Some case studies of construction accidents in India

Special emphasis on safety of temporary structures

Dr. K.N.Jha
Department of Civil Engineering
Indian Institute of Technology Delhi
Block V, Room No. 322
knjha@civil.iitd.ac.in

Contents

- Why 'Temporary structures' do not deserve 'temporary' treatment?
- How accidents are caused due to failure of temporary structures?
- Status of temporary structures in Indian Construction
- Few Solutions
-

Why 'Temporary Structures' do not deserve 'temporary' treatment?

- 'Temporary' gives a feeling as if it is something not that important
- But is it the case-
- In RCC Construction, Temporary structures say formwork
  - Quality, Economy, Safety
  - Consumes about 40-50% of the total cost and about 60-70% of the time
  - Major investment required

Thus 'TEMPORARY' is really not 'Temporary'

Quality

- Common defects due to poor formwork quality

  1. Honey comb

Formwork needs to be designed & built accurately so that the desired size, shape position, correct location, quality and finish of acceptable quality of the cast concrete are attained.

Quality

- Common defects due to poor formwork quality

  2. Poor Construction Joint /Offsets in Concrete Joint

Quality

- Common defects due to poor formwork quality

  3. Plywood Grains Stuck on the Concrete Surface

Safety

- In Building Construction
  - 60% Failure due to Formwork Collapse, Shoring Collapse, Inadequate Shoring & Lateral Bracing
  - 8% due to premature removal of shore.
  - 18% Failure is due to faulty materials.

Thus Formwork needs to be built adequately so that it is capable of supporting all dead & live loads without danger to workmen and to the concrete surface.

How accidents are caused due to failure of temporary structures?

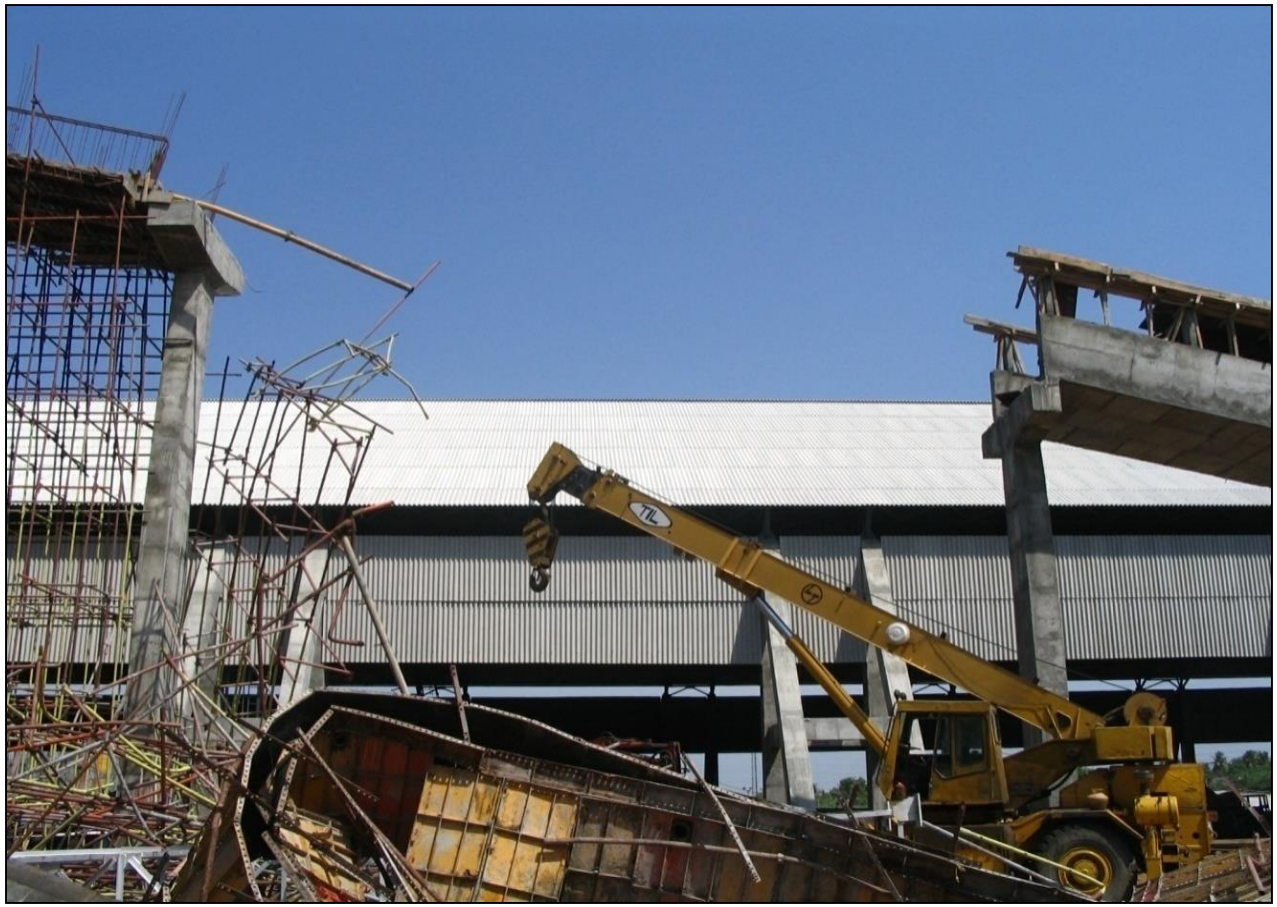
Collapse of one floor leading to another

View of collapsed waffle slab segment

Another view of collapsed waffle slab segment

View of the bent shoring (due to excess load)

Collapse of deck slab between the two piers



Another view of the accident site

Shoring tower in position for the deck slab adjacent to the collapsed slab

View of the portion of the slab which failed due to concrete overloading

Another view of the portion of the slab which failed due to concrete overloading (note the buckled props)

Another view of the portion of the slab which failed due to concrete overloading

View of portion of slab and beam formwork which collapsed

Another view of portion of slab and beam formwork which collapsed

Failure of Launching Girder

Collapse of launching girder in Laxmi Nagar

Collapse of under construction metro bridge

View of Zamrudpur under construction metro bridge span collapse

Bridge failure during construction

view of the accident site (photo courtesy www.chinapost.com.tw)

Bridge failure during construction

Another view of the accident site (photo courtesy www.thehindubusinessline.com)

Fall of Girder during construction

View of dislocated shutters

Fall of Girder during construction

Toppled Girder lying on ground

Status-Temporary Structures

- The access to worksite and ladders are scary to say the least.
- In majority of the packages, the temporary structures are not designed properly
- Consultants instead of checking the drawings wait for the work to get over so that approval formality is avoided.
- Wherever the drawings are approved, the implementation is not as per the drawing.
- The designs and drawings are not vetted from third party.
- Makeshift formwork arrangement with non-standard formwork components are in wide use.
- Shutter plates and reinforcements are misused for providing access and diagonal bracings respectively.

What did we find?

Shuttering plates being used to form brackets to support working platform

What did we find?

Shuttering plates being used as pedestal (even worse, they are kept on loose soil)

A view of access to workplace- misuse of shuttering plate

Another view of access to workplace

A view of bridge formwork-
No trestle is anchored

Another view of bridge formwork-
Reinforcement is being used as bracing

What did we find?

Foot plates not in proper contact with concrete pedestals

What did we find?

Improper working platform, no hand rails, no foot guards

What did we find?

Erosion of soil beneath the shoring was noticed.

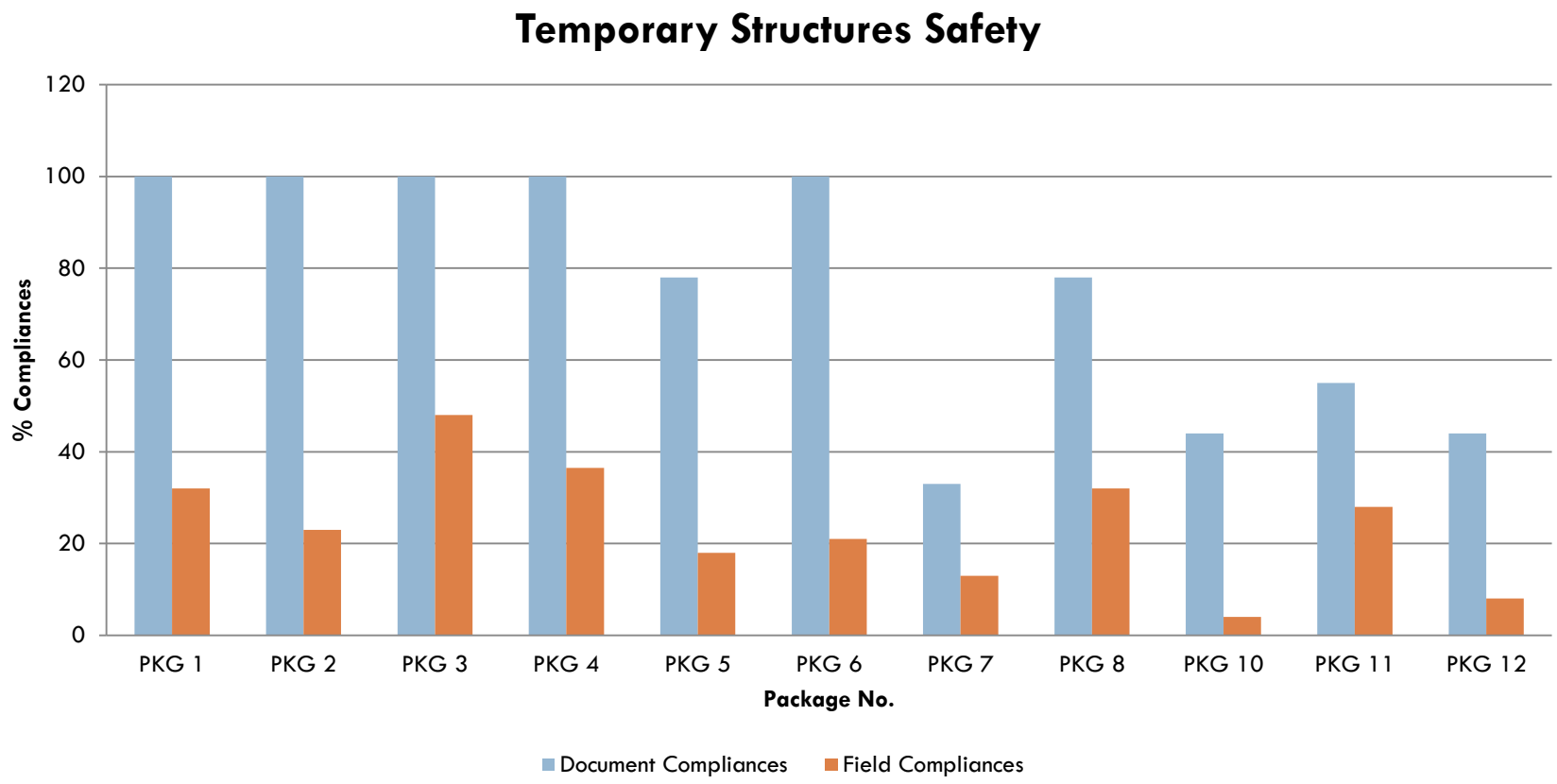
A view of wall formwork-
the unsafe scaffolding

A view of bridge formwork-
All safety norms violated

Children at elevated locations without PPEs.

No control over the public movement in risky working zone.

Compliances Comparison



Recommendations-Temporary Structures safety (SS)		
Scaffolding materials	Standard built up frames are not used and the contractor uses makeshift arrangement.	The contractor shall use standard built up frames for scaffolding.
Access arrangement	Access arrangement is poor at nearly all the locations. As almost everywhere. These were found to be made of substandard , make shift type and unsafe	The formwork design should show the access arrangement. They must be well designed and to provide ramp, walkway, access and approach at the work locations
Formwork design and drawings	No vetting by third party. In some cases it is approved by consultants.	The formwork design and drawings must be vetted by third party. A certificate to this effect must be available for inspection by the CSC and a copy send to Employer.

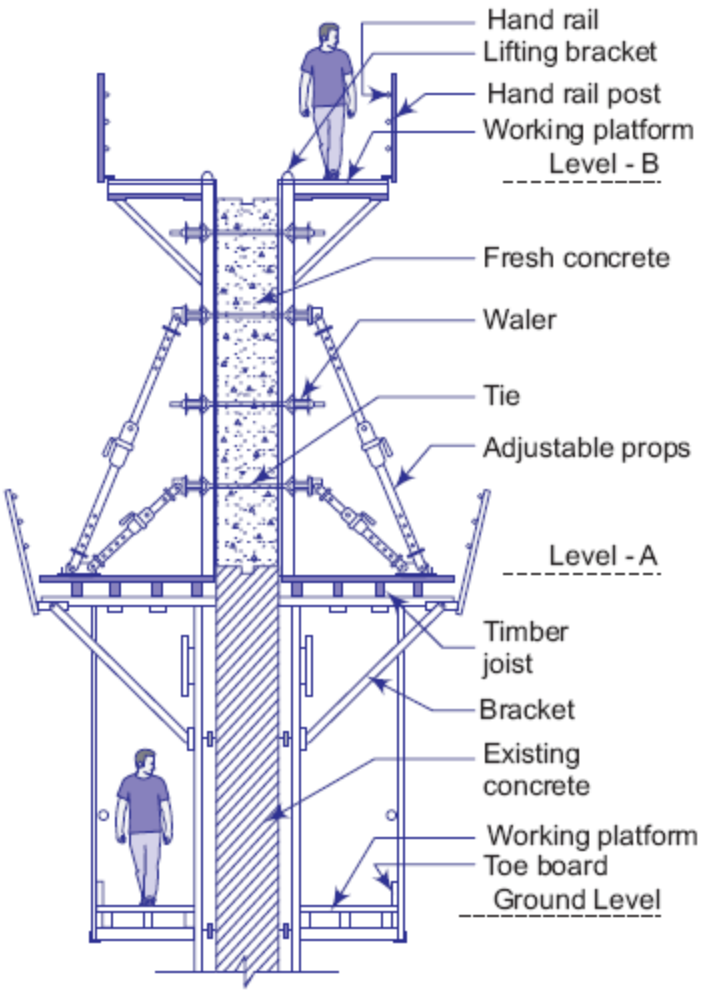
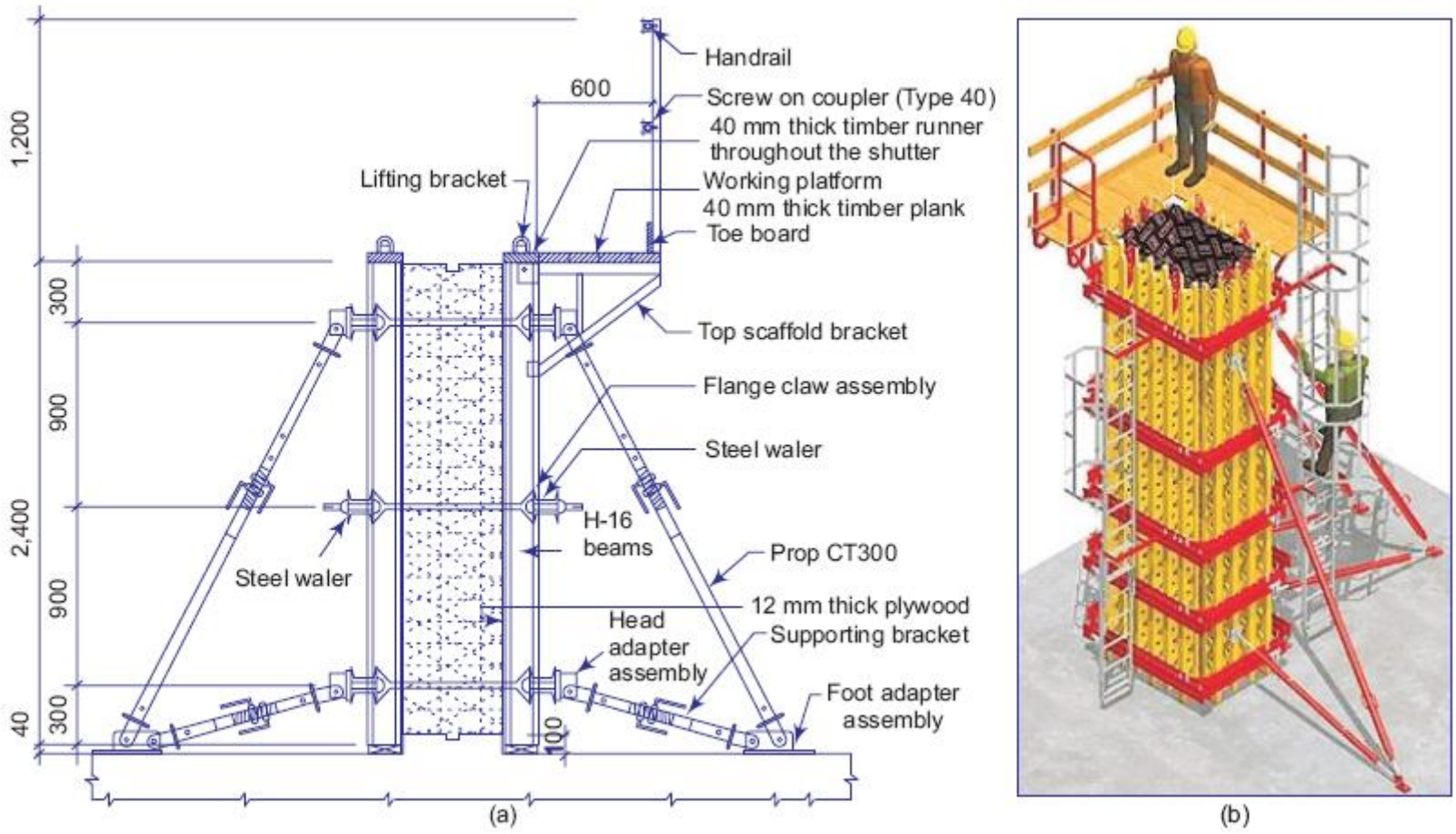
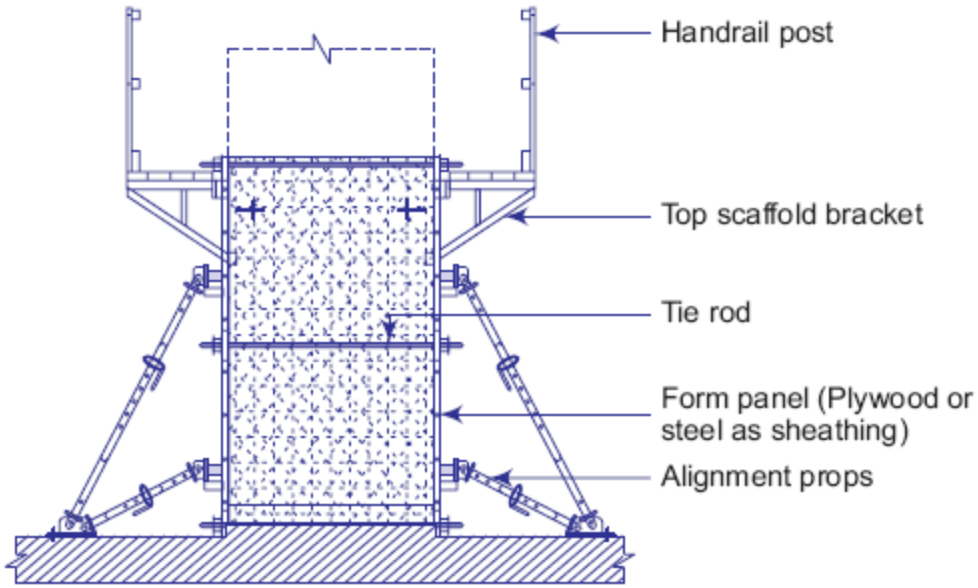


Fig. 5.1 Typical wall formwork

Photograph courtesy- Formwork for concrete structures- Tata Mc Graw Hill

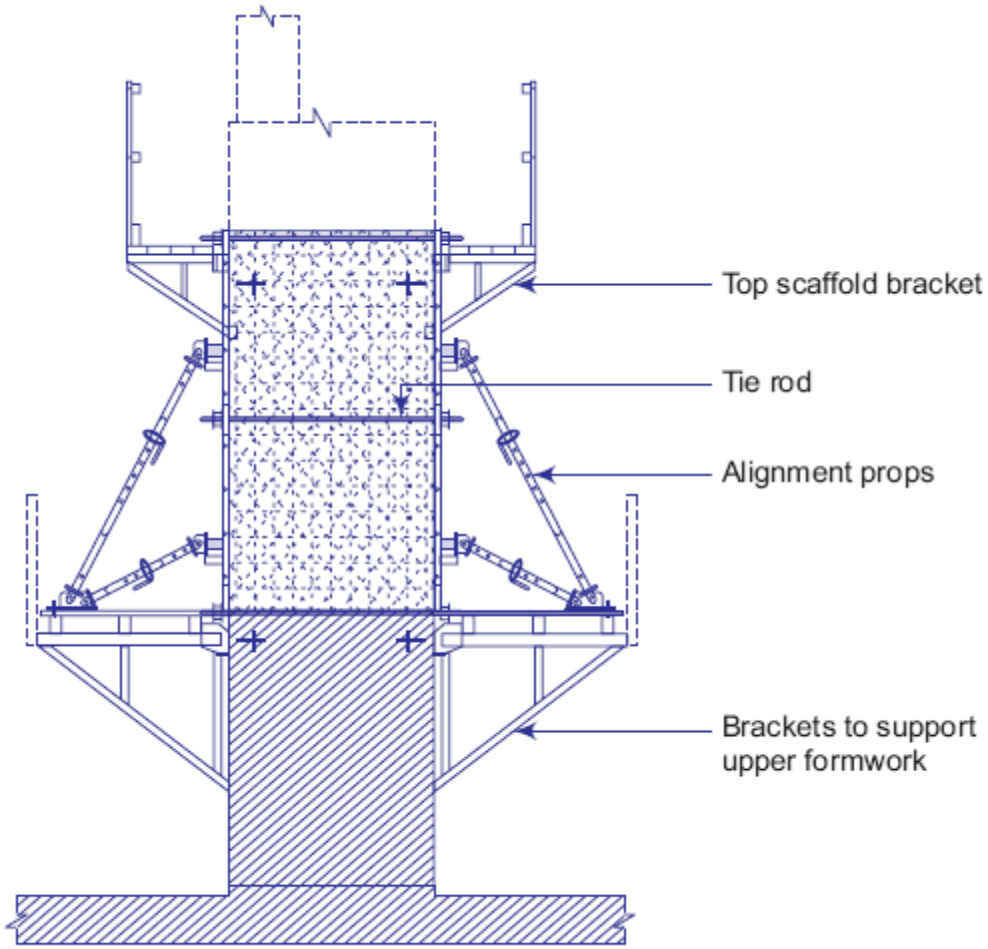


Photograph courtesy- Formwork for concrete structures- Tata Mc Graw Hill



(a) Formwork arrangement of Pier for first lift

Photograph courtesy- Formwork for concrete structures-Tata Mc Graw Hill



(b) Formwork arrangement for subsequent lifts

Photograph courtesy- Formwork for concrete structures -Tata Mc Graw Hill

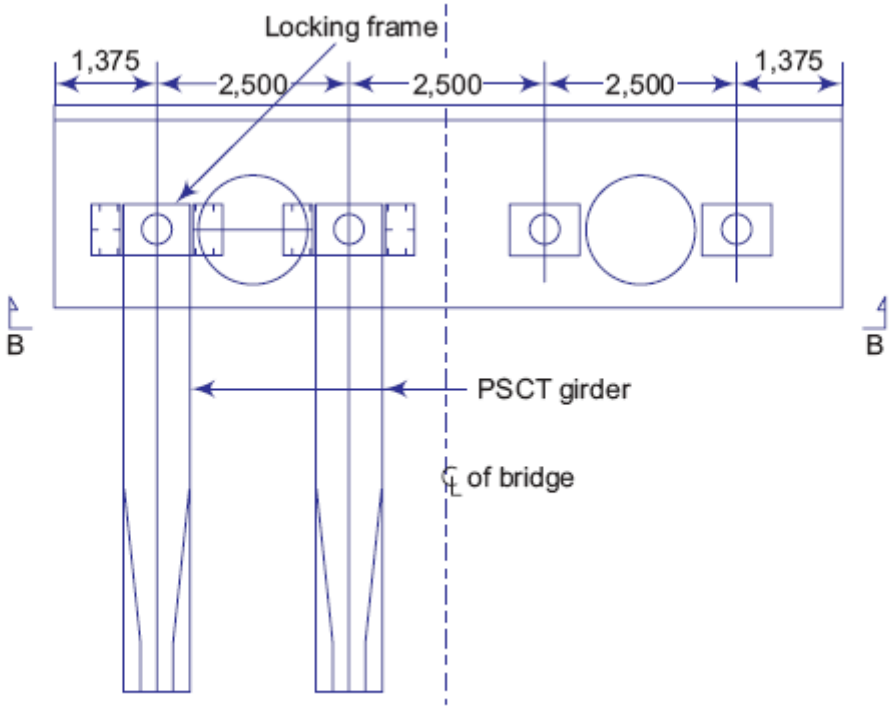


Fig. 5.5 Plan (Temporary arrangement for Girder restraining)

Photograph courtesy- Formwork for concrete structures, in press Tata Mc Graw Hill

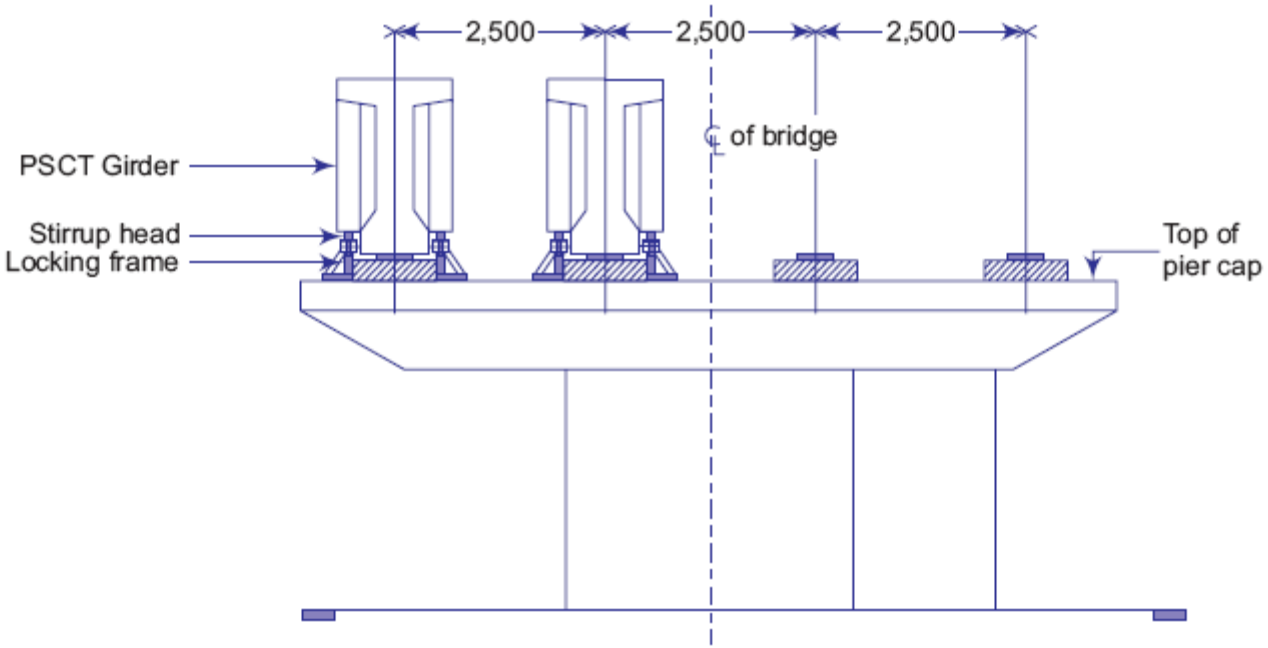


Fig. 5.6 Section BB (Temporary arrangement for Girder restraining)

Photograph courtesy- Formwork for concrete structures, in press Tata Mc Graw Hill

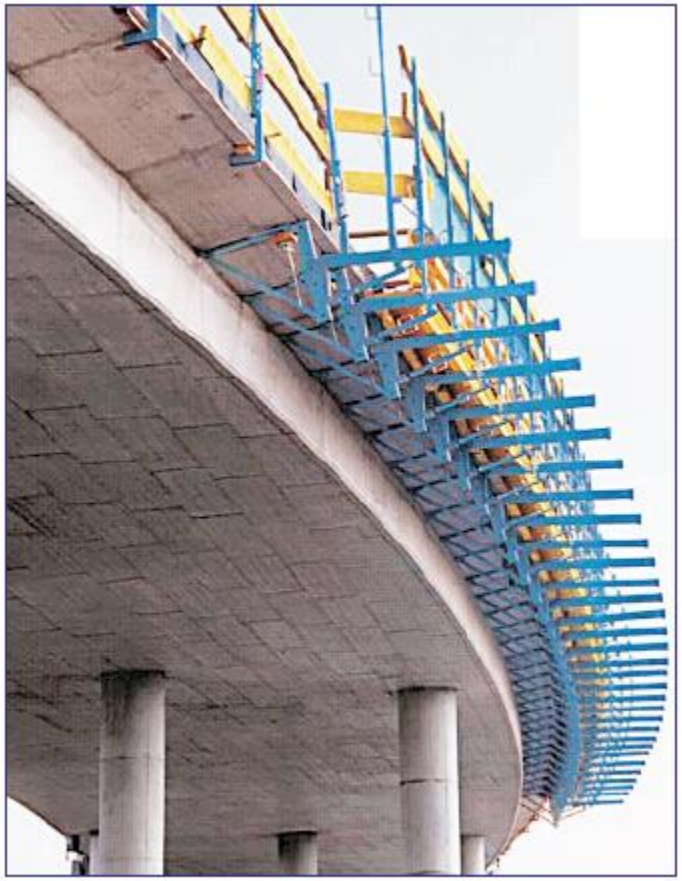


Fig. 5.7 Edge beam formwork

Photograph courtesy- Formwork for concrete structures-Tata Mc Graw Hill


Thanks