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A Case Study on Acceptability of Precast Concrete

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Abstract— *Innovation can mean making a small change to a design or work process that reduces quantities or minimizes workers' exposure in the field, which ultimately yields cost or schedule savings for our Clients.*
Innovations over the decades have contributed greatly to the improvement of both quality and quantity of the structures in construction industry. One such revolution is to construct precast anchor bay at pipe rack.
Promises held by precast technology have been showcased many times theoretically. However rarely have the same been demonstrated at construction sites where engineers have conservatively tried to stick cast-in-situ construction.
Fluor Daniel India is mainly dealing in refinery projects, where precast concrete technology is used in Pipe-racks to achieve fast and economical construction. In one of the recent projects, anchor bays of cast-in-situ concrete pipe rack are replaced with anchor bays of pre-cast concrete pipe rack because of schedule constrains.
The objective of this paper is to provide a comparative study on the change mentioned above, and to explore the acceptability of the change.

1. INTRODUCTION

EPC projects face many challenges to stay in the competitive world. One of the challenges is that EPC (Engineering, Procurement and Construction) projects are highly schedule driven. Now a day's clients are very demanding. They want to receive product having same qualities faster than they wanted before. Hence to meet the expectation of our clients, many ideas have been discussed but the most promising and effective is reducing construction time as it plays a significant role to calculate project duration.

So it is the time to think how major construction work can be completed in a quicker, more efficient and safer way. The use of traditional methods has many problems to full fill the given time frame with required quality. Hence we need to rethink over the traditional construction system and switch over to precast technology with the help of mechanized or automated construction systems available these days.

Precast concrete technology provides minimum site preparation thus achieving faster construction. It can be delivered quickly and correctly, when compared to conventional construction methodology.

Advantages of precast concrete are as follows:-

- Faster construction.
- Sustainable technology.
- Durable technology.
- Lower material wastage.
- Cleaner and safe environment at job site.
- Low maintenance requirement.
- Lower traffic disruption near construction site.

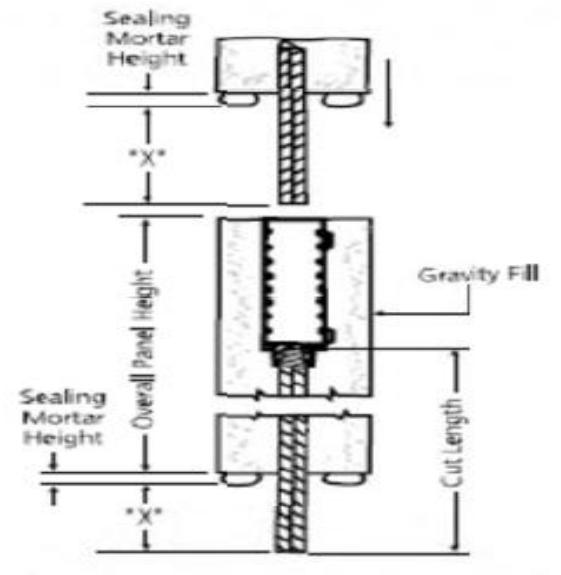
Precast pipe rack construction methodology used in the project is consisted of frames which are casted in a factory after designing, and transported to site where all the components are assembled and erected with couplers, reduces the construction time.

Precast concrete frames are manufactured in a precast plant facility equipped with latest machinery under strict quality controlled conditions. In the same time site can be used for other activities such as excavation, levelling and substructure construction etc, reducing the construction time for the structure.

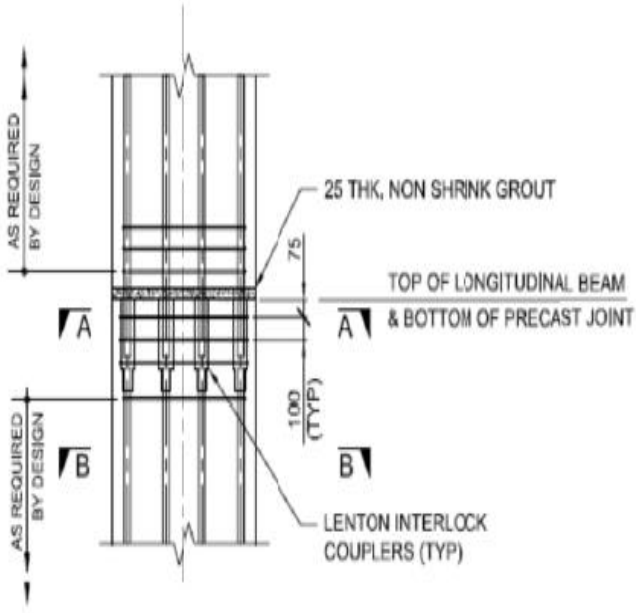
2. LENTON INTERLOK MECHANICAL COUPLER

The LENTON INTERLOK mechanical reinforcing steel splice is designed to connect 16mm through 57 mm rebar, conforming to ASTM A615/A615M, A706/A706M, BS4449, CSA G30.18 or AS1302 standards. The connection incorporates the LENTON taper threaded system in conjunction with a special high-early strength cementitious volume stable filler material (Grout). Assembly of the connection is normally done in two separate stages: the LENTON threaded end is fastened to the coupler at plant prior to placement of concrete in the precast member. The connection is completed at the job site, where the exposed

dowel of the adjoining panel is positioned within the interior of the coupler. The filler material is either poured or pumped into the cylindrical end of the coupler.



Lenton Interlok Mechanical Coupler
Fig. 1



Typical Detail At Precast Joint
Fig. 2

3. AN INNOVATION IN PIPE RACK

For a standard precast concrete pipe rack, anchor bays are cast-in-situ concrete structure and they provide longitudinal stability to the pipe rack.

At our current project, to achieve a tight schedule client suggested changes were reviewed and implemented. One proposal was to change $6^m \times 11^m$ cast-in-situ anchor bays with precast anchor bays to reduce construction time.

Fig. 3 shows the isometric view of a typical precast anchor bay which is segregated by five precast concrete frames such as PR-FRAME-01, PR-FRAME-02, PR-FRAME-03 and PR-FRAME-04. The continuity of two precast frames is done by LENTON INTERLOK mechanical reinforcing steel splice and a typical detail is shown at Fig. 2.Casting of precast frames is performed at casting yard. The erection of precast frames shown at Fig. 4 is performed as follows:

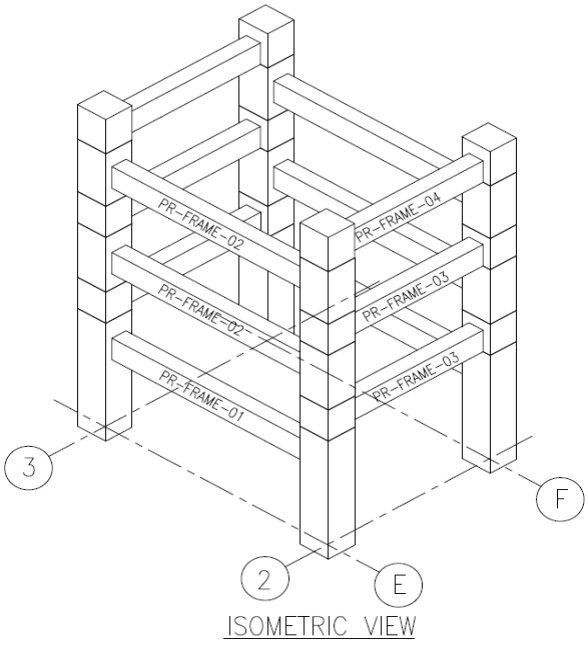
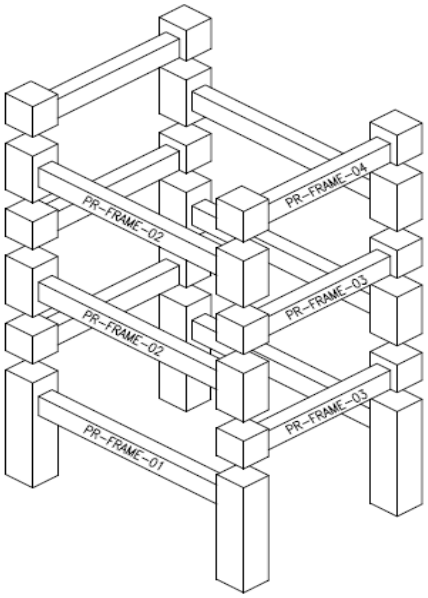


Fig. 3



Erection philosophy of precast anchor bay
Fig. 4

1. **Stage-01**

Scaffolding, erection & alignment to be done for PR-FRAME 01

2. **Stage-02**

Scaffolding, erection & alignment to be done for PR-FRAME 03

3. **Stage-03**

Scaffolding, erection & alignment to be done for PR-FRAME 02

4. **Stage-04**

Scaffolding, erection & alignment to be done for PR-FRAME 03

5. **Stage-05**

Scaffolding, erection & alignment to be done for PR-FRAME 02

6. **Stage-06**

Scaffolding, erection & alignment to be done for PR-FRAME 04

It is to be noted that extra engineering works to be performed for the change are as follows:

- Transportation analysis of pre cast frame.
- Checking of concrete failure at lifting points of pre cast frame.

4. CALCULATION OF CONSTRUCTION TIME TO BE TAKEN FOR CAST-IN-SITU ANCHOR BAY

Cast-in-situ anchor bay is casted through standard construction practices. Maximum height of column that can be casted for one lift is 2.4 m. There are many activities associated with construction of concrete structure such as staging, rebar binding, Shuttering and pouring of concreting, and number of days given below to complete every stage is summation of days required to complete each activities.

Required average time to construct a $6^m \times 11^m$ cast-in-situ anchor bay having height 14.95 m is shown below.

Stage -1 1st lift of 4 no's of column	3 days
Stage -2 2nd lift of 4 no's of column	3 days
Stage-3 3rd lift of 4 no's of column with beams	7 days
Stage-4 4th lift of 4 no's of column with beams	7 days
Stage-5 5th lift of 4 no's of column with beams	7 days
Stage-6 6th lift of 4 no's of column with beams	7 days
Stage-7 7th lift of 4 no's of column with beams	7 days
Stage-8 8th lift of 4 no's of column with beams	7 days

Hence 48-50 days to be required to complete the cast-in-place anchor bay if standard construction practice is followed.

5. CALCULATION OF CONSTRUCTION TIME TO BE TAKEN FOR PRECAST ANCHOR BAY

Precast concrete construction is done in two separate stages. First, casting of frames to be done at yard and second, those frames are erected at site.

- **First Stage- Casting Of Frames At Yard.**

Activity	Time
1. Fixing and shuttering in the yard	4 days
2. Casting of frames	1 day
3. Curing of casted frames.	7 days
4. Lifting and transporting to construction site.	1 day

Hence on average it takes 13 days to complete the first stage.

- **Second Stage- Erection Of Precast Frames At Site.**

Activity	Time
1.PR-Frame-01 Scaffolding, erection & alignment to be done	1.5 days
2. PR-Frame-03 Scaffolding, erection & alignment to be done	1.5 days
3. PR-Frame-02 Scaffolding, erection & alignment to be done	1.5 days
4. PR-Frame-03 Scaffolding, erection & alignment to be done	1.5 days
5.PR-Frame-02 Scaffolding, erection & alignment to be done	1.5 days
6.PR-Frame-04 Scaffolding, erection & alignment to be done	1.5 days
7.Grouting to be completed	1 day

Hence on average 10 days are required to complete second stage.

So on average 23 days to be taken to complete the construction of pre-cast anchor bay.

6. CONCLUSION

The objective to replace the cast-in-situ anchor bay with precast anchor bay is to reduce construction time.

It is shown that using a precast anchor bay can reduce the construction time by more than 50% and the engineering works are remain almost same as compare to that of cast-in-place anchor bay.

More over precast concrete structure is safer to construct as few activities are performed at height, it does not occupy site space for a longer time, and it improves the quality of construction.

Hence it is a step forward for construction industry.

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