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Figure 1: Cast-in conduits with junction boxes laid on slab

Fire Stopping cast-in conduits - ensuring building safety

Cast-in-conduits have become an integral part of modern commercial construction. While the aesthetic and cost advantages they offer are undeniable, they also pose unique challenges in terms of fire stopping.

The use of cast-in conduits in concrete slabs developed alongside advancements in building systems like electrical, plumbing and mechanical. Prior to the widespread use of cast-in conduits in construction, electrical and mechanical services were typically surface-mounted or installed in exposed conduits. This often resulted in unsightly and inefficient installations prone to damage during maintenance and repair operations. Embedding conduits directly into structural elements offered improved space utilisation, better protection, improved aesthetics and easier maintenance.

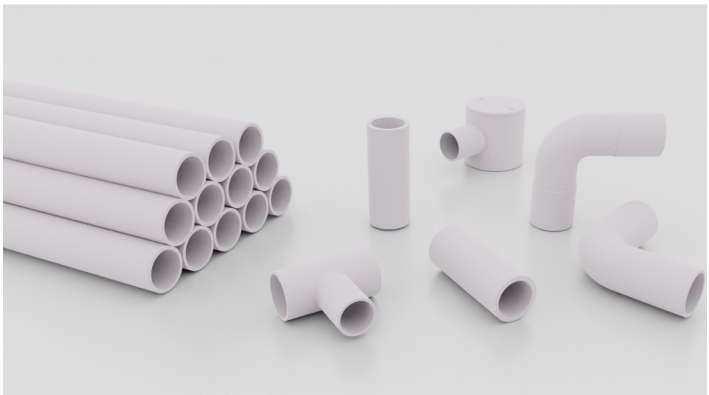
Today, it is considered good practice to provide drawings of the embedded conduit pathways within concrete slabs to avoid costly repairs caused by congestion or lack of knowledge between technicians of different trades. A recent innovation is the use of cast-in-conduits to route PEX pipes through slabs.

Types of conduits

Although flexible versions exist, conduits can broadly be classified as either metallic or non-metallic.

Metallic conduits

- **Rigid Metal Conduit (RMC)** RMCs typically made of steel, can be classified as galvanized or non-galvanized based on the presence of a zinc coating. These conduits offer excellent protection due to their thick walls. However their weight and rigidity make them difficult to handle, and they are prone to corrosion over time. Installation requires additional fittings and takes longer, resulting in higher costs. RMCs are commonly used in areas with heavy machinery and vehicular traffic, such as loading docks and car parks.
- **Electrical Metallic Tubing (EMT)** EMTs are similar to RMCs, however, are constructed from coated steel or aluminium. EMTs have thinner walls and are lightweight, making them easier to handle. They can be bent using specialised tools and can be installed exposed or concealed behind walls or in concrete. Because they are made of metal, they are prone to corrosion over time, which can lead to brittleness and breakage. EMTs are suitable for use in normal environments such as residential or commercial units.
- **Intermediate Metal Conduit (IMC)** IMCs were developed for outdoor use and share similarities with RMCs, although they are lighter with a wall thickness falling between that of an RMC and an EMT. The conduits are typically hot-dipped galvanized on the outside and coated with a special protective layer to enhance their resistance to corrosion and increase their lifespan. They are often used to deliver service to entrance components and run between exterior service panels.



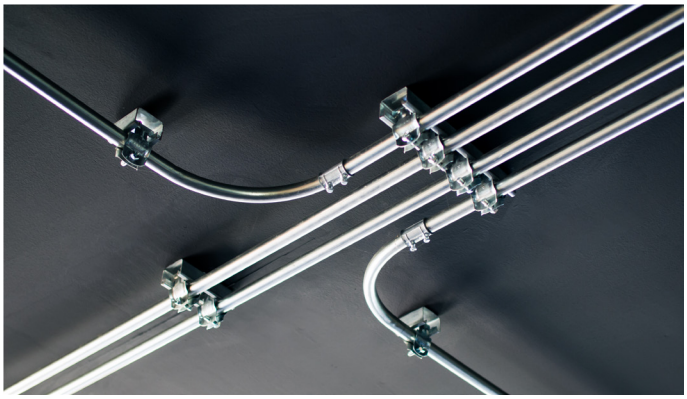


Figure 2: PVC and EMT conduits

Non-Metallic Conduits

- **PVC conduit** PVC conduits are the most commonly used non-metallic conduits. PVC, which stands for Polyvinylchloride, is a synthetic polymer known for its plastic properties. These conduits are suitable for direct burial in the ground or embedding in concrete slabs. They can be easily heated and bent on-site. The main advantages of PVC conduits include their lightweight nature, non-galvanic and non-magnetic properties, resistance to moisture and corrosion, as well as their waterproof construction and use of fittings, making them easy to handle.
- **LSZH conduit,** low smoke zero halogen conduits are another type of plastic conduit. They can be used in the same areas recommended for PVC conduits. LSZH conduits are more expensive than PVC conduits because they undergo additional manufacturing processes to mitigate the risks typically associated with plastic conduits, such as smoke emission and halogen release.

Embedding PVC conduits within slabs

PVC conduits while providing excellent flexibility are required to adhere to certain rules during installation to make them more efficient and long lasting.

- The conduits are often required to be laid between the first and second rebar layer within a slab.
- Using a maximum of two bends in a single run, as any more would render it obsolete and difficult to route services.
- Using junction boxes on the longer runs of conduit to act as pull outlets for a service.
- Providing minimum clearance between parallel runs of two or more conduits as dictated by local codes to provide adequate and uniform concrete cover around the conduits and is crucial to maintain structural strength.
- Ensuring the conduit is not laid directly on the formworks. Instead there should be a minimum height of 50mm to prevent any damage to the services during drilling or similar activities to the underside of the slab. This approach offers two advantages: it reduces the risk of electrocution and provides insulation and protection to the conduits from heat in the case of a fire.
- Conduits are frequently used as an alternative to drilling holes in slabs and walls with fire resistence levels (FRL). They can be employed to connect junction boxes or recess formers on either side of a fire wall or a concrete slab. Depending on the requirements, conduits can be used to route services on the same side or both sides of the concrete slab.

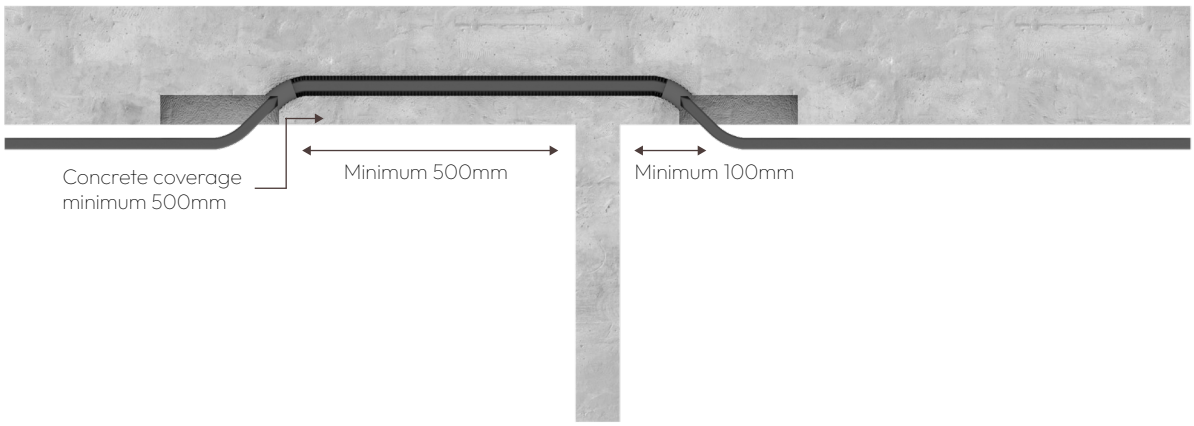


Figure 3: Instance of conduits embedded within slab

How do cast-in conduits behave in a fire?

To comprehend the risks associated with cast-in conduits in fire scenarios, it is important to have a basic understanding of how fires develop and how smoke spreads within a building

The development of a compartment fire can be divided into four stages:

1. Incipient, this is the initial stage of fire development immediately after ignition
2. Growth, the fire has established itself and burns self-sufficiently during this stage
3. Fully Developed, at this stage, the fire reaches its maximum intensity and engulfs all available fuel sources.
4. Decay, the fire begins to run out of fuel and the temperature starts to decrease.

It is crucial to recognise the changes that occur within a fire compartment. During the incipient stage, the fire releases hot gases that mix with cooler air in the room, resulting in an increase in overall room temperature. As the plume reaches the ceiling, hot gases spread horizontally across the ceiling. This layer of hot gases becomes more prominent and expands as the fire progresses beyond the incipient stage.

During the growth stage, the comparment contains two layers of gas/air temperatures: a hot layer near the ceiling or slab, and a cooler layer near the floor. As the volume and temperature of the hot gas layer increase, so does the pressure. The high pressure in this layer causes it to push down within the compartment and escape through openings, including paths created by conduits embedded in the slab soffit. If the conduit ends are in close proximity to a fire wall, there is a risk of fire propagating into adjacent parts of the building.

Figure 4: Smoke from compartment spreading into the adjacent compartment

The fire in the compartment can produce dense black smoke, which can impair visibility and cause disorientation. Additionally, when PVC conduits burn they release toxic fumes, including hydrogen chloride gas, which is corrosive. This gas can damage electrical equipment and, when it interacts with moisture, produce hydrochloric acid. Inhalation of these fumes can lead to eye and airway irritation, breathing difficulties, and even fatality. Smoke should be regarded as a serious threat to life and not be underestimated.

How can FIREFLY assist?

At FIREFLY, we continuously innovate fire stopping solutions for a wide range of scenarios. We have extensively tested our high-performing FIREFLYMastic HP to protect and maintain smoke barriers in various applications. FIREFLYMastic HP is an intumescent sealant that offers excellent insulation and prevents the spread of fire.

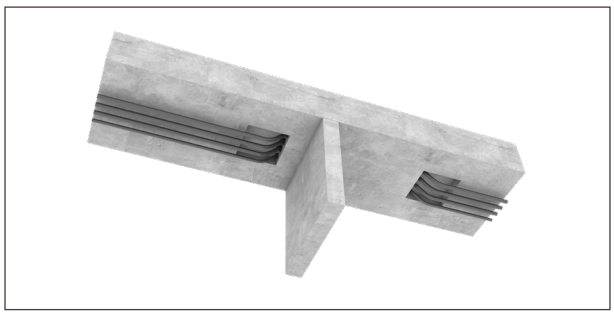
To ensure the integrity of the barrier, FIREFLYMastic HP is applied to a depth of 30mm within the annular gaps around services and conduits in junction boxes or recesses within slabs. During a fire, when heat or flames reach the slab soffit and start spreading horizontally, the sealant undergoes decomposition and forms a foamy char layer that expands by up to 20 times its original volume. In the case of combustible service penetrants, such as PEX pipes, the sealant expands to fill the space left by the melting pipe, effectively creating a fire and smoke barrier. For partially combustible materials like TPS cables, the sealant expands to replace the melted thermoplastic shield jacket, tightly sealing around the remaining copper and providing insulation.

FIREFLYMastic HP has been tested with conduits carrying the services listed below, cast in concrete slabs or walls, with fire ratings reaching up to -/240/240 FRL.

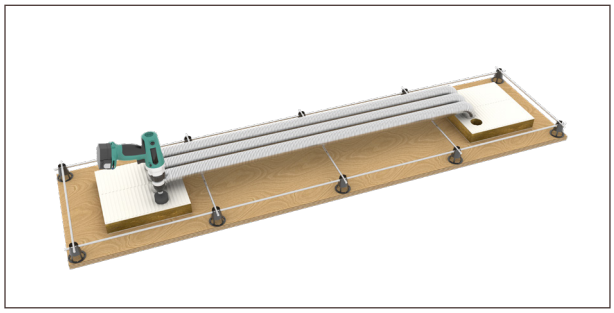
- ✓ Holes or blank seals
- ✓ PEX-A
- ✓ PEX-B
- ✓ PEX-AL
- ✓ Fibre optic cables
- ✓ Fire alarm cables
- ✓ Cat 5 or Cat 6 cables
- ✓ 16mm²3C+E orange power cables
- ✓ TPS cables

Benefits of FIREFLY's cast-in conduits systems

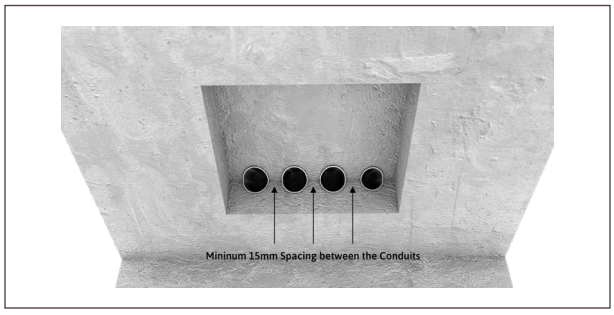
Can be used where the separating wall has an FRL of -/60/60 to -/240/240, irrespective of wall type and thickness.



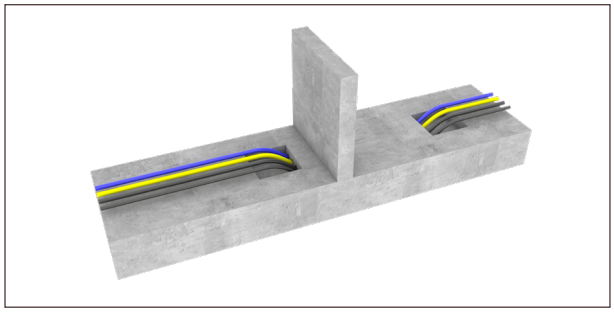
Can be used where conduits are terminated in a slab recess instead of a junction box.



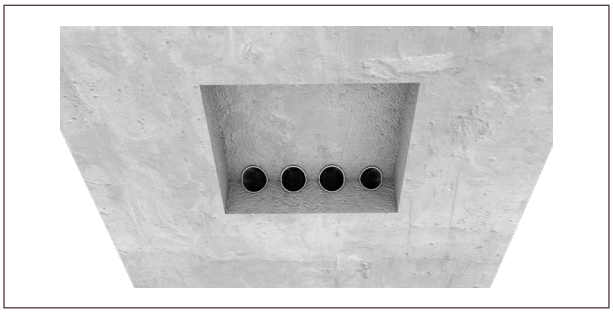
Total of 12 conduits can be included per box/recess spacing them 15mm apart.



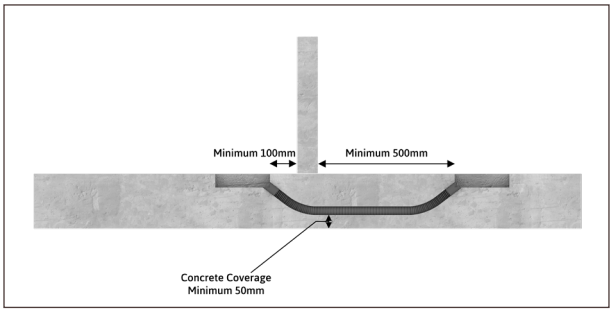
Mixed services can be placed inside each conduit so long as they don't take up more than 50% of the cross-sectional area.



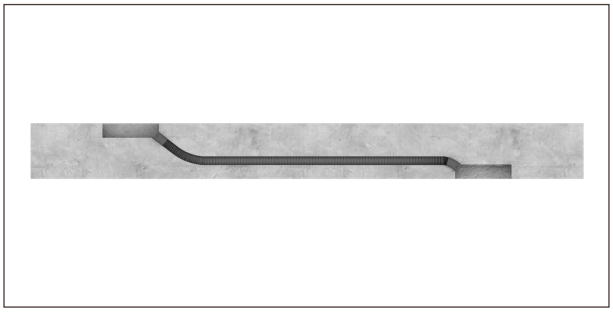
Can be used to seal empty conduits.



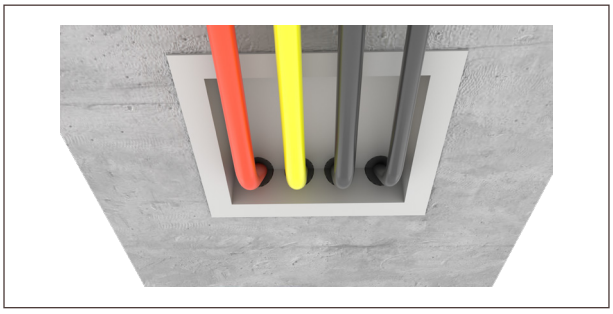
Can be used in inverted configuration where the conduits are embedded in a floor separated by a fire wall.



Can be used in a cross configuration where one box is cast in slab below and the other box is embedded in floor above with no fire wall separation.



Can be used with any brand of junction box.



Contact our customer service team for more information on cast-in conduits. Request an RIR or a quote/BOQ for your next project and schedule a site visit for professional advice on your fire stopping needs. Email us at sales@tbafirefly.com.au or call 02 8004 3333.