Prefabricated reinforced concrete construction:

Construction of RC components of buildings, the majority of which are standardized and produced either at the construction site, or (much more often) in plants in a location away from the building, and then transported to the site for assembly.
general characteristics of precast structures

advantages

- economic use of auxiliary materials (formwork, scaffolding) - several repetition (at least 30 identical casts /mould)
- reduced construction time - larger quantity of components is possible at the same time
- less skilled labor is required

limitations

- size of the units
- location of window openings has a limited variety
- joint details are predefined
- site access and storage capacity

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Site-cast (local precast):

- no transportation
- the size limitation is depending on the elevation capacity only
- lower quality because directly affected by weather
- proper, large free space required

precast at a plant:

- transportation and elevation capacity limits the size
- higher, industrialized quality – less affected by weather
- no space requirement on the site for fabrication
- „unlimited” opportunities of architectural appearance
- option of standardized components (precast catalogue)

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reinforced concrete

SCC (self-compacting (consolidating) concrete)
   – for fair faced concrete

CRC (compact reinforced composite)
   – high strength material for slender structures

GRC (glass-fiber reinforced concrete)

architectural options – surface appearance

plant casting :
   – allows high quality control
   – allows greater option of finishes
   – enable interaction between design phase and production planning
options of surface appearance

surfaces with surface treatment of the material

- Heavy grit blast
- Bush hammered
- Acid etch
- Acid etch
- Heavy grit blast
- Heavy grit blast
- Light grid blast
- Heavy grit blast
- Aggregate transfer and acid etch
- Medium grit blast

options of surface appearance

classical patterns – with the surface of the form-facing
options of surface appearance
advanced patterns – with special designed form-facing / CNC-cut patterns

1. cutting
2. wood/plywood form-facing
3. concrete surface
building types

One or two storey hall-like buildings

Multi-storey buildings

structure types

categories of load-bearing structure

- large-panel systems
- frame systems
- slab-column systems with shear walls
- mixed systems
structure types

large-panel systems
- box-like structure,
- both vertical and horizontal elements are load-bearing
- one-story high wall panels (cross-wall system / longitudinal wall system / two-way system)
- one-way or two-way slabs

frame systems
- components are usually linear elements (beam-pillar frames are rare because difficult to handle)
- the beams are seated on corbels of the pillars usually with hinged-joints (rigid connection is also an option)
- joints are filled with concrete at the site
structure types

prestressed slab-column systems

- 2-3 storey high pillars
- prestressed beams and slab panels (by means of prestressing tendons)
- in-situ concreted joints
- shear walls (precast or cast-in-place) positioned between the columns at appropriate locations (shear system)

structure types

prestressed slab-column systems – arrangement of shear walls

- good
- unfavourable
- unfavourable
- optimal
structure types

- lift-slab systems
  - partially precast in plant (pillars) / partially precast on-site (slabs)
  - one or more storey high pillars (max 5)
  - up to 30 storey high constructions
  - special designed joints and temporary joints
  - slabs are casted on the ground (one on top of the other) – then lifted with crane or special elevators (two lifting methods: Bulgarian, American)

lift slab procedure

1. pillars and the first package (e.g. 5 pieces) of slabs prepared at ground level
2. lifting jacks are mounted on the pillars + a single slab lifted to the first floor level
3-8. boxes are sequentially raised to higher positions to enable the slabs to be lifted to their required final position - slabs are held in a relative (temporary) positions by a pinning system
### Lift Slab Procedure

9. Extension of pillars

10-14. The first package of slabs are lifted further to make space for the next package of slabs. Or new slabs can be fabricated on at a higher level not to disturb the further construction works at the first levels.

At the end of the lifting process the lifting jacks are removed from the top of the pillars.

### Preparatory Work Phases

1. Design of the building
2. Preparation of element consignation
3. Planning the transport routes
4. Planning the lifting sequence of the elements and the temporary bracing system
5. Planning the lifting operations – step by step for each element – Non-isotropic, vulnerable components!!!
6. Selection of the temporary structures of the assembly
7. Planning the site arrangement
preparatory work phases

Design considerations

- final position and loads

- transportation requirements – self load and position during transportation

- storing requirements – self load and position during storing – (avoid or store in the same position as it transported / built in)

- lifting loads – distribution of lifting points – optimal way of lifting (selection of lifting and rigging tools)

- vulnerable points (e.g. edges) – reduction of risk (e.g. rounded edges)

Elements of the structure
**preparatory work phases**

Element consignment

<table>
<thead>
<tr>
<th>ID</th>
<th>Function</th>
<th>Figure (drawing + lifting points + reinforcement)</th>
<th>Geometry (cm)</th>
<th>Weight (t)</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>1. RcW-01</td>
<td>rc wall panel</td>
<td></td>
<td>400x300x12</td>
<td>3,6</td>
<td>36</td>
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<tr>
<td>2. RcP-01</td>
<td>pillar</td>
<td></td>
<td>300x20x20</td>
<td>0,3</td>
<td>40</td>
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<tr>
<td>3. RcS-01</td>
<td>hollow slabpanel</td>
<td></td>
<td>400x750x30</td>
<td>13,2</td>
<td>18</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**preparatory work phases**

Planning traffic route

• How long transport-vehicle is required?
• What is the required load capacity of the transporter vehicle?
• What is the maximum vertical extension of the shipment?
• Is route permission required?
• Routs on the site
preparatory work phases

Planning traffic route

Optimal to avoid storing on site!

If it is not possible - elements recommended to be stored in similar position to their future built-in position!

If it is not possible either - design consideration have to be made for storing regarding to the reinforcement!
Elevation plan

- work sequence
- plan of the elevation step by step for each element (pillars, beams, slabs, wall panels)
- temporary bracing, supporting system and final shear walls

Temporary structures & site organisation plan!
preparatory work phases
Elevation plan (example)
equipments

- mobile crane
- tower crane (above 3 storeis)

lifting tools:
- spreader beams
- wire rope slings

to eliminate extra load from lifting

rigging tools:
- eye bolt
- shackles
- hooks

on the elements (lifting points)

for the crane

selection of mobile crane

relevant parameters:

1. Lifting heights =
   - the level of the final location of the element
   - the height of the highest element +
   - the height of the equipment (lifting and rigging tools) +
   + 1m

2. Lifting weight =
   - the weight of the heaviest element to lift
I. floor

- vertical load-bearing structure (e.g. pillars or walls)
- temporary supports (if needed)
- shear walls
- horizontal load-bearing elements (e.g. beams + slabs)
- preparation of the structural joints
- Non-load-bearing elements (e.g. non-load-bearing wall panels)

II. floor

... ... ...

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erecting multi-storey pillars

lifting wall elements
assembly

wall panels with temporary supports

lifting slab panels

5. preparing structural joints

Foundation types:

plain reinforced concrete

B. Stepped reinforced concrete

C. mass concrete
preparing structural joints

Pillar-beam joints

Slab-slab joints

Beam-slab joints

on-site grouted
preparing structural joints

solid wall panels

sandwich panel system

Wall-joints

scheduling

some approximate data for installation

- emplacement of hollow core floor slabs - 300 m²/day
- erection of pillars/columns - 8 pieces/day
- emplacement of beams - 15 pieces/day
- emplacement of double tee slabs - 25 pieces/day
- emplacement of walls - 15 pieces/day
- construction of stair and elevator shafts - 2 floors/day
GRC facade wall elements, Office building, 25 – 35 Park Lane, London, United Kingdom

SCC construction elements, Office building, 35 Homer Road, Solihull, United Kingdom
Thank you for your attention!

References

[3] Precast Concrete Structures. www.paradigm.in 2012.10.10
[5] Sonjoy Deb: Precast Concrete for Building Systems http://masterbuilder.co.in/Archives/Building%20Materials/Concrete/Precast%20Concrete%20for%20Building%20Systems.pdf 2012.10.10
[8]