

A MACROZONING MAP OF JAPAN ON AMPLIFICATION CHARACTERISTIC  
OF 1-10 SEC STRONG GROUND MOTIONS

by

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A study of amplification characteristics of 1-10 sec strong ground motion is an urgent task, since dynamic earthquake-resistant research should cover recent very high-rise and large-scale structures. In this new situation well-known studies on ground amplification of which period is less than 1 sec have little use. In this paper a macrozoning map on the amplification of long period seismic ground motions is presented by use of the data due to strong motion displacement seismographs with natural period of 6 sec, operating at about 100 local observatories of Japan Meteorological Agency. All the shallow and moderate-to-large earthquakes occurred in and around Japan in recent 15 years were used for analysis. Total number of earthquake was nearly 150.

At first an empirical equation by a least squares method was obtained between the maximum amplitude and epicentral distance for each earthquake. For engineering use the equation is especially important in distances less than 300 km, so the least squares procedure was performed considering this point of view. The deviation at the site from this amplitude-distance equation suggests to be an index to express ground characteristic, though the values may differ from quake to quake. Thus we have a histogram of the relative differential amplitudes at each station. The median value is defined as the most probable amplification of seismic ground motion at the corresponding station. The obtained amplifications were plotted on a map and contour lines were drawn. This indicates large amplifications at most of big cities in Japan as Sapporo, Niigata, Tokyo, Nagoya and Osaka; especially at Tokyo and Niigata the amplifications are 3 to 5 times larger than the average. Secondly the factors other than the epicentral distance as the magnitude, the wave path, the azimuth etc, and their effects upon the amplification characteristic were also investigated.

In point of engineering view, however, the most probable values are not necessarily sufficient because the higher amplifications have been repeatedly observed. So another consideration on the maximum amplification must be introduced. A simple and appropriate way to know the distribution of the maximum values is to apply an extreme value theory. The second macrozoning map was made by use of the extreme value of the amplification. This made clearer the results obtained on the first map.

Finally the amplification characteristics were surveyed more fully in a limited area surrounding Tokyo where 10 routine stations have been working, and found to arrive at the similar result. Furthermore, this clarified a close relation of the thickness of alluvial and diluvial deposits to amplification characteristics. The depths relating to 1-10 sec ground motions are from 100 m to several 1000 m.

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