Precast Concrete Walls

WALLS

Generally, any vertical member whose length and height are both much larger than the thickness may be treated as a wall.

Walls subjected to vertical loads are called **bearing walls.** Walls subjected to no loads other than their own weight, such as panel or enclosure walls, are called **nonbearing walls.**

Walls with a primary function of resisting lateral loads are called **shear walls.** They also may serve as bearing walls.

Precast-concrete wall panels include:

Plain panels, decorative panels,

natural stone faced panels, sandwich panels,

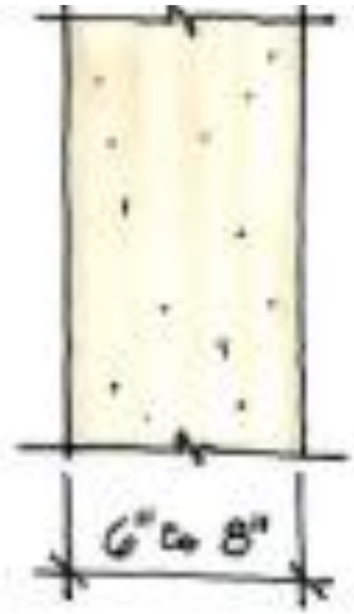
solid panels, ribbed panels, tilt-up panels, load bearing and non-load-bearing panels,

and thin-section panels.

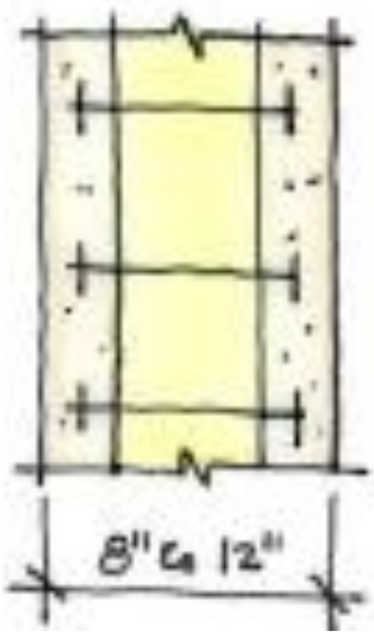
Prestressing, when used with such panels, makes it possible to handle and erect large units and thin sections without cracking.




WALL PANEL TYPES

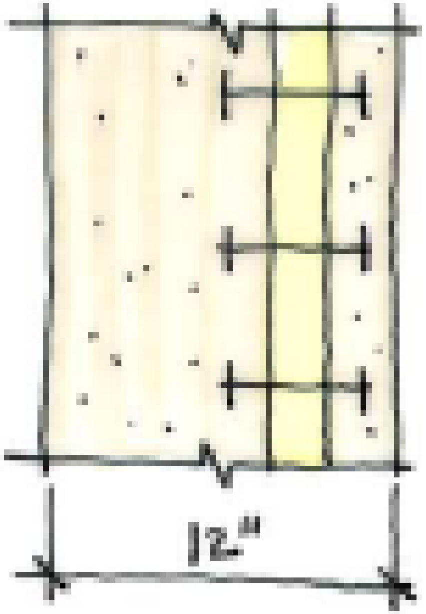


SOLID PANELS are typically used as interior partition walls and can be either load or non-load bearing. These panels can weigh from 75 to 100 psf.

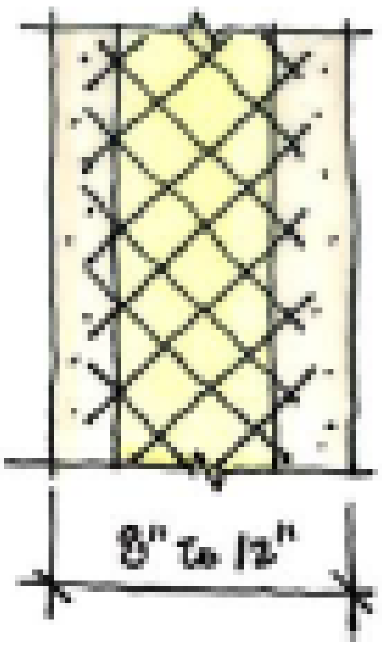


NON-COMPOSITE/NON-LOAD BEARING PANELS are typically used for components and cladding. Designed to resist only their self weight and wind loads, these non-structural panels weigh approximately 75 psf.

WALL PANEL TYPES



NON-COMPOSITE/LOAD BEARING PANELS have a thicker interior wythe which is used to support the structural frame. The exterior face of the panel is an architectural and non-structural concrete wythe. These panels weigh from 110 to 120 psf.



COMPOSITE/LOAD AND NON-LOAD BEARING PANELS are structural panels that have both concrete wythes tied together to act as one with low-thermally conductive carbon trusses. These structural panels are lighter and thinner than others and weigh approximately 75 psf.

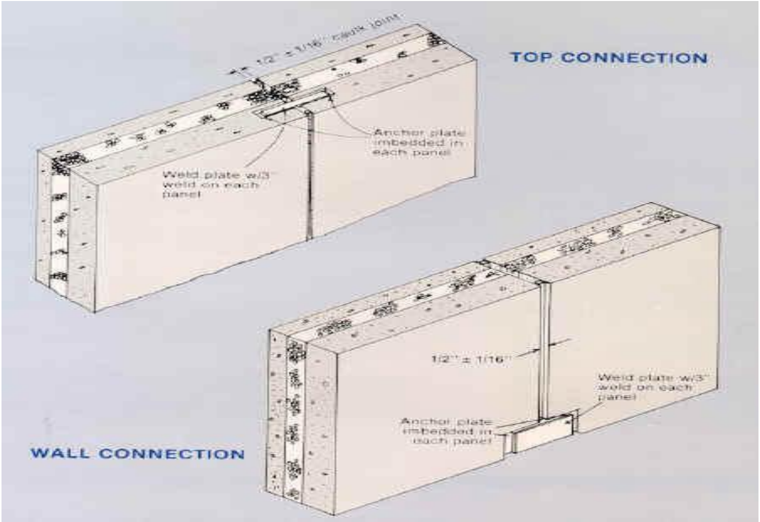
WALL PANEL DEFINITIONS

Sandwich Panels are concrete wall panels that have two layers of concrete separated by a layer of rigid insulation. They can be broken down even further into Composite and Non-composite sandwich wall panels.

Composite panels are fabricated so that the two layers of concrete, with rigid insulation between, act together as a single unit to resist applied loads by providing a shear transfer between the concrete wythes.

Non-Composite panels are fabricated with two concrete wythes acting independent of each other, with rigid insulation between, typically with a non-structural exterior wythe and a thicker structural interior wythe.

Wythe connectors are used to tie two concrete wythes together. They penetrate the rigid insulation and are embedded in each concrete wythe. There is a wide range of connector sizes, shapes and materials based on the structural requirements of the wall panel. However, the CarbonCast® C-Grid is the most economical thermally and structurally efficient connector currently available.



Insulation used in concrete wall panels is of the cellular (rigid) type because it provides material properties that are most compatible with concrete. Cellular insulation comes in two main types, thermoplastic and thermosetting.

Precast Panel Types for Building Envelopes

There are generally three types of precast panels:

- cladding or curtain walls;
- load-bearing wall units;
- shear walls.

Precast cladding or curtain walls are the most commonly used precast concrete components for building envelopes.

This type of precast concrete panel does not transfer vertical loads but simply encloses the space.

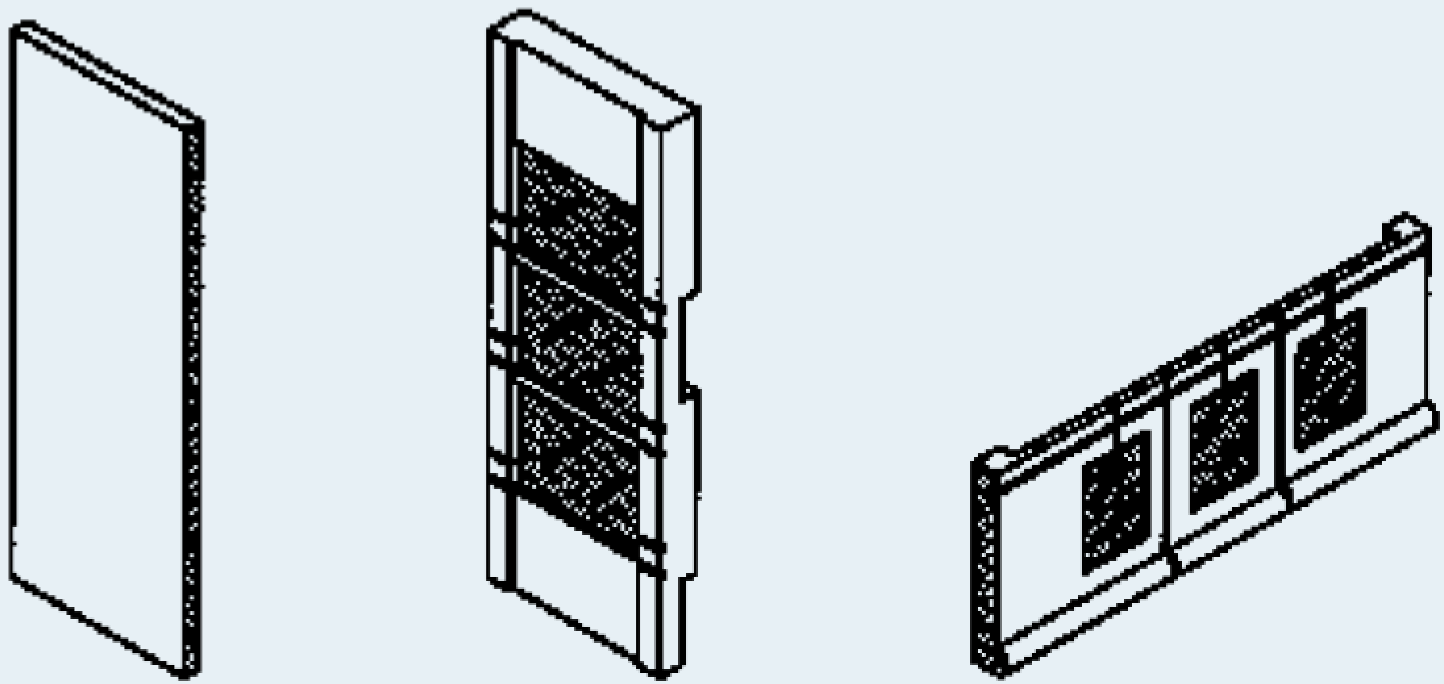
Cladding components are designed to resist wind, seismic forces generated by their own weight and forces required to transfer the weight of the panel to the support.

Common cladding units include wall panels, window wall units, spandrels, mullions and column covers. These units can usually be removed individually if necessary.

Load-bearing wall units resist and transfer loads from other elements and cannot be removed without affecting the strength or stability of the building.

Typical load-bearing wall units include solid wall panels and window wall and spandrel panels.

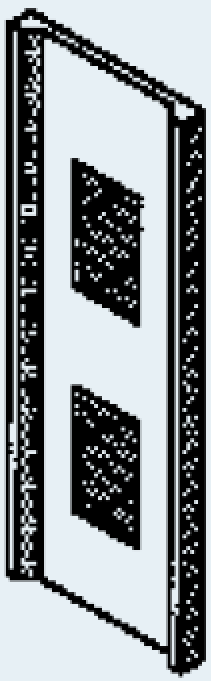
Precast concrete shear wall panels provide a lateral load resisting system when combined with the diaphragm action of the floor construction. The effectiveness of precast concrete shear walls is largely dependent on the panel-to-panel connections.



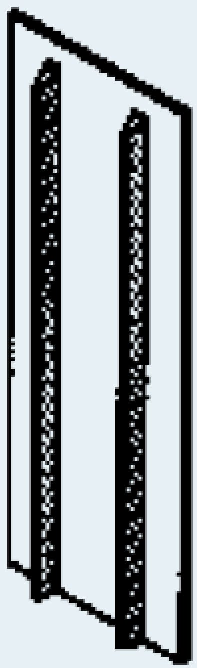
(a) Flat, hollow-core, or insulated panel.

(b) Vertical window or mullion panel.

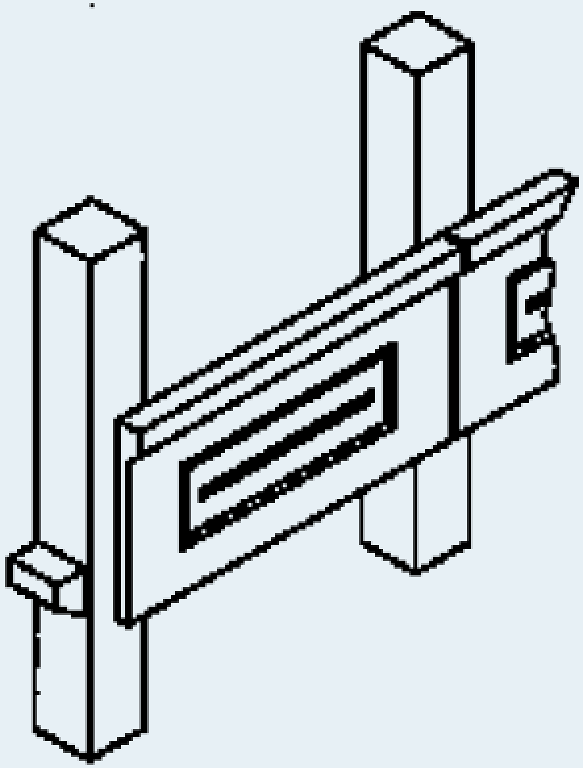
(c) Horizontal window or mullion panel.



(d) Ribbed panel.



(e) Double-tee panel.



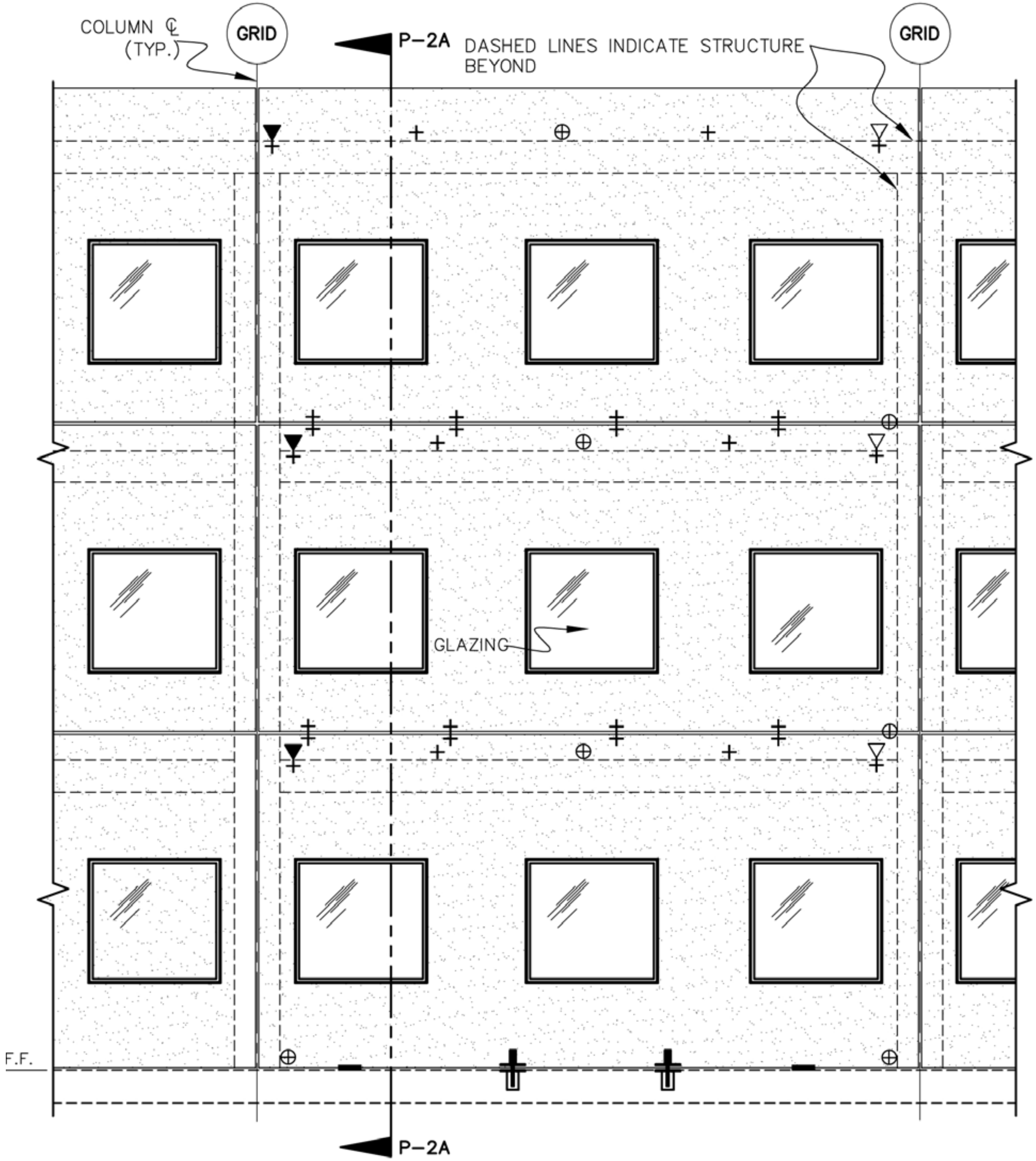
(f) Spandrel (same as "a").

Thickness of wall panels ranges from 120 mm for interior walls to 200 mm for exterior walls .

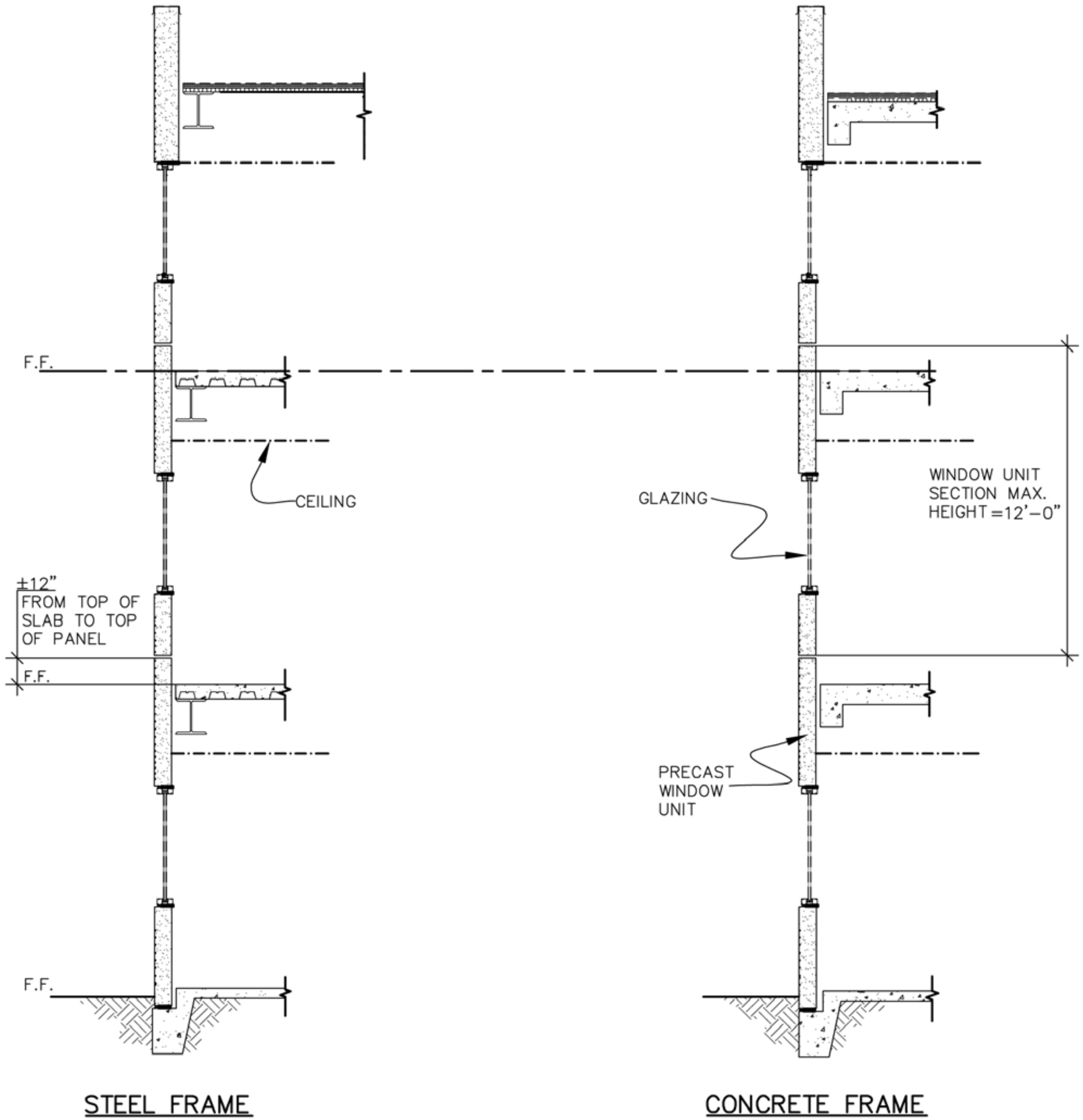
Wall panel length is equal to the room length, typically on the order of 2.7m to 3.6 m.

In some cases, there are no exterior wall panels and the facade walls are made of lightweight concrete.

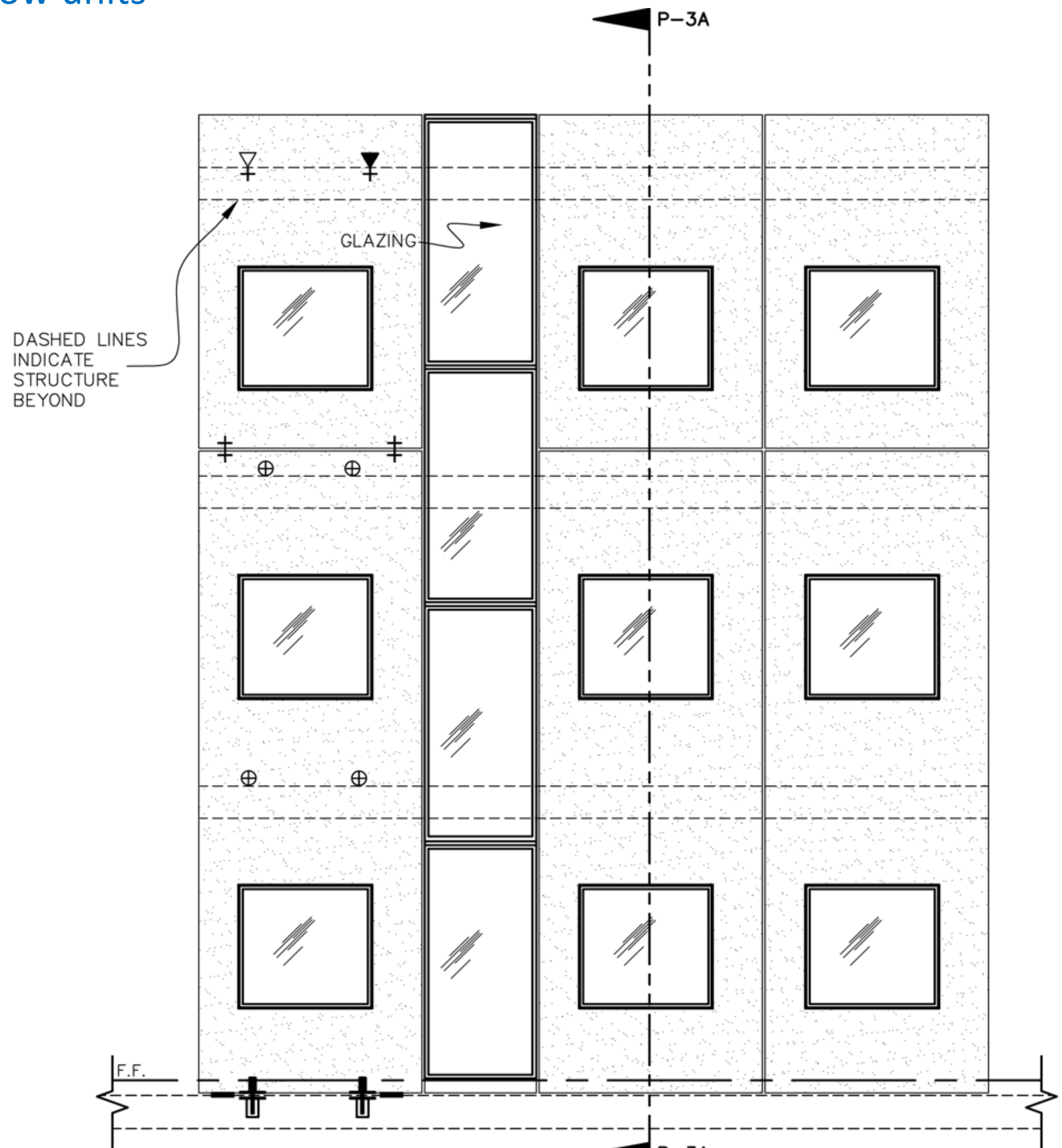
horizontal Window units



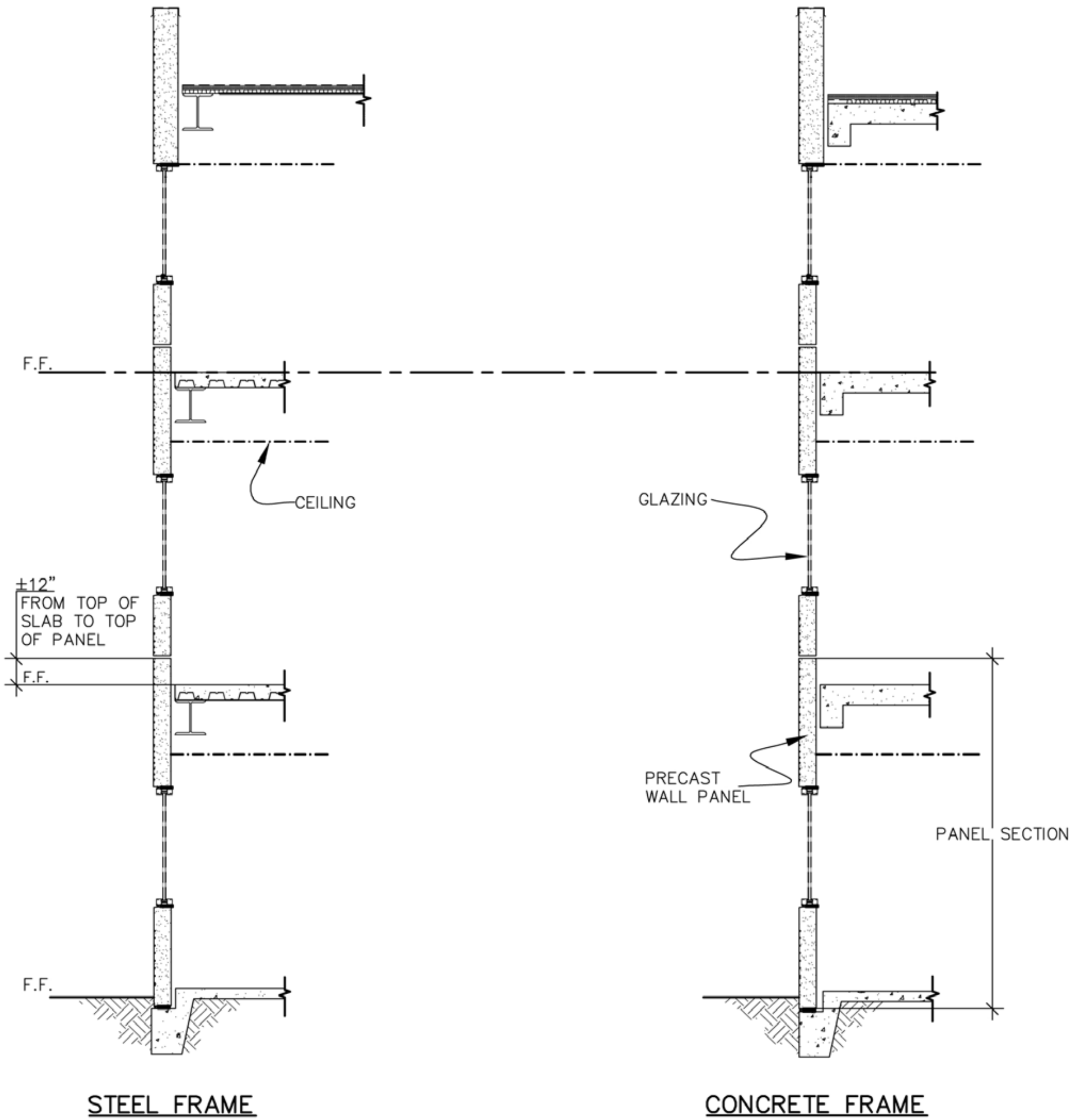
Building Section P-2A



vertical window units



Building Section P-3A



Support and Anchorage Systems

Precast concrete panel connections are an important component of the envelope system.

Precast manufacturers use numerous different types of anchors, which are often characterized as gravity and lateral connections.

The primary purpose of the connection is to transfer load to the supporting structure and to provide stability.

The criteria used to design precast connections includes but is not limited to:

- Strength
- Ductility
- Volume change accommodations
- Durability
- Fire resistance
- Constructability

Types of Connections

Hardware design for connections should take into account the tolerances for both the precast concrete components and the structure.

These considerations may require clip angles and plates with slots or oversize holes to compensate for dimensional variations, field welding or sufficient shim spaces to allow for variations in elevation.

Sufficient minimum clearance between precast units and structure should be provided to allow for product, interface and erection tolerances.

Bolted Connections

Bolted connections simplify and speed-up the erection operation, because the connection is positive immediately.

Final alignment and adjustment can be made later without tying up crane time.

Bolting should be in accordance with the erection drawings, using material specified by the designer.

Welded Connections

Welded connections are the most common and typical connection used in the erection of precast concrete.

These connections are structurally efficient and adjust easily to varying field conditions.

The connections are usually made by placing a loose plate between two structural steel plates that are embedded both in the cast-in-place or the precast concrete panel and welded together.

Some connections are designed to bend and yield in one direction while remaining rigid in all other directions.

Welded connections should be installed exactly as shown on the erection drawings and details.

Dowel/Anchor Bolt Connections

In a dowel connection, the strength of dowels in tension or shear depends on dowel diameter, embedded length and the bond developed.

Good practice is to provide sufficient embedment to develop the full dowel strength.

Threaded anchor bolts and rebar anchor dowels that protrude from the foundation are the critical first connection to precast members.

It is important that these items be placed accurately in both plan and vertical alignment.

Typical Joint Design

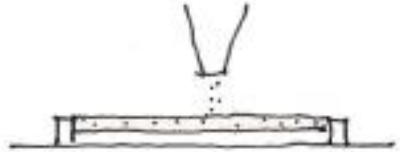
Typical panel joints are 5/8" - 3/4" wide on the exterior and 1/2" on the interior. The typical joint between precast panels has a single line of sealant for weatherproofing and a closed-cell insulating backer rod to set the depth and shape of the sealant. Exterior sealant selection should be based on the ability to maintain elastic properties, weather performance and resistance to harmful UV rays.

Sealant Depth

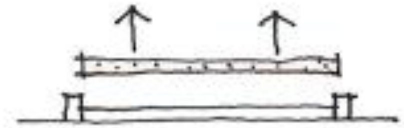
Equal in importance to the width of the sealant joint is the depth. For joints designed for ¾ to 1 inch wide, the depth should be equal to one half the width. In plan view the shape of the sealant should concave, similar to an hourglass. The backer rod

THE MANUFACTURING, TRANSPORTATION & ERECTION OF A PANEL

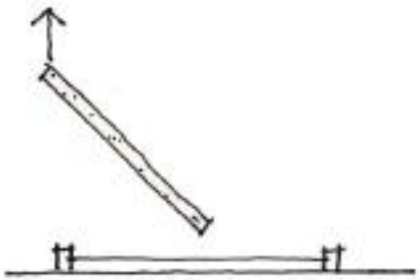
1. SET UP FORM



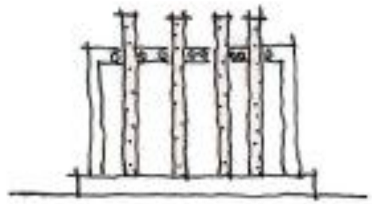
2. POUR CONCRETE



3. LIFT FROM FORM

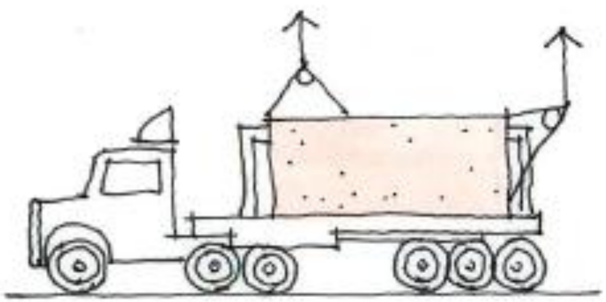


4. ROTATE TO VERTICAL

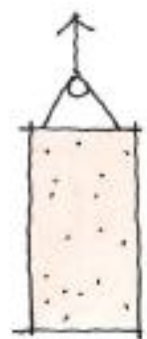


5. STORE IN YARD

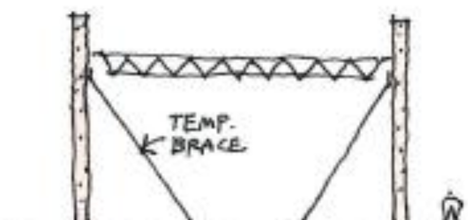
6. TRANSPORT TO SITE



7. LIFT FROM TRUCK



8. ROTATE TO VERTICAL



9. ERECT BUILDING