4. Civil Engineering Research Laboratory

◆Numeric fluid analysis technology

[Objectives]

To make a cutting edge numeric analysis method practical and to improve the prediction accuracy of weather and tsunami, etc.

[Principal Results]

- In the light of the growing amount of surplus scrap, prototype electromagnetic flow analysis codes were developed for the design of a recycling system using electromagnetic or magnetic force to improve the recycling rate of aluminium.
- A 3D body drag measurement technology using a large-scale vertical water tunnel was developed to clarify the wind load reduction mechanism for electric cables.
- A test on shifting sand by tsunami and a reproduction test by means of analysing typhoons and depressions were conducted and the accuracy of the already developed fluid analysis codes was verified using the test data.

◆Structural performance assessment technology

[Objectives]

To advance the nonlinear analysis and earthquake-proof test technology for structures and the structural performance assessment technology, etc.

[Principal Results]

- A hybrid dynamic test method for underground structures was developed by linking a numerical analysis model dealing with the elastic plastic behaviour of the ground-structure system with a loading experiment using a reinforced concrete member. Based on the test results using this method, the differences in the form of destruction corresponding to the depth of underground structures from the ground surface were clarified.
- A new method was developed to judge the soundness based on periodic and detailed survey results and the “Primary Draft Guidelines for Performance Verification Type Maintenance for RC Civil Engineering Structures in Coastal Areas” prepared last year were revised.

◆Earthquake risk reduction technology

[Objectives]

To develop an earthquake motion plotting and earthquake risk assessment technology and an earthquake resistance diagnosis technology for structures.

[Principal Results]

- Using the improved 3D underground geological structure model, simulation analysis was conducted featuring the Great Kanto Earthquake in 1923 and others to clarify the effect of a heterogeneous physical structure on the duration and amplitude of a seismic waveform.
- A 2D sloshing test using a vibration table was conducted, imitating a cylindrical tank equipped with a floating roof under long-period earthquake motion. The test results verified the applicability of general-purpose analysis codes.
- Featuring RC structures, the daily variation mechanism of the character frequency was clarified using the unique vibration identification method developed by the Laboratory. The applicability of this mechanism to the early diagnosis method for the deterioration of RC structures was assessed.

◆Geosphere environment behaviour prediction technology

[Objectives]

To advance the ground property assessment and groundwater behaviour prediction method as well as the method to assess the impacts of volcanic activities.

[Principal Results]

- Based on the laboratory testing of rock core specimens and the analysis of cracked sedimentary rock specimens, analytical codes were developed to assess the physical and dynamic behaviour of non-continuous bedrock.
- Basic geological data on the volcanic stratigraphy, thickness of each formation and mode of sedimentation, etc. was acquired for comprehensive assessment of the impacts of volcanic activities on nearby bedrock, including assessment from the viewpoint of disaster prevention.
- Based on a deep groundwater survey and field experiment using a research tunnel constructed under the seabed, a water circulation model for sedimentary basins was proposed. In addition, basic data on the quantities and types of organic matters affecting the dynamic state of trace substances, such as heavy metals, was obtained to clarify the dynamic state of trace substances affected by water-rock interaction.

◆Maintenance technology for civil engineering facilities for hydropower generation

[Objectives]

To systematize the methods to assess and analyse the impacts of civil engineering facilities in connection with large-scale natural disasters.

[Principal Results]

- Publicly available information on some 40 disasters involving hydropower plants in the past was examined and a disaster scenario was developed to outline the process leading to social impacts as a result of heavy rain, earthquakes or facility problems.
- 3D seismic response analysis using the dam height and seismic wave (observation records) as parameters was conducted for typical types of dam gates and the behaviour of each type of dam gate was clarified.
- A slope maintenance support system was developed for the ground around water channel structures, etc. This system using GIS is capable of centrally controlling geological topographical survey results and displacement measurement results and performing data analysis and ground stability assessment on the network.