CONNECTIONS IN PRECAST STRUCTURES

By Dr. K. P. Jaya
Professor
Anna University, Chennai

CSIR - CBRI Roorkee

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Historic representation of Precast in INDIA

IOB Building, Chennai, 1959
Present Day presence of Precast Structure in INDIA

CONSTRUCTION SITE OF SHIRKEY, PUNE
Present Day presence of Precast Structure in INDIA

VIKAS SOUDHA, BANGALORE - B.G.SHIRKE, PUNE
Present Day presence of Precast Structure in INDIA

CHENNAI SILKS, VELACHERY – TEEMAGE, COIMBATORE
PERFORMANCE OF PRECAST STRUCTURES UNDER EARTHQUAKE LOADING
SEISMIC PERFORMANCE

Northridge earthquake - 1994

Precast parking structures
SEISMIC PERFORMANCE

Adana–Ceyhan (Turkey) Earthquake - 1998

Precast Factories
SEISMIC PERFORMANCE

Bhuj Earthquake - 2001

School Building
SEISMIC PERFORMANCE

Baja Earthquake - 2010
OBSERVATIONS

- Structural Elements were intact

- Joints and Connections failed due to inadequate detailing

- This particular aspect attracts the attention of researchers
MAJOR ISSUE

Poor Connections

NEED MORE ATTENTION
CONNECTIONS

- Column - Foundation
- Wall - Foundation
- Beam - Column
- Column - Column
- Beam - Slab
- Wall - Wall
- Stair - Slab
**Mechanical Splices Connection**

- Reinforcing bar
- Non shrink Grout
- Shims
- Anchoring Dowel
- Tolerance block filled with Non-shrink Grout

**In situ Socket Foundation**

- Precast Column Grouted into pocket
- 100 mm
- 1.5 h

**Base Element**
COLUMN TO FOUNDATION

Mechanical Splices Connection
COLUMN TO FOUNDATION

Base Plate Connection

Baseplate equal in size, or less than column size
Alternative Baseplate Detail

Four corner pockets with anchor bars welded to baseplate

Precast Column
Levelling Shim

Nut & Washer in situ concrete or mortar
Tapered Sleeve
Holding-Down Bolt
Holding-Down Plate

In Situ Concrete Foundation

40mm min.
1.5h min.
200mm min.
TYPICAL COLUMN FOUNDATION CONNECTION
Wall Panel to Foundation using screwed anchors
Wall Panel to Foundation Using Couplers
Foam Wall panel to foundation
BEAM – COLUMN CONNECTION

Discontinuous beams need not all be at same level

Continuous column

e.g. Haunch

Discontinuous beams must be at same level

e.g. Billet or welded plate connection

Continuous beams at connection

Discontinuous single storey columns

e.g. Corbel
Connections with dowels

Without Corbel

Connections with Mechanical Couplers
Method: splice the beam bottom bars using anchorages in the joint core

Using hooked bottom bars

Using straight bottom bars
BEAM – COLUMN CONNECTION

With Corbel
BEAM – COLUMN CONNECTION

Details of Interior Joint With Corbel
BEAM – COLUMN CONNECTION

Hybrid / Emulative Connections

Cast – In – situ and corbel Connection

End Connections of Beams to the Corbels
BEAM – COLUMN CONNECTION
BEAM – COLUMN CONNECTION

Hybrid Connections

Plan view of the end connection

Cross section of columns

Sectional view of interior connection

Courtesy: B.G Shirke
BEAM – COLUMN CONNECTION

Hybrid Connections

Longitudinal View

Courtesy: B.G Shirke
BEAM – COLUMN CONNECTION

Hybrid Connections – with Shell Beams
BEAM – COLUMN CONNECTION

Hybrid Connections – with Shell Beams
BEAM – COLUMN CONNECTION

Mechanical Connections
TYPICAL BEAM – COLUMN CONNECTION

Mechanical Connection
Billet Connection
BEAM – COLUMN CONNECTION

Design Aspects

Transfer zones
BEAM – COLUMN CONNECTION

Design Aspects
COLUMN – COLUMN CONNECTION

SPLICE SLEEVE
COLUMN – COLUMN CONNECTION
COLUMN – COLUMN CONNECTION

BOLTED CONNECTIONS

Shims

Before Assembly

Assembled

Grouted

The entire joint is dry-packed with grout after alignment.
SLAB – WALL CONNECTION

- 160 THK. PRECAST WALL
- OVAL CORRUGATED SLEEVES
- PROJECTING BAR
- NON SHRINK NON METALIC GROUT TO BE FILLED
- CAST IN SITU
- PRECAST SLAB
- TEMPORARY SHORING WITH CONTINUOUS RUNNER THROUGHOUT
- 160 THK. PRECAST WALL
- 25 BEARING
SLAB – WALL CONNECTION

160MM THK. PRECAST WALL
CORRUGATED SLEEVES
PROJECTING BAR
NON SHRINK NON METALIC HIGH STRENGTH GROUT TO BE FILLED

TOC

PRECAST SLAB
TEMPORARY SHORING WITH CONTINUOUS RUNNER THROUGHOUT

160 THK. PRECAST WALL

NON SHRINK NON METALIC HIGH STRENGTH GROUT
BACKER ROD
CEMENTITIOUS WATERPROOFING MEMBRANE

PRECAST WALL
PRECAST SLAB
SLAB – WALL CONNECTION

- Corrugated Dowel Tube
- Dowel Bar Projecting From Below Wall
- Cast in Place Concrete
- Dry Pack Mortar
- Precast Plank Thickness
- Precast Wall
- Precast Solid Slab
- Min. Slab Bearing

Joint filling:
- Bar BST 500 S diam. 12 mm
- HLBC Mix

The joint must be completely filled with mortar.
SLAB – BEAM CONNECTION
SLAB – BEAM CONNECTION

Use of Rebars

[Diagram showing the connection of a precast beam with upper slab reinforcement and connection rebar.]
SLAB – BEAM CONNECTION
SLAB – BEAM CONNECTION
WALL – WALL CONNECTION
WALL – WALL CONNECTION

OUTSIDE FACE

Gap Between Grooves to be left without any Grouting

INSIDE FACE

DETAIL - B
WALL – WALL CONNECTION
WALL – WALL CONNECTION

[Diagram showing a wall connection with labels for dimensions and components such as 'Slug', 'Weld to Embed Plate', 'Embed Plate', '100 mm', '12.5', 'Z-Axis Out of Paper']

[Image of a real wall showing the wall connection]
STAIRCASE TO SLABS
STAIRCASE TO SLABS
STAIRCASE TO SLABS

Section A

Applied finish to landing

Applied finish to landing

PC Landing

PC Landing

Bison support angle

Wall bearings
Primary Inserts

Loop-Type Wire Inserts
Primary Inserts

The Open Wire Inserts use one of the receptacles

Open Wire Inserts

Standard Coil  Tapped Coil  Weld Nut (Ferrule)

Receptacles for Wire Inserts
INSERTS

Secondary Inserts

Used for Handling Purpose
INSERTS

Edge lifting connectors

Panel Lifting
Lifting loops

Lift up Links
CONNECTING SHOES

Column Shoes

Beam Shoes

Wall Shoes
RESEARCH IN PROGRESS
AT
ANNA UNIVERSITY
Precast Connection: Beam To Column Connection

J-bolt (PC-JB)

R. Vidjeapriya
Precast Connection: Beam To Column Connection

Tie Rod (PC-TR)

R. Vidjeapriya
Precast Connection: Beam To Column Connection

Cleat Angle (PC-CL)  R.Vidjeapriya
Precast Connection: Beam To Column Connection

Cleat Angle with Single Stiffener (PC-SS)

R. Vidjepriya
Precast Connection: Beam To Column Connection

Cleat Angle with Double Stiffener (PC-DS)

R. Vidjeapriya
Precast Connection: Beam To Column Connection

Dowel and Cleat Angle (PC-DWCL)

R. Vidjeapriya
Experimental Investigation

R. Vidjeapriya
Analytical Investigation
CURRENT PROJECTS

- Beam – Column Hybrid Connections - Ms. Rajeswari
- Column – Foundation Connections - Ms. Hemamathi
- Shear Wall – Slab Connections - Ms. Arthi
- Wall Panel Connections - Mr. Joyson
THANK YOU