

Introduction to Dr. Okubo's Paper Entitled "Aseismic Considerations of Transportation Systems"

Damage to underground water pipes can be traced back to the 1923 Kanto earthquake, and it was well recognized from the early days that seismic effect was important in the construction of underground structures. It was not known, however, how seismic effect could be included in the design and construction of underground structures. In the late 1960s, field measurements and shaking table experiments gradually showed that ground deformation developed during an earthquake induced deformation in underground structures. This finding led to the development of new seismic design for underground structures embedded in subsurface ground. This was first designated as the "seismic deformation method" when the "new seismic design method" was developed as the final accomplishment in a five-year research project by the Ministry of Construction in 1977.

In the 1960s and 1970s, Dr. Okubo took the leadership in developing seismic design methods for underground tunnels, pipelines, and bridges. Transportation of aviation petroleum was a critical requirement for the new Narita International Airport. Because no alternatives for transporting aviation petroleum other than pipeline embedded under national roads were possible in congested urban areas, it was important to protect pipelines and roads against seismic effects. When the law for petroleum pipelines went into effect, a seismic design method for petroleum pipelines was included in the notice on technical detailing on petroleum pipelines in 1973. This was the first mandated requirement for underground structures in seismic effects. Subsequently, seismic design based on the seismic deformation method has been extensively used for underground structures.

Dr. Toshio Iwasaki, head of the Ground Vibration Division of the Public Works Research Institute of the Ministry of Construction at that time named this method the "seismic deformation method." The author, a researcher of the Ground Vibration Division at the time, proposed calling it the "deformation method." Because "deformation method" was widely used in computational structural analysis, Dr. Iwasaki suggested adding "seismic" to "deformation method."

As shown in his paper, Dr. Okubo contributed greatly to clarifying the failure mechanism of seismic damage, and compiled technical knowledge on seismic effect in various design codes. His interest extended beyond underground structures to bridges, roads, and dams. He expanded the foundation of seismic design of civil infrastructures in the early days of earthquake engineering.

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