TRADITIONAL FIRE PROTECTION METHODS

PROTECTION METHODS OF EMERGENCY ELECTRICAL CONDUCTORS

Introduction

Protection of the emergency electrical conductors is required by Building and Electrical Codes for high-rise buildings to ensure the provision of electrical power to emergency equipment in the event of a fire. The operation of these systems is critical to the life safety of the occupants of the building as well as for firefighting purposes. This protection is necessary due to:

- extended evacuation time in high-rise buildings
- reliance on building equipment for firefighting operations in high-rise buildings
- need to maintain operation of fire alarm systems and pressurization equipment

Fire-resistance ratings of 1-hour or 2-hours are required depending on national and local codes, the type of circuit, and the environment. In order to ensure that these systems will be provided with electrical power for the required period, the conductors providing emergency power must also be operational during this time.

The evaluation of construction methods was prompted by the fact that several fires in high-rise buildings have involved failure of emergency electrical conductors. While the electrical conductors were not directly involved in the fire, they were affected by exposure to the effects of fire from within the building. The failure of the emergency conductors resulted in an increased demand on the firefighting operations and endangered the lives of the occupants.

General

There are several methods used for the protection of emergency electrical conductors in high-rise buildings. These include the following:

- concrete encasement
- drywall, gypsum board
- concrete block
- UL/ULC fire-rated cables

Raceways Embedded in Concrete

This method of protection involves the installation of a raceway for the emergency conductors within the concrete such as in the floor or shear wall. Factors which affect the fire-resistance rating of this protection method are:

- type of concrete used
- thickness of concrete cover achieved in the field

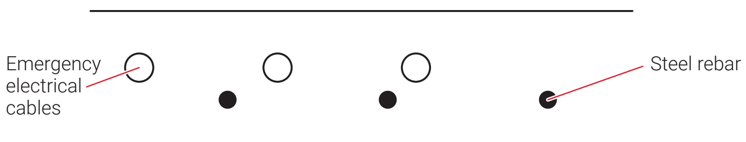

Fig. 1 Section through reinforced concrete slab

Traditional concrete floor slabs in high buildings range in thickness from 6 to 8 inches depending on the span and the type of concrete used. In Canada, for example, the National Building Code (NBC) requires that a minimum fire-resistance rating of 2 hours be provided for floor assemblies in high-rise buildings. In order to achieve this 2-hour rating, Table D-2.2.1.B. of the 1995 NBC requires a minimum cover to reinforcement of one inch (25 mm) for Type S, N, L40S, or L concrete. However, this cover to reinforcement may not provide the protection required for emergency electrical conductors which are exposed to fire.

When a concrete slab is exposed to a standard time-temperature curve (ASTM E-119), which is the basis of the fire-resistance ratings in North America, a grading similar to that shown in Fig. 2 (taken from the NFPA Fire Protection Handbook 17th edition) is achieved. From this figure, it can be seen that the temperature at the point approximately two inches below the exposed surface of the concrete, which would be the potential location of the emergency electrical conductors, has a temperature of approximately 357°C (675°F). While this may satisfy the requirements for a fire separation, it is unlikely that emergency conductors will withstand exposure to this heat. As such, the protection of emergency conductors by embedding raceways in concrete is dependent on the location of the conductors within the concrete itself. As well, the protection by concrete is subject to the spalling of concrete when a hot concrete slab is subjected to cold water from a firefighters' hose.

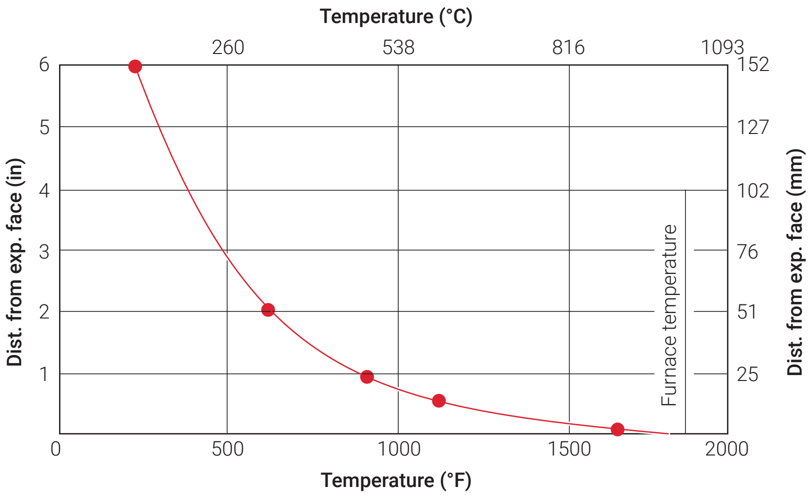

Fig. 2 Thermal gradient in a 6-in slab after 2-hour fire exposure

Drywall/Gypsum

Gypsum wallboard enclosures are used to protect emergency conductors in both the vertical and horizontal configurations. For example, in Canada, designers utilize a 2-hour listed wall such as ULC W404, or W406, or a shaft wall assembly which has been tested to CAN/ULC S101-M89 "Standard Methods of Fire Endurance Tests of Building Construction and Materials" to provide the 2-hour protection. To achieve a 2-hour fire rating, the conductors must be located within a shaft created by the wall, not within the cavity space of the wall, Fig. 3. If the installer places the conductors within the wall cavity space, the conductors are only protected by two layers of drywall rather than the entire tested wall assembly.

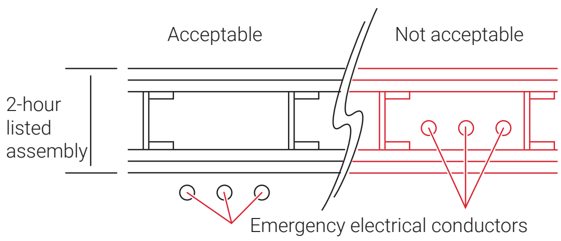

Fig. 3 Protection of emergency conductors using drywall/gypsum

In the event that a horizontal shaft wall is used for protection of conductors in a horizontal orientation, the protection must be by a horizontal shaft wall with drywall on both sides of the steel channels rather than just by two layers of drywall. As well, consideration must be given to the fire-stopping of the drywall on both the inside and outside joints of a horizontal shaft wall assembly.

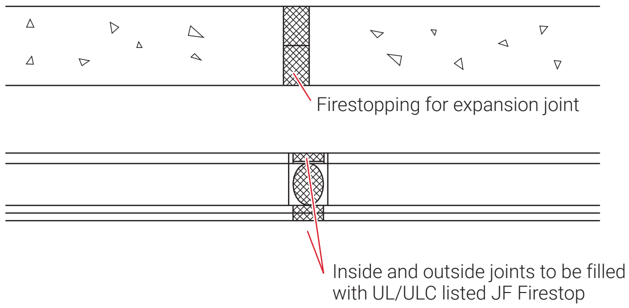

Fig. 4 Protection of expansion, and inside and outside joints

When using drywall protection, the following items must be taken into account:

- location of conductors inside of a shaft created by the entire drywall assembly (Fig. 3 left side) rather than within the wall cavity space (Fig. 3 right side).
- fire stopping of joints in the drywall
- electrical conductors crossing expansion joints in drywall assemblies which are subject to expansion and contraction
- protection of doors and access doors within these drywall enclosures; while walls and floors which are fire separations must not exceed an average temperature rise on the unexposed side of 140°C (284°F), access doors are not tested for temperature rise on the unexposed surface of the door

Concrete Block

When concrete block is used for protection of emergency conductors, it must be ensured that the conductors are located within a vertical service space created by the concrete block rather than within the block cavity itself, Fig. 5. If the conductors are located within the block cavity, the fire-resistance rating provided by half of the block will not provide the minimum protection required by the NBC (Canada).

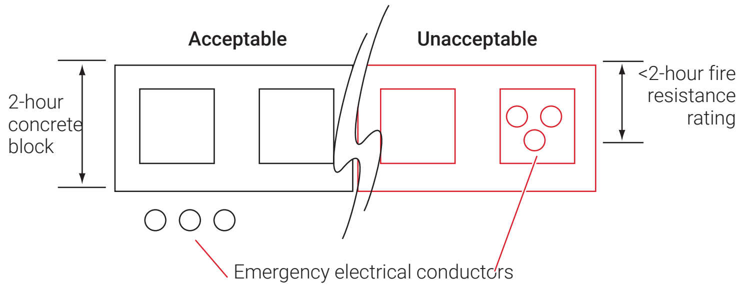

Fig. 5 Protection of emergency conductors using concrete block

UL/ULC Fire-Rated Mineral Insulated Cable

This cable is manufactured using only inorganic materials, copper and magnesium oxide. It does not burn, contribute fuel, or produce smoke when exposed to fire conditions. MI cable may be directly mounted, using clips and straps available from nVent, on noncombustible surfaces such as concrete or masonry, or supported by steel rod and channel (trapeze) systems. The cable, clips, and straps have been subjected to the 2-hour fire test. In this test, the cables are required to maintain the voltage for the listed time. No additional protection is required for this cable, Fig. 6.

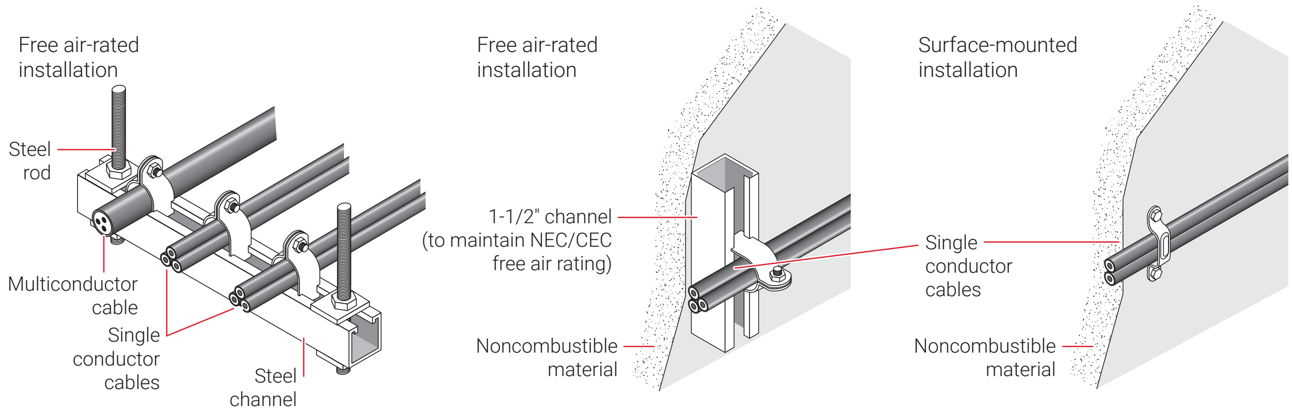

Fig. 6 MI cable installed on noncombustible surface

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