




# PRECAST CONCRETE BUILDING SYSTEMS



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# OUTLINE

## SYSTEMS


- Overall Structural Systems
- Systems for Lateral Load Resistance
- Roof and Floor Systems



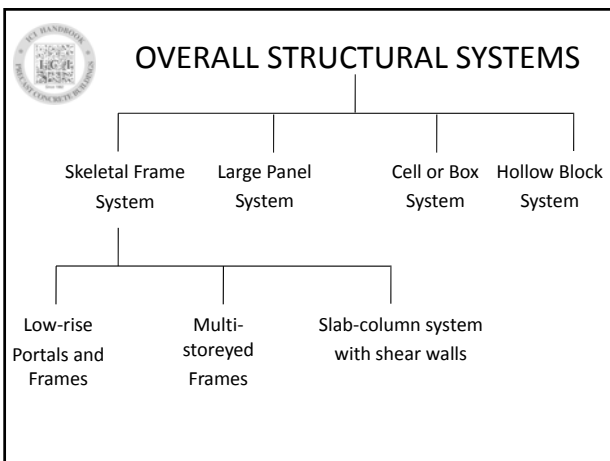

# OUTLINE

## COMPONENTS

- Beams and Columns
- Roof and Floor Units
- Wall Units
- Foundation Units
- Units for Miscellaneous Applications



# OVERALL STRUCTURAL SYSTEMS

# SKELETAL FRAME SYSTEM

- Suitable for buildings that require flexibility in usage and remodelling in the future
- Possibility of large column free space
- No visual obstruction due to walls
- Relatively independent of MEP systems
- Flexibility in the selection of facade cladding
- Individual units are suitable for production, transportation and erection
- May need supplemental lateral load resistance.



## LOW-RISE PORTALS AND FRAMES

- Schools
- Industrial buildings
  - Manufacturing plants: heavy engineering, chemical, etc.
  - Maintenance facilities: railway yards



School in Gujarat

Heavy Engineering Workshop at Hazira



Courtesy: L & T



## LOW-RISE PORTALS AND FRAMES

- Commercial buildings
  - Wholesale outlets
  - Departmental stores
- Convention and congregational centres
- Airport terminals



Terminal building at Bangalore airport

Courtesy: L & T



## LOW-RISE PORTALS AND FRAMES

- Storage facilities
  - Horizontal silos
  - Material storage sheds
  - Godowns and warehouses



Silo at Thoothukudi

Material storage shed, Cement plant at Satna



Courtesy: L & T



## MULTI-STOREYED FRAMES

- Institutional buildings
  - Educational facilities
  - Hospitals
- Commercial buildings
  - Large office buildings
  - Shopping complexes
- Parking structures
- Stadiums



The Chennai Silks Showroom at Chennai  
Courtesy: Teemage Precast



## MULTI-STOREYED FRAMES



Schmersal India Production Facility, Pune

World Trade Centre, Pune



Courtesy: Precast India Infrastructures Pvt. Ltd.



## MULTI-STOREYED FRAMES



Parking structures at Mumbai airport



Jawaharlal Nehru Stadium at Chennai

Courtesy: L & T



## WALL SYSTEM

- Suitable for buildings that require close partitioning of space
- Smooth surface: ready-to-paint, paste wall paper
- Can accommodate insulated panels for thermal comfort
- Adequate lateral strength and stiffness
- Need tie reinforcement for integration
- Limited flexibility based on presence of non- load bearing wall panels.



## WALL SYSTEM

- Residential buildings
  - Low-rise bungalows
  - Mid- to high- rise apartment buildings
- Miscellaneous types of dwelling
  - Dormitories
  - Hotels



Courtesy: L & T

Multi-storeyed apartment buildings at Mumbai



## WALL SYSTEM



Hostel building at IIT Sri City  
Courtesy: Teemage Precast



Hostel building at SRM University, Trichy  
Courtesy: VME Precast



## CELL (BOX) SYSTEM

- Suitable for enclosed spaces
- Can accommodate fittings and finishes before installation
- Can be used as a sub-system
- Adequate lateral strength and stiffness
- Need tie reinforcement for integration
- Limited flexibility.



## CELL (BOX) SYSTEM

- Individual dwelling units
  - Hotels
  - Studio apartments
  - Justice facilities
- As a sub-system
  - Toilet / Bathroom pods
  - Kitchens / Pantries
  - Closets
  - Balconies



Balcony  
Courtesy: Ra-Ni Precast



## HOLLOW BLOCK SYSTEM (CONCRETE MASONRY UNIT SYSTEM)

- Low- to Mid- rise buildings
  - Commercial buildings
  - Residential buildings



Courtesy: The Hindu

- Suitable as vertical load bearing walls
- Adequate lateral strength and stiffness, with reinforcement
- Need reinforcement for integration

**SYSTEMS FOR LATERAL LOAD RESISTANCE**

### LOW-RISE PORTALS AND FRAMES

- Cantilevering columns fixed to the foundation
  - For up to 3 storeyed buildings
  - Beam-to-column connections are assumed to be pin-jointed
  - Subjected to sway, primarily under lateral loads
  - Diaphragm action at roof level provides integrity

1. Saddle beam
2. Column with corbel
3. Socket (pocket) foundation
4. Purlin
5. Slab units

### LOW-RISE PORTALS AND FRAMES

- Portal made of sub-assemblages
  - Sub-assemblages of rigid beam-to-column joints
  - Connections at the locations of zero moment
  - Simple pad footing

1. A-frame top piece
2. Bottom piece
3. Pad foundation

### MULTI-STOREYED FRAMES

- Frames with emulative rigid beam-to-column connections
  - For up to mid-rise buildings
  - Needs on site concreting (wet joints)
  - Options of sub-assemblage units

a) With individual beam and column units      b) With beam-column sub-assemblage units

### MULTI-STOREYED FRAMES

- Frames with dry jointed beam-to-column connections
  - Using corbels and non-prestressed continuity bars
  - Requires supplemental lateral load resistance
  - Option of self-centering system using prestressed tendons
    - Corbels are avoided

a) With corbels and non-prestressed continuity bars      b) With prestressed tendons

### MULTI-STOREYED FRAMES

- Dual System
  - For high-rise buildings
  - Provision of shear walls, cores, braces
  - Sizes of columns are reduced

**WALL SYSTEM**

- With load bearing exterior and interior walls in orthogonal directions
- With load bearing spine walls in the longitudinal direction, and non- load bearing cross partition walls

a) With walls in orthogonal directions      b) With walls along long direction

**ROOF AND FLOOR SYSTEMS**

**ROOF SYSTEMS**

- Slab units on the following, with additional topping
  - Purlins or beams
  - Trusses
  - Arches
- Shell units
- Folded plate units

**ROOF SYSTEMS**

Slab units on beams, School building in Gujarat

Slab units on trussed purlins, Silo at Thoothukudi

Courtesy: L & T

**ROOF SYSTEMS**

Slab units on trusses, Manufacturing factories at Chennai

Courtesy: L & T


**ROOF SYSTEMS**

Slab units on arches, Silo at Jadishpur

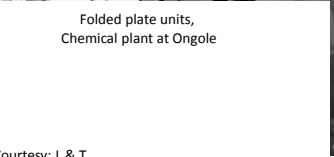
Shell units, Terminal building at Bangalore airport

Courtesy: L & T


**ROOF SYSTEMS**



Folded plate units,  
Laboratory building, Chennai




Folded plate units,  
Chemical plant at Ongole




Courtesy: L & T

**ROOF SYSTEMS**



Shell units,  
Students' Activity Centre, IIT Madras



Shell units,  
Structural Engineering Research Centre

**FLOOR SYSTEMS**

Two types:

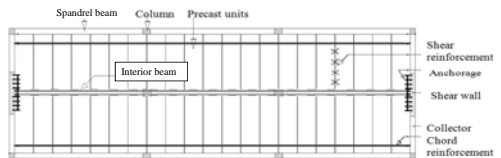
- Made of two-way precast slabs, with emulative connection with the supporting walls
- Made of one-way precast units, spanning between girders or beams.

**FLOOR SYSTEMS**

Components of a floor made of one-way units:

- Untopped or pre-topped floor units
- Spandrels
- Intermediate beams
- Chord, drag (collector) and shear reinforcement
- Topping (optional)

**FLOOR SYSTEMS**







(Topping not shown for clarity)

Jaijith, S., A Study on Flexible Diaphragms made of Precast Hollow-core Slabs, 2013

**COMPONENTS**





**BEAMS**

Choice of Sections

Broad groups of sections				
Applications	Roof purlins and floor joists		Girders to support purlins or secondary beams	
Remarks		Easier form-work removal	Bulbed T-section to accommodate bars	Horizontally un-symmetrical section to increase efficiency


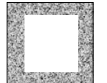


**BEAMS**

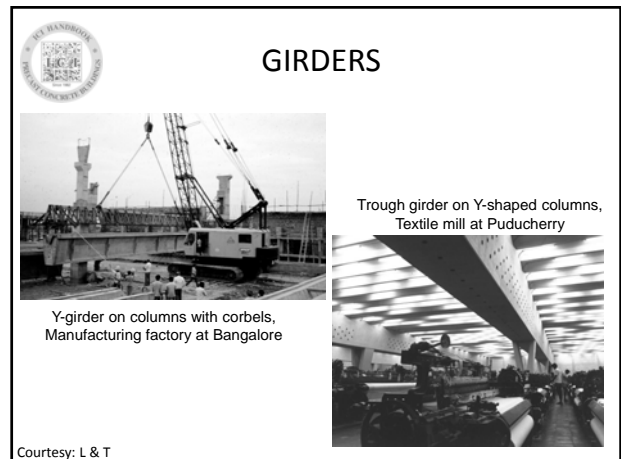
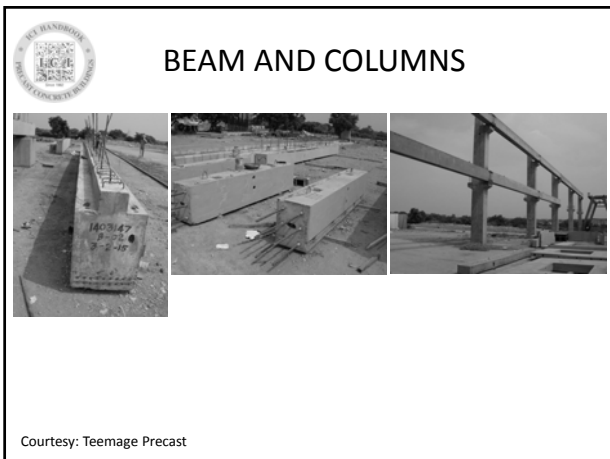
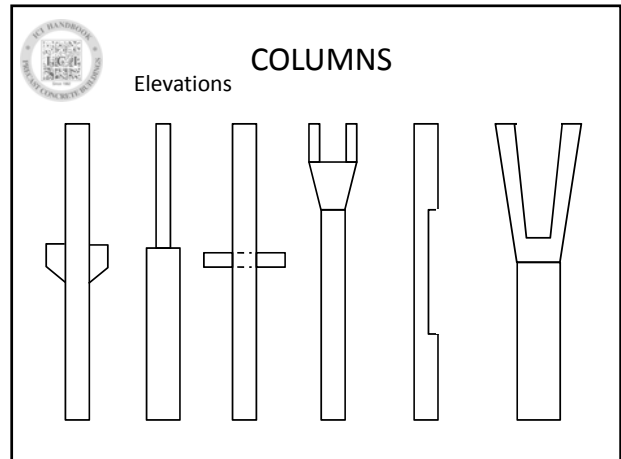
Choice of Sections

Broad groups of sections				
Applications	Spandrels to support floor units	Intermediate girders to support floor units	Spandrels to support double-T units	Intermediate girders to support double-T units
Remarks	Need torsional restraints at the ends		Need torsional restraints at the ends	

**BEAMS**

Choice of Sections

Variations				
Applications	Floor girders with slabs at different levels	Girders with conduits or gutters		
Remarks		High torsional stiffness		




**ROOF UNITS**


- Slab units
- Purlins
- Girders
- Trusses
- Arches
- Shell units
- Folded plate units

**ROOF GIRDERS**

Elevations




a) Saddle Member




b) Member with camber

**ROOF UNITS**




Trusses,  
Godown at Chennai port




Arches,  
Kanteerava Indoor Stadium at Bangalore

Courtesy: L & T

**ROOF UNITS**



Shell units,  
Sai Bhakta Nivas, Puttaparthi



Folded plate unit,  
Manufacturing factory at Bangalore

Courtesy: L & T

**ROOF UNITS**

Comparative statement

TABLE-2 PRECAST TRUSSES				
S.NO	COMPONENT	SPAN IN METRES	JOB AND YEAR OF EXECUTION	REMARKS
1	PRESTRESSED ROOF TRUSS	32.00	PUNJAB UNIVERSITY PATIALA 1968	ROOF TRUSS SUPPORTS PRECAST CONCRETE RIB SLABS 5.5M SPAN
2	PRESTRESSED ROOF TRUSS	28.00	MANGALORE FERTILIZERS 1974	ROOF TRUSS SUPPORTS PRECAST PURLING 5.0M SPAN WITH A.C SHEET ROOF
3	PRESTRESSED ROOF TRUSS	20.00	SPC - TUMICORN 1975	ROOF TRUSS SUPPORTS PRECAST PURLING 5.5M SPAN WITH A.C SHEET ROOF
4	REINFORCED CONCRETE ROOF TRUSS	23.50	ANGLO FRENCH TEXTILES PONDICHERY 1974	ROOF TRUSS SUPPORTS PRECAST PURLING 4.5M SPAN WITH A.C SHEET ROOF AS WELL AS A.C SHEET FALSE CEILING
5	PRESTRESSED ROOF TRUSS	23.00	IFTOD - KANDLA PATIALA 1968	ROOF TRUSS SUPPORTS PRECAST PURLING 6.7M SPAN WITH A.C SHEET ROOF
6	REINFORCED CONCRETE ROOF TRUSS	15.00	MYSORE BREWERIES LIMITED 1973	ROOF TRUSS SUPPORTS PRECAST PURLING 5.0M SPAN WITH A.C SHEET ROOF
7	REINFORCED CONCRETE ROOF TRUSS	16.50	ZURN ACRO CHEMICALS GSA 1971	ROOF TRUSS SUPPORTS PRECAST PURLING 5.5M SPAN WITH A.C SHEET ROOF
8	REINFORCED CONCRETE ROOF TRUSS	17.40	BHEL - TRICH 1975	ROOF TRUSS SUPPORTS PRECAST PURLING 6.0M SPAN WITH A.C SHEET ROOF

**FLOOR UNITS**

- Hollow core units
- Biaxial hollow slabs
- Ribbed slabs
- Single-Tee and double-Tee units
- Waffle units
- Composite slabs



**FLOOR UNITS**

Hollow core slab      Biaxial hollow slab      Ribbed slab

Double-Tee      Waffle      Composite slab

**FLOOR UNITS**

Hollow core slabs

Two-way slab  
Hostel Building, IIT Sri City

Courtesy: Teemage Precast

**FLOOR UNITS**

Ribbed slabs, Sai Bhakta Nivas, Puttaparthi

Hollow core slabs,  
IT Park Canteen building, Pune

Courtesy: L & T

**FLOOR UNITS**

Double Tee units,  
Bharat Forge Research and  
Development Centre, Pune

Double Tee units,  
Schmersal India Production Facility, Pune

Courtesy: Precast India Infrastructures Pvt. Ltd.

**WALL UNITS**

- Load-bearing and non-load-bearing panels
- Load-bearing spandrel units
- Non-load-bearing facade units
- Insulated panels
- Textured panels

**WALL UNITS**

Courtesy: Teemage Precast

**WALL UNITS**

Load bearing panels  
Apartment buildings at Mumbai

Courtesy: L & T

**WALL UNITS**

Facade panels,  
Residential buildings at Jamshedpur

Non- load bearing panels,  
School buildings in Gujarat

Courtesy: L & T

**FACADE UNITS**

Textured panels  
Assembly shop at Bangalore

Textured panels  
Manufacturing plant at Bangalore

Courtesy: L & T

**FACADE UNITS**

Infosys Multi-level Car Parking,  
Pune

Courtesy: Precast India Infrastructures Pvt. Ltd.

**FOUNDATION UNITS**

- Socket (Pocket) units
- Pad and pedestal units
- Piles

Pad and pedestal units  
Courtesy: Teemage Precast

Socket units  
Courtesy: Precast India Infrastructure Pvt. Ltd.

**FOUNDATION UNITS**

- Socket (Pocket) units
- Pad and pedestal units
- Piles


Piles  
Courtesy: Industrial Concrete Products Berhad

Piles  
Courtesy: L & T

**UNITS FOR MISCELLANEOUS APPLICATIONS**

- Service trenches
- Boundary walls
- Stairs
- Grandstand units
- Seating units and risers in auditoriums, stadiums
- Supporting components in industrial structures

**MISCELLANEOUS APPLICATIONS**




Electrical trench units, Bharat Forge Research and Development Centre, Pune

Retaining wall units Schmersal India Production Facility, Pune

Courtesy: Precast India Infrastructures Pvt. Ltd.

**MISCELLANEOUS APPLICATIONS**

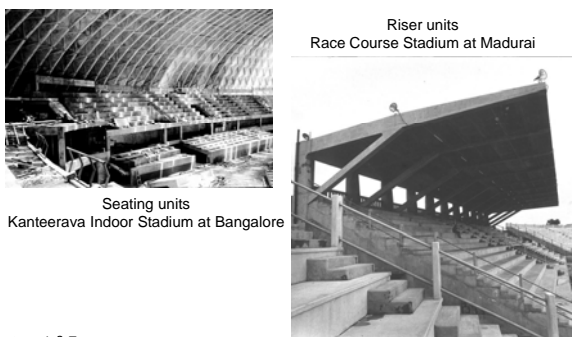


Boundary wall units at IITM extension campus

Stair units

Courtesy: L & T

**MISCELLANEOUS APPLICATIONS**



Seating units Kanteerava Indoor Stadium at Bangalore

Riser units Race Course Stadium at Madurai

Courtesy: L & T

**MISCELLANEOUS APPLICATIONS**



Conveyor housing, Cement factory at Awarpur

Trestles for pipe rack structure, Chemical plant at Chennai

Courtesy: L & T

**SUMMARY**

**SYSTEMS**

- Structural Systems
- Systems for Lateral Stability
- Floor and Roof Systems

**COMPONENTS**

- Beams and Columns
- Roof and Floor units
- Wall units
- Foundation units
- Miscellaneous applications