

SELECTION OF THE APPROPRIATE METHODOLOGY FOR THE PROBABILISTIC SEISMIC HAZARD ANALYSIS ON THE TERRITORY OF THE REPUBLIC OF SERBIA

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Abstract. *This paper presents a review of the approaches to the probabilistic seismic hazard analysis as well as discussion regarding the selection of the appropriate methodology of probabilistic seismic hazard analysis for the territory of the Republic of Serbia. Use of the deductive approach has been suggested, as well as that the new Serbian seismic hazard maps should be expressed through the values of the peak ground acceleration, having in mind that the new hazard maps for the Republic of Serbia should be compiled in compliance with the recommendations of the Eurocode 8.*

Key words: *Probabilistic seismic hazard analysis, peak ground acceleration, Republic of Serbia*

1. INTRODUCTION

There are two basic philosophies for the seismic hazard analysis, the so-called deterministic seismic hazard analysis (DSHA) and the probabilistic seismic hazard analysis (PSHA). Although there is no generally accepted deterministic approach for all parts of the world and all application areas, in its most commonly used forms, the DSHA approach proposes design for the so-called "scenario" earthquakes, i.e., for the earthquakes that are estimated to produce the most severe ground motion at a site. The PSHA approach, on the other hand, estimates the *probability* that a particular level of the strong earthquake ground motion will be experienced or exceeded during the life period of a structure. In the following sections, we will briefly discuss the most important issues regarding the PSHA approach, including the issues regarding selection of the appropriate methodology of probabilistic seismic hazard analysis for the territory of the Republic of Serbia.

2. METHODOLOGY OF THE PROBABILISTIC SEISMIC HAZARD ANALYSIS

There are several methodologies that can be used for the probabilistic seismic hazard analysis. The most common are the "extreme value" approach, "historic" approach and "deductive" approach. The extreme value approach is used to estimate the extrema of strong ground motion parameters, for relatively large probabilities, directly from the earthquake catalogue for the considered region, and using only the appropriate attenuation relationship for the region as an additional input. The extrema of a ground motion parameter in the course of, say, next 100 years, can be estimated if the time span of the earthquake catalogue is firstly divided up into arbitrary bins of 5 or so years, the peak ground acceleration (abbreviated further by PGA) values at a selected location are then calculated for all earthquakes that fall inside each bin (by using the attenuation function) and only the maximum value of the PGA for each bin is left. Finally, the statistical properties of one of the Gumbel's [1] distributions of extreme values are then applied. Obviously with a deficiency of the extreme value approach is that information on any other values other than the largest one are wasted. Anyhow, the extreme value approach has been the basis for the current Serbian zoning maps, similarly as it was, for example, a basis for the second generation of the Canadian seismic zoning maps [2]. The 1970 seismic zoning map of Canada was developed by Milne and Devenport [3], using the extreme-value statistics for the estimation of the seismic hazard (expressed through the values of PGA) at an annual probability of exceedance of 0.01. However, several later publications (e.g., [4], [5]) showed that the deductive approach would be more appropriate for derivation of the probabilistic hazard maps of Canada, and the comparison of the third generation of the Canadian seismic ground motion maps (derived using a deductive method) with maps obtained by the extreme value method, only further asserted this opinion [6].

The historic approach requires only the seismic catalogue for the region, and the appropriate attenuation relations for the strong ground motion parameter that is chosen to represent seismic hazard. Unlike the extreme value approach, this approach makes full use of the available seismicity data. The distribution of the ground motion parameter at a site is first estimated for every historical earthquake in the catalogue (using the chosen attenuation function), the nonparametric function proportional to the historical exceedance rate is then calculated by cumulative summation of all estimated distributions (i.e., for all considered earthquakes), and finally, to obtain an annual rate of exceedance, the obtained nonparametric function is divided by the number of years of the catalogue. The details of the historic PSHA approach can be found in several publications (e.g., [7], [8], [9]). The main disadvantages of the historic approach are (1) its unreliability for annual probabilities smaller than the inverse number of years of the catalogue, while the values obtained from historic method for higher probabilities can be a good check for the deductive method at those probabilities [8], and (2) possibility of unrealistically small (i.e. zero) probability of an event occurring at the site, because the events are taken only at the locations of historical earthquakes. In the last fifteen years, the so-called historical "parametric" method (see, for example, [9], [10], [11]) has been developed, trying to improve the reliability for small annual probabilities by fitting a hazard curve to the tabulated seismicity data and then extrapolating it to estimate the value of the ground motion for the smaller probabilities. Even the parametric version of the historic method is not

able to account for the important issues such as uncertainties in tectonics or migration of seismicity.

The "deductive" approach is so called because beside using the catalogue of historical earthquakes and the appropriate attenuation relationships for the region, we are also trying to *deduce* what are the possible faults and earthquake sources for the selected region, as well as what are their corresponding seismicity characteristics [12, 13, 14, 15]. The first widely available computer program for performing elementary PSHA on the basis of the Cornell's work [16] was presented by McGuire in 1976 [17], while the first complete deductive methodology for introduction and modeling of the tectonic region, and for producing complete response or Fourier spectra having a constant probability of no exceedance ("Uniform Risk Spectra") was developed by Anderson and Trifunac [12, 13]. The concept "Uniform Risk Spectra", introduced in 1977 by Anderson and Trifunac [12], was later renamed to "Uniform Hazard Spectra". Up to date, many variations of the deductive approach have been developed, and the detailed descriptions of the basic theory for these methods can be found in numerous publications (e.g., [8], [18], [19], [20]).

We will now briefly present the most important steps of the deductive method, with parallel reviewing of the most important issues regarding the application of this PSHA method for the territory of Serbia.

2.1. Delineation of seismic source zones

The first step in any deductive PSHA method is the characterization of the various seismic sources, which may affect the site of a structure [15, 21, 22]. The seismic sources can be defined from the spatial distribution of past earthquakes, and/or from the knowledge of various faults in the region. The seismic sources can be modeled as: a) idealized point sources (when the events are concentrated in a very small area far away from the considered site), b) line sources (also for relatively distant source zones), c) dipping plane or volume sources (for zones that are closer to the site and for which the adequate geological data exist), and as d) areal and volume sources (if faults cannot be identified with reasonable accuracy and reliability).

As far as territory of Serbia is concerned, although some seismotectonic maps for the territory of Serbia do exist, these maps are either not readily available or outdated. Thus, since the knowledge of the tectonic features is presently not sufficient to identify different faults and model them as dipping planes or volume sources, we propose definition of the (polygonal) areal source zones, joining the data from the available earthquake catalogues and all national active fault maps we could gather. However, the delineation of the areal source zones is also a rather difficult process and requires judgment because of the uncertainties in the available data on past earthquakes and due to lack of clear correlation of these data with the known tectonic features. The delineation of the source zones must be done with caution, and consulting the work of other experts in the region. When the Republic of Serbia is concerned, one should consider the work of Jiménez *et al.* [23], who presented a unified seismic source model for the Mediterranean region. The unified seismic source models for wider regions, useful for trans-border construction of railways, oil and gas pipelines, for example, are preferable since the integration of independent results of different national hazard maps requires further smoothing and border matching between the different regional results [24].

In addition to the geometrical surface description, one must also define the expected focal depth for each seismic source zone. These depths must correspond to the general distribution of earthquake occurrences in the selected zones and should be consistent with the depths of the frequent major events [25]. Although almost all of the seismic sources in the Republic of Serbia and the neighboring countries are of shallow focal depth (with exception of the intermediate-depth Vrancea source zone in Romania), the definition of the depth values can be equally troublesome task as the definition of the source geometries, also due to the poor knowledge of the crustal structure in different parts of the mentioned countries.

2.2. Definition of the seismicity characteristics

After delineating the seismic source zones and defining their focal depths, it is necessary to define the seismicity (i.e., the expected rate of occurrence of earthquakes of different size), expected to occur in each zone during a specified period of time. The seismicity is usually estimated through a least square regression analysis of the data on past earthquakes, defining the parameters a and b of the Gutenberg-Richter [26] recurrence relationship:

$$\log N(M) = a - bM, \quad (1)$$

where $N(M)$ is the mean yearly rate of occurrence of earthquakes with magnitude greater than or equal to M , a characterizes the mean yearly number of earthquakes with magnitude greater than a selected minimal value, while b describes the relative frequency of larger earthquakes to the smaller ones. The Gutenberg-Richter relationship, as defined here, i.e., with N being the *mean yearly* rate of occurrence, is a result of combining a stationary Poisson model of interoccurrence time distribution with an exponential magnitude distribution. This recurrence relationship assumes that sizes of the earthquakes are temporally and spatially independent. To use such assumption for the estimation of the seismicity characteristics of the selected source zone the foreshocks and aftershocks should be first removed from the corresponding part of the seismic catalogue. This removal of the "dependent" events can be difficult, especially in regions like the Balkans with lack of knowledge of the seismotectonic features.

The probability density function on magnitude for a double-truncated (bounded from both sides) Gutenberg-Richter recurrence relationship, can be expressed (for a Poisson-distributed main shocks) as

$$f_m(M) = \beta \frac{\exp[-\beta(M - M_0)]}{1 - \exp[-\beta(M_{\max} - M_0)]}, \quad M_0 \leq M \leq M_{\max} \quad (2)$$

where M_0 and M_{\max} are the lower and upper bounds on magnitude, β is equal to $(\ln 10)b$, while the annual rate of earthquakes exceeding the magnitude M_0 can be defined as

$$v = \exp[a \ln 10 - (b \ln 10)M_0]. \quad (3)$$

For the fault-specific sources it may be more appropriate to propose characteristic and time-varying distributions, while the time-invariant probability distribution defined by Equation (2) has been used to describe the seismicity of areal source zones, which typi-

cally comprise a number of different faults. The temporal and spatial variations of the seismic potential can be incorporated into the seismic hazard analysis [12, 13, 18, 27, 28], but such analysis are feasible only when there are enough data [29].

If each source zone represents an area of uniform hazard with an appropriate recurrence relation, there will be inherent smoothing of the seismic hazard through the region surrounding epicenters of the historical earthquakes. This is unlike the historic PSHA method which does not use spatial seismic source zones as input, but the "point" sources, and the hazard values, calculated by the historic method, appear (on seismic hazard maps) clustered in comparison with the smoother values calculated by the deductive approach [11]. Such a problem occurred with the derivation of the second generation of Canadian maps by using the extreme value method. Basham *et al.* [6] showed that the extreme value method tended to produce irregular contours on the zoning maps since it used the catalogue of known earthquakes as the only input and thus did not consider future earthquakes in regions where there were few historical earthquakes.

There are at least four different parameters that have to be defined to specify the seismicity of a source zone. These are the two magnitudes, M_0 and M_{\max} , and the two Gutenberg-Richter parameters, b and a . The upper bound magnitude, M_{\max} , reflects the maximum expected magnitude for the specific source zone, while the lower bound magnitude M_0 represents the magnitude below which no significant damage will occur. The maximum expected magnitude for a source zone can be estimated through a detailed analysis of various seismotectonic features and statistical analysis of the available data on magnitude-fault length relationships [30].

The parameters b and a can be determined for each source region through a least square regression analysis. In the case when the number of earthquakes for a source zone is small, these parameters can be evaluated via estimates of geological strain rates [21] and independently in terms of the historical data on earthquake intensity [31].

Many factors contribute to the uncertainty in the estimation of the seismicity characteristics, the most important of all being the level of data completeness of the earthquake catalogue for a particular source zone. The data completeness can be analyzed with different methods and should be performed to check if enough events of a certain magnitude level are contained in the earthquake catalogue. The incompleteness of the catalogue can be compensated to a degree by using the different time windows for different magnitude ranges and by applying the maximum likelihood method [32].

2.3. Ground motion attenuation relations

The ground motion attenuation relations are equations specifying the values of the selected ground motion parameter at a particular site, as a function of: earthquake size, distance from the earthquake source to the site, local soil conditions, and sometimes also some other ground or earthquake characteristics that influence ground motion. The general form of the attenuation relationships can be expressed as

$$Y = f(M, R, Pi) \quad (4)$$

where Y represents the selected ground motion parameter, M the magnitude or some other measure of the earthquake size, R is the distance from the earthquake source to the particular location, while Pi represents all the other parameters that can describe source

mechanism, path effects, or local soil characteristics. To develop an attenuation relationship, one has to possess earthquake ground motion time histories, recorded for different earthquakes in a region of interest. Using large number of such data, it is possible to derive the attenuation relation empirically. Hence, there is no definite, one for all, attenuation relation, and these relations must be updated whenever significant number of new data for the region becomes available.

In those regions where available data is not sufficient to develop the attenuation relations it is common to use the attenuation relations developed for other parts of the world (e.g., for California). However, the attenuation characteristics may differ very significantly from region to region due to differences in geological characteristics and the seismic source properties, and so the indiscriminate use of some "foreign" attenuation relation may lead to biased results. It is therefore important to have region dependent attenuation relationships based on the strong motion seismogram records for that region only. Until such data is available one must use the attenuation relations from other regions with caution.

As an illustration example, we describe the site dependent attenuation relationship proposed by Manić [33, 34], having in mind that the two earlier derived relationships for the territory of former Yugoslavia [35, 36] were incorrectly based on the combined data set (i.e., Yugoslavian, American, and Mexican) with all these data treated as obtained for the average soil conditions. Other relevant attenuation equations for spectral amplitudes and for duration of strong motion for the territory of former Yugoslavia can be found in references [37-44].

The attenuation relationship proposed by Manić was derived based on the data comprised in the EQINFOS bank of the accelerograms recorded on the territory of the former SFRY [45]. Although the mentioned data bank contained 449 accelerograms with 1347 components, only 276 horizontal components, recorded during 56 earthquakes with the magnitude range of $M = 4.0 - 7.0$, were included in the derivation of the attenuation relationship, since only these components were recorded on the locations for which the data regarding the conditions of the local soil existed. The selected accelerograms were recorded either on rock ($V_s > 750$ m/s) or on the hard soil ($V_s = 360 - 750$ m/s). After the performed regression analysis, values of the coefficients were first calculated when the local soil effect was not taken into account (the whole data set – Equation 5), and then when it was taken into account and the local soil was defined either as "rock" or "hard soil" (Equation 6):

$$\log(Acc) = -1.508 + 0.333M_s - 1.093 \log(\sqrt{R^2 + 6.6^2}) + 0.276P \quad (5)$$

$$\log(Acc) = -1.664 + 0.333M_s - 1.093 \log(\sqrt{R^2 + 6.6^2}) + 0.236S + 0.254P. \quad (6)$$

where Acc represents the peak value of the horizontal acceleration (expressed as a fraction of g), M_s is the value of the magnitude of the surface waves, R represents the hypocentral distance, P has a zero value for 50% and 1 for 84% probability that the estimated values of the acceleration shall not be exceeded, and the parameter S has a zero value for rock and 1 for hard soil.

Two publications by Manić [33, 34] comprise the comparison of the attenuation curve given by Equation 6 with attenuation curves derived by other researchers for the territo-

ries of Italy, Greece, the whole Europe, and California. Without getting into the details of the results of these comparative analyses, we shall only mention that differences between the estimated PGA values ranged from the insignificant to the one order of magnitude. The smallest differences were obtained when Manić's relationship was compared with the one which Sabetta and Pugliese [46] proposed for the territory of Italy, while the largest differences occurred after comparison with relationship which McGuire [47] proposed for the territory of California. These results obviously confirmed that attenuation relationships were regionally dependent, and influenced by the geological and seismotectonic characteristics of the region. This is exceptionally significant if attenuation relationships are to be used for evaluation of the seismic hazard, and therefore the selection of the appropriate attenuation relation for the territory of Serbia is obviously of major importance. Furthermore, when the territory of Serbia is concerned, the attenuation for the intermediate-depth earthquakes of Vrancea's seismogenic source should be treated independently by applying, for example, the attenuation relation given in [48].

Definition of the ground motion attenuation relations also includes the definition of the scatter in the estimated amplitude values. Thus, the attenuation relations usually specify the median amplitudes (i.e., the 50th percentile values on the empirically obtained cumulative distribution function) while the scatter in the amplitude values about the median is assumed to follow the "lognormal" [49] probability distribution. It is important to mention that the probability distributions, that are associated with the attenuation relations, are usually not truncated, and thereby the corresponding values of a ground motion parameter are not limited [50]. Thus the strong ground motions that are physically not acceptable for the considered region can have a certain (although very small) estimated probability of exceedance. Having in mind that even the very small probabilities can sometimes be required (e.g., for design or seismic safety assessment of dams, nuclear power plants, long-span bridges, high-rise buildings, etc.), the upper bounds on the values of the ground motion that can be estimated by an attenuation relations should be defined for each seismically active region. Definition of the upper bound values for the strong earthquake ground motion is an important issue for both deterministic and probabilistic seismic hazard analysis [51], and has been recently discussed by a number of researchers from all around the world [52].

2.4. "Total" probability for amplitudes of the selected ground motion parameter

If we follow the formulations of the method by Cornell [16] and McGuire [17; 8] and assume that the overall seismic hazard at a site is composed of the respective contribution from each source zone i (out of the set of zones I), by using the so-called "theorem of total probability" [49], the mean annual *rate of occurrence* (i.e., the mean annual *expected number*) of earthquakes that cause an amplitude $Agmp$ of a ground motion parameter to exceed the expectation A , can be expressed as

$$N(A) = \sum_{i \in I} v_i \int_{M_0}^{M_{\max}} \int_{R_{\min}}^{R_{\max}} G(Agmp > A | M, R) f_{m_i}(M) f_{r_i | m_i}(R | M) dM dR, \quad (7)$$

where v (defined by Equation 3) indicates the annual rate of earthquakes exceeding the lower bound magnitude M_0 , M_{\max} is the upper bound magnitude value, R_{\min} and R_{\max} de-

fine the bound values for the distance for each source zone, $G(Agmp > A | M, R)$ denotes the conditional cumulative distribution function defining the probability that the expectation A of the ground motion amplitude is exceeded under the condition that an event of magnitude M occurred at distance R , f_m denotes the probability density function on magnitude (as defined by Equation 2), and $f_{r|m}$ is the probability density function on distance, which depends on the spatial relationship between the source and the site. Thus, to compute the seismic hazard at a site, hazard contributions from the considered source zones are first integrated over all magnitudes and distances (inside the defined limits specific for a source zone), and then summed. If we further assume that all seismic events in the region (i.e., for all the considered zones), are temporally and spatially independent, then by following the well-known Poisson distribution [49], the *probability* of at least one exceedance of the expectation $Agmp$ of a ground motion parameter of interest, in a period of 1 year (i.e., the annual probability), can be calculated from

$$P(A) = 1 - \exp[-N(A)], \quad (8)$$

and this probability is considered to be time-independent. Furthermore, by using the so-called Binomial distribution [49], the probability of at least one exceedance of the expectation A in a period of t years can be calculated as

$$P_t(A) = 1 - [1 - P(A)]^t. \quad (9)$$

Calculations for $P(A)$ are usually performed for a number of expectation values A of a strong ground motion parameter, and after that, the interpolation is used to find the values of A for the chosen probability levels. By fitting a curve to the calculated probabilities for a range of values A , one can create a *hazard curve*, $P(Agmp)$, for each investigated site. By further creating a closely spaced grid of sites covering the complete territory of a certain region, one is able to develop a whole seismic hazard *map* for a selected value of the probability $P(A)$, or $P_t(A)$, simply by contouring the sub-areas for which the values of A fall in the same range (see [31]).

Although, strictly speaking, only the values of the annual probability, $P(A)$, should be used for quantification of the seismic hazard, the mean annual rate of occurrence, $N(A)$, can be also an estimate for the probability of exceedance, if the values of $N(A)$ are less than about 0.1 [17; 8]. At this juncture, it is important to mention two standard misconceptions about the values calculated by the previously given expressions. The first is that the so-called *return period*, T_r , which in the case of statistically independent set of seismic events can be defined as the reciprocal value of the annual probability $P(A)$ [49], can be connected to a single seismic event that has the mean recurrence time between two consecutive occurrences equal to T_r years. In other words, it is often thought that the output of the PSHA can be directly converted into the definition of a single event that can be further used for the deterministic hazard assessment. However, the direct output values of the PSHA, i.e., the probabilities $P(A)$ and $P_t(A)$, are composed of the respective contribution from each source zone, and thus each earthquake that was considered plausible in a zone and was included in the definition of the source zone seismicity characteristics, contributed to the estimated values of the seismic hazard. Those earthquakes that contribute most to the hazard, i.e., to the calculated values of the probability, $P(A)$ or $P_t(A)$, can indeed be found, but only by using the so-called "de-aggregation" procedure [53]. The pur-

pose of the PSHA is thus to calculate the *probability* of occurrence, $P(A)$, and not the return period, defined as $T_r = P(A)^{-1}$, because such parameter does not have a clear physical meaning, regardless of the fact that it has been used by many researchers as an alternative way for quantification of the seismic hazard. The other frequent misconception is that the probability values, $P(A)$ or $P_r(A)$, that can be obtained even for extremely large and physically unreal (for the considered region and its seismotectonic features) expectations of the ground motion amplitude $Agmp$, if there are no limits on the integration range for magnitudes (unlike the Equation 7), are due to extrapolation of the magnitude-recurrence relations to the very small values of $N(M)$ or $f_m(M)$ (Equations 1 and 2, respectively), or perhaps due to extrapolation of the hazard curves, $P(Agmp)$, to the very low probabilities. The reason of this "error" lies in the fact that the distributions of the ground motion amplitudes (used in conjunction with the attenuation relations) are usually not truncated.

The next issue we have to consider for the new probabilistic seismic hazard maps of the Republic of Serbia is the choice of the reference probability of exceedance, $P_r(A)$. The current Serbian hazard maps are defined for the return periods of 50, 100, 200, 500, 1000, and 10000 years, without mentioning any probabilities. In order to perform at least some comparison with the prior hazard estimates, a set of ground motion values for a number of sites in Serbia should be calculated for the probability values that correspond to the return periods of the current maps. The recommendations of the Eurocode 8 [54] regulations for the reference probability of exceedance and corresponding return period, are $P_r(A) = 10\%$ in $t = 50$ years, and $T_r(A) = 475$ years, respectively. The same value for the probability of exceedance, i.e., 10% in 50 years, was used for the estimation of seismic hazard in all regional seismic maps used for the compilation of the so-called Global Seismic Hazard Map [55, 24, 56, 10, 57], as well as in many other hazard analyses all around the world (e.g., [58], [59], [60], [61], [25]). However, the reference probability of exceedance does not always have to be equal to 10% in 50 years, i.e., $T_r(A)$ equal to 475 years, and it should be chosen in compliance with the target reliability level for the seismic design of common structures in a country (this was the reason why, for example, the reference probability levels for the latest seismic hazard maps of Canada were chosen to be 2% in 50 years [62, 63]). Furthermore, the seismic hazard maps can be also constructed for several alternative values of the probability of exceedance in t years, e.g., for 2% and 10% [64, 65], 2%, 5%, and 10% [66], 2%, 10%, and 50% [11], 1%, 10%, and 65% [23], 2.5%, 5%, and 10% [67], all in 50 years (the "economic life" of common structures). The alternative maps can be then used for design and safety assessment of structures with different target reliability levels, and/or for the estimation of the seismic hazard that will be of comparable level as some other hazards that threaten the region of interest (e.g., flood hazard, cyclone hazard, airplane crash hazard, etc.). Therefore, rather than making a single choice for the reference $P_r(A)$ level, for the new seismic hazard maps of the Republic of Serbia, the selection of several probability values would be perhaps more appropriate than using only the 10% in 50 years level. This is also another reason why a set of hazard curves for different sites in Serbia should be firstly (i.e., before the complete maps) developed, their shapes studied and the relative values of the different probabilities on those curves compared.

3. CONCLUSION

This paper presents a review of the approaches to the probabilistic seismic hazard analysis as well as a discussion of the selection of the appropriate methodology of probabilistic seismic hazard analysis for the territory of the Republic of Serbia.

The current Serbian seismic hazard maps use a macroseismic intensity scale to describe the severity of ground shaking at a site. Having in mind the shortcomings of such approach for Serbia (see [68]) and the fact that the new hazard maps should be in compliance with the Eurocode 8 [54] regulations, we suggest that the new maps should be expressed through the values of the peak strong ground motion acceleration. However, right after deriving such maps (or in a parallel analyses), the seismic hazard for the Republic of Serbia should be also characterized in terms of some other ground motion parameters that could be of more interest for the earthquake-resistant design and seismic safety assessment purposes in Serbia (e.g., response and Fourier spectra, duration of strong ground shaking, artificial time histories, etc.), having in mind that the design spectra that have a normalized standard shape are not able to take into account that attenuation of the strong earthquake ground motion with distance depends on the frequency of the seismic waves and that the earthquakes of different size generate waves with different predominant frequency content [69].

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ODABIR ODGOVARAJUĆE METODOLOGIJE ZA PROBABILISTIČKU ANALIZU SEIZMIČKOG HAZARDA NA TERITORIJI REPUBLIKE SRBIJE

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U ovom radu dat je pregled pristupa probabilističkoj analizi seizmičkog hazarda, kao i diskusija vezana za izbor odgovarajuće metodologije probabilističke analize seizmičkog hazarda za teritoriju Republike Srbije. Predloženo je korišćenje deduktivnog pristupa kao i da bi nove srpske karte seizmičkog hazarda trebalo da budu izražene preko maksimalnih (vršnih, "peak") vrednosti ubrzanja tla, imajući u vidu da bi nove karte hazarda za Republiku Srbiju trebalo da budu sastavljene u skladu sa preporukama Evrokoda 8.