REFERENCE STANDARD RS-5
FIRE PROTECTION
CONSTRUCTION REQUIREMENTS
* LIST OF REFERENCED NATIONAL STANDARDS

AISG	Fire Resistance Ratings, as Modified	1985
AISI FT-900-0480	Designing Fire Protection for Steel Columns, Third Edition	1980
AISI FT-901-0481	Fire Resistant Rating of Load Bearing Steel Stud Walls	1981
AISI FT-902-0285	Designing Fire Protection for Steel Beams	1984
AISI FT-227-1281	Designing Fire Protection for Steel Trusses, Second Edition	1981
GA-600	Fire Resistance Design Manual, Twelfth Edition, as Modified	1988
NFoPA	Report No. WHI-694-020, Report of Testing on a Load Bearing Stud Partition	1981
NFoPA	Report No. WHI-690-003, Report of Testing on a Load-Bearing Stud Partition	1981
ASTM/E 119	Standard Methods of Fire Tests of Building Construction and Materials	1988
AWPA C 20	Structural Lumber-Fire Retardant Treatment by Pressure Processes	1988
AWPA C 27	Plywood Fire Retardant Treatment by Pressure Processes	1988
ASTM E 84	Standard Method of Test for Surface Burning Characteristics of Building Materials	1987
ANSI/ASTM E 69	Standard Test Method for Combustible Properties of Treated Wood by Fire-Tube Apparatus	1980
ANSI/ASTM E 160	Standard Test Method for Combustible Properties of Treated Wood by Crib Test	1980
ANSI/ASTM E 152	Standard Methods of Fire Test of Door Assemblies	1981a
ANSI/ASTM E 163	Standard Methods of Fire Test of Window Assemblies	1984
NFiPA 80	Standard for Fire Doors and Windows	1986
ANSI/ASTM E 108	Standard Methods of Fire Test of Roof Coverings	1983
NFiPA 204M	Guide for Smoke and Heat Venting	1985
ANSI/ASTM D635	Standard Test for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position	1981
ANSI/ASTM D568	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Flexible Plastics in a Vertical Position	1977
ANSI/ASTM D374	Standard Test Methods for Thickness of Solid Electrical Insulation	1979
ASTM E 814	Standard Method of Fire Tests of Through-Penetration Fire Stops	1983
DOC FF1	Methanine Pill Test	1970
ASTM E 648	Standard Test Method for Critical Radiant Flux of Floor Covering Systems using a Radiant Heat Energy Source	1988
ASTM E 662	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials	1983
***UBC Std. 26-9	Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-Bearing Wall Containing Combustible Components Using the Intermediate Scale,Multistory Test Apparatus	1997

Local Law 13-1987; Local Law 16-1984; 242-90 BCR; 1343-88 BCR; 236-87 BCR; 1076-86 BCR; 262-86 BCR; 435-85 BCR; 252-82 BCR

****DOB 3-4-01***

**REFERENCE STANDARD RS 5-1A

AISG 1985-Fire Resistance Ratings, as modified. MODIFICATIONS-The provisions of the AISG Fire Resistance Ratings shall be subject to the following modifications:

1. Delete the following pages in their entirety: 22, 24, 45, 46***, 48, 52, 54, 76, 84, 97, 98, 99, 102, 110, 115, 117.

2. Delete the specified items on the following pages:

PAGE	DESCRIPTION-SPECIFIED ITEMS
25	Protection Type-Unprotected Rating(s) of 45 and 30 min. comb.
28	Protection Type-None Rating(s) of 45 min. comb.
29	2 1/2 slab thickness-Rating 30 min.

41 Ceiling Type-None Rating 5 min.
47 Ceiling Type-Gypsum Wallboard Rating of 30 min. comb.
48 Ceiling Type-Gypsum Wallboard Rating of 25 min. comb.
50 Ceiling Type-Plaster on Gypsum Lath Rating(s) of 45 min. and 30 min. comb.
62 Type-Calcareous Gravel Rating(s) 30 min. and 20 min. comb.
63 Type-Cinder Rating 45 min.
65 Type-Expanded clay, shale or slate (Rotary kiln) Rating 45 min.
68 Type-Siliceous Gravel Rating(s) 20 min. and 15 min.
77 Plaster Type-Gypsum Neat Rating 45 min.
83 Plaster Type-Gypsum and Sand Rating 45 min.
91 Plaster Type-Portland Cement and Sand Rating(s) 45 min. and 30 min.
95 Type-Clay or Shale Rating 45 min.
103 Finish Type-Laminated Wood Rating(s) 45 min., 30 min., 25 min., 15 min. and 10 min. comb.
104 Finish Type-Asbestos Cement Board Rating(s) 40 min. and 30 min. comb.
107 Plaster Type (4)-Gypsum and Sand Rating(s) 45 min. and 30 min. comb.
109 Plaster Type (5)-Gypsum and Sand Rating(s) 45 min., 30 min. and 20 min. comb.
111 Plaster Type-Gypsum and Sand Rating 30 min. comb. Lime and Sand Rating(s) 45 min., 30 min. and 25 min. comb.
112 Finish Type-Asbestos Cement Board Rating(s) 30 min. and 10 min. comb.
114 Finish Type-Gypsum Wallboard Rating(s) 45 min., 30 min., and 25 min. comb.
117 Finish Type-Wood Rating 45 min. comb.

3. An equivalent blend of mineral fibers and cementitious binders may be substituted for asbestos-cement material on the following pages: 46, 51, 52, 92, 104, 112, 114.

****1076-86 BCR

As enacted, but "46" probably intended to be omitted.

* REFERENCE STANDARD RS 5-1B

GA-600 1988-Fire Resistance Design Manual, Twelfth Edition, as Modified.

MODIFICATIONS.-The provisions of GA-600-1988 shall be subject to the following modifications:

1. Revise the heading on the top of page five in the section on USE OF MANUAL to read as follows:

LIMITING HEIGHTS

(a) NONLOAD-BEARING PARTITIONS

2. Insert the following after the paragraphs on (a) NONLOAD-BEARING PARTITIONS and before the heading PERFORMANCE OF PLASTER:

(b) LOAD BEARING PARTITIONS

Lateral bracing and height limitations shall be designed in accordance with the applicable reference standard independent of the sheathing.

3. In the section on GENERAL EXPLANATORY NOTES under the heading USE OF MANUAL, add the following paragraph:

15. All concrete slabs shall be structurally adequate. Such slabs shall have a minimum compressive strength of 3000 psi., with the reinforcement and thickness at least that as shown in the test.

4. In the assemblies listed under the heading WALLS AND INTERIOR PARTITIONS, NONCOMBUSTIBLE, the following requirements are added to the Detailed Description for (LOAD BEARING) assemblies:

WP 1204, WP 1206, WP 1635, WP 1714 and WP 1716 under the GA and Company Codes:

Steel Studs.-Steel studs shall be a minimum of 3 1/2 inches wide and a minimum galvanized steel or 18 GA (.0478) or heavier, primed steel, cold-formed, and shall comply with Reference Standard RS 10-6 (Specification for the Design of Cold-Formed Steel Structural members by AISI, as modified). Lateral supporting members and all details enhancing the structural integrity of the wall assembly shall be as specified by the steel stud designer, and shall meet the applicable requirements of the Code.

5. In the assemblies listed under METAL CLAD EXTERIOR WALLS, assemblies WP 9010, WP 9060, WP 9225, WP 9325, under the GA File No. heading, are deleted in its entirety.

6. Insert the following heading after the paragraph on USE OF PLENUM SPACE in the section on FLOOR-CEILINGS:

SUSPENSION SYSTEMS

Suspended ceilings contained herein shall comply with the requirements of Reference Standard RS 5-16.

7. In the assemblies listed under FLOOR-CEILING ASSEMBLIES, NON-COMBUSTIBLE, assembly FC 4120, under the GA File No. heading, is deleted in its entirety.

8. In the assemblies listed under FLOOR-CEILING ASSEMBLIES, WOOD-FRAMED, assembly FC 5105, under the GA File No. heading, is deleted in their entirety.

9. In the assemblies listed under BEAMS, GIRDERS, AND TRUSSES, assemblies BM 3310, BM 4410 and BM 4420, under the GA File No. heading, are deleted in their entirety.

10. The following assemblies which were listed in the Gypsum Association Fire Resistance Manual, Eleventh Edition, but do not appear in the Twelfth Edition, may continue to be used:

WP 1016
WP 1260
WP 1300
FC 5010
FC 5108
WP 1725
WP 7083
WP 7086
FC 5430

****242-90 BCR; 262-86 BCR***

** REFERENCE STANDARD RS 5-1C MISCELLANEOUS TEST REPORTS FOR LOAD-BEARING WALL ASSEMBLIES NON-COMBUSTIBLE: ONE, ONE AND ONE-HALF, AND TWO-HOUR FIRE RATINGS.

AISI FT-901-0481-1981- Fire Resistance of Load-Bearing Steel Stud Walls with Gypsum Wallboard Protection with or without Cavity Insulation.

MODIFICATIONS: The provisions of AISI FT-901-1981, are modified as follows:

1. Delete all Fire Resistive Assemblies with 45 minute ratings.
2. Substitute the following for paragraph 2:

Steel Studs-Corrosion-Protected steel studs, min. 3 1/2 inches wide, min. No. 18 GSG (0.047 inch thick) galvanized steel or No. 18 MSG (0.043 inch thick) primed steel, cold-formed, shall be designed in accordance with Reference Standard RS 10-6 (Specification for the Design of Cold-Formed Steel Structural members by AISI, as modified). All design details enhancing the structural integrity of the wall assembly including the axial design load of the studs, shall be as specified by the steel stud designer and/or the producer, and shall meet all applicable requirements of the code. The maximum stud spacing of wall assemblies shall not exceed 24 inches. Studs shall be attached to floor and ceiling tracks with 1/2 inch long Type S-12 pan head, self-drilling, self-tapping steel screws on both sides of the studs, or welded in accordance with RS 10-6.

3. Substitute the following for paragraph 3:

Lateral Supporting Members (not shown)-Lateral support or bracing shall be provided in accordance with Reference Standard RS 10-6 independent sheathing.

4. Substitute the following for paragraph 4:

Wallboard, Gypsum-Gypsum wallboard shall conform to ASTM C 36 Type X and be identified as such. The wallboard shall be applied vertically with joints between layers staggered. Outer layer of three-layer construction may be applied horizontally. The thickness and number of layers and percent of design load for the 1 hour, 1 1/2 hour and 2 hour ratings shall be as specified in the table above.

5. Substitute the following for paragraph 7:

Batts and Blankets-All insulation and noise control materials included in wall assemblies shall be Approved by the Board of Standards and Appeals or Accepted by the Materials and Equipment Acceptance Division of the Department of Buildings for the intended use.

252-82 BCR

UL FIRE RESISTANCE DIRECTORY
Design U 425

Interior Walls-Wallboard Protection Both Sides of Wall

Rating	Number of Layers and Thickness of Boards in Each Layer	Percent of Design Load
1 hr.	1 layer, 5/8 in. thick	100
1 1/2 hr.	2 layers, 1/2 in. thick	100
2 hr.	2 layers, 5/8 in. thick or	80
	*3 layers, 1/2 in. thick	100

*Ratings applicable to assemblies serving as exterior walls where Classified fire resistive gypsum sheathing type wallboard is substituted on the exterior face.

*Bearing the UL Classification Marking.

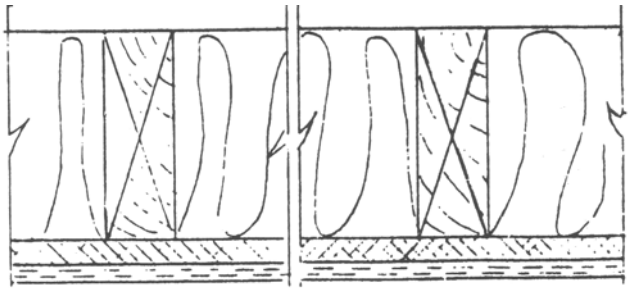
Exterior Walls-Wallboard Protection on Interior Side of Wall

Rating	Number of Layers and Thickness of Boards in Each Layer	Percent of Design Load
1 hr.	2 layer, 1/2 in. thick	100
1 1/2 hr.	2 layers, 5/8 in. thick	100
2 hr	3 layers, 1/2 in. thick	100

6. Steel Floor and Ceiling Tracks-Top and bottom tracks of wall assemblies shall consist of steel members, min. No. 20 GSG (0.036 in. thick) galv. steel or No. 20 MSG (0.033 in.) thick primed steel, that provide a sound structural connection between steel studs and to adjacent assemblies such as a floor, ceiling and or other walls. Attached to floor and ceiling, assemblies with steel fasteners spaced not greater than 24 in.

7. Fasteners-Screws used to attach wallboard to studs: self-tapping bugle head sheet steel type, spaced 12 in. o.c. First layer Type S-12 by 1 in. long; second layer Type S-12 by 1 3/8 in. long: third layer Type S-12 by 1 7/8 in. long.

8. Joint Tape and Compound-Vinyl or casein, dry or premixed joint compound applied in two coats to joints and screwheads of outer layer. Perforated paper tape, 2

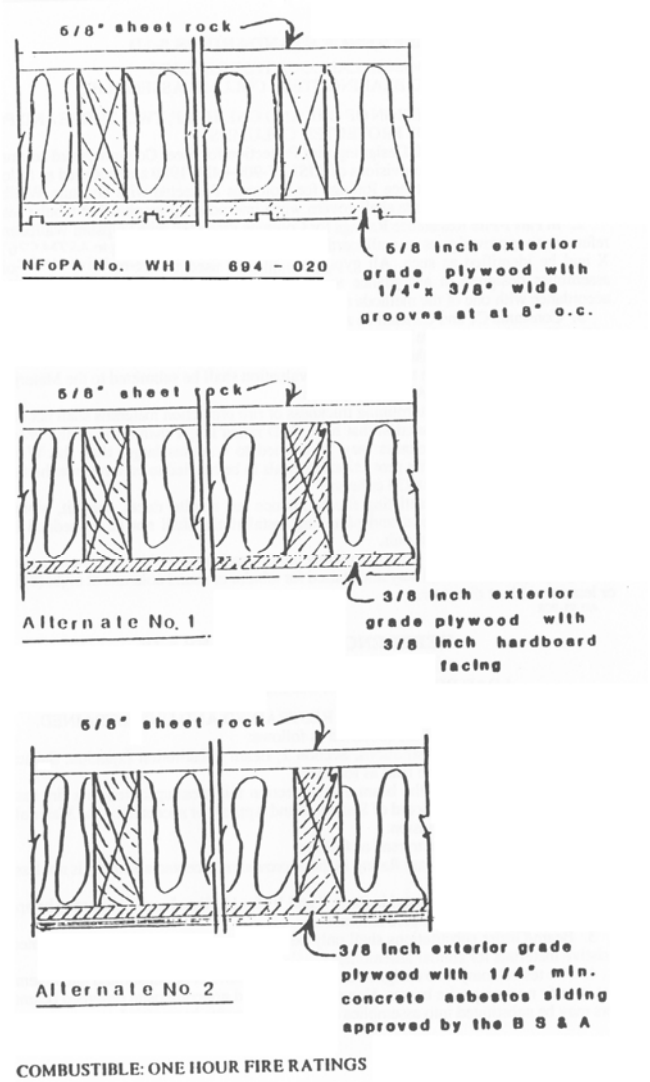


in. wide, embedded in first layer of compound over all joints of outer layer.

Report of Testing on a Load-Bearing Wood Stud Partition -Dated - October 19, 1981

Wall is constructed using 2 in. x 4 in. (nominal) wood studs spaced 16 in. on center. Fire exposed (interior) side is covered with 5/8 in. Type X Gypsum Wallboard applied vertically and fastened with 6d box nails on 7

in. centers. Unexposed side (exterior) is faced with a layer of 1/2 in. thick Fiberboard Sheathing (0.835 psf) applied vertically and fastened with 1 1/2 in. roofing nails on 3 in. centers at edges and 6 in. centers at intermediate supports. Hardboard Shiplap Edge Panel Siding, 3/8 in. thick (1.84 psf) is applied vertically over the Fiberboard Sheathing and fastened with 8d nails on 4 in. centers at edges and 8 in. centers at intermediate supports. The Cavity Spaces (stud spaces) are filled with Mineral Wool Batts having a density of 2.14 lbs./cu ft. (Mineral wool may be rock wool or slag wool of equivalent density.) All insulation and noise control materials included in wall assemblies shall be Approved by the Board of Standards and Appeals or Accepted by the Material and Equipment Acceptance Division of the Department of Buildings for the intended use. The maximum load permissible on the studs in this assembly shall be 2000 lbs. each.



COMBUSTIBLE: ONE HOUR FIRE RATINGS

Report of Testing on a Load-Bearing
Wood Stud Partition - Dated - October 9, 1981
Wall is constructed using 2 in. x 4 in. (nominal) wood studs spaced 16 in. on centers. Fire exposed side (interior) is covered with 5/8 in. Type X Gypsum Wallboard applied vertically and fastened with 6d box nails on 7 in. centers. Unexposed side (exterior) is faced with 3/8 in. thick (5/8 in. between grooves) exterior grade plywood panels applied vertically and fastened with 8d nails on 6 in. centers around edges and 12 in. centers at intermediate supports. The Cavity (stud) Spaces are filled with Mineral Wool Batts having a density of 2 lbs./cu. ft. (Mineral wool may be rock wool or slag wool of equivalent density.) All insulation and noise control materials included in wall assemblies shall be Approved by the Board of Standards and Appeals or Accepted by the Material and Equipment Acceptance Division of the Department of Buildings for the intended use.
The maximum load permissible on the studs in this assembly shall be 2000 lbs. each.

* REFERENCE STANDARD 5-1D
MISCELLANEOUS TEST REPORTS FOR LOAD BEARING STEEL COLUMN ASSEMBLIES NONCOMBUSTIBLE: DESIGN OF ONE, ONE AND ONE-HALF, TWO, THREE AND FOUR HOUR FIRE RATINGS OF PROTECTED COLUMNS

AISI FT-900-0480-1980 Designing Fire Protection for Steel Columns, third edition.

MODIFICATIONS: The provisions of AISI FT-900-0480-1980 are modified as follows:

1. In Part I-Fire Resistance Ratings for Columns Protected with Gypsum Wallboard values determined by formula shall govern when interpolating graphical or tabular results.
2. In Part I-Fire Resistance Ratings for Columns Protected with Gypsum Wallboard, all reference to approved gypsum wallboard shall infer material conforming to ASTM C36 Type X and be identified as such. All gypsum wallboard used in fire resistive steel column assemblies designed in accordance with this Reference Standard shall be installed in accordance with one of the methods recommended in this reference standard.
3. Constants C1 and C2 shall be applicable only to the materials identified in Section C of Part II-Calculating Fire Resistance Ratings for Columns Protected with Spray-Applied Materials. Constants for other spray-applied fire proofing materials shall be determined by ASTM E 119 fire tests. The tests and their evaluation shall be submitted to the Material and Acceptance Division (MEA) for acceptance.
4. The formulas for determining thickness of fire protection materials shall not be used with columns or built-up sections that have W/D ratios larger than those of the W14x233 shape. Fire protection thickness may be applied to columns larger than the W14x233 provided the thickness of fire protection materials to be applied to columns are the same as those required for the W14x233 column.
5. In absence of substantiating fire endurance test results, ducts, conduit, piping and similar mechanical, electrical and plumbing installations shall not be

embedded in any required fire protection materials.
6. The formulas in Part II for calculating the fire-resistance ratings of columns protected with spray-applied material may not be used for tubular or round columns of eight (8) inches or less in width or diameter.
435-85 BCR

**** REFERENCE STANDARD RS 5-1E**
MISCELLANEOUS TEST REPORTS FOR LOAD BEARING STEEL BEAM/GIRDER ASSEMBLIES

NONCOMBUSTIBLE ASSEMBLIES:
RESTRAINED AND UNRESTRAINED

AISI FT-902-0285-1984-Designing Fire Protection for Steel Beams.

MODIFICATIONS: The provisions of AISI FT-902-0285-1984 are modified as follows:
1. In Part V Beam Substitutions, Section 2, Beam Substitution Equation, Subscript 2 and its meaning is revised to read as follows:
Subscript 2 = refers to the beam and protection thickness specified in a fire resistive assembly approved by the Board of the Standards and Appeals or accepted by the Materials and Equipment Acceptance Division.
Subsection 3) is revised to read as follows:
3) the Unrestrained Beam Rating in the approved or accepted assembly is not less than one-hour.
2. The procedures illustrated in Parts V and VI for UL listed assemblies may be applied to similar approved and accepted assemblies.
3. Beam/Girder substitutions shall only be made for similar approved or accepted fire resistive materials for similar assemblies.
4. Fire tested composite designed beams/girders shall not be substituted into assemblies that specify noncomposite beams. However, fire tested noncomposite designed beams/girders may be substituted into assemblies utilizing composite beams/girders.
5. Ducts, conduit, piping and similar mechanical, electrical and plumbing installations shall not be embedded in required fire protection materials without substantiating fire endurance test results.
236-87 BCR

*** REFERENCE STANDARD RS 5-1F**
METHODS OF ANALYTICAL DETERMINATION OF FIRE RESISTANCE OF LOAD BEARING STEEL TRUSS ASSEMBLIES

NONCOMBUSTIBLE ASSEMBLIES:
RESTRAINED AND UNRESTRAINED

AISI FT-227-1281-1981-Designing Fire Protection for Steel Trusses.

MODIFICATIONS: The provisions of AISI FT-227-1281-1981 are modified as follows:
1. Analytically determined fire protection systems for trusses shall be based on fire resistive assemblies approved by the Board of Standards and Appeals or accepted by the Materials and Equipment Acceptance Division.
2. Methods of determining fire resistance of trusses utilizing the column formulas contained in AISI FT-900-0480 shall comply with the requirements and modifications specified in Reference Standard RS 5-1D.
236-87 BCR

REFERENCE STANDARD RS 5-2
ASTM E-119 – a) Standard methods Fire Test of Building Construction Materials 1988 or
b) a combination of small scale and/or half scale tests and engineering evaluation acceptable to the commissioner in conjunction with evaluation of full scale test conforming with ASTM E-119 for a variety of assemblies or combination of materials, or
c) a combination of small-scale, half-scale or full size tests representative of the actual fire exposure of the occupancy and engineering evaluations all acceptable to the commissioner. In either (a), (b), or
d) the materials or combinations of materials constructed shall be in accordance with the specifications of the materials used.
1343-88 BCR; 217-72 BCR

REFERENCE STANDARD RS 5-3
*** AWPA C20-1988-Structural Lumber-Fire Retardant Treatment by Pressure Processes.
****1343-88 BCR; 308-81 BCR; 398-71 BCR***

REFERENCE STANDARD RS 5-4
† AWPA C27-1988-Plywood Fire Retardant Treatment by Pressure Processes.
†1343-88 BCR; 308-81 BCR; 71-79 BCR

REFERENCE STANDARD RS 5-5
††a) ASTM E84-1987-Standard Method for Surface Burning Characteristics of Building Materials, or

b) a combination of small scale tests and engineering evaluations acceptable to the commissioner in conjunction with evaluation of full scale tests conforming with ASTM E84 for a variety of assemblies or combinations of materials. In the case of fire-retardant treated wood, the small scale tests utilized in conjunction with the full scale tests shall conform to either ANSI/ASTM E69-1980-Standard Test Method for Combustible Properties of Treated Wood by Fire-Tube Apparatus or ANSI/ASTM E160-1980-Standard Test Method for Combustible Properties of Treated Wood by the Crib Test.
††1343-88 BCR; 308-81 BCR; 218-72 BCR

REFERENCE STANDARD RS 5-6
† ANSI/ASTM E152-1981a-Standard Methods of Fire Tests of Door Assemblies.
†1343-88 BCR; 308-81 BCR; 71-79 BCR

REFERENCE STANDARD RS 5-7
†ANSI/ASTM E163-1984-Standard Method of Fire Tests of Window Assemblies.
†1343-88 BCR; 308-81 BCR; 71-79 BCR

REFERENCE STANDARD RS 5-8
†ANFiPA 80-1986 Standard for Fire Doors and Windows.
†1343-88 BCR; 308-81 BCR; 71-79 BCR

REFERENCE STANDARD RS 5-9
ROOF COVERING CLASSIFICATIONS

Description	Maximum Incline (In. to Ft.)	Class A	Class B	Class C
Brick Concrete Tile		(1) Brick, 2 1/2 in. thick. (2) Reinforced portland cement, 1 in. thick. (3) Concrete or clay floor or deck tile, 1 in. thick. (4) Flat or French-type clay or concrete tile, 3/8 in. thick with 1 1/2 in. or more end lap and head lock, spacing body of tile 1/2 in. or more above roof sheathing, with underlay of one layer of Type 15 asphalt-saturated asbestos felt or one layer of Type 30 or two layers of Type 15 asphalt-saturated rag felt. (5) Clay or concrete roof tile, Spanish or Mission pattern, 7/16 in. thick, 3 in. end lap, same underlay as above. (6) Slate, 3/16 in. thick, laid American method.		
Metal Roofing	12	Sheet roofing of 16 oz. copper or of 30-*gauge steel or iron protected against corrosion. Limited to non-combustible roof decks or non-combustible roof supports when no separate roof deck is provided.	Sheet roofing of 16 oz. copper or of 30-*gauge steel or iron tile, protected against corrosion; or shingle-pattern roofings with underlay of one layer of Type 15 saturated asbestos-felt, or one layer of Type 30 or two layers of Type 15 asphalt-saturated rag felt.	Sheet roofing of 16 oz. copper or of 30-*gauge steel or iron tile, protected against corrosion; or shingle-pattern roofings, either without underlay or with underlay or rosin-sized paper. Zinc sheets or shingle roofings with an underlay of one layer of Type 30 or two layers of Type 15 asphalt-saturated rag-felt or one layer of 14 lbs. unsaturated or one layer of Type 15 asphalt-saturated asbestos felt.
Cement-Asbestos Shingles	Exceeding 4	Laid to provide two or more thicknesses over one layer of Type 15 asphalt-saturated asbestos felt.	Laid to provide one or more thicknesses over one layer of Type 15 asphalt-saturated asbestos felt.	

As enacted but "gage" probably intended

REFERENCE STANDARD RS 5-10

*(a) ANSI/ASTM E108-1987-Standard Methods of Fire Tests of Roof Coverings, or

b) a combination of small scale and/or half scale tests and engineering evaluations acceptable to the commissioner in conjunction with evaluation of full scale tests conforming with ASTM E 108 for a variety of assemblies or combinations of materials.

1343-88 BCR; 308-81 BCR; 219-72 BCR

REFERENCE STANDARD RS 5-11

** NFiPA 204M-1985-Guide for Smoke and Heat Venting.

****1343-88 BCR; 308-81 BCR***

REFERENCE STANDARD RS 5-12

***ANSI/ASTM D 635-1981-Standard Test for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

*****1343-88 BCR***

REFERENCE STANDARD RS 5-13

†ANSI/ASTM D 568-1977-Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Flexible Plastics in a Vertical Position.

†308-81 BCR

REFERENCE STANDARD RS 5-14

†ANSI/ASTM D 374-1979-Standard Test Methods for Thickness of Solid Electrical Insulation.

†308-81 BCR

REFERENCE STANDARD RS 5-15
MINIMUM COVERING OF PRESTRESSING STEEL FOR VARIOUS FIRE RESISTANCE RATINGS

Type of Unit	Cross-Sectional Area[3] Sq. In.	Rating			
		1 Hour	2 Hour	3 Hour	4 Hour
Prestressed Girders, Beams, and Joists[1,2]	40 to 150	2 in.			
	150 to 300	1 1/2 in.	2 1/2 in.		
	over 300	1 1/2 in.	2 in.	3 in[4]	4 in[4]
Prestressed Slabs, Solid or Cored [1, 2]	—	1 in.	1 1/2 in.	2 in.	2 1/2 in.

Notes:

[1]Members with less covering shall be acceptable where tests show that adequate protection is provided for the required fire resistance rating.

[2]Slab thickness to resist transmission of heat shall be as for non-prestressed concrete. Unbonded tendon anchorage devices shall have 50 per cent greater covering that in the above table.

[3]In computing the cross-sectional area for joists, the area of the flange shall be added to the area of the stem, and the total width of the flange as used shall not exceed three times the average width of the stem.

[4]Adequate provisions against spalling shall be provided by means of a light reinforcement. Reinforcement spacing shall not exceed the depth of the element and shall have a 1-inch concrete covering.

* REFERENCE STANDARD RS 5-16
ACOUSTICAL TILE AND LAY-IN PANEL CEILING SUSPENSION SYSTEMS

Section 1—General

1.1 Scope.-This standard covers ceiling suspension systems used primarily to support acoustical tile or acoustical lay-in panels weighing less than four pounds per square foot, not contributing to the fire-resistance rating of a floor or roof assembly and not used for meeting the noise control requirements of the building code.

Section 2—Definitions

2.1 Where the following terms appear in this standard, they shall have the meaning herein indicated:

Backing board.-The term "backing board" shall mean a flat sheet of gypsum board to which acoustical tile is attached using adhesive, screws, staples or other suitable means (Fig. 1c).

Carrying channel.-The term "carrying channel" shall mean the three sided or "[" shaped metal sections which support the entire structural grid network (Fig. 1 A, B, C). The carrying channels are suspended by hangers from the existing structure and main runners are then attached to the channels.

Ceiling suspension system.-The term "ceiling suspension system" shall mean the entire network or grid of structural components which provides support for acoustical ceiling tile, acoustical ceiling panels, lighting fixtures, and air diffusers.

Cross runner.-The term "cross runner" shall mean the secondary or cross beams of a mechanical ceiling suspension (Fig. 1 A). The cross runners normally support only the acoustical tile. In some forms of suspension systems, however, the cross runners also provide support for other cross runners.

Hanger.-The term "hanger" shall mean the member employed to suspend the acoustical ceiling from the existing structure (wood joists, steel bar joists, steel beams, concrete slabs, etc.) (Figs. 1 A, B, C).

Main runner.-The term "main runner" shall mean the primary or main beams of the type of ceiling suspension system in (Figs. 1 A, B). The main runners

provide direct support for cross runners, and they may support lighting fixtures and air diffusers. In addition, the acoustical tile may also be directly supported by the main runners.

Nailing bar.-The term "nailing bar" or "furring bar" shall mean the continuous sheet metal strips to which a backing board is attached using either nails or screws (Fig. 1 C). The nailing bars are installed perpendicular to and supported by the carrying channels.

Spline.-The term "spline" shall mean a strip of sheet metal or fiber inserted in the kerfs of adjacent acoustical tile to form a concealed mechanical joint seal (Fig 1 B).

Wall molding.-The term "wall molding" shall mean the edge angles or channels of a mechanical ceiling suspension system which are attached to a wall (Figs. 1 A, B). The wall molding provides support for acoustical tile, and cross runners which are located at the periphery of the ceiling.

Section 3—Design

3.1 The provisions of the building code for stresses shall apply.

3.2 The hangers shall be spaced at 4'-6" or less on centers. Each hanger shall be capable of carrying all loads suspended therefrom plus an additional 200 pounds located at midspan. The midspan deflection as attested in accordance with the test method described in Section 6 of this standard or as calculated shall not exceed 1/360 of the span. The connections of the carrying channel to the hangers shall be adequate for the load supported by the carrying channel plus 200 pounds.

3.4 The main runner or nailing bar shall be capable of carrying all loads suspended therefrom. The midspan deflection as tested in accordance with the test method described in Section 6 of this standard or as calculated shall not exceed 1/360 of the span. Each connection of the main runner or nailing bar to the carrying channels shall be adequate for the load supported by the main runner plus two hundred (200) pounds.

* ***353-72BCR***

3.5 Cross runners shall be capable of carrying all loads suspended therefrom. The midspan deflection as tested in accordance with the test method described in Section 6 of this standard or as calculated shall not exceed 1/360 of the span.

3.6 Splines shall not be considered as providing nor shall be used for providing structural support for the ceiling material.

3.7 All connection devices other than bolts shall be approved by the Board of Standards and Appeals. However, they may be accepted under the code test method when test results indicating a factor of safety of four are filed in accordance with the provisions of

***REFERENCE STANDARD RS 5-16**
Acoustical Tile and Lay-in Panel Ceiling Suspension Systems

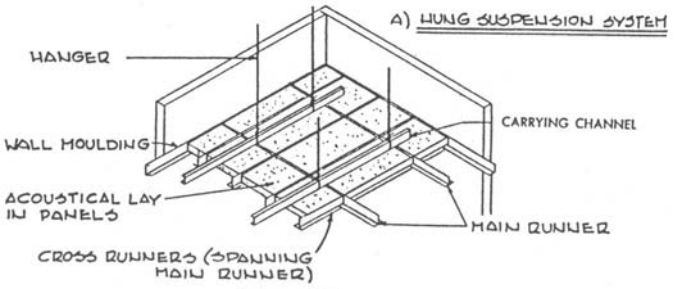


Figure 1-A

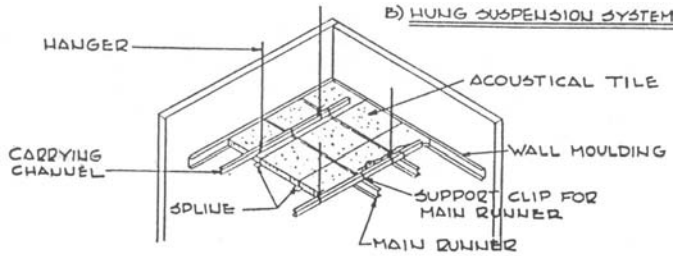


Figure 1-B

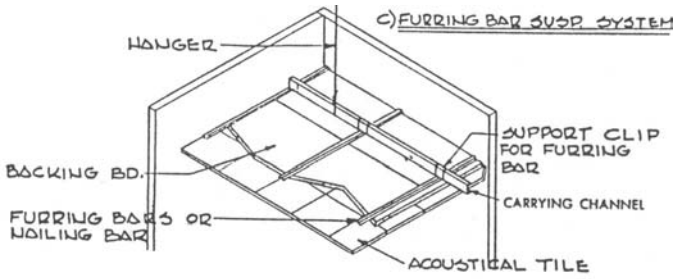


Figure 1-C

section 27-131 of the building code.

Section 4—Coatings

4.1 Protective coatings.-Component materials which oxidize or corrode when exposed to normal use environments shall be provided with protective coatings.

4.1.1 Sheet steel.-Components fabricated from sheet steel shall be given an electro-galvanized, hot dipped galvanized cadmium coating, or zinc coating.

4.1.2 Aluminum alloy.-Components fabricated from aluminum alloys shall be anodized when exposed to a corrosive atmosphere.

Section 5—Installation

5.1 Installation of components.-The components of acoustical ceiling suspension systems shall be installed in accordance with the following requirements and Figures 2A and 2B.

5.1.1 Hangers

5.1.1.1 Buildings of construction group I.-For requirements see Figs. 2A and 2B.

5.1.1.2 Buildings of construction group II.-Every other hanger supported from wood members shall be

attached by two 1/4" diameter through bolts or clinched nails. The remaining hangers shall be attached as described above or by two 1/4" diameter barbed anchor nails 2 1/4" long with oval heads. All bolts and nails shall be at least 2 in. above the bottom of the wood members.

5.1.1.3 Spacing.-Hangers for carrying channels shall be spaced at most 4'-6" on centers.

5.1.1.4 Minimum sizes and quality.-Hangers for suspending carrying channels shall be a minimum of 1/4" diameter galvanized steel rods or flat bars at least 1" x 1/8".

5.1.1.5 Use of existing hangers.-Existing hangers may not be used unless they comply, or are made to comply, with all the above provisions relating to hangers.

5.1.2 Carrying channels

5.1.2.1 Leveling requirements.-Carrying channels shall be installed so that they are level within 1/8 in. in 12 ft. leveling shall be performed with the supporting hangers taut. Local kinks or bends shall not be made in hangers as a means of leveling the carrying channels.

5.1.2.2 Attachment to hangers.-Carrying channels shall be attached to the hangers in a manner that will prevent any vertical movement or rotation.

(See Figure 2-A and 2-B)

5.1.3 Main runners

5.1.3.1 Leveling requirements.- Main runners shall be installed so that they are all level within 1/8 in. in 12 ft. Leveling shall be performed with the main runner in firm contact with the carrying channel.

5.1.3.2 Attachment to carrying channels.- Main runners shall be attached to the carrying channels in a manner that will prevent any vertical movement or rotation.

353-72 BCR

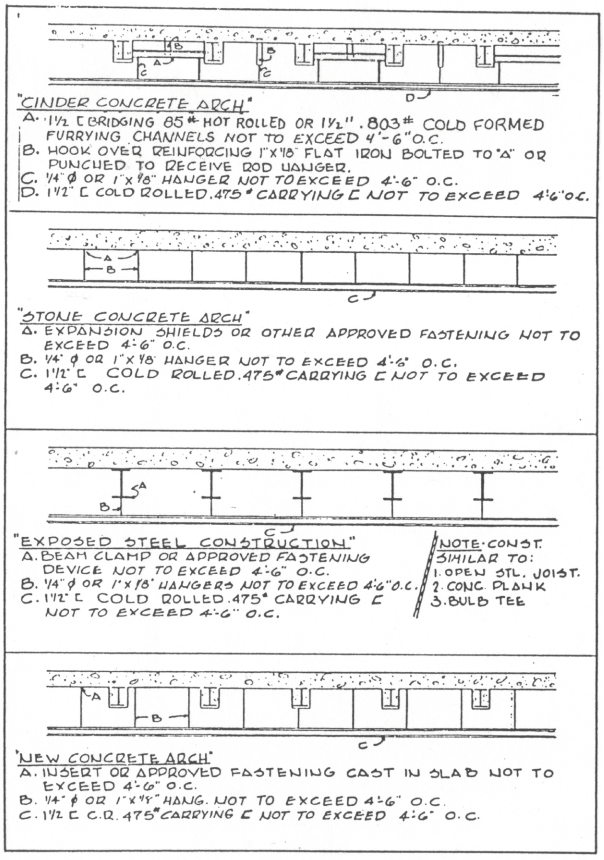


*Figure 2-A

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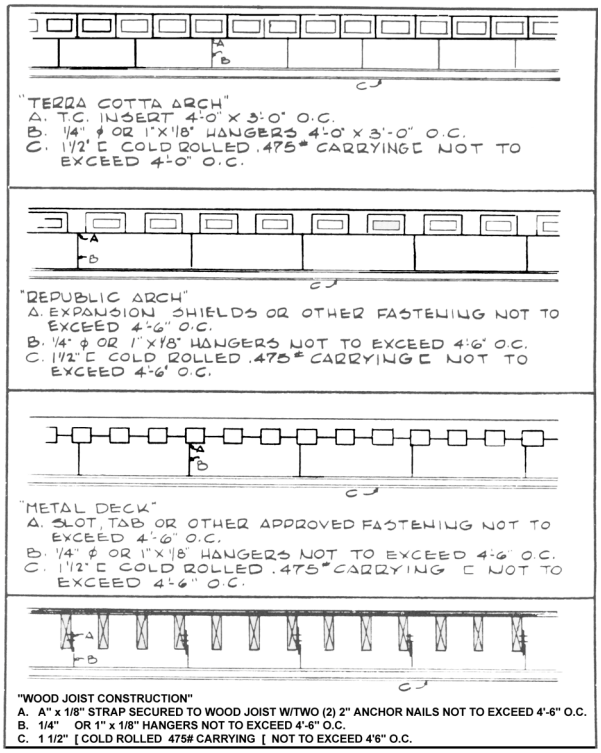

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*Figure 2-B

5.2 New suspended ceilings below existing suspended ceilings

5.2.1 Buildings of construction group 1.-In buildings of construction group 1 not more than one existing suspended ceiling may be retained above the new suspended ceiling. All other existing ceilings must be removed. Where an existing ceiling is retained, the new main runners shall be supported directly from the carrying channels adjacent to the hangers.

5.2.2 Buildings of construction group II.-In buildings of construction group II, all existing suspended ceilings shall be removed prior to installation of new suspended ceiling.

5.2.3 Existing hangers.-Existing hangers shall not be used for new suspended ceilings unless found to be in sound structural condition and comply with all the requirements of this standard relating to hangers.

5.3 Ceiling fixtures

5.3.1 General.-Fixtures installed in acoustical tile or lay-in panel ceilings shall be mounted in a manner that will not compromise ceiling performance. Figures 3A, 3B and 3C are to be used as a guide.

5.3.2 Maximum fixture weights.-Fixtures exceeding 80 lbs. in weight shall be supported independent of ceiling suspension system. Fixtures weighing 80 lbs. or less may be supported from the carrying channels. Fixtures weighing 50 lbs. or less may be supported from the main runners.

5.3.3 Eccentric loading.-Fixtures shall be installed so that the main runners or carrying channels will be eccentrically loaded unless suitable accessory devices (Figs. 3 A, B, C) are employed and the main runner and/or carrying channel design provides for the torsional stresses.

5.3.4 Plans.-The plans shall show the necessary details of the acoustical ceiling to satisfactorily identify the number, size, spacing, location, weights, and types of fixtures and means employed to comply with this section.

Section 6—Test Method for Determining Deflection

6.1 Introduction.-The test method outlined provides the means by which data can be secured for characterizing the structural performance of individual suspension systems. The method consists of placing structural members as beams on simple supports, and subjecting them to simulated uniformly distributed loads over their length. The loading is incrementally imposed and the performance of the structural member is obtained from observing the resulting beam deflections.

6.2 Scope.-The test method shall be used for evaluating the load deflection performance of structural members of all acoustical tile and lay-in panel suspension systems. A simple experimental facility is described which can be adjusted as required to permit testing of structural members of different sizes, having various section configurations, and on different appropriate span lengths.

Some suspension systems incorporate a locking assembly system which enhances performance by providing some continuity or load transfer capability between adjacent sections of the ceiling grid. This test method does not provide the means for making a complete evaluation of continuous beam systems, nor for assessing the continuity contribution to overall system performance. However, the method can be used for evaluating primary structural members in conjunction with secondary members which interlock, as well as with those of noninterlocking type.

6.3 Loading facility.-The loading of structural members shall be performed in a manner which closely simulates their use in suspension systems. Span distances, spacing between secondary supports, etc., shall be typical of ceiling grid designs in which the structural member is used.

6.3.1 Support frame.-A rectangular support frame having the essential features of the unit described below shall be provided.

6.3.1.1 The frame (Fig. 4) shall have the capability for length adjustment to permit testing of structural members on clear spans for a maximum of 8 ft. to a minimum of 3 ft. It shall have the capability for overall width adjustment with a maximum length of 4 ft. and a minimum length of 1 ft.

6.3.1.2 The support frame shall have sufficient stiffness so that no significant deflection occurs within the frame during load tests of suspension system structural members.

6.3.1.3 The support frame may either be ceiling mounted or floor supported.

6.3.2 Test loading.-The main runner weight shall not be used for evaluating load-deflection performance. One-half the weight of the cross runners shall be included as part of the test load.

6.3.2.1 Individual test weights appropriate for evaluating the structural member shall be provided. Loads weighing up to 1 lb. shall be provided so that their actual weight is within 0.01 lb. of their marked weight. Weights over 1 lb. shall be within 1 percent of their marked weight. Loading weights of the sizes required can be conveniently provided by weighing lead shot into cloth bags and tying them closed.

6.3.2.2 A sufficient number of weights of suitable mass shall be provided to permit evaluation of the structural member through its elastic range by loading in approximately ten equal load increments. When elastic performance of the member under test is exceeded, loading shall continue using a suitably reduced load increment until significant sectioning yielding has been produced.

6.3.2.3 A complete load increment shall be applied simulating a uniformly distributed load imposed over the entire section length before measuring the deflection of the structural member.

6.3.2.4 Provision shall be made for imposing test loads on the structural member in a symmetrical manner.

6.3.3 Deflection measurements.-The deflection of structural members shall be observed after application of each full load increment during the entre test.

6.3.3.1 The deflection of structural members being tested shall be measured with dial indicators capable of direct reading to 0.001 in.

6.3.3.2 Dial indicators shall be mounted from a separate gauge frame (Fig. 4) having three points of support. The gauge frame shall be supported from the test loading frame and be properly positioned to locate the dial stems vertically over the structural member being tested.

6.3.3.3 The dial indicators used shall have sufficient travel capability to permit the deflection performance of the structural members to be observed during the entire test without requiring resetting.

6.4 Structural members.-The manufacturer, installer, or architect or engineer, shall determine the load-deflection performance.

6.4.1 The structural members tested shall be identical to the sections used in the final system design. All cutouts, slots, etc., as exist in the system component shall be included in the sections evaluated.

6.4.2 Allowable mill variations of sheet stock thickness have a significant effect on section stiffness and load carrying ability. Consequently, load-deflection studies of structural members shall utilize sections fabricated in accordance with system manufacturers published metal thicknesses and dimensions.

6.5 Procedure.-The procedures used for evaluating performance of suspension system structural members shall utilize the general principle of following actual field installation practice wherever possible. As an example of the general procedure to be followed, the setup and testing of a primary structural member is described below.

6.5.1 Experimental setup.-In preparation for testing, the length and width of the support frame shall be adjusted to the typical grid dimensions that are established as appropriate to the evaluation of the structural member. The primary structural member shall be installed along the longitudinal centerline of the frame and supported at its end as an essentially simply supported beam (Fig. 4). Where secondary members are used, they shall be installed normal to the direction of the primary structural member and at the midpoint and quarterpoint locations along the test span length. One end of such secondary members shall be supported from the side of the test frame and at the other from the flange of the primary structural member (Fig. 4.). Clearances between ends of the secondary structural member in the test setup shall be typical of that which exists in the actual ceiling grid.

Where interlocking secondary structural members are used, they shall be assembled into the central primary structural member being tested in customary fashion and using conventional center distance spacing. The other end of the secondary member shall be simply supported from the perimeter support frame. No interlocking of the secondary member and the perimeter support frame shall be permitted.

6.5.2 Section loading.-With the structural member to be evaluated installed in the support frame, the gauge frame shall be positioned to mount the vertical displacement deflection dials directly over the test section at the midspan and quarterspan locations at which time dials are positioned to read zero (Fig. 4). The test loads shall be applied to the structural member in a manner representative of that which exists in service. For test purposes simple wire hangers shall be provided to suitably introduce the load to the section. Extending from such hangers, attachment wires, cords or lightweight chains shall be provided to permit the preweighed incremental test weights to be added as required. The weight of hangers, wires, pans, etc. shall be incorporated as part of the test load.

The test weights, simulating the weight of ceiling tile or panel, shall be applied to the structural member starting 6 in. from the end supports, and at 1 ft. intervals thereafter, always proceeding from the ends toward the center of the span in applying load. After the first uniformly distributed load increment has been applied, the midspan and quarterspan deflection of the structural member shall be measured and recorded. Loading of the structural member shall be continued in the same manner, applying successive increments of uniformly distributed load and observing deflections after each increment. Loading shall be continued until it is apparent that the test section has yielded.

The load deflection performance of secondary structural members of acoustical tile and lay-in panel ceiling systems shall be similarly determined. The units shall be set up and tested in a manner appropriate to their use in actual grid systems.

6.6 Experimental data.-A test log shall be prepared to record all pertinent data regarding the structural member being evaluated and the principal accessory items used. Such information as the following shall be provided:

Manufacturer's name.

Suspension system identification.

Test section identification.

Description of section: Measured overall height and thickness of basic stock, type of material, section weight, etc.

Test span length.

Spacing of lateral supports.

Identification of accessory items and how used.

Sketch of experimental setup, giving dimensions of grid, dial gauge locations, load spacing, etc.

Record of the incrementally applied uniformly distributed loads and the resultant midspan and quarterspan deflection and the resultant midspan and quarterspan deflection measurements for each loading.

6.7 Section performance.-The performance of structural members of suspension systems shall be represented by individual load-deflection plots obtained from tests performed at each different span length used in service.

6.7.2 The results of replicate tests of three individual sections each tested on the same span length, shall be plotted and averaged to obtain a characteristic load-deflection curve for the structural member.

6.7.3 The average load-deflection curve shall be used to establish the maximum uniformly distributed load which the structural member can successfully sustain prior to reaching the deflection limit of 3/360th of the span length in inches (Fig. 5.).

6.7.4 The load-deflection curve shall be used to establish the maximum loading intensity beyond which the structural member begins to yield.

6.8 Suspension system performance.-Published performance data for individual suspension systems shall be developed by the manufacturer upon the basis of results obtained from load-deflection tests of its principal structural members. Where a ceiling design incorporates a number of components, each of which experiences some deflection as used in the system, the additive nature of these displacements shall be recognized in setting an allowable system deflection criteria.

* ***353-72 BCR***

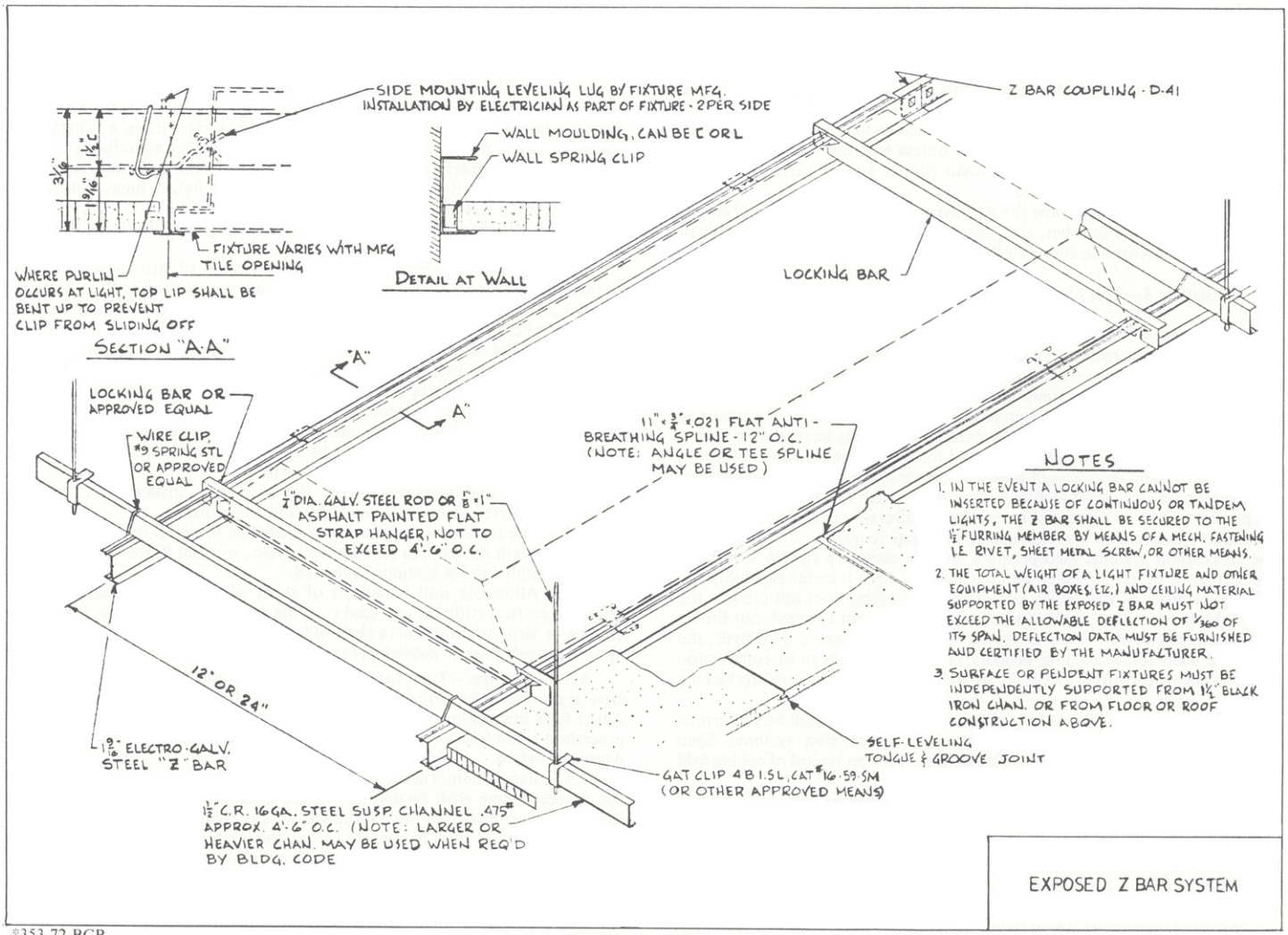

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***Figure 3-A**

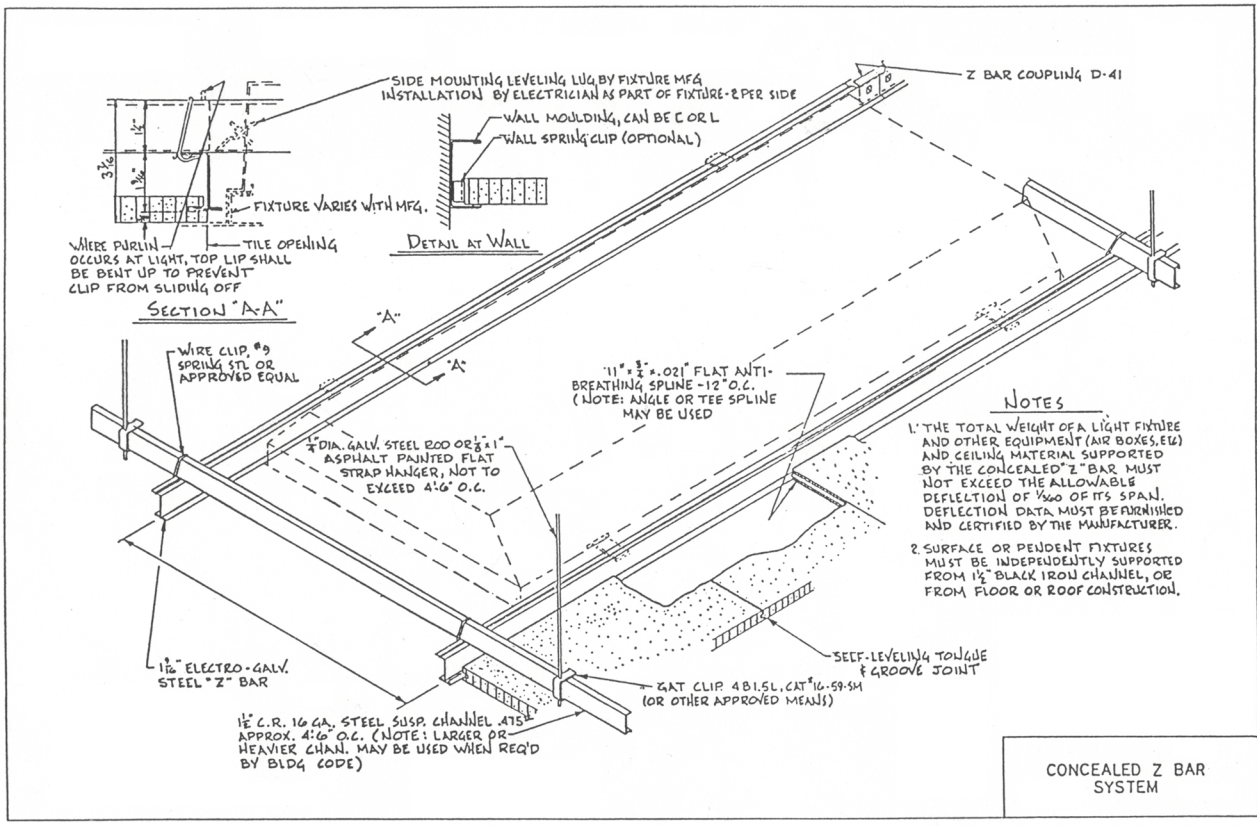

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*Figure 3-B

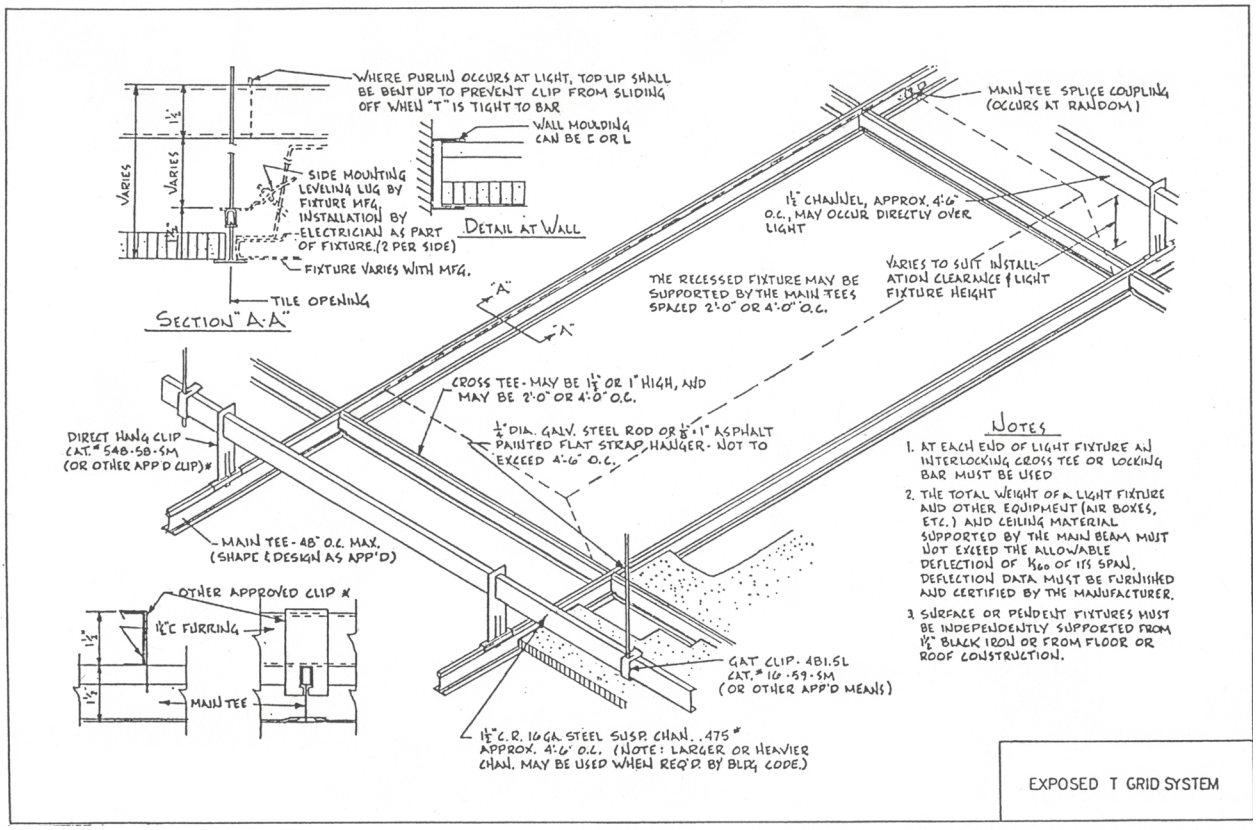

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*Figure 3-C

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REFERENCE STANDARD RS 5-17
Standards for the Installation of Smoke Shafts

1. Smoke shafts shall be constructed as required for shafts in section 27-344.
2. Shafts may serve more than a single compartment on a given floor but in all cases shall have at least one wall common to or abutting the compartments served, or each added compartment shall be connected to the shaft by an individual duct with the same fire resistive rating as required for the smoke shaft.
3. The size of the shaft shall be uniform throughout and of such dimensions as to provide 60 air changes per hour in the largest compartment served and at a velocity of not less than 1,600 fpm nor more than 4,000 fpm.
4. Openings into the shaft shall be provided at each floor and shall be of a size to permit the number of air changes prescribed in 3 above at a maximum air velocity of 3,000 fpm. Such openings shall be located as high as possible and designed to vent the entire compartment. They shall be equipped with an opening protective or closure having a fire protective rating complying with table 5-3 (§27-342). Such closures shall be automatically openable individually upon the activation of a detector located at the return shaft of the compartment and upon the activation of any other detectors installed within the compartment.
5. An approved, automatically controlled, exhaust fan of such capacity as to exhaust 60 air changes per hour from the largest compartment served by the shaft and capable of maintaining not less than a 2-inch negative static pressure at its inlet under flow conditions shall be installed in the shaft.

a. The fan shall be located so that the bottom of the fan inlet is located not less than 3 feet above the top of the automatic protective closure in the highest fire floor served by the shaft.
b. The shaft shall terminate at least 3 feet above the roof level where it penetrates the roof and shall be provided with a protective weather closure which can be opened manually from the outside.
c. When the closure in the required opening on a floor opens, this shall automatically open the weather closure and start the fan.
d. The shaft exhaust fan shall also be controlled from a local start-stop station at the fan, and at either the mechanical control center or the fire command station.
e. The fan shall be operated from circuits that are separate from the general lighting and power circuits, either taken off ahead of the main switch or connected to an emergency power source when such source is provided.

****Local Law 5-1973***

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REFERENCE STANDARD RS 5-18
Standards for the Pressurization of Stairs

1. Each stair shall be provided with air in such amount as to satisfy the following requirements:

a. The air shall be mechanically supplied at one or more levels.
b. Each fan shall supply 100 percent outdoor air.
c. Any opening shall be provided with an intake closure complying with the requirements for opening protectives of Title 27, Chapter 1 of the administrative code with an approved smoke detector located between the outside air intake and the supply fan. Upon the activation of this detector, only the system serviced by such detector shall shut down.
d. The maximum velocity of air supplied at the openings into the stair shall not exceed 3,000 fpm at its point of discharge within the stair enclosure.
e. Intake closures shall open and the supply fan or fans shall start upon the activation of any detector in the building except that called for in paragraph c above. However, only the fan system associated with the activation of the detector shall shut down.

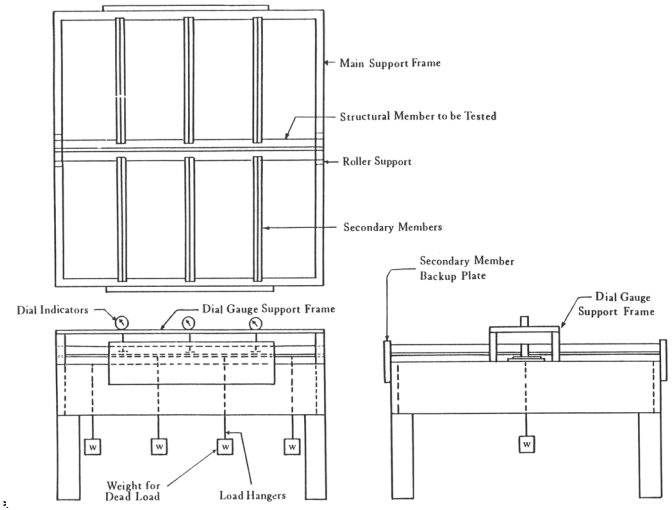

Figure 4 Schematic Diagram of Experimental Loading Facility
****353-72 BCR***

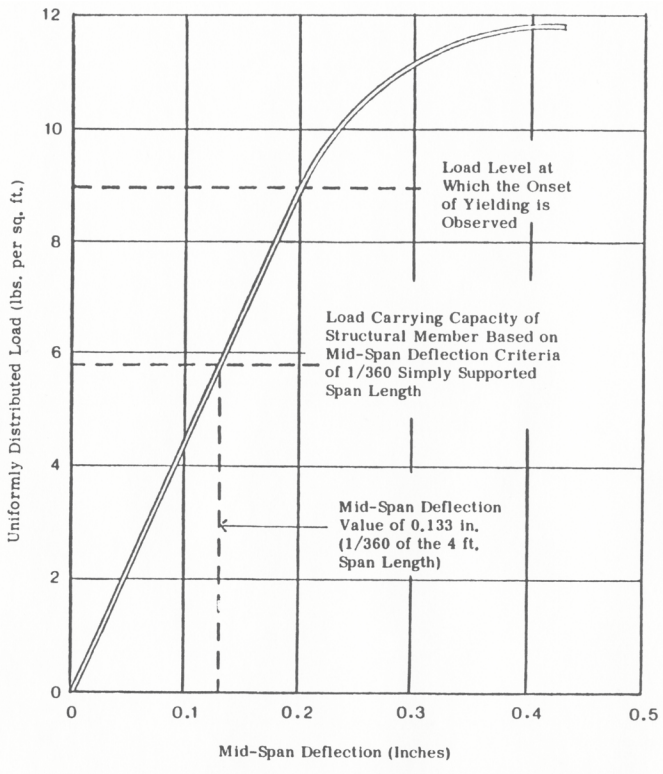

Figure 5. Applied Load vs. Mid-span Deflection for a Hypothetical Structural Member Having a Simply Supported Span Length of 4 Ft.
****353-72 BCR***

2. An approved, automatically controlled louver and weather closure open to the exterior at the highest floor served by the stair shall be installed in the case of a fan or fans producing an upward flow of air, or at the furthest point or points from the fan or fans when more than one fan is used, or at the lower end of the stair venting to outside if a single fan is located at the upper end of the shaft. The size shall be not less than 2 sq. in. per 100 cu. ft. of total shaft volume. Any existing fixed ventilating opening may be included in meeting this requirement. The louver shall be normally closed and shall open automatically by fusible link or other approved device when subjected to a temperature of 135°F. or to a rapid rise in temperature at a rate of 15 to 20°F. per minute, and the louver shall also be remotely operable from the fire command center. Such louver shall also satisfy the requirements of subdivision d of section 27-344.

3. The total supply of air introduced into each stair shall be equal to and not less than the algebraic sum of 24,000 cfm plus 200 cfm per story of stair.

4. Other operating requirements.

a. All weather closures may normally be in closed position.

b. The air supply fans shall provide positive pressure differential between the stair shaft and each floor at a maximum of 0.4 inches of water column whether doors are open or closed. Minimum positive pressure differentials between the stair shafts and each floor of 0.10 inches of water column when all doors are closed, and no less than 0.050 inches of water column when any three doors are open, shall be maintained. As an alternative to the maintenance of 0.050 inches of water column, a minimum average velocity of 400 feet per minute, measured in the plane of any open door, with any three doors open, shall be maintained.

c. Excess positive pressure within the stair closure may be relieved at one or more levels through protected openings in the stair enclosure in the following manner:

(1) Each opening shall be provided with an approved adjustable barometric backdraft damper so arranged as to permit air flow out of the stair enclosure only and shall be adjusted to close if the pressure differential is less than 0.05 inches of water column, and to remain open if the pressure differential is greater than 0.4 inches of water column.

(2) Each opening shall be protected with two 1 1/2-hour fire dampers arranged in series, each with fusible links rated to melt at 125°F.

(3) Acceptable alternative systems for the relief of excessive positive pressure other than through the protective openings in the stair enclosure may be installed, subject to the approval of the Commissioner.

(4) Spill ducts located entirely within the stair enclosure and utilizing barometric dampers may be installed as an acceptable alternative system referred to in sub-paragraph 3 above.

d. Air supply fans shall also be controlled from a local start-stop station at the fans and from the fire command station. In addition, fan controls may also be located at the mechanical control center. These controls shall over-ride the automatic detection shut-down.

e. The fans shall be operated from circuits that are separate from the general lighting and power circuits taken off ahead of the main switch and connected to an emergency power source when such source is provided.

*** 5. Full system testing shall be required for each installation and shall be subject to controlled inspection. Pressure or velocity measurements shall be taken for the purpose of determining whether the desired control of smoke will be established and reports of such measurements shall be made and copies thereof filed with the department as provided in Section 27-132 for controlled inspection. A full system test shall be performed after any construction and/or modifications to the stair enclosures altering the volume of such enclosures.

*** 6. Operational tests of the stair pressurization systems shall be conducted every twelve months by building maintenance personnel and witnessed by the Fire Safety Director or by a Registered Architect or Professional Engineer to ensure that each system functions. The owner or his authorized representative shall retain at the premises a record of each test performed for Building and Fire Departments' use.

*** 7. Operational tests shall determine that initiating devices such as fire alarms, sprinkler alarms, elevator recall, manual switches, and smoke detectors other than those designed to cause the shutdown of outside air intake systems, will cause the stair pressurization systems' intake dampers to open and fans to start.

***** Local Law 84-1979***

******DOB 8-26-98***

* REFERENCE STANDARD RS 5-19

ASTM E814-1983 Standard Method of Fire Tests of Through-Penetration Fire Stops.

****Local Law 16-1984; 1343-88 BCR***

* REFERENCE STANDARD RS 5-20

Standards for the flammability of Carpets

DOC FF 1-1970 Methane Pill Test.

ASTM E648-1988 Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Source.

ASTM E662-1988 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

****Local Law 16-1984; 1343-88 BCR***

*** REFERENCE STANDARD RS 5-21

UBC Std. 26-9-1997 Method of Test for the Evaluation of Flammability Characteristics of Exterior, NonloadBearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale,Multistory Test Apparatus.

******DOB 3-4-01; Local Law 13-1987; 1343-88 BCR***

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