

Section 704 *Fire-Resistance Rating of Structural Members*

Structural frame members such as columns, beams, and girders are regulated for fire resistance based on a building's type of construction. Some types of construction mandate a higher level of fire endurance for structural members and assemblies on account of the critical nature of their function. Type of construction considerations is based primarily on the potential for building collapse when subjected to fire. Therefore, the structural frame is specifically addressed in Table 601 as to the required fire-resistance ratings. This section provides further details for the protection of structural members.

Figure 704-1 provides simple details of fire protection of structural members that indicate the principle of *mass effect*. Mass effect is beneficial to the protection requirements for structural members of a heavy cross section. In the case of steel members, the amount of protection depends on the weight of the structural steel member. A heavy, massive structural steel cross section behaves such that the heat applied to the surface during a fire is absorbed away from the surface, resulting in lower steel surface temperatures. Thus, the insulating thicknesses indicated by tests or in Table 721.1(1) should not be used for members with a smaller weight than that specified in the test or table.

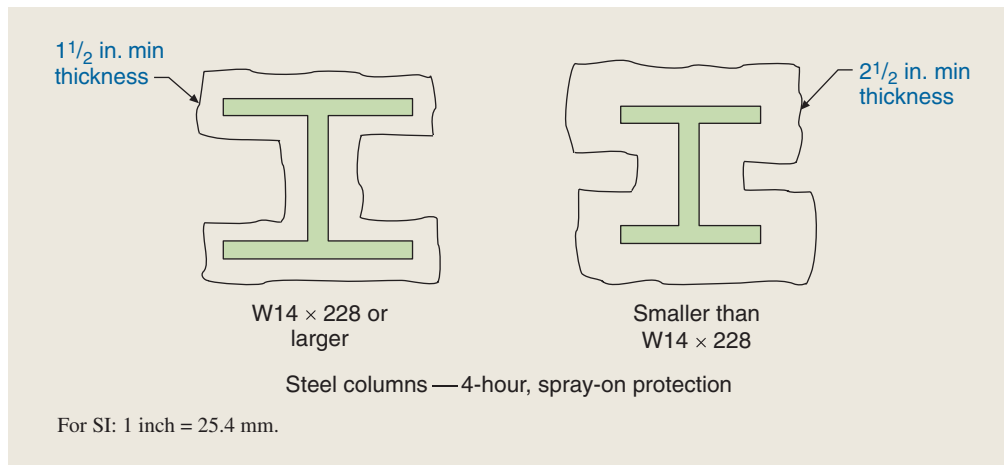


Figure 704-1
Mass effect.

Column protection. Primary structural frame members require fire-resistive protection in buildings of Type I, IIA, IIIA, and VA construction. Under all conditions, columns considered as a part of the primary structural frame system must be protected by individual encasement. This protection must occur on all sides of the column and extend for the column's full height. Where a ceiling is provided, the fire resistance of the column is to be continuous from the top of the foundation or floor/ceiling assembly below through the ceiling space to the top of the column. The fire protection required for the column shall also be provided at the connections between the column and any beams or girders. Where the column is located within a fire-resistance-rated wall assembly as shown in Figure 704-2, the mandated column protection must still be provided through individual encasement. It is not acceptable to simply place an unprotected column within a fire-resistance-rated wall assembly and consider the column as fire-resistant rated.

704.2

Protection of the primary structural frame other than columns. The code intends that the fire-resistive protection for primary structural frame members be applied to the individual structural member. This is based on the differences in both the testing procedure and the conditions of acceptance that were discussed in Section 703. In other words, the code

704.3

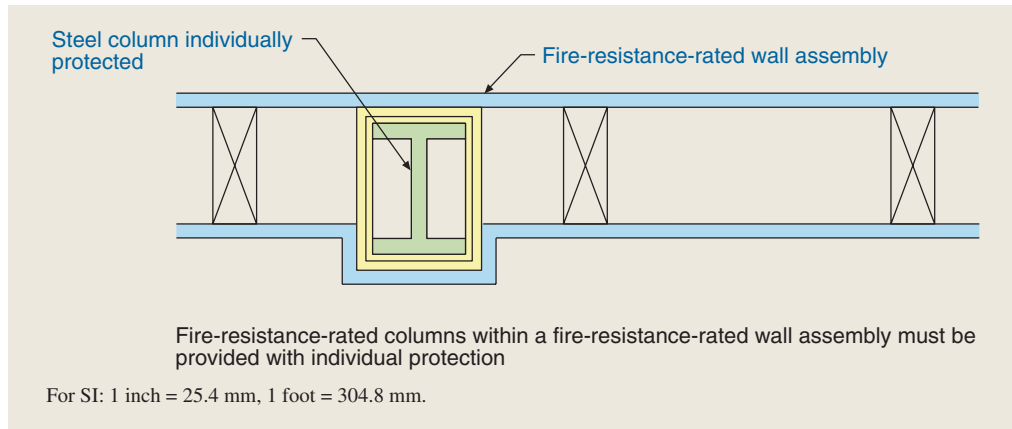


Figure 704-2
Individual protection of structural columns.

does not intend that a primary structural frame member be protected by a wall assembly or fire-resistance-rated horizontal assembly, except as permitted by this section.

Under certain restrictions, the code allows the use of a floor/ceiling or roof/ceiling assembly to provide protection for structural members, rather than requiring that they be individually protected. The criteria for use of alternative membrane protection in lieu of individual encasement are depicted as follows:

1. The use of the ceiling protection applies only to horizontal structural members, such as girders, trusses, beams, or lintels. (See Section 704.2 for column protection.)
2. The structural members shall not support directly applied loads from more than two floors or one floor and roof, or support a load-bearing wall or a non-load-bearing wall more than two stories in height.
3. The required fire-resistance rating of the assembly shall be at least equal to that required by the code for the individual protection of the structural members.

Examples of various conditions are shown in Figure 704-3.

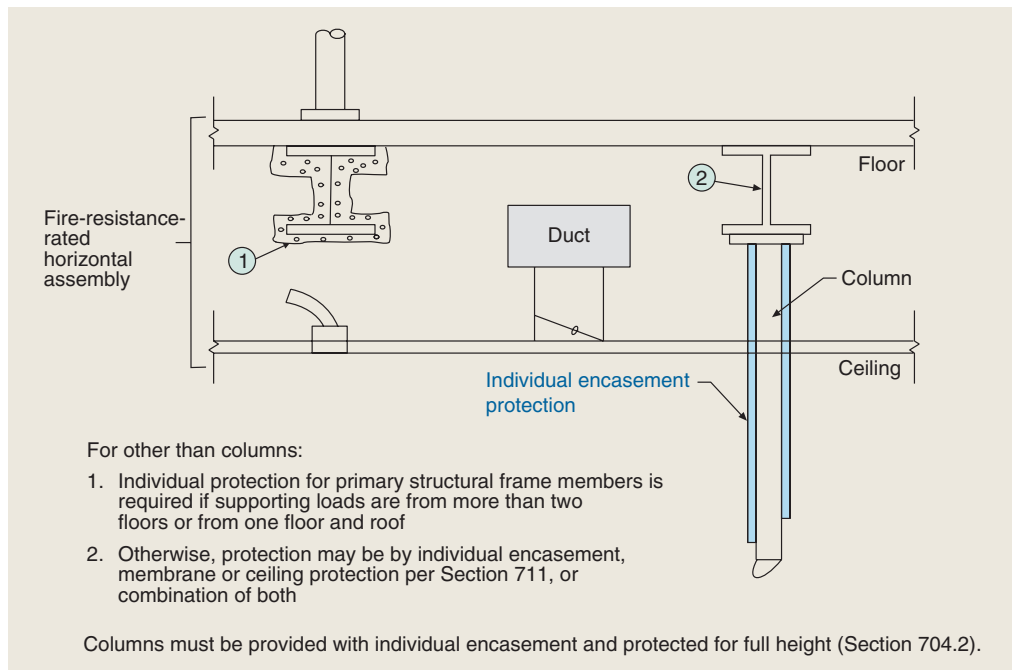


Figure 704-3
Protection of primary structural frame members.