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Seismic Prevention and Existing Buildings in Algeria

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Abstract: This present a substantial problem and an excruciatingly heavy burden for Algeria. In fact, notwithstanding some rare extreme circumstances, such as seaquakes, landslides, etc., earthquakes are solely dangerous because of their devastating effects on buildings. Recent events are a stark reminder of the extensive damage, sometimes bordering on complete destruction, wrought by earthquakes, entailing a halt to the normal course of life. It is precisely insofar as buildings are concerned that earthquakes take their gruesome significance through the usually extensive destruction of the building wealth. This study's opportunity lies in its propounding of the setting up of a strategic preventive scheme through the substantial reduction of the seismic threat in Algeria.

Key words: Existing buildings, seismic prevention, algeria, reduction, seismic risk, paraseismic rehabilitation

INTRODUCTION

A quick glance at the recent past will highlight the number of severe earthquakes that have affected several areas in Algeria. It will equally serve as a measure for the disaster experienced and however old it may seem, it still remains a topical issue.

Basically, buildings are intended to protect. By way of consequence, their reinforcement serves precisely the purpose of implementing that protection. Buildings afford themselves protection against the multifarious damage that nature is likely to inflict upon them. The essential part of that protection consists in seismic prevention, manifesting itself in the behaviour of buildings, which should be capable of withstanding the most harmful effects of earthquakes, under the best possible conditions. The primary aim is evidently the avoidance of the collapse of structures.

By way of example, one can list the excessive expanding of buildings, as well as the total or partial destruction thereof. Owing to natural or catastrophes buildings, which are made to last, display a fragile character and are increasingly left with no possible defence or parry.

Earth has from time immemorial been considered as a natural support for mankind. However, Earth suddenly turns absurd when it starts shaking, and the suddenness of the disaster is usually ascribed to fate (Walker, 1982; Allegre, 1987). Geologists, nonetheless, know this inevitability, even though it exceeds their predicting capabilities. Moreover, architects and engineers are endeavouring to contain it.

SEISMIC REALITY OF ALGERIA

The overwhelming majority of severe earthquakes has been recorded in the areas separating the lithospheric plates (inter-plate earthquakes) (Fig. 1).

The seismicity of Algeria is mainly due to the collision of the Eurasian plate with the African plate whose axis of highest tension precisely crosses all the northern part of Algeria. Indeed, the transasian belt, which releases 15% of the annual seismic energy, extends as far as the Mediterranean, therefore affecting the Algerian coastline.

Examination of the history of seismicity in Algeria reveals the great seismic activity which characterizes its entire northern fringe, where almost all of the existing buildings exist, making seismic hazards a fact to be reckoned with. The last earthquake on record, the one that wrought extensive devastation in Boumerdes in 2003, is a dramatic example (Fig. 2).

The incalculable toll of physical and psychological sufferings is compounded by the incommensurable material damage suffered by Algeria. The stark reality of the post-seismic situation should make us realize the severity of a hazard that could send us back to the Stone Age.

There is a general opinion that the earth will shake again in Algeria some day, with the same, or even greater,

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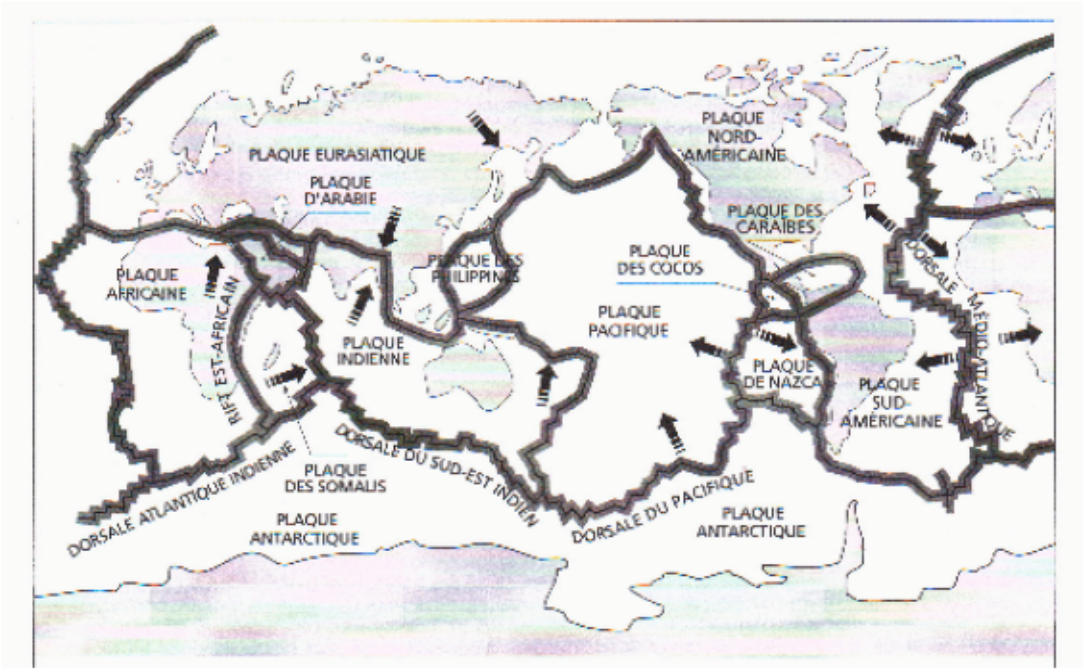

Fig. 1: Areas of important seismic activity

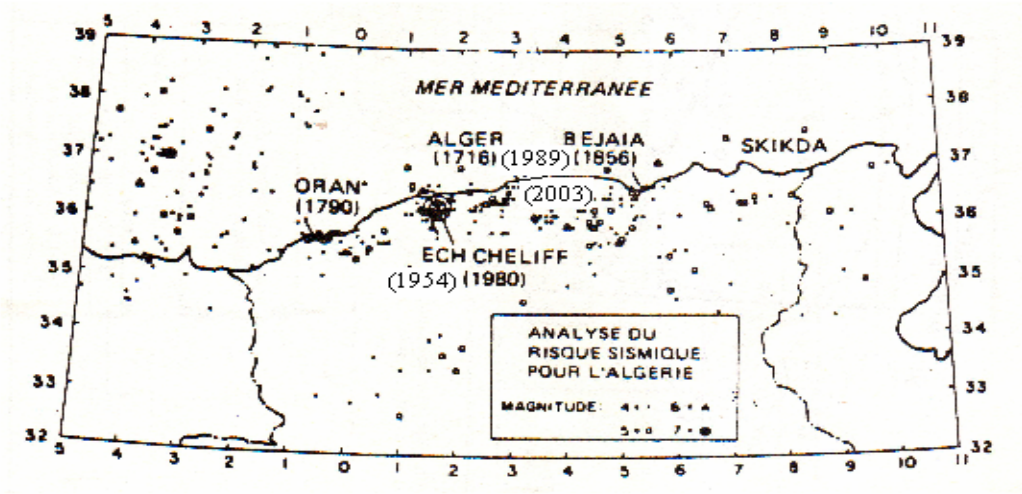

Fig. 2: Chart of the epicentres in Algeria

force than the past. The frequency of earthquakes in Algeria is estimated at one severe earthquake per every 25 years. That day, then, is drawing nearer.

The natural laws governing this fact are solely noticeable when they strike with such titanic might that they leave us overwhelmed. Our recourse to metaphysical explanations by ascribing this phenomenon to a curse maintains our mystical tradition and delays their understanding, which is, nonetheless, growing perceivably. On the other hand, all that which is under our control, everything we create must take the phenomenon into consideration.

SEISMIC PREVENTION AND EXISTING BUILDINGS IN ALGERIA

The inevitable and unforeseeable character of earthquakes should not prevent us from seeking to protect ourselves by minimizing their effects. This protection should start with seismic prevention whose

main aim is to ensure the adequate behaviour of buildings through avoiding the collapse of their structures in earthquakes.

Unfortunately, it should be acknowledged that in Algeria, almost the totality of buildings was designed, analyzed, sized and built without taking account of seismic effects. Although great differences can be observed when compared to paraseismic requirements currently in force (TCC, 2003), the latter themselves being insufficient and having been updated several times, no legislation has been passed or even been proposed for existing buildings. We should not wait until a new catastrophe occurs to display a short-lived interest in the phenomenon. On the contrary, the seismic reality of Algeria, where several areas have been destabilized for long periods, should encourage us to engage in a careful consideration of the seismic prevention of existing buildings that represent the totality of the housing stock of the country. To be reliable, this thinking should address both a technical and a legal aspect.

Technical aspect: Possible operations to be conducted on existing buildings include a long-haul effort, with a particular focus on the renovation along paraseismic lines of the housing stock, and equally a paraseismic rehabilitation which should in the main be a private initiative. For the time being, this rehabilitation is completely absent. It is, nonetheless, sometimes quite possible carry out simple but very useful reinforcements, to substantially reduce the vulnerability of a building, contrary to present practices, which tend to favour vulnerability in most cases (TCC, 2003; DMR, 1993).

The earthquakes of El Asnam (1980), Tipaza (1989) and Boumerdes (2003) highlighted, once more, the gross negligence and the fact that Algeria has fallen behind in this strategic domain for this country.

Through out the world, public authorities are responsible for the prediction and the prevention of catastrophes. In the field of the paraseismic rehabilitation, officials should, on the one hand set an example by undertaking to strengthen of public buildings and on the other hand require the rehabilitation of private buildings, while commissioning studies and implementing actions to facilitate these steps:

Detailed Micro-zoning of all the northern part of Algeria: This essential operation allows both the establishment of an accurate paraseismic code and the identification of the most vulnerable buildings according to the nature of the soil, the topography and the buildings' condition (DMR, 1993). Indeed, presently Algeria suffers greatly from the absence of fundamental dynamic studies of the soil for paraseismic construction. This aspect, completely ignored by the present paraseismic regulations, is little more than a perfunctory, totally static, geotechnical report, often laden with erroneous recommendations. Local micro-zoning should be the result of an in-depth analysis of the local factors that account for the spectacular manifestations of the earthquake's effects on the ground. Thus, accelerations levels should more accurately reflect the seismic character of the zone under consideration. Moreover, the local geological conditions are likely to induce very substantial damage due to the phenomena of seismic wave amplification, soil liquefaction, landslides, land subsidence and the appearance of faults on the surface (Strak, 1995; Pecker, 1984; Campillo, 1990) (Fig. 3).

The effects of such multiple phenomena can often assume a major importance, as occurred during the earthquakes of Chlef (ex El-Asnam) in 1980, when the main accident generated faults on the surface.

Strengthening of grounds with known seismic effects Drafting of a typological classification of existing buildings: This classification, regrouping the buildings into families, should not only meet the sole requirements for the inventory of a large number of buildings existing on a wide area, but must equally it possible to make assumptions on the behaviour of the various types, on the location of their weak points and to determine the principles of preventive improvement applicable, if necessary, regardless of the area whose existing buildings one wishes to investigate.

Investigation of the vulnerability of the various building types, including the likelihood of fall of non-structural elements. Post-earthquake observations permit the establishment of vulnerability classes (Grunthal, 1998; Umesco, 1980) (Fig. 4). Several scales of vulnerability exist, but in all cases, it is a classification that ranges from very vulnerable to far from vulnerable. The damage resulting from an earthquake for a given type is often more or less substantial. The said damage is characterized by a distribution that is amenable to a mean value and lower and upper limits. This distribution reflects the influence of the multiple parameters, in particular the quality and the heterogeneity of materials, the structural system, the presence or absence of paraseismic features, more or less penalizing characteristics (openings, pre-existing cracks, verticality of walls, partial transformation, type of roof) and of connections to neighbouring buildings. Below is a table of classes of vulnerability corresponding to a European macro-seismic scale (Pessina) (Fig. 5).

Definition of measurements of urgent and priority preventive improvement as well as their cost: It is

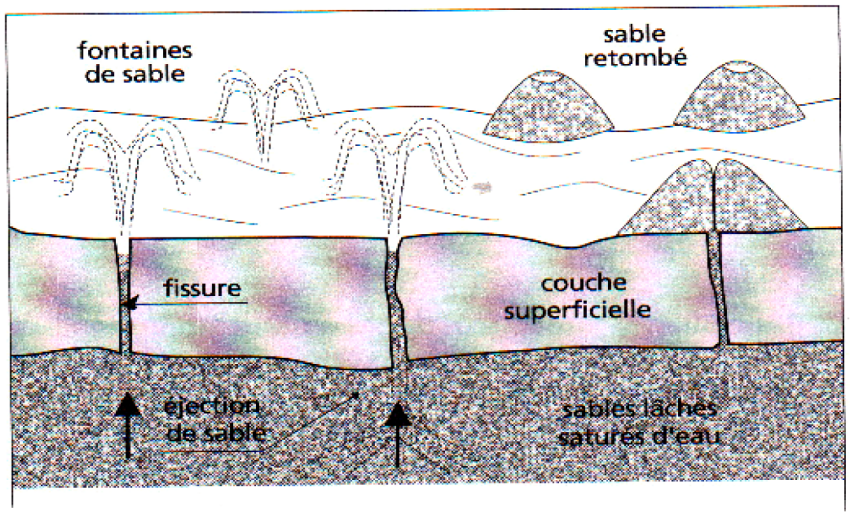

Fig. 3: Liquefaction of ground

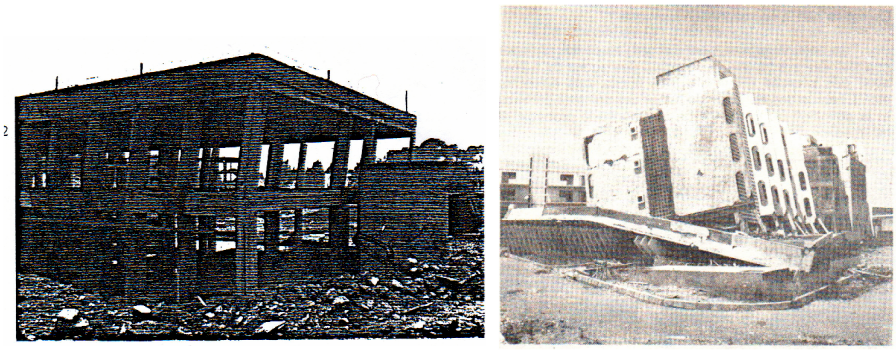

Fig. 4: (a) Construction under realization et (b) Existing multifamily apartments

paramount to bring the essential rules into general use by thoroughly describing the various techniques that have proved their efficiency in the paraseismic rehabilitation of buildings. This popularization consists primarily in the publication of handbooks on natural disasters, notably catalogues on repairs and paraseismic reinforcements that should be simple and essential to the improvement of the resistance of ordinary buildings. Such a measure should be urgently implemented (MCP, 1982).

Whatever the situation, the detailed examination of the condition of buildings under consideration includes the following stages:

- Seismic diagnosis, or to evaluate the resistance of the existing structure or its residual capacity of resistance after an earthquake.
- Analysis of the consequences of the possible preventive measures adopted.
- Preventive treatment, where a particular attention should be paid to the changes imposed on the structure so that the unstrengthened elements should not undergo unplanned or non-compliant stress.
- Carry out checks after rehabilitation.

Legal aspect: The paraseismic rehabilitation of existing buildings will probably not be implemented without a legal obligation planned beforehand by public authorities. To be effective and practical, this obligation should not be formulated in terms of objectives but in terms of resources for the implementation thereof and procedure to and clear criteria for decision-making.

To date, Algerian paraseismic rules have been published and updated on three occasions. They relate to the definition of the geographical areas and the preventive seismic measures for new buildings. But things are different as concerns existing buildings. However, the

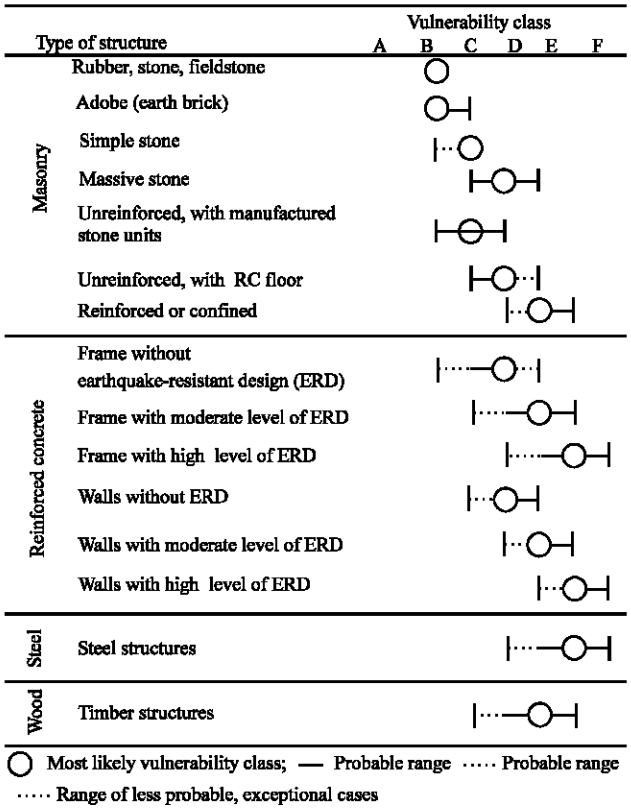

Fig. 5: Vulnerability Classe of the European macroscopic scale

objective remains the same. In fact, it is a matter of ensuring the seismic prevention of the whole building and of preserving human life.

Paraseismic rehabilitation should be compulsory for all buildings whose destruction would seriously affect the safety and the economy of the area under consideration.

Moreover, preventive measures should be enforced in the geographical areas II and III as defined by paraseismic regulations. Thus, the alteration of buildings, a widespread practice in Algeria, should be subsumed in the category of new buildings, and come within the scope of the obligation of meeting paraseismic norms in its totality.

This includes, in particular, alterations relating to the raising, extension, reshaping and the change of purpose of buildings.

The full range of these obligations will underscore the necessity for a specific system for the seismic prevention of existing buildings at the local, regional and national levels.

CONCLUSION

Earthquakes are inevitable and their tolls are increasingly catastrophic for Algeria. But, once the initial shock is over, these destructive events fall into oblivion.

The question is: Should we undertake the rebuilding of the damaged buildings or or preserve it through recourse to paraseismic rehabilitation? The choice is not an easy one to make, and we should not wait till the event occurs to face the obligation to make it.

In principle, the same level of security should be enforced on existing buildings as on new ones. Indeed, paraseismic rules are neutral as to the age of buildings. They are applicable to all buildings, be they new or old.

It is in these terms that the seismic prevention policy for existing buildings should be viewed, where the sole efficient approach is that of paraseismic rehabilitation. This policy can only be carried out with some chance of success through the training of the various actors in this field and a campaign of awareness-raising in public opinion, at present non-existent in Algeria.

To end the deadlock, it is urgent that responsibilities should be clearly defined and the people that assume them be known.

Finally, the official assertion and interest in seismic hazards already represent a denunciation and a refusal of inevitability. They represent a particularly effective tool of consciousness-raising: this is already prevention, it is not protection yet.

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