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Discipline's involvement



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Discipline's involvement

- Piling and Pile Caps
- Superstructure
 - Precast Elements
 - Insitu Deck

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Design criteria

- **Design ship characteristics**

- Deadweight tonnage (DWT) 50 000
- Displacement (t) 66 000
- Length overall (m) 250
- Beam (m) 32
- Draft (m) 13

- **Alternative ships**

- Two bunker barges each 75m in length

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Design criteria and assumptions

- Vessel Loading
 - Mooring

Bow, stern and breasting, 3 per end at 20m centres, $\pm 10\text{m}$ behind cope

Six spring line moorings at 20m centres along cope
 - Berthing

Eight fenders at 20m intervals along cope over $\pm 140\text{m}$

Set forward of the cope to prevent pile damage

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Design criteria and assumptions

- Live Loading
 - Vehicular loads - 10kPa over entire area
 - Crane outrigger load of 80t on 1m x 1m area
- Geometric requirements
 - Link to existing Berth 209
 - Link to possible future chemical berths
 - Have minimum effect on shoreline



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Possible structures considered

- Gravity Structures
 - Dolphin structure with caissons
 - Anchored sheetpile wall
 - Block or counterfort wall structure
- Piled Structure
 - Due to poor soil conditions the only viable solution

The image displays three architectural drawings of a bridge structure, likely for a railway or industrial crossing, showing various components and dimensions.

SECTION (C) 1:30 and **SECTION (D) 1:30** show cross-sections of the bridge deck. Section (C) details the precast slab, precast beam, handrail, and a 700 DIA. PILE. Section (D) shows a similar section with a 5m L 150TH POLES and a 700 DIA. PILE.

PLAN 1:250 shows the top-down view of the bridge deck. It includes dimensions for the deck width (143280), the central access road (17685), and the overall length (17100). The plan also shows the location of 15m LIGHT POLES, HANDRAILING, and a MONITOR TOWER. A central section is labeled **SERVITUDE** and **ACCESS ROAD**.

ELEVATION 1:250 shows the side profile of the bridge. It details the structure of the piers, abutments, and the deck. Key components include the **BOY BOLLARD**, **WELLERSON FENDER**, **ACCESS ROAD**, **PRECAST BEAM**, **PRECAST SLAB**, and **FILE CAP**. The elevation also shows the **15m LIGHT POLE** and **HANDRAILING** details.

The drawings include various dimensions and labels for materials and components, such as **PRECAST BEAM**, **PRECAST SLAB**, **HANDRAILING**, **15m LIGHT POLES**, **MONITOR TOWER**, **SERVITUDE**, **ACCESS ROAD**, **BOY BOLLARD**, **WELLERSON FENDER**, **FILE CAP**, and **700 DIA. PILE**.

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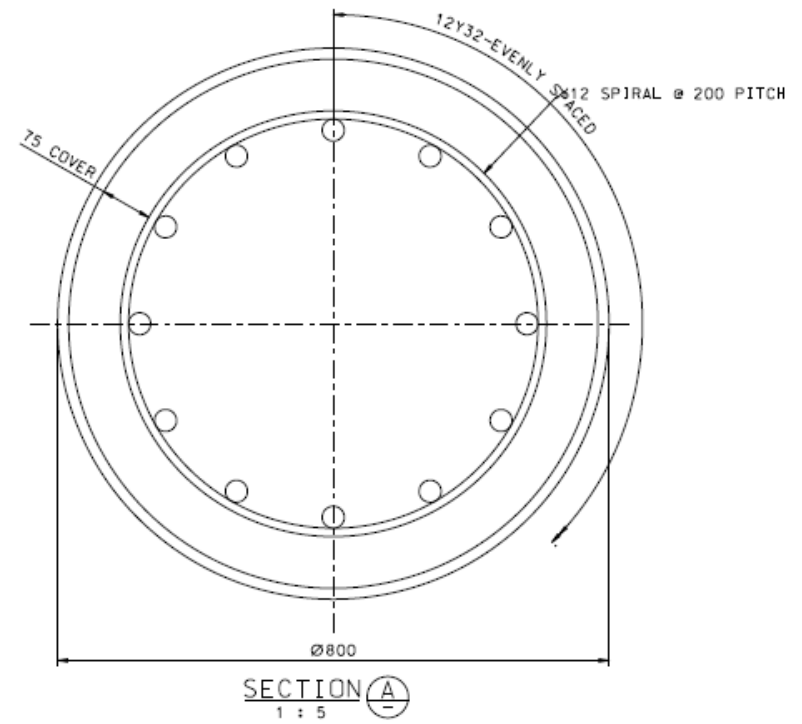
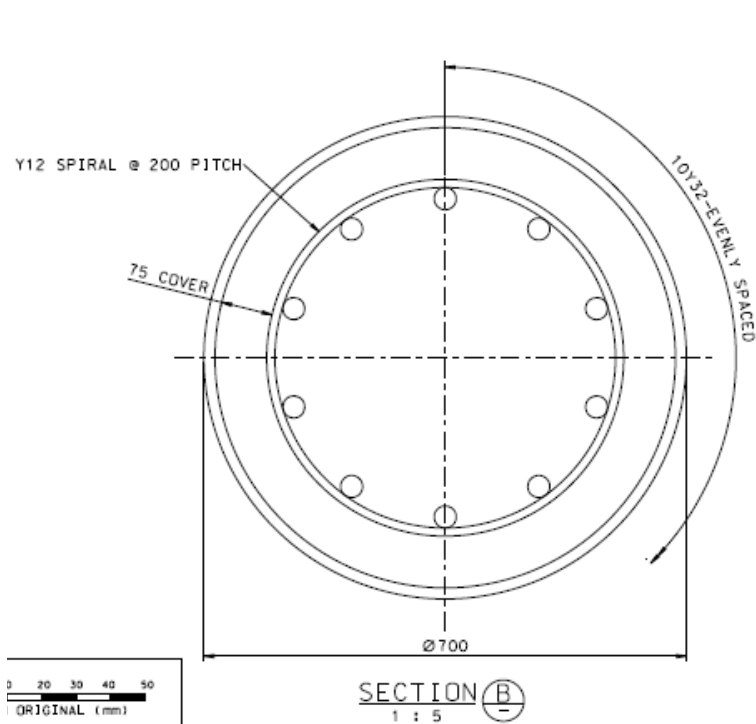
Piling load transfer considerations

- End bearing piles – bedrock too deep at 70 - 80m
- Friction piles – mostly sand, friction not very high
- Combination of the above – most suitable

Piles used

- Tubular steel driven piles with sacrificial casings
- Full load to be carried by reinforced concrete inside casing
- 73 dia. 700 and 5 dia. 800 piles
- Some piles raking to carry lateral loads
- Installation by vibration followed by top driving

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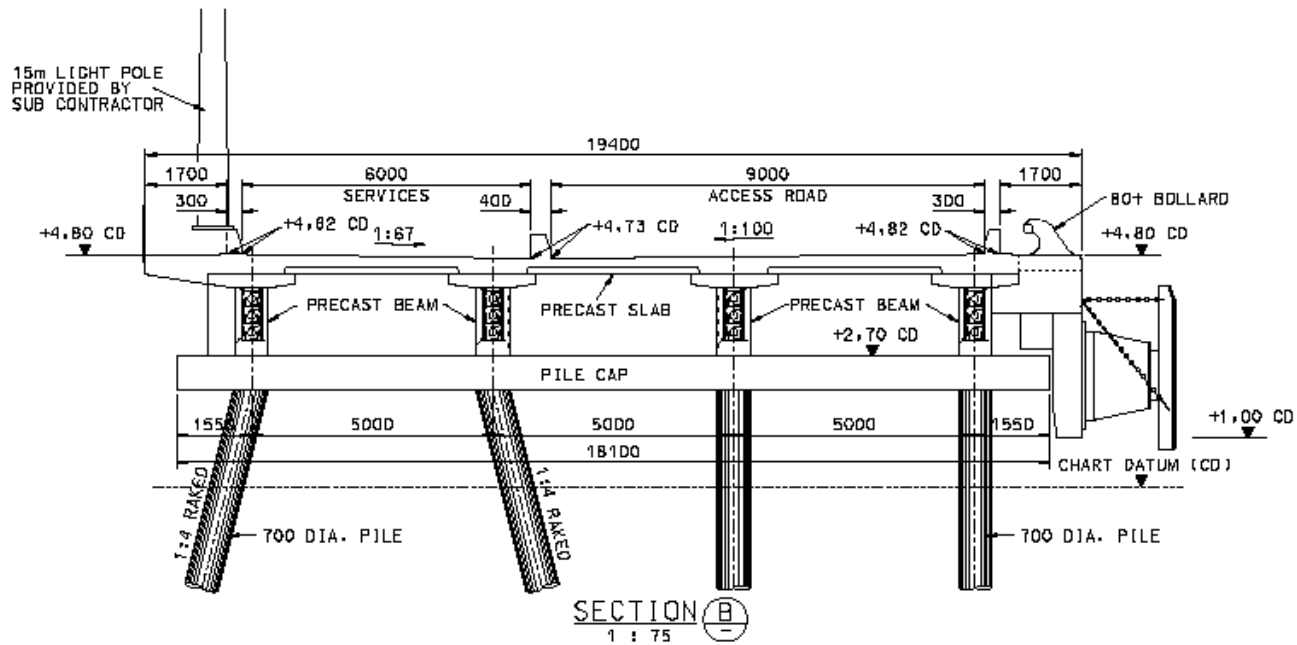
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Deck Structure

- Precast Elements
 - Beams
 - Slab panels
 - Fender panels
- Insitu reinforced concrete
 - Pile caps
 - Beam connections
 - Deck
 - Upstand walls
 - Foam monitor towers



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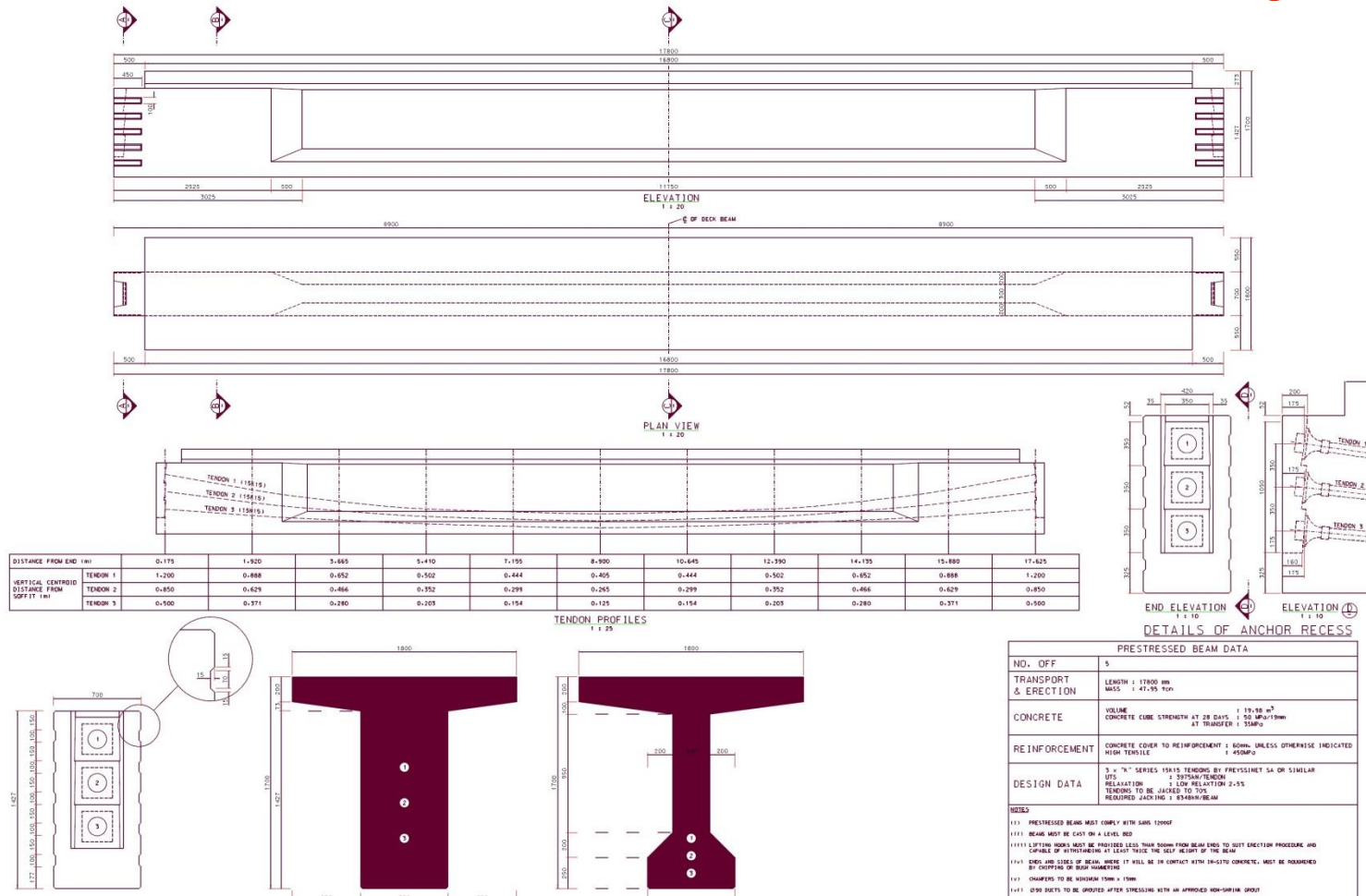


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Problems encountered and solutions

- Contractor's Problems
 - Pile testing
 - Cracks in precast slab units
 - Placing of precast beams during construction
 - Access to place beams after last pile in position
 - Swells caused by passing vessels – especially tugs
 - Cracks in walkway slab
- Design Problems
 - Cracks in some cantilever portions of the main deck
 - Cracks in upstand walls

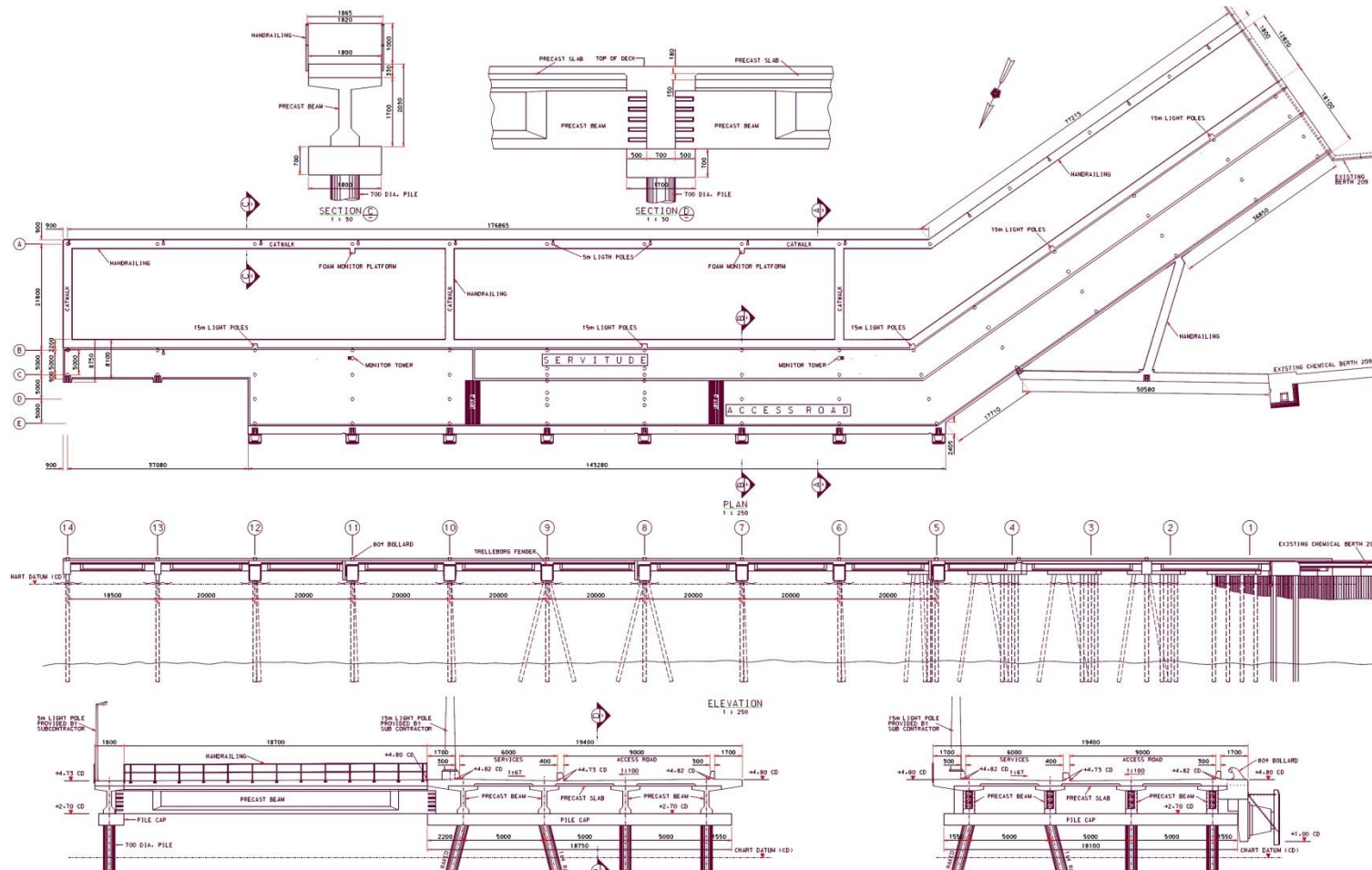
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Pile testing

- CAPWAP (Case Pile Wave Analysis Program) method of analysis
 - Safety Factor for working Load
 - Estimated settlement at 1 and 1.5 times design load
- Results
 - FOS of 1.82 compared to 2.00
 - Predicted settlements within prescribed 15 and 18mm respectively
 - 58% of load carried in end bearing



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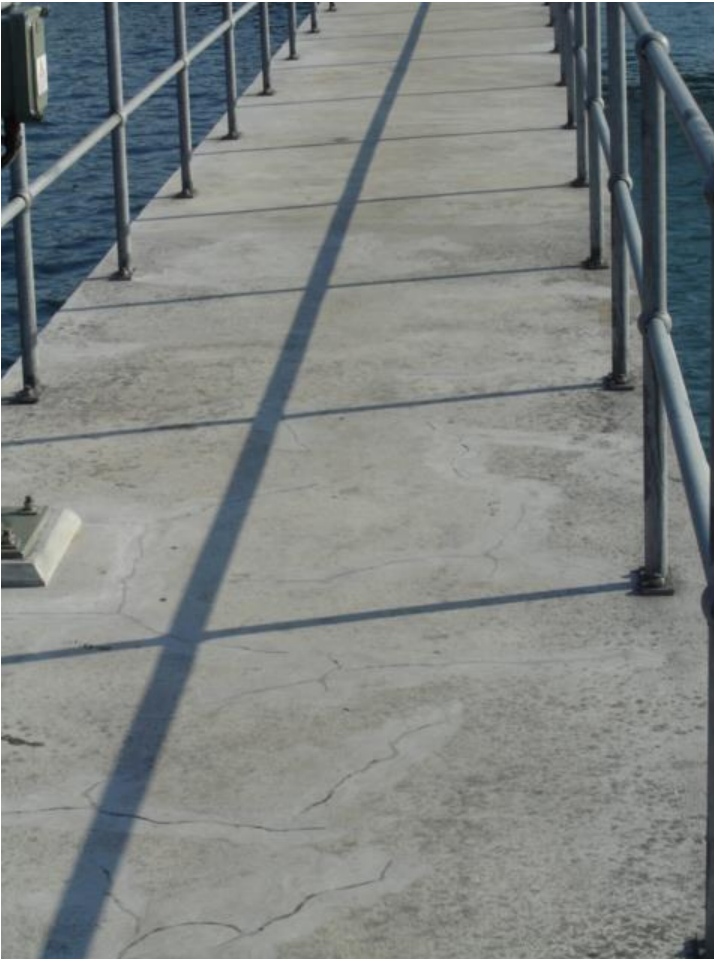


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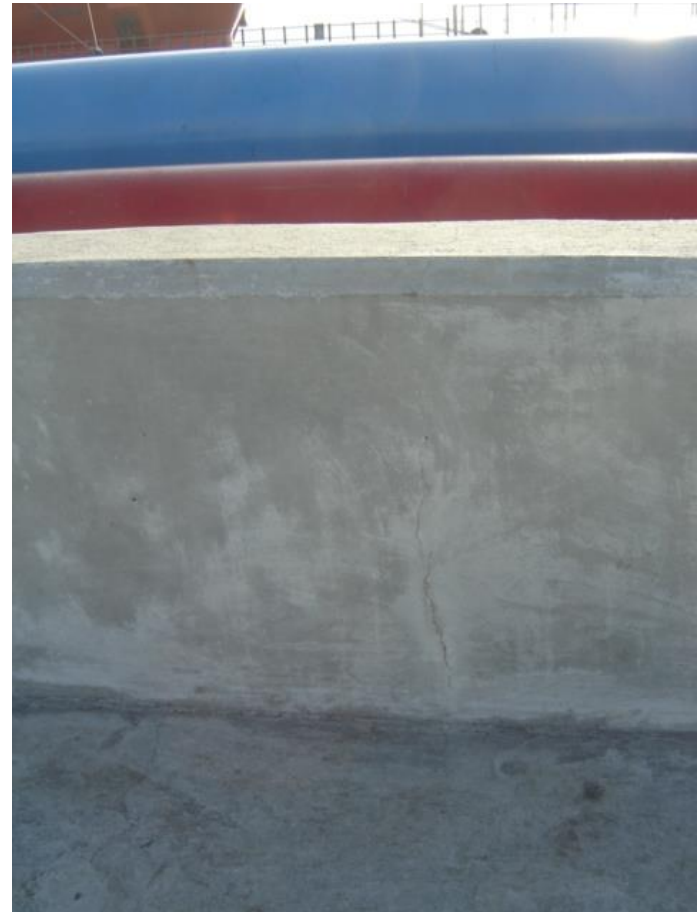


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Lessons learnt

- Do not specify beam weight on construction drawings
- Ensure that prestressing sleeves can fit between the reinforcing
- Have sufficient construction joints in smaller elements i.e. bund walls
- Get Contractor to cast adjoining concrete elements at the same time



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