Assessment of earthquake insurance rates for the Turkish Catastrophe Insurance Pool

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After the two major earthquakes in 1999, the Government of Turkey has decided to enforce the earthquake insurance on the nationwide basis with the sole purpose of privatising the potential risk by offering insurance via the Turkish Catastrophe Insurance Pool (TCIP) and then exporting the major part of this risk to the international reinsurance and capital markets. All registered residential dwellings are required to be in the compulsory earthquake insurance coverage. The probabilistic model of earthquake insurance analysis, which was developed earlier, is applied using the appropriate data processing methods and recent data, to obtain realistic estimates of the earthquake insurance rates applicable for reinforced concrete and masonry buildings in Turkey and check the validity of the current tariff rates. While doing this, the information on future earthquake threat is integrated with the information on expected earthquake damage to buildings.

Keywords: earthquake-resistant design; earthquake insurance; probabilistic modelling; seismic hazard; vulnerability analysis; Turkish Catastrophe Insurance Pool

Introduction

The first study of earthquake insurance in Turkey dates back to 1978 with the consideration of obligatory earthquake insurance feasibility (Gurpinar et al. 1978). But only after the 1999 earthquakes could the obligatory insurance system be put into regulation, and for only residential units. In 2000, with the formation of the Turkish Catastrophe Insurance Pool (TCIP) earthquake insurance was made compulsory.

The insurance system has five tariff zones and also charges different premium rates depending on the construction type (steel, reinforced concrete, masonry and others). The rates charged by the insurance companies, as specified by TCIP, range from 5.50 to 0.44 per 1000 units of insured property. The scheme has a deductible of 2% of the insured value for each property.

The obligatory earthquake insurance system established in Turkey is highly rated by national and international insurance authorities and currently holds the second largest number of policies in the world. The total amount of insured property throughout the country reached approximately to 2.6 million as of November 2007. However, the validity of the present tariff rates continues to be a subject of discussion among academicians as well as in the insurance sector. It is the aim of this study to obtain realistic estimates of the earthquake insurance rates by integrating information on future earthquake threat with information on expected earthquake damage to buildings.

The framework of the probabilistic model of determining the insurance premium rates used in this study is the same as the one developed by Yucemen (2005), and in this respect the study presented in this paper is to a certain extent a follow up of the research work conducted by Yucemen.
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(2005). However, in the present study, compared with Yucemen (2005), much more comprehensive data sets are compiled with respect to the formation of damage probability matrices and the assessment of seismic hazard. Additionally, more recent and up-to-date seismic sources and catalogue data are used. The epistemic uncertainties involved in the seismic hazard analysis are taken into consideration by using logic tree methodology. The most significant difference is the fact that Yucemen (2005) has considered only reinforced concrete structures, whereas in this study in addition to the reinforced concrete structures, masonry structures, which are quite common in Turkey, are also taken into consideration. Besides, earthquake insurance rates are assessed for 21 cities located in different seismic zones, whereas this number is limited to 5 in Yucemen (2005).

Earthquake insurance model and its application

Earthquake insurance rates should be calculated based on the frequency and the severity of earthquakes. This corresponds to a conditional probability of damage given a range of earthquake hazard levels. The frequency of earthquakes at a site will be the same for all structures. However, the severity of damage will change depending on the structural system type, age, configuration, and other features. Hence, severity of damage to different facility classes should be considered separately.

The future earthquake threat at a selected site is quantified by making use of probabilistic seismic hazard analysis techniques, which are based on input data containing uncertainties, because of the lack of understanding of the earthquake phenomenon by mankind as well as the randomness in its occurrence. The magnitude, location, and occurrence time of future earthquakes are not known. For all components, probability distributions have been used. The magnitude distribution of earthquakes is assumed to exhibit an exponential distribution as stated by Gutenberg and Richter (1949). The location randomness is modeled by establishing virtual seismotectonic provinces displaying the so-called “uniform” seismic activity within each province. Finally, the temporal distribution is considered to follow a Poisson distribution in our study. The effect of a given earthquake at a specified location is estimated by ground motion prediction (attenuation) relationships.

The earthquake damage component of insurance considerations is quantified, on the other hand, by assessing the seismic vulnerability of buildings. Owing to underlying uncertainties earthquake damage to buildings has to be treated also in a probabilistic manner. The most reliable data source for earthquake damage estimation is the observed damage data, provided that personal biases in the damage evaluation are eliminated. In this study, empirical damage data is used, but it is supplemented by expert opinion.

The earthquake damage can be presented in various ways. Because of consistency with the previous studies on probabilistic earthquake damage evaluation in Turkey, a relatively old presentation proposed by Whitman (1973), which is the damage probability matrix (DPM), is utilized herein. A DPM is composed of probabilities that a certain damage state (DS) is observed when a certain type of structure (say, k) is exposed to a known earthquake intensity (say, I). The ratio of the cost of repairing the earthquake damage to the replacement cost of the building (excluding the value of land on which the building is constructed) is defined as the damage ratio (DR). For computational convenience, a single DR, called the central damage ratio (CDR), is assigned to each DS to represent the best estimate DR of buildings in that DS. The General Directorate of Disaster Affairs of the Ministry of Public Works and Settlement in Turkey has been using the following damage states since 1994: no damage, N (CDR = 0%); light damage, L (CDR = 5%); moderate damage, M (CDR = 30%) and heavy damage/collapse, H/C (CDR = 85%). Prior to 1994, H and C states were distinct.

With the available post-earthquake damage data, each element of a DPM (the probability that DS is observed in k-type buildings when exposed to a given earthquake intensity, I, Pk(DS, I)) is obtained as the ratio of the number of k-type buildings in damage state DS to the total number of k-type buildings subjected to earthquake intensity I. The sum of the probabilities in each column of a DPM equals to 1.0. For insurance considerations, a Pk(DS, I) does not make much sense. Instead, the weighted average damage ratio of a building stock for a selected building type-earthquake size pair should be obtained. This is called as the mean damage ratio (MDRk) and is obtained from the following relationship

$$\text{MDR}_k = \sum_{DS} P_k(DS, I) \times \text{CDR}_{DS}$$

where, CDR_{DS} = central damage ratio corresponding to the damage state DS. The form of a DPM, in terms of Modified Mercalli Intensity (MMI), is shown in Table I.

Multiplying the seismic hazard (SH) by the MDR and superposing the results for a full range of SHs, represents the expected annual damage ratio for k-type buildings (EADRk). EADRk is a unitless
quantity and corresponds to the insurance rate for a unit property replacement cost. Mathematically expressed $EADR_k$ takes the following form

$$EADR_k = \sum MDR_k \times SH_i$$

where, $SH_i$ = annual probability of an earthquake of intensity $I$ occurring at the site.

Finally, the pure risk premium ($PRP_k$) of a property is calculated proportional to the corresponding property’s value. Certainly, the total insurance premium ($TP_k$) that will be charged by an insurance company should be determined to allow for recovery of expenses and profit. For this purpose, in classical studies the $PRP_k$ is increased by some margin. In the previous studies carried out in Turkey, the corresponding factor is taken as 1.67 (Gurpinar et al. 1978, Yucemen 2005). The same factor is adopted here. However, one should bear in mind that the insurance rate charged by a company is a function of its capital and the demand from the public and also reinsurance rates which are generally controlled by the foreign reinsurance firms and market conditions.

### Probabilistic seismic hazard assessment

In this study, every effort was made to compile a complete and accurate earthquake catalogue as much as possible. For this purpose, the earthquake catalogues of the Earthquake Research Department of General Directorate of Disaster Affairs (Inan et al. 1996, GDDA-ERD 2004), Kandilli Observatory and Earthquake Research Institute of the Bogazici University (KOERI 2004), International Seismological Centre (ISC 2004a, ISC 2004b) and United States Geological Survey (USGS 2004a, USGS 2004b) are utilised. The minimum earthquake magnitude in the moment magnitude scale ($M_w$) is accepted to be 4.5. The data in the body wave magnitude ($M_b$), duration magnitude ($M_d$), local magnitude ($M_L$) and surface wave magnitude ($M_s$) scales are converted to $M_w$ scale by regression analyses, unifying the available earthquake catalogues of Turkey. During the earthquake magnitude conversion, the orthogonal regression is used to account for the effects of measurement error in the predictors. The component earthquake databases and the unified Turkish earthquake catalogue are available in Deniz (2006).

The Poisson model assumes independence between the occurrences of earthquakes. Main shocks are differentiated from foreshocks and aftershocks and alternative seismic hazard analyses are performed by considering only the main shocks. All the earthquakes that fall inside a given space and time window around another larger magnitude event are classified to be foreshocks or aftershocks (secondary events). The spatial aftershock zone sizes are determined as the enveloping space windows of Gardner and Knopoff (1974), Savage and Rupp (2000) and Kagan (2002). For the time windows, on the other hand, average of the windows specified by Gardner and Knopoff (1974) and Savage and Rupp (2000) are utilised. Spatial and temporal aftershock zone sizes are based on the magnitude of the main shock. Foreshock identification is achieved by using magnitude dependent spatio-temporal windows also.

Virtual seismotectonic provinces, within each of which seismicity is homogenised, are delineated at regions of epicenter clustering, based on subjective judgment of experts. The configuration given by Bommer et al. (2002) is adopted with some local modifications (personal communication, Kocyigit 2005). For the earthquakes that can not be related to any of these seismogenic provinces, background seismicity regions are defined and no geographical region, throughout Turkey, is left out of a seismic source zone. The resulting seismic source zones and their geographical coordinates are available in Deniz (2006).

For the temporal distribution of earthquakes, the earthquake occurrence within a seismic source zone is assumed to follow the Poisson distribution, whereas the probability distribution of earthquake magnitude is described by the Gutenberg and Richter (1949) recurrence relationship. The source specific constants of the Gutenberg-Richter recurrence relationship are estimated both by carrying out standard least squares regression analysis and applying the maximum likelihood method to the observed data. The results are combined together at the end.

As smaller magnitude earthquakes are incomplete by the nature of the problem, the rates of small magnitude earthquakes are underestimated if the earthquake catalogue is used as it is. In our study, Stepp’s (1973) method is utilised with separate consideration of each seismic source zone and the
available earthquake catalogue is completed. The seismicity parameters of each seismic source zone are obtained after completeness analyses, again by using both the standard least squares regression and the maximum likelihood methods.

The effect of a given earthquake with respect to the desired ground motion parameter at a certain distance is modelled by using the ground motion attenuation relationship of Musson (2000) as given in equation (3).

\[ I = 1.063 + 1.522 \times M_s - 1.102 \times \ln R - 0.0043 \times R \]  

(3)

Here, I is the intensity, \( M_s \) is the earthquake magnitude (which can be converted to \( M_w \) scale with no systematic error through the inverse of the orthogonal conversion relationship that we developed between \( M_s \) and \( M_w \)) and R is the hypocentral distance in kms. The standard deviation of equation (3) is specified to be \( \sigma_I = 0.486 \), which corresponds to \( \sigma_{\ln I} = 0.06 \) in the logarithmically transformed database. Three different uncertainty levels (\( \sigma_{\ln I} = 0.01, 0.06 \) and 0.10) around the mean attenuation curve are assumed in the hazard computations as shown in Table 2. It is also to be noted that the original attenuation equation of Musson (i.e. equation (3)) is converted to the moment magnitude scale, as the seismic database used in our study is in terms of the moment magnitude scale. Seismic hazard analyses are conducted by using the Musson’s intensity attenuation relationship both in terms of the \( M_s \) and the \( M_w \) scales, as indicated in Table 2. The attenuation analysis of Musson (2000) is based on the earthquake catalogue of Ambraseys (1988), which is a very comprehensive 100-year catalogue of the shallow Turkish earthquakes. As intensity is by definition related to damage, the attenuation relationship selected in terms of an earthquake intensity scale provides convenience while integrating the hazard and the earthquake damage which is known with respect to different intensity levels. Besides, it predicts the intensity as a function of the earthquake magnitude and connects a link between the earthquake catalogue in magnitude scales and the seismic hazard in intensity units. In the study, 21 pilot locations (cities) are selected for the determination of the insurance premium rates. The site group is established such that comparisons are possible with respect to cities in different seismic zones (according to the seismic zoning map accompanying the Specifications for Structures to be Built in Disaster Areas, 1997), and with respect to cities in the same seismic zone.

Different seismic hazard combinations are formed to accommodate the different assumptions that were discussed above. The best estimate hazard curves are obtained as the weighted averages of the combination of 24 \times 3 = 72 different cases. While combining the results of these cases, logic tree and Bayesian approaches are utilised and subjective weights are assigned to each alternative case. These weights, which are shown in Table 2, represent the probability of each assumption being valid as compared to the alternative ones and are based to a large extent on the opinion of the second author, who has 30 years of experience in the development of seismic hazard maps for Turkey.

### Table 2. Subjective probabilities of alternative assumptions.

<table>
<thead>
<tr>
<th>Alternative assumptions</th>
<th>Subjective probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>All earthquakes</td>
<td>0.5</td>
</tr>
<tr>
<td>Main shocks only</td>
<td>0.5</td>
</tr>
<tr>
<td>Incomplete catalogues</td>
<td>0.4</td>
</tr>
<tr>
<td>Artificially completed catalogues</td>
<td>0.6</td>
</tr>
<tr>
<td>Standard least squares regression in the computation of the recurrence relationships</td>
<td>0.4</td>
</tr>
<tr>
<td>Maximum likelihood method in the computation of the recurrence relationships</td>
<td>0.6</td>
</tr>
<tr>
<td>Attenuation relationship of Musson (2000) in its original form</td>
<td>0.5</td>
</tr>
<tr>
<td>Attenuation relationship of Musson (2000) converted to ( M_w ) scale</td>
<td>0.5</td>
</tr>
<tr>
<td>Attenuation uncertainty is equal to ( \sigma_{\ln I} = 0.01 )</td>
<td>0.15</td>
</tr>
<tr>
<td>Attenuation uncertainty is equal to ( \sigma_{\ln I} = 0.06 )</td>
<td>0.60</td>
</tr>
<tr>
<td>Attenuation uncertainty is equal to ( \sigma_{\ln I} = 0.10 )</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**Estimation of earthquake damage through DPMs**

In the conventional way of expressing the expected earthquake damage distribution via DPMs, separate matrices have been formed for different seismic zones. The reason for this is pointed out to be the different levels of expected earthquake excitation considered during the design and construction of buildings in different seismic zones. Gurpinar et al. (1978) separated the expected damage of structures depending on their compliance with earthquake resistant design provisions and established two groups as buildings constructed according to the Code (AC) and buildings constructed not in accordance with the requirements of the Code (NAC). ‘Code’ referred to the Specifications for Structures to be Built in Disaster Areas, put into regulation in 1975. The initial observed damage data was considered to fall into the NAC class.

Gurpinar et al. (1978) established a set of DPMs based on the opinion of a working group. They assumed that the response of the structures is the same if they are in the NAC class, irrespective of the
seismic zone they are located in, when subjected to the same level of earthquake intensity. For this reason, they specified only a single DPM for NAC class buildings. In our study, DPMs based on the opinion of Gurpinar et al. (1978) are considered as the expert opinion DPMs (for reinforced concrete buildings).

The empirical data available so far are poor because of several reasons. All empirical damage distribution studies considered the available databases to correspond to reinforced concrete buildings only, although their DPMs were actually displaying the aggregated damage probability distributions of reinforced concrete and masonry buildings. But the resultant earthquake insurance premium rates were considered to belong to reinforced concrete buildings only. Consequently, the ‘noise’ caused by the masonry buildings was completely ignored in these studies. Whereas in this study discrimination is made depending on the construction material, so that reinforced concrete and masonry buildings are treated in different categories as their earthquake responses are quite different.

**DPMs of recent earthquakes**


Corresponding earthquake intensities are obtained from either available intensity mapping studies or estimated at each settlement where damage occurred, using the relationship of Musson (2000) (for the earthquakes, intensity distribution of which are lacking). In using the intensity attenuation relationship of Musson (2000), the original equation and the converted equation as a function of $M_w$ scale are used together and weighed equally.

**MDRs of reinforced concrete and masonry buildings**

In order to separate the contribution of reinforced concrete and masonry buildings to the overall DPMs, the approximate relative vulnerability of masonry buildings with respect to reinforced concrete buildings is determined as explained in the following: While discriminating the MDRs of reinforced concrete and masonry buildings, a ratio is calculated for convenience, for a given intensity level-seismic zone pair, as the ratio of the MDR of masonry buildings to the MDR of reinforced concrete buildings. This ratio is called as the relative vulnerability coefficient. In Turkey, as shear wall structures are not very common, the reinforced concrete building stock can be considered to correspond to the moment resisting concrete frames according to the classification at the international level (for example, ATC-13 1985). On the other hand, the masonry building stock consists mostly of low-rise buildings. At the point of determining the relative vulnerability of masonry and reinforced concrete buildings with respect to the MDRs, DPMs of ATC-13 (1985) for low-rise and medium-rise non-ductile reinforced concrete buildings, the MDRs of different type of buildings in Turkey as given by Musson (2000) and DPMs of Bayulke (2005) are employed. The average of the ratios at each intensity level is calculated as 1.83, indicating that the vulnerability of masonry buildings to be 1.83 times greater than that of reinforced concrete buildings. Using the corresponding relative vulnerability coefficient, empirical MDRs of reinforced concrete and masonry buildings are separated.

The empirical damage distribution data is not adequate to establish a full set of MDRs for all intensity levels. Therefore, expert opinion DPMs given by Gurpinar et al. (1978) for reinforced concrete buildings are utilised to complement the empirical data. Because of space limitation it is not possible to display the resulting DPMs for the different seismic zones, however the resultant MDRs of reinforced concrete buildings are given in Table 3 and show a satisfactory array from internal consistency point of view. For masonry buildings, there are no expert opinion DPMs. However, scaling the MDRs of reinforced concrete buildings up with a factor of 1.83, (average relative vulnerability coefficient) MDRs for the masonry buildings can also be estimated.

<table>
<thead>
<tr>
<th>Seismic zone</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone I</td>
<td>0.15</td>
<td>4.67</td>
<td>7.98</td>
<td>15.77</td>
<td>24.00</td>
</tr>
<tr>
<td>Zone II</td>
<td>0.11</td>
<td>2.19</td>
<td>8.97</td>
<td>14.31</td>
<td>24.06</td>
</tr>
<tr>
<td>Zone III</td>
<td>0.15</td>
<td>2.50</td>
<td>10.56</td>
<td>21.08</td>
<td>32.08</td>
</tr>
<tr>
<td>Zone IV</td>
<td>0.04</td>
<td>4.16</td>
<td>14.64</td>
<td>22.78</td>
<td>33.40</td>
</tr>
</tbody>
</table>
Earthquake insurance rates for different seismic zones of Turkey for reinforced concrete and masonry buildings

The DPMs obtained in the previous section give the damage probability distributions explicitly for each discrete earthquake intensity level. Accordingly the annual earthquake occurrence rates of each intensity level (intensity levels of V, VI, VII, VIII and IX) are obtained by conducting a probabilistic seismic hazard analysis as described earlier. Matrix multiplication of the hazard and the damage components according to equation (2) yields the EADRₖₛ. While calculating the EADRₖₛ, the contributions of the intensity level V are not taken into account as in the current earthquake insurance application, damage corresponding to at most 2% of the replacement cost of buildings are considered to be deductible and are not covered by the compulsory earthquake insurance.

The best estimate total premium rates for reinforced concrete buildings are computed and given in Table 4 for different seismic zones of Turkey. In the same table, the total premium rates for masonry buildings, which are obtained simply by scaling up the rates for reinforced concrete buildings by 1.83, are shown as well as the currently charged earthquake insurance premium rates.

As observed in Table 4 the earthquake insurance rates currently charged by the insurance companies are quite low compared to the best estimate total insurance rates obtained (per policy basis) in this study. There are a number of reasons for this ‘discrepancy’. The current rates charged by the companies are regulated by the Board of Directors of TCIP and these rates are specified based on the assumption that all buildings under the coverage of TCIP comply with the Seismic Code. So the comparison should be made with respect to the rates computed for buildings that comply with the Code (i.e. AC buildings). TCIP is a nonprofit organisation and the promotion of sales to achieve a certain level of penetration rate has a top priority. This implies that the load factor should be less than 1.67, which is the value assumed in our study as well as in the previous studies (Gurpinar, et al. 1978 and Yucemen 2005). In view of these observations it is more appropriate to make the comparisons against the pure risk premium values where LF = 1.0 and considering the AC case. The earthquake insurance rates corresponding to these assumptions are given in the last column of Table 4. As observed, the currently charged insurance premium rates are still less than these values but the difference has considerably reduced. The remaining difference can partly be attributed to the fact that, as the number of policies increases the uncertainty in the expected loss of an insured building stock decreases owing to the law of large numbers, reducing the insurance rates requested by the insurer (Scawthorn et al. 2003).

The total earthquake insurance premium rates for AC and NAC class buildings are calculated and displayed in Table 5 for both reinforced concrete and masonry buildings. This aims at determining the sensitivity of results to the assumptions made with respect to the DPMs and showing a set of total insurance premium rates ranging from a minimum (corresponding to a building fully complying with seismic design provisions) to a maximum (fully failing to comply with seismic design provisions). The earthquake insurance rate of a building is expected to remain between these two bounds.

Conclusions

The main conclusions of the study are:

1. Assessment of the earthquake insurance premium rates requires the integration of information on future earthquake hazard and seismic vulnerability of buildings. Consequently, the earthquake insurance rates are observed to be sensitive to the assumptions on seismic hazard analysis and damage probability matrices.
2. Estimation of earthquake damage depends mostly on the observed damage statistics compiled from past earthquakes. However,
the observed damage data is generally not sufficient and should be supplemented with expert opinion.

3. The discrimination of the damage distributions of reinforced concrete and masonry buildings is poor in the available damage data bases. From the available domestic and international studies, the vulnerability of masonry buildings is determined on the average to be 1.83 times greater than that of reinforced concrete buildings.

4. As earthquake response of reinforced concrete and masonry buildings are different, different earthquake insurance rates should be assigned to these two classes of buildings.

5. The best estimate total earthquake insurance rates obtained in this study are computed by taking into consideration both group of buildings, namely: buildings constructed according to the Code (AC) and buildings constructed not in accordance with the requirements of the Code (NAC). The load factor is set equal to 1.67. Compared to the currently charged earthquake insurance rates by the insurance companies (Table 4, second column), the best estimate total (commercial) earthquake insurance rates obtained in this study (Table 4, first column) are significantly greater. This is mainly owing to the fact that the currently charged rates, which are regulated by the Board of Directors of TCIP, are based on an unrealistic assumption that all buildings under the coverage of TCIP comply with the Seismic Code (i.e. AC buildings). Also, as TCIP is a nonprofit organisation the load factor can be assumed as 1.0. The earthquake insurance rates consistent with these two assumptions are given in the third column of Table 4. These values are still larger than the currently charged insurance premium rates, but the difference has decreased considerably. The remaining difference can partly be explained by the law of large numbers, which can be stated within this context: as the number of policies increases the uncertainty in the expected loss of an insured building stock decreases reducing the insurance rates requested by the insurer.

6. The current deductible rate of 2% in the Turkish earthquake insurance implementation is much less than what is currently being applied in other countries. At the international level, the deductible rate is on the order of 10 to 15%. Considering the fact that small to moderate magnitude earthquakes occur very frequently but result in minor damage, the percentage of the deductible might be increased in the tariff specified by TCIP so that the insurance rates decrease.

7. Significantly higher (two to three times more) insurance rates that result from the violation of the code requirements strongly suggest that compliance with the code should be an important factor while determining the earthquake insurance rates. In other words, significantly different rates should be charged for buildings depending on their degree of compliance with the code. It is also believed that enforcement of such a criterion, will not only encourage the implementation of the code requirements with respect to earthquake resistant design provisions, but also create a control mechanism.

8. Seismic vulnerability of structures is presented through fragility curves instead of damage probability matrices in recent studies. Multiplication of the elements of hazard curves by the elements of fragility curves would provide a more accurate set of expected annual damage estimates, owing to the continuous format of these two components. Accordingly, it will be more appropriate to utilise fragility curves in future studies concerning the quantification of earthquake insurance rates.

Table 5. Variation of total insurance premium rates for reinforced concrete/masonry buildings with respect to the degree of compliance with the seismic resistant design provisions.

<table>
<thead>
<tr>
<th>Seismic zone</th>
<th>AC</th>
<th>Best estimate</th>
<th>NAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>5.22/9.55</td>
<td>10.21/18.68</td>
<td>14.17/25.93</td>
</tr>
<tr>
<td>II</td>
<td>4.23/7.74</td>
<td>6.81/12.46</td>
<td>8.68/15.88</td>
</tr>
<tr>
<td>III</td>
<td>3.87/7.08</td>
<td>4.50/8.24</td>
<td>5.45/9.97</td>
</tr>
<tr>
<td>IV</td>
<td>2.99/5.47</td>
<td>3.32/6.08</td>
<td>4.47/8.18</td>
</tr>
<tr>
<td>V</td>
<td>1.36/2.49</td>
<td>1.55/2.84</td>
<td>2.58/4.72</td>
</tr>
</tbody>
</table>
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References


