

Results of Research on Anti-Seismic Method for the Existing Sewerage Facilities

Year of research

2009~2010

Promotion of earthquake disaster prevention

(Purpose)

After 1995 South Hyogo Prefecture Earthquake, a lot of sewerage facilities have been equipped with anti-seismic capacities. On the other hand, existing facilities (wastewater treatment plants and pump stations, etc.) constructed before the anti-seismic regulation which was stringent in 1997 after the severe damage of the earthquake have some technical problems, such as the problems of construction during operating the facilities and the problems of restriction of the construction space.

This study is purposed to get some information of the trend of recent anti-seismic design and to survey the application of possibilities to the sewerage facilities.

(Results)

(1) Research study on seismic technologies in other fields

From the research study on seismic design method in other fields, the method is changed to performance evaluation design in recent years, and the structure safety assessment innovates the advanced design by using dynamic analysis.

Table-1 Design Methods of Sewerage and Other Fields of Civil Engineering

Item	Sewerage	Other Civil Engineering
Seismic Movement	Level 1 Seismic Movement: Occurs a few times during structure's design service life Level 2 Seismic Movement: The maximum scale of movement within expectations	
Method of Seismic Design	External Force: Static analysis Evaluation of Cross Section: Allowable stress method, limit state design	External Force: Principally static analysis Evaluation of Cross Section: Examination of performance
Seismic Resistance of Structures	Level 1 Seismic Movement: Reserving sound functions Level 2 Seismic Movement: Not causing significant influences in functions	Affordable level of damage is regulated in criteria for seismic resistance by giving significance in types of facilities
Definition of Damage	No detailed levels of damage defined	Level of damage is defined regardless of levels of seismic movement and level is determined by considering significance and scale of movement
Criteria of Significance	Currently not available for WWTPs and Pumping Stations (important force main is determined)	Significance is determined by functions of facilities

(2) Study on anti-seismic methods

Research on applicable anti-seismic methods (about 200 methods) for pipes, treatment plants and pump stations was made and the methods were summarized in reinforcement points. In addition, a flowchart for the anti-seismic methods was made to select right methods easily.

(3) Study on applicability to sewerage facilities

To evaluate the effectiveness of applying advanced design, the case studies against the real structural object of type-I (water tank object) and type-IV (complex object) were conducted by using dynamic analysis.

The safety of the frame gets higher than the traditional method in type-I, and the reinforcement volume could be decreased, the total costs of reinforcement construction and design could be reduced by 20%.

The safety of the foundation pile gets higher in type-IV, and the significant costs could be reduced than the traditional method. They are just the results of the two case studies, but they showed the effects of the advanced design.

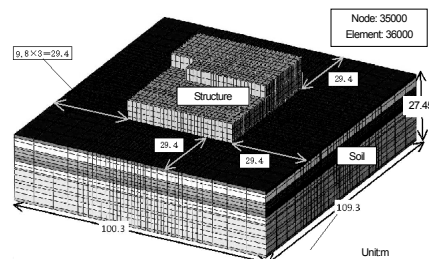


Figure-1 Simulation Model (type-IV)

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Key words

Technique of Seismic Design, Anti-Seismic Method, Dynamic Analysis, Decreasing Reinforcement Volume, Advanced Design