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Continuing Education Course #233
Precast Segmental Bridge Construction
Part 4 - Balanced Cantilever Erection Method

1. Precast Concrete Segmental Bridges are gaining popularity with owners because they offer benefits like:
 - a. Reduced costs, reduced construction time, reduced environmental impacts, and reduced steel requirements
 - b. Reduced costs, reduced rideability, reduced environmental impacts, and reduced maintenance of traffic
 - c. Reduced costs, reduced construction time, reduced concrete strengths, and reduced maintenance of traffic
 - d. Reduced construction time, reduced costs, reduced environmental impacts, and reduced maintenance of traffic
2. Which factor is not a benefit of a designer's choice for choosing Precast Bridge Structures?
 - a. Adaptability for different modes of transportation
 - b. Easily modified deck geometry for future widening
 - c. Higher durability with less maintenance
 - d. Factory like construction allows better quality control measures
3. Balanced Cantilever method of construction:
 - a. Is a method where segments are individually erected and are self-supporting.
 - b. Is a method where segments are erected incrementally both up-station and down-station in a balanced state.
 - c. Is a method where segments are erected in their permanent location starting at a central point and working cantilevered outward.
 - d. All of the above
4. The Balanced Cantilever method of superstructure erection is economical for spans ranging:
 - a. Up to 100 feet
 - b. Spans from 80 to 180 feet
 - c. Spans from 150 to 500 feet
 - d. Spans over 400 feet
5. If excessive span heights or local crane height restrictions prevent the use of ground based or barged cranes to lift segments to the temporary supports of erection, what might be an option?
 - a. Cranes are always used for this procedure
 - b. Specialized gantry transports can be utilized
 - c. Segmental bridges are not designed for limited access sites
 - d. None of the above
6. An engineer should review the tractor and trailer used for hauling the precast segments to determine:
 - a. The quickest route for delivering the segments to the erection operations
 - b. Wheel and axle loads, heights, widths, and other restrictions for permit loads on public roadways.
 - c. The drivers experience in transporting specialized construction material
 - d. The cost effectiveness for on road trucking
7. A loading sequence for barging segments is needed to?

- a. Ensure the barge is uniformly loaded to avoid unsafe conditions
- b. Match the erection sequence needed at point of delivery
- c. Make sure tugboats can push the barges from the loading are
- d. Both A and B

8. Since the pier segments are usually the largest, heaviest, and most complicated segments the engineer may design them to be?

- a. Cast-in-place concrete
- b. Precast concrete
- c. A combination precast shell with cast-in-place elements
- d. All of the above choices can be acceptable

9. If the pier segments are on bearing assemblies, what type of temporary support is needed for the balanced cantilever erection?

- a. A frame to hold the segments in place until they are integrated into the substructure
- b. Strongbacks to hold the cantilevered segments until post-tensioned
- c. Upstation and Downstation shoring towers to prevent overturning
- d. Beam and Winch systems to raise and lower segments

10. (A) Using the geometry control data from the segment casting yard, adjust the two segments to the correct line and grade. (B) Using high strength threaded rods, anchor the strongbacks to the pier segments. (C) Once the concrete has attained the required strength, high strength threaded rod will installed through the segments and tensioned (D) Lift the cantilevered segments and hang them from the strongbacks. (E) Form and place the closure pour between the segments. The correct sequence for “Table-Top” erection is:

- a. A,B,C,D,E
- b. B,D,A,E,C
- c. E,D,C,B,A
- d. D,C,B,A,E

11. In the context of Balanced Cantilever Erection, a closure pour is:

- a. A concrete placement between the precast segments to correct for field conditions or complete a span
- b. A concrete placement to close temporary access points in the superstructure
- c. An epoxy poured on the match-cast faces to seal the joints “closed”
- d. A concrete pour at the end of the pre-stressing tendons to close the ducts

12. After setting a balanced cantilever segment the as-erected survey check yields minor deviations in line and grade, these deviations can be corrected by:

- a. Resetting the segment with shims
- b. Forming and pouring a corrective closure pour
- c. Removing the segment and checking the match-cast faces for irregularities
- d. Shimming the next segment

13. (A) Stress rods to provide “epoxy squeeze” to seat the segments to their match-cast, (B) Connect high strength rods between segments, (C) Place epoxy on match-cast faces, (D) Raise balanced segments along respective sides of previous segments, (E) Install cantilever post-tensioning tendons in the internal ductwork of the balanced segment pair’s top slab and Stress tendons. The correct sequence for typical segment erection is:

- a. A,B,C,D,E
- b. B,D,A,E,C
- c. C,D,B,A,E
- d. D,C,B,A,E

14. When completing a balanced cantilever span, steel strongbacks are used to:

- a. Hang formwork and access scaffolding for closure pours
 - b. Stabilize cantilever tips for placing closure pours
 - c. Vertically align cantilever tips
 - d. All of the above
15. Why is it important to optimize the amount of epoxy at the segment joints?
- a. Too little epoxy may cause the joints to leak and compromise the corrosion protection
 - b. Too much epoxy will be wasted during the epoxy squeeze process and cause waste.
 - c. Both A & B
 - d. Neither A nor B.
16. Prior to permanent post tensioning, precast segments are erected with an epoxy placed on the match-cast faces because:
- a. The epoxy acts as a lubricant and sealer to facilitate a tight fit between segments.
 - b. The epoxy glues the segments together so they act as a single unit.
 - c. The epoxy is required by state DOT's
 - d. The epoxy provides an architectural finish to hide imperfections in the match-cast process
17. Continuity Tendons are?
- a. Longitudinal post tensioning in top slabs of balanced cantilever segments
 - b. Longitudinal post tensioning in the bottom slabs of balanced cantilever segments
 - c. Longitudinal post tensioning outside of flanges or webs, usually runs through segment box interior
 - d. Post tensioning found in the flanges or webs of segments
18. Why are elongations measured on the post tensioning strands after stressing?
- a. Because if the steel stretches it is considered a failure and must be replaced
 - b. It is measured to make sure the wedges don't slip and they retain the loaded energy
 - c. It is a way to make sure the correct size and number of strand were placed in the anchorage
 - d. It is a way to ensure the stresses occurred over the entire length of the strand because a shortened elongation will mean the strand is pinched somewhere along its length.
19. If the segment surface is to be the final riding surface of the bridge what recommended practice can improve rideability?
- a. An asphalt overlay can be added to smooth the surface.
 - b. None is needed, geometry control is sufficient to meet surface requirements
 - c. None is needed, segmental bridges rarely have rideability requirements
 - d. Longitudinal grinding can eliminate imperfections.
20. With Balanced Cantilever construction, when is it acceptable to sacrifice the safety of an operation for added production?
- a. If the schedule critical path shows negative float
 - b. If the budgeted costs show losses for a particular item
 - c. If the project inspectors aren't available during a planned activity
 - d. It is never acceptable to sacrifice safety for production!

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