Corridor Construction and Protection of Corridor Ventilation Systems

PART ONE OF TWO

by Bob Guenther, ICC Senior Technical Staff
and Jay Woodward, ICC Senior Staff Architect

Because corridors serve such an important part of many means of egress systems, it is important to assure that they are properly constructed and protected. Roughly three-quarters of fire deaths are related to smoke, so it is imperative that building occupants be provided with a relatively smoke-free egress route. That is why the details of corridor construction and opening protection requirements differ somewhat from what is typically required for fire-resistive assemblies.

Following is an in-depth look at the corridor construction details under the 2006 *International Building Code* (IBC). The concluding part of this article, which will appear in the next issue of *Building Safety Journal*, will focus on the protection of corridor ventilation systems.

Construction Details

Corridors required to have a fire resistive rating by Section 1017 and Table 1017.1 of the 2006 IBC must be constructed using fire partitions that comply with Section 708. Generally, fire-resistive-rated corridors are required—per Table 1017.1 and Section 708.3—to be constructed with fire partitions that have not less than a 1-hour fire-resistive rating. An exception is corridors that serve an occupant load greater than ten in a sprinklered Group R occupancy, which can be constructed with a ½-hour fire-resistance rating. The basic details of the construction requirements are the same, but unless there is a specific difference, the details and figures provided are based upon a 1-hour fire-resistive rating.

Section 708.4 provides the bulk of the actual construction requirements. Figure 1(a) and Figure 1(b) represent the basic requirements given in the first sentence of Section 708.4: "Fire

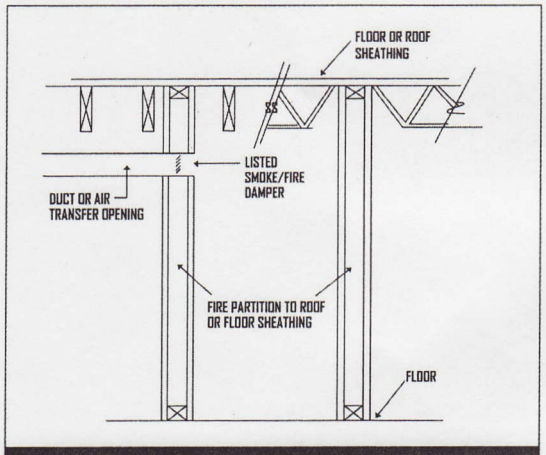


Figure 1(a). Fire partitions extending from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above.

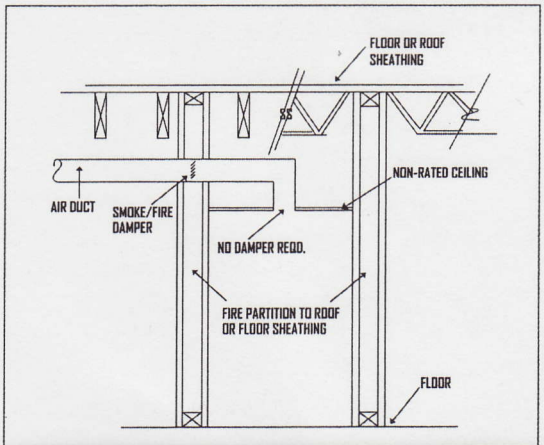


Figure 1(b). IBC Section 708.4 permits corridors to have non-fire-resistive-rated ceilings.

partitions shall extend from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above [. . .]." This option differs from what some legacy code users are familiar with because it permits the corridor to have a non-fire-resistive-rated ceiling, but is an acceptable method of construction because the purpose of the corridor is to protect the egress system from fire or smoke that occurs within adjacent spaces. Note that the IBC's corridor construction requirements are not generally intended to provide protection from fire or smoke on a different level; threats on other floors are addressed by requirements for shafts and horizontal assemblies given elsewhere in the code.

A second option for corridor enclosure is provided in the conclusion of the same sentence: "[. . .] or to the fire-resistance-rated floor/ceiling or roof/ceiling assembly above." Exercising this option imposes an additional requirement for fire-blocking or draft-stopping in areas of combustible construction, as illustrated in Figure 2.

A third option for corridor construction is provided in Section 708.4, Exception 2. Under this option, the corridor ceiling must be constructed "as required" for a 1-hour fire-resistance rated floor or roof system. A true 1-hour fire-resistive horizontal assembly where the floor and ceiling are tested together is not required, just the ceiling portion.

Note that Figure 3, which illustrates this option, does not depict the ceilings of the adjacent rooms because the exception requires that the "room side" membrane be carried through "to the underside of [. . .] a fire-resistance rated floor or roof above." This language was carried over from the *Uniform Building Code* (UBC), one of the legacy codes used to develop the IBC, but an important distinction is that the UBC always required a rated ceiling for a corridor while the IBC does not. Therefore, it is our opinion that the code does not intend that the room side membrane must extend to the floor or roof slab or deck of a rated assembly.

Based on the language of the base paragraph of Section 708.4, it would seem permissible that the room side protection may end at "the underside of the floor or roof sheathing, slab or deck above" even if it is a non-rated floor or roof. Rather, the exception is only intended to address the fact that the corridor side membrane is not carried through to the deck. It is important that the ceiling within the corridor provide the continuity to complete the inside corridor enclosure. Also, when the room side membrane of the corridor wall does not extend to the floor or roof slab or deck above, fire-blocking or draft-stopping within or above the corridor walls must be provided per Section 717.

The fourth and final option is given in Section 708.4, Exception 3. Often termed a "tunnel corridor," this method of construction—

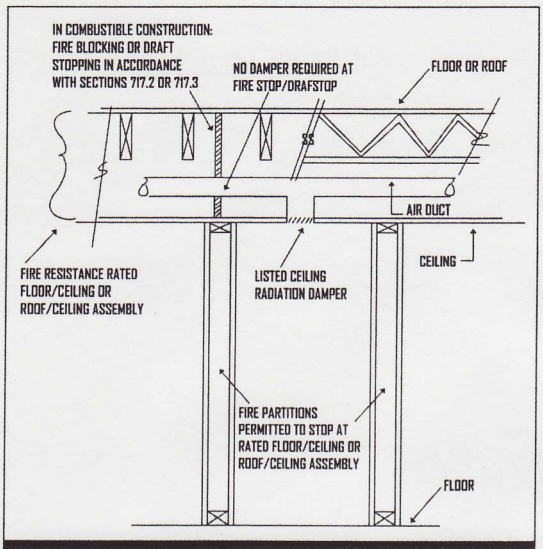


Figure 2. Fire-blocking or draft-stopping is required in situations where fire partitions terminate at the ceiling of a fire-resistance rated floor/ceiling or roof/ceiling assembly.

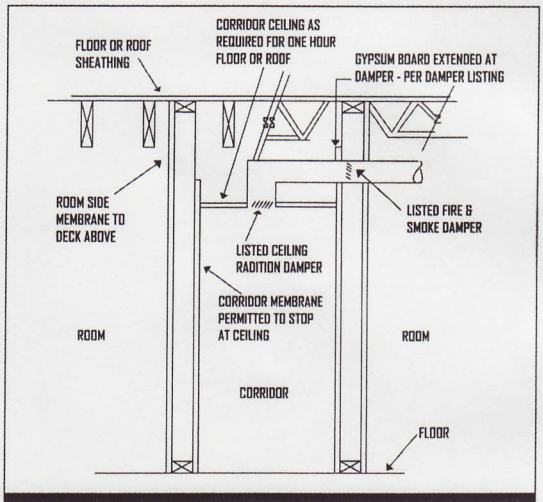


Figure 3. IBC Section 708.4, Exception 2, allows corridor ceilings to be constructed "as required" for a 1-hour fire-resistance rated floor or roof system.

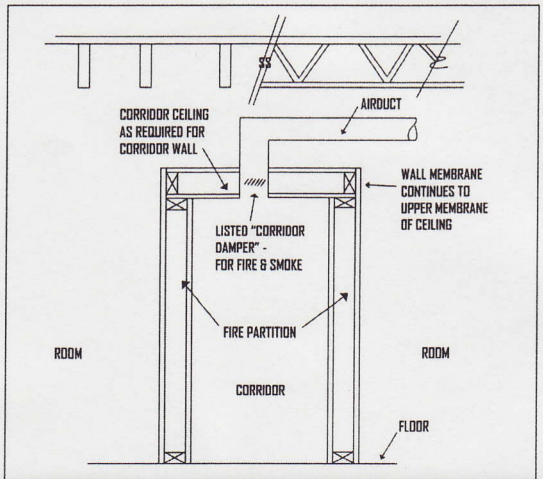


Figure 4. The "tunnel corridor" construction option provided by IBC Section 708.4, Exception 3.

illustrated in Figure 4—is frequently used because of the convenience of not having to carry the walls up into the area occupied by the floor or roof framing members, and also allows duct work and other items to pass over the corridor without requiring any additional protection. This is a significant allowance because although it may not be able to pass a horizontal fire test, the corridor serves its intended purpose by completely separating the means of egress from adjacent spaces and providing a protected path through the space.

The ceiling of a tunnel corridor does not have to be constructed exactly the same as the walls: any complying corridor wall assembly can be used. For example, the walls may be constructed using a 2 x 4 stud wall but the ceiling may need to use a 2 x 6 assembly in order to span a wider-width corridor. The important thing is not that the wall and ceiling are the same, but that the ceiling is constructed using an assembly that would be permitted to be used for the corridor walls.

The three options for corridor construction given in IBC Section 708.4 allow a wide variety of potential compliance designs while assuring that corridors are effectively separated from adjacent spaces. Section 407.3 provides one other option for constructing corridors, but it is limited to those in Group I-2 occupancies. Under this option the corridor walls are permitted to be constructed as smoke partitions per Section 710, but this leaves many unanswered questions because smoke partitions do not require a fire-resistance rating and many of the provisions of Section 710 only apply "where required elsewhere in the code."

A look at the various requirements given in Section 710 provide some guidance on the wall's intended performance, but unlike fire barriers, which require a fire-resistance rating per Section 709.3 and an air leakage rating when used with a smoke control system per Section 909.5, or even the language in Section 508.2.2.1 regarding incidental use areas about "construction capable of resisting the passage of smoke," the level of performance is not explicitly addressed and therefore debatable. Section 710.2 provides that a smoke partition can be constructed of any "materials permitted by the building type of construction." It is our opinion that gypsum board, wood structural panels, glass, steel panels or any other solid material could be used.

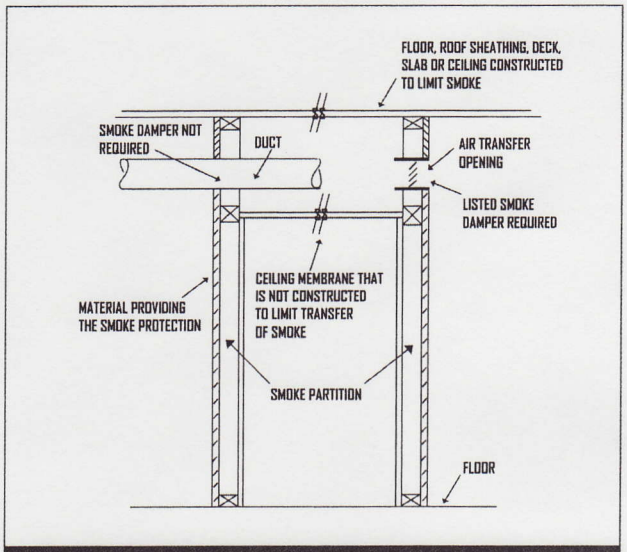


Figure 5a. IBC Section 407.3 provides for corridor walls in Group I-2 occupancies to be constructed as smoke partitions. This example shows the smoke partition material running to the underside of the floor or roof sheathing, deck or slab above.

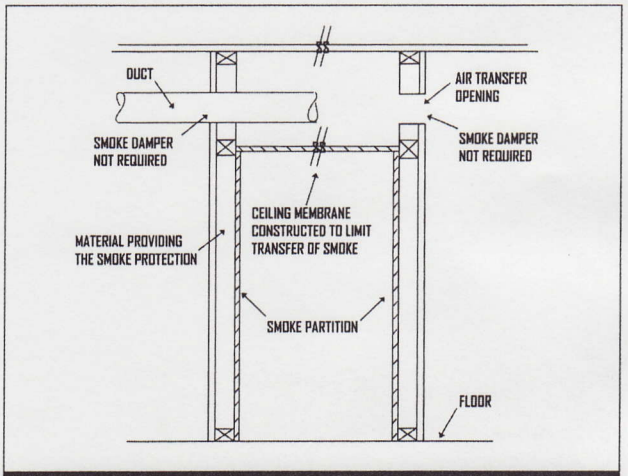
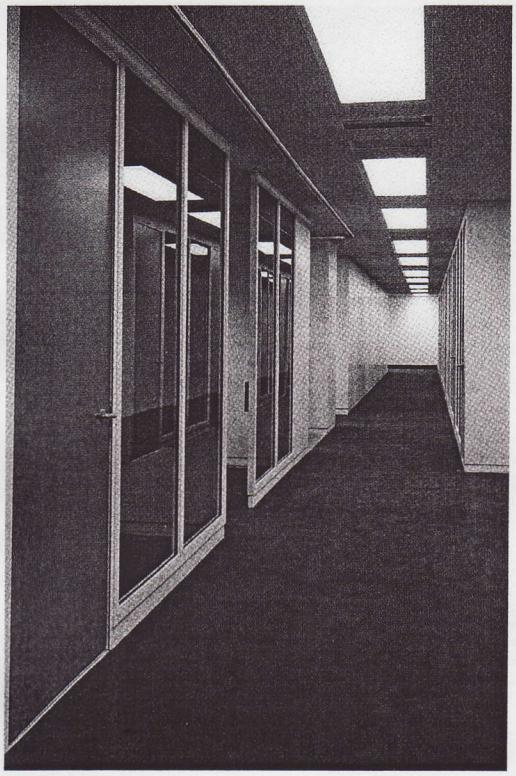


Figure 5b. This example shows the walls as smoke partitions that terminate at the underside of the ceiling above where the ceiling membrane is constructed.

In addition, unlike a fire-resistive rated assembly, which is tested from both sides, the material providing the smoke protection could be installed on only one side. Therefore, the smoke partition could be constructed with the material running "to the underside of the floor or roof sheathing, deck or slab above" or it could be terminated at the "underside of the ceiling above where the ceiling membrane is constructed to limit the transfer of smoke." These two options are illustrated in Figure 5a and Figure 5b, repectively. ◆



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Part 1 of this article, which appeared in the January–February issue of *Building Safety Journal,* focused on corridor construction details. This concluding entry addresses code issues related to the protection of corridor ventilation systems.

Opening Protection

Because openings into a corridor can provide a path for smoke and fire to enter and thereby compromise its integrity, the code will generally require that the openings are protected. IBC Section 708.9 requires that penetrations by ducts and air transfer openings comply with Section 716. Depending on which of the four construction options are used for the corridor, the location and requirements for protecting the openings can vary. The majority of the requirements for corridors are given in Section 716.5.4 and its subsection, Section 716.6.2, and Section 712.

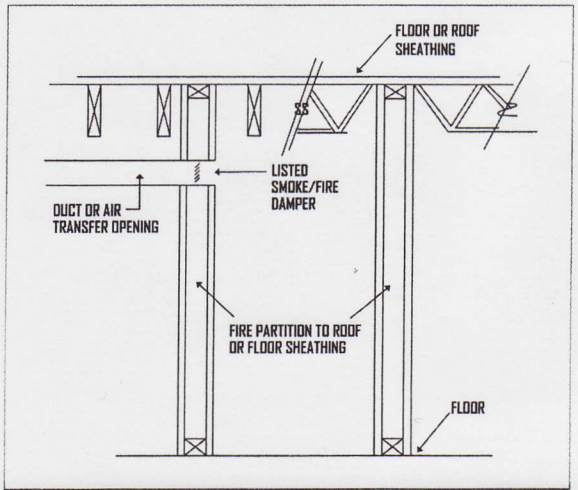


Figure 1(a). In corridor construction where fire partitions extend from the top of the foundation or floor/ceiling assembly below to the underside of the floor or roof sheathing, slab or deck above, a fire damper and smoke damper or combination damper are required where a duct penetrates the fire partition.

To properly apply the code, all relevant sections should be reviewed. For example, the requirements for fire dampers in corridor walls are given in Section 716.5.4 while smoke damper requirements are given in Section 716.5.4.1 and ceiling dampers are addressed in Section 716.6.2. It is also important to review any exceptions that may be applicable. Section 716.5.4, Exception 1, allows the omission of fire dampers in corridor walls in other than Group H occupancies if the building is sprinklered. In this instance, being aware of the separate requirements and exceptions may not only make compliance easier but may also make it less costly.

Figure 1(a) shows the damper requirements for a corridor constructed with fire partitions that extend to the floor or roof sheathing, slab or deck above as permitted by Section 708.4. In this type of construction, a fire damper is required by Section 716.5.4 and a smoke damper is required by Section 716.5.4.1 where a duct penetrates the fire partition. Note that it is permissible to install either separate fire and smoke dampers or a combination damper. Additional information on damper testing and listing is given in Section 716.3.

Figure 1(b) depicts essentially the same situation as Figure 1(a) except a non-fire-resistive-rated ceiling is installed within the corridor. In such cases, fire and smoke dampers are required at the point where a duct penetrates the wall but not where a duct penetrates the ceiling. Therefore, any type of ceiling diffuser or register can be used. Figures 2 and 3 depict the provisions given in Section 716.5.4, Exception 3, and Section 716.5.4.1, Exception 2, respectively, for the elimination of fire damper and/or smoke dampers in corridor wall penetrations.

Where corridor wall fire partitions end at the ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly, duct work above the ceiling only needs to be protected in accordance with Section 716.6.2, as illustrated in Figure 4. Ceiling radiation dampers are typically required at all openings in the ceiling, whether there is a duct attached or a diffuser with no duct attached is used, such as at an opening to a return air plenum. Section 716.6.2.1, item 1, allows that assemblies which have been shown to meet the requirements of ASTM International E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, fire test or equivalent without ceiling radiation dampers may be left unprotected.

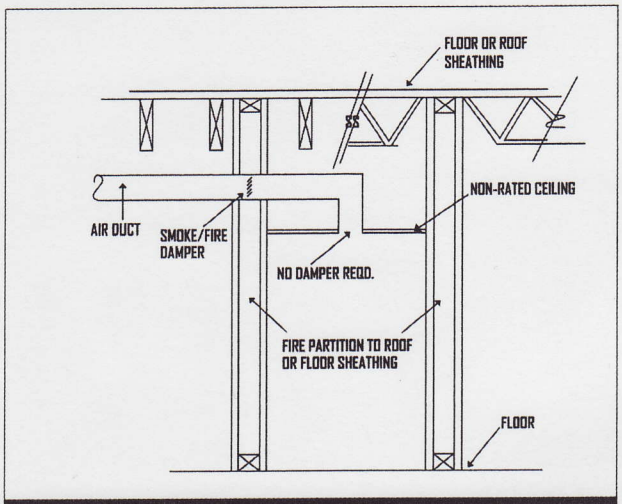


Figure 1(b). Ducts are not required to be protected where they penetrate non-fire-resistive-rated corridor ceilings.

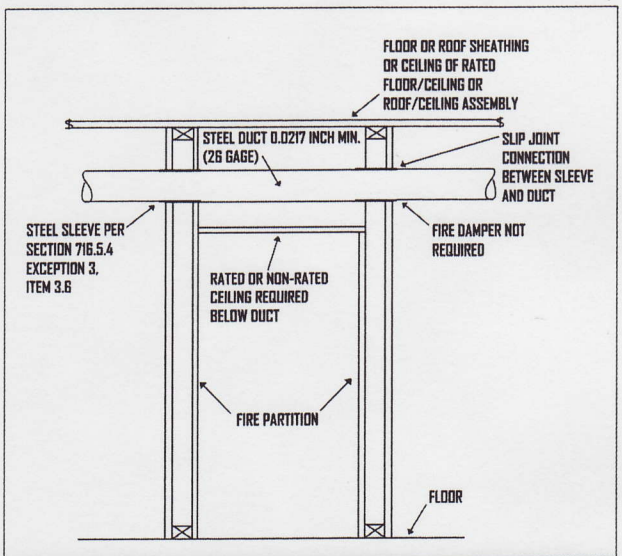
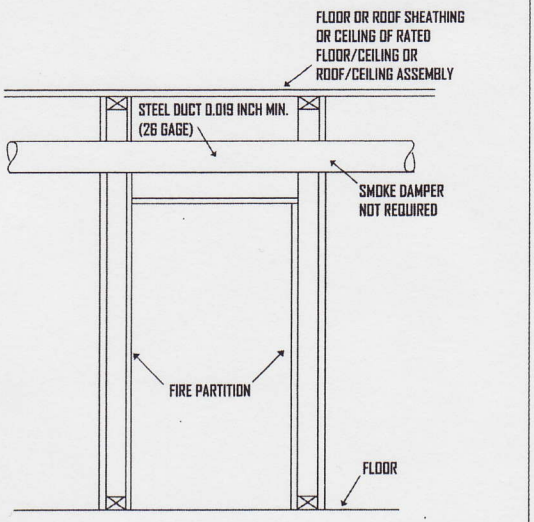


Figure 2. IBC Section 716.5.4, Exception 3, allows for the elimination of fire dampers in wall penetrations of corridors constructed as shown.

This exposes a coordination problem between Section 716.6.2.1 and Section 716.5.4.1, which generally requires a smoke damper where duct or air transfer openings penetrate a "corridor enclosure." The wording "corridor enclosure" is used for both the vertical fire partitions regulated by Section 716.5.4 and the horizontal "lid" of a tunnel corridor



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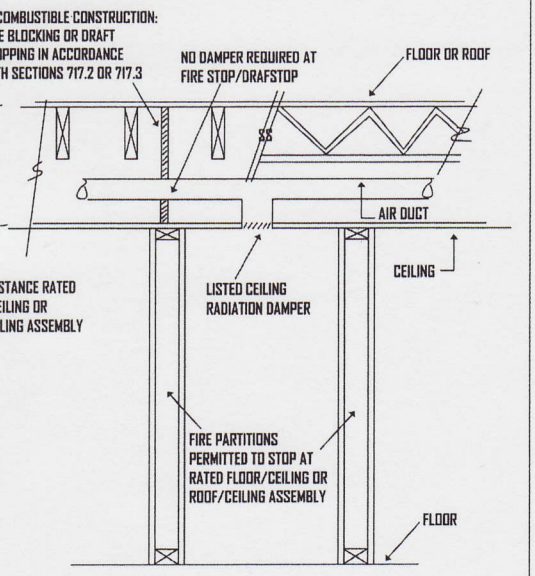

Figure 4. Where the corridor wall fire partitions end at the ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly, duct work above the ceiling only needs to be protected in accordance with IBC Section 716.6.2.

constructed per Section 708.4, Exception 3, as well as, potentially, the ceiling of a corridor constructed per Section 708.4, Exception 2.

While constructing a corridor per Figure 4 is somewhat unusual and the elimination of ceiling radiation dampers per Section 716.6.2.1, item 1, is rare, if both of these situations occur the ductwork shown would be permitted to have openings into both the corridor and the adjacent spaces without any type of damper. The legacy *Uniform Building Code* addressed this situation by limiting the requirements corresponding to IBC Section 716.6.2.1, item 1, so that they did not apply to fire-resistive ceilings in corridors. That way even though a smoke damper is not provided, the opening is protected by a radiation damper.

Another potential concern with this type of construction is duct penetration of the required fireblocking or draftstopping above the partition in combustible construction. The IBC does not require that any type of damper be installed at such penetrations, but most code officials would require that some method of protecting the annular space between the duct and the fire-block or draft-stop be provided, and language in support of this viewpoint is given in Section 717.2.1 and Section 717.3.1 requiring that the integrity of fireblocks and draftstops, respectively, be maintained.

When using the construction option provided by Section 708.4, Exception 2, illustrated in Figure 5, there are essentially two points that provide the protection for the corridor enclosure and must therefore be protected by dampers. The requirements of Section 716.5.4 and Section 716.5.4.1 require both a fire damper and a smoke damper at the penetration of the wall membrane, while Section 716.6.2 requires a ceiling radiation damper at the penetration of the ceiling.

Requiring dampers at two fairly proximate locations may seem excessive to some, but in fact usually indicates a design problem. The designer would be wise to consider revising the duct layouts to reduce or eliminate the number of locations where the requirement for multiple dampers occurs or select a different method of corridor construction. That said, this is a detail for which some code officials are willing to accept an alternate method of compliance. ICC staff have seen two possible alternatives, both dependant on the use of minimum 0.0179-inch-thick metal ducts.

The first is to require the ceiling radiation damper and not require the fire and smoke damper in the wall. If this is

allowed, Section 716.1.1 requires that the wall opening be protected as a penetration in accordance with Section 712. A more moderate alternative is to allow the omission of the fire damper at the wall but still require the smoke damper. The rationale is that ceiling radiation dampers are not required to meet the smoke damper requirements of Underwriters Laboratories (UL) 555S, *Standard for Smoke Dampers*, so the radiation damper serves to protect the integrity of the corridor's ceiling while the smoke damper limits the potential for smoke to enter the corridor through the duct. Both of these methods are based on the consideration that with the use of metal ducts the benefit of providing dampers at both the ceiling and wall penetrations is not substantially greater than just providing ceiling dampers.

Penetrations in the lid of a "tunnel corridor" constructed in accordance with Section 708.4, Exception 3, are not permitted to be protected by a ceiling radiation damper. Rather, a "corridor damper" specifically listed for this purpose—having successfully passed both UL 555S and UL 555, *Standard for Fire Dampers*, test criteria—must be used. However, corridor dampers are not tested or intended for wall penetrations. If a duct enters a tunnel corridor by penetrating the wall, either a separate fire damper and smoke damper or a combination damper are required per Section 716.5.4 and Section 716.5.4.1.

Finally, IBC Section 407.3, which covers Group I-2 occupancies, allows the use of the smoke partition provisions of Section 710 to provide a unique method of constructing corridors. Section 710.7 addresses the penetration of the smoke partition by a duct and locations where an air transfer opening may be used. The term "air transfer opening" is not explicitly defined in the *International Codes* but is generally viewed as referring to a relief vent, hole, louvered grill or other such feature that does not have a duct connected to it. As such, a duct penetration that terminates at a supply diffuser or return air grill would not be considered an air transfer opening.

If a duct is used for the penetration a damper is not required and the protection requirements given in Section 712 do not apply and only the use of an "approved material to limit the free passage of smoke" per Section 710.7 to seal the annular space around the duct is needed. Except under very limited circumstances, however, the code requires that an air transfer opening be protected by a smoke damper. Hospital designers who must comply with both the IBC and *NFPA 101: Life Safety Code* should be aware that the two codes conceive of an "air transfer opening" differently, which may affect the interpretation of whether a smoke damper is required for a ducted penetration. ◆

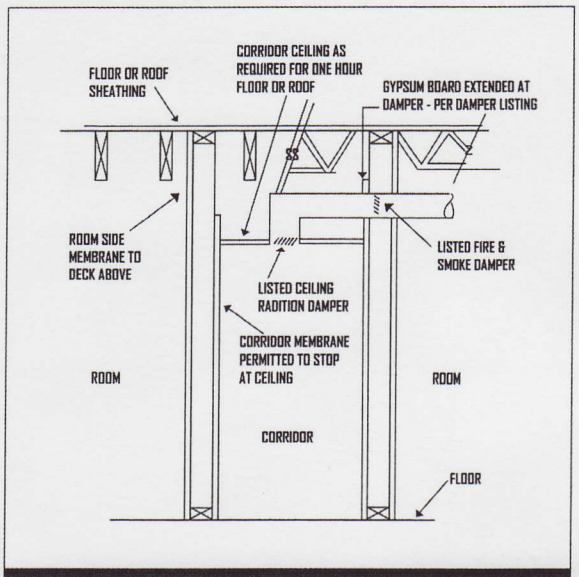

Figure 5. This type of corridor construction requires a fire damper and a smoke damper at wall membrane penetrations and a ceiling radiation damper at ceiling penetrations.

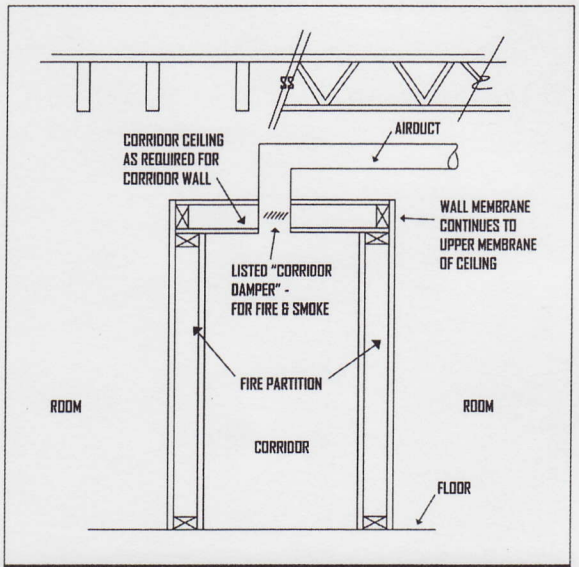

Figure 6. Duct penetrations in the lid of a "tunnel corridor" require the use of a listed corridor damper.

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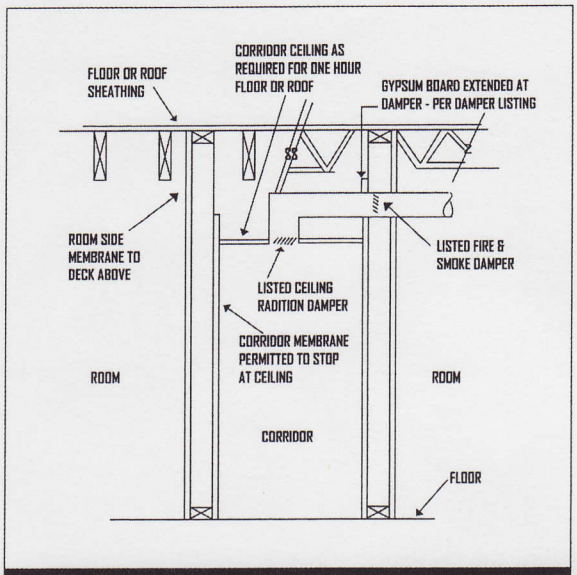

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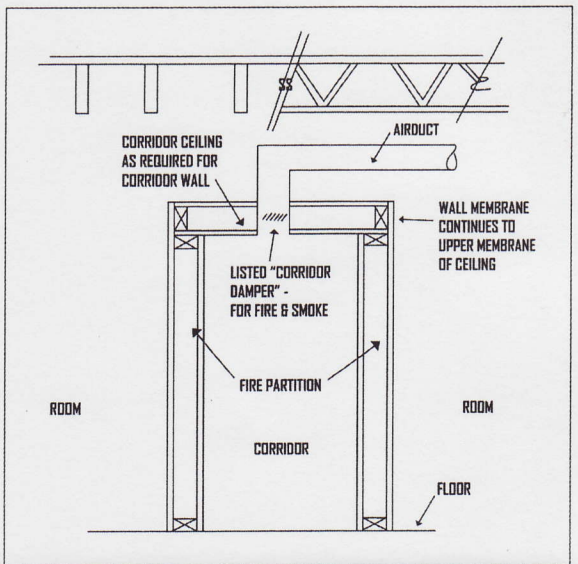

Figure 6. Duct penetrations in the lid of a "tunnel corridor" require the use of a listed corridor damper.