



PROFESSIONAL FORMWORK SOLUTIONS



## What do we do?

Design and build solid concrete structures.

- Design entire structure from your frozen architect's drawings.
- Fabricate formwork panels in factory, including all openings.
- Erect formwork panels on site.
- Supply and cast all concrete for walls and slabs.
- Supply and fix all reinforcement for walls and slabs.
- Tape and joint walls ready for decoration.



## Contents

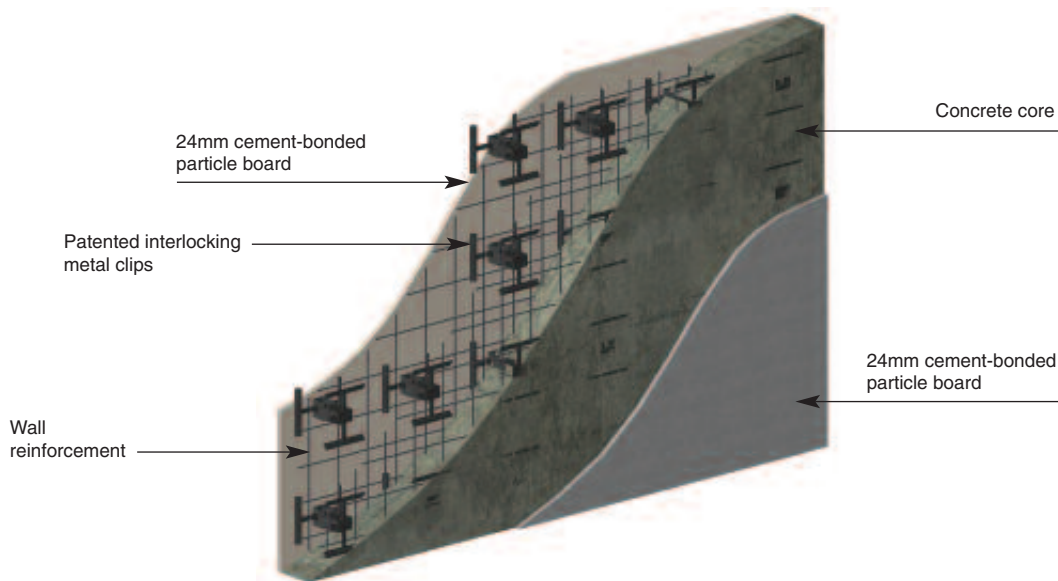
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## PFSolutions System Advantages

The permanent formwork wall system provides a Modern Method of Construction (MMC) similar to a precast wall system, but with several distinct advantages. Some of the main inherent advantages of the PFSolutions System, in comparison to precast and conventional forms of construction are:

- 1 **Reduced construction programme** – typical cycle-time per floor is 10 working days including first fix, mechanical and electrical.
- 2 **Reduced labour requirements** – structure can be erected with a minimal labour force and a lower capacity self-erector crane.
- 3 **Off-site construction** – approximately 60% of works completed off-site including reinforcement to walls.
- 4 **Design and Build Service** – reduced project management/coordination requirements.
- 5 **Flexibility** – all M&E services are site installed prior to concreting thereby accommodating any late changes in layout.
- 6 **Health and Safety** – panels are relatively light, making them easier and safer to install. A typical 6 meter long panel is equal to 1.2 tonnes.
- 7 **Construction tolerances** – excellent tolerances achieved due to factory production and ease of installation.
- 8 **'Just-in-time' deliveries** – minimal requirements for site equipment ensures a clean and uncluttered site in conjunction with a zero-waste policy.
- 9 **Excellent thermal fire and acoustic ratings.**
- 10 **Minimal wet-trades** – the panel finish is such that minimal wall or slab-soffit preparation, other than cleaning, is required before the panels can be painted. Localised taping and jointing is required at joint locations.



Typical PFSolutions Wall Build-up

## Introduction to the PFSolutions System

The PFSolutions system originated in Austria approximately 20 years ago and has been used extensively throughout mainland Europe and was introduced into Ireland in 2004. PFSolutions is a permanent formwork system which utilises cement-bonded particle boards (CBPB) as the permanent-form to the faces of walls, slabs and stair soffits, beams and columns.

### The PFSolutions Formwork Building System:

The formwork system is a method of constructing reinforced concrete building structures. Generally this entails constructing the party and internal leaf of external walls, suspended slabs and stairs on a typical residential building. The lift shafts, staircores and circulation corridors are also included. This is achieved by fabricating formwork panels from 24mm thick cement bonded particle board off site in a factory in accordance with approved drawings and specifications. The cement bonded particle board is manufactured in the Czech Republic by a company called CETRIS [www.cetris.cz](http://www.cetris.cz) and the formwork panels are fabricated in Slovakia by the VST Group [www.vst-austria.at](http://www.vst-austria.at)

The cement bonded particle board is used as the permanent formwork for each element and is left in place after casting the concrete on site. This permanent formwork is then prepared for decoration by taping and jointing the abutting panels.

Professional Formwork Solutions Limited trading as PFSolutions [www.pfsolutions.ie](http://www.pfsolutions.ie) is the sole distributor and constructor of this permanent formwork system in Ireland. We provide all labour, reinforcement, temporary works and concrete for our structures.

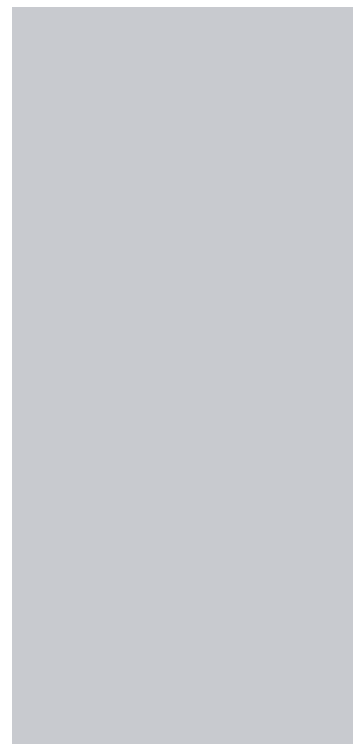


### Design Programme:

Upon receipt of frozen architect's drawings, PFSolutions proceed to design the building for approval by the clients design team. This task can be carried out within 2 weeks assuming sufficient information is provided. After this design is approved PFSolutions require an 8 weeks period to produce fabrication drawings, manufacture the system and commence transportation to site.

### Construction Programme:

PFSolutions generally divide up typical residential blocks into sections varying in floor area from 500 to 700m<sup>2</sup>. This facilitates the construction to progress in manageable areas of between 5 and 8 apartments at a time. PFSolutions construct up to 3 of these sections concurrently but allowing continuity for M&E installation between each section. The duration to complete a floor of a typical residential building is 2½ weeks. This will include all walls, slabs, beams and stairs erected, reinforcement fixed, M&E installation complete and concrete cast. Construction of the subsequent levels of the building commences immediately afterwards.





### Windows and Doors:

All external windows and doors can be fitted to the permanent formwork structure as the superstructure progresses. This allows the external façade to progress and makes the building weather proof earlier. All external windows and doors can be pre-ordered as PFSolutions can guarantee the accuracy of the structural openings in the walls.

### Façade Cladding:

All façades can be accommodated with the permanent formwork structure. Bricks, blocks, rain screeds, insulated renders, precast cladding and timber cladding can all be fixed to the walls.

### Craneage:

The craneage for the project is supplied by the main contractor/client. PFSolutions require one crane per 1000m<sup>2</sup> of building floor area. This crane does not have to be of large capacity. No wall panel weighs over 1.2t and no lift to unload trucks will be any greater than 5t. Generally one tower crane is provided and any additional craneage for larger floor areas can be accommodated with a self erector crane. All of the above are dependant on the relevant site conditions.

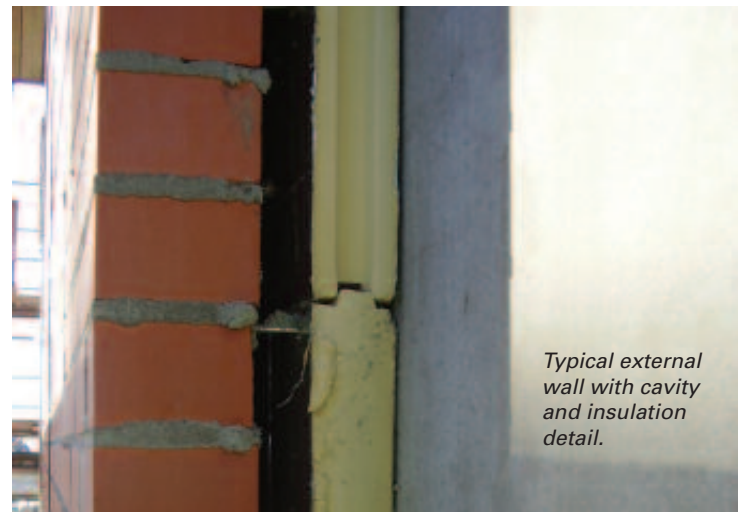
### Structural Design Indemnity:

The structure is designed by consulting structural engineers in Ireland for PFSolutions. They provide full professional indemnity

insurance warranting performance of the structure. The structures are designed to BS8110 and all other relevant standards.

### Tender Process:

Upon receipt of preliminary architect's plans and sections PFSolutions will produce an approximate bill of quantities and return it to the client within 10 days. PFSolutions are available to meet and discuss any aspects of our build system with the clients or any member of the design or project team. A client can proceed to design stage by issuing a limited letter of intent in favour of PFSolutions.



### Internal Finishes:

The PFSolutions formwork structure forms the basic shell of the apartments in a typical residential building ready for fit out. Depending on the slab option agreed with our client, limited suspended ceilings may be required with the apartments. If the permanent formwork option is used for the suspended slabs then the slab joints will require taping and jointing prior to decoration. If a precast wide slab option is used the slab joints can have an altek spray applied in the bedroom areas and suspended ceiling installed in the remaining areas. All walls joints require taping and jointing prior to decoration. All of the above options require minimal wet trades and can be carried out relatively quickly after the stud partition walls have been completed. Only taping and jointing is required to all window and door reveals as these are also formed with the cement bonded particle board.

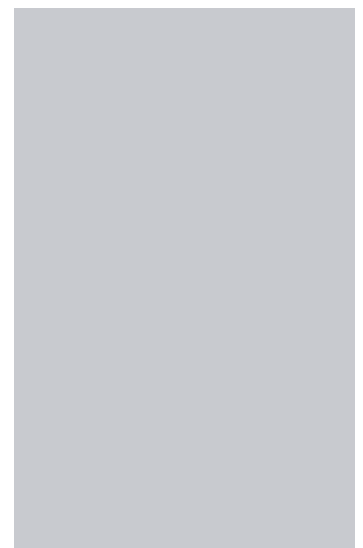
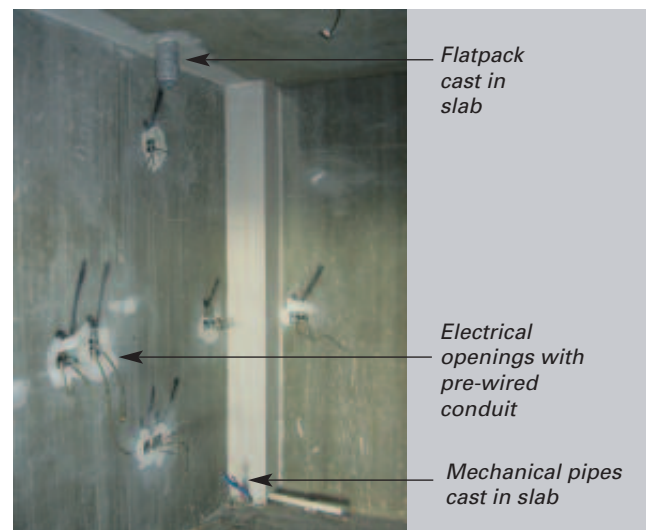
### Temporary Works:

During the construction of the structure minimal temporary works are required to the walling system and these can be removed immediately after the walls are cast. This usually equates to one wall prop for each 3m length of wall panel. Wall panels vary in length up to 6m long. The precast wide slabs require minimal propping, usually a line of props along the end of the spans and a line of props in mid span. The mid span props will remain in place for back propping up to two levels. For the full in situ PFSolutions slab option the propping is

required at 1.4m centres and back propping of two levels is required where 50% of the props are left in position. PFSolutions supply, design, install and remove all of the temporary works associated with the structure.

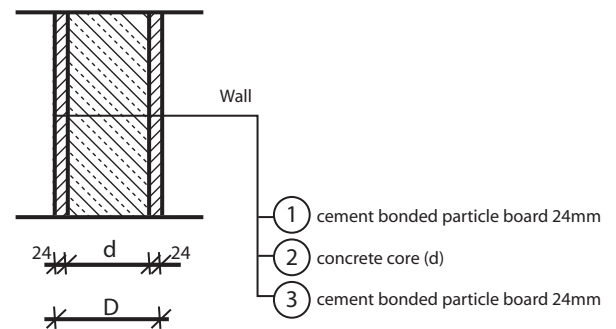
### Scaffolding:

Scaffolding is required to the perimeter of the building during construction. This is supplied and erected by the main contractor. In certain instances the structure can be constructed without scaffolding but this must be reviewed specific to each project.



## Walls

The permanent-form panels are pre-manufactured in the factory, in Nitra (Slovakia), comprising two CBPBs (each 24mm thick) which are joined together by a patented connection system. The wall reinforcement for each side of the wall is fitted, using metal brackets, to each of the respective CBPBs before they are joined using a hydraulic press. Full beam reinforcement cages (including links) can also be incorporated for lintels across wall openings (windows, doors, etc).



### Loadbearing walls:

VS D = 175mm (d=127mm concrete core + 2\*24mm cbpb)  
 VS D = 200mm (d= 152mm concrete core)  
 VS D = 215mm (d= 167mm concrete core )  
 VS D = 230mm (d= 182mm concrete core)  
 VS D = 250mm (d= 202mm concrete core)  
 VS D = 300mm (d= 252mm concrete core)

### Non loadbearing partition walls:

VS D = 150mm (d= 102mm concrete core)  
 Preferred types: D=175,200,230,250mm

Other thicknesses available after discussion

Abbr. cbpb = cement bonded particle board  
 D = overall thickness of wall section [mm]  
 d = thickness of concrete core [mm]





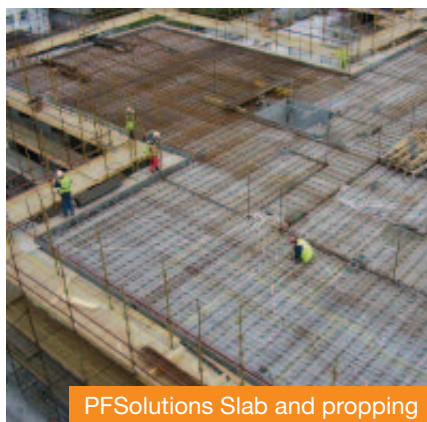
## Slabs

The PFSolutions slabs are pre-manufactured in the factory using a single CBPB (24mm thick by approximately 1200mm wide) which is fitted with four rows of trusses comprising metal top-hat sections with 10mm diameter reinforcement bars welded to them. These trusses help to strengthen the boards during transportation, installation and pouring of the slabs. They also

negate the requirement for bottom spacers as the bottom reinforcement mat is laid directly onto the trusses. The various types of precast slabs available on the market can also be used in conjunction with the PFSolutions wall system in lieu of the PFSolutions slabs.



PFSolutions Slab



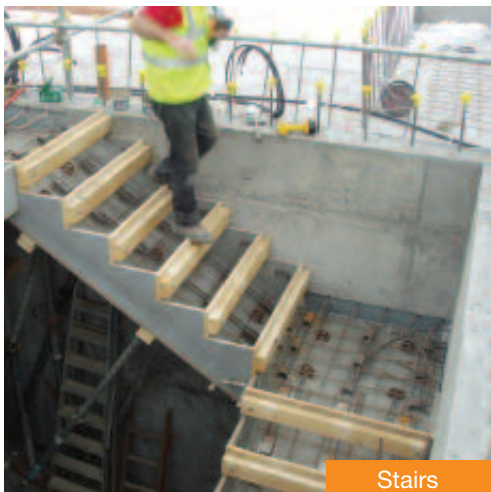
PFSolutions Slab and propping



Precast (Pre stressed) wide slab

## Stairs, columns and beams

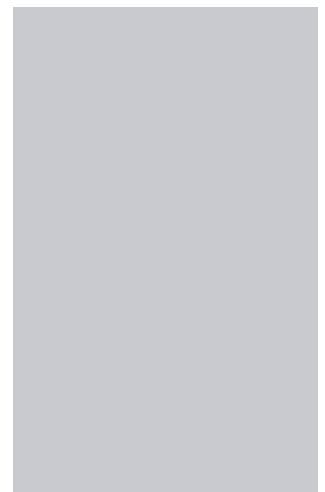
Staircases are fully formed using the CBPBs including the stair-soffit, risers and stringers. Other structural elements such as columns and beams are also formed in the PFSolutions system – either as separate permanent formwork elements or incorporated into the PFSolutions walls subject to design requirements.



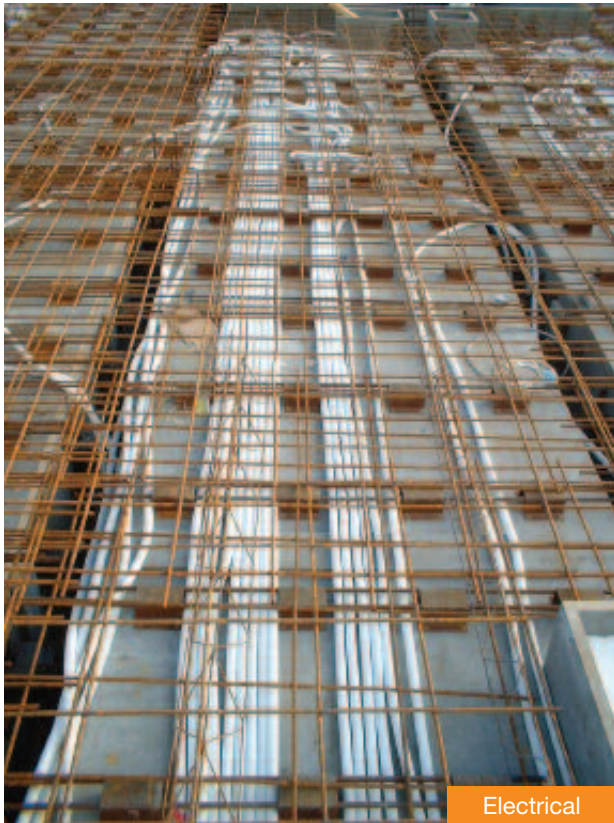
Stairs



Columns



## Installation of Services



Electrical

### Electrical

Pre wired electrical conduits are installed in the wall system prior to casting concrete. All electrical openings are easily formed on site. Alterations to electrical fixings can be easily accommodated.

### Mechanical

All mechanical services can be installed on the slab prior to casting concrete. Typically this is a qualplex pipe in pipe system. Openings for soil risers can be formed in the slab prior to casting. Ventilation flat packs can be situated on the slab prior to casting the concrete.

### Pods

Solid concrete or metal prefabricated pod units are easily installed as the structure progresses.



Mechanical



Pods



## Drawing Production & Approval Process

The PFSolutions system is provided as a full design-and-build service for the main building structural frame, with design consultancy services provided by our design team. The scope of services includes the design and construction of all concrete elements within PFSolutions's contract, as well as ancillary steel items associated with the main concrete structural frame design. The PFSolutions system usually starts from top of rising-wall level or at podium/transfer level. All elements not within our team's design scope remain within the main structural consultant's remit.

Our design team work closely with the Client's design team from initial preliminary design stage through to completion of construction. This ensures that our design team's requirements are incorporated into the PFSolutions structure and that it is fully compatible with the balance of the works which are not in our design team's scope of design services.

### Temporary-works Design

Our design team provide guidance on temporary works and a full construction propping schedule for use by the temporary-works co-ordinator. All slabs are designed and detailed to achieve the required early-age slab strengths necessary to allow early striking; typically after 3-4 days. This allows follow-on trades access to the building as early as possible as well as accelerating PFSolutions's construction program. Slab strengths are confirmed using standard cube tests. Temporary-works are designed in accordance with the recommendations of the Construct publication 'Guide to flat slab formwork and falsework', and crucially consideration is given to striking and loading of slabs at the permanent design stage of the project. For a typical project the first panels will be delivered to site approximately 6 weeks after our design team's construction drawings have been approved by the Client/Client's representative (typically the architect). This 6 week period allows

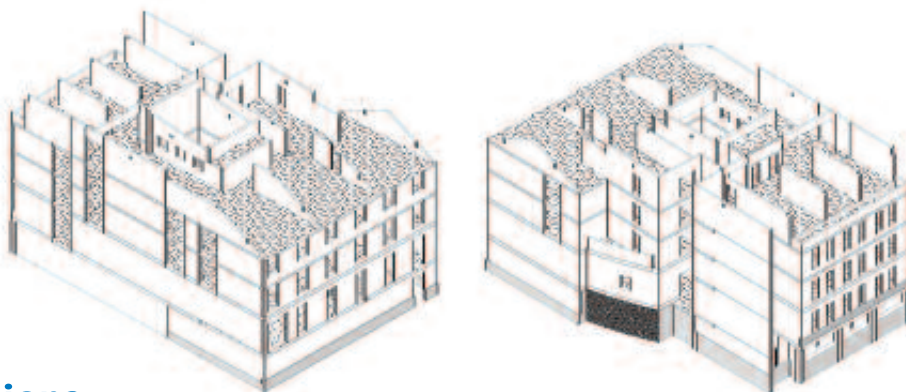
The typical procurement process is as per below;

Procurement Program	
Procurement Stage	Period before construction (weeks)
Our design Team's drawings issued to Client / client's representative (typically the architect) for approval	8 weeks + Agreed period
Approved design team drawings issued to VPG (Austria) to produce panel fabrication drawings	6 weeks
Panel Fabrication commences in Nitra (Slovakia)	4 weeks
Site deliveries commence	1 week

for VPG to produce, and our design team to approve, panel fabrication drawings. The fabrication of the panels takes 4 weeks with an additional 1 week allowance for delivery to site.

The period for our design team to produce construction stage drawings, for approval, will be agreed on a project-specific basis and is dependant on receipt of all the necessary information by our team. Subject to provision of the required information, our design team's drawings can be quickly and efficiently produced. The team's drawings will typically be issued, for approval, one level at a time starting at the lowest level of the PFSolutions structure.

PFSolutions is typically engaged on a sub-contractor basis with our design team supplying consultancy services directly to PFSolutions. As such there is no requirement for the Client or the main contractor to engage the design team.







## Construction Process

Construction typically commences from the top of foundation or podium/transfer slab level with the erection of the first level of PFSolutions wall panels. These walls are temporarily propped using 'push-pulls' for stability after which the M&E installation to the walls is completed. Slab false-work is then erected and the PFSolutions slab panels, or alternatively pre-cast wide slab door units are installed. The slab bottom mat reinforcement is then placed and tied into the walls as required and the M&E installation to the slab is completed. Self-compacting concrete is then cast into the wall panels in several stages allowing adequate setting time between

stages to prevent excessive wall (formwork) pressures: maximum concrete rise rate of 500mm per 30 minutes. After the lower two-thirds of the wall have been poured the top mat of reinforcement is installed and tied into the walls as required. The final top-third of the wall is then cast simultaneously with the slab using regular concrete (not self-compacting). This process is then repeated for each successive level of the building.

For a typical building this cycle can be achieved in 10 working days, as outlined here:







## PFSolutions 10-Day Construction Cycle

Cycle Time (day number)	Item
1	Panels delivered to site in stillages.
2	Commence erecting wall panels.
3	Commence erecting slab falsework.
4	Commence erecting slab panels (or precast units).
5	Commence bottom mat reinforcement and M&E installation.
6	Continue bottom mat reinforcement and M&E installation.
7	Commence top mat reinforcement installation.
8	Continue top mat reinforcement installation and cast bottom-third of walls.
9	Complete top mat reinforcement installation and cast second-third of walls.
10	Cast top-third of walls and slab – End of Cycle.



## Technical Information

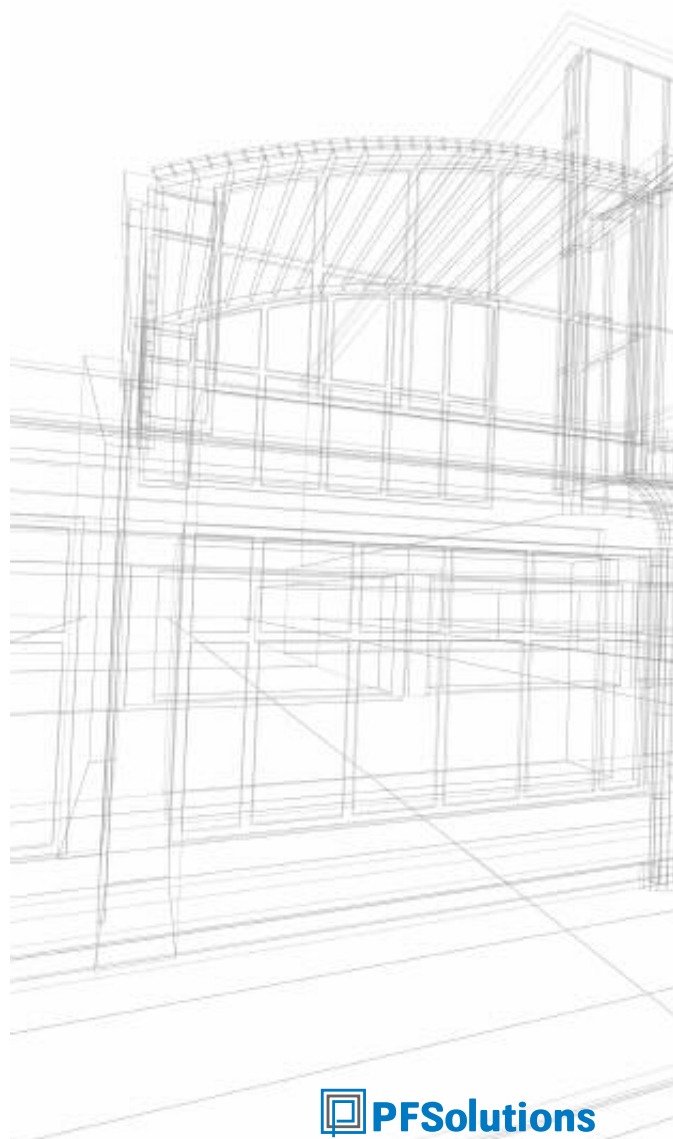
### European Technical Approval

The PFSolutions System achieved European Technical Approval from the European Organisation for Technical Approvals (EOTA) in July 2007. The British Board of Agreement (BBA) is the UK representative for the EOTA and is responsible for issuing European Technical Approvals in the UK. The PFSolutions System has therefore achieved the equivalent of BBA certification and achieved the required 'CE' mark of approval.

A full copy of the European Technical Approval is available upon request.



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<b>European Technical Approval</b>		<b>ETA-07/0039</b>	
English translation, the original version is in German			
<b>Handelsbezeichnung</b> Trade name	<b>VST-Verbundschalungssystem</b> VST permanent formwork system		
<b>Zulassungsinhaber</b> Holder of approval	<b>VST Verbundschalungstechnik GmbH</b> Wildgansgasse 1b/2 2332 Hennerdorf Österreich		
<b>Zulassungsgegenstand und Verwendungszweck</b> General type and use of construction product	<b>Nicht lasttragender verlorener Schalungsaussatz bestehend aus Schalungselementen aus Wärmedämmstoff</b> Non load-bearing permanent shuttering kit based on panels of insulating material		
<b>Geltungsdauer vom</b> Validity from	<b>11.07.2007</b>		
<b>bis zum</b> to	<b>10.07.2012</b>		
<b>Hersteller</b> Manufacturing plant	<b>VST Verbundschalungstechnik s.r.o.</b> Novozámocká 179 949 05 Nitra Slowakei		
<b>Diese Europäische Technische Zulassung umfasst</b> This European Technical Approval contains	<b>18 Seiten, einschließlich 4 Anhängen</b> 18 Pages, including 4 Annexes		
069-030-001/04-010			
European Organisation for Technical Approvals Europäische Organisation für Technische Zulassungen Organisation Européenne pour l'Agrément technique			





## Technical Information

### Fire Resistance

Wall thickness (including CBPBs)	Verification procedure	Fire resistance period (min)
150mm	ETAG 009, Annex C	REI 30
175mm		REI 90
200mm		REI 120
215mm		REI 120
230mm		REI 120
250mm		REI 120
300mm		REI 120

### Acoustic (Airborne sound insulation)

Wall thickness (including CBPBs)	Verification procedure	Acoustic rating
150mm	EN ISO 140-3 EN 12354 and EN ISO 717-1	Rw = 51dB
175mm		Rw = 53dB
200mm		Rw = 55dB
215mm		Rw = 56dB
230mm		Rw = 57dB
250mm		Rw = 58dB
300mm		Rw = 61dB

### Thermal resistance

Wall thickness (including CBPBs)	Verification procedure	Thermal resistance
150mm	Calculation according to EN ISO 6946	R = 0.229m²K/W
175mm		R = 0.240m²K/W
200mm		R = 0.251m²K/W
215mm		R = 0.257m²K/W
230mm		R = 0.264m²K/W
250mm		R = 0.272m²K/W
300mm		R = 0.294m²K/W



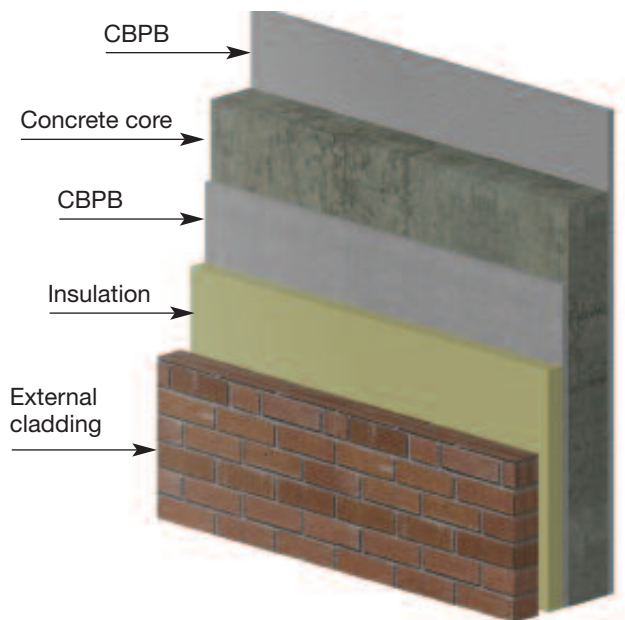
## Technical Information

### Thermal CO<sub>2</sub>

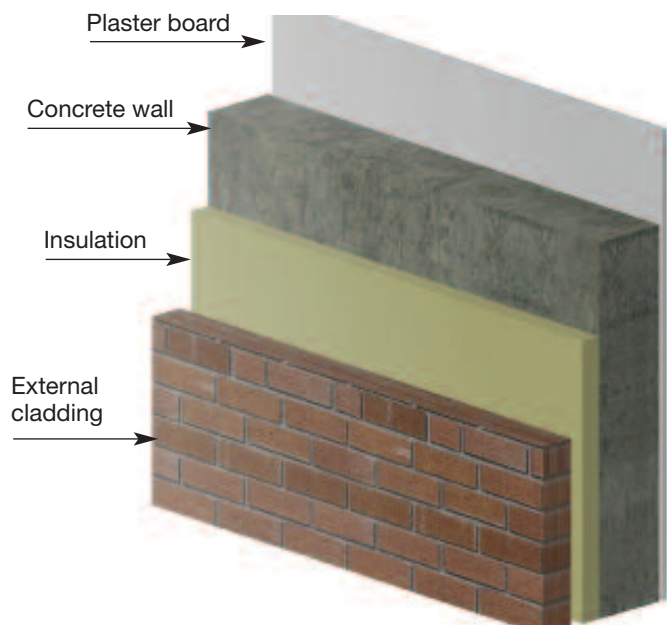
The energy expenditure required (embodied CO<sub>2</sub> burden) to produce a concrete structure is greater than for steel or timber structures. This embodied CO<sub>2</sub> burden can be demonstrated, subject to BREEAM (BRE Environmental Assessment Method), to be offset against the operational CO<sub>2</sub> emissions, many times over, in comparison to lighter-weight forms of construction employing active heating and/or cooling systems which are not based around the structure's inherent thermal mass.

Plasterboard on walls and ceilings acts to reduce the effectiveness of heavyweight thermal mass benefits as it is more (heat) reflective than exposed concrete or masonry.

The thermal conductivity ( $\lambda$ ) of Cetris board (24mm thick) is 0.26W/mK in comparison to plasterboard which is 0.17W/mK. There is no cavity in the PFSolutions system between the permanent-form panel and the concrete as there is with conventional plasterboard panels which have been dabbed onto the wall. The absence of this cavity further improves the thermal mass rating of the PFSolutions system.



PFSolutions Cavity Wall – No Internal Finish Required



Traditional Cavity Wall – Internal Plasterboard

## Finished projects

### Gateway



#### Gateway project

- ▶ 157 Residential apartments, one retail unit.
- ▶ Approx. 15,000 m<sup>2</sup> of walls
- ▶ Approx. 11,600 m<sup>2</sup> of slab
- ▶ Construction program: 24 weeks.



## Finished projects

Annamoe Road, Cabra

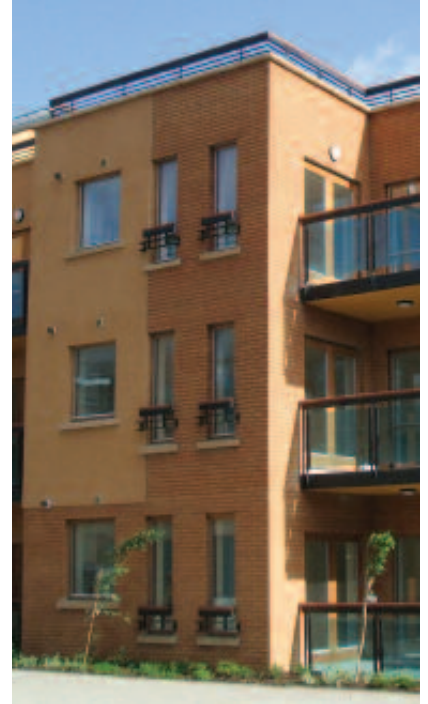


### Annamoe Road

- ▶ 3 blocks of residential units, including apartments and duplex units.
- ▶ Approx. 5,000 m<sup>2</sup> walls
- ▶ Approx. 3,500 m<sup>2</sup> slab
- ▶ Program: 16 weeks.

## Finished projects

### Adamstown



### Adamstown

- ▶ 6 blocks of residential units including apartments and duplex units.
- ▶ Approx. 10,100 m<sup>2</sup> of walls
- ▶ Approx. 6,100 m<sup>2</sup> of slab
- ▶ Program: 26 weeks



## Finished projects

### Ballymun / UCD



#### Ballymun

- ▶ 10 blocks of residential units
- ▶ Approx. 8,500 m<sup>2</sup> of walls
- ▶ Approx. 7,600 m<sup>2</sup> of slab
- ▶ Program: 24 weeks

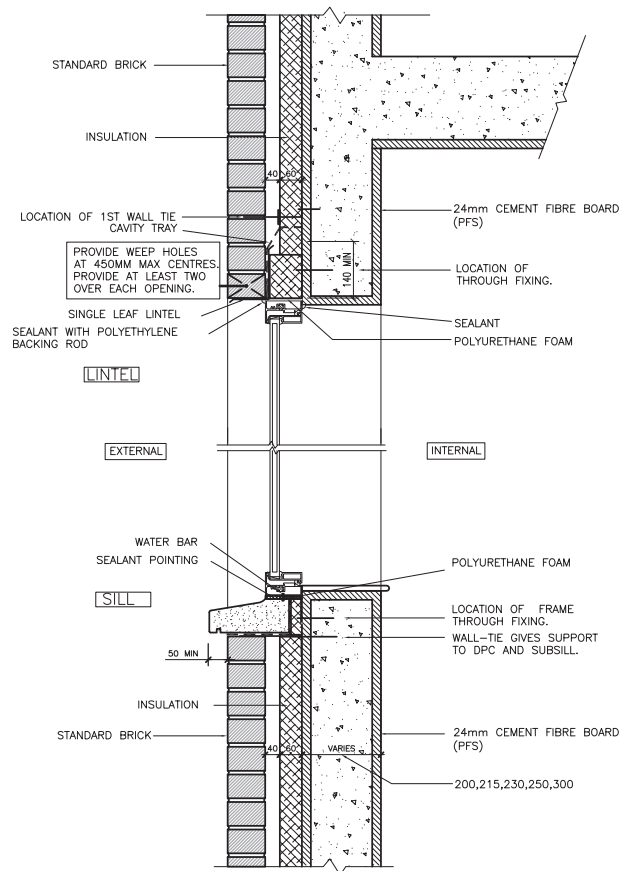


#### UCD student accommodation

- ▶ 350 student bedrooms
- ▶ Approx 10,200 m<sup>2</sup> of walls
- ▶ Approx 7,800 m<sup>2</sup> of slab
- ▶ Program: 30 weeks



## Standard Details



### Standard Window Detail

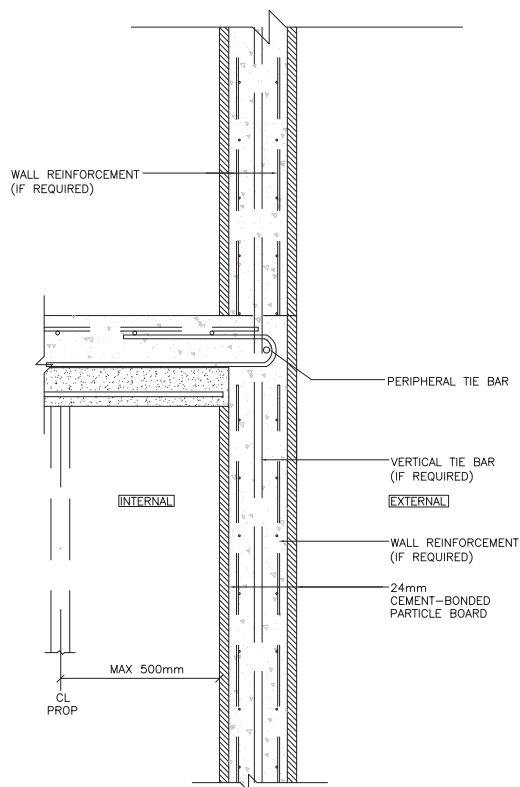
(Scale 1:10)



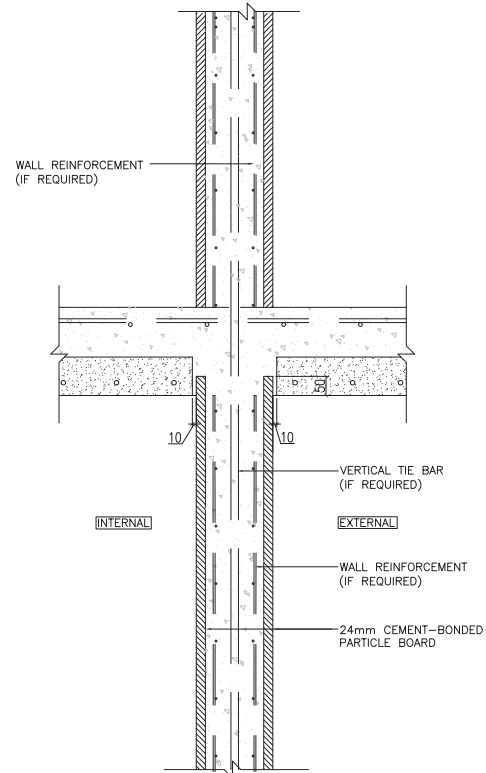
Internal window detail



External window detail



External Wall -  
Precast Slab Span Perpendicular to Wall  
(Scale 1:10)



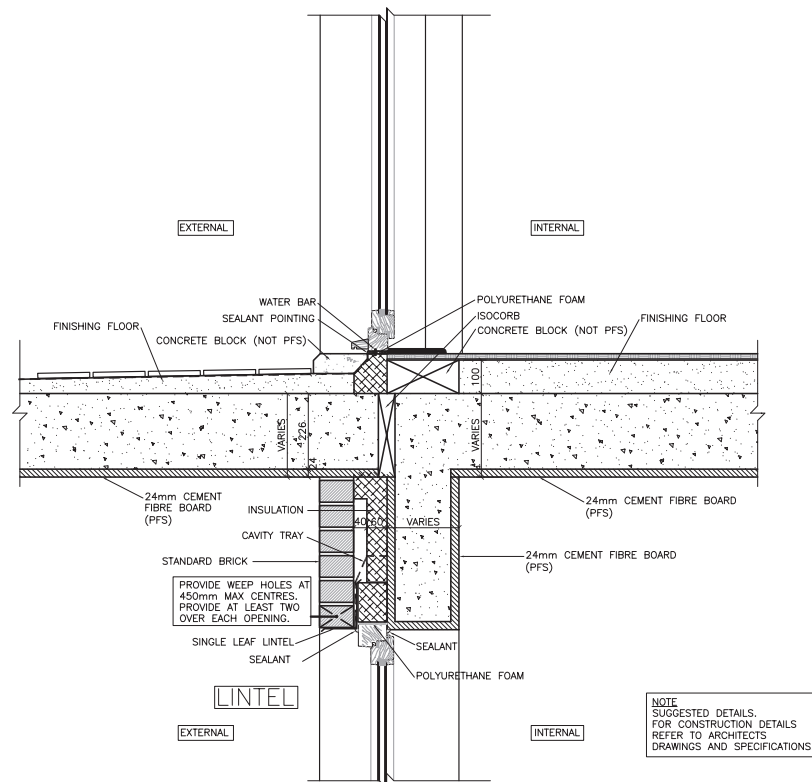
Internal Wall -  
Precast Slab Span Parallel to Wall  
(Scale 1:10)



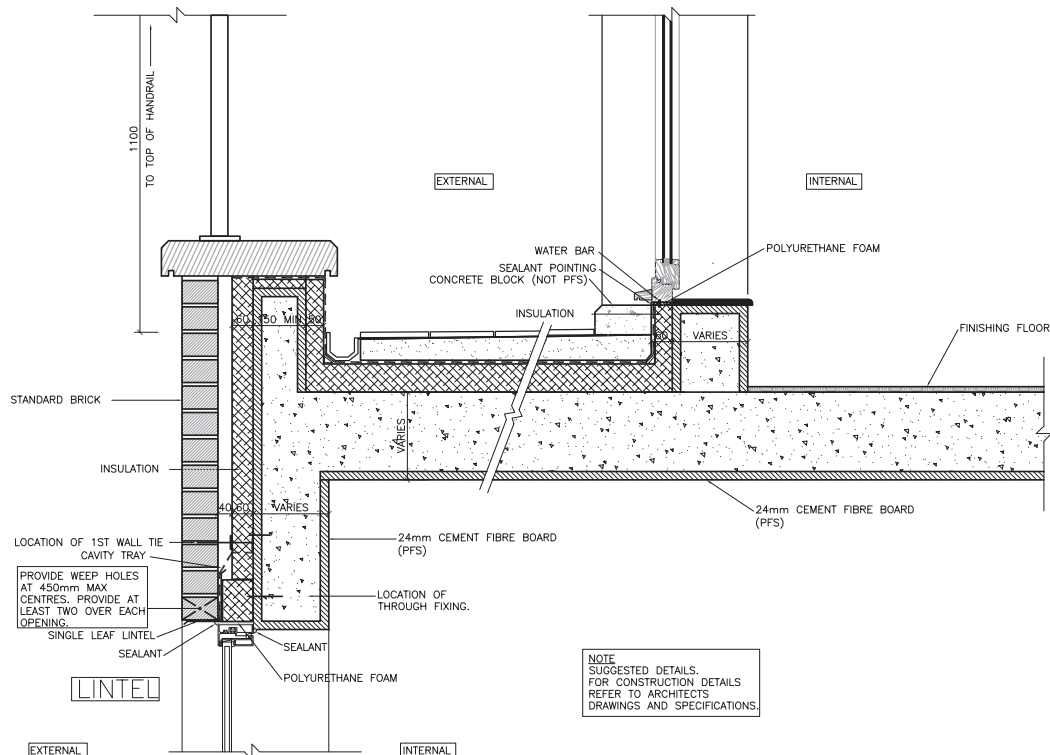
Relieving angle fitted directly to PFSolutions wall



Typical external wall with closed cavity detail

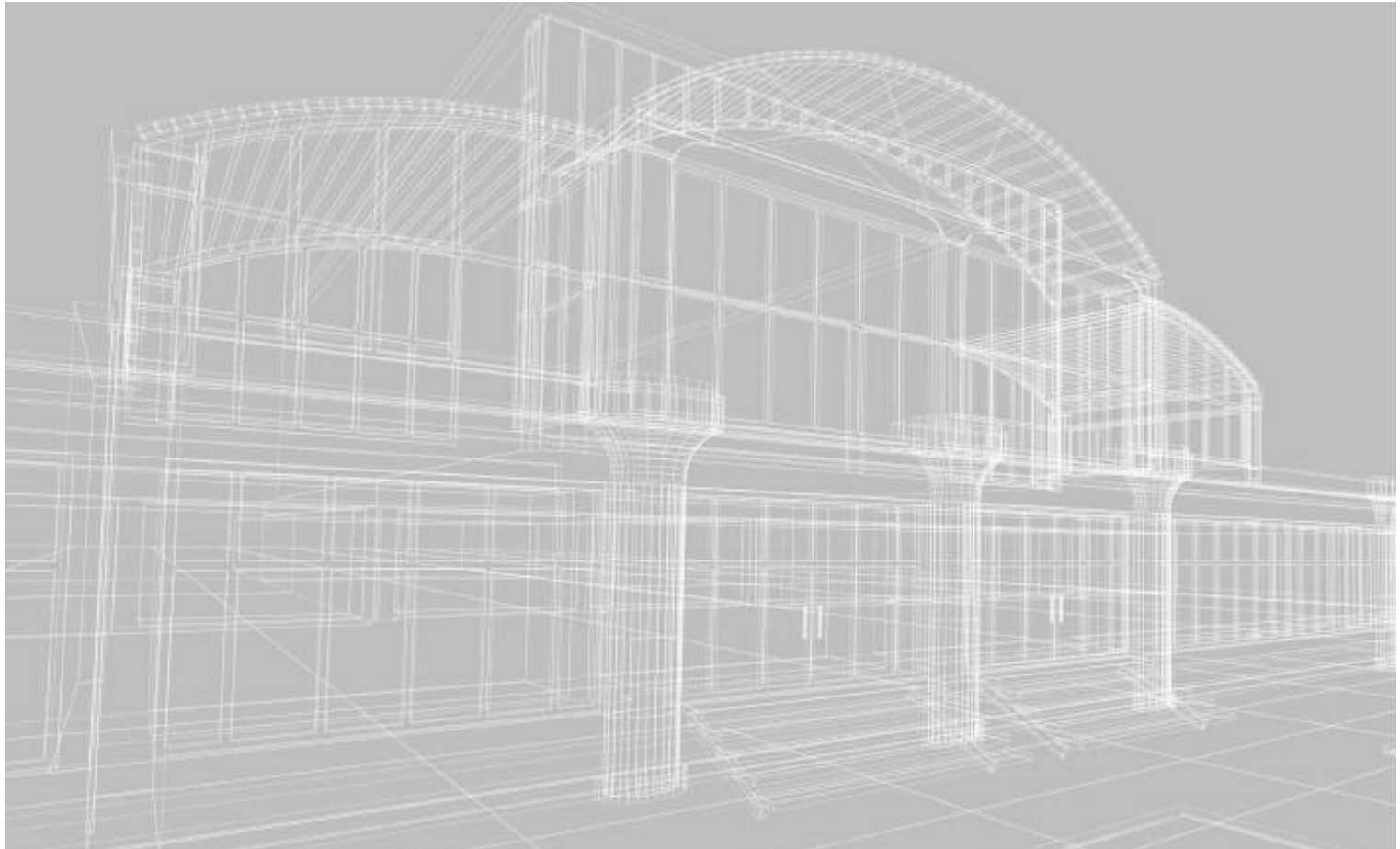


**Dropped Isolated Balcony Spanning Parallel to Wall**  
(Scale 1:10)



**Flush Terrace**  
(Scale 1:10)





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