

## Disaster prevention - liquefaction measures -

Recently Japan has been exposed constantly to natural disasters such as the Great East Japan Earthquake, the Kumamoto earthquake, Kinugawa dike breakage and flooding as well as localized heavy rains and landslide disasters occurring in Hiroshima. People are concerned about the increase in disaster risks in the future.

It's imperative that preparation is undergone with respect to disaster risks for urban facilities that are becoming more sophisticated and complex, particularly in big city areas.

During the 2011 off the Pacific coast of Tohoku Earthquake, there was large scale damage occurring due to the "ground liquefaction phenomenon" in areas surrounding Tokyo Bay as well, which is far-removed from the epicenter. Due to this liquefaction, not just the subsiding and slanting of roads, there is also extensive impact on utilities like the uplifting of water pipes and water supply failures. This means that the phenomenon give a major impact not only by the ceasing of operations at a place of business, but also on shore protections, tide embankment, electrical substation facilities, energy storage facilities and building, and more which are important as urban infrastructure.

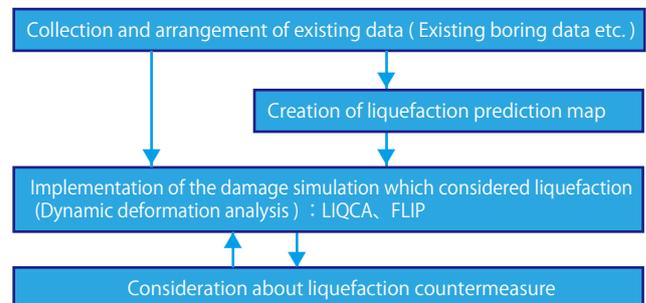
At Nikken Sekkei Civil Engineering, we conduct simulations of ground and structure behaviors occurring at the time of an earthquake and produce forecasts on the liquefaction damage to buildings and periphery facilities, civil engineering structures and others associated with liquefaction and deformation of the ground.

### Prepare for liquefaction

- Create liquefaction prediction map assumed at site
- Based on this, we will support the planning of important facilities, selection of priorities for liquefaction countermeasures, and selection of evacuation routes.
- We will predict liquefaction damage by applying analysis of dynamic transformation, investigate liquefaction countermeasures, and propose appropriate measures.

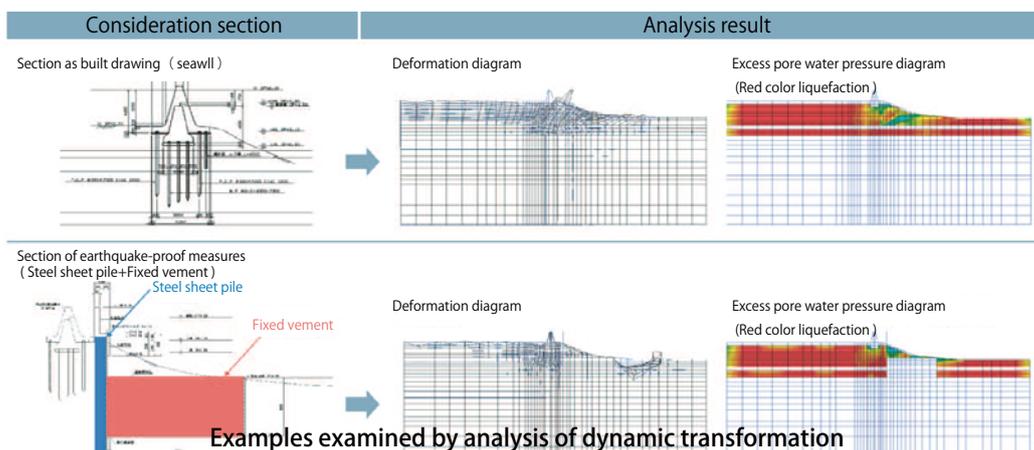
### Analysis procedure

- (1) Set the assumed seismic waveform.
- (2) The structure, the foundation and the topography which do liquefaction damage prediction are modeled.
- (3) The assumption seismic waveform is input to an analysis model, and the change amount is sometimes calculated every moment.
- (4) During an earthquake, the transformable amount after an earthquake and the damage degree of the target structure and ground are checked.



### The characteristic

- (1) Liquefaction prediction according to characteristics of assumed earthquakes
- (2) Prediction of the change amount with the liquefaction
- (3) Diagnosis of health and safety of facilities
- (4) Consideration of liquefaction countermeasure



( Liquefaction damage prediction and countermeasures examination by Tonankai and Nankai earthquakes for revetment and Seawalls )