PRECAST CONSIDERATIONS

The Use Of Precast

It is possible for most buildings of various types such as commercial, residential and industrial to be designed for construction in precast concrete. Buildings with high degree of modular co-ordination and repetitive structural grids are ideal for precast construction. Even buildings with irregular layouts are often suitable for partial precast construction.

It is a common misconception that precast concrete lacks flexibility. With creativity and standardisation of basic precast elements, details and connections, a wide variety of plans, elevations and features can be achieved with precast concrete.

Personnel And Expertise

A good precast building is a joint effort of the Developer, Architect, Engineer, Precaster and Contractor. A good precast building has to begin with a precast design intent at the initial design stage.

At the design stage, the Architect and Engineer should integrate inputs from Precaster and Contractor in order to realise the advantages of precast. These include minimum wastage of material and maximum efficiency in production and erection of precast components.

At the construction stage, the Precaster and Contractor who have taken over the project for construction should work closely with the Architect and Engineer. They should collaborate on the workshop drawing details and refinement, if any, to suit their specific production and erection considerations. This helps to achieve the objective of shorter construction time and better quality.

Planning And Layout

In general, modular co-ordination should be adopted throughout the building. Dimensions between grid lines could be used in modules of 1200mm to facilitate the use of precast components. A modular grid of 300mm is recommended as a basis of design for horizontal dimensions and 100mm for vertical dimensions.

Grids need not be just rectangular. Other geometric shapes can be used. The important point is to achieve regularity so that there is higher repetition of elements and components.

In addition, precast concrete elements should be as large as possible bearing in mind limitations of production, transport, erection and crane lifting capacity. Connections between elements should be as simple as possible.

General Steps In Design

After establishing the design brief with the developer, the following stages are recommended for the design development of a precast building :

Preliminary Design Stage

The Architect and Engineer will develop floor layout plans with grid dimensions, storey heights and building form. This is the critical stage in which modular planning and standardisation of grids and storey heights should be pursued.

In collaboration with the Engineer, the type of precast structural system is then selected. The basic precast structural systems are discussed below. The Architect needs only to consider the possible basic structural systems during the initial design stage.

Section Four of this Guide provides tables for a quick reference on selection of structural precast components for various categories of buildings. Other engineering considerations should be taken up by the Engineer and Precaster at the subsequent design development stage.

Design Development Stage

The Engineer develops detailed design and drawings for the precast structural system established. When necessary, the Precaster should be consulted to achieve practicability and buildability on site.

Selection of Structural Precast Systems

The most common precast structural systems are:

- ***Frame Systems***

Frame structural systems are suitable for buildings which need a high degree of flexibility. Large spans and open spaces can be achieved without interfering walls. This system is particularly suitable for shopping malls, multi-storey carparks, sports facilities, office buildings and industrial buildings.

- ***Load Bearing Walls and Floors***

Precast load bearing walls can appear as walls in shafts and cores, cross-walls and load bearing external walls. Precast wall systems have been used in residential projects. They offer the advantages of fast construction, ready-to-paint surface finishing, acoustic insulation and fire resistance. The slabs between walls can either be precast or in-situ flat plate structure. The aim is to build free open spaces between the load bearing walls and to use light partition walls for the internal layout. This offers flexibility in interior layout.

- ***Cell Systems***

Cell units are feasible for specific uses of a building, for instance, bathrooms and kitchens. The advantage of the system lies in the speed of construction and high productivity in manufacturing since the finishing and fittings (including mechanical and electrical services) of the cells are completely done at the factory. The HDB upgrading programme, for example, uses cell systems.

The above systems may be combined in the same precast building. Precast components are also used in conjunction with in-situ concrete. Structural compatibility should not be a problem. However, stability and robustness should be looked into. The Engineer may refer to the CIDB Precast Design Handbook for engineering considerations.

Site Location

The site location, accessibility and project scale are determining factors in organising precast production, storage and erection. Where practical, some components can be cast at the site.

For congested sites, all elements will have to be delivered by trucks and directly lifted for installation using the 'just-in-time' method. The accessibility of the site and the location of the lifting crane will determine the weight of precast components that can be lifted. Generally, units weighing more than 5 tons may pose lifting problems for tower cranes. Inputs from the Precaster and Contractor should be sought.

Costs

The construction cost of a building using precast components should be assessed in its overall context. The traditional method of costing by material quantities with a fixed factor for labour cost can lead to incorrect estimation. For example, if labour usage is halved, this will more than compensate for a 10 percent material increase.

More importantly, there is savings in time. Also, if properly designed and executed, precast can lead to much better quality work. The overall cost impact of precast has therefore to take all these factors into consideration.

With the rising costs of labour and less assurance of dependable skilled manpower, the trend is that precast construction will become increasingly competitive compared to cast-in-place construction.

M & E Installation

It is important to integrate, at the design stage, M&E services with the use of precast components. Location of openings for ducts and pipes, concealed wirings and fastenings for duct support should be considered at this stage. This will avoid costly rectification work later. Some of the duct work, pipe work and wiring work can be incorporated in precast components. For example, precast walls should include wiring work and cell systems such as prefabricated toilets often come with pipe work and wiring work installed in the factory.

Waterproofing

In precast construction, the effectiveness of watertightness depends on the design of joints and use of appropriate sealants. External joints must be able to resist water leakage due to rain and wind; where feasible, joint design should allow water that has penetrated to drain off. Internally, use of water for cleaning must be expected at certain locations and waterproofing of slabs and wall connections will therefore be necessary. Reference may be made to the CIDB Precast Design Handbook for more information.