4. DELIVERY

Delivery of precast elements should be planned according to the general erection sequence to minimise unnecessary site storage and handling. Where possible, it is desirable to transport the precast elements into a manner which they can be lifted directly for erection or storage without much change in orientation and sequence. For example, wall panels can be transported using A-Frame type trailer in upright position.

Precast elements should be loaded and delivered with proper supports, frames, cushioning and tie-downs to prevent in-transit damage. Adequate packing or protection to the edges of precast elements should also be provided to minimise risk of damages during transit.

Figure 4.1  The manner of delivery will depend on the type, dimension and weight of the precast elements
Figure 4.2 Protection measures such as the use of cushion packing or polythene wrapping can be used to minimise damages to precast concrete elements.
4.2. HANDLING

The handling process mainly involves the removal of the precast elements from the mould, transportation to the storage yard, loading and unloading operation and erection of these elements at the job site. Different sets of lifting points and cast-in devices will have to be used for various handling stages.

Typically, precast concrete elements are demoulded and lifted from their casting position to storage yard and delivery to site once they reach the expected concrete strength required. As these elements have not gained their full designed strength, they are generally more susceptible to damages during handling. It is therefore important to ensure that they are handled in a way that is consistent with their shapes and sizes, to avoid excessive stresses or damages. For elements with large openings, temporary bracing, ties or strongbacks should be provided for safe handling as shown in Figure 4.4.

The handling requirements depend on the following factors:

- Position of the casting mould (i.e. vertical casting vs horizontal casting)
- Minimum concrete strength of the precast elements for demoulding, delivery and erection
- Adequacy of the design reinforcement to resist handling stresses
- Size and weight of the precast element
- Number, size and location of lifting points and type of inserts/devices
- Method of lifting, type of lifting equipment and crane capacity
- Support points for storage and transportation
Figure 4.4  Temporary strengthening of panels with openings

Basically, the elements when handled must be balanced and in line with their centre of gravity. The general hoisting methods used for different precast concrete elements are illustrated in the following Figure 4.5 - Figure 4.8.

**Precast Beam**

Note: The lifting points should be designed and located to limit the bending moments within the beam element. As a general guide, they should be located at about one fifth of the beam length measured from the edge.

Figure 4.5  General hoisting method for beam
**Precast Wall**

For wall panels, it is recommended to lift the panel in vertical position for installation so that turning is not required.

Hoisting method adopted for demoulding of wall panels that are cast horizontally.

Figure 4.6 General hoisting method for wall

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**Precast Plank / Slab**

Note: Where necessary, multiple lifting points can be designed and located to minimise undue stresses within the slab elements, in particular for slender panels such as precast planks.

Figure 4.7 General hoisting method for plank/slab
Precast Column

Note: Columns are usually first handled in horizontal position. Slings are attached to the inserts at the top to facilitate the rotation of the elements to vertical position, before hoisting and placing to their designated location.

Figure 4.8 General hoisting method for column

4.3. STORAGE

The storage area provided in the yard and job site should be adequate to permit easy access and handling of the precast elements. The area should be relatively level, firm and well drained to avoid any differential ground settlements which may damage the stored elements.

Appropriate stacking method should be used to store the precast concrete elements to prevent any undue stresses and damages (see Fig 4.9 and 4.10). Horizontal precast concrete elements such as precast slabs, planks, beams and hollowcore panels, can be stacked and supported separately using strips of woods or battens across the full width of the designated bearing points. Precast walls and façade panels are usually stored in vertical position supporting their own weight using racks with stabilising wall. Storage conditions can be an important factor in achieving and maintaining panel bowing and warping tolerances. More lateral support should be given to slender panels, which are more likely to bow or warp. To minimise handling, the elements should also be stored based on the erection sequence.
Stacking method and packers (or support spacers) vary according to the types of precast elements. Horizontal stacking of slab/beam or column units can be done with suitable packers or support spacers shown above. As a guide, the storage support position for beams and planks should be within 300mm from the lifting points.

Do not use more than two support points in particular for prestressed element such as hollow core slab.

The packers or support spacers should not be misaligned as shown.

Wall panels should be stored vertically and braced in position by A-frames or a racking system.

Figure 4.9 General guidelines on stacking method of precast elements
Figure 4.10 Different storage and stacking requirements for different precast elements
Figure 4.11 Examples of improper storage and stacking methods

The storage area at the job site should preferably be close to the locations where the precast elements are to be installed to minimise the risk of damage by handling.

Figure 4.12 Precast concrete elements should preferably be stored near their final position for easy handling.