ASIAN JOURNAL OF CIVIL ENGINEERING (BUILDING AND HOUSING) VOL. 13, NO. 1 (2012)
PAGES 147-154

Technical Note

RESPONSE SPECTRUM IN THE EAST OF ALGERIA

C. Amouri* and H. Houari
Laboratoire de Matériaux et Durabilité des Constructions, Route Ain El bey, University Mentouri of Constantine, 25000, Algeria

Received: 10 January 2011, **Accepted:** 5 September 2011

ABSTRACT

The area of Constantine being located in a seismic zone, the management on the parameter of seismicity requires a precise micro zoning. The compilation of the historical seismic data of the area of Constantine, as those of the neighbouring areas will make it possible to determine the impact of the historical seismicity on the maximal establishment on the ground which will be an essential data for the establishment of the response spectrum for the study area.

Keywords: Seism; response spectrum; maximum acceleration; seismic faults

1. INTRODUCTION

It possible to affirm that the forecast of the place where the catastrophe will occur is established thing. Indeed, from their tectonic causes, one knows today that where there is in large seism, there will be irremediably, others also strong at least [1].

Unfortunately, the forecast of the date (day, hour) is very difficult to realize. And even if among the natural disasters, the seismic phenomenon called earthquake more commonly, the most terrified the man since his appearance on ground. The disastrous consequences of the seism, as well for the men as on their works, often reach gigantic proportions.

The great questions which are then put to the man are:

How to react vis-a-vis this calamity?

Can one envisage it?

The fact of envisaging it is enough it to solve the problem?

The history of the seism makes day it should succeed, would do nothing but move the problem. For example, to evacuate million people of an urban site in a few minutes, and during several days, would be, one suspects it, very difficult and would pose multiple problems.

* E-mail address of the corresponding author: c.amouri@yahoo.fr (C. Amouri)

Although the forecast cannot be regarded as a solution, it possible to undertake actions aiming at reducing the losses in goods and human lives when the next seisms occur because the collapse of constructions is the principal cause. Lastly, it is especially necessary to center our efforts on a better knowledge of the seism and the development and the improvement of the rules of protection to be taken at the time of the realization of the various works able to resist the seism's well.

2. FRAMEWORK SISMOTECTONIC REGIONAL

The seismic activity in Algeria of north is today well to explain by the theory of the plate tectonics [2]. Indeed it is the confrontation of about 1 cm/year both African and Eurasian tectonic plates which involves the deformation of the southernmost parts of Europe and Northern of Africa and gives place to the seism which leads our country (Figure 1).

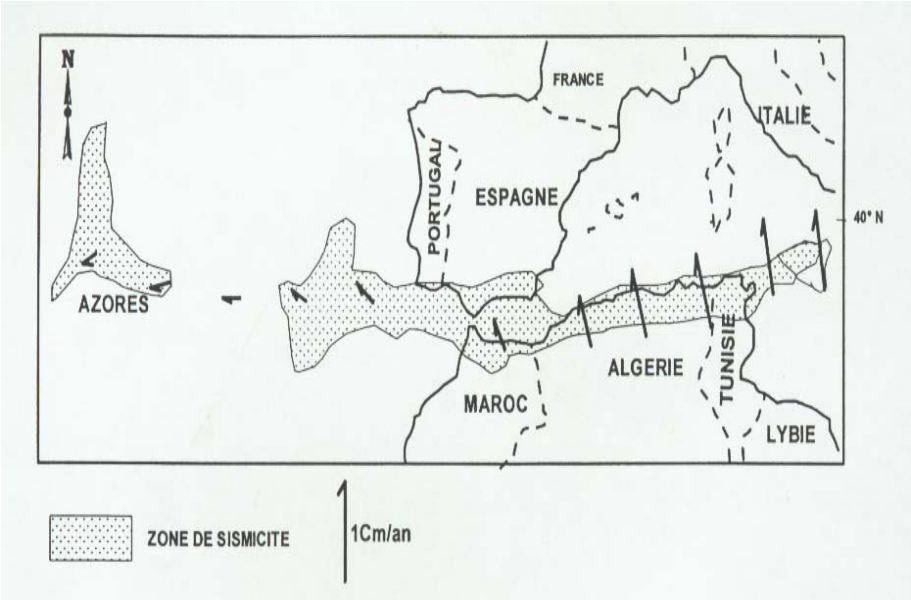

Figure 1. The limit of the plates African and Eurasian

3. ADMINISTRATIVE CHART OF THE AREA OF CONSTATINE

The area of Constantine extends on approximately 55 km from ray starting from the center from the agglomeration from Constantine. It corresponds administratively to the perimeter of the town of Constantine and that of certain administrative units of the town of Mila, of Oum El Bouaghi, Skikda and Guelma. Indeed, it is allowed in this kind of studies that all the localized seismic sources with less than 50 km of a site given can generate there more or less significant effects in the structures and the grounds [3] (Figure 2).

Figure 2. Administrative framework of the area of Constantine

4. ACTIVE FAULTS OF THE AREA OF CONSTANTINE

The examination of Figure 3 shows four active faults able to generate earthquakes:

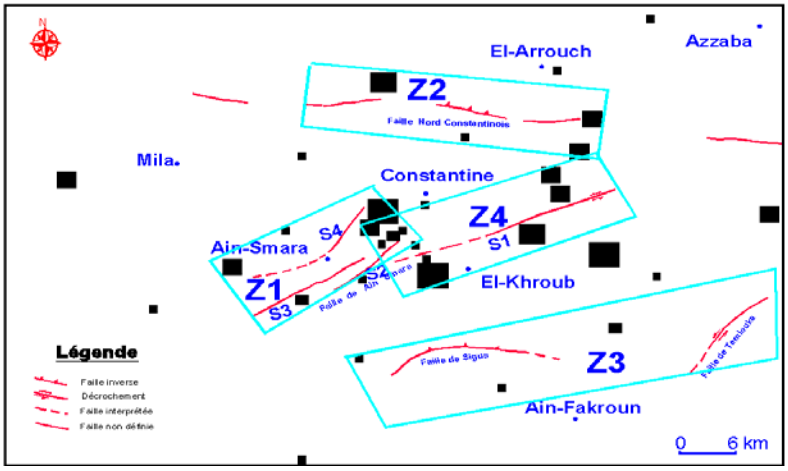

Figure 3. Chart of the seismic sources

- Source area of Ain–Smara (Z1): this zone is defined on the basis of presence of certain numbers earth tremors.
- Northern source area Constantinois (Z2): it is a segmented fault which seems to have produced some small earth tremors.
- Source area Sigus-Temlouka (Z3): this zone is defined to take into account in the analysis of the seismic risk of the area of Constantine the contributions of the faults of

Sigus and Temlouka. The fault of Sigus located in the walled of Ouem El Bouaghi, to approximately 50 km of the town of Constantine. 03 earth tremors seem to be related to the activity of this fault. The fault of Temlouka located in the walled of Guelma, to approximately 50 km of the town of Constantine. In historical term of seismicity there are no jolts located near this fault.

- Seismic source of El Aria (Z4): this source defined to model the fault of Ain Smara whose seismic activity was confirmed by the seism of October 27, 1985. The majority of the seism recorded in the area of Constantine is related to the activity of this fault. This fact it constitutes the first threat in seismic term for the area of Constantine and its surroundings.

5. STAGES OF SEISMIC ANALYSIS OF RISK

The determination of the seismicity of a site is based primarily on qualitative data. Of another dimensioned, the problem of the engineer is to build on this site, an installation which must resist the possibility of a new seism. To solve this problem the probabilistic method makes it possible to combine the probabilistic models localization, size, time as well as the effects on the level of one or more sites in order to determine the probability that a certain value of acceleration (g) occurs on the level of a site given during a given period.

The diagram of Figure 4 summarizes the methodological stages followed in the probabilistic analysis:

The assessment of seismological data is presented in charts of the historical seismicity and historical intensities maximum.

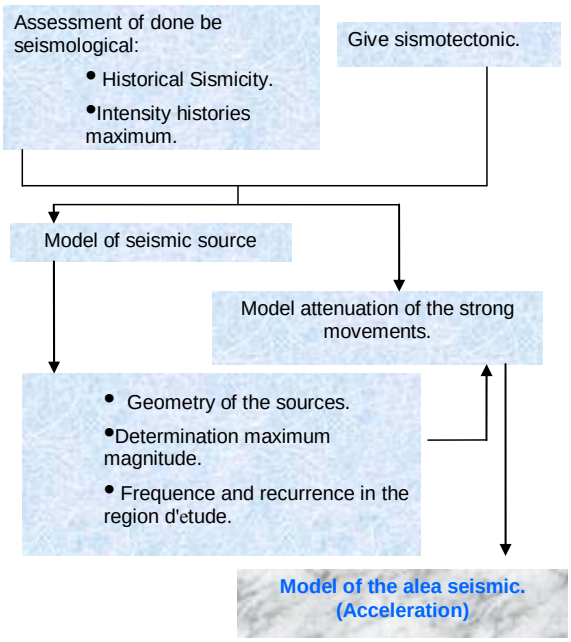

Figure 4. Stages of seismic analysis of risk

The data of the historical seismicity as well as the sismotectonic data make it possible to help to locate the seismic sources which would have generated future seism.

The identification and characterization of the seismic sources of the area considered highlight all the sources with their maximum magnitudes which could thus generated the definition of the frequency of occurrence of the seism various magnitudes.

A stage of the calculation of the seismic risk requires the choice or the development of one or more laws of attenuations which define the strong movement according to the magnitude of the seism and the distance since the site considered until the source.

All these data and results make it possible to calculate the seismic risk in term of maximum acceleration on the ground for a given site.

With regard to Algeria, laws of attenuations developed in other areas were used. The problem runs up against the problem of the availability of a bank of data of strong movements sufficient and representative to establish specific laws.

6. MAXIMUM ACCELERATIONS OF THE SOIL IN THE AREA OF CONSTANTINE

In our study the evaluation of the maximum acceleration of ground (PGA) in a site for various types of soil based on the magnitude of earthquake and of the distance epicentrale was provides by using the law of AMBRAHAMS and SILVA.

The graphs of the data relating to this study are represented in Figure 5, 6, 7 and 8. For a given magnitude acceleration is high for the soil rock, and then it drops successively for the firm soil, soft soil and very soft. This acceleration decreases with the distance. With each time that we passes to a higher magnitude, we always keeps the same pace, only that maximum acceleration becomes more significant than acceleration due to a seism preceding magnitude. The waves cross the soil rock quickly thus acceleration is very large compared to the firm soil, soft soil and very soft. More one is far from the source the waves attenuates except rare case where there is an amplification of the waves. It arises that acceleration varies with the distance.

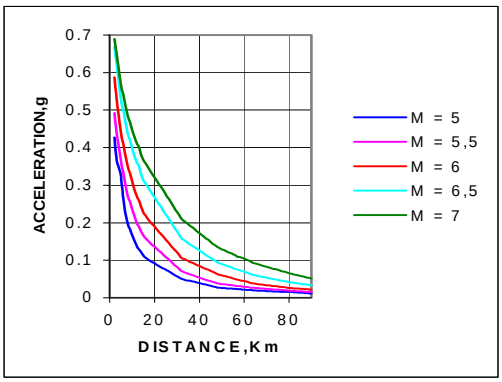

Figure 5. Acceleration of the Rock soil for various magnitude

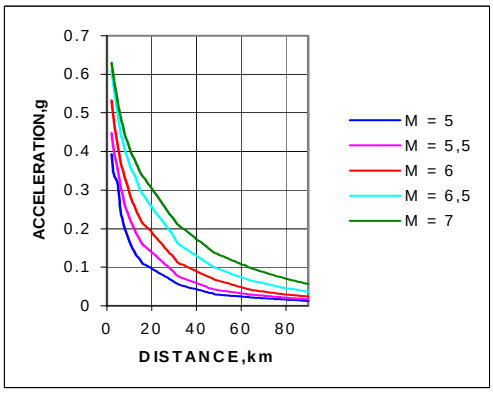

Figure 6. Acceleration of the Firm soil for various magnitude

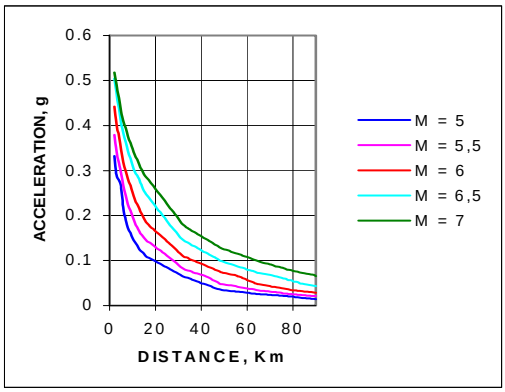

Figure 7. Acceleration of the Soft soil for various magnitude

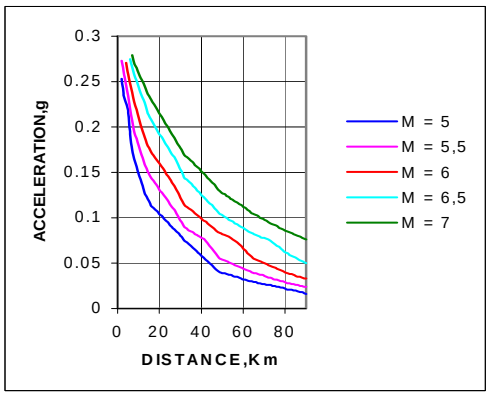

Figure 8. Acceleration of the very Soft soil for various magnitude

The Algerian Parasismique [6] regulation gives accelerations for all the area (between 0.15 and 0.25) independently of the position of the seismic fault, whereas calculated accelerations can reach until 0.6g. This same remark was noted at the time of the seism of Boumerdes by the seismologists. So there is under estimate of acceleration (PGA), in particular in the areas close to the active faults, compared to that calculated.

7. CONSTRUCTION OF THE RESPONSE SPECTRUM

One proposes to study the dynamic behaviour of the structure, subjected to a seismic excitation represented by the accelerogrammes. And like, for a given site, there are very seldom a sufficient number of recordings of significant seisms. This explains the use of the recordings of another area.

The built response spectrum starting from the accelerations measured during seism's often presented irregularities and are not directly exploitable in the calculation of constructions. It is thus advisable to determine a spectrum which will be the envelope of a whole of spectrum correspondents to accelerogrammes recorded in comparable sites from the point of view of the nature of the ground.

The method used is normalization to the same value of peak accelerations. Each response spectrum for a given recording is normalized to 1g. The spectrum of final response will be composed of peak accelerations for all records.

The normalized spectrum will be given for various types of damping, on figure 9. One notes same the observations as for those of maximum spectral acceleration. In this study the construction of the spectra of answer was made for the area of Constantine on the basis of historical seismicity. However the study was carried out only for the rock soil starting from seismic recordings of other areas.

For the reliability of the exploitation of the spectra of answer it is necessary to make a study of the variation of the seismic waves according to the nature of the crossed grounds.

Once, these determined parameters, a spectrum will be carried out for the users (spectrum

of calculation).

This work remains a support for any study concerning the construction of the response spectrum in any area.

It is noticed that the range of the periods of the RPA where acceleration is constant locates between 0.1 and 0.4 while in the calculated spectra the range of the periods is stretched, they can go up to 1.2 S. The spectrum calculated in term of acceleration is much more significant than the values of the RPA99.

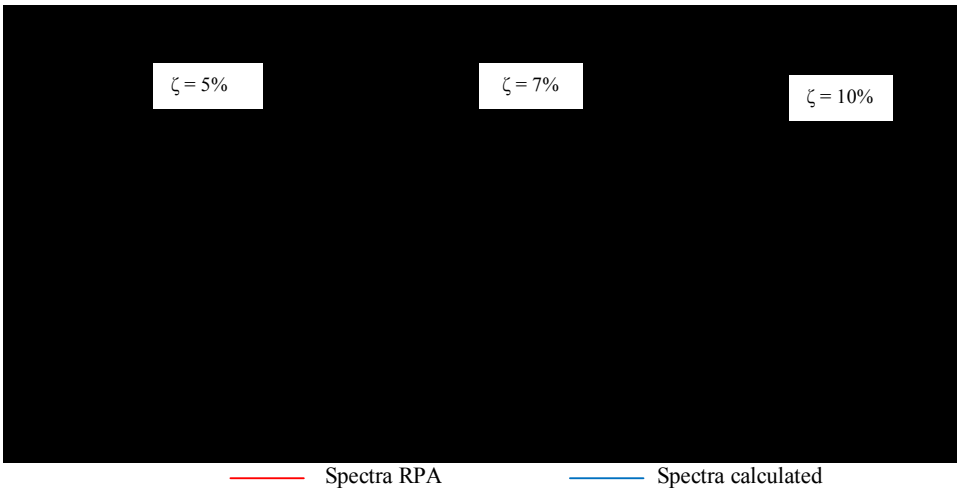

Figure 9. Comparison of the response spectrum for various damping

8. CONCLUSION

Like the seism different from an area to another in particular according to the influence of the local conditions, of further information, a thorough investigation is necessary to the local scale, any decision as regards town planning, of regional planning or genius parasismic must be based on the knowledge of the characteristics of the known and probable seism.

The area of Constantine was the object, as well as the remainder of other Algeria areas of a seismic study of risk based on the data of the seismicity in 1978. It is normal to reappraise the seismic risk in the light of the new knowledge obtained as well in the field of the seismicity, such as the Re-evaluation of the data, as data of the seismic sources.

The use of only one spectral acceleration for all Algeria us could sufficient to cover all the structures built in various places for that of the local spectra of answer must be placed at the disposal of the engineers.

The study of the seismic risk of the area of Constantine shows the various faults active. The determination of maximum accelerations was given according to the magnitude, of the distance epicentrale and the type of soil. It is noticed that RPA under regard the maximum acceleration of the soil in particular in the areas close to the active faults. This same remark was noted at the time of the seism of Boumerdes by the seismologists.

For the reliability of the exploitation of spectral accelerations:

- Require a multi-field team going geophysicists, geologists, seismologists, engineers…etc.
- Creation of a bank of seismic data on a regional scale.
- One needs carried out the study of the variation of the seismic waves according to the nature of the crossed grounds.
- Development of the regional and total experimental laws of attenuation.
- Calculation of the experimental spectra of answer and derivation of the lawful spectra of calculation.

Being able to us to say that the catastrophes related to the important seism can be seriously attenuated and even reduced by the strict application of seismic risk regional. The expenditure, even if they are significant, will be largely justified after the seism when the assessment of the damage is established.

REFERENCES

1. Baddari, K, et Djeddi, M, Les séismes et leur prévision. Office des Publications universitaires, (1994).
2. CGS, ARCADIS EEG SIMECSOL, Etude des glissements de terrain à travers la ville de Constantine, (2003).
3. Bounif, M.H, Etudes sismotectonique en Algérie du Nord. Contribution à l'étude d'un tronçon de la chaîne tellienne à partir des répliques du séisme de Constantine du 27 Octobre 1985. Thèse de magister. USTHB.
4. CRAAG, Les séismes en Algérie de 1365 à 1992. Publication du centre de Recherche en Astronomie, Astrophysique et Géophysiques, (1994). CRAAG, Alger-Bouzaréah.
5. CRAAG, Les séismes en Algérie de 1992 à 2001. Publication du centre de Recherche en Astronomie, Astrophysique et Géophysiques, (1994). CRAAG, Alger-Bouzaréah.
6. CGS, Règles Parasismiques Algériennes RPA 99. Document technique réglementaire, D.T.R.-B.C.-2.48