

PORT BOTANY CONTAINER TERMINAL EXPANSION PROJECT

Questions & Answers

Counterfort Units being used for the new container terminal

Q. What is a counterfort and what is it made of?

- A. In general terms the entire unit is called a counterfort. In engineering terms the word counterfort comes from the triangular tie-back part of the unit (buttress) which acts as a tension brace strengthening the connection between the wall and the base section to reduce bending and shear stresses.

Counterforts are used in cantilever walls, in this case used to retain the reclaimed sand, with a height greater than 8 to 12 m. When used in port construction these types of walls provide a vertical face for ships to berth against.

The counterfort units are made from high quality, durable reinforced concrete.

Q. What does a counterfort do?

- A. The counterfort units are used to make up the outer wall of the new container terminal with a concrete beam (cope or capping) cast on top providing an anchor point for ships to berth.

Q. How many will there be?

- A. The outer wall of the new terminal against which the ships will berth consists of 199 counterfort units with an additional 17 units used for the tug wharves. In total 216 units will be used on the Port Botany Expansion project.

Q. Have counterforts been used in construction before?

- A. The history of the use of counterfort units in wall construction dates back to the 12th Century. The units have been used in many projects around the world in various applications involving deep excavations.

Q. Has this design been used on other wharf construction projects in Australia?

- A. The existing Brotherson Dock adjacent to the new container terminal is constructed from counterfort units with a single central triangular tie-back (or buttress). The new counterfort units to be used on this project have been refined and rationalised to gain further efficiencies in structural design by increasing the overall width of the unit and introducing twin triangular tie-backs.

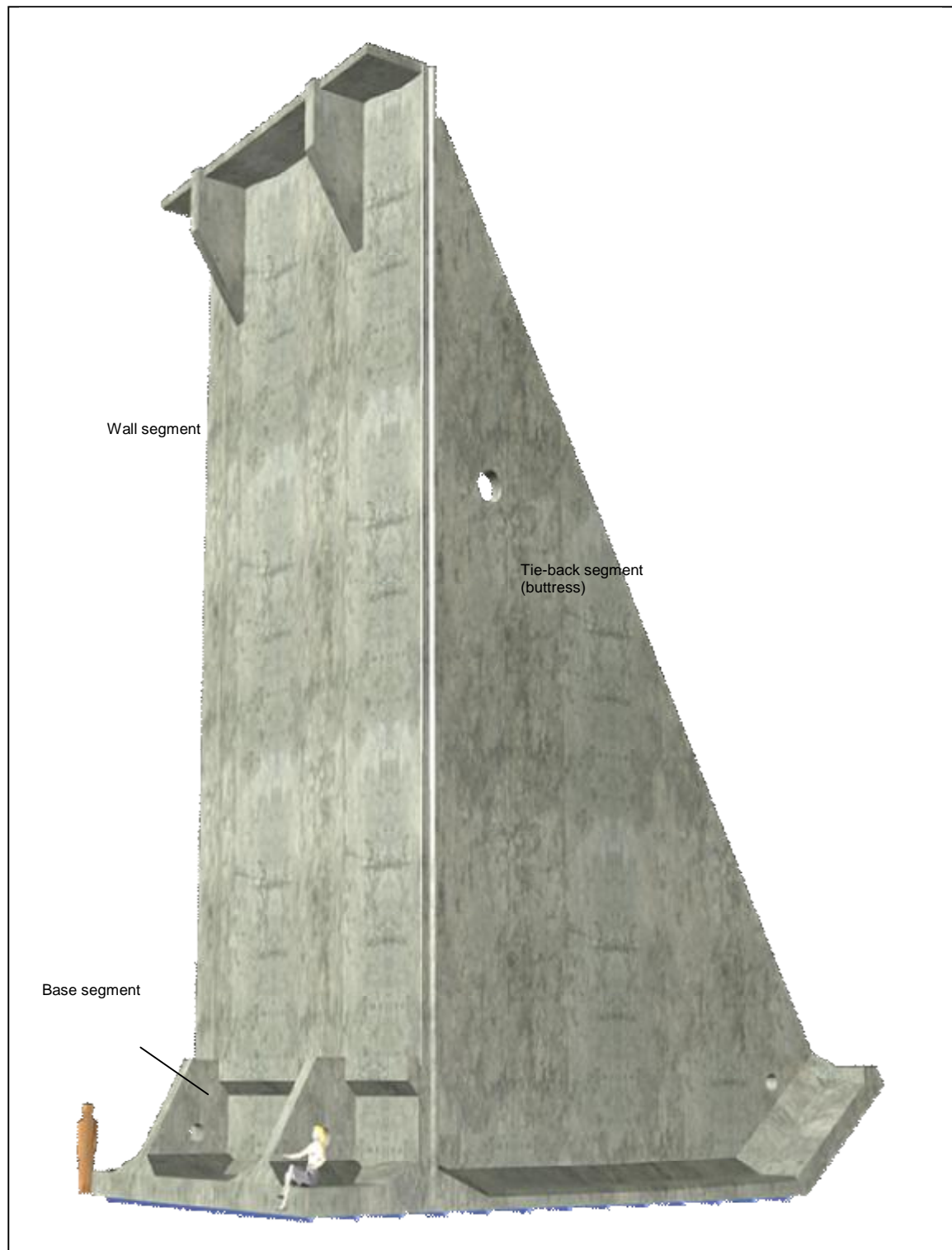
Q. How heavy are the counterfort units?

- A. The counterfort units used for this project comprise 3 components – base, wall and buttress. In total each counterfort unit weighs 640 tonnes.

Q. How tall are the counterforts and what are the dimensions?

- A. The counterforts units used on this project have a width of nine metres (along the wharf length), a height of 20 metres (equivalent to a seven storey building) and a base length of 15 metres, with twin triangular buttresses spaced. (see image)

Figure 1. Assembled counterfort unit





Q. What technology has been used in the design of the counterfort walls?

- A. The design of the counterfort walls has been carried out using various methods, cross analysis and comparisons.

Structural design methods consisted of computer modelling of single and multiple units with hand calculations used to provide a broad base check on the results from the computer analyses.

For the geotechnical design of the foundation for the counterfort units specialist design analysis software was used to examine bearing, sliding, overturning and analysis for earthquake response.

Q. How are the counterforts constructed?

- A. The counterforts are made in three sections - the base, the wall and the triangular tie-backs (buttresses). The completed sections are then assembled to make the one complete unit. Each section is cast onsite using purpose built steel formwork.

The steel reinforcing for each section is pre-assembled on site and then lifted into the form for pouring the concrete.

Q. Why are the units left on the dock?

- A. The completed units are transported to a lay-down (storing) yard for up to 28 days to allow the concrete units to cure prior to placement in water.

Q. When will the units be installed?

- A. The construction sequence is to manufacture and complete assembly of the units, then lift into place at the rate of one unit per working day. This process commenced at the end of May 2009 and will continue through to July 2010.

Q. How are the counterforts installed?

- A. A purpose built lifting barge has been fabricated and will be fitted out with two shear legs that will act as a crane to lift the counterfort units from the load out wharf to their designated position.

Q. How are the units transported?

- A. The three individual section of the counterfort units are lifted from the purpose made formwork by a ringer crane. Situated in the middle of the precast yard, this crane is capable of lifting 310 tonne. The sections are then assembled using the ringer crane and two x 280 tonne crawler cranes.

The completed counterfort units are then transported using two x 48 wheel self propelled modular transporters (SPMTs) capable of lifting the assembled counterfort unit (approximately 640 tonnes). The SPMTs travel at 1km/h down the Haul Road to the load out wharf where the units are lifted by the barge-mounted shear leg crane for transportation and placement in the Bay.

Q. What will the counterfort units be lowered onto?

- A. The counterfort wall is designed to sit on a one metre gravel bed overlying a vibro-compacted backfilled sand base.

Q. What are some of the design criteria for the counterfort units?

- A. The units are designed for a 100 year life including an ultimate design earthquake event of 1 in 1000 year AEP as specified in the project specific technical criteria.

Q. Where are the counterforts made?

A. Each unit is made on site in the precast yard utilising the onsite concrete batch plant.

Figure 2. Counterfort precast yard



Q. How do I find out more about the construction phase of the Project?

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