CONSTRUCTION OF WATER RETAINING STRUCTURES USING THE SEMI-CAST METHODOLOGY

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CASE STUDY DETAIL

The construction of water retaining structures are high risk. The need to ensure water tightness is imperative to meeting the program durations for testing, installation of mechanical equipment and commissioning activities. Delays caused by leakage could add weeks to the program with repairs and additional testing also being costly. On most projects, an in-situ water retaining structure is a critical path activity.

The approach of using off-site manufacturing and fabrication leads to higher efficiencies with lower risks and costs on site.

Semi-cast Construction Advantages:

Simple construction: The basis of the Semi-cast construction approach is that the "difficult-to-construct" elements of the works (vertical, suspended and complex profiles) are manufactured off-site leaving the "simple" slabs on ground and vertical joints to be constructed on-site.

Safety: There are a number of safety risks associated with an in-situ method of construction that are reduced when using the Semi-cast system. These include:

- Reduced activities working at height: Rather than working at a 5m height with scaffolding, the work can be done using Elevated Work Platforms (EWP's) only when constructing the stitches and removing lifting equipment when placing the panels.
- Manual handling issues reduced: No need to tie large amounts reinforcing bar for walls. Only need to tie simple straight bars for stitches. Reducing the risk of back injuries and cut/abrasions.

Program benefits: The program to construct the tanks using a conventional in-situ methodology was anticipated to take 12 weeks of on-site works. The program to construct the tank using the Semi-cast technique was 6 weeks, halving the duration of a critical path activity.

Semi-cast adds value by shortening the construction period, requiring less man-hours on site, improving quality and reducing safety risk. The productivity per person per day on site is greatly increased with only "simple" slabs on ground and vertical joints.

Versatility: The Semi-cast solution can reflect exactly the design-required configuration by building the panels in a controlled environment. Semi-cast is not a proprietary product nor post tensioned, rather the implementation of a typical reinforced concrete construction process using both precast and in-situ construction techniques. For the Mirani WRF, different precast profiles including cast-ins and cut-outs were fabricated.

Value of the In-Situ Joint: The in-situ joint is sometimes regarded as being inefficient however the Semi-cast approach succeeds for the following reasons;

- Tolerance: the joint provides a transition between elements, eliminating the requirement for impractical precision in setting-out and resulting in a smooth overall appearance and functionality.
- Induced Stresses: the Semi-cast solution delivers a 'relaxed' structure prior to the imposition of dead and live loadings rather than mechanically connected solutions
- Two-Way Spanning Solutions: by analysing the design in both orthogonal directions, the structure becomes more efficient than using conventional precast approaches
- Low Cost In-Situ Vertical Component: the placement of in-situ reinforcement in the stitch joint is limited to a small number of vertical bars. Typically 30% of the vertical structure is locally sourced ready-mixed concrete, allowing the precast manufacture of complex shapes off site.
- Structure sequence with no pre-stressing: the absence of pre-stressing and mechanical dry-jointed interfaces allows the structure to be sequenced in the manner of in-situ works with no high-risk zones.
- Joint Integrity: the concept is often criticised on the linear meterage of joints in the walls, however joint integrity is based on the distance between joints and not the length of joint. Typically construction joints may be formed at 6m to 12m centres resulting in accumulated thermal and drying shrinkage strains at these locations, the strains in the Semi-cast joint is usually limited to 0.5m with the benefit of a hydrophilic strip, scabbled interface at each end and the precast unit having long completed its shrinkage.

Figure 1 shows the Semi-cast design of the Mirani WRF. Note the different wall heights, cast-ins for pipework and cut-outs for decanters/weirs.

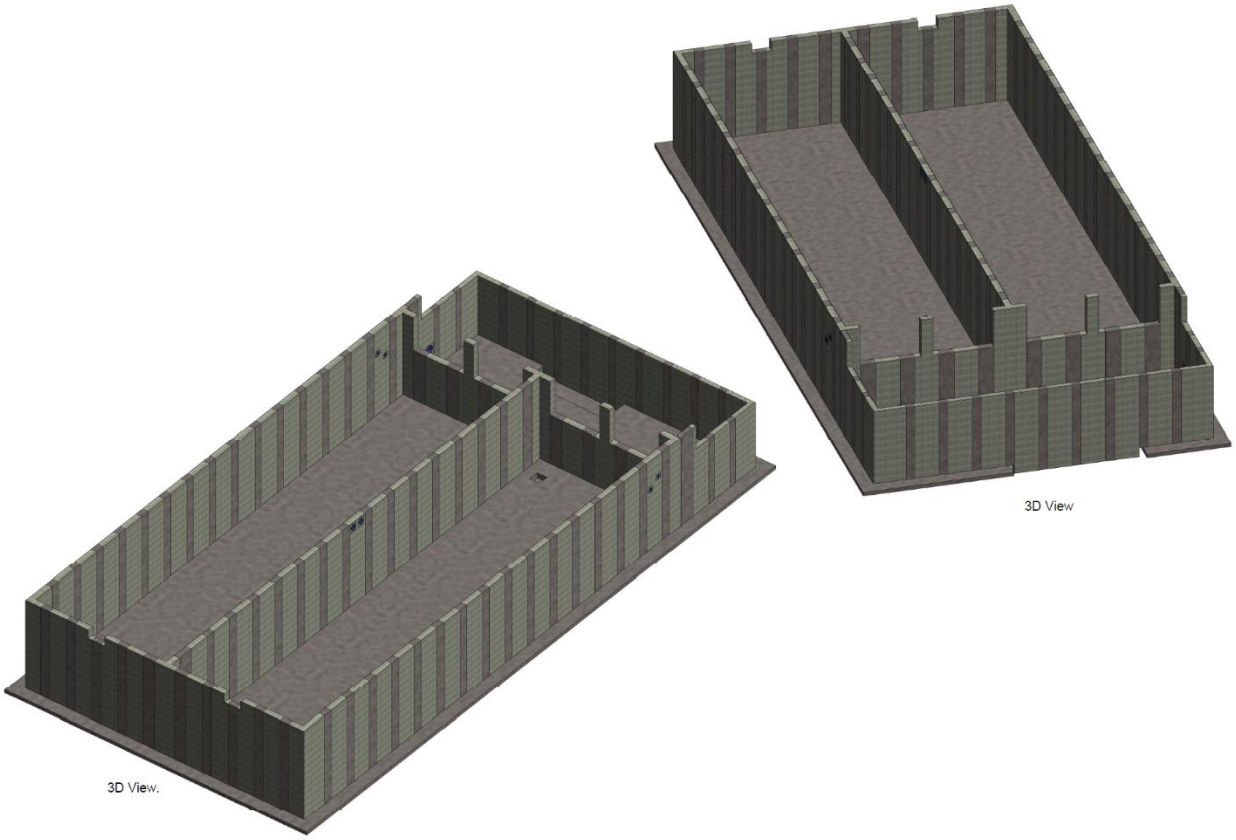


Figure 1: Mirani WRF Semi-cast design

Photo 1 is an example of the Semi-cast panels similar to those used for the Mirani WRF.

Photo 1: Semi-cast panel

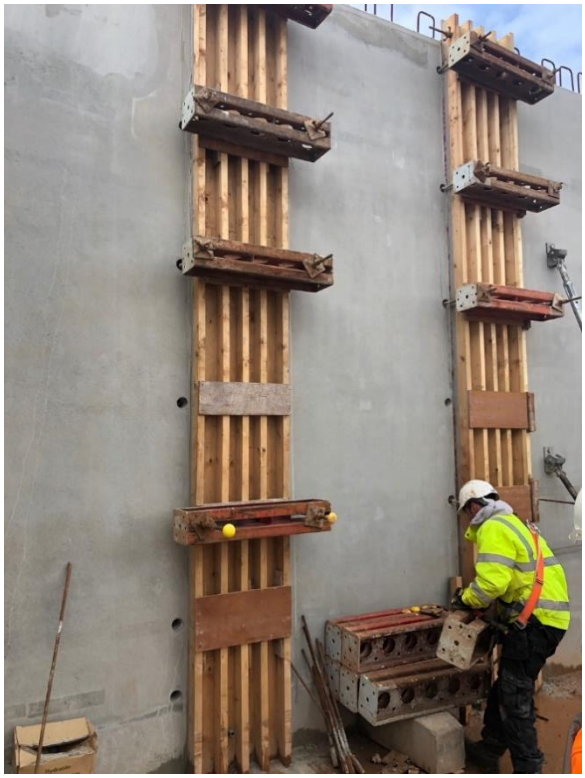
Photo 2 shows a lifting device used for lifting the panels into position

Photo 2: Semi-cast lifting device

Photo 3 shows the in-situ joint associated with Semi-cast system. Note the blockouts for attaching the in-situ joint formwork, scabbling of joint interface and hydrotite strip in rebate, all part of the precast panel supply.

Photo 3: Semi-cast in-situ joint

Photo 4 shows the formwork installation of the in-situ joint and a completed in-situ joint. Blockouts are grouted prior to completion.



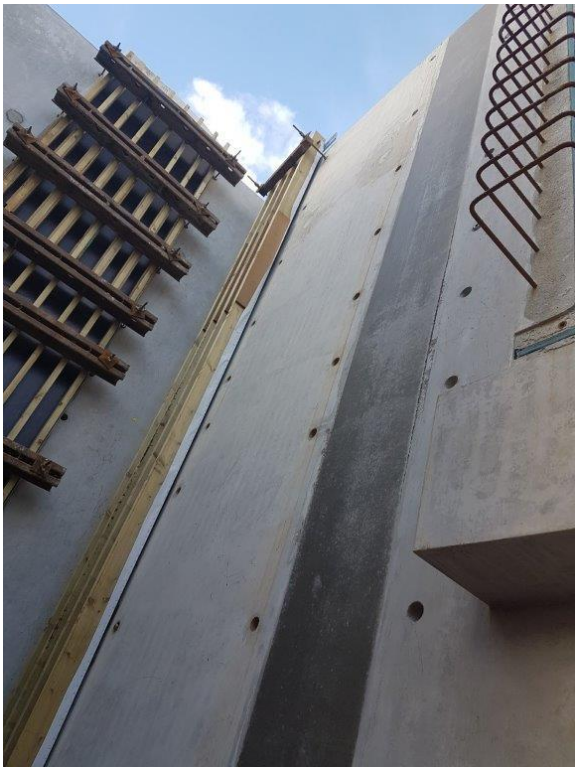


Photo 4: Formwork of in-situ joint and a completed in-situ joint

Photo 5 shows panels lifted into position. Floor reinforcement is being undertaken. Rather than using scaffold, pedestrian access is via walkways (missing reinforcement between panels) later replaced at end of work activity. After floor is poured, in-situ stitches can be completed.

Photo 5: Erected panels at the Mirani WRF