Design principles for precast concrete

Recent projects

City office, The Hague, The Netherlands
- Precast façade elements
- Bearing inner walls
- Prestressed hollow core slabs
- Floor plan triangular
- Atrium triangular
- Façade elements: derived from triangular shape

Recent projects

Crystal Court Dwellings, Amsterdam
- 36 multi-apartment apartments
- (all different)
- Precast walls
- Thin precast floors
Recent projects
Shopping Centre Velpenbroek
The Netherlands

Ground level: shopping centre
1st floor: parking garage
2-9th floor: 106 apartments
Advantages:
- long spans
- short construction time
- low nuisance for environment
- precast floor with integrated ducts.

Recent Projects
City harbour hotel
Amsterdam, The Netherlands

Hotel rooms 5th-19th storey supported by two prestressed precast concrete trusses, h = 4.2m, b=2.5m and l = 61m.
Cantilevering at both sides 7.6m and supported any 15.2m
Recent projects
Parking Garage de Cope
Utrecht, The Netherlands
Helical access ramps consisting of precast concrete elements: no complex formwork at building site needed.

Title
Parkinghouse Kelfkensbos
Nijmegen, The Netherlands
4 parking levels 90 x 48 m² prestressed inverse T-beams for roof structure

Recent projects
Parking garage Amsterdam
Inverted T-beams
Hollow core slabs
Composed to composite floor system
Advantages of precast concrete

High concrete strength: under controlled factory conditions, high concrete strength can easily be achieved. For the precast concrete industry this is a “must”: high production requires a high early strength, which corresponds to a high 28-days strength: $f_{ck} \geq 50$ Mpa.

Low cost prestressing

Prestressing with wires and strands: anchorage by bond; no expensive prestressing anchors required.

Office building to be created over access road to city of The Hague in The Netherlands

Precast prestressed high strength concrete beams ($f_{ck} = 100$ Mpa) to support the building placed in one night.

Advantages of precast concrete

High strength concrete in combination with prestressing can be used to produce large span slender beams and slabs; that means freedom in arranging the interior ground plan and flexibility to change this in future.

Office with free span 18m

Car park with 9.60x16m grid
Advantages of precast concrete

- Small construction site needed. No storage of structural elements required. Mounting even large elements directly from transport vehicle. Important in urban areas.

Mounting a TT-element for a car park directly from transport car.

Advantages of precast concrete

- Reduced construction time: no delay by hardening of concrete at construction site. Elements are already approved in factory. In general simple assembly if rational connections are used. Lower noise level, less waste, less dust.

Advantages of precast concrete

High quality detailing in factory possible
Design philosophy

1. Design the structure from the beginning as a precast structure and not as assembled parts of an in-situ structure.

   In-situ structure: frame with monolithic nodes

   Precast alternative: columns fixed at bottom and beams supported by corbels

Design philosophy

2. As little as possible different element types

   Structure built with bearing facade elements and prestressed hollow core slabs

Design philosophy

3. Shape of precast elements as simple as possible
Design philosophy

Examples of standard solutions for connection of column to foundation

4. Precast elements as large as reasonable (transport limitation)

The larger the elements, the lower the number of connections and the lower the number of operations.

Precast beams for a car park.
Design philosophy

5. Precast elements should be designed in such a way that they can easily be transported.

Design philosophy

6. As little as possible in-situ concreting
- Joints between hollow core decks to be cast in-situ.
- Moreover, in-situ concrete for small areas in irregular floor systems may be more appropriate than precasting one single fitting element.
- In-situ concrete leads often to delay.
- It is more complicated to cast small volumes of in-situ concrete than large volumes.

Design philosophy

7. Design preferably in such a way that the structure is stable in all stages.

Statical system inappropriate for precasting:
- Columns have to be stabilized in construction stage.
- Moment resistant connections column-beam require cast in-situ concrete in small volumes.

Statical system suitable for precasting:
- Columns are stable in construction stage.
- Hinged connection is easily achieved simple support.
Design philosophy

8. Use as much as possible modular systems

The basic module is mostly 3M (M = 100 mm), and 6M and 12M are widely used measures. Internal columns are positioned centrically on the modular axis grid. Modulation in connection with industrial production is not imperative, but has an influence on the cost of the elements.
Design philosophy

9. Take due account of dimensional tolerances

- Tolerances
- Avoid combinations of camber in two directions
- Connections able to cope with dimensional deviations

10. Use as much as possible standardized elements and connections

Standard products are cast in existing moulds. The designer can select the length, dimensions and load bearing capacity within certain limits. This information can be found in catalogues from the precast element producers. Standardization constitutes an important economic factor in prefabrication, because of the lower costs for moulds, industrialization of the production process with high productivity, large experience in execution, etc.

Repeated handling at the construction site means also avoiding errors and bad experiences.