are an automatic spellout of the codes. Items 3 and 4 require proper proportioning and shaping of spaces by the architect in order to comply with a specific maximum travel distance and a specific maximum dead-end corridor length. This proportioning can have a dramatic effect on the overall shape of the building. For example, most codes will not permit any dead end corridors in a hospital; therefore, the stairs must be located at the ends of the building.



Elevators can make a major design contribution or be part of a nondescript core, but in either case they may not count as a means of exiting as they could fail during an emergency. Hyatt Regency Hotel, Atlanta, Georgia.

APPROXIMATE AREAS of CODE INFLUENCE

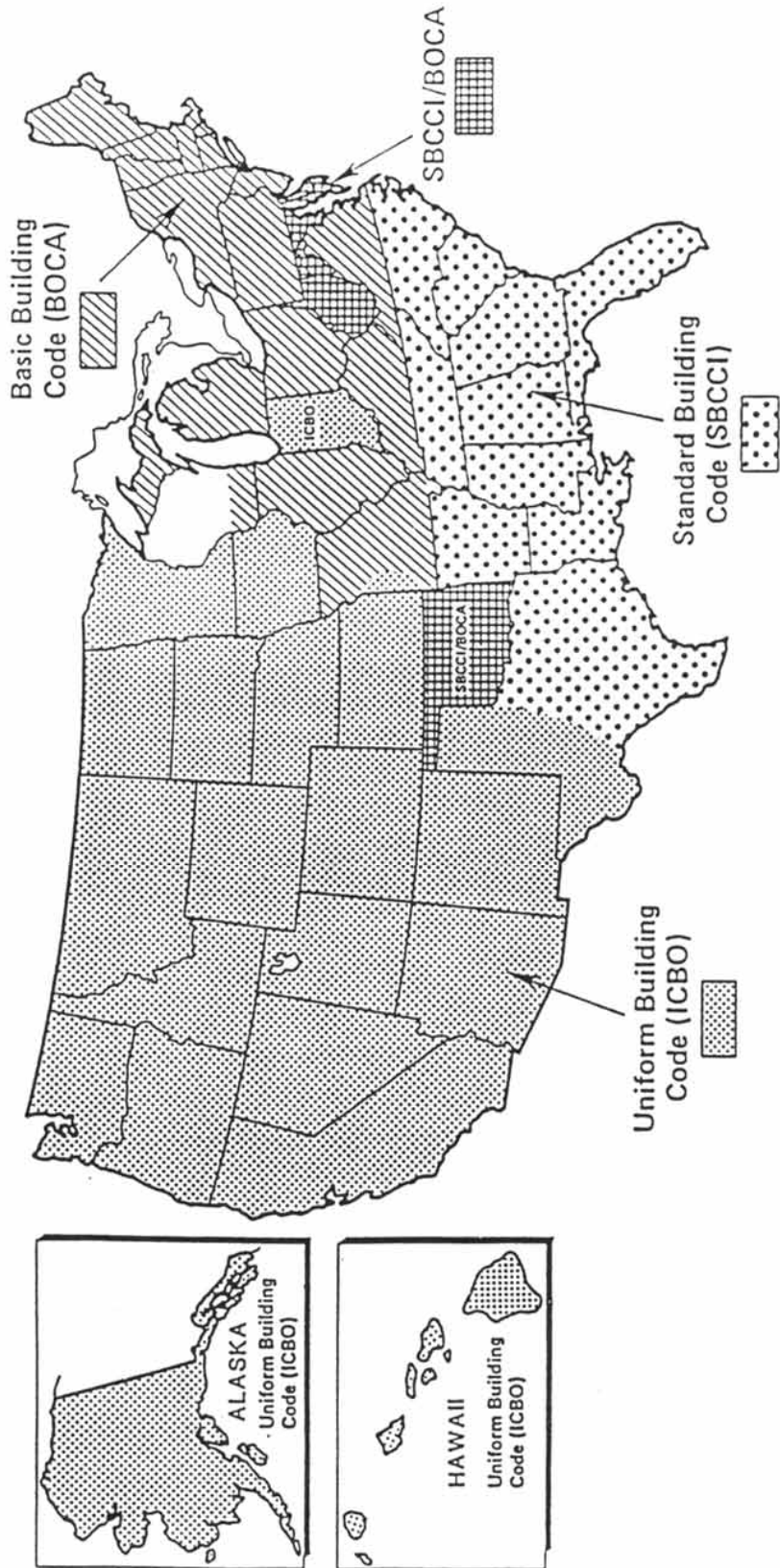


Figure 1. Geographical Influence of Model Codes (After Perry, 1986)

Perry