Upgrading of Method for Setting Large-scale Earthquake Ground Motion that Acts on Dam Foundation

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Key words: Level 2 earthquake ground motion, attenuation formula (empirical approach), semi-empirical approach

1. Introduction

For the earthquake ground motion to be set in evaluation of the earthquake resistant performance of dams, the distance attenuation formula [1)] (empirical approach), which was prepared based on the record of earthquake motions measured on the dam foundation, has often been used. Meanwhile, due mainly to the accumulation of new findings obtained from fault investigations by government institutions, semi-empirical approach has been also used considering more detailed information on epicenter, etc. Then, by conducting detailed analysis on correspondences between estimated values obtained by empirical and semi-empirical approaches and measured values, we refer to the applicability of both approaches and aim to improve the accuracy of design external force.

2. Method of setting earthquake ground motion in dam

Generally, the nature of earthquake ground motion at a certain point is expressed in the combination of three elements: source characteristics, propagation path characteristics, and site amplification characteristics (see Figure 1).

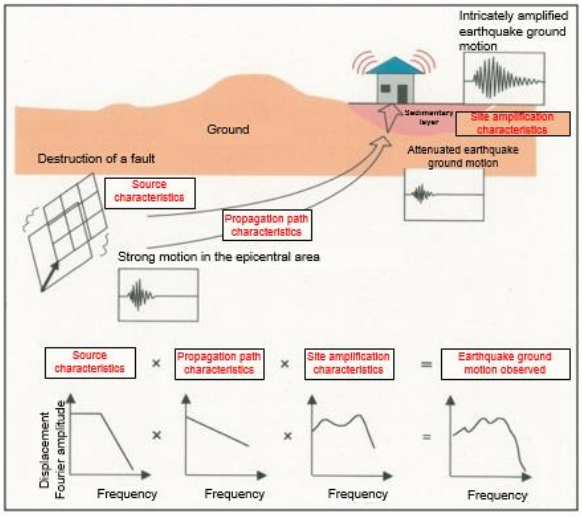

Figure 1. Three Elements of Earthquake Ground Motion

Methods for forecasting earthquake ground motion are classified into empirical approach, semi-empirical approach, and theoretical approach. Characteristics in setting earthquake ground motion by each approach are shown in Table.

Table. Characteristics of Approaches for Earthquake Ground Motion

Approach	Characteristics
Empirical approach	Prepare a regression equation with parameters of earthquake scale and distance based on the past earthquake records, and estimate the maximum ground acceleration and response spectrum of the earthquake.
Semi-empirical approach	Classified into empirical Green function method, which synthesizes earthquake ground motions of a big earthquake by overlapping the record of small-and-medium earthquakes in the same epicentral area as of a big earthquake in accordance with the destructive process of fault so as to conform to the law of similarity applicable between a big earthquake and small earthquakes, and statistical Green function method, which uses small earthquakes prepared artificially.
Theoretical approach	A theoretical method based on the assumption of source model and underground structural model for estimating earthquake ground motions by evaluating the three elements (characteristics) of earthquake ground motions theoretically with a formula.

3. Issues on empirical approach

Since it is being found that values calculated in the attenuation formula to be used for dams may be considerably different from measured values depending on the specific types of earthquakes and characteristics of the location of earthquake (as shown in Figure 2), it is necessary to organize the points of attention when using empirical approach.

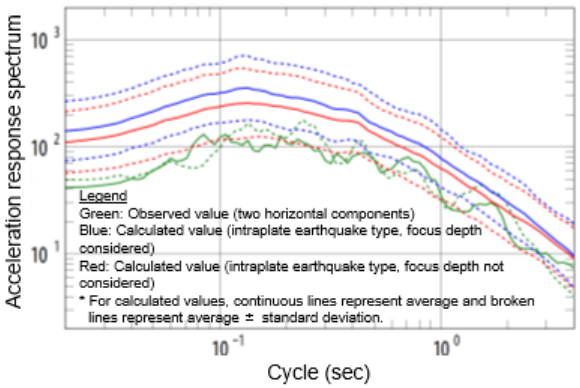

Figure 2. Comparison of Empirical Approach and Measured Values (Spectrum)

4. Future schedule

We examine points of attention in setting earthquake ground motion using attenuation formula by comparing with data of past earthquake ground motions in dams and considering the scope of data collection for earthquake ground motions, etc. We also compare with earthquake ground motions calculated by semi-empirical approach and organize matters concerning the applicability of empirical and semi-empirical approaches in setting up earthquake ground motions for dam foundation.

[Reference]

1) Civil Engineering Journal, Vol. 56, No. 11, pp.38-41