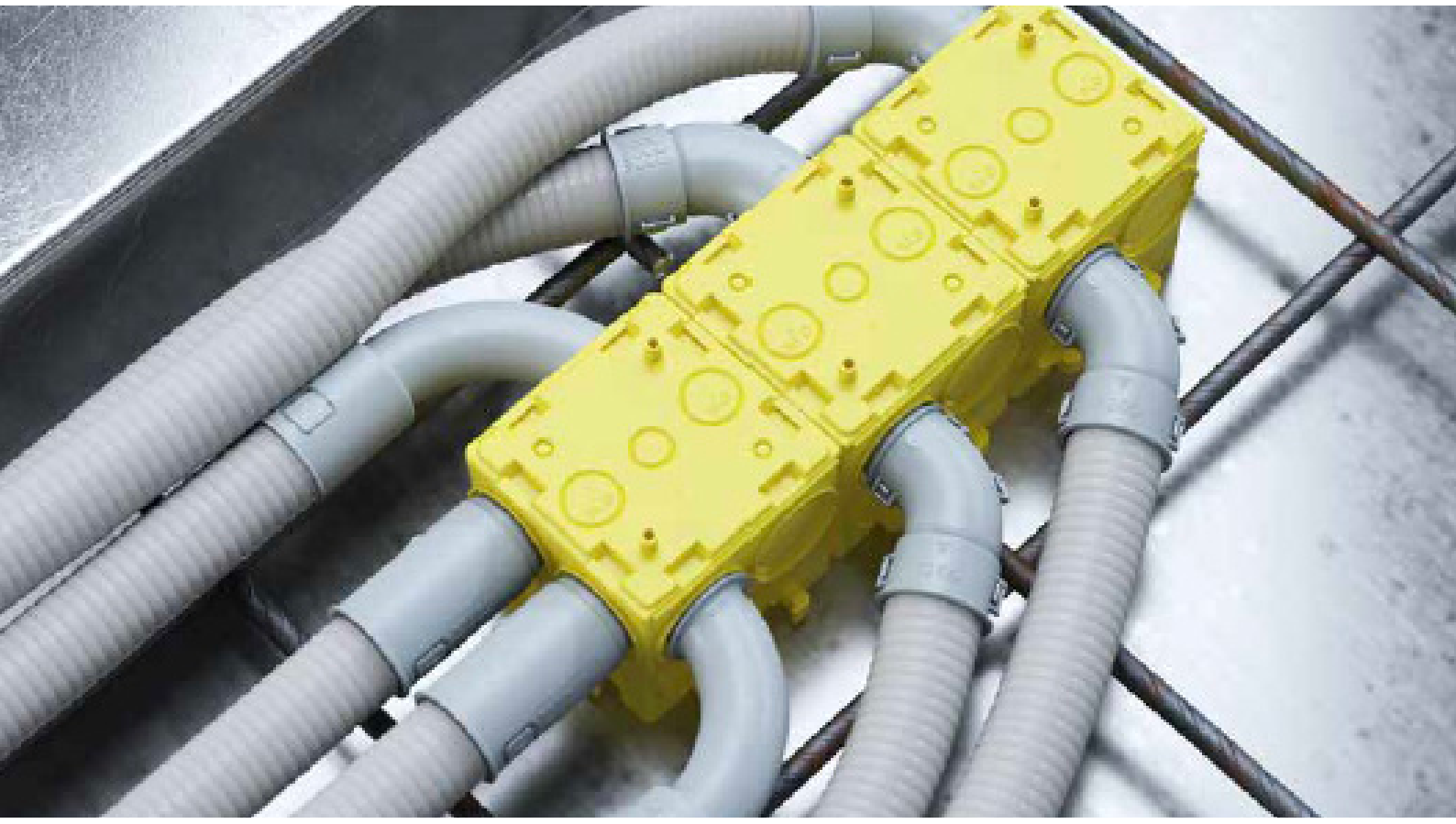
Guidelines for electrical installations

in elements of concrete and lightweight concrete (LECA concrete)



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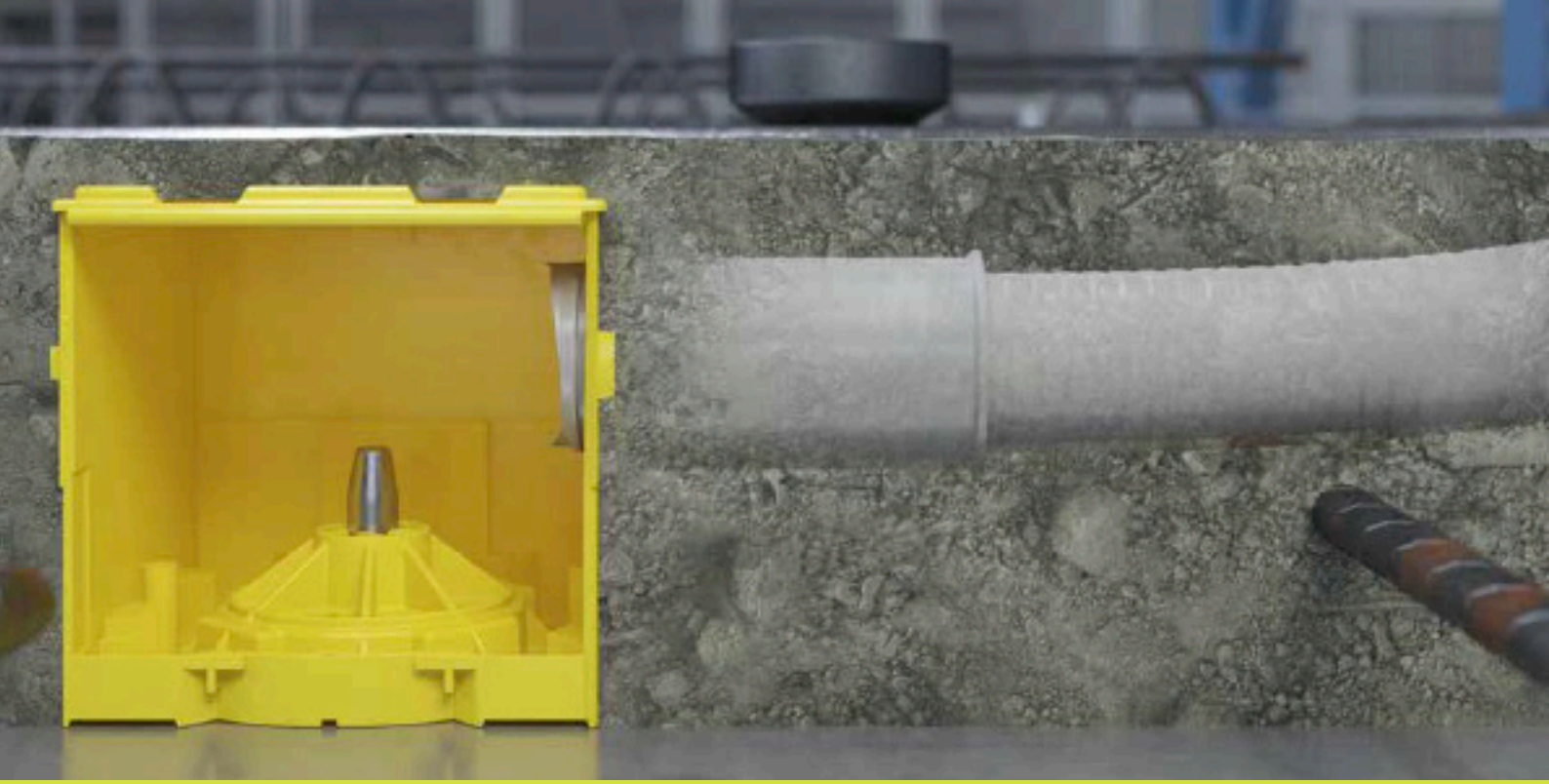

INTRODUCTION

Constructing a modern building is a complex process involving many parties whose work is interconnected. The quality of the result depends not only on one's own work but also on the quality of the materials and information handed over.

Interfaces are the points in the construction process where one trade hands its work to the next. Unresolved interfaces lead to lost time, additional costs and lower building quality.

Precast elements of concrete and LECA concrete play a key structural role and have many interfaces with other trades. Their design depends on documentation from the architect, the structural engineer and the services designers. Without consistent design material, work cannot begin.

The purpose of this document is to describe the interfaces relating to casting electrical installations into precast elements and to present the possible solutions and limitations of this technology.

The Molio A113 standard sets out the documentation requirements, including the obligation to supply drawings showing the position of the items to be cast in. The design must be complete, unambiguous and consistent. The design coordinator is responsible for reconciling the contributions of the individual trades so that no clashes arise.

In practice the detailed design of electrical installations is often passed to the contractors, which can lead to errors if it is not coordinated with the design as a whole. The documentation must be ready before precast production begins.

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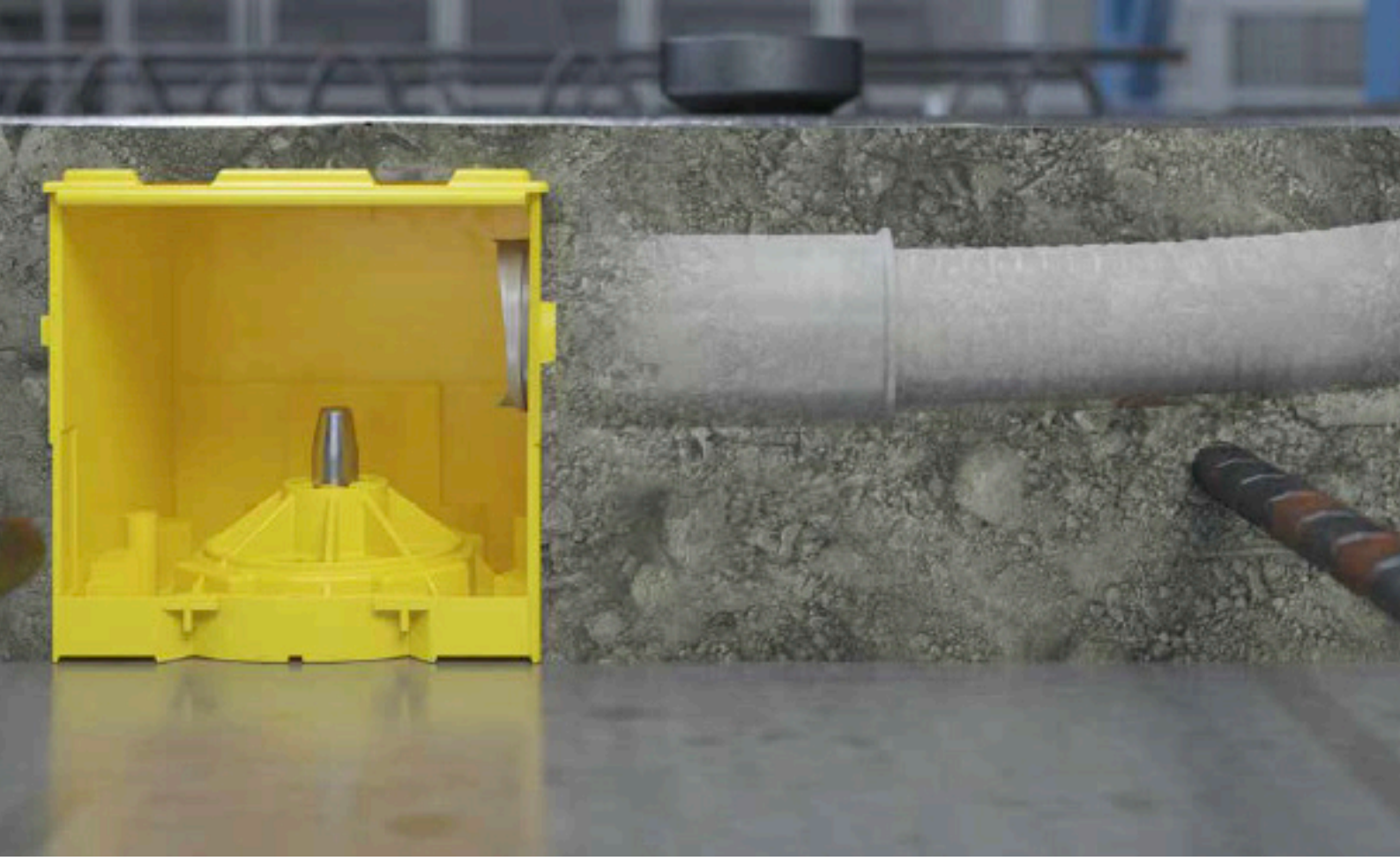


Casting in of conduits and electrical boxes

Casting electrical boxes and protective conduits into precast concrete elements is a key stage of preparing the electrical installation already in production. Correct positioning and fixing of these items ensures not only the function and durability of the installation but also the required appearance and compliance with technical and acoustic standards. This section covers the design, production and inspection principles to be observed when manufacturing elements with a built-in electrical installation.

The typical solutions shown in the drawings comprise:

A. Box with conduit run from the floor

B. Box with conduit run from the ceiling

C. Box with conduit run from the suspended ceiling

D. Group of boxes with conduit runs from above and below

E. Box with an offset conduit run

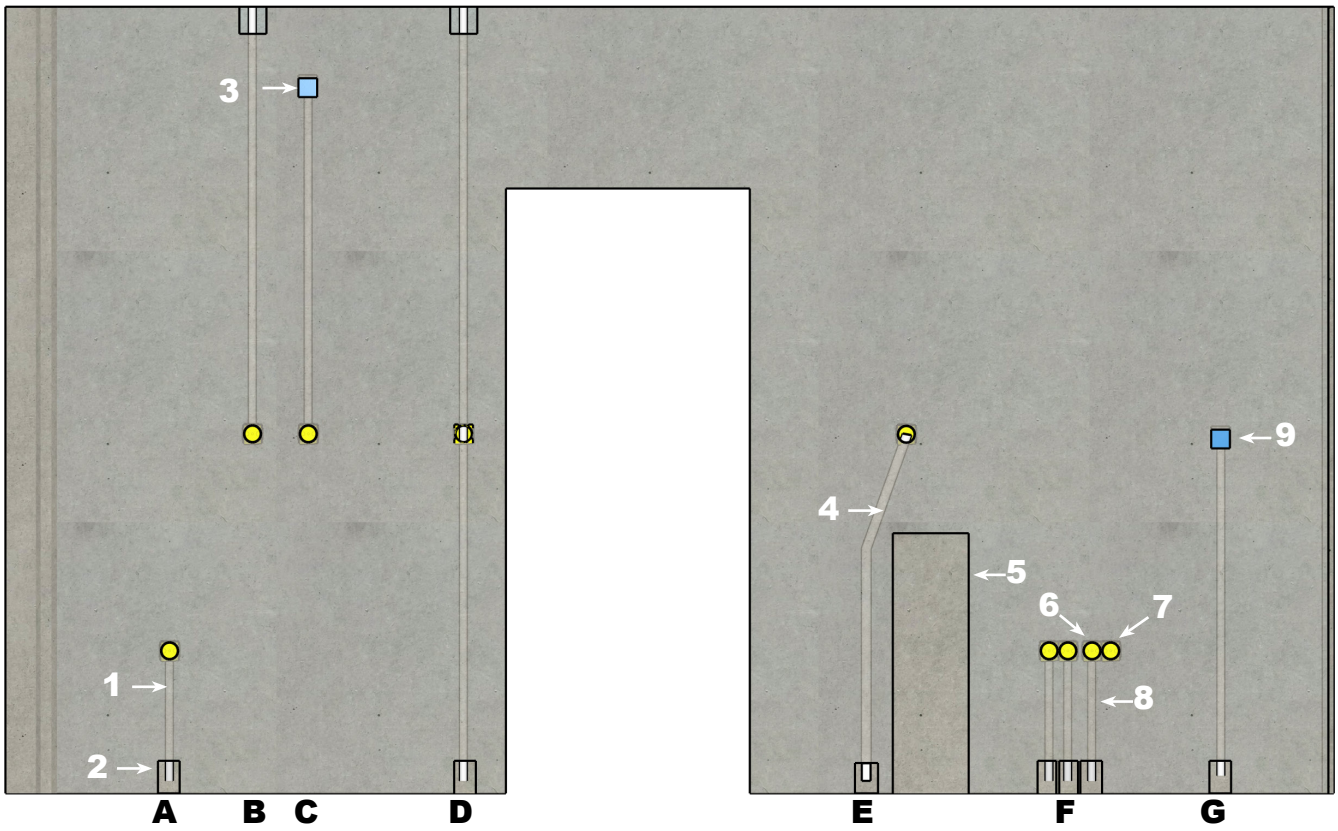
F. Group of boxes in a horizontal arrangement

G. Conduits terminating in a recess for later box installation

Main principles:

1. As standard, 1 conduit runs to each box. The minimum diameter is 25 mm.

2. Conduits run to the top or bottom edge of the element terminate in a polycon coupler placed in a suitable recess. The distance from the coupler to the edge of the element should be at least 50 mm. Individual manufacturers



use different recess standards.

3. Where conduits terminate below the top edge of the element, the couplers should also be located in a recess.
4. Where there is a clash with other items, e.g. reinforcement, lateral offset of the conduits is permitted.
5. Recesses may also be formed for plumbing services (e.g. VVS).
6. Spacers may be used.
7. Horizontal groups of boxes in load-bearing walls can significantly affect the load-bearing capacity of the wall – in such cases additional reinforcement may be required.
8. When boxes are joined in a horizontal arrangement, only 2 conduits per type of service are run as standard (power, data, telephone, aerial).
9. For boxes not suitable for casting in or requiring precise alignment, the conduits may terminate in a recess in which the box is fitted later, during the electrical works.

Placing boxes on opposite sides of a wall

Where cast-in boxes are installed directly opposite one another in party walls, it is essential to maintain at least 60 mm of concrete between the boxes and to fill the space behind and around them properly. The following rules also apply:
If a given wall type only just meets the sound insulation requirement of R'w = 55 dB, the boxes must be offset from one another where there is more than one module.
If the boxes are installed in walls with a sound reduction index R'w of at least 57 dB, they may be placed directly opposite one another, provided the minimum distance of 60 mm of concrete between the boxes is maintained.

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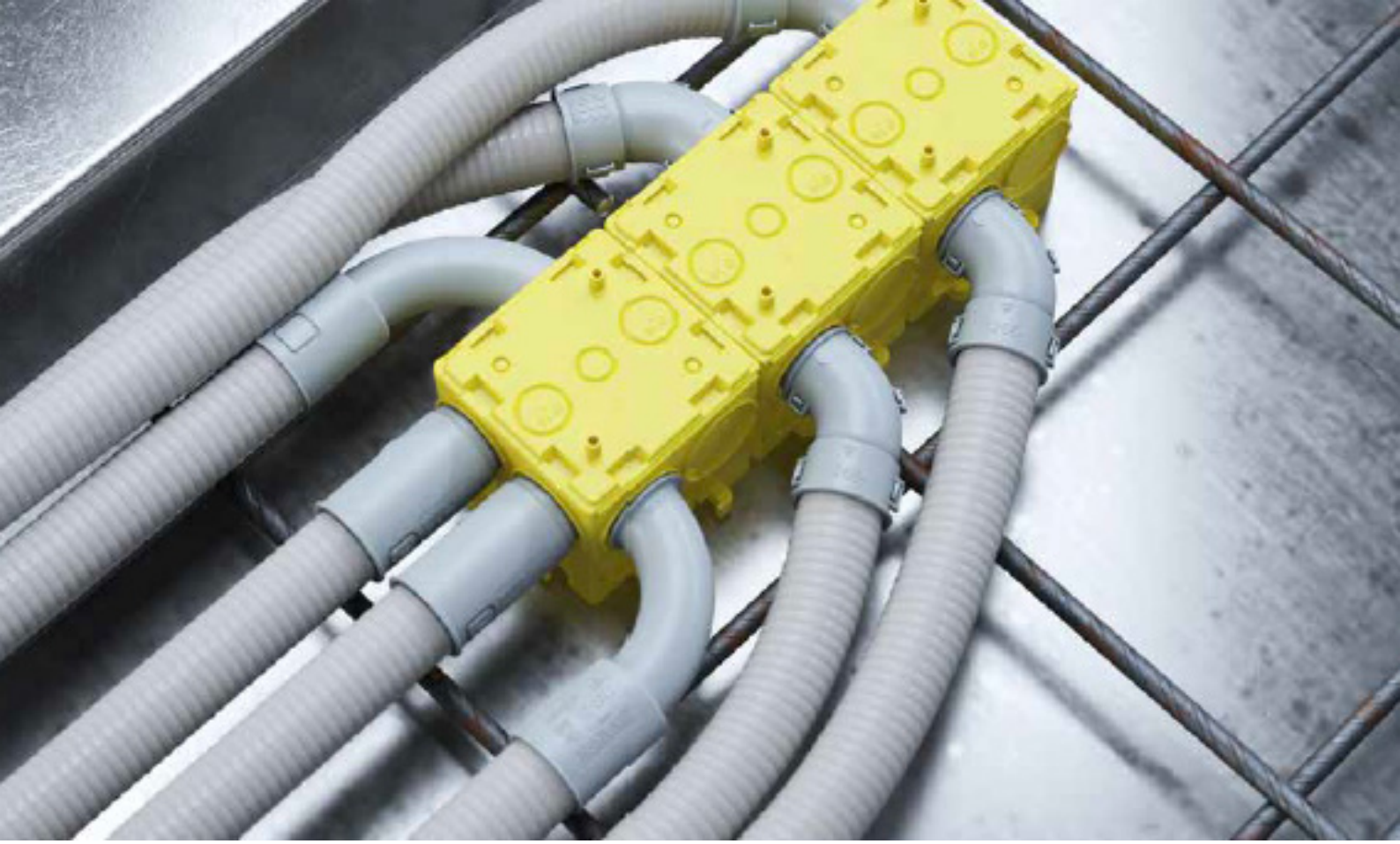
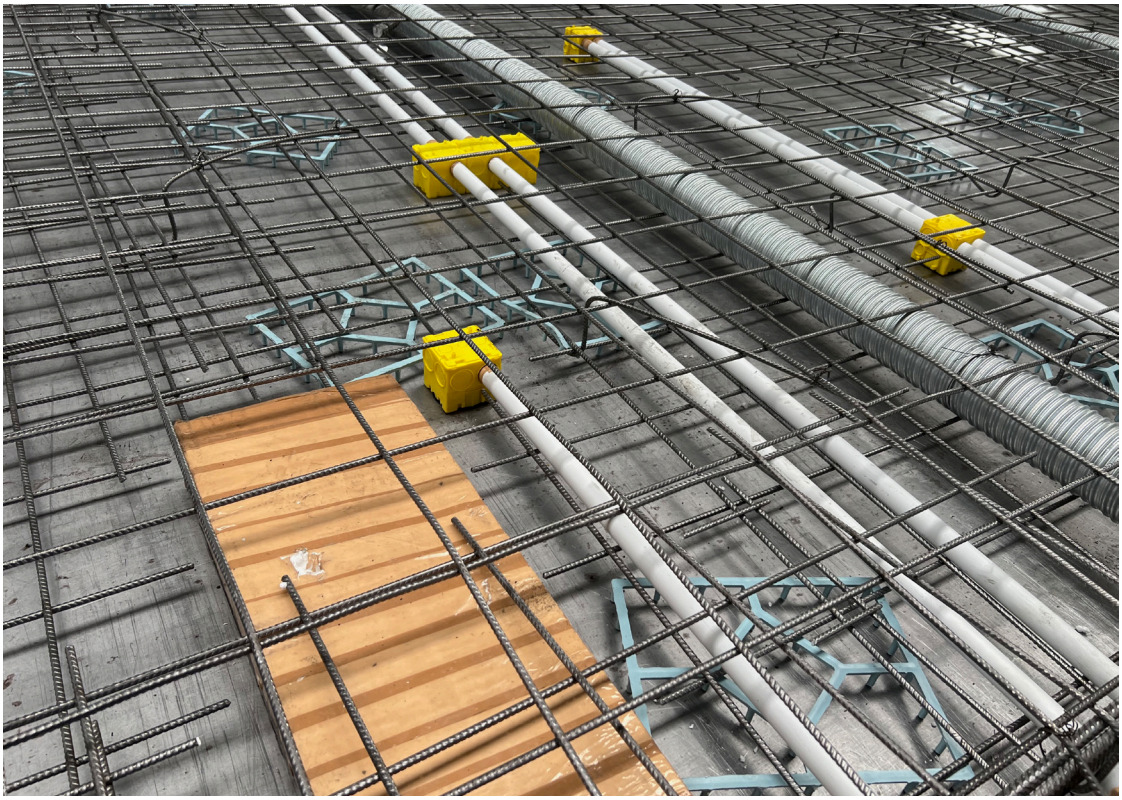


Installing conduits and electrical boxes on the casting tables

Before actual production of the precast element begins, the conduits and boxes are assembled into finished accessory sets matched precisely to the geometry of the particular element, its reinforcement and the other cast-in parts. For this reason changes to the cast-in sets are not possible once the element has been released for production. Precast wall elements are produced on steel casting tables. Recesses, boxes and other items to be cast in can be fixed to the mould with magnets; alternatively the boxes can be glued to the mould. In general it is easier to fix electrical boxes to the mould face than to its upper surface, and the accuracy of placement on the mould face is usually higher.
If there are no structural reasons against it, the aim is to have the wall face with the greatest number of cast-in items facing downwards, towards the casting table. This method of installation gives greater accuracy and stability of the installation during concreting.



Electrical boxes fixed to the mould with a magnet are measured and aligned precisely. The conduit run in the element should in principle be vertical, although the geometry of the element, the recesses and other cast-in parts may make a deviation from the vertical necessary.
At the top and bottom of the element the electrical conduits terminate in recesses, where the projecting conduit ends allow them to be extended and the installation to be continued.
These recesses are formed using reusable magnets. Alternatively, single-use expanded polystyrene inserts can be used.
Where necessary, the electrical conduits can also terminate without a recess – directly at the top edge of the element.
To ensure the conduits are fully encased in concrete, spacers are placed under the reinforcement and conduits on the casting table. If spacers are not used, care must be taken by hand during concreting to ensure that the conduits are properly encased in concrete on all sides. Concreting itself places a heavy load on the cast-in parts, so high demands are made on securing them in position.
The fixing must prevent not only lateral displacement of the parts but also counteract the uplift force

Chases for electrical services

Recesses for distribution boards or similar installations can be formed in wall elements. If distribution boards are to be built into walls subject to sound insulation requirements, it must be ensured that the wall still meets those requirements after the board has been installed.
There is often a need to run a large number of cables and conduits to and from the distribution board. This can be done in various ways:

- On the outside of the wall (visible in service rooms or service cabinets, in cable trunking or concealed in wall cavities)

- In a service recess in the wall
- In conduits cast into the wall

With lightweight concrete a recess is most often used, because of the difficulty caused by closely spaced conduits floating up. Where there are many boxes and numerous conduit runs – both above and below the niche – there is a risk of significantly weakening the element cross-section. Although it is easier to cast a larger number of conduits into concrete (unlike lightweight concrete), in such situations it is worth considering running them within the niche walls in order to limit the effect on load-bearing capacity.

Recess for later box installation

Instead of casting the boxes directly into the concrete, it is possible to form only a recess with a suitable conduit run. This solution may be appropriate where:

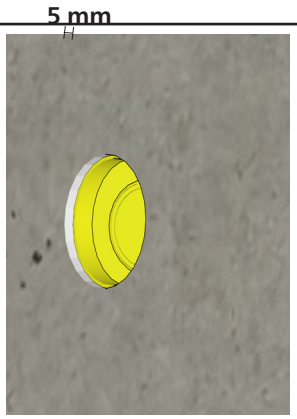
- greater accuracy of box placement is required than can be achieved by casting in at the factory (see the section on casting-in tolerances). It need not be used throughout the project but can be applied to particularly critical installations,

- the boxes to be used are not suitable for casting into concrete.

At points where boxes are to be fitted later, or where cables are to be run into cable trunking and the like, recesses such as the one shown in the illustration are formed. The dimensions of the conduits and recesses are matched to the particular requirements.

Tolerances of execution

All dimensions relating to the position of the boxes and the conduit runs should be treated as indicative and are subject to standard precast tolerances. The permissible deviations arise from the production and installation of the concrete elements and should be taken into account when designing and carrying out the electrical installation. The detailed tolerance values should be established in accordance with the applicable standards and the manufacturer's requirements.

Inspection method	**Item inspected**	**Required tolerance**	**Notes**	
D 1.1 – Check of dimensional tolerances	Position of the box / recess in the precast element	±15 mm	All dimensions measured from the zero point or as running dimensions	
D 9 – Box below the surface	Depth of the box set into the concrete	max. 5 mm below the surface	The box must be set slightly back from the face of the element	
E 1 – Deviation of the box from the vertical	Deviation of the box from the vertical (plumb)	max. 5 mm over 150 mm of height	The deviation may occur on one side only	
D 1.1 – Conduit without a box – horizontal deviation	Horizontal deviation of the electrical conduit without a box	±10 mm	Applies to horizontal offset of conduits run directly in the concrete	

Formee standard for designing electrical installation equipment

Type of boxes
Kaiser installation boxes are used – model B^2 one-gang junction box, 83.5 mm deep.

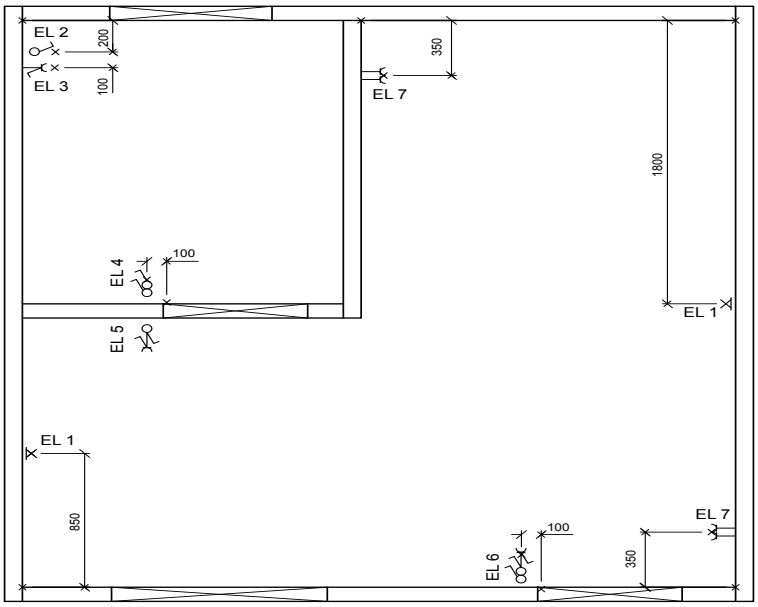
Conduit runs
A single installation conduit with an outside diameter of Ø 25 mm is run to each box
The conduits must be run as designed – vertically downwards, upwards or in both directions – depending on the layout of the installation

Position relative to openings
Socket by the door: The standard distance from the edge of the opening (niche) to the axis of the box is 150 mm

Closing remarks
Any departure from the above assumptions must be agreed in each case with the Formee design team before precast production or construction work begins.

Typical heights from the finished floor to the centre of the box:

Room	Service	Height (mm)
Bathroom	Ceiling light point2100 Socket by	
	the mirror	1200
	Socket by the SPA bath1200	
Kitchen	Cooker	500
	Extractor hood	1800
	Refrigerator	500
	Built-in oven1100 Microwave	
	oven1600 Socket at the worktop	
	Point under the wall cabinet1300	
	Dishwasher	
	Washing machine	500
Utility room	Dryer	500
	Aerial socket	500
Other rooms	Telephone socket	300
	Socket by the door1200 Socket	300
	at floor level300	
All roomsLight point – dis-	tance from the ceiling	100

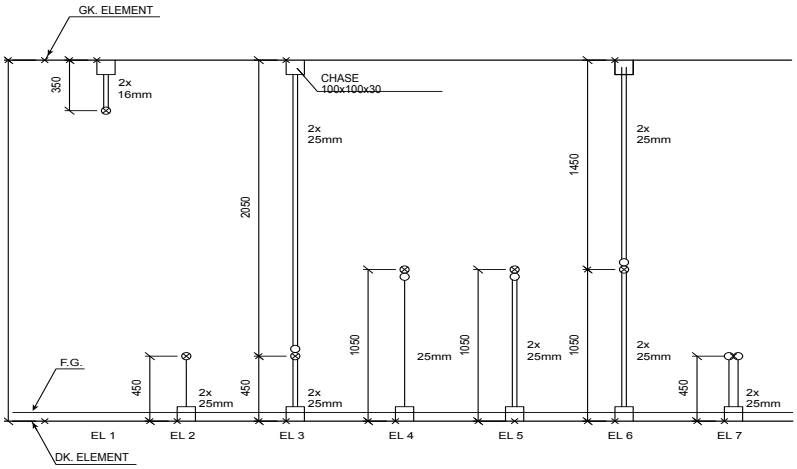


The general plan should include:

- A statement of which services are cast in and which are visible or run in trunking
- Identification of the types of items to be cast in
- Horizontal dimensions given to the centre of the box
- Identification of the electrical trunking and the dimensions of the openings for conduit penetrations in the element
- Cable trays – dimensions of the openings and their horizontal and vertical position

regarding the horizontal dimensions:

- In bathrooms and kitchens, where the services must be matched to the fittings and other installations, detailed dimensioning is required.
- In living rooms, standard distances from door frames and corners can be used.



The installation diagram should include:

- The type of box
- Module dimensions and instructions for joining boxes
- The height to the top edge of the box, measured from the finished floor or the bottom edge of the element
- The direction of the conduit run – upwards, downwards or in both directions?
- The diameter and number of conduits or boxes

Clashes between the structural and electrical designs occur frequently – a typical example is the pier next to a door, where the structural engineer designs reinforcement using the full cross-section of the element. A minimum pier cross-section of 150 mm has been adopted, in which an electrical box can be accommodated

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