Development of 2D and 3D Numerical Model of Fluidity on Coastal Structure

1. Numerical Simulation of Wave Overtopping and Overflow at Coastal Dykes

During typhoon attack generating storm surge and rough waves, wave overtopping and overflow generate against coastal dykes. These complex phenomena are reproduced by numerical model, CADMAS-SURF2D.
It is supported that in the phenomenon compete overflow by high water level and severe wave overtopping are co-generating.
Figure 1 shows the water height and current distribution in front of and behind coastal dykes in 2 time steps after overtopping wave. The hydraulic jump is observed because the wave propagating to behind the coast dyke is strong due to shallower water depth by wave intrusion. A number of vertical whirlpools are formed behind coastal dykes and the counter current occurs near the bottom.

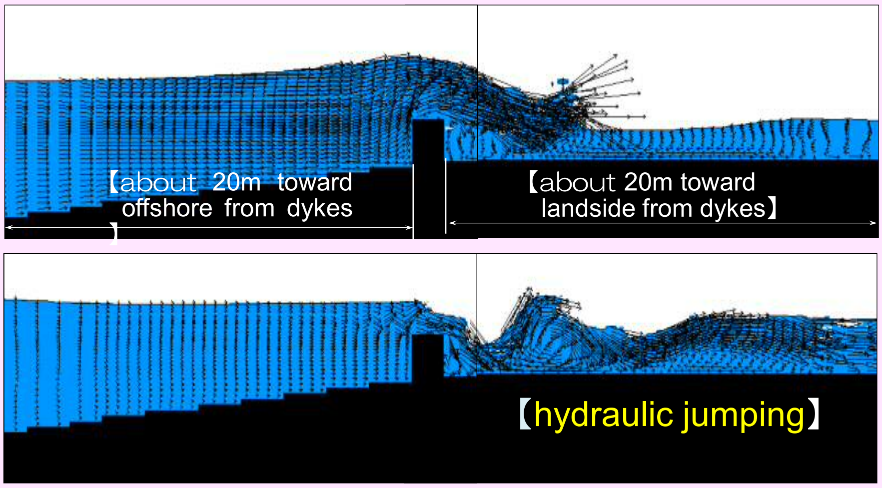

Figure 1: Numerical Simulation of Wave Overtopping and Overflow at Coastal Dykes in case of High Water and High Wave Condition

CADMAS-SURF2D/3D: SUper Roller Flume for Computer Aided Design of MAritime Structure developed by PARI (Port and Research Institute) in Japan

2. Numerical Analysis of Current around Islands in Strong Tidal Current

CADMAS-SURF3D is applied to reproduce the complicated flow pattern around island in the strong tidal currents.
The calculation area divided into 20 topographical grids with 5m vertical layer. High-Reynolds-type k-ε 2-equation is used as the turbulence model.
Figure 2 shows the flow pattern and the turbulence energy distribution. The direction of main flow and the that junction are also indicated. The area with strong turbulence emerges at a starting point where tidal pattern is formed, and becomes the area of stripe identical with the tidal pattern. In the area of the sea like this, it can be confirmed that the eddy of flows down with gaining its strength. Because the location of tidal pattern becomes convergence region, the vertical descending stream generates.

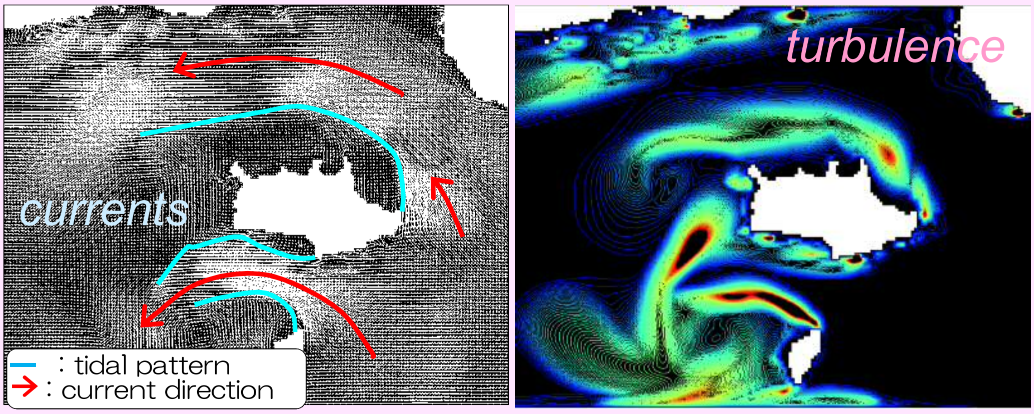

Figure 2 : Numerical Analysis of Current and Turbulence Energy around Islands on the Belt of Strong Tidal Current

3. Numerical Simulation of Tsunami Runup in a Group of Buildings

Direct numerical solution of 3D Navier-Stokes equations is shown as an example.
Using unstructured grid it is enabled to express complicatedly distributed structure with excellent precision and the turbulence model is introduced in the 3D fluidity analysis code.
Figure 3 is a snapshot of tsunami approaching to a group of tank site after wave run up. It can be confirmed that the height of tsunami becomes lower when the tsunami is propagating to the tank of landside after wave transformation at the tank near shoreline. It is also confirm that the tsunami jump up in front of the tank and the height of tsunami behind the tank becomes lower.

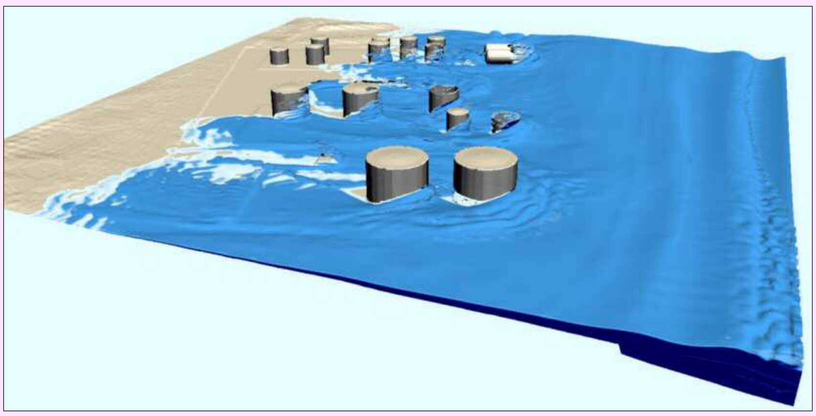

Figure 3 : Numerical Analysis of Tsunami Runup to a Group of Structures