ANALYSIS OF WAVE LOADING ON SEA DEFENCES

Location: Fistral beach, Newquay, UK
Project Dates: December 2014
Clients: Geo Consulting Engineering

Scope of Work:
- Estimation of wave set-up at the structure from nearshore wave buoy measurements
- Prediction of tidal elevation using a calibrated harmonic method
- Estimation of 1 per cent exceedance atmospheric (wind and inverse barometric effect) surge statistics using tide gauge data and a Monte Carlo method
- Weibull analysis of a peak wave height time series to predict the 5, 10, 20, 50 and 100 year return significant wave heights at the structure toe for different toe depth scenarios.

PROJECT DESCRIPTION

This project involved the development of a simple bespoke model that was used to estimate the return wave heights at the toe of the sea defences at N. Fistral, Cornwall, UK.

The current defences are located (toe ≈4.6 m ODN) above the spring water level (3.4 m ODN), and are only directly impacted by waves during conditions of low beach levels (an eroded beach), high tide and significant surge.

The total surge level is a summation of the effects of high waves, low atmospheric pressure and onshore winds. Wave height at the base of the structure is, under most (storm) conditions, depth limited. Thus, it was essential to provide a good estimate of the water depth at the structure toe. This required accurate predictions of tidal levels and surge.

The combined (wave, pressure and wind) surge and tide at Perranporth were used to predict seven years (2007-2014) of wave heights at the toe of the structure for different beach level scenarios, including measured beach levels in January 2014 (≈3.5 m ODN) after the severest storm sequence in over 60 years and the extreme case where the beach is eroded down to estimated location of the bedrock (≈1.5 m ODN).

Storm damage at Fistral beach café after the winter storms of 2013-2014.