HOUSTON PUBLIC WORKS

Date:	January 3, 2024
To:	City of Houston HPW-HPC
Attention:	CCM
From:	Jensen Hughes
Subject:	Prescriptive and Calculated Fire Resistance

This technical memo is provided to describe how to identify the prescriptive fire-resistance ratings for materials in addition to describing the significant changes to the Houston Construction Codes with regards to the requirements of prescriptive and calculated fire resistance requirements.

Determining the Prescriptive Fire-Resistance Ratings

The fire-resistance rating of an assembly is determined by subjecting the assembly to a specific test to identify the number of hour(s) that the assembly will resist fire on one side. These tests are conducted under standards that ensure the fire-resistant properties of materials and assemblies are measured to a common specification. ASTM International E119 Standard Test Methods for Fire Tests of Building Construction and Materials and UL 263 Standard for Safety of Fire Tests of Building Construction Materials are the standards used to test structural members, walls, and horizontal assemblies (floor/ceiling and roof/ceiling assemblies).

Section 721 specifies the prescriptive details of fire protection systems that have historically been accepted as fire-resistance-rated construction. These components and assemblies are listed among three tables within this section, **Table 721.1(1)** provides details for structural parts, **Table 721.1(2)** for walls and partitions, and **Table 721.1(3)** for floor and roof systems. Those items listed within the tables have been tested in accordance with the fire-resistance rating indicated. To identify the fire-resistance rating of an assembly, navigate to the associated table, find the specific assembly, and determine the fire-resistance rating, in hours, as a function of the thickness of the specified assembly. It is important to note that adding materials that are not part of the tested assembly may adversely affect the fire-resistance rating of the assembly. Often materials such as insulation are added to the fire-resistance rated assemblies. The code requires substantiating fire test data to be provided to show that when materials are added, they do not reduce the required fire-endurance time period. As an example, adding insulation to a floor/ceiling assembly may change its capacity to dissipate heat and, particularly for noncombustible assemblies, the fire-resistance rating may be changed. Although the provision is intended primary to cover those cases where thermal insulation is added, the language is intentionally broad so that it applies to any material that may be added to the assembly.

Section 722 contains procedures by which the fire resistance of specific materials or combinations of materials are established through calculations. The procedures specified are to be only applied to those materials specified for this section and none otherwise.

2021 Building Code Significant Changes to Fire Resistance

The addition of Section 722.7 provides a prescriptive approach to achieve the required fire-resistance ratings for new mass timber construction type members and assemblies. This section should be considered as a companion to Section 602.4. Section 703.6 outlines a testing protocol to determine the contribution of noncombustible protection. The IBC contains requirements for a minimum fire-resistance rating of each mass timber element, whether exposed, where permitted, or protected with noncombustible protection.

The noncombustible protection for mass timber in Types IV-A, B, and C construction serves to provide a minimum portion of the fire-resistance rating of the individual elements. Thus, Section 722.7 requires the fire-resistance rating to be established by determining the minimum contribution of noncombustible protection (for mass timber) and adding that contribution to fire resistance rating of the mass timber. This is similar to the manner in which building elements of other construction types are determined where protected with an additional material component. The ICC Tall Wood Building Ad Hoc Committee determined that the noncombustible protection, where required, must provide at least two-thirds of the minimum required building element fire-resistance rating. Mass timber members are allowed to contribute toward the fire-resistance rating even where noncombustible protection is required. Where unprotected, the mass timber is required to provide the full fire-resistance rating required in Chapter 6. This applies to all mass timber elements regardless of the method by which the mass timber fire-resistance rating was determined.

When using the prescriptive method, the protection required is set forth in Table 722.7.1(1), with Table 722.7.1(2) then establishing the protection provided by each layer of noncombustible material. Because Section 722.7 is a prescriptive methodology, the noncombustible protection must be installed as indicated in the code. These prescriptive installation provisions must be followed just as those in Tables 721.1(1), 721.1(2) or 721.1(3) are used when constructing a rated assembly with those systems.

2021 Building Code Changes –

SECTION 722
CALCULATED FIRE RESISTANCE.

722.1 General. The provisions of this section contain procedures by which the fire resistance of specific materials or combinations of materials is established by calculations. These procedures apply only to the information contained in this section and shall not be otherwise used. The calculated fire resistance of specific materials or combinations of materials shall be established by one of the following: ~~concrete, concrete masonry and clay masonry assemblies shall be permitted in accordance with **ACI 216.1/TMS** 0216. The calculated fire resistance of steel assemblies shall be permitted in accordance with Chapter 5 of ASCE 29. The calculated fire resistance of exposed wood members and wood decking shall be permitted in accordance with Chapter 16 of **ANSI/AWC National Design Specification for Wood Construction (NDS)**.~~

1. Concrete, concrete masonry and clay masonry assemblies shall be permitted in accordance with **ACI 216.1/TMS 0216**.
2. **Precast and precast, prestressed concrete assemblies shall be permitted in accordance with PCI 124**.
3. Steel assemblies shall be permitted in accordance with Chapter 5 of **ASCE 29.**
4. Exposed wood member and wood decking shall be permitted in accordance with Chapter 16 of **ANSI/AWC NDS**.

722.7 Fire-resistance rating for mass timber. The required fire resistance of mass timber elements in Section 602.4 shall be determined in accordance with Section 703.2. The fire resistance rating of building elements shall be as required in tables 601 and 705.5 and as specified elsewhere in this code. The fire resistance rating of the mass timber elements shall consist of the fire resistance of the unprotected element added to the protection time of the noncombustible protection.

722.7.1 Minimum required protection. Where required by Sections 602.4.1 through 602.4.3, noncombustible protection shall be provided for mass timber building elements in accordance with Table 722.7.1(1). The rating, in minutes, contributed by the noncombustible protection of mass timber building elements, components or assemblies, shall be established in accordance with Section 703.6. The protection contributions indicated in Table 722.7.1(2) shall be deemed to comply with this requirement were installed and fastened in accordance with Section 722.7.2.

TABLE 722.7.1(1)
PROTECTION REQUIRED FROM NONCOMBUSTIBLE COVERING MATERIAL

REQUIRED FIRE-RESISTANCE RATING OF BUILDING ELEMENT PER Table 601 AND Table 705.5 (hours)	MINIMUM PROTECTION REQUIRED FROM NONCOMBUSTIBLE PROTECTION (minutes)
1	40
2	80
3 or more	120

TABLE 722.7.1(2)
PROTECTION PROVIDED BY NONCOMBUSTIBLE COVERING MATERIAL

NONCOMBUSTIBLE PROTECTION	PROTECTION CONTRIBUTION (minutes)
1/2-inch Type X gypsum board	25
5/8-inch Type X gypsum board	40

722.7.2 Installation of gypsum board noncombustible protection. Gypsum board complying with Table 722.7.1(2) shall be installed in accordance with this section.

722.7.2.1 Interior Surfaces. Layers of Type X gypsum board serving as noncombustible protection for interior surfaces of wall and ceiling assemblies determined in accordance with Table 722.7.1(1) shall be installed in accordance with the following:

1. Each layer shall be attached with Type S drywall screws of sufficient length to penetrate the mass timber at least 1 inch (25 mm) when driven flush with the paper surface of the gypsum board.

Exception: The third layer, where determined necessary by Section 722.7, shall be permitted to be attached with 1-inch (25 mm) No. 6 Type S drywall screws to furring channels in accordance with AISI S220.

2. Screws for attaching the base layer shall be 12 inches (305 mm) on center in both directions.
3. Screws for each layer after the base layer shall be 12 inches (305 mm) on center in both directions and offset from the screws of the previous layers by 4 inches (102 mm) in both directions.
4. All panel edges of any layer shall be offset 18 inches (457 mm) from those of the previous layer.
5. All panel edges shall be attached with screws sized and offset as in Items 1 through 4 and placed at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the panel edge.
6. All panels installed at wall-to-ceiling intersections shall be installed such that ceiling panels are installed first and the wall panels are installed after the ceiling panel has been installed and is fitted tight to the ceiling panel. Where multiple layers are required, each layer shall repeat this process.
7. All panels installed at a wall-to-wall intersection shall be installed such that the panels covering an exterior wall or a wall with a greater fire-resistance rating shall be installed first and the panels covering the other wall shall be fitted tight to the panel covering the first wall. Where multiple layers are required, each layer shall repeat this process.
8. Panel edges of the face layer shall be taped and finished with joint compound. Fastener heads shall be covered with joint compound.
9. Panel edges protecting mass timber elements adjacent to unprotected mass timber elements in accordance with Section 602.4.2.2 shall be covered with 1 1/4 -inch (32 mm) metal corner bead and finished with joint compound.

722.7.2.2 Exterior Surfaces. Layers of Type X gypsum board serving as noncombustible protection for the outside of the exterior mass timber walls determined in accordance with Table 722.7.1(1) shall be fastened 12 inches (305 mm) on center each way and 6 inches (152 mm) on center at all joints or ends. All panel edges shall be attached with fasteners located at least 1 inch (25 mm) but not more than 2 inches (51 mm) from the parcel edge. Fasteners shall comply with one of the following:

1. Galvanized nails of minimum 12 gage with a 7/16-inch (11 mm) head of sufficient length to penetrate the mass timber a minimum of 1 inch (25 mm).
2. Screws that comply with ASTM C1002 (Type S, W or G) of sufficient length to penetrate the mass timber a minimum of 1 inch (25 mm).

Examples From 2021 IBC Section 722

Example 1: Foam Plastic Insulation in Wall Assemblies.

GIVEN: A sandwich wall panel consists of two 21/2-inch (63 mm) wythes of normal-weight concrete with a 2-inch (51 mm) layer of foam polystyrene between them.

FIND: Does the panel qualify for a 3-hour fire-resistance rating?

SOLUTION: From Table 722.2.1.2(1) in the code, the value of $R_n^{0.59}$ for a carbonate aggregate concrete is higher than for siliceous aggregate concrete, but because the type of concrete was not given, the value for siliceous should be used. From Section 722.2.1.2.2, the value of Rn 0.59 for the 2-inch (51 mm) layer of foam polystyrene is 2.5.

$R^{0.59} = 8.1 + 2.5 + 8.1 = 18.7$

From Table 722.2.1.2(2), a 3-hour rating is required to have an $R^{0.59}$ value of 21.41.

18.7 < 21.41, thus the wall does not qualify for a 3-hour rating.

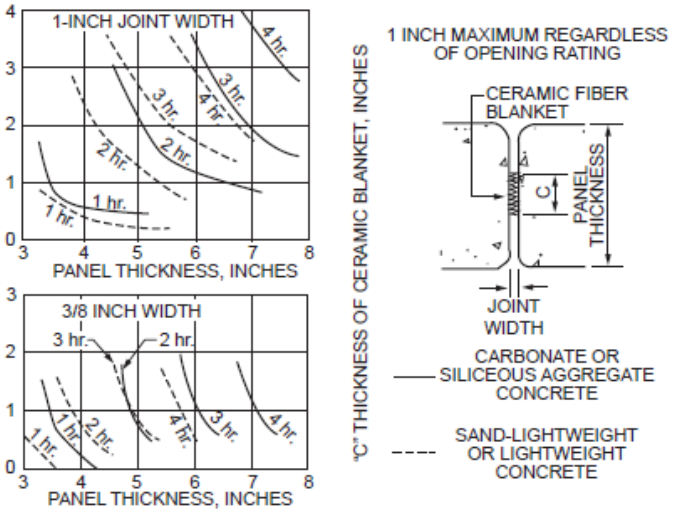
Example 2: Ceramic Fiber Joint Protection in Wall Assemblies.

FIND: Determine the thickness of a ceramic fiber blanket needed for a 2-hour fire-resistance rating for joints between 5-inch-thick (127 mm) precast concrete wall panels made of siliceous aggregate concrete if the maximum joint width is 7/8-inch (22.2 mm).

SOLUTION: Figure 722.2.1.3.1 indicates a minimum 0.7-inch (18 mm) thickness of ceramic fiber blanket for 5-inch (127 mm) panels for a 2-hour rating of a 3/4-inch-wide (19.5 mm) joint and 2.1 inches (53 mm) for a 1-inch-wide (25 mm) joint. By interpolation, the thickness is computed as follows:

t = 2.1 - (2.1 - 0.7) (1 - 7/8) = 1.93 inches

Therefore, the required thickness for a 2-hour rating is 1.93 inches (49 mm).



For SI: 1 inch = 25.4 mm.

FIGURE 722.2.1.3.1
CERAMIC FIBER JOINT PROTECTION

Example 3: Minimum Concrete Fire-Resistance Rating in Wall Assemblies.

GIVEN: An exterior bearing wall of a building of Type IB construction with 4 feet (1216 mm) of horizontal separation is required to have a 2-hour fire-resistance rating. The wall will be cast in place with siliceous aggregate concrete. The interior will be finished with a 1/2-inch (12.7 mm) thickness of gypsum wallboard applied to steel furring members.

FIND: What is the minimum thickness of concrete required?

SOLUTION: First calculation: Assume the interior to be the fire-exposed side.

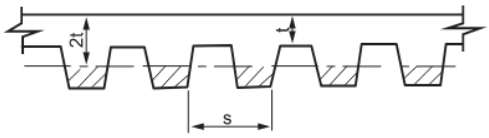
1. From Table 722.2.1.4(2), the 1/2-inch (12.7 mm) gypsum wallboard has a time-assigned value of 15 minutes; therefore, the fire-resistance rating that must be developed by the concrete must not be less than 13/4 hours (2 hours - 15 minutes).
2. Since Table 722.2.1.1 does not include a minimum thickness requirement corresponding to 13/4 hours, direct interpolation between the values for 11/2 and 2 hours is acceptable. The interpolation results in a required thickness of 4.65 inches (118 mm) of concrete.

Second calculation: Assume the exterior to be the fire-exposed side.

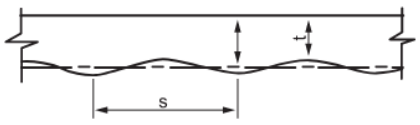
1. From Table 722.2.1.4(1), the multiplying factor for gypsum wallboard and siliceous aggregate concrete is 1.25; therefore, the corrected thickness for 1/2 inch (12.7 mm) of gypsum wallboard is 0.63 inch (16.02 mm) [1.25 inches (32 mm) ×1/2 inch (12.7 mm)].
2. Table 722.2.1.1 requires 5 inches (127 mm) of siliceous aggregate concrete for a 2-hour fire-resistance rating. Therefore, the actual thickness of concrete required is 4.37 inches (111 mm) [5 inches (127 mm) – 0.63 inches (16 mm)].
3. Since the thickness of concrete required when assuming the interior side to be the fire-exposed side is greater, the minimum concrete thickness required to achieve a 2-hour fire-resistance rating is 4.65 inches (118 mm).
4. Section 722.2.1.4.4 requires that the concrete alone provides not less than one-half the total required rating; thus, the concrete must provide at least a 1-hour rating. From Table 722.2.1.1, it can be seen that only 3.5 inches (89 mm) of siliceous aggregate concrete is required for 1 hour, whereas 4.65 inches (118 mm) will be provided.

Example 4: Slabs with Ribbed Soffits in Floor Assemblies.

FIND: Determine the fire-resistance rating of the floor section shown in Figure 722.2.2.1.3 if the units were made of siliceous aggregate concrete.



NEGLECT SHADED AREA IN CALCULATION OF EQUIVALENT THICKNESS



For SI: 1 inch = 25.4 mm.

FIGURE 722.2.2.1.3
SLABS WITH RIBBED OR UNDULATING SOFFITS

SOLUTION:

s = 12 inches.

t =4 inches.

Therefore:

4t > s > 2t (16 inches > 12 inches > 8 inches)

$$t_e = \frac{(4")(12") + (5")(1.6") + (1/2")(1")(1.6")}{(12")}$$

t_e = 4.8 inches < 2t.

Therefore the thickness to be used, t_s:

$$t_e = 4" + (\frac{(4)(4")}{12} - 1)(4.8" - 4")$$

t_s = 4.27 inches.

From Table 722.2.2.1, using interpolation, the fire-resistance rating of the floor section shown is 1.48 hours or 1 hour, 29 minutes.

Example 5: Concrete Masonry in Wall Assemblies.

FIND: Determine the equivalent thickness of a standard 8-inch by 8-inch by 16-inch (203 mm by 203 mm by 406 mm) concrete masonry unit. The unit is normal weight with sand and gravel aggregate.

SOLUTION: The equivalent thickness is actually the average thickness of the solid material in the unit. The equivalent thickness is determined by the following:

T_e = 1728 A/(L × H)

where:

T_e = Equivalent thickness, in.

A = Net volume of unit, ft^3.

L = Length of unit, in.

H = Height of unit, in.

Net volume, A, is determined by the following equation:

A = C/D

where:

C = Dry weight of unit, pounds.

D = Density of unit, pounds per cubic foot.

From data furnished by the manufacturer, the dry unit weight is 44 pounds (20 kg) and the density is 135

pounds per cubic foot (pcf) (2115 kg/m^2).

$$T_e = \frac{(1{,}728\ in.^3/\ ft^3)(0.326\ ft^3)}{(15.625 in.)(7.625 in.)}$$

T_e = 4.73 inches (120 mm).

Example 6: Minimum Concrete Masonry Fire-Resistance Ratings in Wall Assemblies.

GIVEN: A wall required to have a 4-hour fire-resistance rating will be constructed with concrete masonry units of expanded shale aggregate. The wall will be finished on each side with a layer of 1/2-inch (12.7 mm) gypsum wallboard.

FIND: What is the minimum equivalent thickness of concrete masonry required?

SOLUTION: Since the wall has the same type and thickness of finish on each side, only one calculation is required.

1. The 1/2-inch (12.7 mm) gypsum wallboard on the fire-exposed side has a time-assigned value of 15 minutes in accordance with Table 722.2.1.4(2).
2. Therefore, the fire resistance required to be pro-vided by the masonry and gypsum wallboard on the unexposed side is 3 hours and 45 minutes (4 hours - 15 minutes).
3. From Table 722.2.1.4(1), the corrected thickness of gypsum wallboard on the unexposed side is 1/2 inch (12.7 mm) (1.00 × 1/2 inch).
4. From Table 722.3.2, the minimum equivalent thickness of masonry, including the corrected thickness of gypsum wallboard, required for a rating of 3 hours and 45 minutes is 4.9 inches (124 mm).
5. Therefore, the equivalent thickness of masonry required is 4.4 inches (112 mm) [4.9 inches (124 mm) - 1/2 inch (12.7 mm)].
6. From Table 722.3.2, it can be determined that 4.4 inches (112 mm) of expanded shale aggregate concrete masonry will provide a fire resistance of 3 hours. Therefore, the requirement that the masonry alone provide at least one-half of the total required rating is satisfied.

Example 7: Plaster Finishes in Wall Assemblies.

GIVEN: A 4-inch (102 mm) solid brick wall is required to have a 3-hour fire-resistance rating with clay

masonry units.

FIND: The thickness of one side of plaster required to attain a 3-hour rating.

SOLUTION:

1. From Table 722.4.1(1), a 2-hour solid brick wall is 3.8 inches (99 mm) of equivalent thickness and a 3-hour wall is 4.9 inches (124 mm). Through interpolation (Note a), a 4-inch (102 mm) wall is approximately a 131-minute (2.18 hours) fire rating.
2. From Table 722.4.1(4), plaster has a coefficient of 0.3 for 1/2-inch thick (12.7 mm) plaster, 0.37 for 5/8-inch thick (15.9 mm) plaster or 0.45 for 3/4-inch (19.1 mm) thick plaster.
3. From Equation 7-9:

$R = (R_n^{0.59} + pl)^{1.7}$

where:

$R = 3$

$R_n = 2.18$

$3 = [(2.18)^{0.59} + pl]^{1.7}$

$\sqrt[1.7]{3} = \sqrt[1.7]{[(1.58 + \text{pl})]}^{1.7}$

1.91 = 1.584 + *pl*

pl = .326.

4. Therefore, one coat of 5/8-inch-thick (15.9 mm) sanded gypsum plaster on a 4-inch (102 mm) solid brick masonry wall would result in a 3-hour fire-resistance rating.

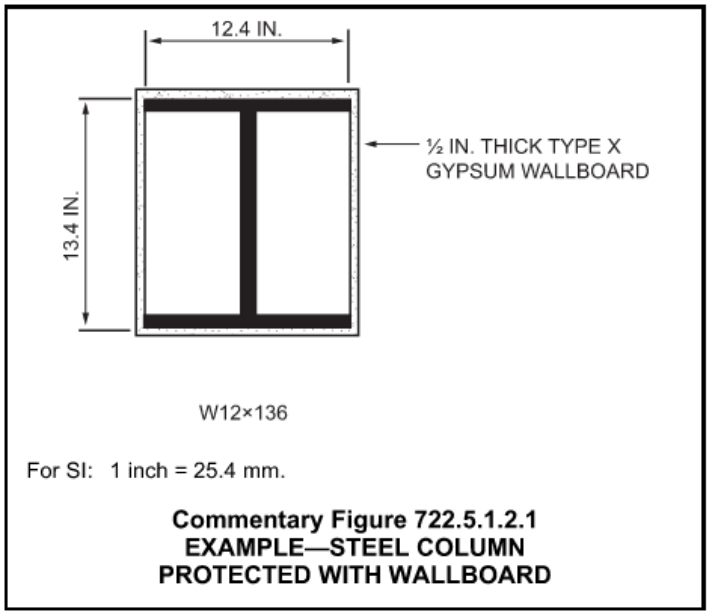
Example 8: Gypsum Wallboard Protection for Structural Steel Columns.

GIVEN: A W12 × 136 column protected by 1/2-inch (12.7 mm) Type X gypsum wallboard as shown in Commentary Figure 722.5.1.2.1.

FIND: The fire-resistance rating of the column.

SOLUTION:

1. The heated perimeter D = 2(12.4 inches + 13.4 inches) = 51.6 inches (1311 mm).
2. W' = 136 + (50)(0.5)(51.6)/144 = 144.96.
3. W' = 144.96 / 51.62 = 2.81.
4. R = $130[(0.5)(2.81)/2]^{0.75}$ = 99.7 minutes (1.66 hours).
5. Alternatively, from Table 722.5.1(1), the W/D ratio for a W12 × 136 is tabulated as 2.63. From Figure 722.5.1(4) using a W/D ratio of 2.63 and 1/2-inch (12.7 mm) gypsum wallboard, an R-value of approximately 1.6 hours is obtained.



Commentary Figure 722.5.1.2.1
EXAMPLE—STEEL COLUMN PROTECTED WITH WALLBOARD

Example 9: Sprayed Fire-Resistant Materials for Structural Steel Columns.

GIVEN: The fire endurance test data given in Commentary Figure 722.5.1.3.

FIND: The thickness of a spray-applied cementitious material required for a 3-hour rating on a W12 × 136.

SOLUTION:

1. Determine C_1 and C_2. From the end points of the graph:

   R/h = 75 for a W/D ratio of 0.6 and

   R/h = 200 for a W/D ratio of 2.5.

   From this, two equations with two unknowns are created:

   $75 = C_1 (0.6) + C_2$.

   $200 = C_1 (2.5) + C_2$.

   Solving these results in: $C_1 = 65.79$; $C_2 = 35.53$ and Equation 7-13, with h in the denominator, becomes:

   R/h = 65.79 (W/D) + 35.53.

2. From Table 722.5.1(1), a W12 × 136 has a W/D ratio of 1.82.

3. The required fire resistance is 180 minutes. Calculating for h yields:

   180 = [(65.79)(1.82) + 35.53]h

   h = 1.16 inches (29 mm).

Therefore, the required thickness of the spray-applied material is 1.16 inches (29 mm).

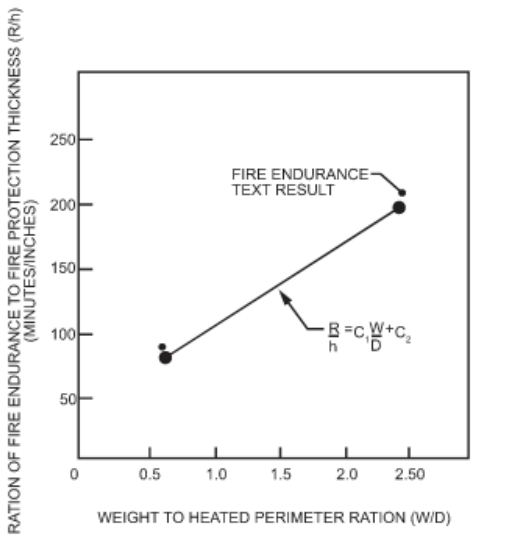


ILLUSTRATION OF THE PROCEDURE FOR DETERMINIG THE MATERIAL DEPENDENT CONSTANTS FOR SPRAY-APPLIED CEMENTITIOUS AND MATERIAL FIBER FIRE PROTECTION MATERIAL

Commentary Figure 722.5.1.3
EXAMPLE—SPRAY-APPLIED MATERIALS, FIRE ENDURANCE TEST DATA

Example 10: Fire-Resistance Ratings for Concreted-Protected Structural Steel Columns.

GIVEN: A W8 × 28 steel column encased in light-weight concrete [density = 110 pcf (1762 kg/m^3)] shown in Figure 722.5.1(4), with all reentrant spaces filled with concrete cover 1.25 inches (32 mm) and a moisture content of 5 percent. The web thickness is 0.285 inch.

FIND: The fire-resistance rating.

SOLUTION:

D = 4(6.535) + 2(8.06) - 2(0.285) = 41.69 inches (1059 mm).

W/D=28 lb/ft/41.69” = 0.67 lb/ft-in.

h = 1.25 inches (32 mm).

k_c = 0.35 Btu/hr x °F.

c_c = 0.20 Btu/lb x °F.

r_c = 110 pcf (1762 kg/m^3).

L = (6.535 + 8.06)/2 = 7.30 inches (185 mm).

A_s = 8.25 square inches (.005 m^2).H=0.11(28) + [(110)(0.20)/144][(6.535)(8.06) -8.25] = 9.87

$$R_O = 10(0.67)^{0.7} + 17(\frac{(1.25)^{1.6}}{(0.35)^{0.2}})$$

$$1 + 26[\frac{9.87}{(110)(0.2)(1.25)(7.3 + 1.25)}]^{0.8}$$

R_o = 99 minutes.

Therefore, R = 99[1 + 0.03(5)] = 114 minutes.

For comparison purposes, the minimum cover requirement for a W8 × 28 steel column from Table 722.5.1(8) is 1 inch (25 mm) for a 11/2-hour rating. The column does not quite meet the required fire rating for a 2-hour column since 1.5 inches (38 mm) is required. Therefore, the fire resistance of the column is 11/2 hours.

Example 11: Sprayed Fire-Resistant Materials for Structural Steel Beams and Girders.

GIVEN: Determine the thickness of spray-applied fire protection required to provide a 2-hour fire-resistance rating for a W12 × 16 beam to be substituted for a W8 × 15 beam requiring 1.44 inches (37 mm) of protection for the same rating.

SOLUTION:

From Table 722.5.1(4):

W_1/D_1 = 0.54 for W8 × 15

W_2/D_2 = 0.45 for W12 × 16

h_1 = 1.44 inches.

$$h_2 = \left[\frac{0.54 + 0.60}{0.5 + 0.60}\right] + 1.44$$

= 1.56 inches (39 mm).

It is noted within this section that intumescent, or mastic fire-resistant coatings are required to be tested in accordance with the requirements of Section 703.2.

Example 12: Wood Assemblies for Walls.

GIVEN: The exterior wall assembly shown in Commentary Figure 722.6 having a layer of 15/32-inch (12 mm) wood structural panel bonded with exterior glue covered with a layer of 5/8-inch (15.8 mm) gypsum wallboard and attached to studs spaced at 16 inches (406 mm) on center (o.c.).

FIND: Does the wall assembly qualify as a 1-hour fire-resistant wall assembly?

SOLUTION: From Tables 722.6.2(1) and 722.6.2(2):

Wood structural panel = 10 minutes.

Gypsum wallboard = 30 minutes.

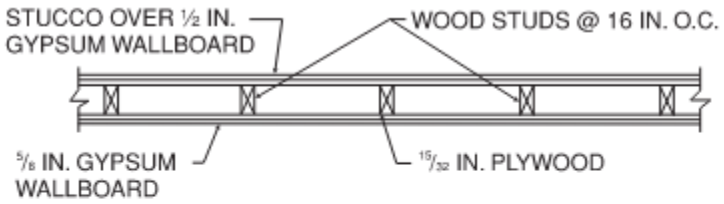
Wood studs = 20 minutes.

Total = 60 minutes.

Therefore, the wall qualifies as a 1-hour wall. If the wall is an interior wall, both sides would be required to be fire protected with at least 40 minutes of membrane coverings (60 minutes - 20 minutes for wood frame).

It should be noted that Section 722.6.2.3 requires the exterior side to be protected in accordance with Table 722.6.2(3).

It should also be noted that if the wall cavities between the studs are filled with mineral fiber batts weighing not less than that specified in Table 722.6.2(5), the 15/32-inch (12 mm) plywood membrane layer could be eliminated because the insulation adds 15 minutes of fire resistance, as indicated in Section 722.6.2.5 and Table 722.6.2(5). Thus, adding the contribution times for the 5/8-inch (15.9 mm) gypsum board, the wood framing, and the insulation (30 minutes + 20 minutes + 15 minutes), the resultant rating for the wall would be 65 minutes and meet a 1-hour fire-resistance rating.



FIRE EXPOSED SIDE

For SI: 1 inch = 25.4 mm.

Commentary Figure 722.6
EXAMPLE—WOOD STUD WALL WITH WALLBOARD

Example 13: Wood Assemblies for Floor and Ceiling.

GIVEN: A floor/ceiling assembly using wood joists spaced at 16 inches (406 mm) o.c., protected on the bottom side (ceiling side) with two layers of 1/2-inch (12.7 mm) Type X gypsum wallboard and protected on the upper side (floor side) with a 15/32-inch (12 mm) ply-wood subfloor, a 3/8-inch (15.9 mm) panel-type underlayment and carpet.

FIND: Does the floor/ceiling assembly meet the requirements of a 1-hour fire-resistance-rated assembly?

SOLUTION: Referring to Sections 722.6.2.1 and 722.6.2.4, Table 722.6.2(1) indicates that the time contribution for each layer of 1/2-inch (12.7 mm) Type X gypsum wallboard is 25 minutes. The time of contribution for wood joists 16 inches (406 mm) o.c. is listed in Table 722.6.2(2) as 10 minutes. By adding the two layers of gypsum board (2 × 25 minutes) to the wood frame (10 minutes), a fire-resistance rating of 60 minutes, or 1 hour, can be obtained. It should be noted that Section 722.6.2.4 requires the upper membrane to be specified as in Table 722.6.2(4) or any membrane that has a time of contribution of at least 15 minutes as listed in Table 722.6.2(1).

If the above example had been a roof/ceiling assembly, the upper membrane would have been treated the same. If the proposed assembly is a ceiling with an attic above, Section 722.6.2.4 notes the exception to Section 711.2.6, which allows the elimination of the upper membrane.

The fastening requirements for assemblies developed by Section 722.6 should be in accordance with Chapter 23 as stated in Section 722.6.2.6.