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BASIC CRITERS FOR SELECTION OF SEISMIC DESIGN COEFFICIENT IN DAM PROJECT

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The purpose of this study is to present the basic critters for selection the seismic design coefficient of the dam project and to give some application examples from the dam project in Turkey.

Anatolia is situated on one of the seismically most active region named Alpine-Himalayas Belt. Acoording to Mc.Kenzie (1972) plate tectonic model Anatolian Peninsula is composed of Anatolian, Black Sea and Eagean micro-plates surrounded by three macro-plates such as Eurasian, Arabian and African.

Due to relative mutual movements of micro and macro plates, main fault systems were developed such as North Anatolian Fault zone and East Anatolian Fault zone. More than 1170 destructive earthquakes had occurred according to the historical sources for the interval BC.2100-1900 A.D. in Anatolian. (H.Soysal, 1981) between the years 1903-1996 strong and destructive 168 earthquake occurred in Turkey which were caused a lot of death, injured and high amount of property lost. Last three earthquakes among those were Adana-Ceyhan-1998 (Ms=6.3), Afyon-Dinar-1995 (Ms=6.8)

Earthquake Zoning Map of Turkey was prepared in 1996 by the Government of Turkey (Imar ve Iskan Bakanlýgý). Turkiye is divided into 5 degree of risk zone in this map. According to Earthquake Zonning Map, 95% of the total population lives in earthquake regions and 92% of the exiting or planned dams are under earthquake risk.

DSI (State Hydraulic Works) is mainly responsible for planning, investigation, design and construction of dams and hydroelectric power plants in Turkiye. For that reason DSI has been made a special effort for seismicity, seismic risk and earthquake engineering studies by establishing local seismometer network around big dams and mounting strong-motion equipment's at the dam bodies. DSI has been carried out seismic and geoelectrical engineerig surveys, soil and rock mechanic tests and drilling boreholes in addition to geological investigation at the dam sites to determine local ground conditions. Based on the results obtained in above-mentioned studies, satisfactory evaluation of seismic design coefficient (k) has been made and requred data for earthquake resistant design of dams have been derived.

It is clear that important engineering structures such as dams and hydraulic powerplants are much stronger against earthquake vibrations than normal structures. But unexpectedly if a failure occurs on a dam body, its influence will be very serious and dramatic on human life and economic.

Determination of design seismic coefficient and making an earthquake resistant design of a dam means make a contract with nature. If the project engineers well defined and detailed all of the circumstances about future seismic activity, local ground conditions and the specification of the project on the contract before the construction, project will be safe and there will be only a very small risk. Otherwise serious damages and failures may have been expected on the dam bodies and appurtenant structures. The selection of seismic parameters, methods of analysis and the final evaluation of the seismic safety of the dam should be based on the multidisciplinary engineering interpretation such as geology, geophysics, seismology, geotechnical and structural engineering. It should be keep in mind that every dam project and seismotectonical behaviour of it’s natural environment a unique and specific system that is not duplicated elsewhere.

Determination procedure of required seismic parameters are given in the following steps.

a) Seismological Data Analysis

-compilation of Historical and Instrumental data

-epicentre coordinates, magnitude, intensity, focal depth

-epicentral distribution map
-intensity map
-acceleration records
-iso-acceleration maps
b) Geological and Tectonical Data
-definition of tectonic province
-active faults and shear zones asseme
-crustal movement and geodetic measurements
-landstad images and aerial photos
-sleep rate measurements
c) Seismotectonic Map Setting
-determination of earthquakes sources
(point, line and area type earthquake sources)
Probabilistic and Deterministic Seismic Risk Evaluation
-sellecting of Probabililistic Model (Poisson, Markov, Gumble)
-magnitude-frequency relations of earthquake sources
-determination of MCE (Maximum Credible Earthquake), MDE (Maximum Design Earthquake) and OBE (Operation Basic Earthquake)
d) Attenuation model of ground acceleration
e) Response Spectra
f) Reservoir-Induced Seismicity

MCE: MaximumCredible Earthquake is the largest reasonably conceivable earthquake the appears possible along a recognised fault or within a seismotectonic province. Little regard is given to its probability of occurance, which may vary from less than a hundred, to several tens of thousands of years.

MDE: The Maximum Design Earthquake presents the maximum level of ground motion for which the dam should be designs or analysed.

OBE: The Operation Basis Earthquake presents the level of ground motion at the dam site with a 50% probability of not being exceeded in 100 years. The dam, appurtenant structures and equipment should remain functional and damage easily repairable from the occurrence of earthquake motion not exceeding the OBE.

In DSI (State Hydraulic Works) standardisation, seismic design coefficient can be determined from the below table based on horizontal peak ground acceleration for the dam project in which the dynamic analysis is not required.

Horizontal Peak Ground Acceleration (a) –cm/s^2	Seismic Design Coefficient (k)
$475 \leq a$	$0.15 < k$
$300 < a \leq 475$	$0.12 < k \leq 0.15$
$140 < a \leq 300$	$0.10 < k \leq 0.12$
$45 < a \leq 140$	$0.05 < k \leq 0.10$