Analysis of deformation of embankment during earthquakes

【Example of application to embankment ①: embankment at Shiribeshi-Toshibetsu river】
Among the damaged embankments at Shiribeshi-Toshibetsu river during 1993 off Southwest Hokkaido earthquake, the embankment No.1 cross section which suffered the largest settlements of 267cm is selected for analysis by FLIP TULIP.

The location of Shiribeshi-Toshibetsu river relative to the epicenter of the earthquake is shown in Fig. 1. The cross section of embankment at No.1 site and deformation after the earthquake are shown in Fig. 2.

Acceleration time history and Fourier spectra of input earthquake motion used for the analysis are shown in Figs. 3 and 4. This motion is obtained by equivalent linear analysis at the bottom of Ac2 layer as E+F wave from bedrock motion, which was obtained by the recorded ground surface motion at Suttsu observatory during 1993 off Southwest Hokkaido earthquake (Matsuo et al, 1999).

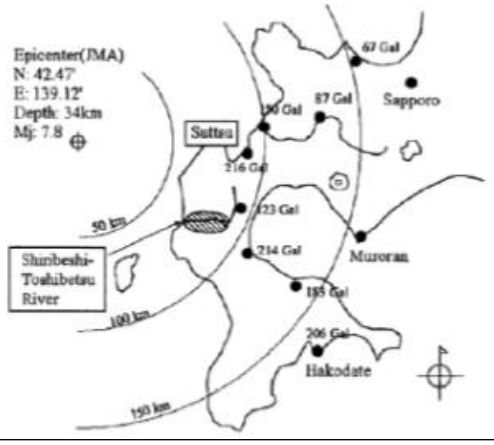

Fig. 1 Locations of Shiribeshi-Tobhibetsu river and the epicenter of 1993 off Southwest Hokkaido earthquake (Katsuyama et al, 1994)

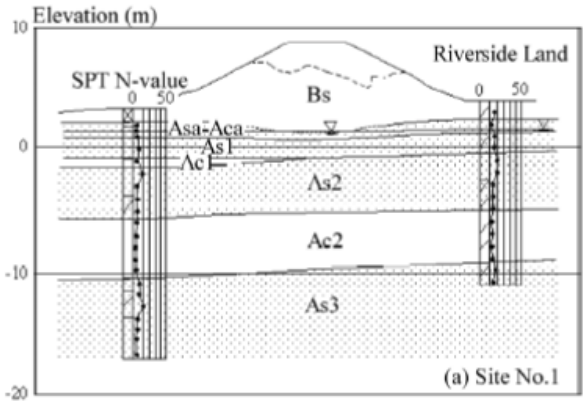

Fig. 2 Cross section of embankment and deformation (broken line) after earthquake (Matsuo et al, 1999)

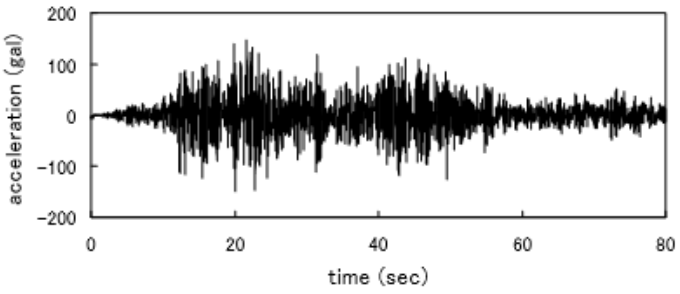

Fig. 3 Time history of input earthquake motion

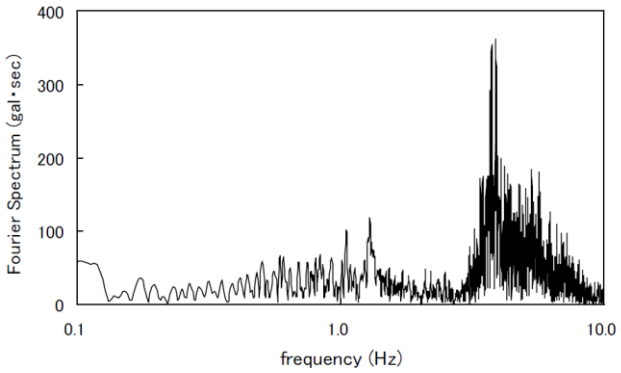

Fig. 4 Fourier spectra of input earthquake motion

Finite element mesh for analysis is shown in Fig. 5. This mesh is made in reference to Imono et al (2008). Boundary conditions are rigid bottom boundary and viscous lateral boundaries and free field response are also considered. Ground water table is set at top of Asa～Aca layers.

Computed deformation and excess pore water pressures by FLIP TULIP are shown in Fig. 6.

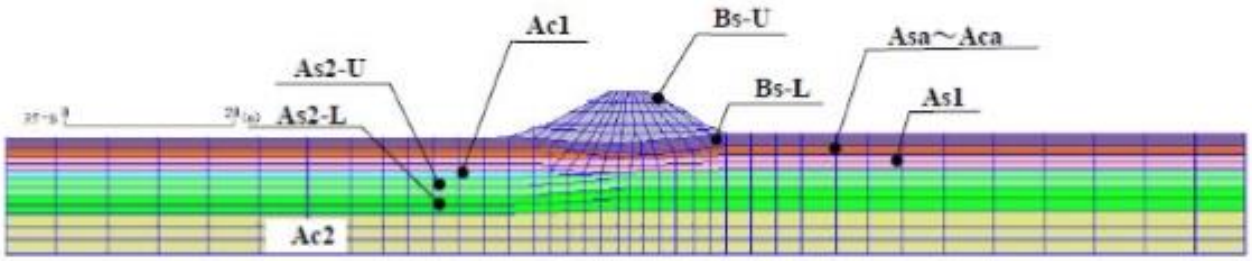

Fig. 5 Finite element for analysis

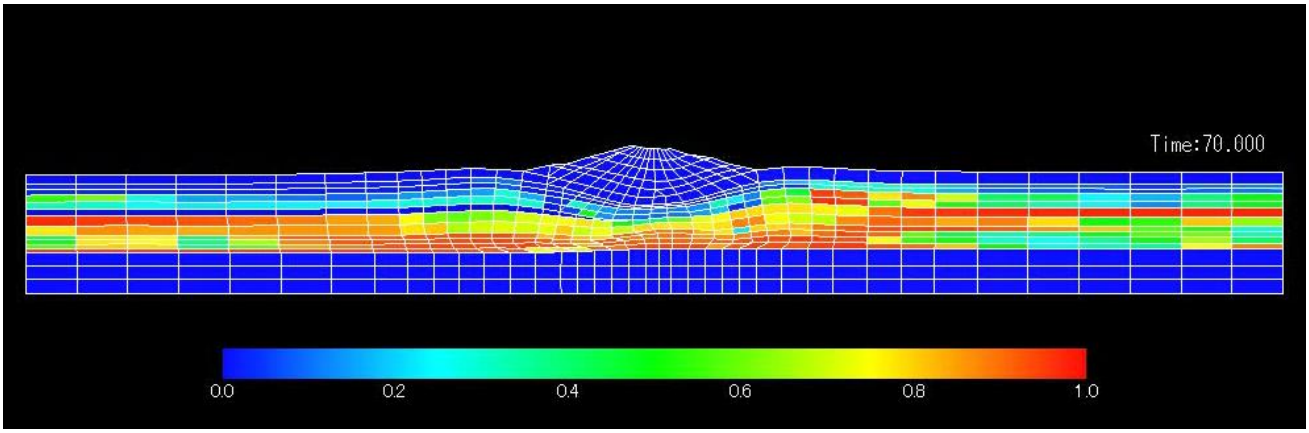

Fig. 6 Computed results by FLIP TULIP