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"Precast Superstructure In Metro Corridor" (Segment Casting In Yard And Erected By LG Box Girder)

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ABSTRACT

The construction of both medium and long span precast concrete segmental spans is widely spread throughout India for metro projects. This method can also be taken in highways, railways, and rapid transit, in both urban and rural area. Alignment can be straight or curved, and can implement in long spans for difficult obstructions and territory.

INTRODUCTION

Precast segmental technique when employed in India uses traditional internal post-tensioning tendons with epoxy bonded joints. The tendons are threaded through preformed ducts before tensioning in situ. Being a span-by-span erection, post-tensioning of cables can be effected fromthe free end only.

The match-cast segments are produced in a centralized casting yard and transported to site. The process of 'match casting' where the adjoining segment is cast against the previous one is pivotal to the formation of shear keys that enable shear transfer across the joints of the segments.

IMPORTANCE OF PRECAST STRUCTURE i.e, SEGMENTS

The precast construction method reduced the working space to just half of it and that too at available spaces in any other location. Such gains were essentially required for the proposedmetro alignment which is characterized by sharp curvatures in crowded areas of the city.

CONSTRUCTION METHOD

Precast segments are usually erected using the span-by-span method, balanced cantilevermethod, or progressive placement method.

Span-by-Span

In the span-by-span method, an entire span is assembled, post-tensioned, and erectedso that it is self-supporting before the next span is erected. The method is appropriatefor span lengths up to about 150 ft. Beyond 150 to 180 ft, the method is less cost effective.

In one variation of this method, all the segments are supported by an erection truss before the segments are post-tensioned together. The erection truss may be located either above or below the segments. Once the segments are post-tensioned togetherand the span is resting on its bearings, the erection truss is moved to the next span. When space permits, the segments may be assembled at ground level, post-tensionedtogether, and the entire span lifted into place.

Balanced Cantilever

In the balanced cantilever method, the superstructure is erected by cantilevering outfrom opposite sides of the pier. The segments are added either at the same time or alternately to each cantilever to maintain a relatively balanced system. Often segments are offset by one-half segment length to reduce the out-of-balance moment. After the cantilevers from each adjacent pier reach midspan, a cast-in-placeclosure segment is placed followed by additional post-tensioning.

The balanced cantilever method is most economical for span lengths greater than about 160 ft. For span lengths greater than about 500 ft, the weight of the segments near the piers reduces the feasibility of using precast segments in balanced cantileverconstruction .In the balanced cantilever method, segments are lifted into place usingground- or water-based cranes, deck mounted lifters at the end of each cantilever, oran overhead gantry. The selected method depends on the number of spans, contractor's preference, and available access. An overhead gantry will typically be supported at three piers.

Progressive Placement

The progressive placement method involves starting at one end of the bridge and erecting segments in sequential order. This method of construction is particularly suitable for environmentally sensitive areas or where construction access is limited. It is often called "top-down" construction because the substructure and superstructure can all be erected from the superstructure. The method usually requires the placement of temporary piers at about the middle of each span and is suitable for span lengths of 100 to 300 ft.

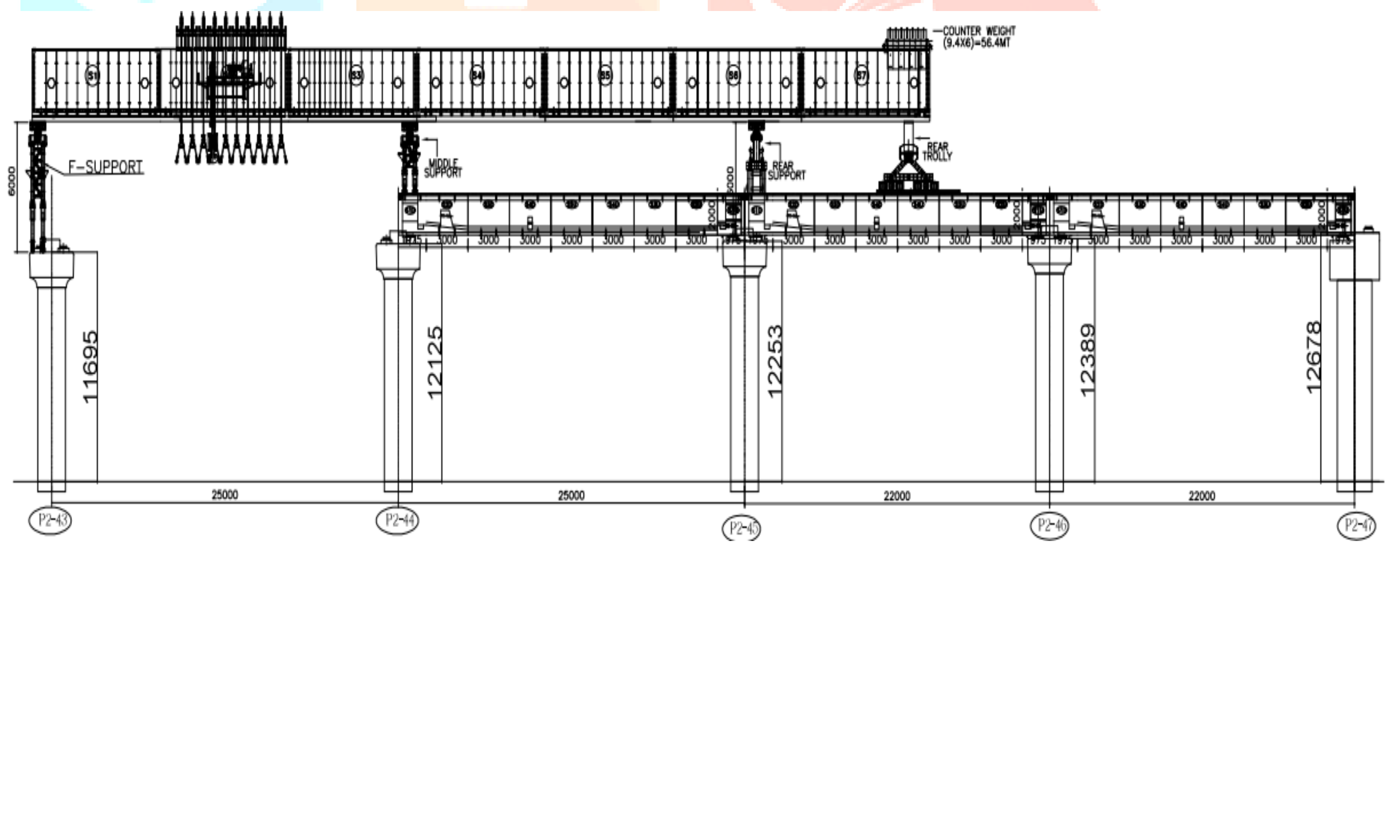
Cast-in-Place

Balanced Cantilever

Cast-in-place segmentally constructed bridges are generally built using the balancedcantilever method. A form traveler is used at the end of each cantilever to support the formwork and new concrete segment prior to post-tensioning. The form travelersat opposite ends of the cantilevers may be advanced simultaneously or alternately. Cast-in-place segmental construction is used when the precast segments are too heavy to be shipped or access is too restrictive. It has been used for span lengths upto 760 ft in the United States.

The superstructure at the abutment ends cannot be easily constructed as part of the cantilevering process because of the large out-of-balance moment, so these are oftenconstructed on falsework resting on the ground.

MAIN BODY OF PRECAST SUPERSTRUCTURE(ALIGNED SEGMENTS & LG BOX)



CONCLUSIONS

The methodology and standardization of manufacture, handling, transportation, and erection of precast elements are the major points of review and contemplation during the planning stages of the project. Approximately 60 percent of the overall construction concrete will be precast in the casting yard concurrently with the foundation work at site, thereby slashing the construction time by approximately 50 percent as compared to the conventional cast-in situ process.

Precast construction enabled us to get a better-quality control by casting in casting yard. Cast-in situ construction of heavy structures like U-girders, pier cross arms and other station elements would have required extensive labour and temporary structures for support from the ground and about 20m wide construction space on narrow and busy roads.

REFERENCES & DOCUMENTS

1. Contract Documents of Phase-01 of CS-01 Stretch GMRC/SURAT/PH-1/CS-1/VDCT+STNS/C&P/2021/ Dt. 11.06.2021

2. Various drawings of Phase-01 of CS-01 Stretch for Surat Metro of Gujarat Metro Rail Corporation Ltd. (GMRCL) which are having Detail Design Consultant (DDC) of Consortium Of Systra, Sa France And Systra Mva Consulting (India) Pvt. Ltd. & ProofCheck Consultant Of LKT Engineering Consultants Ltd For The Client Gujarat Metro Rail Corporation (GMRC).

3. Reference Codes refereed during execution of various activities:

- IS:1343 – PRE STRESSED CONCRETE
- IS:14268 –STRESS RELIEVED LOW RELAXATION 7 PLY STRANDS FOR PSC
- IS:210-- GREY IRON CASTING-SPECIFICATION
- BS:970: SPECIFICATION FOR WROUGHT STEELS FOR MECHANICAL &ALLIED ENGINEERING PURPOSES
- IRC:18-2000 ------------- DESIGN CRITERIA OF PSC ROAD BRIDGES
- IS :456-2000 –PLAIN & REINFORCED CONCRETE

4. Documents required from Quality perspective for CMRS Inspection for any metroproject:

- The Approved Project Quality Assurance Plan including ITP for material testing
- Initial Pile Load & Routine Pile Load Test Reports including PIT reports
- Concrete cube compressive strength Records including permeability test reports.
- Internal and third party test reports of aggregates (both Coarse & Fine)
- Summary of MTC's and third party test reports of reinforcement steel, HT Strands and structural Steel.
- MTC's, weekly internal and third party monthly test reports of Cement.
- Test reports of water.
- Summary of MTC's and third party test reports of admixture
- Summary of FAT reports of Bearing (Elastomeric, POT-PTFE and Spherical)
- FAT reports of Omega Seal Expansion joints.
- FAT reports of Building expansion joints (used in Stations)
- FAT of Shear Key Bar reports
- Span Load Test Reports
- MTC's and test reports of prestressing material
- Summary list of MTC and test reports of all material like SS railings, Viaduct Hand rails,
- Epoxy Glue, Granite, HDPE sheathing ducts, Station Roof Sheets, etc.,
- Viaduct Post tension Girder, Pre & Posttension I Girders Stressing details.
- Grouting records of Viaduct girders and Post-tension I girders including Grout strength reports.
- Summary list of all approved method statements with document.
- All Calibration reports.
- Summary of NCR's
- Monthly Quality Reports
- Pile Cap/UG Stations backfilling records with density reports.
- Summary of Approved concrete design mix
- Summary list of approved material/products.