PHYSICAL MODELLING OF ROCK BAGS FOR COASTAL PROTECTION APPLICATIONS

Dan Messiter, Royal HaskoningDHV, dan.messiter@rhdhv.com
Ian Coghlan, Water Research Laboratory, UNSW, i.coghlan@wrl.unsw.edu.au
James Carley, Water Research Laboratory, UNSW, james.carley@unsw.edu.au
Gabriela Lumiatti, Water Research Laboratory, UNSW, g.lumiatti@wrl.unsw.edu.au

INTRODUCTION

Storms in 2020 caused significant erosion at numerous locations along the NSW, Australia coast, including evacuation of many houses. Emergency responses included the deployment of a 250 tonne crane to lift 2 and 4 tonne Kyowa Rock Bags (Figure 1) onto Wamberal Beach, which overcame significant emergency constructability constraints. This formed a protective toe and was the first use of this technique on the open coast of NSW. Furthermore, a 120 m, 4 tonne Rock Bag structure was constructed at Stockton. Consideration of the potential broader use of Rock Bags for short to medium term protection prompted more research into the engineering effectiveness of the technology.

INNOVATION

Textbook solutions to coastal engineering challenges may not be feasible due to: budgetary, construction and materials limitations; environmental and socio-political drivers; and project timing. Including the need for an emergency or temporary response requires innovative solutions.

Innovative solutions in a risk averse society face difficulty gaining acceptance among stakeholders and industry. For Rock Bags, physical modelling was undertaken on this previously untested technology at the Water Research Laboratory (WRL) of UNSW. This reduced the project risk and significantly reduced the volume and size of rock required compared to traditional rip rap and layered armour. Furthermore, Rock Bags are also easy to remove.

ROCK BAG PRODUCT

Rock Bags are a product developed by Kyowa in Japan to protect against erosion from hydraulic processes in riverine, lake, coastal and marine environments. Within Australasia, the Rock Bags are imported and distributed by Bluemont.

The behaviour of Rock Bags in shallow water, coastal environments had not previously been assessed in a physical modelling study. Bluemont has already provided Rock Bags as a temporary or emergency coastal protection unit for seawalls located at the back of some beaches in NSW (such as, Wamberal Beach and Collaroy Beach). Since this is an emerging erosion protection application for Rock Bags, Bluemont wanted to assess their hydraulic stability using scale model laboratory tests. At the commencement of the project, Royal HaskoningDHV (RHDHV) was designing an interim seawall comprising 4 tonne Rock Bags at Stockton Beach, NSW, for the City of Newcastle.

PHYSICAL MODEL TESTING

Physical modelling (approximately 1:20 scale in the 1.2 m wave flume at WRL) of the stability and overtopping of the Rock Bags in a back beach revetment arrangement typical to the open coast (Figure 2) are presented in this paper.

The Stage 1 objective was to assess hydraulic stability under generic design conditions. That is, the offshore bathymetric profile in the physical model was broadly representative of many Australian beaches, and the wave period-water level combinations were representative of Stockton Beach as well as many other coastal locations across Australasia.

Stage 2 of testing examined distinctive aspects of the Stockton Beach design following the commencement of its construction. Design wave and water level conditions specific to Stockton Beach were used to examine how two different structure slope and crest elevation options affected the hydraulic stability of the Rock Bags and the mean wave overtopping rate over the seawall.

Figure 1 -Kyowa Rock Bags

Figure 2 -Flume testing of Kyowa Rock Bags

STUDY OUTCOMES

Key outcomes were the quantified hydraulic stability of the pattern placed units used by RHDHV to verify the stability of the Stockton Beach seawall design and the development of generic stability design curves that can be used by engineers in applying this technology elsewhere.