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Discipline's involvement

Port of Richards Bay: New Chemical Berth 208

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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

Design criteria and assumptions

- Vessel Loading
  - Mooring

    Bow, stern and breasting, 3 per end at 20m centres, ± 10m behind cope

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

    Eight fenders at 20m intervals along cope over ± 140m

    Set forward of the cope to prevent pile damage

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

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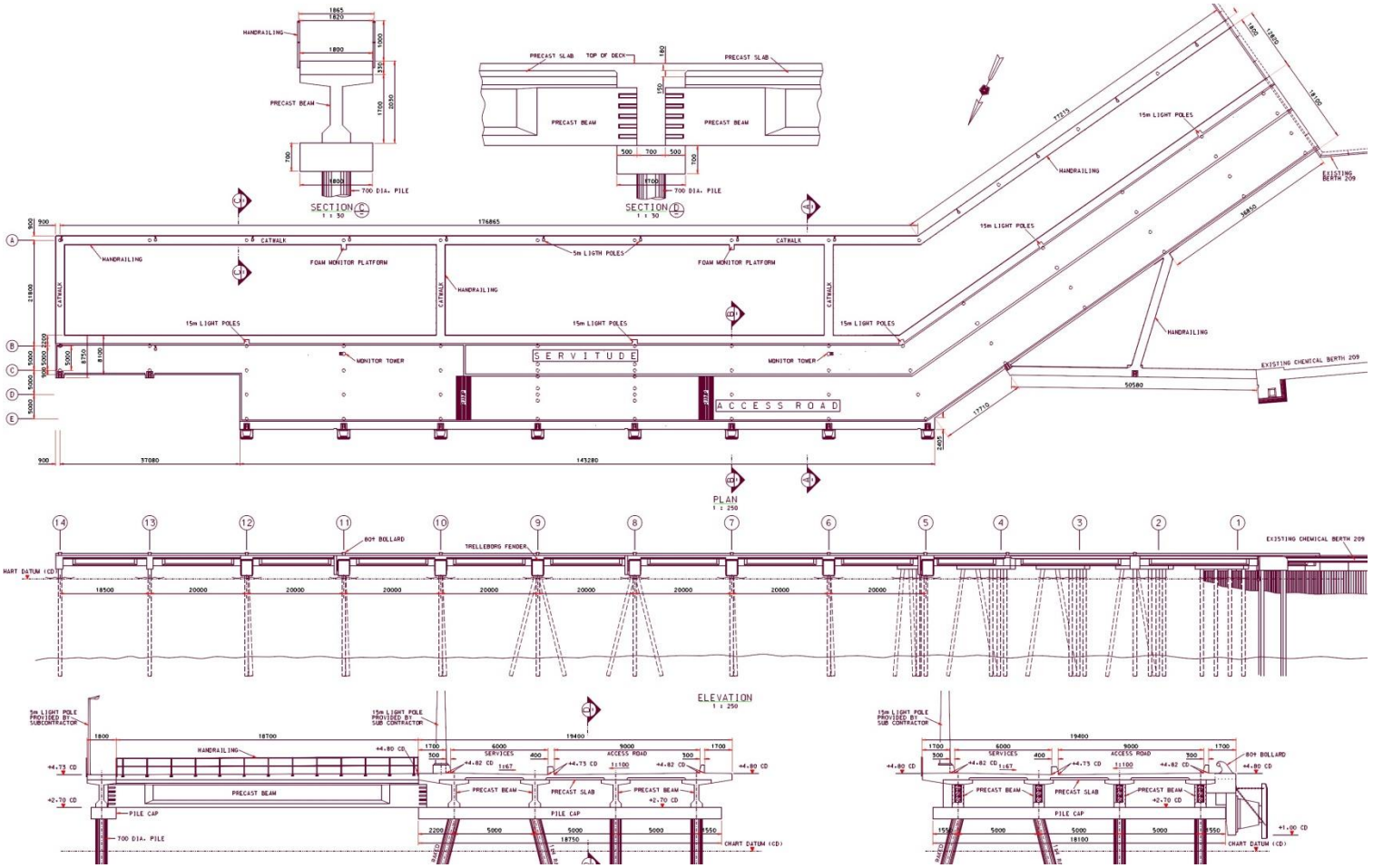

Piling load transfer considerations

- 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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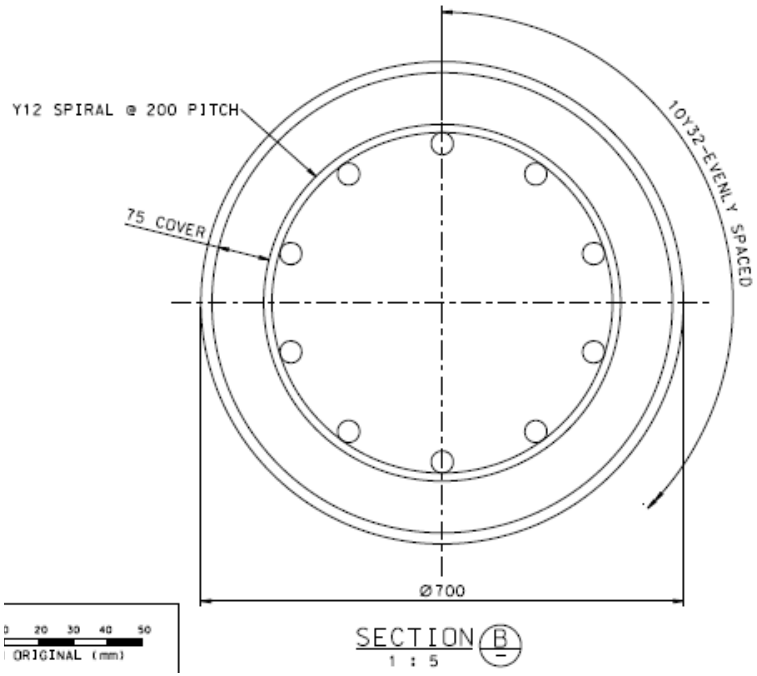

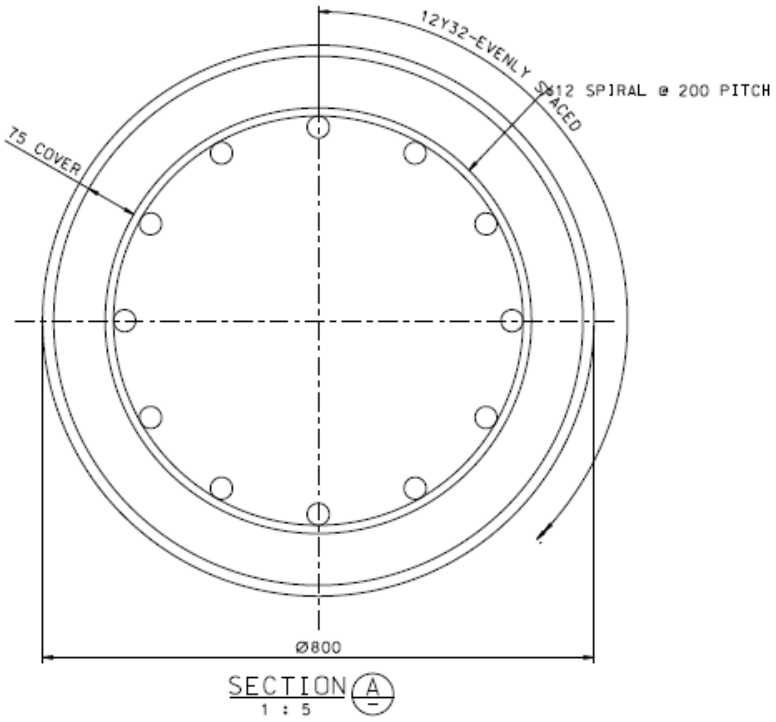

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Deck Structure

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

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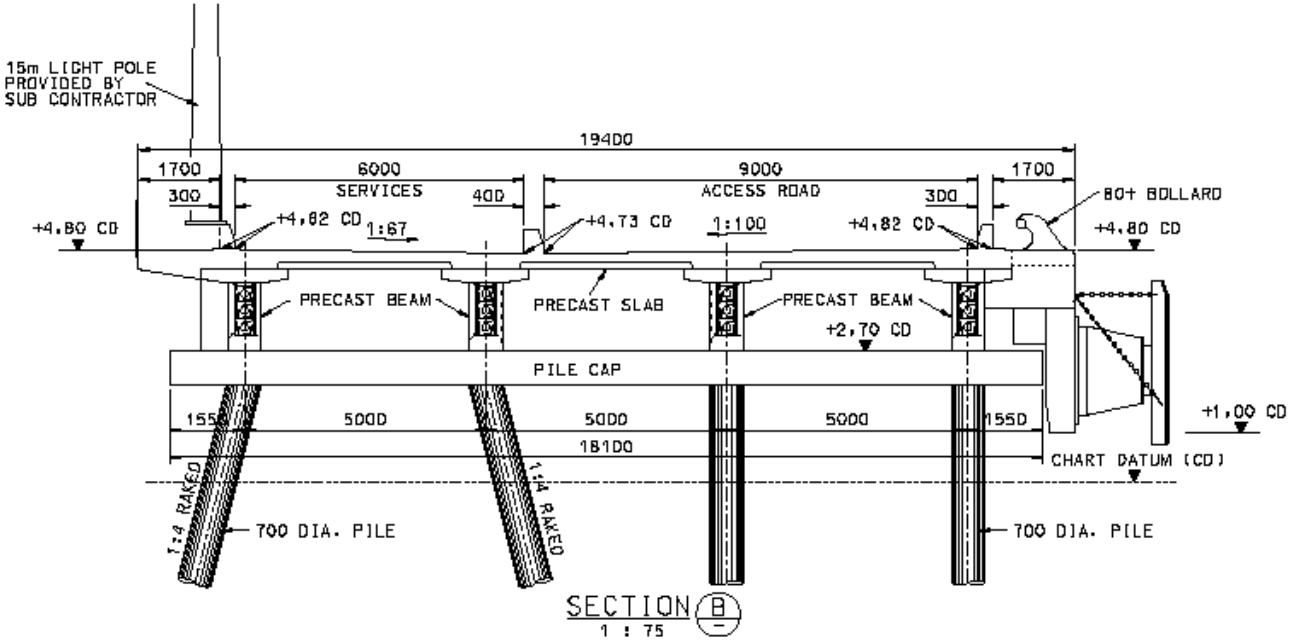

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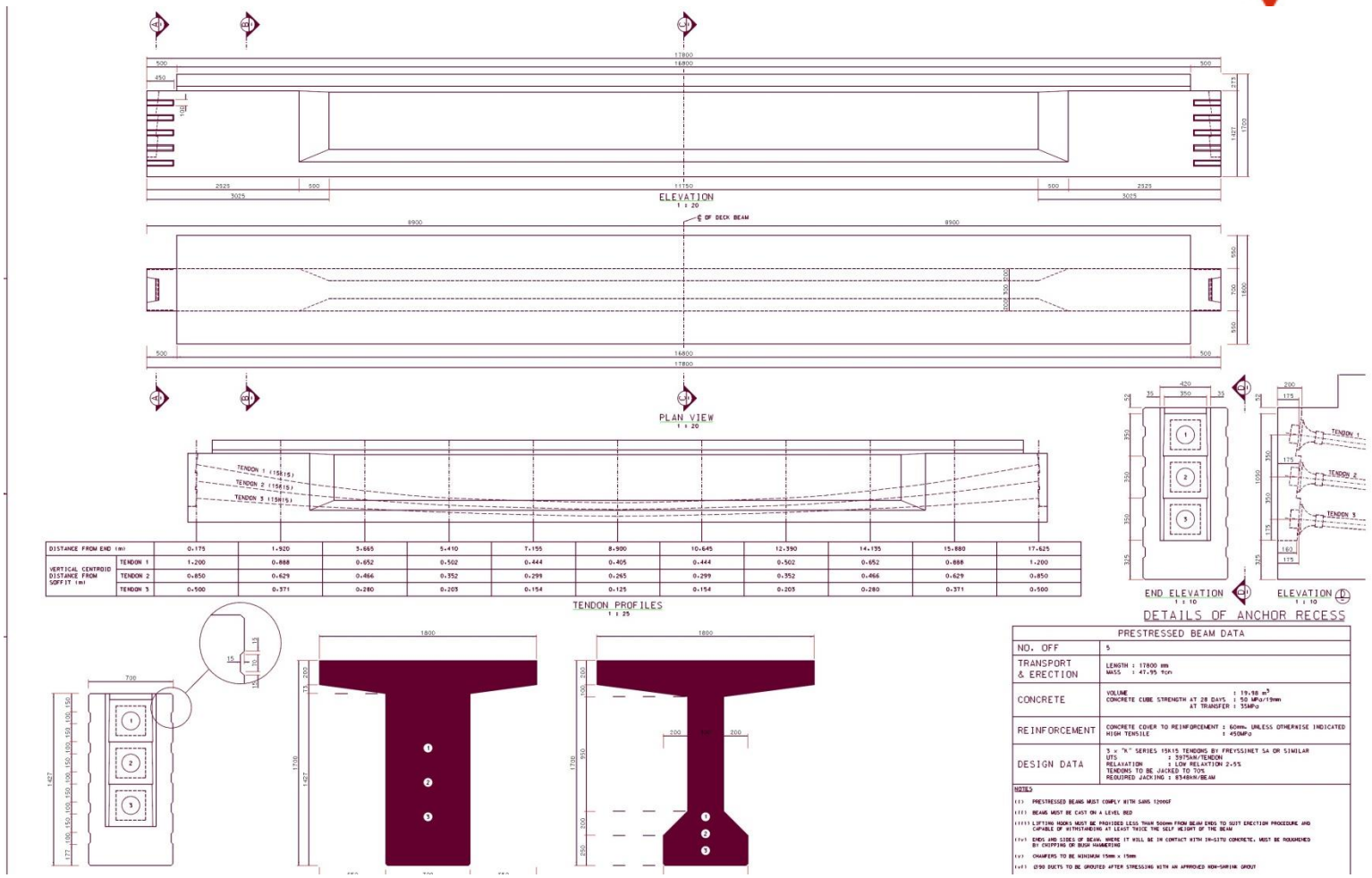

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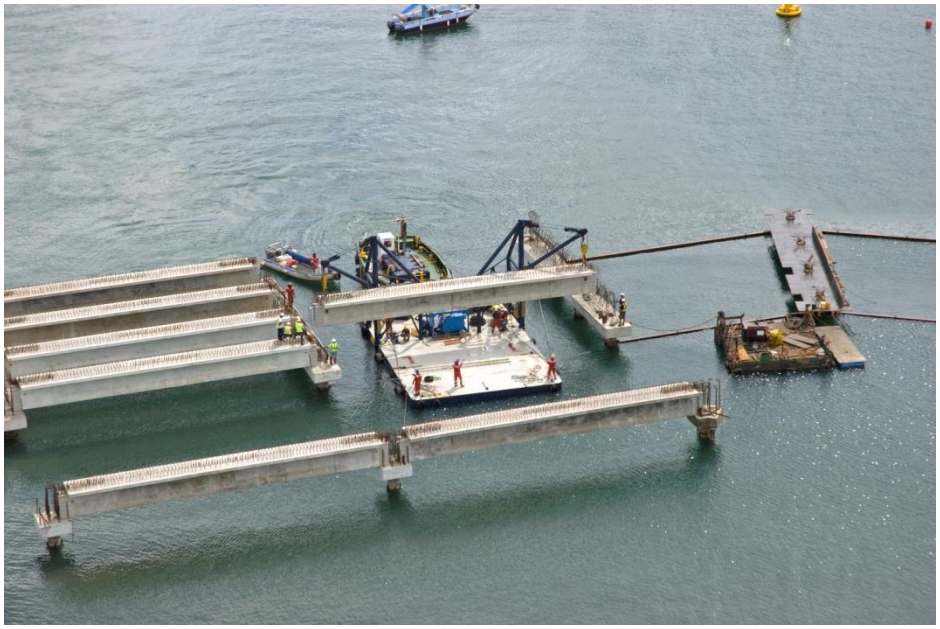

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Problems encountered and solutions

- 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

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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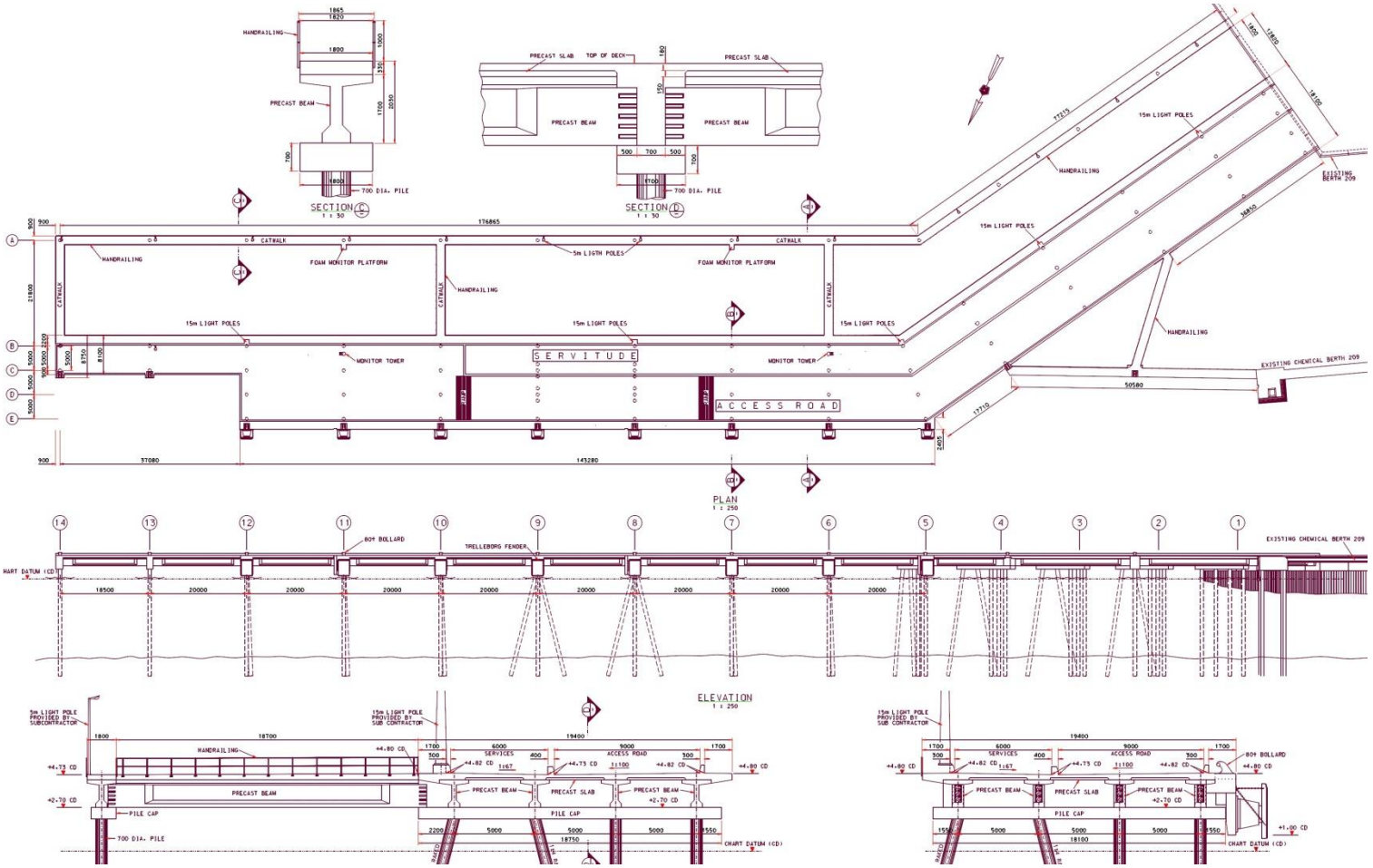

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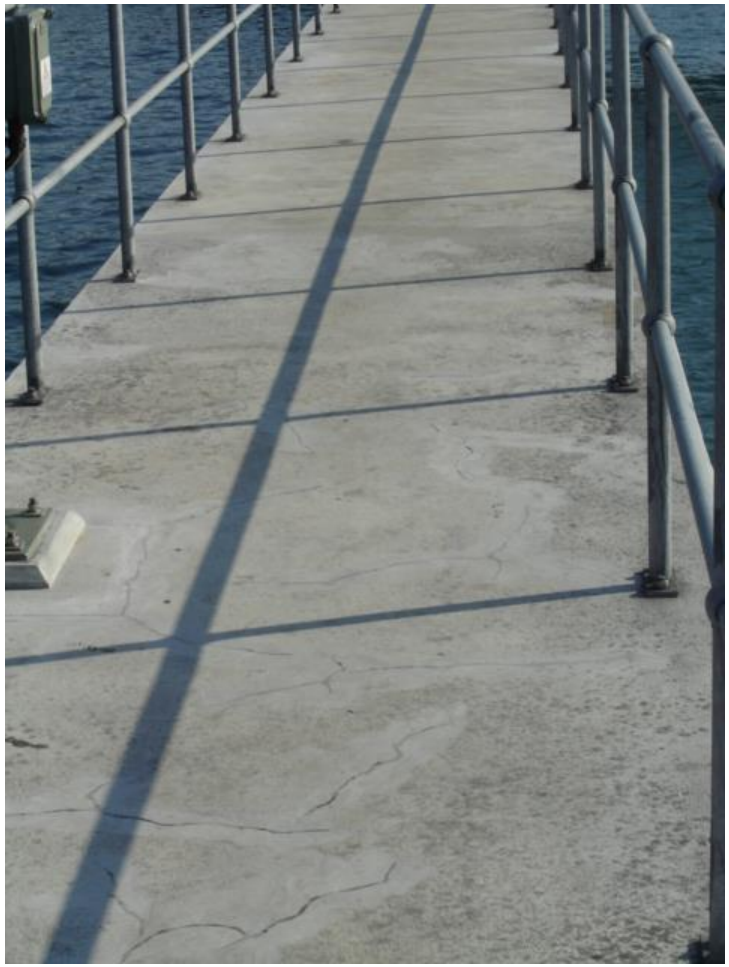

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Lessons learnt

- 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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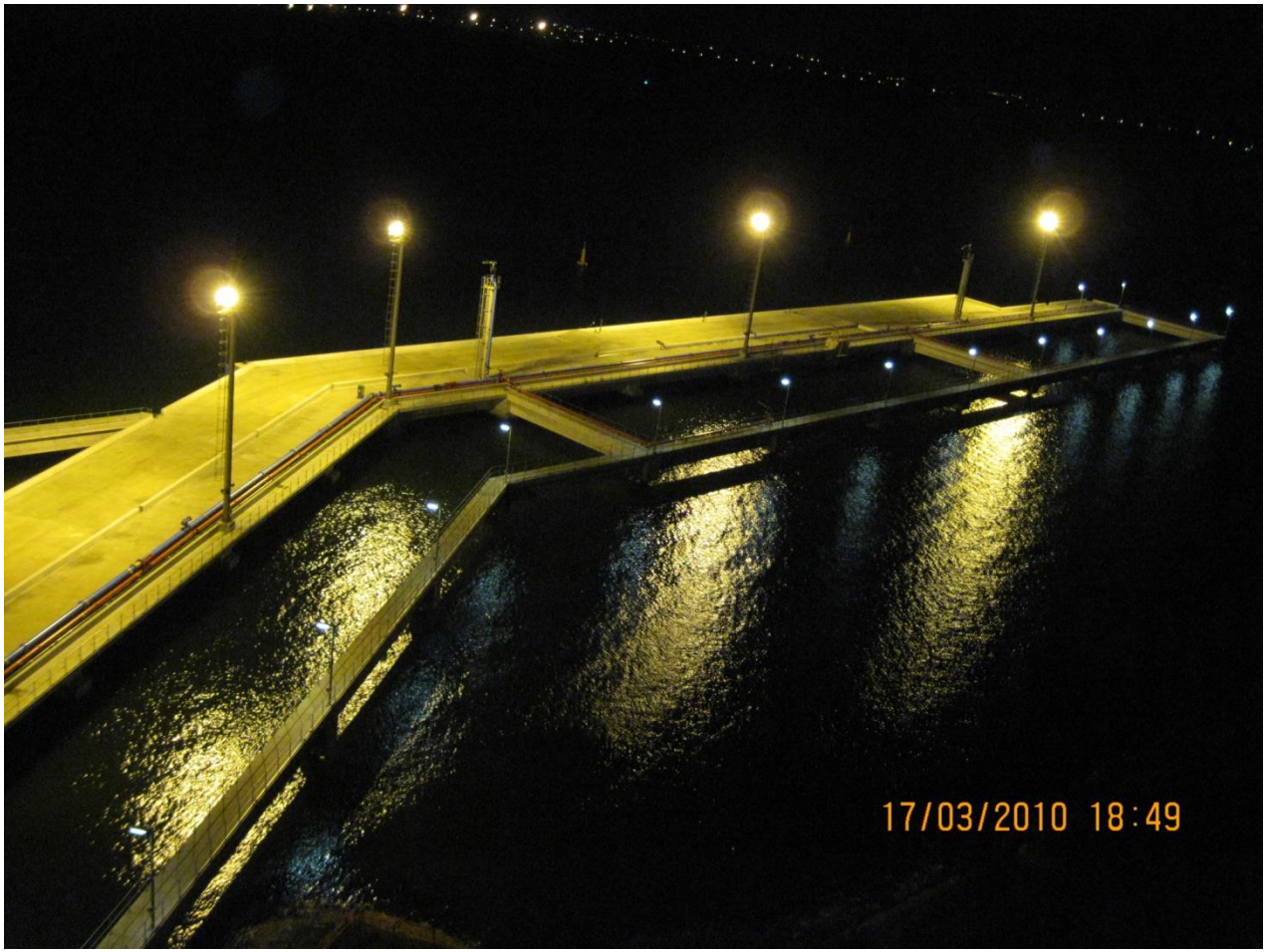

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