PRECAST WALL

Hospital - Angers
Architect : Agence G.P.A.A.
Precast Wall products
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Precast Wall products

Rhéna Clinic - Strasbourg
The Advantages of Precast Walls
A - The Advantages of Precast Walls

1. Introduction

Why choose a Precast Wall?
For faster, safer, simpler construction

By opting for a project based on precast concrete elements, you will be able to rely on the support of our engineering design office to define an overall solution: the concrete wall, the insulation, the finish of the facing, the precast slabs, etc. are all dealt with at the same time to ensure the simplest possible management of the construction site afterwards.

The flexibility of our production facility is such that there is no need for series production: every element is made to your measurements. Our bespoke products also take account of the specific characteristics of your project. In addition, you have the benefit of a higher quality des than you would have with cast-in-place concrete.

The use of precast elements will also enable you to shorten your construction time: thanks to fast installation of course, but also the reduction in the number of trades required on the site, making its management by the prime contractor that much easier.

Less arduous work involved in installation than for conventional formed concrete, better safety, no emanations of hazardous substances during installation and easier organisation of the construction site are all factors that contribute to healthier working conditions for the site workers.

The precast facade is therefore the ideal solution, suitable for all construction site configurations (renovation, presence of adjoining buildings, extensions, etc.) and for sites in the most confined spaces (urban environments, spots that are difficult to access).

- short lead times
- easier management
- less arduous work
- suitable for all configurations
- new build and renovation

Uses
Can be used for houses and apartment blocks, office buildings, shops, schools, hospitals, sports and pool complexes, arts centres, silos, retaining walls, waterproof structures, deep beams, etc.
Remember:
- Industry-standard quality of the precast products – rigorous continuous quality control during manufacturing
- Bespoke products
- Consistent mechanical performances
- Deliveries compliant with the specifications
- Adapts to the specifics and constraints of any construction site
- Easy to install
- Simplified organisation and coordination of construction sites
- Fast, flexible use and shorter construction times
- Improved safety on construction sites
- Attractive wall facings – Variety of surface finishes (colours, textures)
- Low environmental impact – Reduced negative impacts of the construction work and nuisance to neighbours
- Easy-care, low maintenance
- Long service life
- Fire and weather protection
2. Construction advantages

A custom solution
Exclusively made to measure, Precast walls offer:
- Incorporation of recesses and openings for:
  - electrical enclosures, ducting, etc.
  - doors and windows

Optimisation of the work on the construction site
taking account of
- the architectural characteristics of the project (layout specifications)
- dimensioning specific to the capacity of the crane used

A solution designed and adapted to the configuration of your construction job:
- new build, renovation, adjoining building, extension

Optimisation of the construction
Precast walls make it easier to coordinate the work:
- no need to worry about the rotation of the trades
- no saturation of the crane.

Made in the factory and delivered “semi-finished” to the construction site, they ensure you meet the timing of the construction job.
Just-in-time delivery using self-unloading trailers means there is no risk of saturating the building site and allows you to regulate the logistics flows.
Controlled costs

No investment in formwork.
\- no depreciation of formwork
\- no maintenance costs

Using Precast Walls enables a contractor to overcome peaks in activity if there is mixed use of conventional formed concrete and Precast Wall

Precast enables you to:
\- reduce the immobilisation of construction site equipment
\- save money on overheads

Adaptable to the tightest of spaces

Urban renovation accounts for a large part of construction work. Precast is ideal for urban environments and places where access is difficult.

Just-in-time delivery avoids blocking the accesses to the sites: storage of equipment is limited to the size of a container (9.50 m).

Precast Wall is perfectly suited to:
\- renovation of buildings
\- the bringing into line with the latest standards of lift shafts and stairwells
\- new construction on the edge of a site or adjoining another building
\- only 20 cm of space is needed to place a Precast Wall
Safe, ergonomic working

Quick and easy to install, the Precast Wall requires no physical effort or heavy handling.

Only 4 handling operations are necessary:
taking the wall out of the container, placing the wall and shoring it, infilling with concrete and treating the joints.

- No oiling (so no inhalation)
- No dirty work

A Precast Wall can be installed by 2-3 people (+ a crane operator).

Automatic unloading of the container

Our self-unloading lorries allow for considerable flexibility in supplying a construction site, for example delivery avoiding peak hours on the roads helping to easing the traffic on main roads the day before the weekend.

This "advance" delivery of the products allows deferred installation: the building contractor responsible for the shell will not need to immobilise its crane for unloading and can take the walls one at a time as and when needed.
3. Sustainable development

Eco-construction – Eco-management – Comfort & Health

Concrete, a top-class 100% recyclable material

Producing concrete does not emit much CO₂ because the material is produced locally and its components are only transported over very short distances to the place of production. The concrete mix (cement, aggregate, sand, some water) represents on average 0.08 kg of CO₂/kg of concrete. To compare, producing 1 kg of veal generates the emission of 47 kg of CO₂ (source: ADEME).

Concrete is particularly resistant to aggressions and stresses of all kinds, such as pollution, corrosion, frost and so on. In many circumstances, because it is so reliable, it is the only material that can be used. Concrete requires little maintenance, does not favour the development of fungi, has nothing to fear from termites or any other insects and needs no aggressive treatments that are harmful to the environment. Furthermore, if we consider the entire life cycle of a building (from the production of the materials through to the demolition of the building at the end of its life), we find that concrete buildings resist better and last longer and are therefore more economical in terms of energy consumption than those built with other materials.

Concrete:
- 100% safe and recyclable
- a locally produced material
- low carbon footprint
- long life and robustness
The Elithis Tower: the first positive energy residential tower block in the world
Arch. Agence X-Tu
Black Swans flats - Strasbourg - Arch. Anne Démians
Photographer: LN Photos
PRECAST WALL

Precast Wall
B - Precast Wall

The integrated formwork wall

The Precast Wall is an integrated formwork wall consisting of two thin reinforced concrete skins tied together and held apart by metal stiffeners and a central void for in situ filling with ready-mix concrete.

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Max. dimensions</td>
<td>up to 12.34m x 3.80m*</td>
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<tr>
<td>Wall thickness</td>
<td>from 16 to 50 cm</td>
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<tr>
<td>Thickness of skins</td>
<td>from 4.5 to 7.5 cm</td>
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<tr>
<td>Concrete class</td>
<td>min. C 40/50</td>
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<tr>
<td>Average weight</td>
<td>from 280 to 350 kg/m²</td>
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<tr>
<td>Concrete exposure classes</td>
<td>XF1; XA3</td>
</tr>
</tbody>
</table>

*depending on production site; please contact us for more information

**Uses**

Can be used for houses and apartment blocks, office buildings, shops, schools, hospitals, sports and pool complexes, arts centres, silos, retaining walls, waterproof structures, deep beams, etc.
Some references

1. **Agnès Varda secondary school** - Ligné
   - Arch.: Caudron de Coquereaumont / Lebreton

2. **Lucy Léa’s community hall**
   - Arch.: LMN Architects

3. **University Hospital** - Angers
   - Arch.: G.P.A.A. agency

4. **Burgundy School of Business** - Dijon

5. **Colline de Verville primary school** - Mennecy
   - Cité Architecture

6. **Chaperon Vert flats** - Gentilly
   - AEC Architecture

7. **Les Deux Rives medical centre** - Strasbourg
   - Rey-Lucquet Architecte

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**Precast Wall products**
Lazard building - Limonest
Architect: AS Architecture-Studio
Photographer: Luc Boegly
C - Thermal Precast Wall
The wall with integrated formwork and integrated insulation

The Thermal Precast Wall is an integrated formwork wall consisting of two thin reinforced concrete skins tied together and held apart by a system of connectors (composite connectors and load-bearing anchors), with a layer of insulation on the outer skin providing external thermal insulation and a central void for in situ filling with ready-mix concrete.

**TECHNICAL DATA (IN LINE WITH THE CURRENT TECHNICAL NOTICE)**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Max. dimensions</strong></td>
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</tr>
<tr>
<td><strong>Wall thickness</strong></td>
<td>from 28 to 50 cm*</td>
</tr>
<tr>
<td><strong>Thickness of skins</strong></td>
<td>inner 6 to 7.5 cm / outer 6 to 9 cm</td>
</tr>
<tr>
<td><strong>Insulation</strong></td>
<td>from 6 cm to 20 cm: polyurethane polystyrene</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>approx. 350 kg/m²</td>
</tr>
<tr>
<td><strong>Uwall</strong></td>
<td>from 0.504 to 350 W/m².K</td>
</tr>
</tbody>
</table>

*depending on production site; please contact us for more information

- sustainable, bespoke solution
- protected insulation
- air and watertight
- suitable for use in earthquake zones
- infrastructure uses
- no restrictions on building height

![Diagram of Thermal Precast Wall]

**Uses**
Can be used for houses and apartment blocks, office buildings, shops, schools, hospitals, sports and arts centres, industrial buildings, category 2 underground basements, etc.
**Thermal performances, fire protection**

Thermal Precast Wall is a wall with integrated formwork and integrated insulation. It is therefore a bearing wall, precast, working on the principle of external insulation.

The thermal performance of the Thermal Precast Wall depends on the nature and thickness of the insulation integrated in the wall. Using polyurethane (PU) or expanded polystyrene (ESP) allow an $U_{w}$ varying between 0.504 and 0.13 W/m².K to be achieved.

Connections (floors, division walls, parapet walls) constitute singular points in a construction that generate heat loss. Locating the insulation against the outer skin of the wall offers the advantages of external insulation as it eliminates thermal bridges.

Thermal Precast Wall can be made, by a special process in the factory, to be fire resistant up to 2 hours. At the openings and horizontal joins, Fehr systematically places a strip of rockwool instead of the polystyrene or polyurethane, with a view to meeting the requirements of fire regulation IT249: fire protection of insulation.

**Technical performances :**

Made to measure, each panel can be equipped in the factory with joinery or electrical fittings, thereby optimising costs and timings as well as guaranteeing construction safety.

- up to $U_{w}$ 0.13 W/m².K with a view to meeting the future RT2020 and passive building standards
- thermal comfort winter/summer
- energy savings
- acoustic comfort
- fire and weather protection
Comfort building occupants

The Thermal Precast Wall provides comfort in summer. High inertia, due to the mass of concrete, is an advantage, since the wall accumulates heat in the daytime and releases it at night.

The qualities of acoustic comfort are provided by the concrete and the insulation. For the same wall thickness, the Thermal Precast Wall will insulate much better than a masonry or timber or metal-framed wall.

The Precast® Thermique wall gives a building a comfortable atmosphere, with no cold wall effect, whilst eliminating the phenomena of superficial condensation or internal condensation liable to lead to numerous structural issues.

A building designed, positioned and oriented to capture as much heat as possible from the sun, good sealing of the building shell, efficient counterflow heat recovery ventilation plus Thermal Precast Wall will guarantee unequalled air quality and comfort inside the building as well as meeting future passive building requirements.
Some references

Children’s centre - Bourg Les Valence
Rue Royale Architectes

Luciline flats - Rouen
Arch: Bureau 112

Special school - Beaune
X-TO Architectes
Photo: Jérôme Beg

Lazard offices - Limonest
Architect: AS Architecture-Studio
Photographer: Luc Boegly
L'Industrie Magnifique
Screen-printed concrete
D - Design Precast Wall
The 100% aesthetic integrated formwork wall

A made-to-measure industrial product providing a higher quality of finish on the upper facing than that of visible concrete.

The standard facing is smooth grey concrete for both the inner and the outer skin.

The outer skin can be given an application of paint, a mineral rendering, a thick plastic coating, a mortar rendering (as long as the joints between the panels are marked).

It is possible to produce coloured concrete façades, false joints, negative reliefs, lettering and pattern imprints (we can also offer imprints made to order for your job).

The outer skin can also serve as a substrate for cladding or a stone veneer*.

*subject to conditions stipulated in the current Technical Notice.
Some references
Airport - Entzheim
Arch. Serge Brunet

Rosa Parks school - Ivry
Arch. Daquin et Ferrière

Chauvet Cave
Arch. Fabre Speller - Atelier 3A

Anthracite concrete
Integral Precast Wall
E - Integral Precast Wall

The 100% safe integrated formwork wall

The **Integral Precast Wall** product, with its 10 patented solutions, facilitates erection and improves safety while optimising productivity, gaining 44% on the construction site.

The Integral Precast Wall comes with openings precast in the factory and spares you all the disadvantages of wooden formwork that you would have to remove on site: no strenuous effort, risk of falling, disposal costs or recycling.

The integrated steel tie-bars make the work less arduous, as there is no longer any lifting of heavy baskets of reinforcements.

The door threshold integrated in the factory is a real time-saver, as it spares you the need to cut strengthening on site.

① – Integrated formwork
② – Integrated steel tie-bars
③ – Integrated door threshold
④ – Integrated guard rail
⑤ – Safety slings
⑥ – Fastening plate for guard rail
⑦ – Fehr guard rail
⑧ – Secure container
⑨ – Automatic stabilising legs, front
⑩ – Automatic stabilising legs, rear
1. Opening precast in the factory

2. Integrated steel tie-bars

3. Guard rail and door threshold integrated in the factory

4. Integrated safety slings to facilitate handling from the ground

5. No risk of falling

6. No strenuous effort required

7. No waste

8. No recycling costs

9. Fastening plate and guard

10. Secure container
Burgundy School of Business - Dijon
Architecte : Hervé Régnault
PRECAST WALL

Technical requirements
Thermal Precast Wall
F - Technical requirements

Thermal Precast Wall

1. General points

Can be used for houses and apartment blocks, office buildings, shops, schools, hospitals, sports and arts centres, industrial buildings, category 2 underground basements, etc.

For underground walls it is necessary to provide a drain and a drainage complex (such as Delta MS). The bottom joint must remain open (untreated) so that any water that has accidentally entered the shell can get out.
If the wall is partially underground, it will be necessary to provide a control joint* between the underground part and the above-ground part (*depending on the stresses, please contact us for more information)

Wall with integrated formwork and integrated insulation can be bearing walls as long as there is a structural part of at least 16 cm.

Maximum thickness under the Technical Notice: 50 cm (depending on production site - please contact us for more information.
The dimensions given in the technical notice are the dimensions in the tables, but not the maximum dimensions that can be produced on an industrial line.

Composition of a Thermal Precast Wall:
– A precast inner shell 6 to 7.5 cm thick with a layer of reinforcing bars and stiffeners spaced a maximum of 60 cm apart ensuring the monolithic structure with the infill concrete core poured in situ.
– A space for the infill core to be poured in situ: min. 8 cm (non-bearing wall) or min. 10 cm (bearing wall)
– Insulation 6 to 20 cm thick
– A precast outer shell 6 to 9 cm thick with a layer of reinforcing bars (ST25C).

Can be used for buildings near the sea or exposed to sea or salt spray in accordance with exposure class XS1 (7 cm outer skin, 3 cm concrete cover + PM-ES cement).
Use in buildings near the sea or exposure to sea or salt spray in classes XS2 and XS3 and in buildings exposed to very aggressive atmospheres is not covered by the Technical Notice for Thermal Precast Wall.

The Thermal Precast Wall is suitable for use in earthquake zones 1 to 4.
**Exposure classes**

<table>
<thead>
<tr>
<th>Corrosion induced by carbonation</th>
<th>XC1</th>
<th>XC2</th>
<th>XC3</th>
<th>XC4</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<table>
<thead>
<tr>
<th>Corrosion induced by chlorides from sea water</th>
<th>XS1</th>
<th>XS2</th>
<th>XS3</th>
</tr>
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<tbody>
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<td></td>
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<td>No</td>
<td>No</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Corrosion induced by chlorides other than from sea water</th>
<th>XD1</th>
<th>XD2</th>
<th>XD3</th>
</tr>
</thead>
<tbody>
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<tr>
<th>Freeze/thaw attack</th>
<th>XF1</th>
<th>XF2</th>
<th>XF3</th>
<th>XF4</th>
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<td></td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<th>Aggressive chemical environment</th>
<th>XA1</th>
<th>XA2</th>
<th>XA3</th>
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<tbody>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
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</tbody>
</table>

The concrete of the precast skins can be sand-blasted*, polished* or deactivated, although the skin concerned by the treatment will need to be thicker.

* according to feasibility, please contact us for more information.

The materials used to make and install Thermal Precast Wall are:

- the concrete of the precast shells
- the infill concrete, poured on the construction site
- the polystyrene, polyurethane or rockwool insulation (used only to meet IT 249: fire protection of insulation)
As the insulated outer skin is not a bearing wall, heavy loads must be fixed to the structural part. Cladding and adhesively bonded coatings are acceptable subject to conditions: surface loads of less than 0.50 kN/m² are permissible, and the fastening of the cladding must not interfere with the free dilation of the insulated skin (must respect the joints between Thermal Precast Wall).

The walls are limited to 2-hour fire resistance (from the structural part towards the insulated skin).

The acoustic performance taken into account for the Thermal Precast Wall is $D \leq 30$ dB.

Stipulated in the current Technical Notice and validated by the CSTB, the acoustic performance of the Thermal Precast Wall is at least equivalent to that of an cast-in place wall, without taking into account the insulation used.

For the wall dimensions, when we are dealing with a case of an isolated wall such as a column or the corner of a building, a minimum width is defined by the use of a cylindrical sleeve anchor, but also by production issues relating to turning walls and removing them from formwork. A minimum width of 80 cm is required. For smaller dimensions, a special study will be necessary.

When there is one or more openings in the walls the widths of the piers must be at least 30 cm, with at least 1 width or height element that can integrate a load-bearing anchor.
It is possible to integrate columns with a structural part that is larger in a certain place (reduces the thickness of the insulation)

Creation at the butt end of the wall

If necessary reduce the thickness of the insulation at the place where the column is to be integrated.

Reinforcing bar of reinforced concrete column integrated in a Precast Wall

Creation in the wall

If necessary, reduce the thickness of the insulation at the place where the column is to be integrated.

Reinforcing bar of reinforced concrete column integrated in a Precast Wall

Depending on how the walls are cut out, it is sometimes necessary to cut the reinforcing bars of columns or lintels. These reinforcing bars will therefore need to be spliced in the part poured in situ (need to provide splicing hatches), under certain conditions.
Example of treatment of a thermal bridge on a parapet wall

Coping stone or waterproofing

Insulation to be added in situ

Seals
2. Insulation and fire safety

The materials used to make and install Thermal Precast Wall are:

- the concrete of the precast shells
- the infill concrete, poured on the construction site
- the polystyrene, polyurethane or rockwool insulation (used only to meet IT 249: fire protection of insulation)

Reminder:
- U: heat transfer coefficient (W/m².K)
- R: Thermal resistance (m².K/W)
- λ (lambda): thermal conductivity of insulation (W/m.K)
- ψ (psi): point heat transfer coefficient (W/m.K)

The insulation materials used by FEHR have an ACERMI classification guaranteeing their thermal performances:

The design of panels using only rockwool is not covered by the Technical Notice.

In the standard sections, the insulation is protected by the thickness of the concrete of the inner shell. The outer skin conventionally has a M0 fire classification.

10 cm strips of rockwool are placed in the factory around the edge of the openings to prevent the spread of fire from one floor to the other. This strip of rockwool is increased to 20 cm when it is at the wall’s edge.

In order to cut off any chimney effect in the space dedicated to the insulation between two levels of a building, a fire break must be provided in accordance with IT 249. This can be done by inserting a strip of a material such as high-density rockwool every two levels (every level for buildings subject to the application of “C+D”).
Example of a calculation of the Uwall value - Thermal coefficient of the Precast Wall

Assumptions:
Without any openings, 12 m²
4 connectors per m²
1 Cylindrical sleeve anchor per wall
Outer skin 6 cm thick
Inner skin 6 cm thick
In situ concrete infill 11 cm

<table>
<thead>
<tr>
<th>Thickness (cm)</th>
<th>POLYURETHANE</th>
<th>EXPANDED POLYSTYRENE A</th>
<th>EXPANDED POLYSTYRENE B</th>
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<td>Lambda = 0.022</td>
<td>Lambda = 0.030</td>
<td>Lambda = 0.032</td>
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<tr>
<td></td>
<td>U_{wall} (W/m².K)</td>
<td>R_{wall} (m².K/W)</td>
<td>U_{wall} (W/m².K)</td>
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<td>6</td>
<td>0.358</td>
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<td>0.154</td>
<td>6.503</td>
<td>0.203</td>
</tr>
<tr>
<td>17</td>
<td>0.147</td>
<td>6.822</td>
<td>0.192</td>
</tr>
<tr>
<td>18</td>
<td>0.139</td>
<td>7.171</td>
<td>0.183</td>
</tr>
<tr>
<td>19</td>
<td>0.134</td>
<td>7.478</td>
<td>0.176</td>
</tr>
<tr>
<td>20</td>
<td>0.131</td>
<td>7.613</td>
<td>0.168</td>
</tr>
</tbody>
</table>
3. Control joint

Case 1: Insulation between 100 mm and 200 mm

\[ l = 7.40 \text{ m} \] for insulation between 100 and 200 mm thick inclusive.

There is no requirement for a control joint in this case with our production dimensions.

The positioning of a control joint on a wall is determined by a combination of the insulation thickness and the COMBAR connectors, or the fact that the wall is partially underground.

The connectors are dimensioned to take up:

1. The tensile stresses due to the pouring of the infill concrete (speed of concreting according to the installation guide).
2. The pressure and negative pressure due to the wind.
3. The shearing stresses generated by the differential thermal expansion between the 2 precast shells.

This 3rd stress implies a maximum distance between the dilation centre (generally the same as centre of the cylindrical anchor) and the most distant connector.

Case 2: Insulation < 100 mm

\[ l = 2.40 \text{ m} \] for insulation between 60 and 100 mm thick inclusive (< 100 mm).

Example of dimensions with insulation <100mm:

<table>
<thead>
<tr>
<th>Height/length of wall</th>
<th>Length/height of wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00m</td>
<td>5.05m</td>
</tr>
<tr>
<td>1.50m</td>
<td>4.95m</td>
</tr>
<tr>
<td>2.00m</td>
<td>4.79m</td>
</tr>
<tr>
<td>2.50m</td>
<td>4.57m</td>
</tr>
<tr>
<td>2.80m</td>
<td>4.40m</td>
</tr>
<tr>
<td>3.00m</td>
<td>4.27m</td>
</tr>
<tr>
<td>3.25m</td>
<td>4.09m</td>
</tr>
<tr>
<td>3.50m</td>
<td>3.88m</td>
</tr>
<tr>
<td>3.65m</td>
<td>3.74m</td>
</tr>
</tbody>
</table>
If the wall is partially underground, it will be necessary to provide a control joint* between the underground part and the above-ground part.

Conditions:
- The underground part must be at least 70 cm deep
- The wall’s centre of gravity must be above ground

4. Joints between walls

The width of the joints between Thermal Precast Wall is determined by:

- The manufacturing tolerance of the panels (cf. Table §4.4 in the Technical Notice)
- The installation tolerance, defined as 5 mm
- The thermal expansion of the concrete
- The displacement of the outer panel if subjected to an earthquake load (avoid the risks of panels knocking into each other, counter-phase vibration)

Basically, the width of the joints between Thermal Precast Wall is 2 cm.

The connection between Thermal Precast Wall must be checked for shearing. For a skin reinforcement greater than ST25C in an earthquake zone (also corresponds to the section of the Integrated Steel Tie-bars), we will be obliged to leave openings in the skins of at least 20 cm.
5. Load-bearing anchors (cylindrical and flat)

A cylindrical anchor takes the weight of its insulated skin alone. The cylindrical sleeve anchor is normally placed in the vertical panel at the centre of gravity of the precast shell on the insulation side.

In earthquake zones the number of cylindrical anchors used may be higher due to lower resistance to shearing (Art. 2.5 of the Technical Notice).

For firewalls, the insulation must be at least 80 mm thick.

For a wall exposed to fire, extra anchor bars will be provided in the precast skins, HA6 bars that through the thickness of the core of the cylindrical load-bearing anchor.
A Thermal Precast Wall may include several cylindrical sleeve anchors. They are generally placed at the centre of gravity of the insulated skin and will be at least 75 cm apart.

HALFEN MVA flat anchors can be used as the main anchors under certain conditions:
- 6 cm outer skin when the insulation is less than 12 cm thick.
- Outer skin must be 8 cm when the insulation is between 12 and 15 cm thick inclusive.
- Outer skin must be 8.5 cm when the insulation is more than 15 cm thick.

NB: * = flat anchor intended to take up earthquake loads
6. Joinery and raised edges

The way joinery is dealt with on Thermal Precast Wall is very important. In all cases, it is prohibited to fix joinery onto the insulated outer skin. Joinery must systematically be fixed onto the structural part of the shell. Recesses are possible for roller shutter boxes or Venetian blinds.

Examples of treatments of openings
Different treatments (lintels, jamb linings and thresholds/breast walls)
Examples of installation with Venetian blinds

1. SECTION SHOWING RECESSING OF VENETIAN BLINDS INTO PRECAST WALL

2. SECTION SHOWING RECESSING OF VENETIAN BLINDS INTO PRECAST WALL
Possibility of casting raised edges (integrated formwork) on Thermal Precast Wall in the configurations shown below.

*(For Double Raised Edges, count the amount of the option twice)*

All the raised edges here are only available on walls that are NOT to be turned

A few examples of raised edges

Opposite is an example of a raised edge possible on a wall to be turned (restriction: lifting ropes will have to cut and the raised edge treated on the construction site)
7. Lifting ropes and reinforcements

Thermal Precast Wall are handled and lifted using steel wire ropes with a diameter of 9 mm or 12 mm. These ropes are integrated in the precast reinforced concrete shells when they are poured. At least 4 wire ropes are provided for each Thermal Precast Wall, i.e. 2 on each skin, positioned opposite each other.

The panels are handled with tower or mobile cranes. The wire ropes are attached to the crane hook from the ground. On no account must the angle $\alpha$ of the slings be greater than 60°.

For walls < 8.5 tonnes to be lifted straight and turned, use 4 wire ropes diam 9 mm. (SWL 1: 26.2 kN; SWL 3: 19.5 kN)
For walls $\geq$ 8.5 tonnes to be lifted straight and turned, use 4 wire ropes diam 12 mm. (SWL 1: 33.2 kN; SWL 3: 19.8 kN)

For 12 mm wire ropes, a reinforcing bar of ST25C minimum is obligatory on the inner skin.

Reminder:
The FEHR system of lifting ropes is compliant on walls up to 50 cm thick.
In order to reduce strenuous work on the construction site as much as possible, we offer our customers, for the Thermal Precast Wall, as already for the Precast Wall, the possibility of removing the concrete thresholds to be recut on site, subject to certain conditions...

1

When the opening in a Thermal Precast Wall allows the lifting ropes to be placed on either side of the opening, when this opening is 1.40 m maximum and the lintel is at least 20 cm high, we can remove the concrete thresholds.

The minimum width between the edge of the wall and the opening in this case must be 50 cm.

Concrete joint sealer placed in the factory to avoid the threshold being filled and therefore facilitate cutting on the construction site (only the 2 skins to be cut)

2

When the lifting ropes are not on either side of the opening, and a small pier is necessary at the edge of the wall the threshold to be cut remains necessary for the moment.
3
For very high walls (to be turned) when the opening is at the edge of the wall, there is no pier or threshold to be cut.

Concrete joint sealer placed in the factory to avoid the reinforcement being filled and therefore facilitate cutting on the construction site (only the 2 skins to be cut).

4
When the opening is centred on a very high wall, it remains necessary to have an element to be cut for the lifting rope.
8. Interim phase

When installing Thermal Precast Wall one above the other, it is necessary to place a shim on the outer skin.

It is necessary to make sure the outer skin is held by another device once the slings are removed from the wall, in case the ties are insufficient. Where necessary, the outer skin must rest on a strong support using shims that are rigid enough to resist compression.

The shimming will be done either on a strong support (provisional or a structural element) or on the outer skin of the Precast Wall below, which is itself resting on a strong support, with shims.

These shims may be wedge-shaped, with a height corresponding to the joint dimensioned. It will also be possible to use shims that are not wedge-shaped with a height corresponding to the joint dimensioned minus the manufacturing and installation tolerances, couple with an expanding seal.

The shims can be removed once the core infill concrete in the top Precast wall has set. The shims must removed starting with the highest horizontal joints and working down to the lowest.

9. Finishing/Installation

Below are the recommendations for treating the joints given in the Technical Notice. For a house in a light colour with panels less than 5.00 m long, the sealant can be replaced with type i4 façade rendering.

Elastic sealants, class SNJF 25 E
Concrete infill:

- The maximum free-fall distance $H_{\text{max}}$ of the concrete must not exceed 3 m, however thick the core infill (with reference to Art. 1.3 “Pouring from buckets” of standard NF P 18-504 “Structural concrete workmanship”).
- Use of concrete chutes

Height of concrete chute:

For heights $> 3.00$ m the infill must be done:

1. By introducing a flexible tube (where the space between the two skins allows it)
2. Through one or more openings whilst respecting the same free-fall distance.

Without carrying out any special studies, concreting rates will be limited to the following values, whatever the spacing of the wall connectors:

- Temperature of concrete $\geq 15^\circ\text{C}$: 70 cm/h
- Temperature of concrete $\geq 10^\circ\text{C}$: 60 cm/h
- Temperature of concrete $\geq 5^\circ\text{C}$: 50 cm/h

What type of concrete to order?

- Thickness of core infill to be poured in situ $\leq 9$ cm:
  BPS - NF EN 206/CN - XF1 C25/30* - Dmax 12.5
  Recommended consistency target value 200 mm to 220 mm

- Thickness of core infill to be poured in situ $> 9$ cm:
  BPS - NF EN 206/CN - XF1 C25/30* - Dmax 16
  Recommended consistency target value 200 mm to 220 mm

Remark: The infill concrete must meet the requirements of standard NF EN 206/CN and the specifications of the project in question.
*The strength class is that required by the structural design office and will be at least equivalent to C25/30.
Very high infill:

An exemption from the recommended concreting rate of 70 cm/h is possible, when filling a Thermal Precast Wall in one pass, up to a height of 2.30 m, as long as the following measures are taken:

- A specific study by FEHR's engineering design office to validate the increasing of the infill height up to a maximum value of 2.30 m, by putting in extra COMBAR connectors to take up the pressure from the fresh concrete in the Thermal Precast Wall.

- The walls on which such filling has been authorised will be specially marked. A label will be placed on the wall specifying that the maximum free-fall distance $H_{max} = 2.30$ m is possible on the Thermal Precast Wall concerned.

- For the same phase, all the walls must be filled in one pass, or be filled at the rate recommended in the general case for walls with integrated insulation. It is not possible to have 2 different filling rates on the same phase.

The study will be carried out specifically for each concreting height required.
10. Transport

It is possible to place walls on top of each other.

Delivery with 2½ containers should be prioritised, thereby making loading of the lorries more efficient and cost effective.

(see table below for max. dimensions)
Maupassant flats
Dijon
PRECAST WALL

Installation guide
FEHR safety reminders
Safety is managed by thinking and preparing ahead. Prepare by studying the plans and the organisation of the construction site and refer to the conventional safety devices proposed in the user guide.
Hard hat, safety shoes, gloves and work clothes are obligatory on the construction site.
The user declares that he/she is aware of these instructions and undertakes to comply with them when installing Precast Wall.

Measures to be taken in the event of the nonconformity of the Precast Wall:
In the event of a nonconformity other than aesthetic or concerning the dimensional tolerances of the wall, the Precast® wall should not be unpacked from the container or not installed if only found to be defective after unpacking.
In both cases, the FEHR engineering design office must be contacted and will have sole authority to decide whether wall can be installed or must be scrapped.

User training:
A customer using the Precast® wall technology for the first time must contact us to that they can be assisted by a FEHR expert in the preparation and installation of the first Precast Wall.
This measure can also be offered on a case-by-case basis for any *Precast Wall user.

Bibliography
INRS, OPPBTP, Assurance Maladie (health insurance). (August 2012). Murs à coffrage intégré MCI - Prescriptions minimales à l’Intégrité à la conception du procédé constructif MCI pour une mise en oeuvre en sécurité (Minimum instructions for safe use of walls with integrated formwork)
Editions INRS ED 6118.
Currently valid technical notices (Avis techniques) for Precast and Thermal Precast Wall.
Technical data sheets provided by the different manufacturers of the equipment needed for installation.
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   1.2 Thermal Precast Wall p.65

2 Organisation and Preparation of the construction site p.66
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   5.4 AMP work platform p.108
1. Description & areas of use

1.1 Precast Wall

The Precast Wall is an integrated formwork wall consisting of two thin reinforced concrete skins tied together and held apart by metal stiffeners and a central void for in situ filling with ready-mix concrete.

Each Precast Wall is identified by a label ensuring its traceability until it is integrated in the construction.

Areas of use

Can be used for houses and apartment blocks, office buildings, industrial buildings, shops, schools, hospitals, sports and pool complexes, arts centres, silos, retaining walls, waterproof structures, deep beams, etc.
1.2 Thermal Precast Wall

The Thermal Precast Wall is an integrated formwork wall consisting of two thin reinforced concrete skins tied together and held apart by a system of connectors (composite connectors and load-bearing anchors), with a layer of insulation on the outer skin providing external thermal insulation and a central void for in situ filling with ready-mix concrete.

Each Thermal Precast Wall is identified by a label ensuring its traceability until it is integrated in the construction.
2. General organisation and preparation of the construction site

2.1 Preparing the project: how to read the plans?

Step 1: prepare the job launch sheet

Items to be defined and provided to FEHR:
- the technical, aesthetic and environment specificities
- a precise plan locating the shells concerned by the Precast Wall product
- the construction site layout plan, showing points of access and storage areas for the containers
- the type of crane available and its lifting capacity. NB: use of a crane not in static mode is forbidden
- the progress schedule for the construction site, zone by zone, and the delivery intervals
- the safety measures that will be taken on the construction site (p. 101)
- the choice of the type of tie-bars to be used* (p.84)
- the construction drawings: foundations, formwork, steel reinforcements, cross sections and recesses
- the concreting rate preferred

*NB: The choice of the type of tie-bars to be used (i.e. either conventional tie-bars or steel ties integrated in the Precast® walls, when this is technically feasible) is the customer’s decision and must be determined at the time of placing the order. The type of ties will be chosen by the FEHR design office according to the nature of the building and the stresses to be taken up. The details of the solution will be provided on the installation plan. The type of ties recommended will depend on the direction and method of installation. The user must check which type of ties is envisaged on their project.

FEHR’s engineering design office will work from the structural drawings (and the loads applying to the walls to be built using Precast Wall) supplied by the customer’s design office.

FEHR’s design office checks the technical feasibility and optimises the Precast Wall solution based on the information provided by the customer, which will be recorded in “information sheets”. These contain the requirements and constraints necessary to the feasibility study and the optimised implementation of the Precast Wall solution (taking into account seismicity, characteristics of the building land, climatic and environmental constraints, traffic plan, etc.)

Warning: FEHR forbids any use of a Precast Wall for a purpose other than that for which it was designed by the FEHR design office. Precast Wall are not designed to resist earth pressures during the interim phase.
Step 2: Fehr sends the assembly layout plan

What to check and validate in this assembly layout plan?

1. the placing of the reinforcements
2. the lower and upper levelling courses, the levels
3. the locations of the recesses and openings
4. the weight of the walls
5. the layout of the walls

Once the assembly layout plan has been validated, no more changes may be made to the plan or the composition of the deliveries.

The composition of the depot: list of Precast Wall elements
Precast Wall formwork plan

Concealed side:
4 x D9 cable

Face visible:
1. 2x Plot ELEC CAPRI 859900
2. 2x Douille M16
3. 2x Arret betonage 15/19/7 cm
4. 1x Gaine ELEC d25 1.61 m
5. 1x Gaine ELEC d25 1.78 m
6. 1x CBcsC 98/233/18 cm

NOTE: ...

Face
Béton
Ep. faces (cm)
Face 1 C40/50 5.5
Face 2 C40/50 5.5

CHANTIER: MURS HORIZONTAUX
Client: Nuance

WAFFRE N°: 027
PLAN: 027

Date: 03.03.03
Sign par: ...

FÉVRIER TECNOLÓGIES - 59, rue de Strasbourg - 54140 DÜSSELDORF - Tel: 03.69.49.39.30 - Fax: 03.69.49.39.61

PLANBAR
Nota: ...

Face visible:
Fer : PAF10

c : 2,0 cm
as L*: 2,40 cm/2m
as T*: 1,21 cm/2m
PoulA5 7 d 6
L* : 10 d 6/33-370
T* : 16 d 6/24-303

Face cachée:
Fer : PAF10

c : 2,0 cm
as L*: 2,07 cm/2m
as T*: 1,02 cm/2m
PoulA14 d 5
L* : 10 d 6/33-350
T* : 16 d 6/24-303

Face cachée:
Poul 2 KTB13-338
Poul 4 KTB13-246
Poul 4 KTB13-338

Face visible:
(1) 2x 1 d 10-346
(14) 1 x 1 d 10-242
(21) 2 x 1 d 10-196

Face cachée:
(1) 2x 1 d 10-346
(12) 1 x 1 d 10-150
(13) 1 x 1 d 10-107
(14) 1 x 1 d 10-242
(21) 2 x 1 d 10-196

Face cachée:
(15) 1 x 1 KTB13-225

Face cachée:
FF1 1x AB-3027-059/001

chantier :
Client :
Affaire N° :
Plan : 027
Date :
Signé par :

N° portée : 27
Catégorie : MURS HORIZONTAUX

PLANBAR
Step 3: Production

After checking and validating the assembly layout plan, the plans are sent by FEHR in electronic form:
- to the customer
- to the customer’s design office is this has been requested.

NB: The site foreman must plan the dates of the depot deliveries with the FEHR supply chain department.

The as-built drawings (DOE) as provided on electronic media.
2.2 Preparing the equipment

Marking, tracing

- Installation guide
- Installation plan
- Metre
- Tape measure
- Pencil
- Hammer and nails
- Chalk line
- Laser level or surveyor’s level + rod
- Cans of spray paint
- Plastic shims (different thicknesses)

Lifting, positioning

- Crane
- All-in-One kit
- Lifting kit
- Rope + hook
- Shears and disk grinder
- Heeled crowbar
- Spirit level and plumb line
- Foam tape

Turning

- Turner
- Sling + Pulley kit
- All-in-One kit
Adjustment, stabilisation

- Screwdriver
- Push-pull props (min. 2/wall)
- Ratchet wrench + sockets
- Drill
- Power bolter (for concrete screws)

- Screws H M16 and M20 + washers
- Screws M16
- For fastening to the ground: concrete screws or metal expansion plugs or female expansion plugs + bolts and washers
- Ballast if necessary

Concrete infill

- Concreting bucket
- Hose pipe
- AMP work platform
- Articulated work platform (working height = max. Precast® height + 2 m)

Treatment of joints

- Wire brush
- Float
- Trowel
- Backer rod and sealant gun

Articulated work platform (working height = max. Precast® height + 2 m)

Safety features

- Shared use built-up scaffolding
- Integrated guard rail
- Traditional construction site guard rails
- AMP work platform
2.3 Preparing the construction site before erection

Unloading:
Plan a suitable clear unloading area for the lorry (permissible cross slopes as shown) at least 25 m long, where the container can be deposited and the stabilising legs deployed.

Storage:
Provide a storage area for the container that is flat, with a compacted or concrete surface, measuring 2.50 m x 12.50 m.

Ensure there is a clear safety zone of at least 1.5 times the height of the largest Precast Wall element.

Provide an extra storage area of 2.50 m x 12.50 m if a turner is to be used.

Safety: General rules
In accordance with construction site safety rules, it is PROHIBITED to walk under a loaded crane.

Define the type of crane according to the weight of the Precast Wall and the dimensions of the building and where to locate it, as well, if necessary, as the turner.

Provide a support to fix the push-pull props used to stabilise the Precast Wall on the ground:
- reinforced concrete ballast
- fixing on the solid slab, flagging, foundations, etc.
- micropiles

Provide a drainage system at the foot of the wall if it is underground or partially underground and not subject to hydrostatic pressure.
2.4 Anticipating the installation to save time and gain in efficiency: *Marking out on the ground and adjusting the levels*

1. Check that the starter bars are situated in the concrete infill to be poured in situ.
2. Mark out the outline of the Precast Wall according to the alignment required with a chalk line or using strips of wood.
3. Work out the position of the elements, taking account of the respective joints (cf. installation plan).
4. Identify how the panels are going to be installed at the corners (thickness of the Precast Wall covered by the overhang of the outer skin of the Precast Wall placed perpendicular to it).
5. Check the level of the foundations, find the high point to determine the thickness of the PVC shims needed (from 3.5 to 30 mm), depending on the play provided for on the installation plan and the type of sealing mortar to be used.
6. Secure the starter bars:
   - loops
   - hooks
   - caps (*NB: accident prevention bodies do not recommend the use of caps*)
7. Make sure the area is cleared of any rubble etc. to facilitate the installation of the Precast Wall.
3. Delivery of the Precast Wall
3.1 Description of the containers

The transport and storage equipment used by FEHR are referred to as “containers” and they are self-unloading and self-supporting.

Types of use and counter-indications
FEHR’s containers are used to transport and store Precast Wall upright. Any other use is strictly forbidden.
The storage of Precast Wall out the containers is forbidden on the construction site.
Handling of a container loaded with Precast Wall is also strictly forbidden.

Dimensions
The containers come in 2 sizes.

![Standard container](image)

1.50 m 9.50 m

![Half-container](image)

1.50 m 4.65 m
The advantages of the FEHR container

FEHR has developed and patented numerous solutions to make the use Precast Wall more ergonomic on the construction site.

Plate adjustment system:
- a more ergonomic and safer solution
- no screwing/unscrewing
- less arduous work
- less noise

NB: it is strictly forbidden to tighten or loosen the nuts on the end plates. Use only a tightening/loosening bar (not supplied).

Elastomer plates at the ends
- better grip
- avoids soiling and scratching

Holders and a front stop made of elastomer protect and secure the Precast Wall and the workers on site.

Reminder of professional rules:
- for lifting
- and handling on a construction site

Plate adjustment system:
- ergonomic and safer solution
- no screwing/unscrewing
- less arduous work
- less noise

Elastomer plates at the ends:
- better grip
- avoids soiling and scratching

Holders and a front stop made of elastomer protect and secure the Precast Wall and the workers on site.

Reminder of professional rules:
- for lifting
- and handling on a construction site
3.2 Delivery

For the preparation of the platform, see page 73 of this guide.

- **Standard delivery: Lorry + standard Faymonville trailer:**

  ![Standard delivery Lorry + standard Faymonville trailer](image)

  length of flatbed 12.94 m

- **Short delivery Lorry + short Faymonville trailer:**

  ![Short delivery Lorry + short Faymonville trailer](image)

  length of flatbed 9.10 m

  NB: On delivery of the Precast Wall, the delivery note is signed electronically using our FDriver application.

3.3 Storage

The container is equipped with front stabilisers that open automatically and fixed rear stabilisers.

According to reports 2015 CERIB 4452 and 2015 CERIB 4300, the stability of the containers has been checked in the following conditions:

- Depositing on a 5% maximum cross slope
- Longitudinal slope acceptable for the vehicle and less than 10%
- Working wind speed of 85 km/h
- Bearing capacity of the ground on the platform where the container is deposited: class PF2 platform and surface allowing the lorry to diver over it without damaging it.
- 5,000J impact in an accidental situation

It is essential to ensure these requirements are met when unloading and using the containers.

At the same time care will be taken to ensure that in the event of a strong gust of wind destabilising the container, if the latter falls over it will not endanger any person in the vicinity or the building.

NB: the storage of Precast Wall and Thermal Precast Wall out of the container is forbidden.
3.4 Returning empty containers

Rules for lifting and handling empty containers

It is forbidden
• to use a pulley
• to move a container loaded with Precast Wall
• to move a container using site machinery

Use a 4-legged sling suited to the weight of a container ≤ 1700 kg

1 - Remove the secondary rack

The main rack equipped with stabilisers is welded onto the chassis

2 - Attach the 4-legged sling to the anchor points provided.
3 - Stack the containers

4 classic containers max.

7 half-containers max.

- make sure the containers are perfectly aligned
- all the stabilisers must be retracted
- the racks must be positioned one up against the other
- where applicable, the secondary racks, already dismantled before lifting, must be placed flat on top of the stack of containers, end plates upwards

Each container has an identification number contained in a QR Code. **With FEHR’s FDriver application you can scan this QR Code to facilitate the return process.**

NB : Containers must be returned to FEHR in their original condition.
4. Installation of Precast Wall

4.1 Unloading Precast Wall

The technical lifting solutions developed by FEHR for its Precast Wall allow most of them to be gripped at 2 lifting points, including the heaviest Precast Wall elements. In some particular cases, however, 4 lifting points may be necessary; in these cases it will be necessary to use a lifting beam to ensure the loads are evenly spread between the lifting ropes.

NB: Lifting the walls flat is strictly forbidden, including for sawing operations on the ground before installation.

Safety: General instructions
- Check the lifting equipment is in good condition,
- Check the handling slings are in good condition: anchored in the concrete, no protruding edges,
- The use of a head pulley is forbidden,
- Follow the slinging rules,
- Ensure the max. angle of 60° between the 2 legs of the sling is not exceeded,
- Never fix 2 hooks onto the same handling sling or 2 handling slings onto the same hook,
- The bend diameter of a handling sling must not be less than twice its diameter.
- The use of a “lattice” crane to lift Precast Wall is tolerated if the lifting is done in static mode. It is forbidden to move the crane when carrying a load.

Instructions for unloading the wall:
This operation requires the presence of 2 people: one in charge of handling the wall, the other to oversee the operations. The walls must be removed from the container in the order of presentation and access to the slings.

Handle the walls with the integrated handling slings (NB: The handling slings are not reusable).
Handling kit for Precast Wall

- **Head ring**
- **Fixed leg**
- **Sling with adjustable leg**

For a wall weight ≤ 12T:
- \( a = \) tilt angle ≤ 11.5°
- \( d = \) distance between the highest point and the lowest point: < 20% of the length of the wall

Handling kit for Thermal Precast Wall

- **Head ring**
- **Fixed leg**
- **Sling with adjustable leg**

Notches in the insulation allowing the movement of the handling slings. To be filled in with PU foam once the panel is in position.
4.2 Turning Very High Precast Wall

After unloading, the Very High Precast Wall must be placed in the FEHR turner. For the preparation of the platform, see page 73 of this guide.

Turner with ballasted base
Overall dimensions: 4.49 m x 1.52 m
Weight: 2550 kg

- economical
- easy to handle (thanks to the red hooks provided to this effect)
- self-loading/unloading without a crane
1. Make sure there is a maximum slope and cross slope of 5%

2. Cordon off the area of movement

3. Place the yellow chock
   
   using the handling kit (p.81), extract the Precast Wall from the container and place it in the turner
   
   Tighten the yellow guide wheels moderately

4. Put the props in place

5. Put the turning kit in place (p.84)

   Loosen the guide wheels to release the Precast wall and turn it and then put it in position.
Turning kit for Precast Wall

- Head ring
- Sling with adjustable length
- Pulley-sling assembly
- Opening pulleys

Turning kit for Thermal Precast Wall

- Head ring
- Adjustable hoist for balancing
- Opening pulleys
- Pulley-sling assembly
- Opening pulleys
- Balancers

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4.3 Installing Precast Wall with integrated steel tie-bars

The tie-bars are integrated into the Precast Wall (Precast Wall “B”) wall in the factory in the form of a module, combined with a CSA (cut-shaped-assembled) basket. The characteristic of this module, of equivalent height to that of the vertical connection, is that the horizontal reinforcement (hairpin) can pivot and therefore integrate without any conflict into the Precast Wall already in place (Precast Wall “A”) when installing walls edge to edge. Precast Wall “A” has a basket, with the same spacing, opposite, which, once the wall is in position, enables the hairpin to be kept horizontal. When Precast Wall “B” is put into place, the part of the tie-bar that overruns Precast Wall “B” pivots along each frame of Precast Wall “A” until it rests on the frame opposite in Precast Wall “A”.

1. Place the wall plumb in its location, position it on the plastic shims and in line with the markings.

2. Position Precast Wall “B” in its location, next to Precast Wall “A”.

3. The flexible tie-bars in Precast Wall “B” slot in, as it descends, between the rigid tie-bars in the Precast Wall “A”.

4. The connection between the 2 Precast Walls is made: all the flexible bars in the Precast Wall “B” have slotted in between the rigid bars in Precast Wall “A” and are positioned horizontally, which can be checked at the joint.

5. Check the Precast Wall is correctly positioned on the shims and in line with the markings (in particular as regards the position of the joints).

6. To make the connection, the straight steel bar must be positioned between the loops in the tie-bar.

7. After concreting, incorporate the steel bars at the top of the wall.
8. Stabilise the wall with push-pull props and adjust until it is perfectly plumb.

9. Fill spaces with foam tape to avoid laitance leakage.

Advantages:
- No need to procure, store and handle steel rebars
- No waste to be disposed of
- No strenuous work involved
- No time wasted

Bird's eye view of the tie-bars integrated in a CL wall.
4.4 Installing Precast Wall/Thermal Precast Wall without integrated steel tie-bars

In this case, the customer must ensure that, based on the information available in the installation plan, it has procured enough of the right type of steel tie-bars from its rebar supplier.

The tie-bars are inserted as the installation progresses.

The principles that apply to tying Precast Wall together are given below. This applies to vertical connections between Precast Walls. Other routine examples are available in the technical notices for Precast Wall or Thermal Precast Walls.

1. Put the steel tie-bars in place *(as you go along)*

2. Place the wall plumb in its location, position it on the plastic shims and in line with the markings.

3. Put any straight steel bars in place

4. Stabilise the wall with push-pull props and adjust until it is perfectly plumb

5. Fill spaces with foam tape to avoid laitance leakage
Simple articulated connection

**Straight:**
- Folded welded mesh

**Corner:**
- 2HA10 to be integrated in situ
- Steel tie-bars

In this case, the reinforcement could be put in place after the Precast Wall are placed.

Splice link

**Straight:**
- Straight steel bars to be integrated in situ
- TYPE 3 steel tie-bar
- Opening to facilitate sliding at the bottom of the wall 20x20

**Corner:**
- Straight steel bars to be integrated in situ
- Steel tie-bar
- Opening to facilitate sliding at the bottom of the wall 20x20

Embedded link

**Straight:**
- 6 straight steel bars to be integrated in situ

**Corner:**
- Frames to be integrated in situ HAXX e = XX cm
- Straight steel bars to be integrated in situ
4.5 Particularity concerning the installation of Thermal Precast Wall

When installing Thermal Precast Wall one above the other, it is necessary to place a shim on the outer skin.

It is necessary to make sure the outer skin is held by another device once the slings are removed from the wall, in case the ties are insufficient. Where necessary, the outer skin must rest on a strong support using shims that are rigid enough to resist compression.

The shimming will be done either on a strong support (provisional or a structural element) or on the outer skin of the Precast Wall below, which is itself resting on a strong support, with shims.

These shims may be wedge-shaped, with a height corresponding to the joint dimensioned. It will also be possible to use shims that are not wedge-shaped with a height corresponding to the joint dimensioned minus the manufacturing and installation tolerances, coupled with an expanding seal.

The shims can be removed once the core infill concrete in the top Precast Wall has set. The shims must be removed starting with the highest horizontal joints and working down to the lowest.
4.6 Method of anchoring and type of shoring

FEHR recommend fixing the top part of the push-pull props onto the Precast Wall before installing it.

Fixing on the ground: different types of stabilisation on the ground are possible. Any specific type of shoring envisaged should be validated by our engineering design office.

The push-pull props will be chosen according to the dimensions of the Precast Wall.

The fixings used are M16s.

The number and location of the props will be decided by FEHR’s engineering design office and will indicated on the installation plan.

The fixings are normally placed on the inner skin, but can be placed on the outer skin depending on the specific requirements of the project.

By default, the size of fixings used is adequate for a wind speed of 85 km/h. In winds above 85 km/h, the work area around Precast Wall not cross-braced by the structure should be evacuated.
Walls subject to severe loads during the interim phase require serious stabilisation at the top and bottom.

If necessary:

• Seal in the anchors when casting the foundations

• Stabilise the Precast Wall by adding horizontal props at the bottom of the wall to ensure:
  – its plumbness
  – its stability

The props should only be removed when the wall’s stability is effective in accordance with the recommendations of the structural design office or engineering office.
4.7 Infilling with concrete

What type of concrete to order?

- Thickness of core infill to be poured in situ < or = 9 cm:
  BPS - NF EN 206/CN - XF1 C25/30* - Dmax 12.5
  Recommended consistency target value 200 mm to 220 mm

- Thickness of core infill to be poured in situ > 9 cm:
  BPS - NF EN 206/CN - XF1 C25/30* - Dmax 16
  Recommended consistency target value 200 mm to 220 mm

Remark: The infill concrete must meet the requirements of standard NF EN 206/CN and the specifications of the project in question.

*The strength class is that required by the structural design office and will be at least equivalent to C25/30.

1. Ensure that all the work planned to be done by other trades before infilling has been done (in particular the electrician for the installation of ducting, blocks, etc.).
2. Check the safety equipment is in place.
3. It is recommended that consistency of the concrete be checked by doing a slump cone test; it is also recommended that you check before concreting that all the steel tie-bars and extra steel reinforcements are present, that the caulking of the joints between walls has been done and that the formwork is in place at any openings.
4. Hydrate the inside of the Precast Wall to improve the flow of the concrete during infilling and achieve better adherence to the sides.
5. Concrete the walls from the ground using the concreting kit, or from the work platform, making sure to respect the concreting rate and the max. fee-fall distance indicated on the installation plan.
6. Complete the safety installations at the top of the wall.
7. Install the precast slab or place the formwork for the slab.
8. Place the horizontal Precast Wall tie-bars for the next level or the wall ties.
9. Concrete the rest of the wall from the precast slab.

The concreting is done without vibration (except if there is a high density of reinforcements).
It is recommended that you anticipate the vertical joint seals by ordering a metal profile (e.g. Nerlat) - available as an optional extra - which can be integrated into the Precast Wall in the factory.

**The contractor must ensure that the concrete in one pass has set before starting the next pass. Particular attention must be paid to ensure the first pass has set.**

- The concreting rate specified on the installation plan must be respected to avoid the wall bursting apart *(for an external temperature of +15°C and above)* - (by default 70 cm/hour).

- The concreting rate must be reduced by 20% if the temperature of the skins is below 10°C and by 30% for skins temperatures below 5°C.

- The concreting rate can be optimised, as long as a setting accelerator is used in the concrete poured in situ. *(For more details, see the technical notice).*

- Special case: Precast slabs can be installed on non-infilled walls as long as the slab is supported by shoring towers *(FEHR’s engineering design office must be consulted in advance).*

- Concreting joints: concreting is stopped at least 200 mm below the top surface, a distance that must be compatible with the covering of any reinforcements:

![Concrete joint in the case of a slab.](image1)

![Concrete joint in the case of a Precast Wall placed one on top of the other.](image2)
**Concreting from above:**

Several solutions are possible:

- if the concreting height is \( \leq 4 \) m, a special individual work platform for walls with integrated formwork (AMP platform available from the FEHR store) can be used, or portable scaffolding,

- if the concreting height is > 4 m, the best solution is an aerial work platform.

**Concreting from the ground:**

The upper floor, for example a precast slab, can be used to concrete from as long as suitable protection is placed along the edges first. The shoring of the precast slabs must then be adapted to concrete pouring operations (potential excess load).

When the Precast Wall is to be filled using a chute, the contractor must ensure that the chute is of a suitable diameter, in particular when the gap between the 2 skins is not very wide.
4.8 Treatment of joints

4.8.1 Precast Wall

The joints are treated during the finishing phase of the building structure before the finishing trades begin work on the Precast Wall. To access the high joints, use of peripheral scaffolding or an aerial work platform is recommended.
Accessible skin

- Filling with repair mortar
- Self-adhesive bitumen tape
- Foam backing rod
- Seal

Non-accessible skin (non-service location)

- Impregnated foam sealant rod
- Foam backing rod
- Seal

Inner surface

- Shrinkage compensating hydraulic mortar
- Foam backing rod
- Seal
- Steel tie-bar
Surface in contact with the earth

Water pressure

Skin in contact with an aggressive environment

- Impregnated foam sealant rod
- Foam backing rod
- Elastic sealant, SNJF F 25 E, able to resist hydrostatic pressure
- Elastic sealant, SNJF F 25 E, able to resist hydrostatic pressure and contact with aggressive solutions
- Steel tie-bar
- Seal

Material:
- Mastic élastique de classement SNJF F 25 E, apte à résister aux pressions hydrostatiques et au contact de solutions agressives
Treatment of horizontal joints on foundations

- To ensure correct use of each product, see the manufacturer’s instructions.
- Sealant used between panels must be applied to surfaces free of dust, that are not wet and which have been treated, if necessary, with a primer recommended by the sealant supplier. (min. depth of sealant: 2 cm)
- Sealants on outer surfaces will need redoing every 10 to 15 years.

NB: Expanding backer rod only plays a role during the interim phase. It is not indispensable to guarantee a good seal to the joint in the final phase.
4.8.2 Precast Wall

Treatment of joints - Façade wall with paint, lasure, untreated or marked joints

- To ensure correct use of each product, see the manufacturer’s instructions.
- Sealant used between panels must be applied to surfaces free of dust, that are not wet and which have been treated, if necessary, with a primer recommended by the sealant supplier. (min. depth of sealant: 2 cm)
- Sealants on outer surfaces will need redoing every 10 to 15 years.
Joint intersections

- General view

- Close-up of the joint intersection
5. Safety features

The Precast Wall concept is perfectly suited to the use of work platforms, guard rails and peripheral scaffolding.

For peripheral or bracket pouring platforms, on request FEHR’s design office can plan the layout of the PVC sleeves to be inserted into the Precast Wall in the factory.

The fasteners will be fixed in the conventional way, using plates and suitable bolts.

The concrete infilling of the walls must already have been done.

• For a height less than 4.00 m: access the wall using and individual platform: AMP (available in 2 heights) – available from the FEHR store

• For a height over 4.00 m, we recommend using an articulated aerial work platform

• It is also possible to use standard construction site equipment such as a bracket platform which will be fixed 1 m from the top of the wall (wall pockets to be specified when ordering the walls – Precast Wall only).

• Scaffolding
5.1 Shared use built-up scaffolding

The Precast Wall solution allows the use of shared use built-up scaffolding:
we recommend using "MDS" - type safety scaffolding

This scaffolding will be used by all the trades needing to work at height and will
serve:
– as protection against the risk of falling
  from a height,
– as an ergonomic workstation,
throughout the duration of the construction
site (building shell, roof structure, joints,
painting, installation, of windows, etc.)

This scaffolding will need to be designed at the
same time as the construction project

This scaffolding must be installed by a specialist
contractor or qualified personnel, as required by

Shared use scaffolding:
– provides optimum working conditions : continuity
  of collective protection against against the risk of
  falling from a height and falling objects,
– allows successive and/or simultaneous working
  by the contractors,
– secures access to the facades,
– renders the work less arduous,
– improves ergonomics,
– reduces the number of operations
  (transport, assembly, disassembly, etc.)

The Precast Wall system allows
the installation
of scaffolding
1 level in advance

1
Safe installation of shoring towers
and the 1st level of scaffolding
after erection of the 1st level

2
Safe installation of precast slabs
and pouring of 1st floor slab

3
Safe erection of the 2nd level
of wall from the precast slab

4
Safe erection of the 2nd level
shoring towers and complete
scaffolding
5.2 Guard rails integrated into Precast walls
(preferred solution for Precast Wall)

The integrated guard rail protects against falls from a height. This solution does not require the removal of the guard rails at any time during the installation work phases:
ideal construction site safety!

Description:
The guard rail comes in two versions: fixed or adjustable, both of which slot easily into the plate pre-embedded in the Precast Wall in the factory.

2 types of guard rails are available:

Standard guard rail (GCS)
(1.95 m wide – 1.10 m high) galvanised steel. Weight approx. 25 kg. The toeboard overruns by 10 cm to ensure continuity of protection at the bottom.

Adjustable guard rail (GCR)
(1.20 m to 1.90 m wide – 1.10 m high) consisting of a fixed central part and 2 sliding side parts. Can be adjusted from 1.20 m to 1.90 m with intervals of 5 cm. The side parts must be extended by the same amount on either side to ensure overall balance when handling with the poles. The GCR weighs approx. 37 kg. It locks with pins on the middle rail.

Guard rails can be hired directly from the FEHR store.
Advantages:

• optimum safety

• no tools required: simply slots in

• installed quickly

• openings in the slab (e.g. for stairs or lifts) are protected

• protection against falls from a height around the edge of the building during all the work:
  – installation of precast slabs
  – concreting of precast slabs
  – installation of next level of Precast Walls

The use of FEHR guard rails must be planned for in the design of the construction.
Installation

- Arrival of the Precast Wall on the construction site, pre-equipped with fastening plates

- Place the guard rails with a crane

- The guard rail simply slots into the fastening plate

- Sling the Precast Wall and take it out of the container
Installing the first level

Using the crane, lift the guard rails using the pole

Fit directly onto the next Precast Wall to be installed

Install the next level

Fill in the holes where the plates were fixed at the same time as the joints.
5.3 FEHR fastening plate + mixed adapter + traditional construction site guard rails
(preferred solution for Precast Wall)

Mixed adapters can be slotted into the FEHR fastening plates (screwed into an insert embedded in the Precast Wall skin)

These adapters allow you to install traditional construction site guard rails on the FEHR fastening plates and to benefit from assembly of the guard rails outside the work areas.

The mixed adapter is specially designed to receive Ø 40 or Ø 25 posts on the same device.
5.4 AMP work platform
(mobile access for Precast Wall)

Technical characteristics

• Material: aluminium
• Work platform: 55 cm wide
• Easily transportable
• Suitable for use on uneven ground

The mobile access for Precast Wall (AMP) enables you to access Precast Walls in total safety to insert steel tie-bars or to pour the concrete infill.

Total peripheral protection total of the user thanks to the integrated guard rail,
Freedom of movement
Attaches inside the wall

1. Standard AMP: 3.67 m
2. Extra high AMP: 4.39 m
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