PRECAST SKELETAL TOWER BUILDINGS

Arnold Van Acker
Past chairman fib
Commission on Prefabrication
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1. Structural concept
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Tower buildings

- Office buildings in Brussels

Office buildings
20 to 37 storeys
High strength circular concrete columns
Slender prestressed floor beams
Prestressed hollow core floors

Examples of recent realisations

Ellipse building 26 storeys
Dexia Tower 37 storeys
Tower buildings
Tower buildings

• First project in 2003

North Galaxy twin towers - 36 storeys – 156.500 m² floors

Initial design: steel frame + composite steel deck floors

After tender, variant solution in precast concrete:

- 7% cheaper
- double speed of erection
- 2 hours fire resistance without additional protection
- less deformation of the precast concrete floors
1. Structural concept
Structural concept

- **Construction principle**
  - Precast columns, beams, floors
  - Central core
  - Light façades

Columns in high strength self-compacting concrete 80/95 MPa

Hollow core floors
Floor lay-out

• Large architectural freedom

Central core cast in-situ

Column distance 8.10 m

Floor spans HC 200 6.20 to 9.47 m

Orthogonal lay-outs are ideal but other shapes are equally possible
Floor lay-out

- Other examples of realisations

Floor spans HC 6.20 to 7.33 m
Column distance 5.20 – 5.46 m

"Lex" building

Floor spans TT 19.00 m

"Ellipse" building

Floor spans HC 5.75 to 8.70 m

Floor spans HC 200 6.20 to 7.33 m
Column distance 5.20 – 5.46 m
Skeletal system

- **Ellipse building**

Constant cross-section of circular columns over the total building height

Hollow core floors
Skeletal system

- **Floor lay-out ellipse building**

  - Floor beam with curved upper flange
  - Floor beams supported on the edge beam
  - Cast in-situ wedges
  - See detailing

L = 6.23m
2. Structural stability
Structural stability

The horizontal stability of medium and high rise precast buildings is realised through:

- Central cores
- Floor diaphragms
Robustness

• Design to prevent progressive collapse

Suspension via column to above structure

Corner column taken away

Cantilever action of floor beams

Mechanisms to provide for alternate load path

Failure of corner column
Robustness

- Design to prevent progressive collapse

Suspension via column to above structure

Cantilever action of floor beam

Cable action of floor beam

Failure of intermediate façade column
3. Precast components
Precast components

• **Columns**

**High strength concrete C 80/95**

2 storey columns Ø 500 or 600 mm

Projecting bars for column splicing

Dowels for beam connection
Precast columns

- Composite, C 80/95 and C 45/60 in same project

Normal strength concrete C 45/60 at higher levels

High strength concrete C 80/95 at intermediate levels

Composite steel-concrete columns at lower levels
Precast columns

- Vertical casting single storey columns

Casting up side down

One storey columns
Precast columns

- Horizontal casting two storey columns

Two storey columns

Horizontal casting self-compacting concrete
Tower buildings

- **Floor beams**

  - Booth height 80 mm
  - Normal booth height ≥ 150mm
  - Booth height 120 mm
  - Slender booth height
  - Beam end with half joint
4. Detailing
Detailing

• Joining of elliptic – rectangular building parts

Small floor corner cast in-situ
Detailing

• Edge design elliptic floor

- Edge beam with cantilevering top flange
- Floor beams supported by edge beam
- Neoprene strip for floor support
- Holes for pinned connection
Detailing

- Floor arrangement ellipse building

*Very slender column corbels*

*Central core*
Detailing

- Projecting façade part
Detailing

- Peripheral tie reinforcement

Ellipse building 26 floors

Detail tie reinforcement calculated to prevent progressive collapse
Detailing

• Passage for technical conduits

HC on bottom fange steel beam
Detailing

- **Installation technical conduits**

- Column splicing with projecting bars in grout tubes

- Inverted U-shaped beam for transversal conduits
5. Structural connections
Connections

- **Edge column - to - beam and hollow core floor**

- Column splice with projecting bars in grout tubes
- Transversal ties
- Longitudinal floor ties anchored in open cores
Connections

- **HC Floor - to - composite beam**

![Slender composite floor beam diagram]

- Tie bars in filled open sleeves
- Column splice with projecting bars in grouted tubes
6. Erection
Erection

- Columns
Erection

- Dexia tower (37 storeys)
Erection

- Simultaneous erection and building finishing
Erection

- Installation glass façade.
Basement construction

- Up and down at the same time

Piles for basement wall (41.7 ton)
Length 14.70 m

Longitudinal pipe for positioning control

28 precast foundation piles
Basement construction

- Installation in excavated slot filled with bentonite

Temporary pile suspension during casting of footing

Footing reinforcement fixed to pile
Conclusion

Precast concrete is a modern industrialised and environmentally friendly method of construction, with a bright and promising future.

Thank you for your kind attention