

PRECAST CONSTRUCTION JOINTS AND CONNECTIONS

Prof C B K Rao

National Institute of Technology , Warangal

raocbk@nitw.ac.in



G + 10 structure at Hyderabad



Main structural **difference between cast *insitu* and precast structures** lies in their **structural continuity**.

For cast *insitu* buildings-

Inherent continuity is an automatic consequence of the construction process.

For precast structures –

Ensure structural continuity when precast elements are connected.

Joint and Connection

Joint

- A joint is a **meeting point** of members of structure

Connection

- A connection is an **assembly** of the adjoining members of a joint
- Action of forces takes place at a joint and Connection to be designed to resist the action of forces

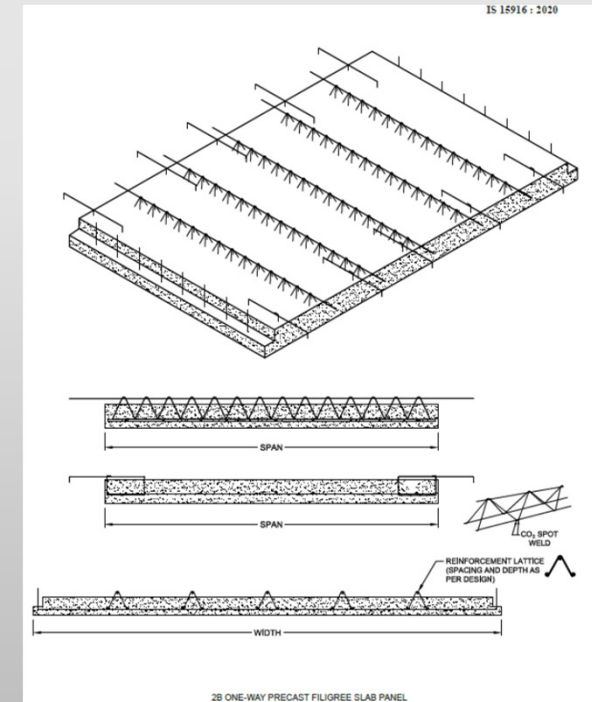
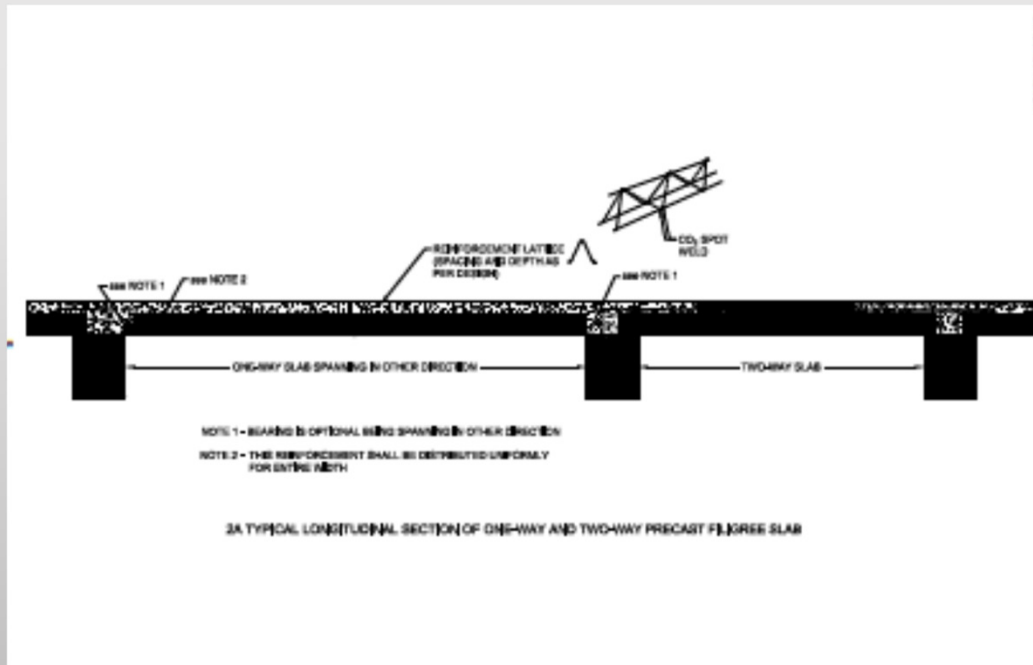
8.1.1 Precast structures could be analyzed either as an emulative systems or as a jointed system. However, emulative analysis is typically preferred where the structure is detailed such that the overall behaviour of the building in its service life will be similar to a reinforced cement concrete building constructed *in-situ*.

Requirements for connections

- **Strength**: connection must resist the forces to which is subjected during its lifetime. Forces such as those caused by dead and live gravity loads, wind, earth and water pressure etc.
- **Ductility** : the ability of the connection to undergo large deformations without failure.
- **Change in volume** :combined shortening due to creep, shrinkage and temperature reductions induces tensile stresses in precast components.
- **Durability** : an exposed section in a connection should be periodically inspected and maintained
- **Fire resistance** :connections which may be weakened by exposure to fire should be protected by concrete or grout or enclosed or sprayed with fire resistance materials.

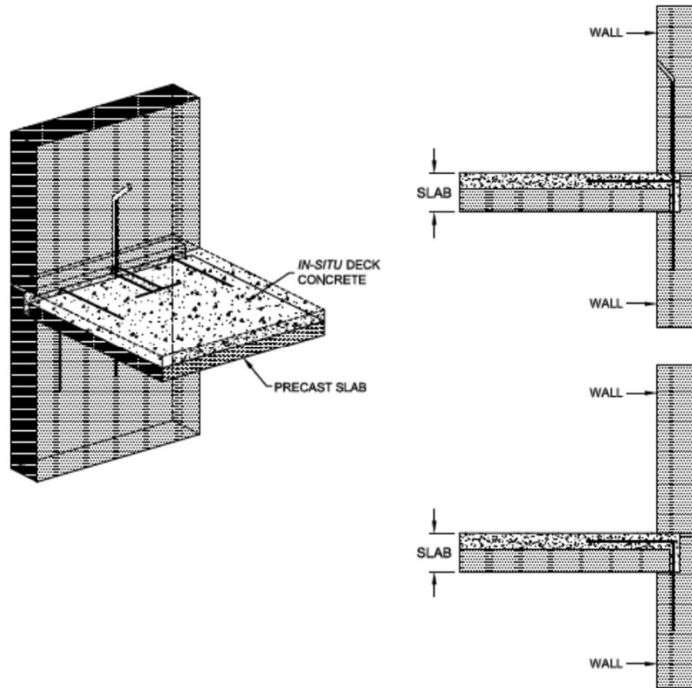
IS 15916 : 2020

Building Design and Erection Using Prefabricated Concrete — Code of Practice

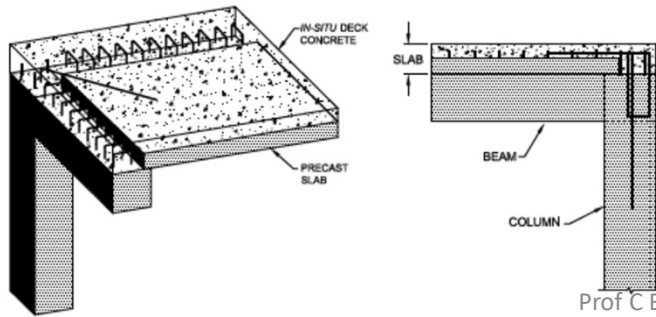


Connections and Jointing Techniques / Materials (IS : 15916-2020 , C1 - 9)

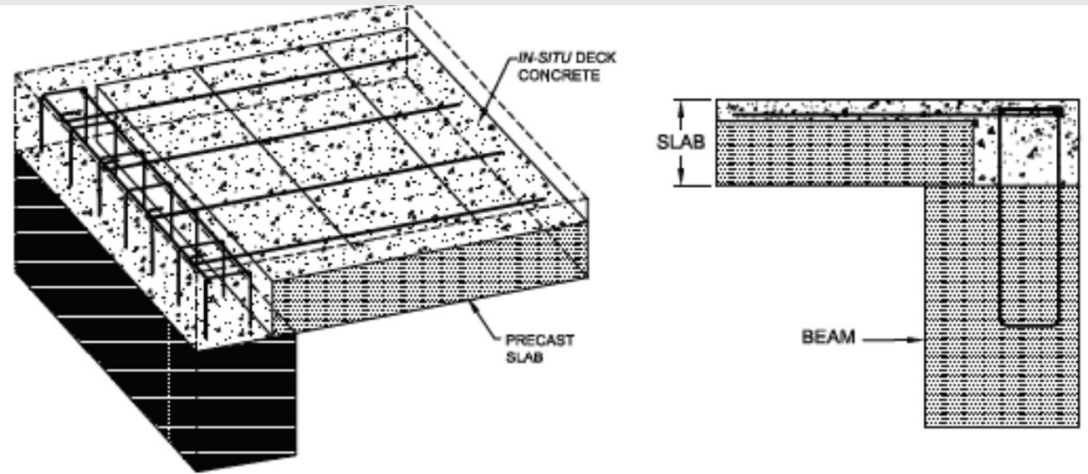
- a) Welding of cleats or projecting steel;
- b) Overlapping reinforcement, loops and linking steel grouted by concrete;
- c) Reinforced concrete ties all around a slab;
- d) Pre-stressing;
- e) Epoxy grouting;
- f) Cement/lime grout with non-shrink additive;
- g) Polymer slurry grouting at dowel cast bolts and nuts connection;
- h) Rebar fastener, chemical fastener and expansion fastener; Rebar coupler
- k) Combination of the above; and
- m) **Any other method proven by test**



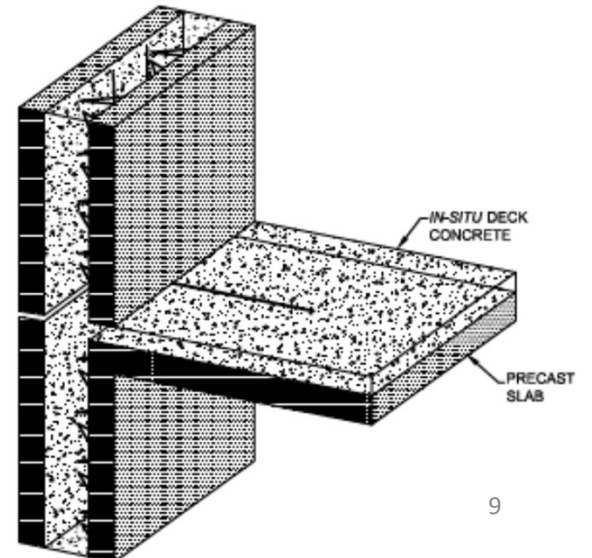
6B PRECAST WALL TO WALL CONNECTION WITH SHEATHING PIPE

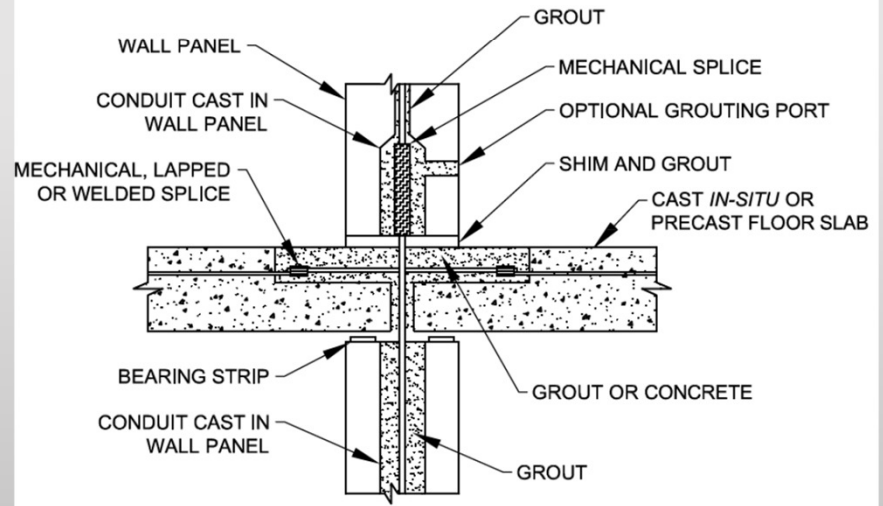
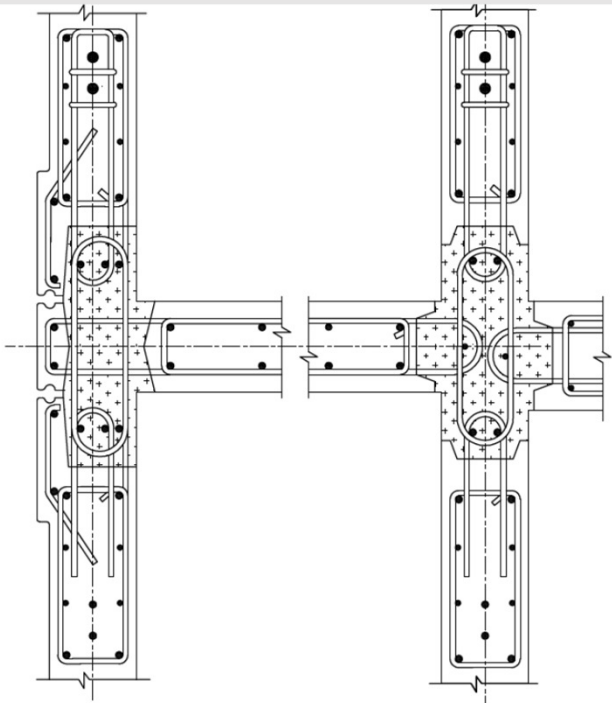
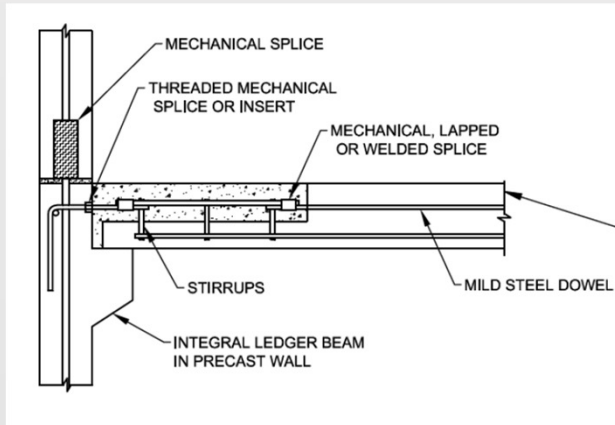
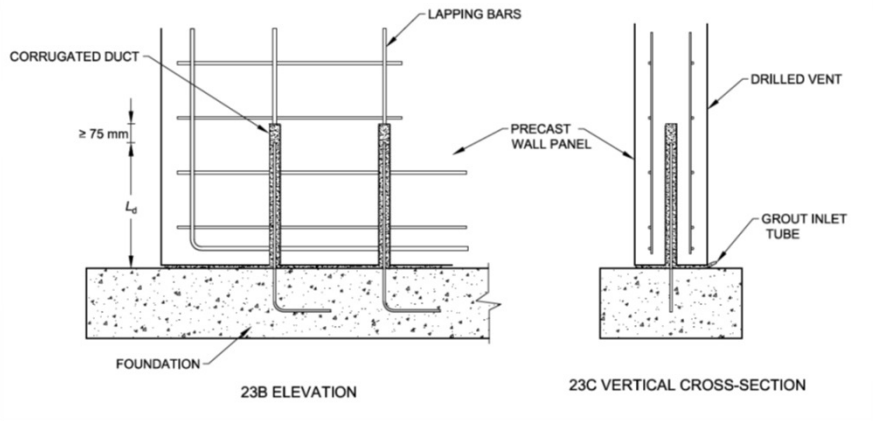


6C PRECAST COLUMN, BEAM AND SLAB CONNECTION



6E PRECAST BEAM SLAB CONNECTION





Different Types of Connections

- Column to foundation
- Wall to foundation
- Wall to wall
- Wall to column
- Wall to beam
- Column to column
- Beam to column
- Beam to slab
- Wall to slab
- Stairs to wall
- when the standard solutions do not fit, and to develop innovative solutions, the designer must be prepared to work with connections in a more creative way.

Types of joints

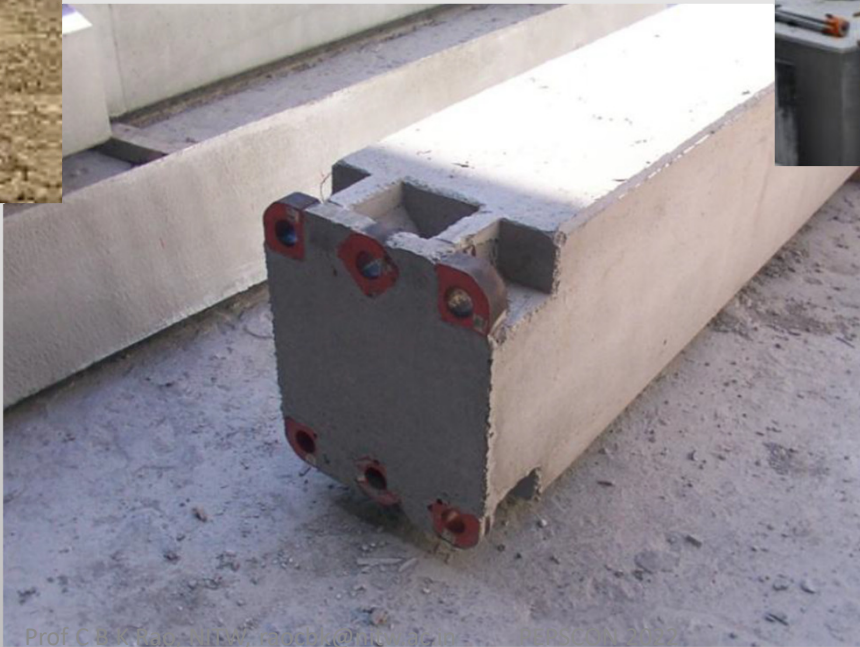
- **Dry joint:** Joint accomplished by simple placing of two members by means of fastening.
- **Wet joint:** Joint requires not only casting with cement but also concreting and grouting material.

COLUMN TO FOUNDATION



Column-to-pocket foundation

BOLTED CONNECTIONS



WALL PANEL TO FOUNDATION



2019/3/15 17:33

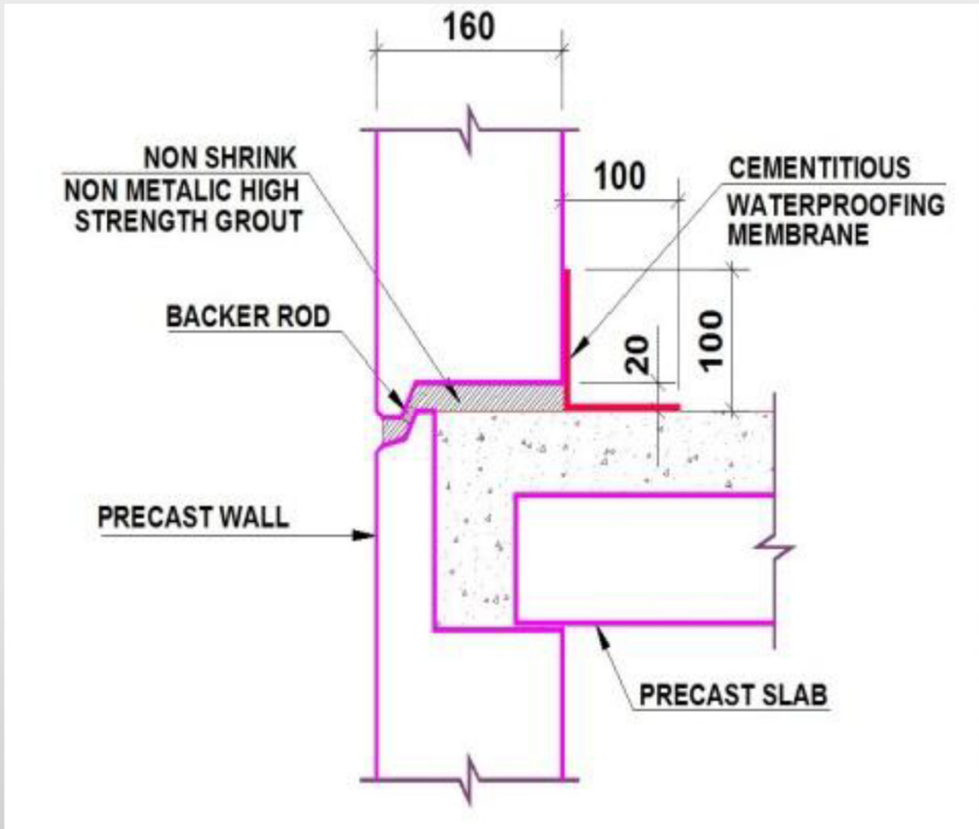
WALL PANEL TO FOUNDATION



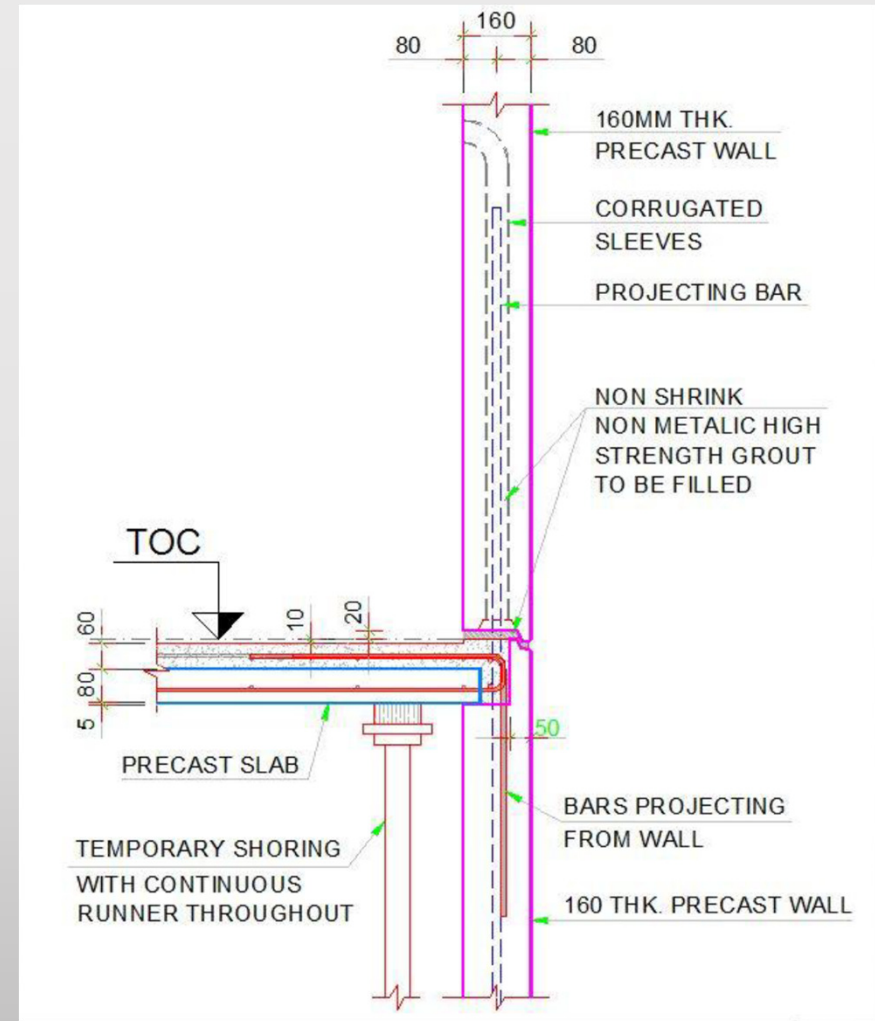
WALL PANEL TO FOUNDATION



SLAB – WALL CONNECTION



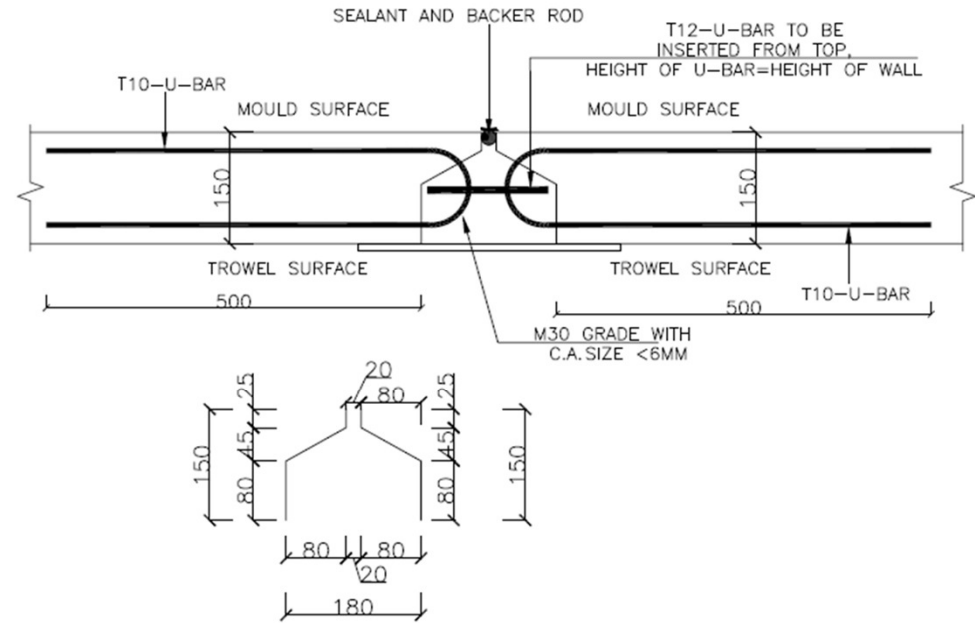
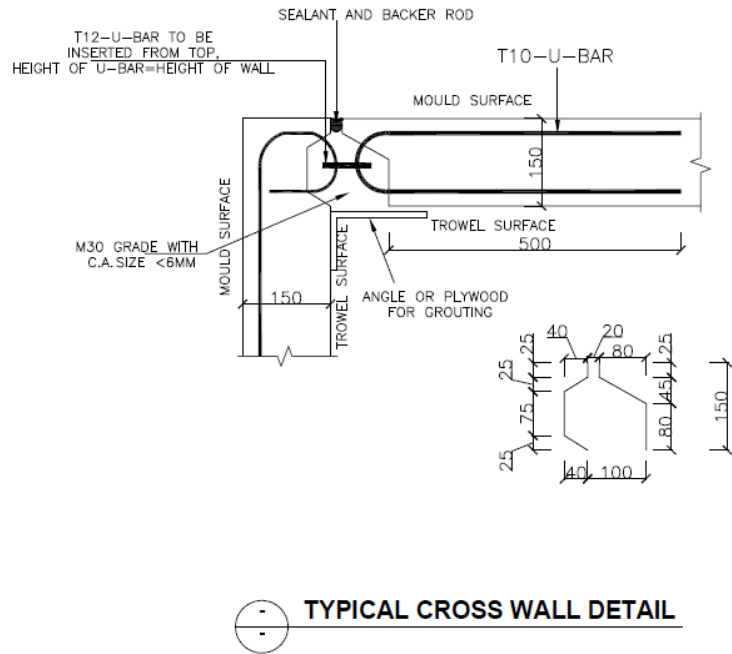
SLAB – WALL CONNECTION





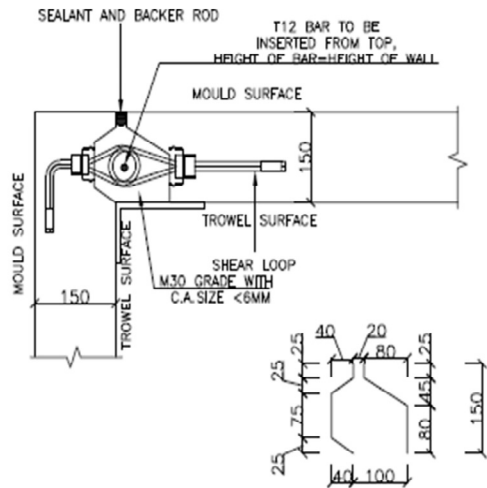
PRECAST WALL CONNECTION DETAILS

TYPICAL WALL JUNCTION DETAILS- Monolithic / Rigid Connections

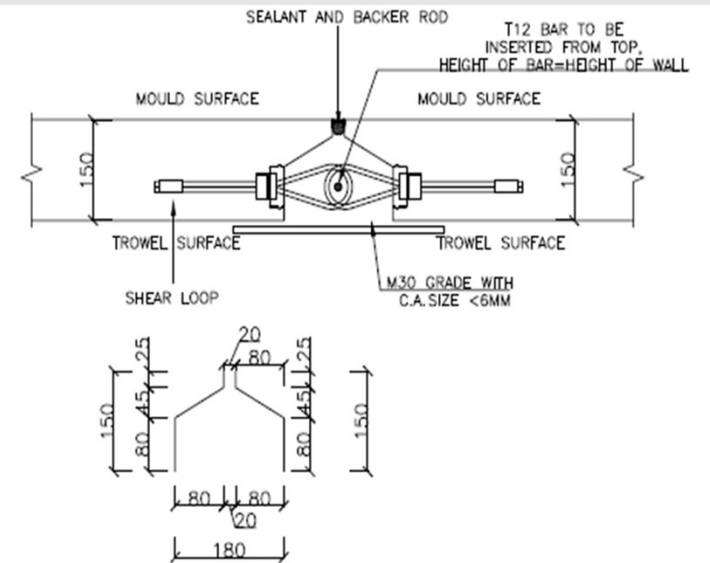
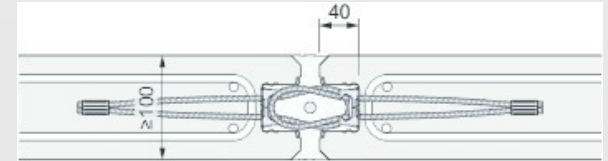




TYPICAL WALL JUNCTION DETAILS



TYPICAL CROSS WALL DETAIL(SHEAR LOOP)



TYPICAL PARALLEL WALL DETAIL(SHEAR LOOP)



B. K. Rao, M.T.W., retd. IAS (Retd.)



Prof C B K Rao, NITW, raocbk@nitw.ac.in

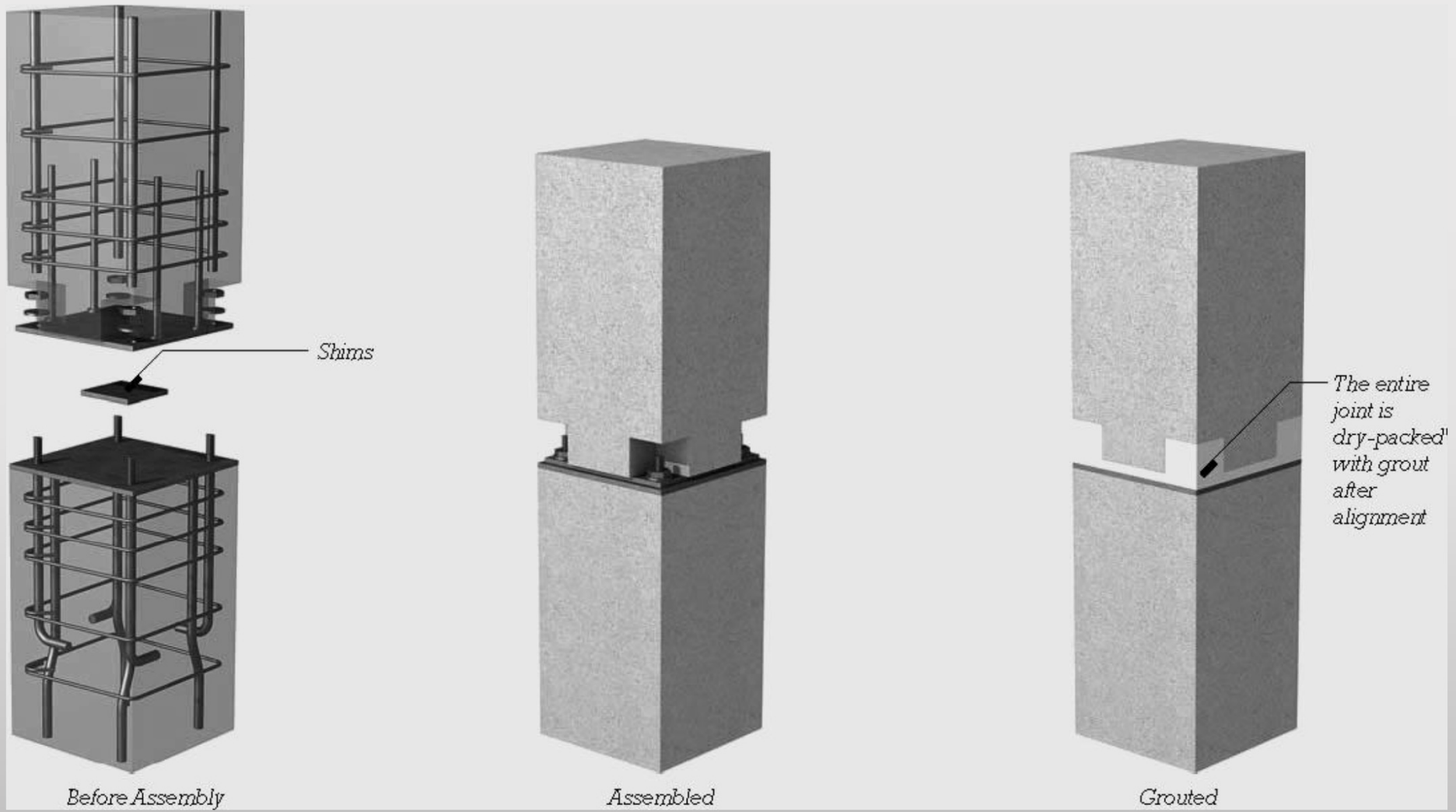


PEPSCON 2022

Wall Systems



COLUMN – COLUMN CONNECTION

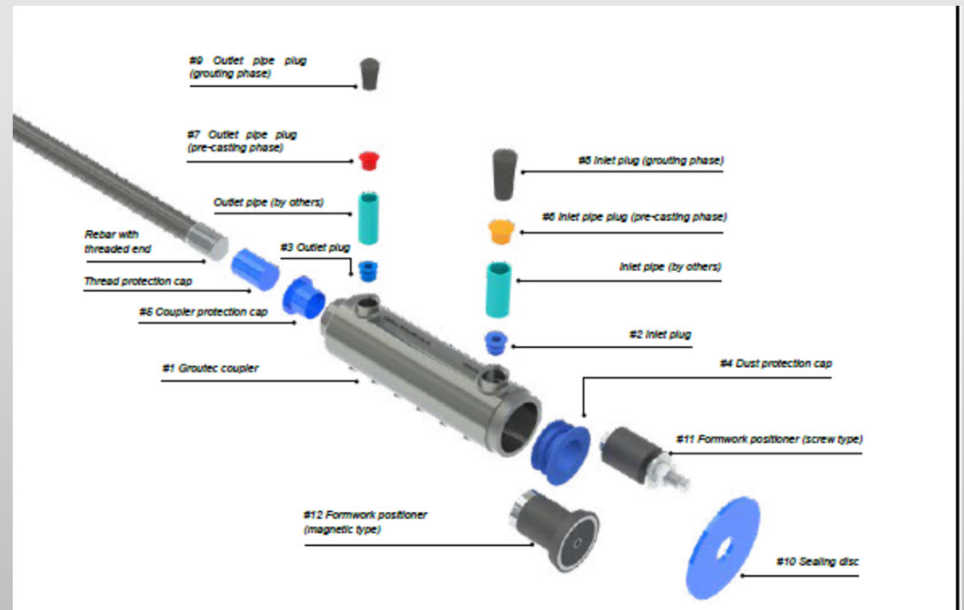
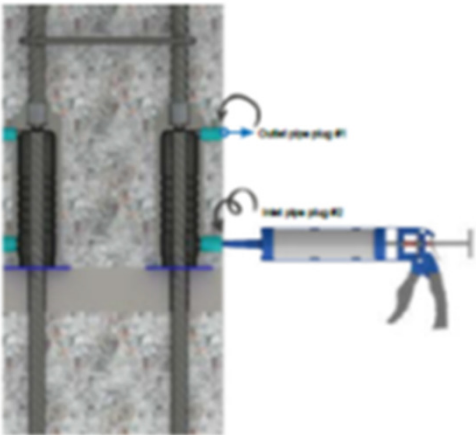


COLUMN – COLUMN CONNECTION

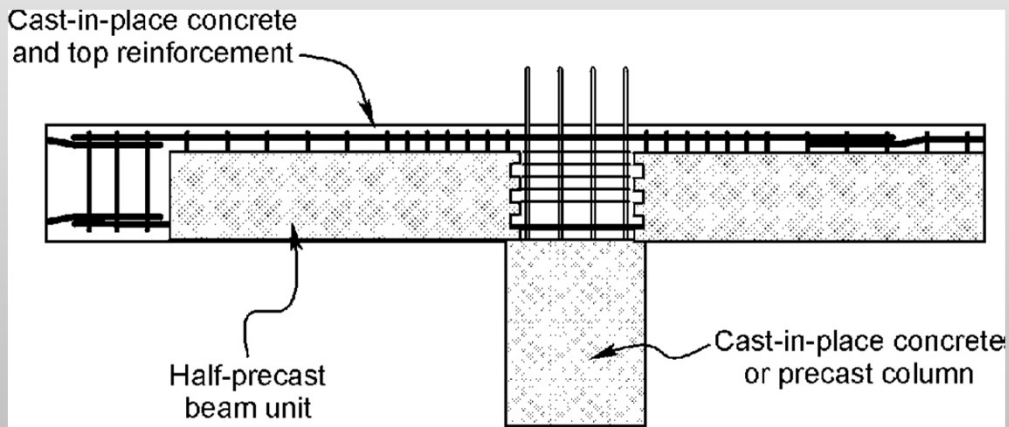
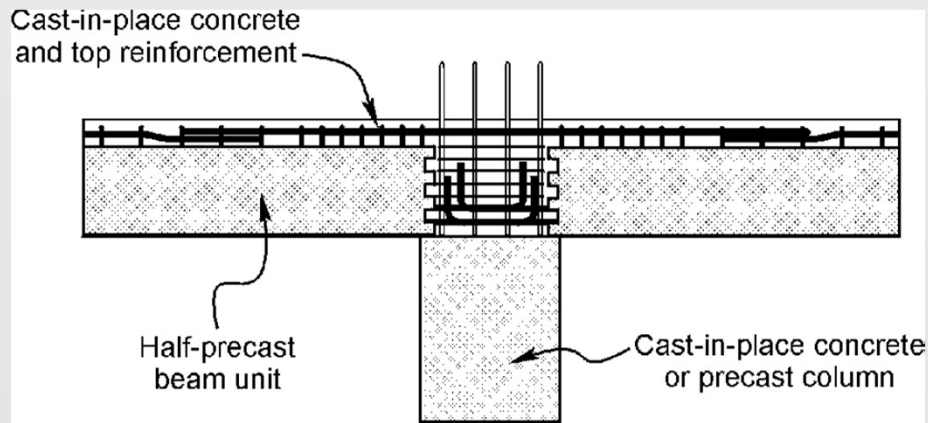




2. Inject the cement grout by pump through the bottom hole (Inlet).
3. If the cement grout flows out from the top hole (Outlet), the inside of the coupler is completely filled.
4. Tightly close the top hole (Outlet) with a pipe plug. Then inject more grout during approx. 3 seconds. After that remove the injection valve and quickly close the bottom hole (Inlet).

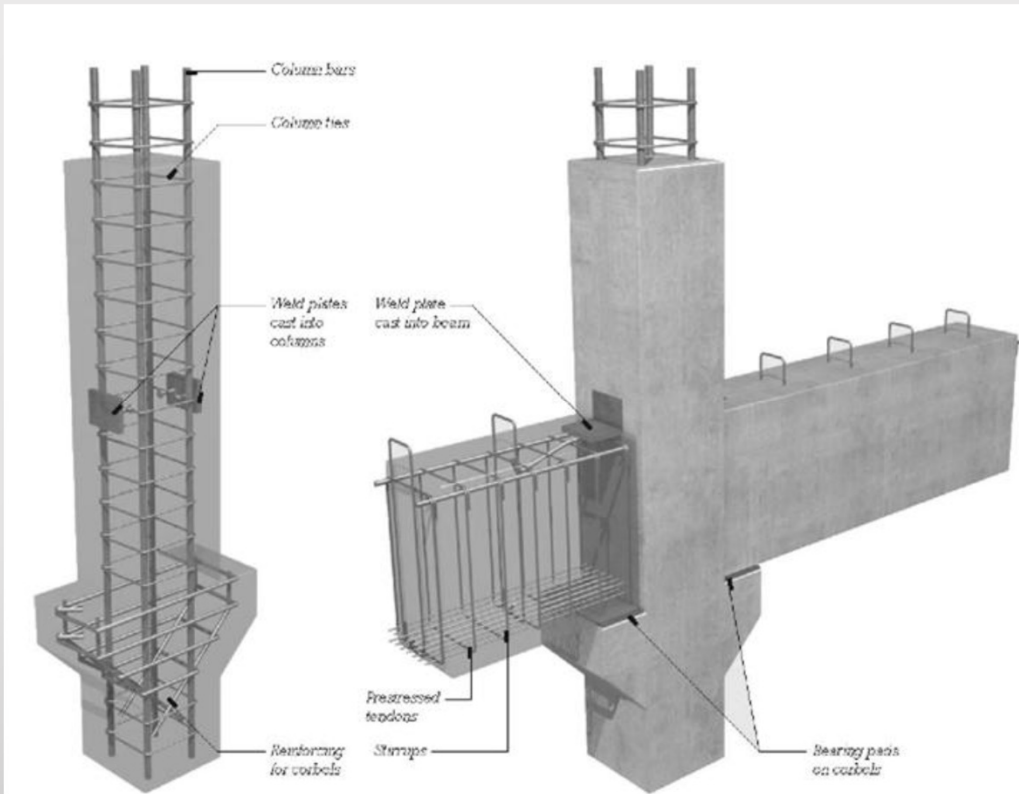


BEAM – COLUMN CONNECTION



BEAM – COLUMN CONNECTION







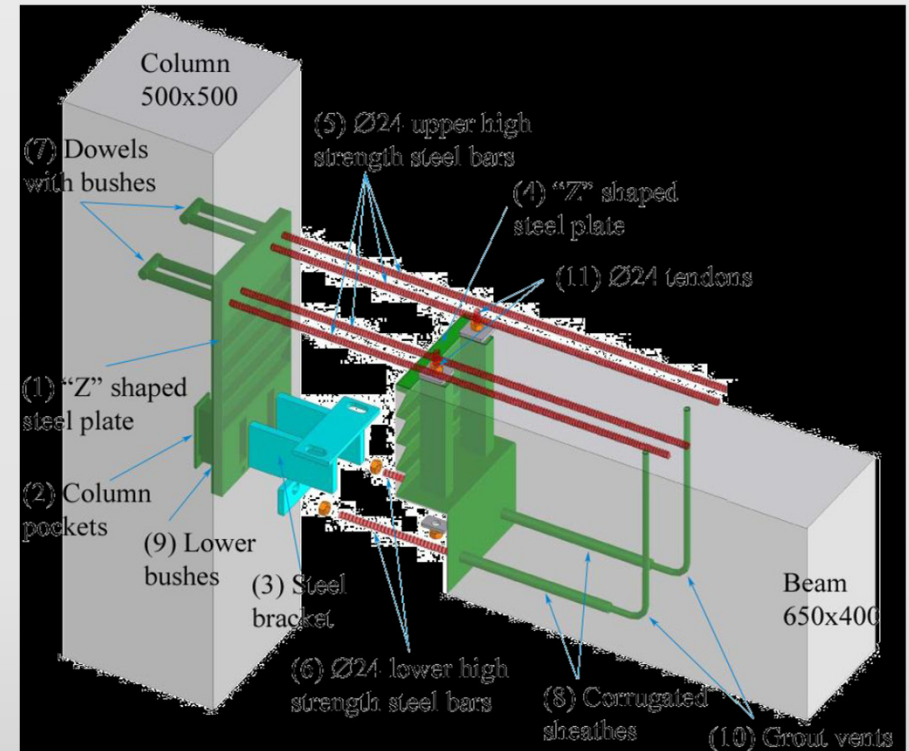
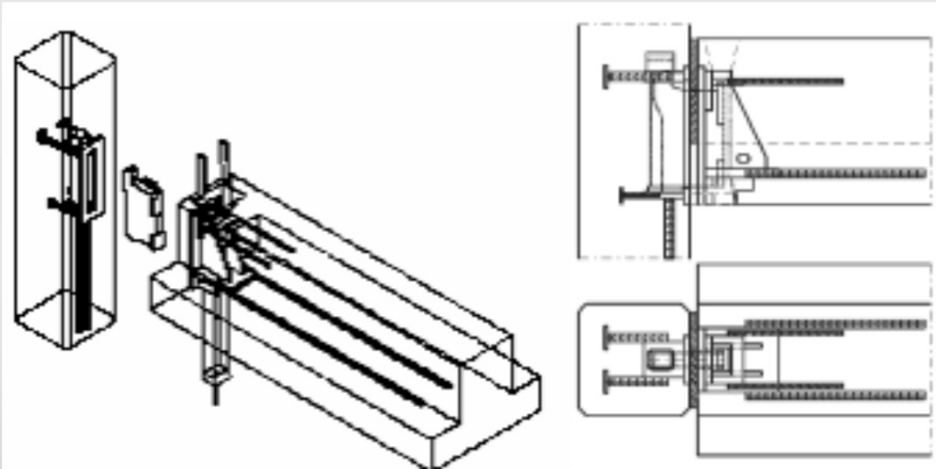






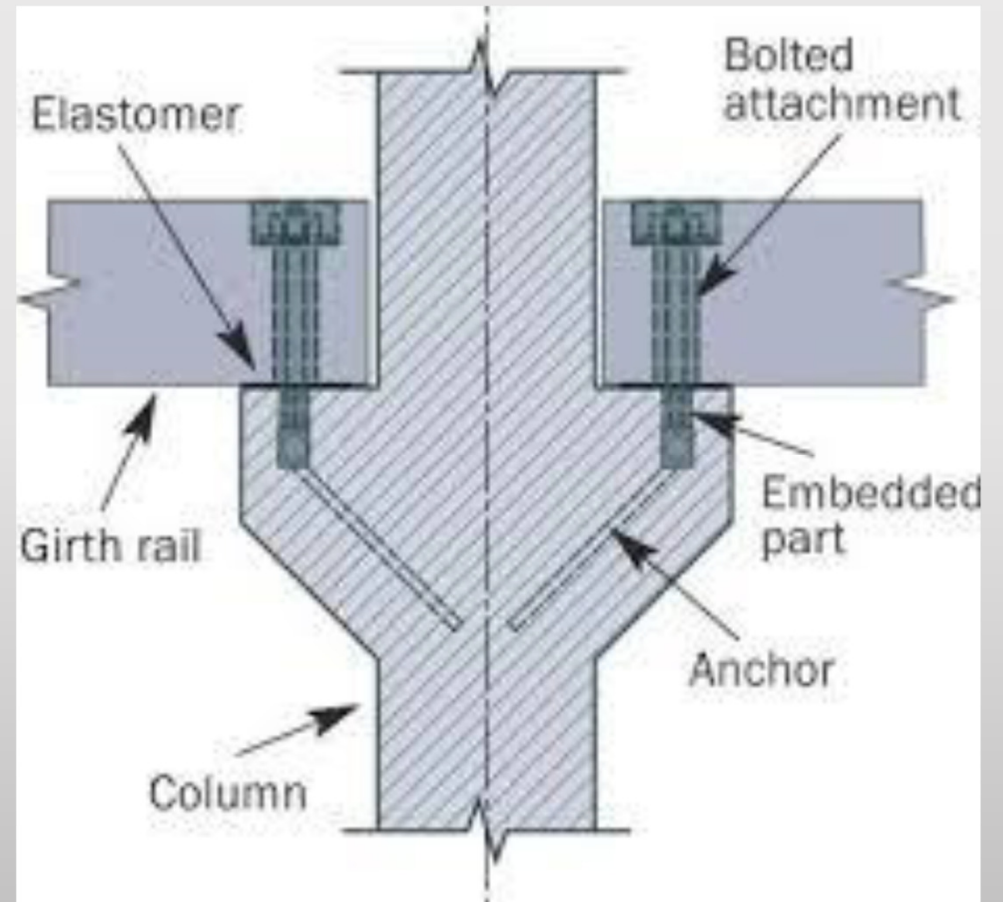
Prof. C. B. ... cb@mitw...

Mechanical Connections



Dry Joint

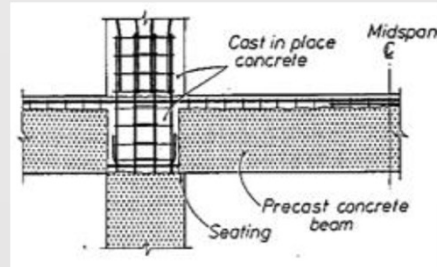
Edilmatic system components for typical beam-column joints in precast reinforced concrete structures



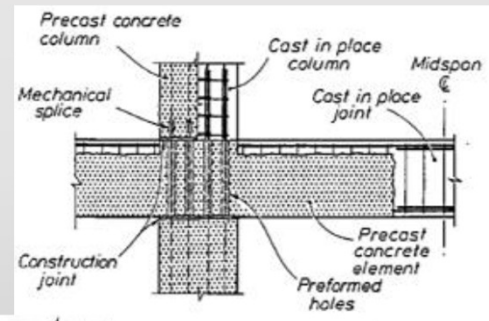


Hybrid Connections – with Shell Beams

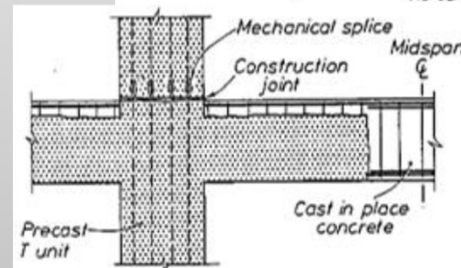
Frame Connections



precast beam units
between column



precast beam units
through columns



precast T or cruciform units

Beam-to-Beam Connection of Precast Concrete Structures: State of the Art , Kristiyanto Hery^{1,2,*}, Triwiyono Andreas², Muslikh², and Saputra Ashar² ,
<https://doi.org/10.1051/mateconf/201922585804002>



SLAB – BEAM / WALL CONNECTION

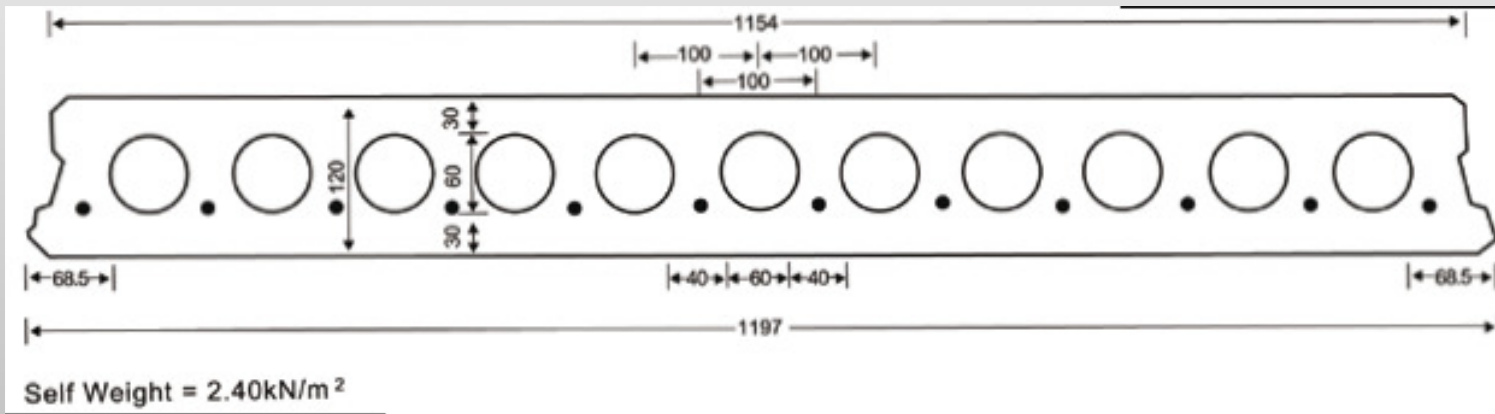
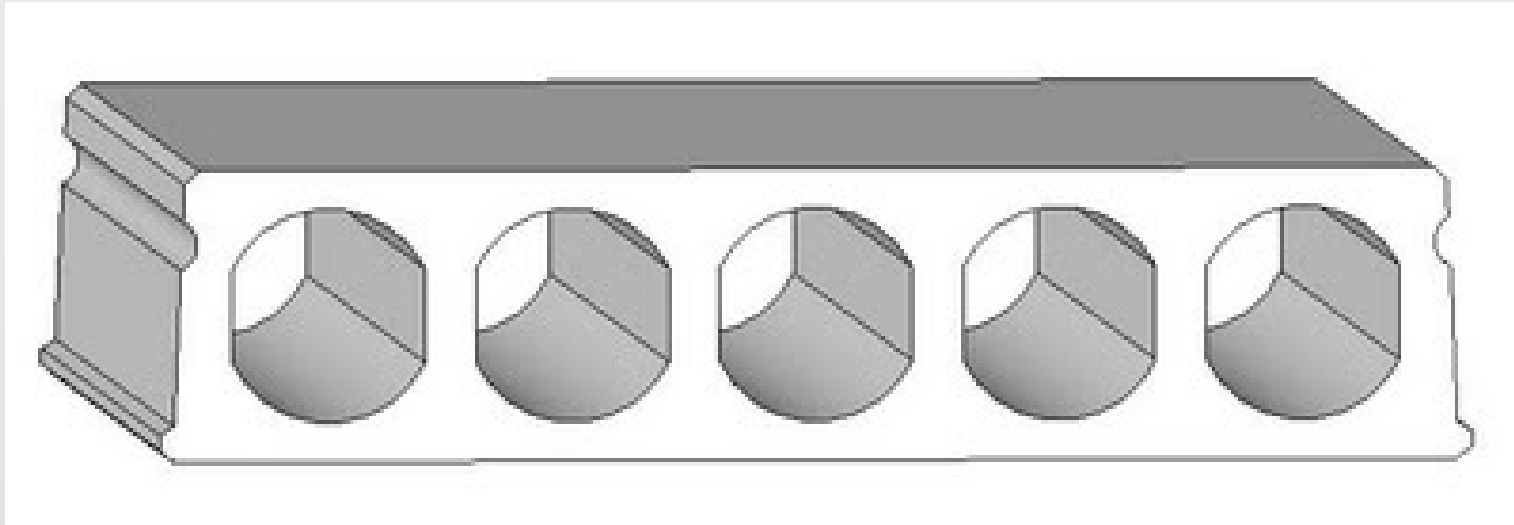
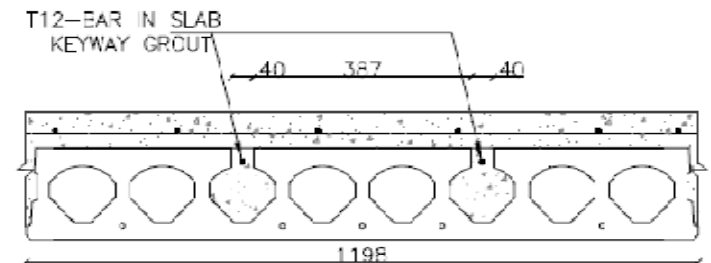
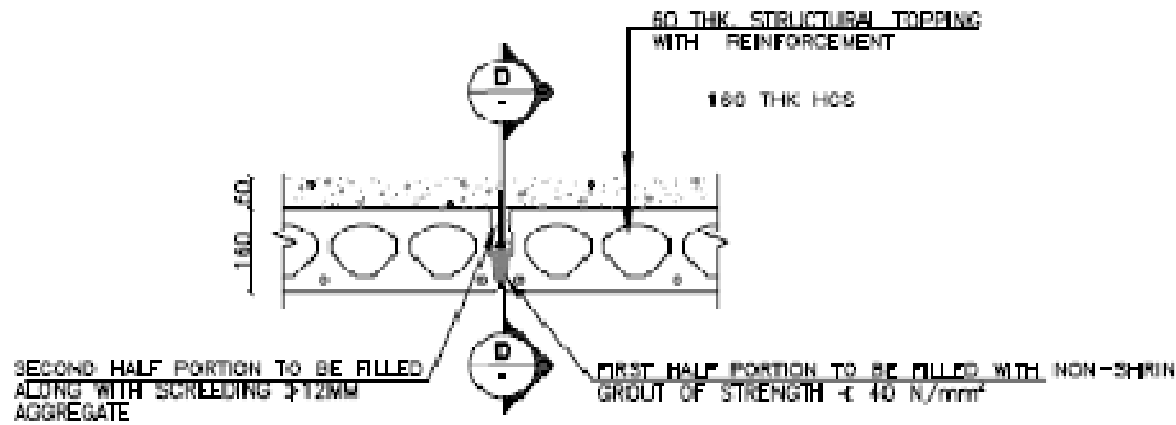




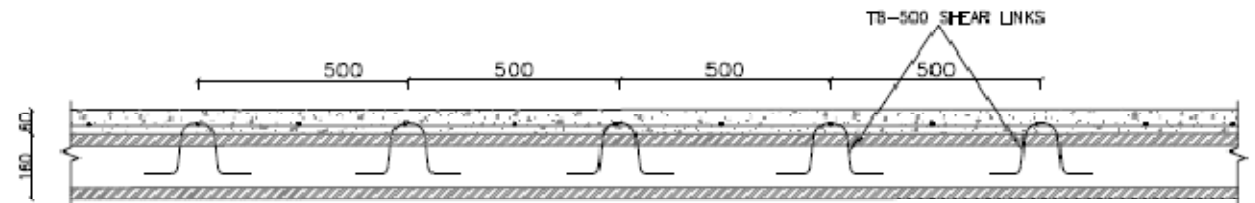
image courtesy of SPC Industries

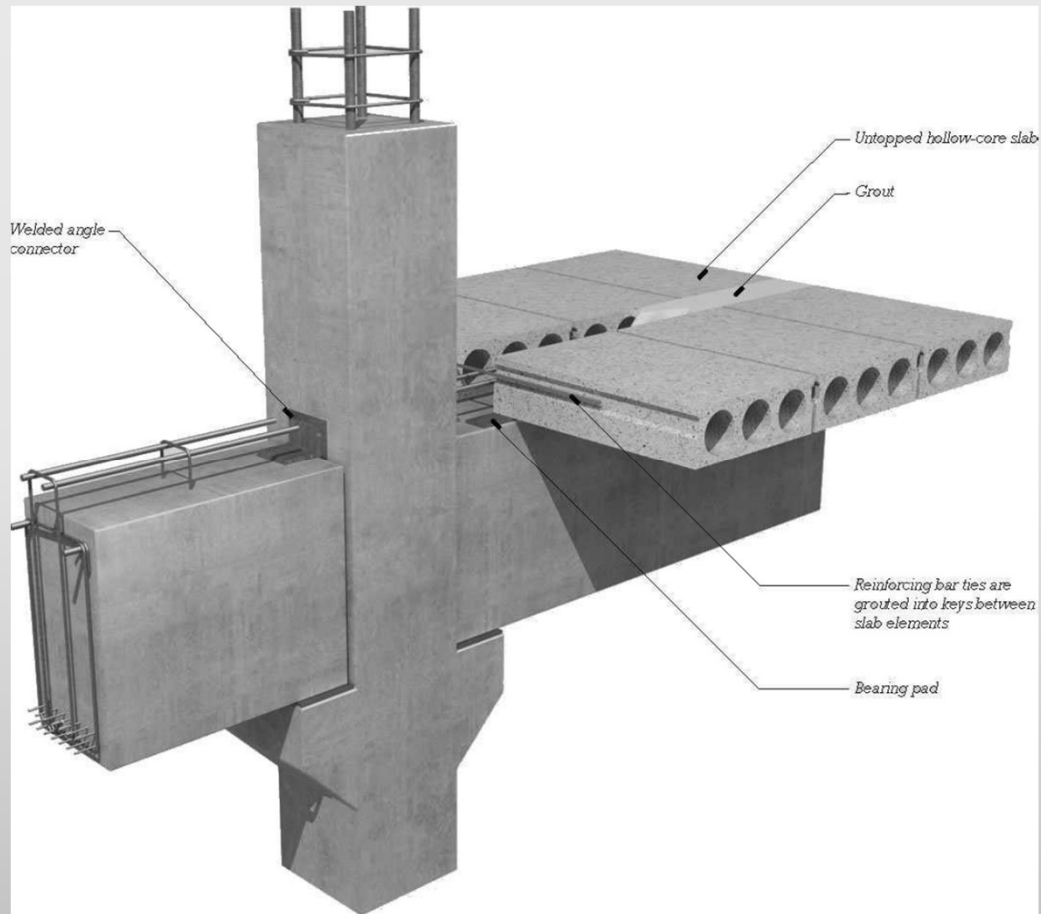


TYPICAL HCS SECTIONAL DETAILS

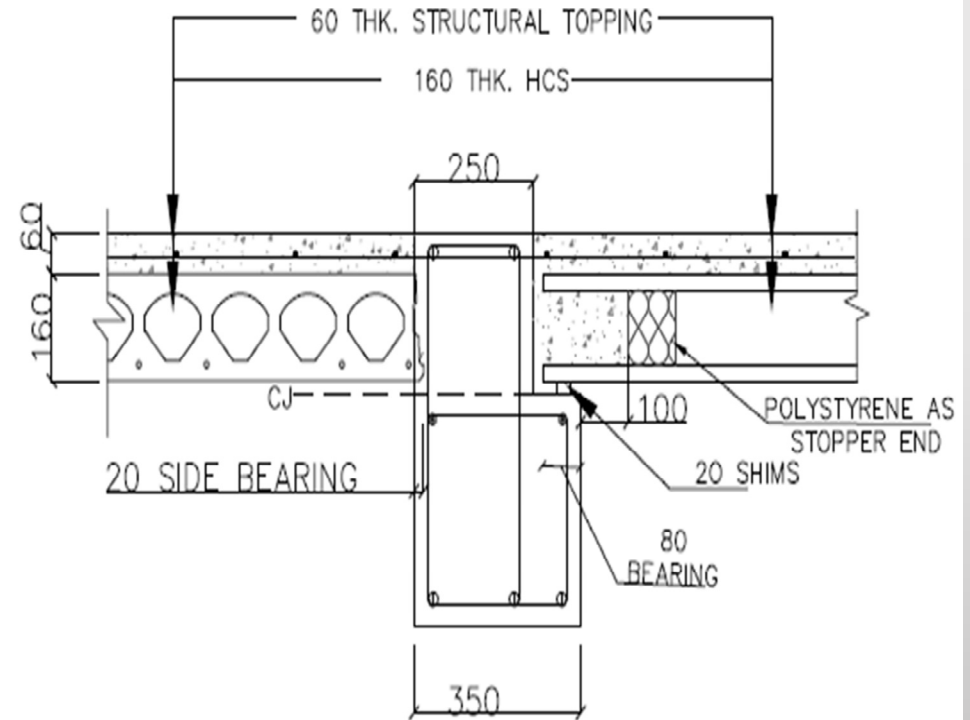
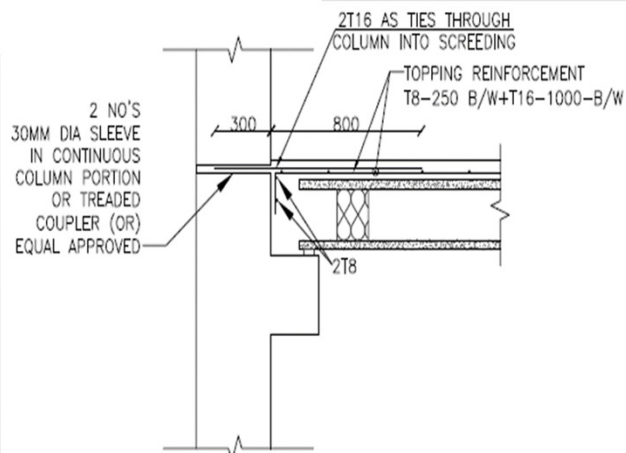
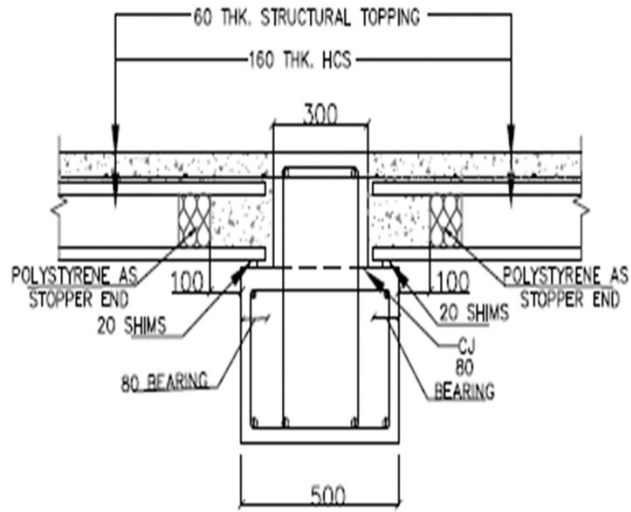


TYPICAL SHEAR LINK DETAIL AT JUNCTIONS OF HCS





TYPICAL HCS SECTIONAL DETAILS



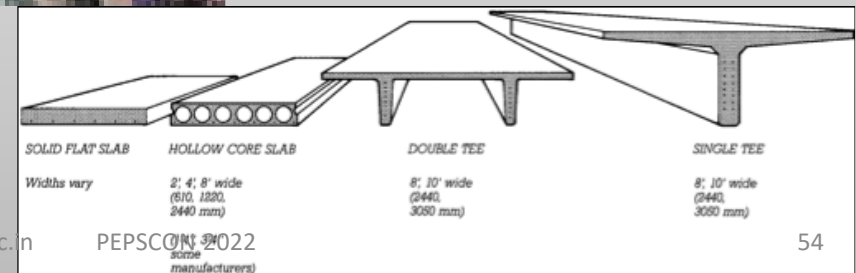








Double Tee slab



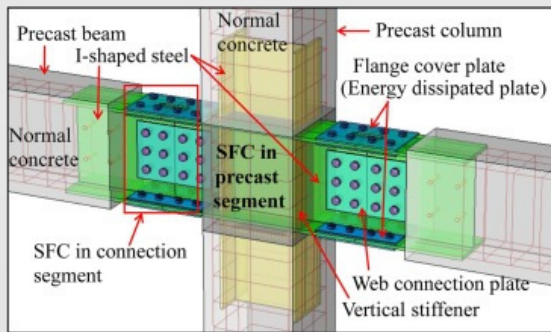


Staircase

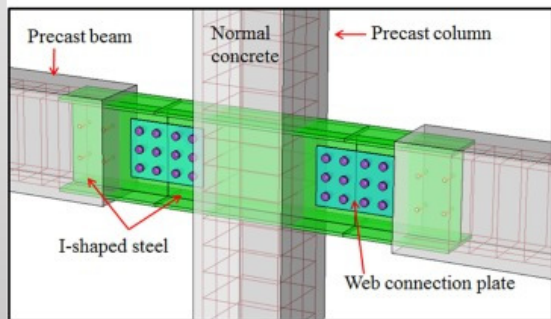




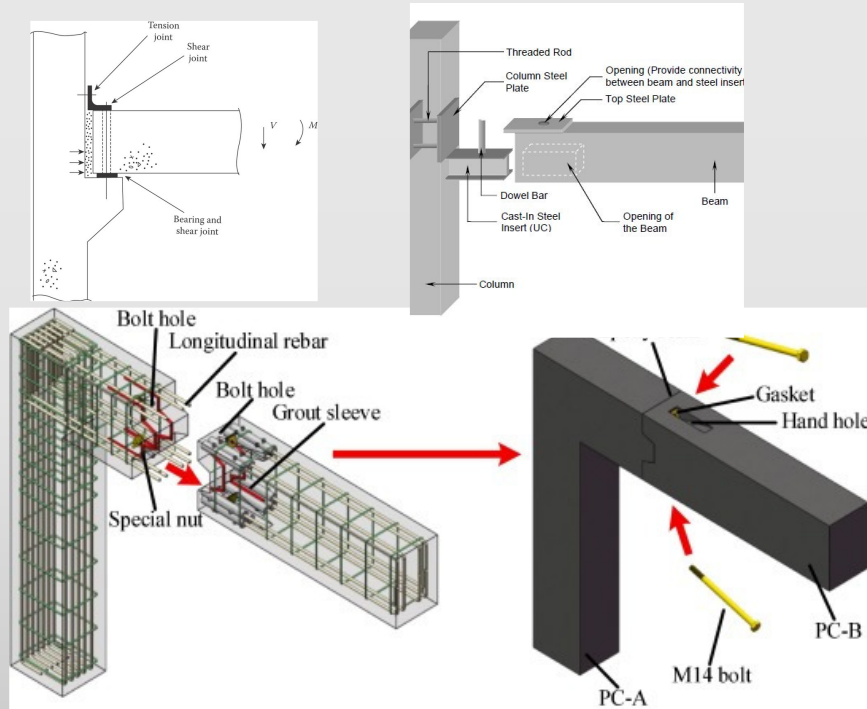
Some Innovations in Jointing/ Connection Systems



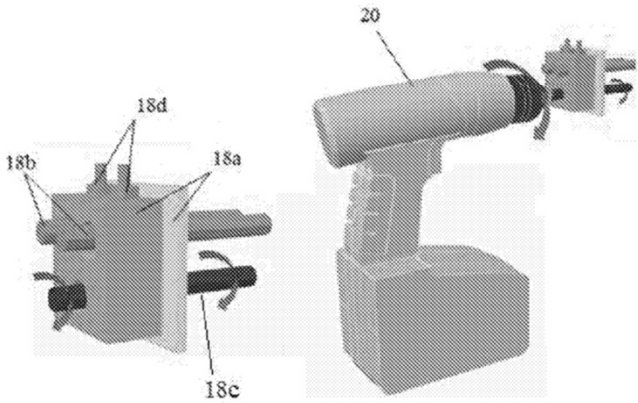
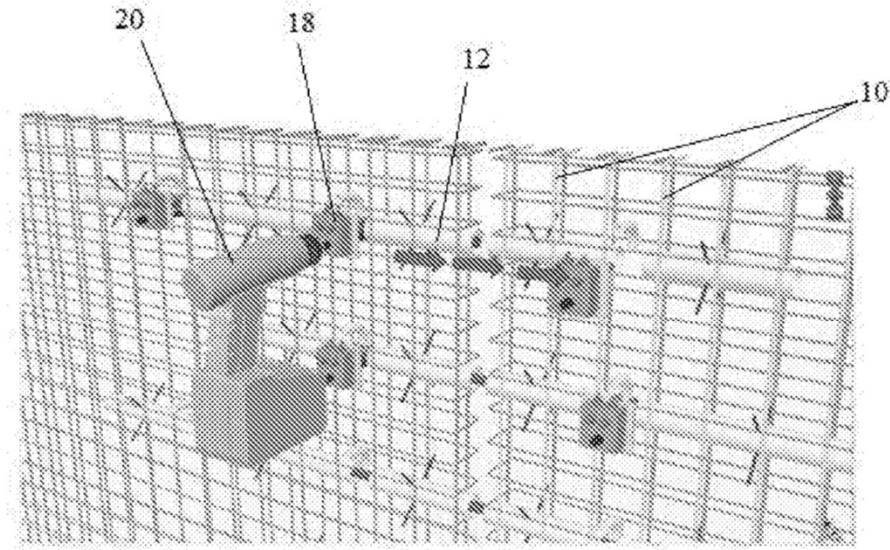
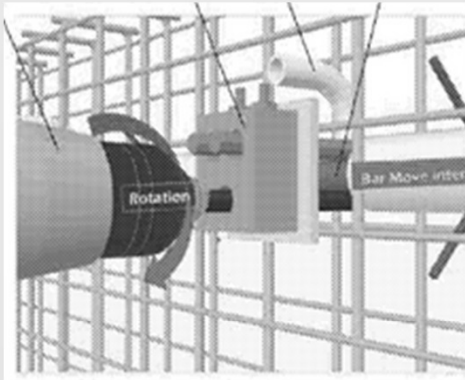
(a)



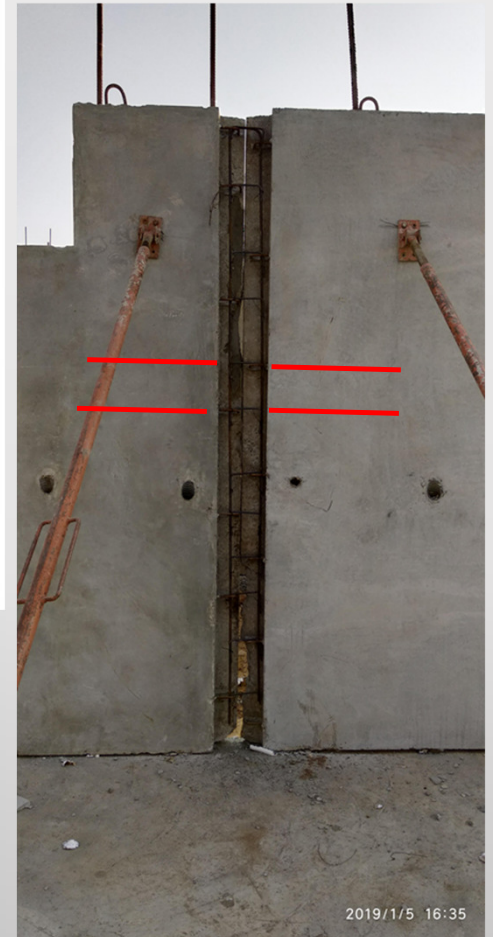
(b)

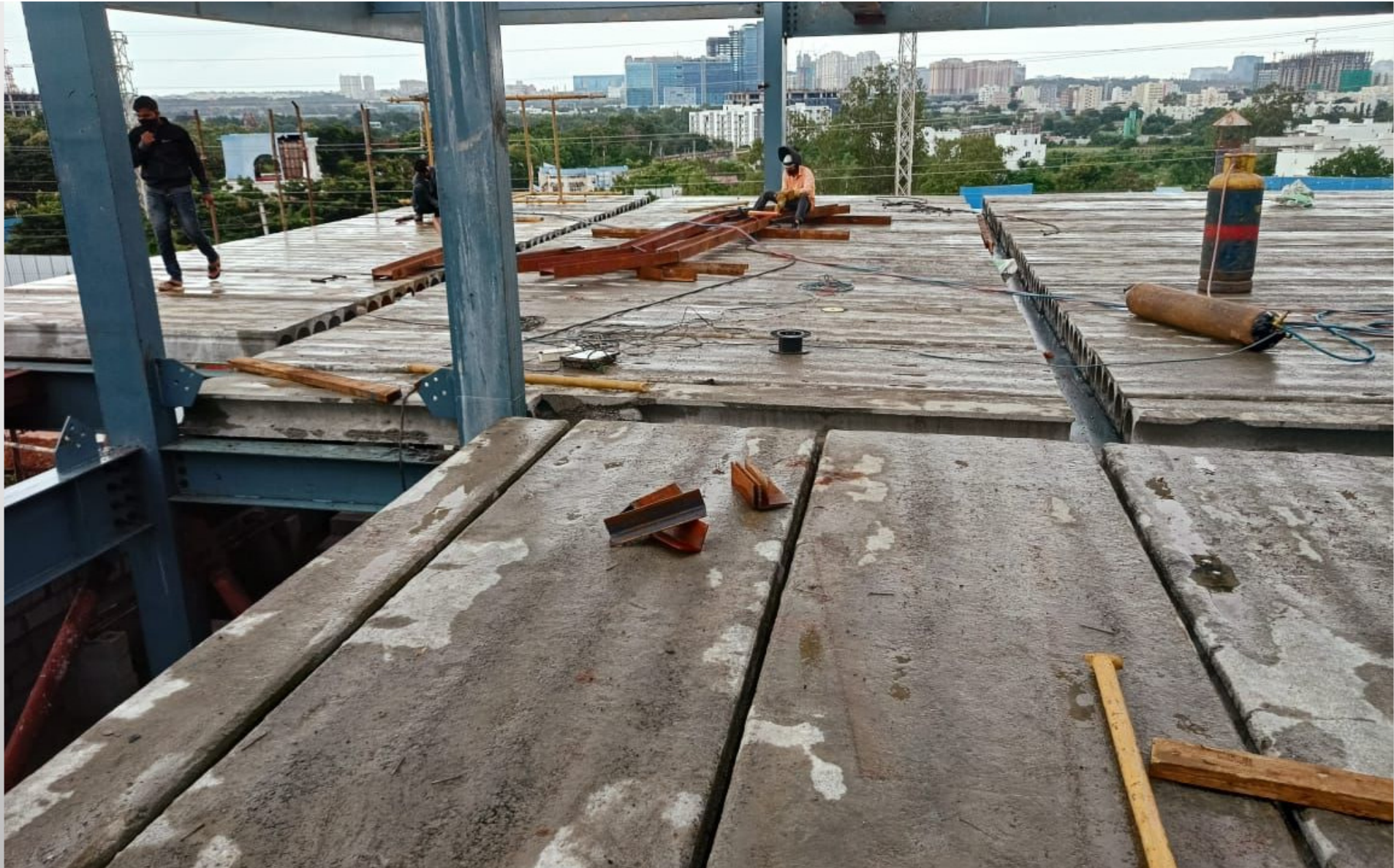


Cogging Joint

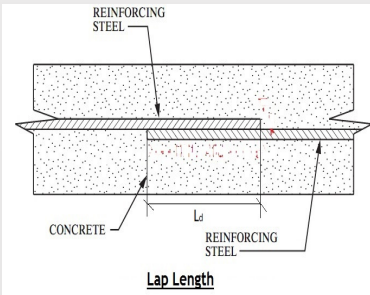


Wall to wall connection





Rebar anchorage



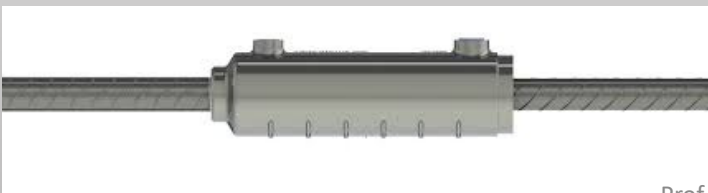
Couplers



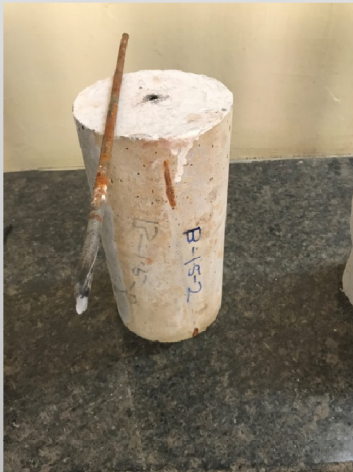
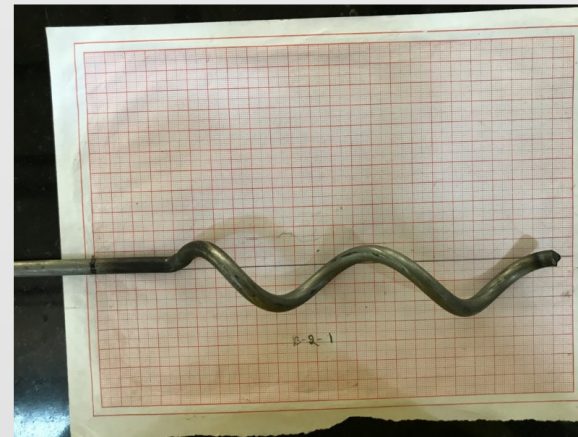
Headed Bars



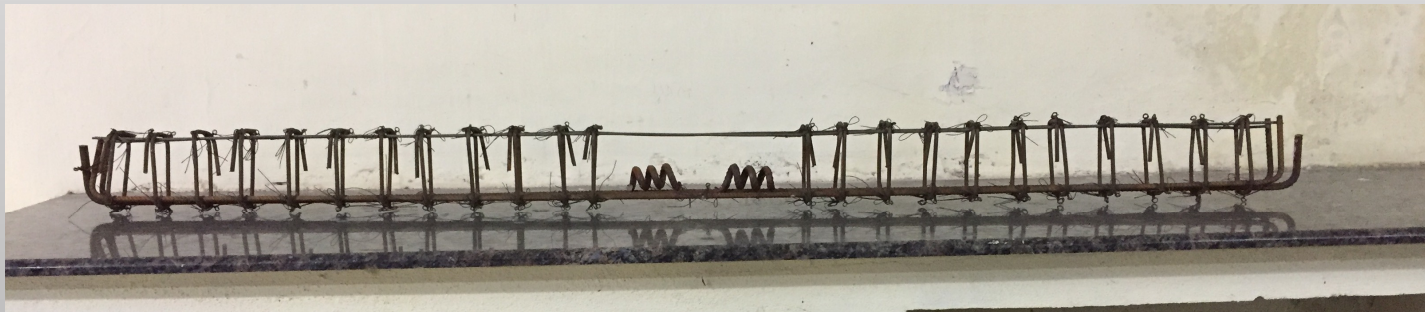
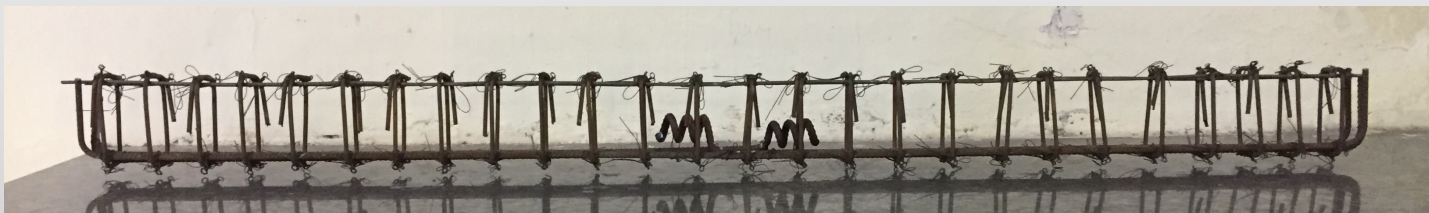
Helical end Rebar (HeR)



Helical end Rebar (HeR) Research at NITW

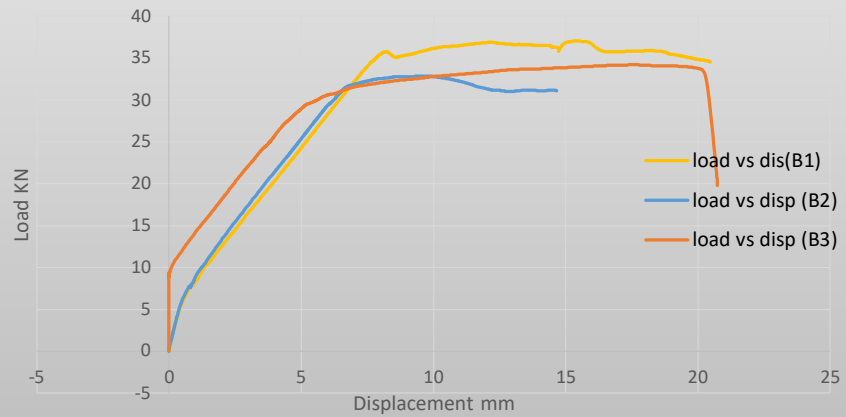


Beam Joint Test



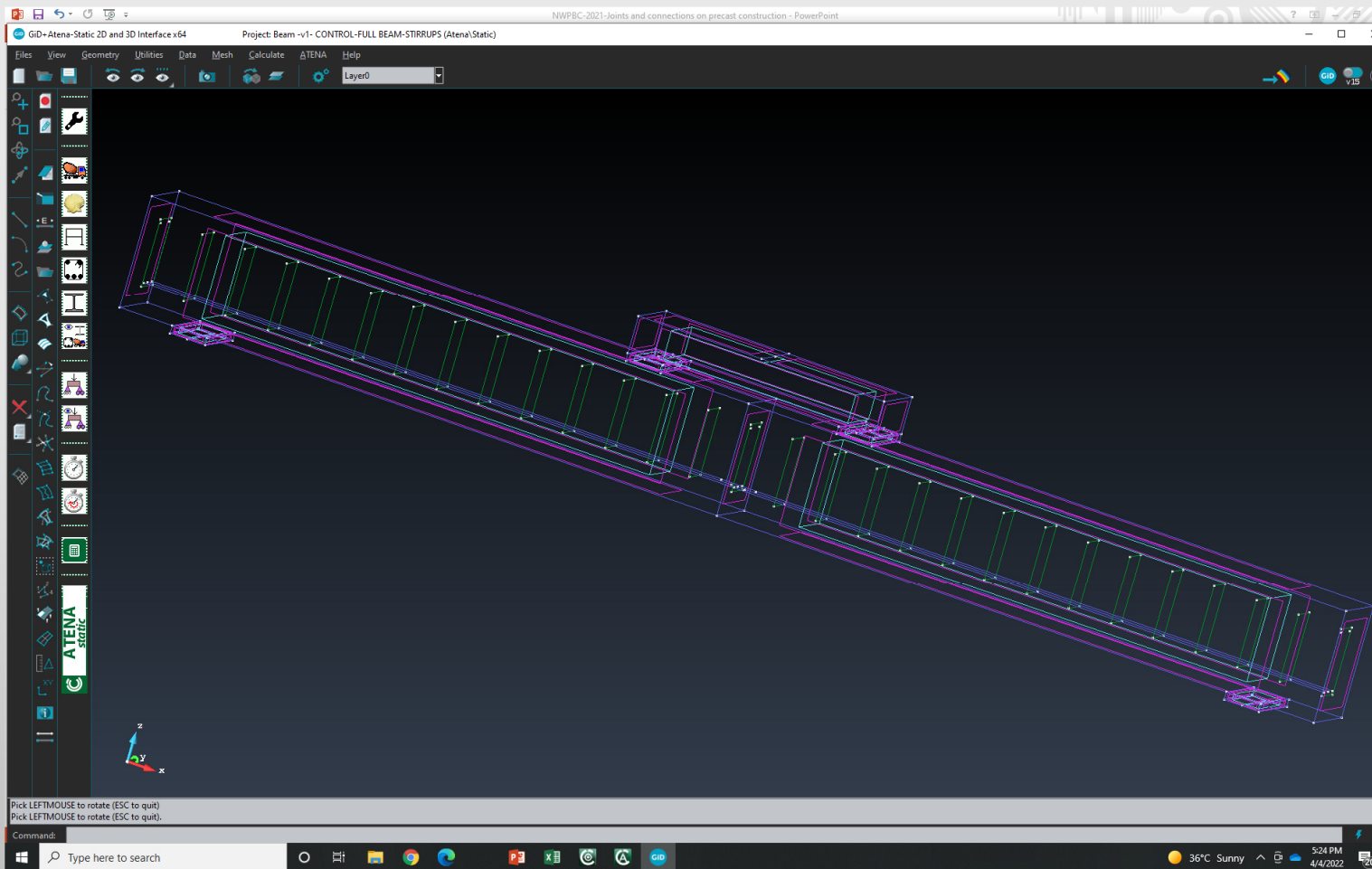


Beam Results

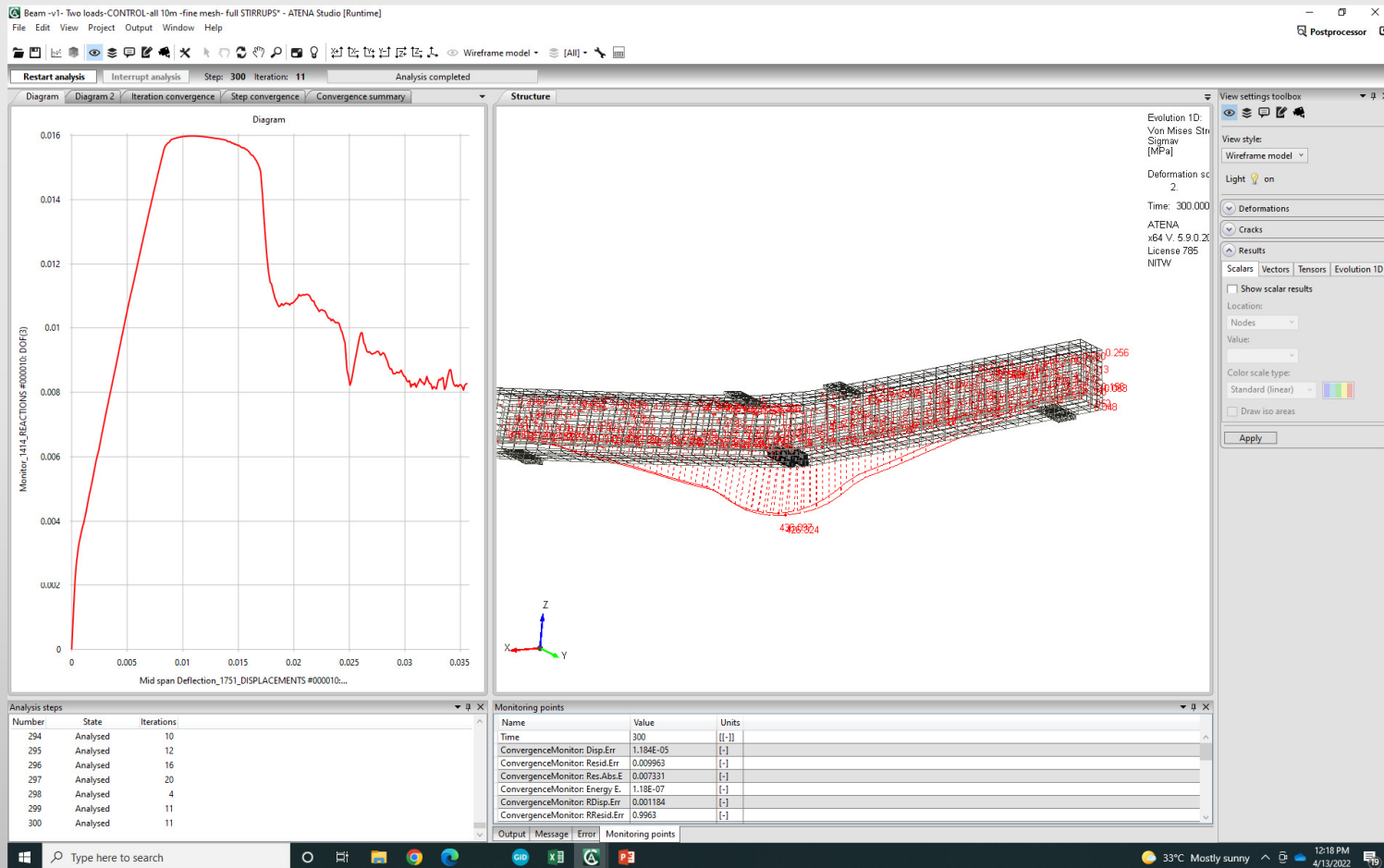


B1-control specimen.
 B2-specimen without
 confinement.
 B3-specimen with
 confinement.

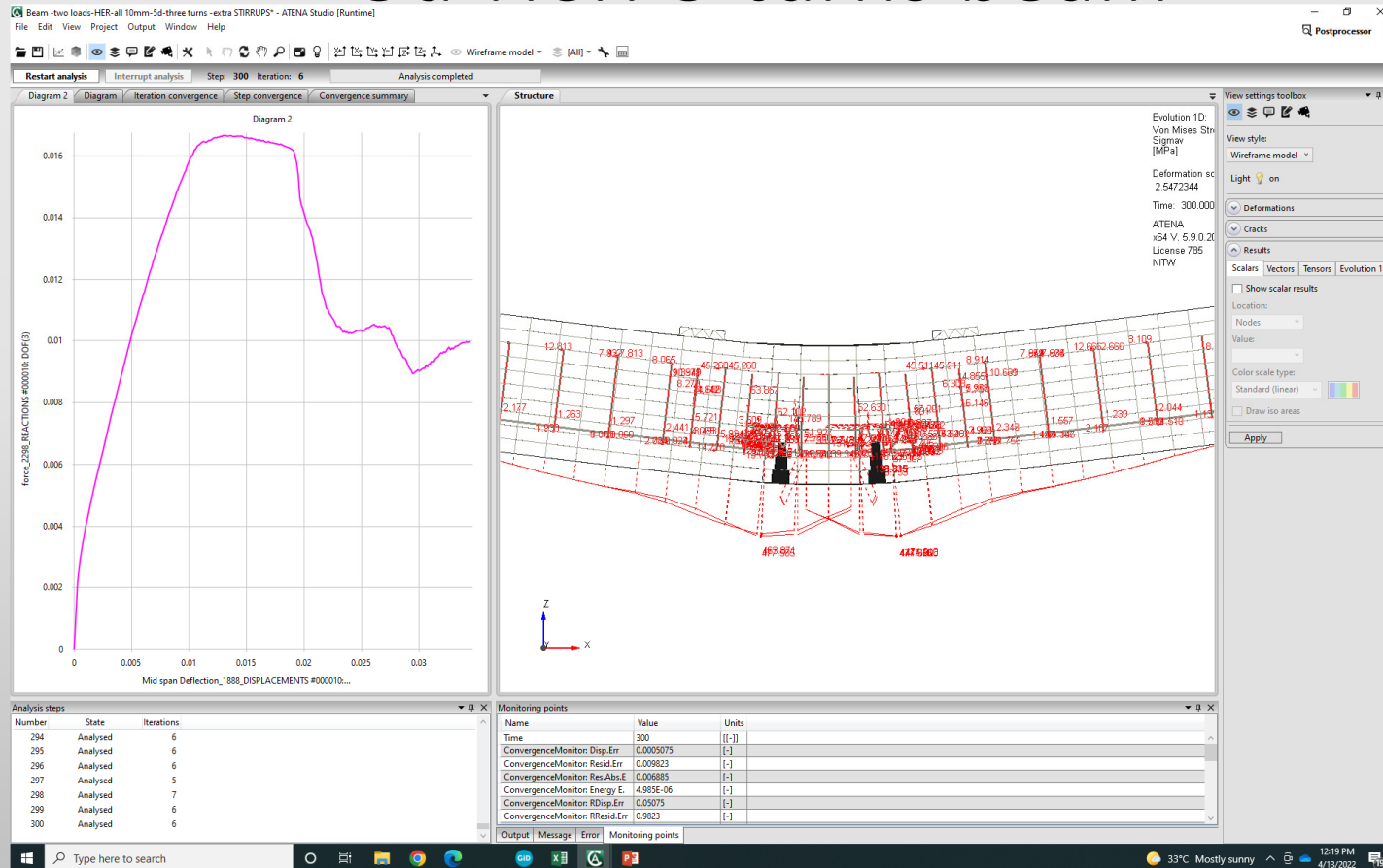
Control beam



Control beam



5d-HeR-3 turns beam



Load-Deflection curves



Problem faced by the precast industry is finding a reliable and economic method to join prefabricated members.

Summary

There should be adequate design of joints in order to transfer the subjected load on the structure.

The alternate load path should be always available in case of failure of joints.

The type of material used in joint between two components also plays an important role in strength of joint.

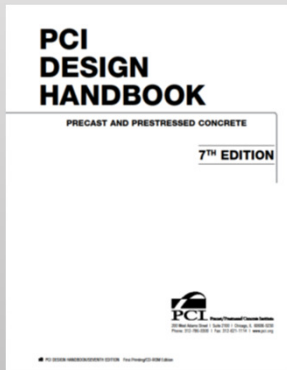


PCI Design Handbook_Precast & Prestressed Concrete - 7th

FIB-43-Structural-connections-for-precast-concrete-buildings

[Bulletin 6] - Special Design Considerations for Precast Prestressed Hollow Core Floors_ Guide to Good Practice 6(2000, FIB)

Singapore. Building and Construction Authority - Structural precast concrete handbook (2001, Building and Construction Authority)





raocbk@nitw.ac.in