APPENDIX F

REFERENCE DATA FOR REPAIR, ALTERATION, ADDITION AND CHANGE OF USE OF EXISTING BUILDINGS

PART ONE- GUIDELINES FOR APPLICATION

F-101 PURPOSE

F-101.1 Intent of 780 CMR 34: The purpose of Appendix F is to provide guidance to users of 780 CMR (the Massachusetts State Building Code) as to techniques of acceptable practice which can be used to assess the acceptability of various methods of meeting the intent of code provisions of 780 CMR 34 on a case-by-case basis. The purpose of the provisions in 780 CMR 34 and Appendix F is to allow the repair, alteration addition, and change of use of existing buildings without requiring the entire building to be brought up to new construction requirements, while still providing for the public health, safety and general welfare. The provisions of 780 CMR 34 and Appendix F recognize that the provisions of 780 CMR for new construction reflect the latest improvements in materials, construction techniques, standards of living and safety and, therefor, may preclude the repair, alteration, addition, or change of use of existing buildings that have demonstrated their usefulness and safety.

F-102.0 SCOPE

F-102.1 Techniques: Appendix F is intended to demonstrate techniques of analysis and compliance with 780 CMR 34 in the repair, alteration, addition, and change of use of existing buildings.

F-103.0

F-103.1 General conditions: Conceptually, it is the intent of 780 CMR 34 and Appendix F to allow repair, alteration, addition, or change of use of existing buildings without meeting all new construction requirements under the following general conditions:

1. all hazardous conditions must be corrected;
2. the existing building becomes the minimum performance standard; and
3. the degree of compliance of the building after changes must not be below that existing before the changes, except that nothing in 780 CMR 34 will require compliance with requirements more stringent than that required for new construction.

F-104.0 IMPLEMENTATION

F-104.1 Framework: Implementation of the above concept requires that a framework be established for evaluating the condition of the building; determining the potential for modification; and establishing the acceptability of proposed changes.

F-104.2 Evaluation of existing building: Evaluation of existing conditions in a structure is required to determine the existence of any hazardous conditions, which must be corrected; and to provide a basis for evaluating the impact of the proposed changes on the performance of the building.

The following list of evaluation tools described in Appendix F-104.1.1 through F-104.2.7 can be used for determining the condition of the structure. However, this list is not necessarily complete and the use of other methods should not be precluded.

F-104.2.1 Available documentation of existing building: Prime sources of design information for existing buildings are the architectural and engineering drawings and specifications used in the construction of the building. Although the passing of time often obscures depositaries of such documents, the following are likely prospects in attempting to locate such information:

1. If the building is currently in use, an individual or office responsible for its management may have retained drawings and specifications to facilitate maintenance. A building manager, resident engineer, superintendent, custodian, stationary engineer or plant engineer may be the most direct contact at the building site.
2. Other potential sources (especially if the building is not in use) include the original designer-architect or engineer.
3. The building department which issued the permit for construction may have documentation.
4. Documentation may have been retained by the general contractor or numerous subcontractors; i.e.: the mason, carpenter, plumber, electrician, HVAC installer, steel erector, etc., as well as manufacturers of component parts, as potential sources of documentation.
5. In the case of large corporations or government agencies, a separate contracting officer may have developed a technical file on the erection of a building.

6. In some cases, individual consultants are contracted to serve as "clerk-of-the-works" and pursue the inspection of a building project from start to finish with the keeping of a file likely.
7. Insurance companies sometimes maintain drawings or records of their insured buildings.
8. Historical or archaeological societies may have considered a building to be important enough to develop a file of documentation.

F-104.2.2 Field surveys: Having drawn upon available documentation to help evaluate a building's condition, such documentation may be augmented by on-site data acquired through field survey. The most obvious approach is to make use of detailed visual examination to confirm and/or alter any previously available information pertaining to the building.

F-104.2.3 Testing: Testing is a tool that may be used in evaluating the condition of a building or structure or parts thereof when other methods of evaluation will not suffice. Testing may be initiated voluntarily on the part of the permit applicant or may be required by the building official in the absence of approved rules as indicated in 780 CMR 109.0, 116.0, and 34. The costs of all such tests are to be borne by the permit applicant and should, therefore, be required by the building official only when other methods of evaluation prove inadequate or insufficient. Such testing should be conducted by an approved testing agency under the supervision of a registered architect or engineer. The report of the tests shall be submitted to the building official and shall include the details of test procedures, references to any accepted test standards used, the results of the tests and any conclusions drawn from the test results.

F-104.2.4 Nondestructive testing: This includes techniques where the structural integrity of the building is not affected, such as the following:
1. analyzing various portions of the building to determine dimensions, types and condition of materials, etc.;
2. portable apparatus for impact testing;
3. load application short of failure to determine capacity of materials and components;
4. magnetic methods for detecting flaws in ferrous metal;
5. proximity magnetometers (locating rebars in concrete, concealed ferrous fasteners, etc.);
6. electronic means for measuring the sonic modulus of elasticity of concrete and masonry in assessing its soundness;
7. ultrasonic transmission or reflective methods in detecting flaws in various materials; and
8. x-ray or infrared-ray photographic techniques used to evaluate portions of elements whose integrity is questionable.

F-104.2.6 Destructive testing: In destructive testing a sample of the building could be removed and tested (e.g., concrete core), or components of the building could be reconstructed and tested in the laboratory.

F-104.2.7 Laboratory analysis: In some cases, tests can be performed in the laboratory. Such tests might include the following:
1. chemical or metallurgical test;
2. optical or electronic microscopic examination which can help identify and evaluate the soundness of materials where decay or other molecular degradation is involved;
3. conventional laboratory tests for determining physical properties (strength, ductility, absorption, solubility, permeability, stiffness, etc.; and/or
4. testing of a scale model of the building (computer model, wind tunnel model, etc.).

F-104.3 Evaluation of change in performance level: It is necessary to determine if the level of performance of the building after alteration is below that which existed before the change. The hazard level could be increased for certain attributes (such as fire safety) while decreased for other attributes (such as floor loads) for a given alteration. The evaluation of the change in hazard levels of each attribute can be accomplished using various tools singly or in combination as described below in Appendix F -104.3.1 through F-104.3.5.

F-104.3.1 Data on archaic systems: Performance data on architectural and structural systems encountered are tabulated in Appendix F, Part Four. This data can be compared to the proposed altered systems to determine if the performance is adversely affected.

F-104.3.2 Compliance alternatives: Alternate solutions tabulated in Appendix F, Part Two were developed from appeal data and from accepted practice. The list is not all-inclusive and should not preclude consideration of other alternatives.

F-104.3.3 Analysis methods: Analytical methods based on good engineering practice may be used to determine changes in performance levels.

F-104.3.4 Test methods: Test procedures as discussed in Appendix F-104.2.3 through F-104.2.6 can be used to evaluate the performance of existing construction.

F-104.3.5 Professional judgement: Professional judgement based on previous experience with

similar buildings should be used to the fullest extent possible.

PART TWO- SUGGESTED COMPLIANCE ALTERNATIVES

F-201.0 PURPOSE AND SCOPE

F-201.1 Purpose: The purpose of Appendix F-201.0 is to assist the building official and those regulated by 780 CMR in judging the acceptability of compliance alternatives to specific provisions required by 780 CMR.

F-201.2 Application: Appendix F-201.0 contains generally acceptable compliance alternatives and examples. The examples are solely for the purpose of illustrating principles which can be applied to the solution of code compliance problems and are not necessarily acceptable under all circumstances. It is recognized that all building systems interact with each other. Therefore, any consideration of compliance alternatives must take into account all existing and proposed conditions to determine their acceptability. The principles applied can be used for the solution of similar compliance problems in other buildings and occupancy groups. Commentaries are provided where the philosophy in establishing the alternatives is not obvious. The examples were developed from appeal data and accepted practice. They are not all-inclusive and should not preclude consideration of other alternatives.

Note: It is anticipated that additional compliance alternatives will be added to Appendix F-201.0 through the mechanism of appeal decisions and from results of research being conducted by various organizations in the field of relative permanence of life safety systems.

F-202.0 COMPLIANCE ALTERNATIVES FOR EGRESS REQUIREMENTS

F-202.1 Number of exits:

F-202.1.1 General compliance alternatives:

1. Provide connecting fire balconies.
2. Provide alternate egress facilities (windows, etc.).
3. Provide a fire escape.
4. Provide fire-rated areas of refuge.

F-202.1.2 Examples:

Example 1 involves a five-story Building of Use Group B without a fire suppression system and with only one *means of egress*.

Solution A. Add one or more fire escapes as may be necessary to provide all tenants with reasonable access to two *means of egress* in separate directions. Access to a street, public way or area of refuge shall be provided at the termination of the fire escape.

Solution B. Add connecting fire balconies across fire walls if the above solution is impractical due to construction difficulties.

Example 2 involves a building of Use Group R-2 occupancy with an apartment in the basement. There is only one *means of egress* from the basement.

Solution A. Provide egress windows in each apartment that comply with 780 CMR 10.

F-202.2 Travel Distance:

F-202.2.1 General Compliance Alternatives:

1. Add detection system.
2. Add a partial fire suppression system.
3. Add smoke doors.
4. Increase fireresistance rating of corridor walls and doors.

F-202.2.2 Example: This example involves a four story building of Use Group R-2 without a fire suppression system. The length of exitway access travel is 150 feet.

Solution A. Add a partial fire suppression system off the domestic water supply (if adequate) in the exit access corridor.

Solution B. Subdivide corridor into segments, if less than 100 feet, with smoke doors.

Solution C. If not required by other sections of 780 CMR, install smoke and fire detectors with audible alarms in the corridor.

Solution D. Increase the fireresistance rating of the exit access corridor from one hour to two hours and provide "B" label self-closing or automatic closing fire doors in all openings into the corridor.

F-202.3 Enclosure of exitways:

F-202.3.1 General Compliance alternatives:

1. Improve enclosure of exitway.
2. Add a partial fire suppression system.
3. Add a detection system.

F-202.3.2 Examples: This example involves a four story row building of Use Group R-2 with connecting fire balconies and an interior stair. The stair is enclosed with lath and plaster, wood stud partitions and paneled doors.

Solution A. Cover partitions on the apartment side with _" Type X gypsum wallboard or its equivalent. Replace or build up panel doors until minimum solid portion is 1_" and install self-closers.

Solution B. Provide a heat and smoke detection system in the stairwell with an alarm audible to all tenants. Provide self-closers on all stairwell doors.

Solution C. Provide a partial fire suppression system in the stairwell off the domestic water

supply (if adequate). Provide self-closers on all stairwell doors.

F-202.3.3 Commentary: The above example, while pertaining to a four story, Use Group R-2 building, can also be applied to other buildings of occupancies and floor levels. The principle that the degree of code compliance may not be reduced should be remembered. If the existing enclosure is of fireresistive construction, it must be maintained. The primary principle to remember, in the required enclosure of exitway, is that an enclosure must be provided, whether fireresistive or not, so as to provide a smoke barrier. The purpose of providing a smoke barrier is to prevent the passage of smoke from a fire on one floor to the exitways and exit access corridors of other floors and thus render them unusable for egress. This principle is illustrated by solutions A, B, and C in the above example.

F-203.0 COMPLIANCE ALTERNATIVES FOR FIRE HAZARDS

F-203.1 Fire separations and partitions;

F-203.1.1 General compliance alternatives:

1. Improve fire separation.
2. Add a fire suppression system.
3. Add a detection system.

F-203.1.2 Examples: **Example 1** involves a three story building of Type 3A construction, containing a Mercantile (M) Use Group, on the first floor and occupancy Business (B) Use on the second and third floors. The required separation is three hours.

Solution A. Add a fire suppression system to the first and second floors.

Solution B. Add _ inch Type X gypsum wallboard or its equivalent to the underside of the second floor and install a system of smoke and heat detectors with audible alarms on the first and second floors.

Example 2 involves the separation between two tenants of wood lath and plaster on a wood studs partition. The required separation is one hour.

Solution A. Add _ inch Type X gypsum wallboard or its equivalent to either side of the existing partition.

Example 3 involves a building of Use Group B with unrated exit access corridors.

Solution A. Install a partial fire suppression system in the exit access corridors.

Solution B. Add _ inch Type X gypsum wallboard or its equivalent to either side of the corridor partition and install self-closers on all corridor doors.

Solution C. Install a smoke and heat detection system in the corridor with and alarm audible to all tenants on the floor and install self-closers on all corridor doors.

F-203.2 Openings and exterior wall protection:

F-203.2.1 General compliance alternatives:

1. Add fire suppression system.
2. Improve fireresistance.
3. Remove or improve openings.

F-203.2.2 Examples: **Example 1** involves a two story of Type 5B construction building, with Use Group M, on the first floor the basement and upper floors. The distance between the building and the side lot line is five feet and ten feet between it and the adjacent building. The adjacent building is of Type 5B construction and Use Group R-2. The former occupant was a grocery store; the new occupant is a hardware store.

Solution A. Install a deluge sprinkler system along the interior side of the wall affected.

Solution B. Add _ inch Type X gypsum wallboard to interior side of the wall affected.

Example 2 is the same as example 1 but with double-hung wood windows in affected wall.

Solution A. Remove windows and close opening with one hour fireresistive construction.

Solution B. Remove windows and install fire windows.

Solution C. Install a deluge sprinkler system as in solution A to example 1.

PART THREE- DETAILED CLASSIFICATION OF OCCUPANCY BY HAZARD INDEX NUMBER AND USE GROUP

Appendix F, Part Three provides a more detailed guide for users of 780 CMR to determine hazard index numbers and use groups for various types of occupancies. It supplements 780 CMR 3 and Table 34 contained in 780 CMR 3404.

TABLE F-1
HAZARD INDEX AND USE GROUP CLASSIFICATION

Use of Structure	Hazard Index No.	Use Group
Advertising Displays Manufacture including billboards	3	S-1
Airport or other aircraft landing or service facility (see also: Helicopter rooftop landing facility	3	F
Amusement park, indoor	4	A-3
Animal		
Crematorium	3	F-2
Hospital, kennel, pound	2	B
Apartment (see Residences)		
Appliances		
Manufacture	3	F-1
Sales	3	M
Arenas	4	A-3
Asphalt		
Processing and products manufacture	8	H
Athletic equipment		
Manufacture	3	F-1
Sales	3	M
Auditoriums	6	A-1 with stage
	5	A-1 without stage
	4	A-3
Automobile and other motor vehicles		
Gasoline service station	3	M
Rental agency within a building	2	B
Repair	3	S-1
Repair incidental to auto sales with limitation	3	S-1
Sales within a building	3	M
Wrecking	3	F
Washing	3	S-1
Awning manufacturer	3	F-1
Baked goods shop	3	M
Bakeries	3	F-1
Banks	2	B
Banquet halls	5	A-3
Barber shops	2	B
Beauty shops	2	B
Beverages	2	F-1
Bottling		
Manufacture		H
Alcoholic	8	F-1
Less than 0.5% alcohol @ 60^{o}	3	
Bicycle		
Manufacture	3	F-1
Rental or repair conducted within a building	3	S-1
Sales	3	M
Billiard Parlor	4	A-3
Blacksmith shops	3	F-1
Blueprinting, etc. establishments	3	F-1
Boarding house	2	R-1 or R-2
Boats or ships		
Building or repair of boats	3	F-1
Bone distillation	3	F-1
Bowling alleys	4	A-3
Broom or brush manufacture	3	F-1
Building materials		
Wholesale business in roofed structures	3	M or S-1
Bus terminals or stations	4	A-3
Business schools or colleges	4,2 or other	A-4, B or dependent upon use
Camera and other photo equipment		
Manufacture except film sales	3	M
Sales	3	M

TABLE F-1 (continued)
HAZARD INDEX AND USE GROUP CLASSIFICATION

Use of Structure	Hazard Index No.	Use Group
Canvas or canvas products		
Manufacture or repair	3	F-1
Carpet and rug		
Cleaning establishments	8 or 3	H, F-1
Manufacture or repair	3	F-1
Catering for outside consumption	3	F-1
Cemeteries		
Crematory in cemetery	3	F-2
Mausoleum, crypt, columbarium	1	S-2
Mortuary chapel in cemetery	4	A-4
Ceramics products manufacture, including pottery, small glazed tile and similar items	3	F-2
Charcoal, fuel, briquettes, or lampblack manufacture	8	H
Chemicals		
Packaging	8 or 3	H or F-1 depending on nature of material
Manufacture	8 or 3	H or F-1 depending on nature of material
Churches or other places of worship	4	A-4
Circuses, temporary	4	A-3
Cleaning (see Drycleaning & dying; Laundries; Automobiles, washing)		
Clothing		
Manufacture	8 or 3	H or F-1 depending on nature of material
Rental establishment	3	M
Retail sales	3	M
Tailoring, custom manufacture or repair (see also Feathers; Felt; Fur; Leather)	3	M
Clubs		
Private	4	A-3 without residence
Nightclubs (see Eating & drinking establishments)		
Coal, coke or tar products		
Manufacture	8	H
Colleges and Universities	4	A-3
Classroom buildings	2	R-2
Dormitories	2	R-2
Fraternities or sororities		
Community centers	4 or 2	A-3, or B
Convalescent homes (see Nursing homes)		
Convents	2	R-2
Cosmetics or toiletries manufacture	8	H
Cotton ginning	8	H
Cotton wadding or linters manufacture	8	H
Courthouses	2 or 4	B or A-3
Crematoriums		
Animal	3	F-2
Human	3	F-2
Dance halls	7	A-2
Day care agencies	4	I-2 or E
Day nurseries	4	I-2
Dental offices (see Medical & dental)		
Department stores	3	M
Dormitories	2	R-1 or R-2
Dressmaking shops, custom	8	H
Drinking places (see Eating & drinking establishments)		
Drive-in restaurants	5	A-3
Drug stores	3	M
Dry cleaning and dying establishments	8 or 3	H or F-1 depending on solvents used
Dwellings (see Residences)		
Eating or drinking establishments	5	A-3
Lunchrooms, restaurants, cafeterias, etc., primarily enclosed	4	A-3

Drive-in	7	A-2
With entertainment or dancing		
Electric		
Power or steam generating plants	3	F-1
Substation	3	F-1
Electrical appliances, bulbs, wiring, supplies, etc.		
Manufacture	3	F-1
Sales	3	M
Electronic components & supplies		
Manufacture or repair	3	F-1
Feathers		
Curing, dyeing, washing or bulk processing	8	H
Manufacturing exclusive of above	8	H
Felt		
Curing, dyeing, washing or bulk processing	3	F-1
Products manufacture, exclusive of above	3	F-1
Fertilizer manufacture	8	H
Film, photographic, manufacture	3 or 8	F-1 or H
Storage and studios	3 or 8	F-1 or H
Fire stations	2	B
Fish processing	3	F-1
Florida shops	3	M
Food		
Product processing except meat & fish	3	F-1
Retail sales	3	M
Fraternities or sororities	2	R-1 or R-2
Funeral establishments	4	A-3
Fur		
Curing, dyeing, finishing, tanning	8	H
Products manufacture exclusive of above	3	F-1
Garage (see Parking garage)		
Garbage incineration or reduction	3	F-1
Gas		
Manufacture	8	H
Public utility stations for metering or regulating	2	B
Storage		
2500 cu. ft. or less	3	S-1
more than 2500 cu. ft.	8	H
Gasoline service station (see Automobiles)		
Gelatin manufacture	3	F-1
Generating plants, electric or steam	3	
Gift shops	3	M
Glass products from previously manufactured	3	F-2
Glue manufacture	3	F-1
Golf		
Indoor courses or driving ranges	4	A-3
Gymnasiums	4	A-3
Grain storage	8	H
Hair		
Curing, dyeing, washing, bulk processing	3	F-1
Product manufacture exclusive of above	3	F-1
Hardware		
Manufacture	3	F-1
Retail sales	3	M
Hat bodies manufacture	3	F-1
Helicopter landing facility, rooftop	3	S-1
Home occupations	2	B
Homes for the aged	4	I-2
Hosiery manufacture	3	F-1
Hospitals		
Including convalescent, nursing, or rest homes and sanitariums, provided	4	I-2
custodial care is not provided for drug addicts, alcoholics, mentally ill	5	I-3
or mentally deficient	2	B
For care of drug addicts, mentally ill, or mentally deficient		
Research or teaching laboratories		

(see also Animal hospitals)		
Hotels	2	R-1
Ice manufacturing (dry or natural)	3	F-2
Ice skating rinks	4	A-3
Incineration or reduction of garbage, offal, or dead animals	3	F-1
Industry uses (see specific items)		
Without resulting noise, vibration, special danger, hazard, dust, smoke, fumes, etc.	3	F-2
Other than above	3 or 8	F-1 or H
Ink or inked ribbon manufacture	3	F-1
Jewelry	3	F-1
Kennels (see Animal)		
Laboratories		
Research laboratory not accessory to school or hospital	2	B
Scientific research or teaching laboratory, non-profit, accessory to school, or hospital, subject to limitations	2	B
Laundries		
Hand laundry	2	B
Self service; pick-up and delivery station of laundry or dry cleaner		
Steam laundries without limitations	3	F-1
Leather		
Curing, dyeing, finishing or tanning	3	F-1
Product manufacture exclusive of above	3	F-1
Libraries	4	A-3
Linoleum or oilcloth manufacture	3	F-1
Liquor sales, package	3	M
Luggage manufacture	3	F-1
Lumber (see Wood)		
Manufacturing	3 or 8	F-1 or H
Matches manufacture	8	H
Mattress manufacture and renovation	3	F-1
Meat Markets	3	M
Slaughtering or packaging	3	F-1
Medical & dental offices (see also Laboratories; Orthopedic & medical appliances; Hospitals)	2	B
Meeting hall	4	A-3
Metals, manufacture	3	F-2
Reduction, refining or smelting	8	H
Monasteries	2	R2
Motels	2	R-1
Motor freight stations (see trucking terminals)		
Museums		
Musical instruments manufacture	3	F-1
Newspaper publishing	3	F-1
Newsstands	3	M
Novelty products manufacture	3	F-1
Nursing Homes	4	I-2
Offices	2	B
Oilcloth manufacture	3	F-1
Optical equipment or similar precision instruments manufacture	3	F-1
Orphanages	3	I-2
Orthopedic or medical appliance manufacture	3	F-1
Paint, turpentine or varnish		
Manufacture	8	H
Spraying booths	8	H
Paper products manufacture	3	F-1
Parish houses	4	A-3
Parking garages		
Group 1	3	S-1
Group 2	1	S-2
Petroleum or petroleum products		
Refining	8	H
Storage	3	S-1

Pharmaceutical products manufacture	3	F-1
Photography studio	2	B
Plastics		
Product manufacture	8	H
Raw, manufacture	8	H
Police stations	2	B
Pool rooms	4	A-3
Post offices	2	B
Printing		
Plant	3	F-1
Printing or newspaper publishing	3	F-1
Prisons & other correctional or detention institutions	5	I-3
Pumping station or substation, water or sewage	3	F-2
Radio	3	M
Sales	5	A-1-B
Studios with audience	2	B
Studios without audience		
Railroad		
Freight terminal	4	A-3
Passenger station	3	S-1
Recreation		
Center, indoor	4	A-3
Community center building	4	A-3
Rectories	2	R-2
Residences		
One-family	2	R-3, or R-4
Two-family	2	R-3, or R-4
Apartment	2	R-2
Temporary dwelling structure	2	R-3
Boarding or lodging house	2	R-1 or R-2
Dormitory	2	R-1 or R-2
Fraternity or sorority	2	R-1 or R-2
Hotel, motel apartment with accessory services	2	R-1
Convents, monasteries, rectories	2	R-2
Research laboratories (see Laboratories)		
Restaurant, lunch room, cafeteria or other establishments primarily for eating	5	A-3
Retail business	3	M
Stores with combustible or flammable goods constructing a high hazard	8	H
Rubber		
Manufacture (natural or synthetic), including tires, tubes, or similar products	8	H
Products (exclusive or processing) including washers, gloves, footwear bathing caps and the like	3	F-1
Sanatariums		
Not providing custodial care for drug addicts, alcoholics, mentally ill, or mentally deficient	4	I-2
Providing care for the above	5	I-3
Schools	4	E
Seminaries	4 or 2	A-4 & R-1
Settlement houses (depending on nature of activities)	4 or 2	A-3 or B
Sewage		
Disposal plant	3	F-1
Pumping station	3	F-1 or F-2
Shoddy manufacture	8	H
Shoes		
Manufacture	3	F-1
Repair shop	2	B
Silverware manufacture, plate or sterling	3	F-1
Size manufacture	3	A-3
Skating rinks	4	A-3
Soap and detergents		
Manufacturing, including fat rendering	8	H
Packaging	3	F-1
Solvent extracting	8	H
Sporting or athletic goods	3	F-1
Manufacture	3	M

Stores		
Stables	3	S-1
Stadiums	4	A-5
Wholesale business, including accessory storage other than flammable liquids, gases and explosives, in roofed structures	3 or 1	S-1 or S-2 depending on nature of materials
Stores (see Retail stores; or specific items)		
Tailor shops, custom	2	B
Tanning (see leather; Fur)		
Taxidermist shops	3	M
Telephone exchanges		
Automatic	2	B
Non-automatic	2	B
Television		
Sales	3	M
Studios	3	M
	6	A-1 with scenery
	5	A-1 np scenery
	2	B no audience
Textiles		
Manufacture, including knit & yard goods, thread or cordage, spinning, weaving, dyeing & printing, shoddy manufacture	3	F-1
Theaters	6	A-1 with scenery
	5	A-1 no scenery, motion picture
Tires, manufacture	8	H
Tobacco products manufacture including curing	3	F-1
Tools & hardware		
Manufacture	3	F-1
Sales	3	M
Toys		
Manufacture	3	F-1
Trailer park (see Mobile homes)		
Truck		
Repairs	3	S-1
Sales	3	M
Trucking terminals	3	S-1
Turpentine manufacture	8	H
Warehouses	8, 3, or 1	H, S-1, or S-2 depending on nature of materials
Waterpumping stations	2	F-2
Wax products manufacture	8	H

PART FOUR- ARCHAIC CONSTRUCTION SYSTEMS

F-401.0 PURPOSE AND SCOPE

F-401.1 Purpose: The purpose of of Appendix F, Part Four is to assist the building official and those regulated by780 CMR in evaluating the properties of archaic construction systems.

F-401.2 Scope: Appendix F, Part Four contains data on construction systems no longer in general use but which may be encountered in older existing buildings. It is meant to be used for assessing existing conditions when evaluating how proposed changes will impact upon the performance of the building.

F-401.3 Application: In any given problem, all available data should be collected and professional judgement exercised in arriving at decisions. Evaluative judgment should be used when test data does not exist or when applying the data contained in this standard.

F-402.0 ARCHAIC FIRERESISTIVE SYSTEMS

F-402.1 General: Appendix F, Part Four contains a list of fireresistive materials and construction which are not necessarily currently in common use. Some of the hourly ratings contained in the listing predate ASTM E-119 that is in current use. The hourly ratings may be higher or lower if tested according to ASTM E 119. In addition to the data contained herein, see Report BMS92, Building Materials and Structures, dated October 7, 1942, National Bureau of Standards. The data listed below is extracted from the Boston Building Code, circa 1943.

F-402.2 Fireresistive materials and construction:

F-402.2.1 Minimum qualities: Materials, to be given the fireresistive ratings specified in this part, shall have the following minimum qualities set forth in Appendix F F-402.2.2 through F-402.2.19.

F-402.2.2 Class 1 concrete: Concrete of Class 1 shall be so proportioned as to have a strength of at least 1500 pounds per square inch (psi) and the coarse aggregate shall consist of limestone, trap rock, blast furnace slag, cinders containing not more that 20% of combustive material, burned clay or shale.

F-402.2.3 Class 2 concrete: Concrete of Class 2 shall be so proportioned as to have a strength of at least 1500 pounds psi, the coarse aggregate consisting of sandstone, granite, quartzite, siliceous gravel or other similar material not over one inch in size.

F-402.2.4 Masonry: Masonry shall be laid in lime-cement or cement mortar, or approved masonry cement mortar, except that masonry of gypsum tile shall, and masonry of structural clay tile may, be laid in gypsum mortar. Masonry shall be thoroughly bonded by breaking joints in successive courses or by the use of metal ties.

F-402.2.5 Brick: Brick shall be burned clay or shale, concrete or sand-lime brick of Grade C or better.

F-402.2.6 Stone: Stone shall be limestone, marble, slate or equally fireresistive natural stone. Sandstone, granite or other stone which, because of its crystalline structure or for other reason, is less fireresistive, shall not be considered fire protection for structural metal, but may be used in a masonry wall not less that 12 inches thick required to have fireresistance. Stone masonry shall have the same fireresistive rating as brick masonry.

F-402.2.7 Cast stone: Cast stone masonry shall have the same fireresistive rating as brick masonry.

F-402.2.8 Concrete blocks: Concrete blocks, whether solid or hollow, shall have as coarse aggregate limestone, trap rock, blast furnace slag, cinders containing not more than 20% of combustible material, burned clay or shale.

F-402.2.9 Structural clay tile: Structural clay tile shall conform to the specifications for load-bearing tile, floor tile or partition tile. Where partition tile is specified load-bearing tile may be used.

F-402.2.10 Gypsum: Gypsum tile or pre-cast gypsum concrete, whether solid or hollow, shall conform to Standard Specifications for Gypsum Partition Tile or Block of the American Society for Testing Materials and shall not contain more than 3% by weight of wood or other combustible binder or filler.

F-402.2.11 Gypsum concrete: Gypsum concrete shall not contain more than 12½ by weight of wood or other combustive binder or filler and shall have a compressive strength of at least 500 psi. It shall not be used where exposed to the elements.

F-402.2.12 Lath: Expanded metal or wire lath as a base or reinforcement for plastering shall weigh

not less that 2.2 pounds per square yard and shall have not less than 2½ meshes per inch.

F-402.2.13 Metal mesh for masonry: Metal mesh reinforcement specified for masonry fire **F-402.14 Metal mesh for concrete**: Metal mesh reinforcement specified for concrete fire protection of structural metal shall consist of wire mesh weighing not less than 1½ pounds per square yard with wire spaced not over four inches, or not less than No. 11 gauge steel wire spaced not over four inches apart, or its approved equivalent.

F-402.2.15 Cement plaster: Cement plaster shall be proportioned of one part Portland cement, and not more than two parts of sand measured by volume dry and loose to which may be added lime putty or hydrated lime not exceeding 15% of the cement.

F-402.2.16 Gypsum plaster: Gypsum plaster, except where otherwise specified, may contain sand, not in excess of three times the weight of the gypsum.

F-402.2.17 Lime plaster: Lime plaster shall consist of a mixture of one part lime, not over three parts sand, and water.

F-402.2.18 Pneumatically projected mortar: Pneumatically projected mortar made of Portland cement, sand nd water shall be rated for fire protection the same as Class 1 concrete.

F-402.2.19 Concrete fill: Concrete fill, where specified in this appendix in connection with hollow masonry units shall consist of Class 1 or Class 2 concrete poured in the hollow spaces of the units as they are laid.

F-402.2.20 Reinforced concrete: Portland cement concrete or gypsum concrete poured in place as fire protection for beams, trusses and other horizontal or inclined members of structural steel and pneumatically projected mortar applied to structural steel as fire protection shall be reinforced with metal mesh reinforcement. Concrete protection for vertical columns of structural metal shall have reinforcing consisting of No. 5 wire spaced not over eight inches apart or its equivalent. Reinforcement shall be wrapped around the structural member and so arranged as to be completely embedded in the fire protection material and to ensure its integrity.

F-402.2.21 Reinforced plaster: Plaster used as fire protection or to resist the spread of fire shall be reinforced with metal lath, except plaster less than one inch thick or masonry or concrete. protection of structural metal shall consist of wire lath strips the full thickness of the masonry, laid in the beds thereof, or its approved equivalent.

F-402.2.22 Replacement material: In the protection of structural metal including reinforcement, ½ inch of cement or gypsum plaster may replace an equal thickness of poured concrete or pneumatically projected mortar as protective material; and one inch of cement or gypsum plaster reinforced with metal lath may replace an equal thickness of poured concrete, pneumatically projected mortar or masonry protection.

F-402.2.23 Plaster: Where plaster is required without other specification, it shall consist of ½ inch of cement or gypsum plaster, except that only gypsum plaster shall be used on gypsum masonry.

F-402.2.24 Thickness: In this appendix, except where otherwise specifically stated, the thickness given in a list of materials applies to the next following item only, and not to the total thickness where additional materials are specified.

F-402.2.25 Embedding limitations: Pipes, wires, conduits and ducts shall not be embedded in or placed behind the fire-protective materials required for the protection of structural steel or iron except as otherwise provided in this paragraph. Above fire-protective hung ceilings and within the enclosed space in building of Type 1 and Type 2 construction within which, other than the enclosure, fire protection of steel is not required, pipes, wires, conduits and ducts may be placed, provided they are so arranged and so secured that they will not, either by expanding in the event of fire, or otherwise impair, the effectiveness of the enclosing protective materials. Electric conduits and wires and gas pipes may be embedded in concrete or masonry fire protection of structural steel where the protective material is reinforced with wire mesh, provided they shall have protective covering except over the tops of beams and girders, at least as thick as required for the steel.

F-402.2.26 Damage protection: In factories, garages, warehouses and other buildings in which the fire-protective covering required for steel or iron columns may be damaged by the movement of vehicles, materials or equipment, such covering shall be protected by metal or other material in a manner satisfactory to the building official.

F-402.2.27 Firestopping: Firestopping shall mean the stopping off or enclosure at the ends and

wherever else specified of the spaced between studs of partitions, joists of floors and roofs and other similar spaces to prevent drafts of air and the communication of fire from one such space to another. Fire-stopping shall consist of wood not less than 1½ inches thick, of sheet metal not less than No. 24 gauge or of masonry, or a combination of such materials. Firestopping shall

F-402.3.1 Protective thickness: Structural steel columns required to have fire protection of a given rating shall be covered on all sides with protective material having not less than the thickness necessary for the required rating. Except where "no fill" is specified, re-entrant and other accessible spaces behind the specified outer protection shall be filled with concrete or brick masonry or the material of the outer protection.

F-402.3.2 Fireresistance rating: Materials shall be assumed to afford to steel columns fire protection of the rating indicated in the following Appendix F-402.3.3 through F-402.3.6:

F-402.3.3 Four hour rating:

1. Two inches Class 1 concrete.
2. Three inches Class 2 concrete, metal mesh reinforcement.
3. 3½ inches brick masonry.
4. Two layers two inch structural clay partition tile masonry, metal mesh in beds.
5. Two inches structural clay partition tile masonry, concrete fill, metal mesh in beds, ¾ inch gypsum plaster.
6. Four inches structural clay partition tile masonry, concrete fill, metal mesh in beds, _ inch lime plaster.
7. Four inches structural clay partition tile or concrete block masonry, concrete fill, plaster.
8. Three inches hollow gypsum tile masonry and plaster.
9. Two inches gypsum concrete, metal mesh reinforcement.
10. Two inches solid gypsum tile masonry and plaster.
11. Three inches solid cinder concrete block masonry and plaster.
12. Four inches hollow cinder concrete block masonry and plaster

F-402.3.4 Three hour rating:

1. 1¾ inches Class 1 concrete.
2. Two inches Class 2 concrete, metal mesh reinforcement.
3. Two inches gypsum concrete.
4. Two inches solid cinder concrete block masonry and plaster.
5. Two inches structural clay partition tile masonry, concrete fill.

be tightly fitted in the space to be filled, about pipes, wires and ducts and, if cut or disturbed in the placement of pipes, wires and ducts, shall be repaired.

F-402.3 Fire protection of steel columns:

6. Four inches structural clay partition tile masonry, concrete fill, metal mesh in beds, _ inch lime plaster.

F-402.3.5 Two hour rating:

1. 1½ inches Class 1 concrete.
2. Two inches Class 2 concrete, metal mesh reinforcement.
3. One inch Class 1 or Class 2 concrete encased in standard weight steel or wrought iron pipe.
4. Two inches structural clay partition tile masonry and plaster.
5. Two layers plaster, each on metal lath, with ¾ inch air space between, two inches total thickness.
6. Two inches gypsum concrete.
7. Two inches solid or three inches hollow gypsum tile masonry.

F-402.3.6 One hour rating:

1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete with metal mesh reinforcement.
3. 2¼ inches brick masonry.
4. Two inches structural clay partition tile or concrete block masonry.
5. One inch cement or gypsum plaster on metal lath.

F-402.3.7 Thickness: The thickness of protection on the outer edges of lugs or brackets need not exceed one inch.

F-402.4 Fire protection of cast iron columns:

F-402.4.1 Protective thickness: Cast iron columns required to have fire protection of a given rating shall be covered on all sides with protective materials having not less than the thickness necessary for the required rating. Re-entrant spaces, if any on the exterior of cast iron columns, and other accessible spaces behind the specified protection, shall be filled with Class 1 concrete or brick masonry or the material of the outer protection.

F-402.4.2 Fireresistance rating: Materials shall be assumed to afford to cast iron columns fire protection of the rating indicating in the following Appendix F-402.4.3 through F-402.4.5:

F-402.4.3 Four hour rating: Cast iron columns shall not be used where the protection of a four hour rating is required.

F-402.4.4 Three hour rating:

1. Two inches Class 2 concrete.
2. Three inches Class 2 Concrete, metal mesh reinforcement.
3. Two inches structural clay partition tile or concrete block masonry concrete fill.
4. 1½ inches cement or gypsum plaster on metal lath and metal furring to form ½ inch air space.
5. 1½ inches Class 1 concrete.
6. Two inches Class 2 concrete with metal mesh reinforcement.

F-402.4.5 One hour rating:

1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete with metal mesh reinforcement.
3. One inch cement or gypsum plaster on metal lath.

F-402.5 Fire protection of steel in reinforced concrete columns:

F-402.5.1 Protection thickness: The main steel reinforcement, including spiral reinforcement and ties larger than ½ inch, in reinforced concrete columns required to have fire protection of a given rating shall be covered with concrete having not less than the thickness listed in Appendix F-402.5 for the rating indicating in the following Appendix F-402.5.2 through F-402.5.6.

F-402.5.2 Four hour rating:
1. 1½ inches Class 1 concrete.
2. Two inches Class 2 concrete.

F-402.5.3 Three hour rating: 1½ inches Class 1 or Class 2 concrete.

F-402.5.4 Two hour rating:
1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete.

F-402.5.5 One hour rating: One inch Class 1 or Class 2 concrete.

F-402.5.6 Ties less than ½ inch: The thickness of protection on column ties not larger than ½ inch may be ½ inch may be ½ inch thinner than that listed above.

F-402.6 Fire protection of steel beams, girders, and trusses:

F-402.6.2 Protective thickness: Steel beams, girders and trusses or the members of trusses, required to have fire protection of a given rating, shall be covered on all sides with material having not less than the thickness necessary for the required rating.

F-402.6.3 Four hour rating:
1. Two inches Class 1 concrete.
2. Three inches Class 2 concrete.
3. Three inches structural clay partition tile or concrete block masonry and plaster.
4. Three inches hollow gypsum tile masonry and plaster.
5. Two inches gypsum concrete.
6. Two inches solid gypsum tile masonry and plaster.

F-402.6.4 Three hour rating:
1 1¾ inches Class 1 concrete.
2. 2½ inches Class 2 concrete.
3. Two inches gypsum concrete.
4. Two inches structural clay partition tile, or concrete block masonry and plaster.
5. Two inches solid, or three inches hollow gypsum tile masonry.

F-402.6.5 Two (2) hour rating:
1. 1½ inches of Class 2 concrete.
2. Two inches gypsum concrete.

F-402.6.6 One hour rating:
1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete.
3. _ inch or cement or gypsum plaster on metal lath.

F-402.7 Fire protection of steel in reinforced concrete beams:

F-402.7.1 Protective thickness: The main steel reinforcement, including stirrups larger than ½ inch, in reinforced concrete beams, girders and trusses, including the ribs of reinforced concrete ribbed floors or roofs where one or both sides of the ribs, in addition to the soffit, are exposed to fire, required to have fire protection of a given rating, shall be covered on all sides with concrete having not less than the thickness listed in Appendix F-402.7 for the required rating. Where a reinforced concrete floor or roof has a flush ceiling formed with approved permanent masonry filler between ribs, the reinforcement shall have the protection required for reinforcing steel of floors and roofs in Appendix F-402.8.

F-402.7.2 Four hour rating:
1. 1½ inches Class 1 concrete.
2. Two inches Class 2 concrete.

F-402.7.3 Three hour rating: 1½ inches Class 1 or Class 2 concrete.

F-402.7.4 Two hour rating:
1. One inch Class 1 concrete.
2. 1½ inches Class 2 concrete.

F-402.7.5 One hour rating: One inch Class 1 or Class 2 concrete.

F-402.7.6 Stirrups less than ½ inch: The thickness of protection on stirrups not larger than ½ inch may be less than that listed by not more than ½ inch.

F-402.8 Fire protection of steel reinforcing in floors and roofs:

F-402.8.1 Protection thickness: The steel reinforcement in reinforced concrete floors and roofs with flush or plane ceiling, such that the exposure to fire is on the soffit only, required to have fire protection of a given rating, shall be covered with concrete having not less than the thickness listed in Appenfix F-402.8 for the

required rating. In floors or roofs having reinforced concrete ribs where the concrete surrounding the steel reinforcement is exposed to fire on one or both sides in addition to the soffit, such reinforcement shall have the protection

2. 1¼ inches Class 2 concrete.

F-402.8.3 Three hour rating: One inch Class 1 or Class 2 concrete.

F-402.8.4 Two hour rating:

1. ¾ inch Class 1 concrete.
2. One inch Class 2 concrete.

F-402.8.5 One hour rating: ¾ inch Class 1 or Class 2 concrete.

F-402.9 Fireresistive floor and roof construction:

F-402.9.1 Protective thickness: Floors and roofs required to have resistance of a given rating to the spread of fire shall have such thickness of the materials of which it is constructed, as shall be necessary for the required rating, and structural metal forming a part of such floors or roofs shall have protection against fire of such required rating. Floors and roofs required to have two hour or longer resistance to fire be constructed of noncombustible materials. Granolithic, burned clay tile, ceramic tile or other similar incombustible floor finish of a given thickness may be substituted for an equal thickness, and sand, cinder or other incombustible filling material, with or without embedded wooden screeds, may be substituted for _ its thickness, of the floor or roof construction material specified in Appendix F-402.9, provided that such floors and roofs shall have adequate thickness for structural purposes.

F-402.9.2 Fireresistance rating: Floor or roof construction shall be assumed to afford resistance to the spread of fire of the rating indicated in the following Appendix F-402.9.3 through F-4029.6:

F-402.9.3 Four hour rating:

1. Four inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.
2. Four inches solid masonry arched or slabs.
3. Four inches structural clay floor tile masonry arches or slabs with top covering of not less than two inches of solid masonry or reinforced concrete.
4. Five inches combination reinforced Portland cement concrete slab consisting of permanent fillers of concrete block, gypsum or structural clay tile and 1½ inches of concrete topping; but if structural clay partition tiles are specified in Appendix F-402.7 for steel in reinforced concrete beams.

F-402.8.2 Four hour rating:

1. One inch Class 1 concrete.

used for fillers, they shall be plastered on the soffit.

F-402.9.4 Three hour rating:

1. Three inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.
2. Three inches solid masonry arches or slabs.
3. Four inches structural clay floor tile masonry, arches or slabs with top covering of not less than 1½ inches of solid masonry or reinforced concrete.
4. Four inches combination reinforced Portland cement concrete slab consisting of permanent fillers of concrete block, gypsum or structural clay tile and one inch concrete topping; but if structural clay partition tiles are used for fillers, they shall be plastered on the soffit.

F-402.9.5 Two hour rating:

1. 2½ inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.
2. 2½ inches solid masonry arches or slabs.
3. Three inches structural clay floor tile masonry, arches or slabs with top covering of not less than one inch of solid masonry or reinforced concrete.

F-402.9.6 One hour rating:

1. Three inches structural clay floor tile masonry, arches or slabs with all joints thoroughly filled with cement or gypsum mortar.
2. Wood floor or roof construction with joists not less than 1_ inches in least dimension, firestopped, double board floor, approved asbestos felt between lay of boards, and with a ceiling of at least ¾ inch cement or gypsum plaster on metal lath.
3. Steel beams or steel joists not more than 36 inches apart on centers with noncombustible floor and a ceiling of at least ¾ inch cement or gypsum plaster on metal lath furring.

F-**402.10 Fireresistive ceiling construction**:

F-402.10.1 Protective thickness: Ceilings required to afford fire protection of a given rating to the floor or roof framing under which it is supported shall be of fireresistive materials of at least the thickness necessary for the given rating. A fireresistive ceiling and all hangers and fastenings necessary for its support to the

protected framing shall be of noncombustible materials. It shall be capable of sustaining its own weight without exceeding allowable stresses. Metal reinforcement in such a ceiling shall be protected from fire as specified in Appendix F-402.8 for reinforcing in a floor.

F-402.10.2 Fireresistance rating: Ceiling construction shall be assumed to afford to floor or roof framing fire protection of the rating indicated in the following Appendix F-402.10.3 through F-402.10.6.

2. Two inches precast reinforced gypsum concrete, plastered.

F-402.10.4 Three hour rating:

1. Two inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.
2. Two inches precast reinforced gypsum concrete, lapped or rabbeted joints.

F-402.10.5 Two hour rating: 1½ inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.

F-402.10.6 One hour rating: ¾ inch cement or gypsum plaster on metal lath.

F-402.11 Fireresistive bearing walls and partitions:

F-402.11.1 Protective thickness: Bearing walls and partitions required to have resistance to fire or the spread of fire of a given rating shall be constructed of fireresistive materials and shall have at least the thickness necessary for the required rating. Walls required to have two hour or longer rating shall be of noncombustible materials. Steel reinforcement in reinforced concrete walls shall have the same protection for the given rating as is required in Appendix F-402.9 for floors.

F-402.11.2 Fireresistance rating: Bearing walls and partitions shall be assumed to have resistance to fire and the spread of fire of the rating indicated in the following Appendix F-402.11.3 through F-40211.6:

F-402.11.3 Four hour rating:

1. Eight inches solid brick masonry.
2. 12 inches hollow wall of brick masonry, minimum eight inch masonry thickness.
3. 12 inches structural clay load-bearing tile masonry with two units and not less than three cells in the thickness of the wall.
4. Eight inches structural clay load-bearing tile masonry with one unit and not less than two cells in the thickness of the wall, plastered both sides.

F-402.10.3 Four hour rating:

1. 2½ inches solid slab of reinforced Portland cement concrete or reinforced precast gypsum concrete.

5. 12 inches concrete block masonry with one unit and not less than two cells in the thickness of the wall.
6. Eight inches one piece concrete block masonry with shells and webs at least 1½ inches thick, plastered both sides.
7. 12 inches total thickness of brick masonry facing bonded to structural clay load-bearing tile masonry backing.
8. Eight inches solid concrete.
9. Six inches solid reinforced concrete.
10. A steel or reinforced concrete frame bearing wall in which the steel has fire protection of four hour rating, with panel filling as specified in Appendix F-402.12 for a nonbearing wall of four hour rating.

F-402.11.4 Three hour rating:

1. Eight inches structural clay load-bearing tile masonry with two units and not less than four cells in the thickness of the wall.
2. 12 inches structural clay load-bearing tile masonry with one unit and not less than three cells in the thickness if the wall.
3. Eight inches one piece concrete block masonry with shells and webs not less than 1½ inches thick, plastered both sides.
4. Eight inches one piece concrete block masonry with shells and webs not less than two inches thick.
5. Five inches solid reinforced concrete.
6. A steel or reinforced concrete frame bearing wall in which the steel has fire protection of three hour rating, with panel filling as specified in Appemdix F-402.12 for a nonbearing wall of three hour rating.

F-402.11.5 Two hour rating:

1. Eight inches structural clay load-bearing tile masonry with not less than three cells in the thickness of the wall.
2. Eight inches concrete block masonry with shells and webs not less than 1½ inches thick.

3. A steel or reinforced concrete frame bearing wall in which the steel has fire protection of two hour rating, with panel filling as specified in Appendix F-402.12 for a nonbearing wall of two hour rating.

F-402.11.6 One hour rating:

1. A steel or wooden stud bearing wall covered on both sides with one inch cement or gypsum plaster on metal lath, firestopped if of wood.
2. A steel or reinforced concrete frame bearing wall in which the steel has fire protection of one hour rating, with panel filling as specified in Appendix F-402.12 for a nonbearing wall of one hour rating.

F-402.12.2 Fireresistance rating: Nonbearing walls and partitions shall be assumed to have resistance to fire and the spread of fire of the rating indicated in the following Appendix F-402.12.3 through F-402.12.6.

F-402.12.3 Four hour rating:

1. Eight inches solid brick masonry.
2. 3½ inches solid brick masonry, plastered goth sides.
3. Six inches structural clay load-bearing tile, plastered both sides.
4. Six inches solid concrete.
5. Four inches solid reinforced concrete.
6. Any wall which, as a bearing wall, has a three hour or four hour rating in Appendix F-402.11, except the steel or reinforced concrete frame bearing wall.

F-402.12.4 Three hour rating:

1. 3½ inches solid brick masonry.
2. Four inches structural clay load-bearing tile, plastered both sides.
3. Four inches solid concrete.
4. Three inches reinforced concrete.
5. Any wall which, as a bearing wall, has a two hour rating in Appendix F-402.11 except the steel or reinforced concrete frame bearing wall.

F-402.12.5 Two hour rating:

1. Three inches gypsum tile masonry plastered both sides except in exterior walls.
2. Eight inches structural clay partition tile masonry, plastered both sides.
3. Eight inches structural clay load-bearing tile, with three cells in the thickness of the wall.
4. 2½ inches solid cement or sanded gypsum plaster on metal lath and noncombustible studding.
5. Three inches total thickness of hollow wall, ¾ inch cement or gypsum plaster on metal lath and noncombustible studding.

F-402.12 Fireresistive nonbearing walls and partitions:

F-402.12.1 Protective thickness: Nonbearing walls and partitions required to have resistance to fire and the spread of fire of a given rating shall be constructed of fireresistive materials and shall have at least the thickness necessary for the required rating. Walls required to have two hour or longer rating shall be of incombustible materials. Steel reinforcement in reinforced concrete walls shall have the same protection for the given rating as is required in Appendix F-402.8.

6. Three inches total thickness of hollow wall, ¾ inch cement or gypsum plaster on metal lath and wooden studding, firestopped.

F-402.13 Fireresistive doors:

F-402.13.1 General: Doors which are required to be fire doors, fireresistive doors, or of fireresistive construction shall conform to the requirements of Appendix F-402.13 and Appendix F-402.14

F-402.13.2 Classification: Fire doors shall be classified for the proposes of this code as Class A, Class B, and Class C.

F-402.13.3 Class A fire doors: Class A fire doors shall be doors of the following construction and as specified in Appendix F-402.14:

1. Tin-clad, three ply wood core, sliding.
2. Tin-clad, three ply wood core, swinging single leaf, doorway not over six feet wide.
3. Tin-clad, three ply wood core, swinging in pairs, doorway not over feet wide.
4. Hollow metal, swinging single leaf, doorway not over four feet wide.
5. Hollow metal, swinging in pairs, doorway not over eight feet wide.
6. Sheet metal, sliding, single, doorway not over ten feet wide.
7. Sheet metal, sliding in pairs, doorway not over 12 feet wide.
8. Sheet metal, swinging single leaf, doorway not over feet wide.
9. Sheet metal, swinging in pairs, doorway not over ten feet wide.
10. Steel rolling doorway not over 12 feet wide.
11. Steel plate, doorway not over four feet wide.
12. Any other construction equal or superior to a tin-clad three ply wood core door in a standard fire test, for resistance to fire, the spread of fire and smoke, and transmission of heat.

F-402.13.4 Class B fire doors: Class B fire doors shall be doors of the following construction and as specified in Appendix F-402.14:

1. Tin-clad, three ply wood core.
2. *Tin-clad, two ply wood core, sliding, doorway not over ten feet wide.*
3. Tin-clad, two ply wood core, swinging single leaf, doorway not over six feet wide.
4. Tin-clad, two ply wood core, swinging in pairs, doorway not over ten feet wide.
5. Hollow metal, sliding, doorway not over eight feet wide.
6. Metal-clad, paneled, swinging single leaf, doorway not over three feet wide.
7. Metal-clad, paneled, swinging in pairs, doorway not over six feet wide.
8. Any other construction equal or superior to a tin-clad two ply wood core door in a standard fire test, for resistance to fire, the spread of fire and smoke, and transmission of heat.

F-402.13.5 Class C fire doors: Class C Fire doors shall be doors of the following construction and as specified in Appendix F-402.14:

1. Metal-clad, paneled, swinging single leaf, doorway not over four feet wide.
2. Metal-clad, paneled, swinging in pairs, doorway not over eight feet wide.

F-402.13.6 Substitution: A Class A door may be used where Class b or Class C is specified; a Class B door may be used where Class C is specified. Two Class B or Class C doors on opposite sides of the wall may be used where a single Class A or Class B door is specified.

F-402.13.7 Overlap: Fireresistive doors, when closed, shall completely cover the doorways in the walls and partitions or the openings in the floors or roofs to which they ar fitted. A swinging fire door shall either overlap both jambs and the head of the opening not less than four inches or be fitted to a fireresistive frame with a rabbet the full thickness of the door and with not less than ½ inch overlap on the door. A sliding fire door, except in enclosures about passenger elevators, shall overlap both jambs and the head of the opening not less than four inches. A sliding fire door in an enclosure about a passenger elevator shall overlap jambs, head and adjoining panels not less than ½ inch. Fire doors shall fit closely at the floor with clearance of not over ¼ inch.

F-402.13.8 Thresholds: In buildings with combustible floors, doorways required to have fire doors shall have noncombustible thresholds the full thickness of the wall, extending at least four inches from the face of the wall where a door is hung and extending laterally at least six inches behind each jamb of the doorway. Thresholds may be flush with the floor.

F-402.13.9 Rabbeted frame: The rabbeted frame of a swinging fire door shall be constructed of structural steel built into the concrete, masonry or other fireresistive material of the wall about the opening and secured thereto, except that the rabbeted frame of a Class B or C door may be of wood, covered with sheet metal not less than No. 26 gauge in thickness, secured to the wall in the opening.

F-402.13.10 Fit: Fire doors when closed shall fit tightly against the wall or frame so as to provide an effective stop for fire and smoke. Except for the metal-covered wooden frame specified in Appendix F-402.10, combustible material shall not intervene between the door and the fireresistive material of the wall, floor or roof to which it is fitted.

F-402.13.11 Hardware: Hinge hardware for fire doors shall be of malleable iron or rolled structural steel not less than ¼ inch thick except that tubular steel track for sliding doors may be not less than _ inch thick. Equivalent thickness of solid bronze or brass may be used. Fire doors shall not depend upon cords, cables or chains to support them in closed position except in elevator shafts.

F-402.13.12 Tracks: Tracks for sliding fire doors shall be so supported that a track hanger comes at each door hanger when the door is closed. Track hangers shall be secured to wood stud walls by through bolts and to concrete walls by through bolts or approved built-in inserts. Expansion shields shall not be used to support fire doors.

F-402.13.13 Hinges: Hinges for swinging fire doors, except in wooden stud walls, shall be riveted or through-bolted to the structural steel frame of the opening, through-bolted to the wall if of masonry or concrete or secured by approved inserts in the concrete or built into masonry in an approved manner

F-402.13.14 Strap hinges: Strap hinges and sliding door hangers shall be secured to fire doors by through-bolting, riveting or welding. Swinging fire doors in rabbeted frames, except tin-clad, wood core doors, may be hung on butts. Other swinging fire doors shall have strap hinges.

F-402.13.15 Straps, locks and latches: Sliding fire doors shall have adequate stops for the closed position. Swinging Class A fire doors shall have surface lathes or unit locks. Class B and C doors shall have surface latches, unit or mortise locks.

The latch bolts of unit or mortise locks on fire doors shall have a throw of ¾ inch. When mounted in pairs, fire doors shall be rabbeted by means of an astragal or otherwise where they come together. One of a pair of swinging fire doors shall have push bolts at top and bottom with a throw of ¾ inch and the other shall be held by latch to the first.

F-402.13.16 Opening hardware: Except in detention buildings, fire doors hung in required exits shall be so fitted with hardware that they can be opened from inside without use of a key when the building is occupied.

F-402.14 Fire door construction:

F-402.14.1 Fastening: In the construction of fire doors, solder shall not be used except for filling joints. Sheet metal shall be fastened to wood by nailing and to metal frame by bolting, riveting or welding.

F-402.14.2 Glass: Class A doors shall not have glass panels. Class B doors may have glass panels not larger than 100 square inches in exposed area nor more than 12 inches in width or height. Class C doors amy have glass panels not larger than 2,016 square inches in total exposed area, and any single light shall not have an exposed area exceeding 1,296 square inches. Glass in fire doors shall be wire glass not less than ¼ inch thick and shall be set _ inch in grooves ¾ of an inch deep.

F-402.14.3: Deleted

F-402.14.4 Tin-clay, two ply: In-clad, two ply wood core doors shall be shall be constructed in accordance with the specifications of the National Board of Fire Underwriters for such doors in Class B openings and shall bear the label of the Underwriters' Laboratories to this effect.

F-402.14.5 Hollow metals: Hollow metal doors shall have substantial stiles and rails of heavy pressed steel, reinforced for hinges and other hardware. Panels shall be of sheet filled with asbestos board or other approved insulating materials. The door shall be assembled by welding or riveting.

F-402.14.6 Sheet metals: Sheet metal doors shall be constructed with a rolled steel rigid frame covered both sides with $^{1}/_{16}$ inch asbestos board and No. 26 gauge corrugated steel metal, with corrugations vertical on one side and horizontal on the other, bound on the edges with rolled steel or pressed steel shapes.

F-402.14.7 Steel rolling: A steel rolling fire door shall be constructed of sheet steel interlocking slats, sliding in grooves, counterweighted by springs, with the roller and mechanism enclosed in heavy sheet metal.

F-402.14.8 Steel plate: A steel plate fire door shall be constructed of not less than No. 12 gauge steel plate mounted on a rolled steel frame, assembled by welding or riveting.

F-402.14.9 Metal clad: A metal clad, paneled fire door shall have a wood core with stiles and rails not less than 1¾ inches thick covered with No. 26 gauge sheet steel; panels ¾ inch thick covered with No. 26 gauge sheet steel, set ¾ inch in grooves; joints of metal lapped and well nailed.

F-402.14.10 Class A label: A door properly bearing the Underwriters' label certifying that it is suitable for the protection of a Class A opening shall be acceptable as a Class A door.

F-402.14.11 Class B label: A door properly bearing the Underwriters' label certifying that it is suitable for the protection of a Class B opening shall be acceptable as a Class B door, except that metal clad doors wider than three feet shall not be accepted as Class B doors.

F-402.14.12 Class C label: A door properly bearing the Underwriters' label certifying that it is suitable for the protection of a Class C opening shall be acceptable as a Class C door.

F-402.15 Fireresistive shutters: Shutters required to be fire shutters or fireresistive shutters shall be constructed and hung as specified for Class B fireresistive doors in Appendix F-402.13 and F-402.14.

F-402.16 Fireresistive windows:

F-402.16.1 General: Windows which are required to be fire windows, fireresistive windows, or of fireresistive construction shall conform to the requirements of Appendix F-402.16.

F-402.16.2 Moveable: Firereisistive windows may be fixed or arranged to open and close. Fixed fireresistive windows shall be so secured in the walls in which they are placed that they may expand in case of fire without buckling. Moveable firereisitive windows shall be opened or closed in one of the following manners:

1. One or more sashes may slide horizontally in a fireresistive frame.
2. One or more sashes may slide vertically with counterweights or with tow sashes counterbalanced and hung on chains. If a sash is closed in raised position, it shall have a fastening.
3. A sash may be hinged at top, bottom, or either side.
4. A sash may be pivoted at top and bottom or at the sides.
5. A sash may be arranged to open and close in any other approved manner, with approved hardware.

F-402.16.3 Sash: Moveable sashes in fireresistive windows shall be furred to fireresistive frames of the same or similar construction. Both sashes and frames, and metal mullions between window units, shall be so fitted in the walls in which they are placed as to be continuous with the fireresistive material of the wall and so secured that they may expand in case of fire without buckling.

F-402.16.4 Glass: Glass in firereisistive windows shall be wired glass not less than ¼ inch thick and the area of a single light shall not exceed 720 square inches. Glass shall be set _

F-402.16.7 Rolled steel: Fireresistive windows of rolled steel construction shall not exceed 84 square feet in area not 12 feet in either height or width.

F-402.16.8 Wind pressure: Fireresistive windows and their fastenings shall be capable of resisting the wind pressure on the wall of the building applied either on he inside or the outside of the window exceeding allowable stresses.

F-402.16.9 Substitution: Where fireresistive windows are required, wooden windows and plain glass may be substituted provided the openings are protection by fireresistive doors or shutters, or, in buildings of approved occupancy and construction, by an approved system of open sprinklers.

F-402.17 Fireresistive roof covering:

F-402.17.1 Classification: Roof covering allowed under this code shall be classified as fire-retardant or ordinary, according to resistance to fire outside, as provided in Appendix F-402.17. Fire-retardant roof covering is the more firereisistive and may be used where fire-retardant roofing is specified. Roof covering less fireresistive than ordinary roof covering shall not be used on any building.

inch grooves at least ½ inch deep. Glass shall be secured by glazing angles or molding screwed to the sash and forming continuous grooves for the glass.

F-402.16.5 Construction: Fireresistive windows shall be of the following construction:
1. Hollow sheet metal sashes and frames fabricated by pressing, welding, riveting or crimping without the use of solder or other fusible alloy, except for filling joints, and bearing the label of Underwriters' Laboratories.
2. Rolled steel or pressed steel sashes fabricated by pressing, welding, riveting or crimping, of a make and style approved by the commissioner.
3. Any other approved constructions as fireresistive as that specified in Appendix F-402.16.5 item.

F-402.16.6 Hollow sheet metal: Fired fireresistive windows of hollow sheet metal construction shall not exceed seven feet in width not ten feet in height. Fireresistive windows of hollow sheet metal construction with moveable sashes shall not exceed six feet in width nor ten feet in height.

F-402.17.2 Fire-retardant roofing: Fire-retardant roofing shall be any roof covering than meets the requirements of Class A or Class B roofing under the specifications of the Underwriters' Laboratories, Inc. The following roof covering shall be assumed to meet the requirements for fire-retardant roofing:
1. Built-up roofing consisting of successive layers of roofing felt impregnated with asphalt; a final layer of asphalt in which, while molten, is embedded a continuous layer of roofing gravel or slag.
2. Built-up roofing consisting of successive layers of roofing felt impregnated with coal tar; a final layer of tar in which, while molten, is embedded a continuous layer of roofing gravel or slag.
3. Built-up roofing consisting of successive layers of roofing felt impregnated with asphalt; a final layer of asbestos roofing felt impregnated with asphalt weighing not less than 14 pounds per 100 square feet, or a final layer of asphalt-saturated prepared roofing coated with granulated slate or other similar material.
4. Built-up roofing consisting of successive layers of roofing felt impregnated with tar or asphalt and a finish of burned clay floor tile, stone flagging, cement concrete or other similar material.

5. Sheet metal with locked and soldered joints not less than No. 26 gauge in thickness.
6. Shingles of natural slate.
7. Shingles of burned clay tile.
8. Shingles of sheet metal not less than No. 26 gauge in thickness.
9. Shingles of asbestos board not less than _ inch thick.
10. Shingles of asphalt saturated felt surfaced with granulated slate or other similar material and carrying the Underwriters Class "C" label.
11. Corrugated sheet metal with lapped joints not less than No. 26 gauge in thickness.
12. Corrugated asbestos board not less than $^{3}/_{16}$) inch thick.

F-402.17.3 Ordinary roofing: Ordinary roofing shall be of any roof covering which meets the requirements of Class C roofing under the specifications of the Underwriters' Laboratories, Inc. The following roof covering shall be assumed to meet the requirements for ordinary roofing:

1. Built-up roofing consisting of successive layers of roofing felt impregnated with asphalt, coal tar or other approved material, not equal in fireresistance to a fire-retardant roofing.
2. Prepared roofing consisting of felt or fabric impregnated or coated, or both, with asphalt, tar or other approved material or shingles of such prepared roofing, not equal in fireresistance to fire-retardant roofing.
3. Canvas stretched tightly and coated with paint.

F-402.17.4 Means of securing: Built up roofing shall be secured to the roof deck in the following manner:

1. Over masonry slab, the first layer shall be laid in molted asphalt or tar mopped on the roof deck, after the deck is properly primed, or by nailing a layer of building paper to nailing inserts other than wood placed in the deck.
2. Over wood decks, the built-up roofing shall be secured by nailing a layer of building paper to the roof deck over which the prepared roofing is to be laid with the first layer laid in molten asphalt or tar.
3. Roofings other than built-up roofings, such as shingles, slates, and tile roll roofing shall be well secured to the deck by nailing, bolting, wiring, or other approved methods.