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Stéphane Cartier

EDITOR'S NOTE

Translation: Brian Keogh

- 1 The urban areas of the sedimentary valleys of the Alps are subject to moderate to strong seismic movements, amplified by "site effects" (amplification, liquefaction) (Bard, 1983). The European scientific programme Sismoalp has brought together French, Swiss, Italian and Slovenian scientists with the aim of characterising this risk in conjunction with the following land use planners and decision-makers: bureau cantonal du Valais (Switzerland), Agence Régionale de la Protection de l'Environnement du Piémont (Piemont Regional Environmental Protection Agency, Italy), Slovenian Ministry of the Environment (Cotton, 2006). This innovative approach has led to the inclusion, in the seismology programme, of questions of a political nature regarding conditions for the local management of "site effects" by seismic micro-zoning. The scientific characterisation of seismic micro-zones enables the definition of more precise rules for building and urban zoning. The alpine valleys are thus able to test different forms of administrative management aimed at anti-seismic safety. The possibilities provided by micro-zoning reveal the extent to which differences in political culture continue to play a role in orienting anti-seismic safety rules in different ways. Although each country is doing more to deal with the earthquake risk (Katarisk programme in Switzerland, setting up of a seismic service in Slovenia, seismic regulations in 2003 in Italy, Plan Séisme (earthquake plan) in 2005 in France) in line with a common European approach (EuroCode 8), there are considerable variations in the devolution of power to local authorities. The organisation of local and national

regulations depends very much on the institutional organisation of each State and the distribution of responsibilities between private and public actors.

- 2 Seismic risk prevention is seen as covering numerous aspects such as knowledge of the specific characteristics of the risk and vulnerability levels, the existence of safety rules in urban planning and construction, incentives for reinforcing existing built areas, the possibilities and obligations of insurance companies, and the methods of financing prevention. The complexity of prevention measures precludes analysis here of seismic observation and population warning systems, not to mention the conditions of evacuation and assistance in the event of an earthquake. Given the lack of comprehensive legislation, the aim of this comparative study is to explore a few crucial points in the earthquake safety measures provided by public institutions, a field sufficiently extensive in each country, without attempting to examine the diversity of actors concerned (users, private owners, real estate promoters, builders, design offices, insurance companies, industrial companies, etc.). Indeed, earthquake safety involves numerous technical and sociological difficulties: advanced technical level, expertise enhanced by scientific research into the margins of uncertainty, numerous languages, very heterogeneous democratic regimes, important regional powers in Switzerland and Italy, and different ways of adopting European regulations. In addition, a specific difficulty relates to the fact that responsibility for safety depends on bringing together very different regulatory systems, which are impossible to examine in full. The analysis, prepared with the help of input from members of the Sismoalp European programme, is therefore largely based on interviews with the services responsible for earthquake monitoring and protection and on analysis of the documents used as legislative, technical and scientific references or as means of communicating.

Earthquake vulnerability of the alpine valleys: adapting urban planning and development regulations to scientific knowledge

- 3 The vulnerability of the sedimentary alpine valleys to the risks of seismic activity has increased as a result of urban and demographic growth. The valleys, which are often flat and still used for agriculture, have provided platforms for the urban colonisation of the mountain areas where land suitable for building is in short supply. They also determine the major arteries of communication. However, they are often exposed to flooding and earthquakes. Potential damage relating to these risks is affected by a number of factors: demographic growth, urban development, industrial redevelopment (from hydroelectricity to nanotechnologies), the development of transport, increasing numbers of tourists (winter and summer; Olympic games in Grenoble, Albertville, Chisone). Exposure to earthquake risks is increased by the fragility of the older built areas, urban growth, the spatial concentration of networks, the presence of dangerous chemical industries, the influx of newcomers to the area and outside tourists. The local population's lack of knowledge about earthquake risks is related to a general lack of scientific culture, to the specificity of the risk of a relatively infrequent event, which does not help maintain the collective memory, and to the changing conditions governing vulnerability (urbanisation of area at expense of agricultural uses).

- 4 As with flooding and avalanches (Cartier 2002; Cartier, Mettoux 2005), earthquake safety depends on numerous actors who often have a poor understanding of their interdependence. Earthquake prevention involves issues related to public safety, measures for reducing natural hazards, urban planning regulations, building regulations, building techniques and insurance. It combines two public approaches, spatial (spatial planning and development, risk prevention plans, urban development plans, building regulations according to seismic zones, building permits) and sectoral (professional practices, building obligations, technical safety recommendations, examination and issuing of building permits, contracts between Owners and project managers, coordination between numerous professionals in building industry, technical inspections, insurance contracts) (Cartier, 2005). The responsibilities of the different actors involved are of several types: public and private; private and professional; contractual and civil; owners and users.

Earthquake macro-zoning: general knowledge for a generalised constraint

- 5 At the national scale, earthquake macro-zoning reflects the specific characteristics of natural conditions as well as political history. In this respect, French zoning has been influenced by catastrophes in the colonial territories, particularly the Maghreb (Orléansville in 1954), and the French West Indies, a zone of maximum risk. Slovenian zoning is based on two cartographic systems that serve as legal references, one of these being of Yugoslavian inspiration, the other European. As for the Italian zoning system, it was for a long time reactive, gradually developing in response to each earthquake incident, but the present system was set up by a national commission. Its use, however, remains subject to national principles, abstract legislative and scientific injunctions, and the importance of regional authorities, reinforced by partnerships with local universities, which have to find a compromise between local interests and safety. Zoning in Switzerland is also decided on at the federal level by the Service Sismique Suisse (Swiss Seismic Service). This department is responsible for publishing an earthquake risk map, which is then interpreted at the cantonal level thereby ensuring its adaptation in the best way possible to local needs. The federal service also encourages local interpretation by limiting the number of general constraints that apply to the federation as a whole. It should be noted that the Swiss reference system for decisions on earthquake risks includes an official intervention by a paraprofessional learned association whose recommendations have force of law, the Société des Ingénieurs et Architectes (Architects and Engineers Society), and is marked by increasing adaptation to European standards (Euro Code 8, EC8), even though the Confederation is not a member of the European Union.
- 6 Anti-seismic legislation, nuanced by the national political culture in which it is formulated, is based on administrative, technical and scientific expertise, corrected over time by the experience acquired from catastrophes. In addition, the seismic classification of buildings determines the degree of anti-seismic protection required depending on the importance of demographic or strategic stakes. Since some zones are more seismic and some activities more vulnerable than others, the legislator acknowledges the heterogeneity of risks affecting the area by reinforcing the anti-seismic codes on the basis of macro-zoning and the consequences of a disaster.

- 7 In all States, public safety requires knowledge about the risk, diffusion of appropriate information, and above all the power to enforce the adoption of anti-seismic techniques. However, from a legal point of view, this obligation is relative, since for Switzerland recommendation of the SIA standards is only legally binding for the Canton of Valais.
- 8 Indeed, to avoid any legal loopholes, this Canton explicitly specifies that the SIA standards must be adopted. In the other Cantons, the SIA standards are not legally considered as a professional reference for best practices. These differences bear witness to the stakes implicit in adopting anti-seismic regulations as a function of macro-zoning. Each State acknowledges having extensive areas without any earthquake dangers and without the antiseismic regulations that are assumed to be more costly and more difficult to apply than standard regulations.
- 9 By acknowledging the existence of specific zones and uses, this application of anti-seismic regulations within a given territory results in different construction investment costs. While these may be relatively low for new detached houses (Czitrom, 1999), the obligation of reinforcing the anti-seismic resistance of existing or new structures in some zones may be sufficiently costly to make it a decisive economic factor for industrial installations or bridges (particularly ambitious in mountain areas, for example the Mediterranean TGV (High Speed train) link, the Lyon-Turin link). Above all, anti-seismic requirements upset the work practices of professionals, who are generally ill-prepared. Their know-how is often challenged by a lack of technical knowledge and by the margins of interpretation of uncertainties linked to natural risks.
- 10 The need for a hierarchy among anti-seismic investments is generally acknowledged but is nevertheless delicate to establish at the limits of zones and on the basis of estimated risk. Apart from the unequal economic and legal treatment of zones, such uncertainties may encourage the more prudent experts to adopt "conservative" references, overestimating the risk, sometimes through lack of knowledge of the margins of safety included in the earlier stages of risk assessment. These relative references, sometimes contested in the case of investments for industrial projects (energy, chemical plants, nuclear plants) or transport (TGV), introduce the possibility of modifying constraints according to local geological conditions identified by micro-zoning.

Micro-zoning: towards a devolution of power to local authorities?

- 11 Risk is a source of concern that is reinforced by site effects specific to local geology, such as the amplification of vibrations in sedimentary alpine basins. Consequently, regulations proposed at the macro-seismic scale may prove to be ineffective at the local level. The introduction of potential site effects in urban planning and architectural recommendations depends very much on the opening up of national legislation to interpretation by local authorities. In other words, it raises a number of questions: Is it possible for municipalities to modify the application of national anti-seismic regulations, by what right, according to what scientific criteria, according to the opinion of which experts, and in whose interest? Do seismic micro-zones provide criteria for public and private actors responsible for safety? In France, what legal (or

restrictive) value do such zones have in Seismic Risk Prevention Plans (Plans de Prévention des Risques Sismiques (PPRS)) provided for in the 2005 Seismic Plan? Although the adoption of the PPRS is often accepted by local actors as a further extension of planning constraints, expertise may also provide a possible recourse for envisaging a reduction in anti-seismic constraints. Analysing investment needs for safety in terms of risk requires determining the criteria and thresholds for taking risks (how many people, what level of safety, at what cost, what time-scale, what level of uncertainty can be tolerated). Given the extremely technical nature of such questions and the scientific uncertainties, these determining factors are more often implicit or confidential rather than explicit and debated publicly.

- 12 Micro-zoning, which varies considerably depending on the research institutes involved (Benelhadj, 2005), characterizes local dangers from the scale of the plot of land (Switzerland, in the case of important building issues) to that of the regional sedimentary basin (Italy). However, soil/structure interactions specific to sedimentary basins are still the subject of scientific research aimed at reducing uncertainties, characterising damage probability, establishing technical references, making building and urban planning recommendations, and in general helping to draw up administrative and prescriptive rules. The high stakes mean that expertise has a key role in the constant discussion around the interpretation of uncertainties by actors with divergent interests (absolute safety / need to reduce investment costs; development opportunity / renouncement of urban development or industrialisation).
- 13 In this implicit context, micro-zoning provides technical information for investors, both public and private, but also input for arguments in controversies, characteristic of situations of uncertainty when the earthquake risk is brought into discussions to denounce or approve a project (for example, the Cadarache nuclear project in France). Modifying rules on the basis of micro-zones means that public authorities are deprived of the political comfort of having a basic generalised macro-zoning system to apply, but it is also an acknowledgement of the problems of local interpretation of successive assessments and second assessments. The introduction of micro-zoning meets the need for enhanced local knowledge of risk in order to ultimately optimise safety. Despite the diversity of methods employed, this is a general trend in the alpine arc that has received considerable stimulation from international interaction between scientists, often involved in the preparation of administrative and regulatory proposals. An approach that contrasts sharply with the decentralised interpretation of national rules (France, Italy, Slovenia) is that adopted by the Swiss, who base their system on local needs in terms of the vulnerability of issues.

Decentralisation in France, Italy and Slovenia: from a national universal system to local specific applications

- 14 The recognition of local modifications to town planning and building regulations is part of the move toward political decentralisation (France, Italy) and independence (Slovenia). Such a trend encourages local responsibility for land-use management, town planning, investment and safety. The possibilities for earthquake regulations at the local scale also give rise to different laws and administrative decrees.

- 15 In France, information remains fairly confidential. Faced with a complex phenomenon, it is important not to worry the population, which basically has to rely on the efficiency of the public expertise provided by science and government departments. Because of the lack of detailed information on exposure to risk and associated constraints, there is an overriding suspicion of negligence on the part of building or project owners regarding their responsibility for ensuring safety (a private wait-and-see policy reinforced by the guarantee of national solidarity from the CAT-NAT (natural catastrophe) insurance system). But the French measures suffer from the need for an impossible omniscience and omnipotence. The State's limits in terms of its capacity to identify risks and inspect the implementation of anti-seismic regulations make it necessary to free it from its obligations or run the risk of condemning it to assuming an "intolerable" responsibility with regard to faulty inspections. The multiplication of information sources and expertise, related to the increasing capacities of insurance companies, makes it impossible for the public services to explore every local uncertainty, even though there is an increasing number of legitimate public authority sources, whether they be European for seismic codes, or local for urban planning. Consequently, to justify the anti-seismic safety of a new structure or a structure that has undergone substantial modifications, seismic actions defined at the municipal scale in a Risk Prevention Plan take precedence over general regulations (according to the interpretation by the Association française de Génie Parasismique (French association of anti-seismic engineering) of decree 2000-892 of 13 September 2000 concerning the prevention of seismic risks, which corrects and completes decree 91-461 of 14 May 1991). But then the "Bachelot" law of 2003 acknowledged the possibility of less strict local regulations based on the more precise results obtained from micro-zoning (Fabriol and Garry, 2002). It involves first of all increasing the strictness of anti-seismic standards depending on the results of micro-zoning, then of encouraging the search for more precise local references with a view to possibly decreasing the level of investment needed for anti-seismic measures if the uncertainty is put into perspective. Such flexibility has given new life to public policies in France, which are now more concerned with adjusting constraints to local natural conditions. This approach has also encouraged local responsibility for risk taking, with municipalities now defining their own Risk Prevention Plan and preparing their own urban development plan.
- 16 In Italy, there is a similar trend toward decentralisation since the regions must now identify earthquake zones (Gazzeta ufficiale serie generale n. 105 dell' 8/5/2003, Ordinanza del presidente del consiglio dei ministri 20 marzo 2003). By integrating local effects into the national map of geological and seismic risks, regions such as Friuli Venezia-Giulia or Piémont are able to adopt different anti-seismic policies. This possibility leaves the regional experts with considerable latitude in their interpretation of national recommendations, since, depending on the regions, the State ruling on soil mapping at the regional level translates into a simple consultation of the national geological map or into detailed geophysical analyses (Friuli Venezi-Giulia). This increasing precision then makes it possible for regional authorities to reintroduce the idea of applying anti-seismic standards according to estimated risk. This progressive decentralisation, however, introduces significant differences in the way risks are dealt with, depending on the regional interpretation. Thus the new zoning system in the Aoste region only includes two municipalities that are exposed to "average risk", all the others being at "high risk". A total re-examination of the seismicity map of the Frioul area, which is currently in progress, is incorporating the scientific results of local

universities. The new seismic zoning of the Piémont area has led to doubling the effort to take responsibility for risk and to a reorganisation of all inspection procedures. Finally, each Regional Assembly decides what level of precision is required in the soil study, which must then be accepted by the Regional Environmental Protection Agency (ARPA).

- 17 Obtaining local autonomy in anti-seismic measures is a gradual process. In Slovenia, the main issue concerns the compatibility between Yugoslavian seismic references and Slovenian anti-seismic standards of European inspiration (EC8). In France and Italy, the objective is to apply national directives locally.

Switzerland: local responsibilities and national incentives

- 18 Influenced by Helvetian political culture, the Swiss approach is very different, since local management, both municipal and cantonal, takes precedence over the enactment of universal federal rules. A surprising consequence is that, until the 1990s, Switzerland, as a State, seems to have virtually ignored the earthquake risk, despite this being significant within its borders. Although the Basle earthquake of 1356 remains the historical reference, policies mainly concern the monitoring of gravity risks. Landslides, avalanches and floods have, over the years, helped develop a strong feeling of national solidarity (Pfister, 2000) and contributed to federal and local public measures (Peltier, 2005). On the other hand, the earthquake risk seems to have been a subject of less concern and has given rise to fewer investigations and regulations. In fact, for the most part, the Swiss earthquake policy is based on the observation of physical phenomena and individual and voluntary responsibility for anti-seismic safety, encouraged in some cases by insurance contracts (Von Ungern-Sternberg, 1997). According to this general principle, the application of anti-seismic rules depends on the instructions from the contracting authority or Owner, the professional application of best practices, and inspection by the insurers. The effectiveness of this very liberal approach of encouraging individual responsibility for safety has nevertheless given rise to numerous doubts, resulting in several local initiatives that have contributed towards the constitution of a body of regulations available for each canton. The increasing divergence between the value of property exposed to risk and the financial capacity of public (cantonal) or private insurance companies to accept joint responsibility for such risk has only heightened concerns. In the 1990s, the Katarisk programme revealed that Switzerland was very vulnerable to earthquake activity, linked to higher urban densities. This led to a revision of the seismic macro-zoning system in 2003, when efforts were made to achieve greater harmony with the EC8. Given the lack of a universal, global or generalised approach in formulating anti-seismic recommendations, the cantons developed specific approaches incorporating significant input on local risk conditions, with some cantons even accentuating their estimation of the earthquake risk (Basle, Valais). The cantons thus acquired specific expertise and promoted solutions at the federal scale, relayed by the Office Fédéral des Eaux et de la Géologie, cantonal insurance companies and even the Federal Council in an attempt at constitutional modification in order to standardise approaches.
- 19 Oriented toward increased local management and individual responsibility, Swiss anti-seismic measures thus benefit directly from seismic micro-zoning (Principe pour

l'établissement et l'utilisation d'études de microzonage en Suisse, OFEG 2004). The first studies, which were essentially qualitative (Canton Obwald, 1995-2000), provided a map correcting seismic intensity values based on soil studies. Then, in 2000, Sion introduced a frequency factor specific to the soils to characterise seismic amplification. This prepared the local maps of maximum relative amplification and associated frequency based on measurements of seismic background noise and numerical modelling. Between 2002 and 2004, numerical simulation studies were then used to establish a dimensioning spectrum specific to the construction site so that civil engineering works could be parameterised according to geology. One particularity of the approach was that micro-zoning investigations were conducted progressively, depending on the results of the vulnerability study. In the first stage, micro-zoning thus indicates soil categories. The second stage, more costly and lengthy, is reserved for plots where there are important construction issues at stake or a complex geology. The investigations are thus structured according to local needs and depend on local decisions and responsibilities.

- 20 The initial work of collectively defining safety thresholds and criteria, and then classifying levels of vulnerability, thus determines the potential of detailed seismic micro-zoning. By focusing diagnosis more on vulnerable issues, the Swiss cantons make public discussion of choices obligatory, which in turn requires providing information on available physical data so that an informed acceptance of risk can ultimately be made. In such a context, generalisation at the national level remains difficult because seismic risk, which for a long time was ignored, may be deliberately refused by private owners and public authorities. The first obligation concerns the taking of responsibility for the anti-seismic safety of public buildings. The second stems from the contractual relationship between project owners, professional contractors and insurers, who have become de facto promoters of anti-seismic techniques, and inspectors. Thus, in 2004, the federal working group (Office Fédéral Eaux Géologie) was able to define the principles for setting up and using micro-zoning in Switzerland but, as the group stated, this proposal of micro-zoning criteria was "to be adapted by the cantons according to their interpretation of the socio-economic issues and criteria (translation)" (OFEG 2004). The purpose of micro-zoning remains of an informational nature, to be used to influence urban development plans and building regulations (Cantonal Master plan, Communal Land-Use plan). It does not prohibit building but merely provides specific recommendations on the basis of the zones determined in the community building regulations, which are binding on both authorities and individuals.
- 21 In Switzerland, the earthquake risk does not explicitly prohibit building, but instead increases constraints. Soil maps are prepared according to earthquake excitation categories. Inspired by methods used in California, spectral micro-zoning at the scale of the plot of land represents a source of information that the owner can use to specify a level of safety. Its cost means that it should be reserved for resolving important issues and, if necessary, for loose ground that is difficult to characterise. It is a question of avoiding, firstly, construction stoppages by developing detailed knowledge of the local area and, secondly, the extra costs due to anti-seismic measures by specifying the conceivable level of acceleration depending on the plots of land. In this way, the sizing of structures in terms of seismic resistance capacity is presented as a challenge to the intelligence of the engineer. A direct display of information on risk (internet) clarifies the degrees of responsibility between actors in the planning and development

profession and those in the building trade, who cannot ignore local natural conditions. In 2000, a government decision by the Federal Council made it obligatory to comply with anti-seismic standards for federal structures or structures benefiting from federal subsidies. The Cantons can demand that anti-seismic standards be respected in accordance with the natural risk zones shown on the plan for local area development. The municipalities may receive help from the Cantons (subsidies, advice) in getting their micro-zoning carried out by specialised consultants. The criminal responsibility of architects and engineers requires that they integrate site effects to ensure that best practices are respected (SIA). Finally, with regard to problems arising from faulty construction or poor maintenance, the owner is responsible if he does not take site effects into consideration.

- 22 Switzerland has shown pragmatism in acknowledging the diversity of local situations and in imposing an assessment of risk factors, including an assessment of the vulnerability of different issues, in order to obtain specific knowledge of risks. The focus is on the responsibility of owners in taking risks. In this context, the public authority provides the means for calculating reasonable risk. Generalised diffusion of information facilitates negotiations on safety objectives. Monitoring compliance with commitments is partially delegated to private experts, including those of the insurance companies. Swiss political culture continues to scrupulously impose limits on the intervention of public authorities, particularly federal, thus encouraging direct civil responsibility. Having started with serious shortcomings, the Swiss anti-seismic protection policy has succeeded in the space of a decade in developing an overall approach that constantly combines private decision-making with public monitoring, particularly through the insurance companies, by integrating, among other things, the possibility of adapting to local geological conditions. However, to be realistic it remains very targeted on those Cantons that are the most exposed to risk and the most determined.

Conclusion: towards a realistic approach that takes into account the vulnerability of urban issues

- 23 Despite their common aim of increased safety, anti-seismic solutions differ considerably depending on the national political culture. While scientists now form a united professional community, managers and decision-makers are confronted with differences in the safety expectations of local populations, the types of regulatory systems (decentralised or state-controlled, public authority or private responsibility), and the levels of adherence to European standards (adoption of EC8 by France, Italy, and Slovenia, but also Switzerland). The risk of earthquakes mobilises very different public bodies. Thus, in Slovenia, after independence, the Ministry of the Environment intervened directly in the country as a whole. On the other hand, in Switzerland the move to encourage local areas to assume more responsibility led to a limiting of federal power (refusal to modify the constitution). The Italian method of controlling building permits and urban development plans has become lengthier with the increasing exchange of dossiers between owners, professional service providers (contractors, consultants etc.) municipal offices, regional services of the ARPA (Environmental Protection Agency), and provincial departments. As for France, the situation varies considerably according to the area in question. Thus the mobilisation of public

authorities observed in the French West Indies is far from that seen in the alpine departments, where the limited administrative services considerably reduce the possibilities of effectively monitoring either local geological conditions or the application of anti-seismic techniques. While the principle of negotiated responsibility underlies the Swiss system, it is difficult to understand how local French actors, subject to national regulations and European directives, can adapt locally to the acceptable risk acknowledged by the PPR (Risk Prevention Plan).

- 24 Whatever the case, the growth of scientific references is making it increasingly difficult to define seismic codes. While managers and decision-makers would like simple criteria and stable references, the scientists are constantly questioning results obtained and proposing new methods. In situations of uncertainty, identifying acceptable risk requires a consensus among actors, which is unfortunately very difficult for phenomena where the degree of expertise required is highly specialised. Adopting conservative and generalised solutions thus simplifies action. On the other hand, exploiting the safety margins multiplies the assessments required to justify arguments. Such re-examination is costly, takes time and clouds the responsibilities of the public authorities. Whereas in Switzerland individual responsibility underlies seismic risk taking, French culture is strongly influenced by the increasing obligation of public authorities to protect the "spineless and ignorant" citizen. However, seismic assessments based on probabilistic methods and recommended by groups of European experts (EC8) are worrying for decision-makers who have to assume their responsibility on the basis of relative elements. In this perspective, mapping plays a decisive role since a choice has to be made between scientific measurements of natural physical parameters and regulatory zoning which determines urban development possibilities. Depending on their degree of precision and their capacity to integrate new scientific results, geographic information systems may accept a certain degree of uncertainty and tolerate more or less approximate interpretations.
- 25 To be efficient, the commitment of actors depends on collectively determining the level of acceptable risk. Defining the aims of safety, apportioning costs and determining responsibilities requires a detailed knowledge of risk factors. Safety is a delicate issue and requires excellent local knowledge of natural threats and vulnerabilities. However, local issues may upset the independence of decision-makers whose competence is limited when it comes to phenomena that are rare and often of unexpected proportions. Support from impartial national authorities and from improved resources represents an indispensable guarantee. Depending on the political culture, the precision gained in earthquake expertise makes micro-zoning either a prescriptive and restrictive measure that is difficult to accept or a valuable tool for increasing local awareness and responsibility.

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ABSTRACTS

Management of earthquake risks in the sedimentary valleys of the Alps depends on the ability to transcribe scientific knowledge obtained from micro-zoning into urban planning regulations. France, Italy, Slovenia and Switzerland are working with new European codes, and within their respective political contexts, to improve earthquake safety on the basis of enhanced input on local geological conditions and vulnerability levels.

Confrontées au risque sismique, les vallées sédimentaires alpines testent différentes solutions politiques pour transcrire en règles d'urbanisme les connaissances apportées par les micro-zonages. France, Italie, Slovénie et Suisse composent avec leur tradition politique et l'adoption de codes européens pour améliorer la sécurité selon la vulnérabilité et la géologie locales.

INDEX

Geographical index: France, Italy, Slovenia, Switzerland

Keywords: alpine valleys, local authority, micro-zoning, seismic risk management, urban planning

Mots-clés: micro-zonage, politique risque sismique, pouvoir local, urbanisme, vallées alpines

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