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Policy Dilemmas: The use of local information to reduce seismic vulnerability

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Abstract

Seismic safety needs the share of information and coordination between the stakeholders of urbanism. The solidity of buildings depends of quality of data provided by builders. The control challenges the understanding of professional interactions between ground and buildings. The trust is linked to public capacity to rule buildings technology and to verify the application of anti-seismic codes. The rules combine territorial zoning and professional skill selection. The lake of respect of codes is sanctioned by authority. The capacity to control offers safety for investments. Progress in engineering offers capacity to adapt building technologies to local constraints, but rules and economical interests need to follow technical opportunities. Management of seismic dilemmas is observed in the Alps area. Evolution of buildings, urbanism and land use rules is compared with foreign choices to understand how local take-holders deal with safety, investment and liability. The definition of local criteria challenges the universal standards and also French regulation way.

1) Mean principles of aims, codes and anti seismic control.

For ordinary buildings, French anti seismic codes follow universal principles of safety in the buildings: protect injuries from collapse, i.e. the duty is not to keep normal use. This goal is gradually demand according to the use of the building: collective and strategic buildings are more protected than individual houses. Usual in anti-seismic practices, this ordinary choice doesn't warranty investment. Actually, each modification of rules up grades safety and extends the boundaries of application. Now, even single houses in middle seismic hazards areas have obligation to be protected with anti-seismic technologies. This classification of the buildings includes criteria as high, number of users, type of use.

The application of anti-seismic codes is crossed with seismic area classification. According determinist and probable methods, the seismic areas becomes administrative zones, where the safest protection is needed in seismic areas and no exigency in low hazard areas.

According the laws, safety is the liability of the owner, but also of state and municipalities. The application of codes needs control of professionals and public administration. The control of technologies used in buildings is given to private agencies, which certify the good use of proper technologies to protect the building of collapse. Organized under state rule, the safety is linked to professional deontology, diplomas, mutual survey, insurance warranty, contracts and trial denunciation in case of doubt. Public interventions are more to broad scientific

information about seismic hazards, publish rules, watch the safety of public owned buildings (which are numerous in France) and eventually control the use of good technologies according the area and the use of the building. Anti-seismic technologies represent a challenge for control because it needs interventions for each stage of the production process. Quality is linked to design, compute of forces, adaptation to ground, building site practices. It makes control very difficult, considering the defaults are hard to understand and the seismic hazard is invisible.

2) Public ways to constraint stakeholders to warranty anti-seismic safety.

The French organization of quality control for building mixes liberal liability of owners and builders according the contract and public involvement at state level (definition of rules, administrative expertise) and municipal level (building authorization, building certificate, urbanism rules). Such an organization supposes the share of data between numerous actors and, almost, the understanding of their own liabilities. With the same aims, some other countries decide to have more liberal interventions or more state rule. Swiss codes insist very much on the owner of the building to bring safety, which suppose to verify contracts with builders, soil analyzes, anti seismic technologies, insurances accountability and local constraints to prove the good practice in case of trial. On the contrary, Algeria developed a state ruled approach, which includes states managed technical control agencies and a public research center dedicated to seismic safety.

In every case, the impossibility to control all the buildings obliges to promote information to stakeholders. In France, the “seismic program” engaged since 2005 offers a global approach of safety dedicated to professional of building, owners, users and public authorities. The information is declined according the public targeted with flyers, information meetings, collective training and professional education. The financial and human constraints lead to target first West Indies islands (Guadeloupe, Martinique), where the hazard and vulnerability are especially dangerous.

Seismic safety involves a large number of stakeholders, who can also play tricky games, especially with frauds or un-care practice. The difficulty to control all participants leads to privilege self check, mutual control and coordination. Education completes fear of sanction to develop good practices. Professional builders are use to deal with coordination troubles. Public authority main intervention is to keep good way of process, which transforms practices to papering … Among the ordinary mountains of formal proceedings and reports, the coherency of anti-seismic control need to check key points of design and construction. The difficulty to understand seismic parameters augments uncertainty of data and the bill of specialized analyzes. That technical and economical parameters lead to find some simple criteria to give information about ground motion, building capacity and use possibilities to help stakeholders to choice safety technologies adapted to their need and the local constraints.

3) New information to adapt urbanism rules to local constraints.

Anti-seismic technologies are reputed to be hard data to gather, compute and understand. Only a few specialists are able to appreciate the validation of models needed to give agreement for a building project. More, the estimation of risk for existing buildings needs diagnosis and interpretation that depend very much of personal skill of the expert. Keeping quality of such a process calls for more simple criteria to give useful information to the stakeholders. In that perspective, the “SIRSEG” scientific project of the “seismic risk team”

of the LGIT is testing with Grenoble's stakeholders and state support new information useful to simplify choice.

Geological diagnostic

The exam of ground motion supposes to appreciate site effects possibilities according the local geology. In complement of classical geophysical data, the SIRSEG project try to analyze ground motion with simple data issued of geotechnical boreholes. Such numerous data are usually needed to construct new buildings. The information is provided by private geotechnical agencies to the owner of the field, and helps to calibrate the foundations needed for the building. The information belongs to the ground owner, who usually loses it. The private geotechnical agencies use to keep it as long the company history permit it … In France, after ten year, the law obliged only the deep borehole data to be collected in a public databank held by a public company (BRGM). Such an organization of data, field by field, doesn't offer an overview of soil components in the urban area. Compelling only the borehole data concerning public investments (roads, bridges, public buildings) could give a panoramic view of the ground map.

Private collection of geotechnical data of Grenoble area held by a geologist offers the opportunity to correlate geotechnical data and ground motion acceleration observed and seismic models. Developed thanks to the SIRSEG project, these scientific tests indicate new information about soil and geological component of Grenoble area. This collaboration also helps to characterize ground motion and site effects at local scale. These indications contribute to propose micro-zoning of Grenoble area, with lower cost than classical analyzes. New information gives more capacity to adapt the buildings to ground constraints, but also gives more anxiety: the models issued of these precise data indicate some exceeds of the EuroCodes parameters …

Before generalization of such new way of ground motion analyze, the deal is to definite the gathering of geotechnical data. Considering that a geologist hobby is not often shared by normal people, the duty of data gathering must be examined with economical and right parameters. Geotechnical data represent an important market for private agencies, which certify ground parameters and sell information to each field owner. Creation of geological databank represents a perturbation of this easy market. The other point is to decide which authority can gather the data. Giving very fine information, geotechnical data lead to the possibility of "nano-zoning" at the scale of the field. The scale of databanking could be:

- the owner, with obligation of transmission to the buyer of the field, so linked with notarial booking,
- the municipality with cadastral information,
- the regional authority, with an obligation to indicate geotechnical information before to obtain building authorization (which exist for Italian regions)
- some national mapping by state administration

Geophysical reading of geological data represents a challenge in French academic organization, which supposes new scientific collaborations to propose practical competency. It is also a challenge to share geotechnical data, which shakes the liabilities of stakeholders. The development of new interpretation of geotechnical data represents also an opportunity to

upgrade the professional skills of geotechnical agencies to furnish low cost site effects analyzes to builders and public authorities.

Structure diagnostic

In France, anti seismic mitigation is a business for specialized engineers. Few architects are skilled to certify the solidity of a structure or propose technologies to retrofit a building. Inspired by Italian methodologies, French scientists try to develop statically approach of urban vulnerability according simple data like type of architecture, number of level, material composition, age and use. Such methodologies are developed to help urban management, especially to choice the priorities of safety programs. The aim is to obtain useful indications with short time analyze and at low cost. Special issues would be reserved for complex structures, by the way historical monuments. Simple information is offered to municipal technicians to try to choice the priorities among the buildings belonging to the city. The training of technician prepares their autonomy in seismic management of current building. Such programs help local community to develop their own capacity to adapt to their local constraints and encourage the share of seismic mitigation preoccupation.

The first aim is to educate public servants, especially building technicians, to appreciate the state of vulnerability in public buildings (city hall, rescue buildings, schools). The second objective is to broadcast such criteria to the managers of public collective housing. In the same way, the French “Seismic program” encourages initiatives in the West Indies (Martinique, Guadeloupe) to promote professional education of builders (owners, architects, engineers, masons) to adapt single housing to local constraints. In each situation the first step is to offer simple criteria to understand the vulnerability of buildings and develop simple technologies of retrofitting included in renovation projects.

Use diagnostic

Mitigation of seismic risk depends on the use of the building. Classification helps to choice the level of safety standards needed for a new building. The diagnostic of use can also indicate how to reduce the danger according users capacity to adapt to constraints. If the situation is very bad, the best could be to destroy the dangerous building. But it is very often impossible in short term because of need, price or historical value. Seismic diagnostic can also lead to another use of the building in order to moderate the casualties. It can also be a very important opportunity to explain to users how to adapt furniture to reduce the danger of falling and to train people for seismic emergency, which is less done in France. Observation of management of safety in schools indicates that is difficult to obtain the respect of administrative indication and that sport lessons are never used to prepare to emergency group reflexes. Combined with the information of structure vulnerability, the use diagnostic could promote indications to adapt behavior to the building, which supposes regular training of protection. According the structure diagnostic, some priorities can be accepted for training programs and explained to users, especially to children parents about school safety. This share of information encourages a community trust helpful for global mobilization to mitigate the danger.

Cost diagnostic

Seismic mitigation is reputed to be expensive, specially to retrofit buildings. Different parameters have to be included in cost compute. All the experts agree that an anti seismic design included during the architectural project lead to very low cost safety. But for existing buildings very few studies are developed with scientific methodology, i.e. indicating modalities and elements of the calculation. Accountability of benefice and cost in risk mitigation doesn't interest economical academy, which a surprise considering the importance of insurances in financial business … French natural and political situation could explain these lake of economical studies. The seismic hazard is a low probability risk. The political organization of natural catastrophes insurances is based on state warranty, which doesn't encourage insurances companies to calculate the ratio between their financial engagement and building vulnerability. Being often their own insurer of patrimony, state administrations are more pushed than private owners to study the cost of a damage including the investment and the cost of injured people.

Guided by Swiss, American and Canadian studies, the SIRSEG scientific program includes new way to integrate Cost Benefice Analyze in local management of safety. About school buildings, the aim is to propose simple criteria to municipalities to appreciate the opportunity of retrofit, destroy or mitigate risk by use of the building. Integrating time and municipal financial capacity, the accounting leads to hierarchy the priorities of safety programs and helps to explain to local leaders and community members the constraints and opportunities of collective choice. Such an economical approach opens broadly the number of people involved in safety management. Shared by experts, administrations, local leaders and users, the information helps to definite a policy program including safety level and cost choice. The identification of mitigation costs gives also the opportunity to understand where national or European subsides are the more efficient. The experience developed in the Martinique and Guadeloupe French islands indicates that financial help for architectural studies gives good result in mitigation and to mobilize all the components of the local community, including territorial authorities.

The economical challenge is firstly the share of information. Civil servants are reluctant to gives simple economical information like the cost of a new school building. The priority of the majority of civil servants is to control information about risk. Keeping information about school vulnerability, building prices, diagnostics and retrofitting opportunities indicates a real difficulty to trust people capacity to understand public choices. Considering the Vancouver political initiatives (British Columbia, Canada) of parents about seismic safety of schools to oblige public administration to broadcast vulnerability information, to hide information leads to the development of a lobby dedicated to safety. Calling for seismic safety of schools in British Columbia, the Vancouver parents develop a political push advocating with political leaders and developing self economical accountability and propositions. In France, even confronted with the evidence of some school buildings fragility, the civil servants are reluctant to give economical parameters to help to develop new financial propositions to reduce seismic risk. This mistrust mind doesn't help to involve local communities to adapt their safety to local natural constraints.

Local standards in buildings

Scientific progress gives new opportunities to develop micro zoning studies. This capacity leads to develop local rules for urbanism and local codes for building. But local standards in building present also a risk of confusion. Owners and professional builders can be reluctant to accept the proliferation of local constraints according natural geology and municipal choice of

safety level. Without hierarchy of the priorities and authorities, these new local standards compete with official national rules. The anti-seismic bumpers represent a very interesting case to understand how a technical innovation challenges all the pyramid of liabilities. The Martinique's Regional Authorities decision to include bumpers in new school buildings supposes to think about the technical benefit for safety, but also about financial and liability aspects. The innovation promoted by Martinique Regional Authority corresponds to a political choice giving priority to safety and regional technology development. This case demonstrates a capacity to transform local constraints to economical opportunities, with the help of public subsides. Giving more safety, this new technology is more expensive than ordinary anti seismic mitigation, but who must pay the over price? Who decides to protect classrooms or dormitories? How keep the equity of safety for all the students of the region? What if another school collapses because of the lake of bumpers? What justification to achieve safety level equivalent to surgery room in hospitals or nuclear plants? Include bumpers in the book of building destabilized all the management of risk in public buildings. Owner and professional need stability in rules to present economical planning of safety in urbanism.

Local constraints in urban design

Furthermore, the development of new local information about seismic risk leads to include the mitigation in the urban design. Dealing with the vulnerability of the historical city center, the municipalities can choose to implant new buildings and safety structures around the city, especially to keep the capacities of emergency intervention. Progress in scientific understanding of site-effects can also help to develop a mitigation of soil-structure vibrations. Analyze of structure-soil-structure interactions can also help to adapt architectural and urban design according the vulnerability of the quarter. Urban design could help to create mitigation areas with special building created to cushion or spread the effects of seismic waves. Such possibilities challenge the urban design for decades. Integrating seismic mitigation could transform the shape of cities according to architectural parameters adapted to local soil conditions but also to the neighborhood of other buildings. The urban consequences of seismic safety parameters involve so many stakeholders that this purpose must be linked to the policy of sustainable urbanism.

Conclusion: Information share and public trust

Seismic safety depends on the information available according to each stake-holder liability. Progress in knowledge of local constraints offers opportunities to definite new standards of building, but also new rules. By the way, some points have to be integrated in public management and private investment:

- necessity to adapt users skills according to local diagnostic
- share of information about soil structure interaction
- stimulate stakeholders involvement in safety management with local data
- local information calls for local rules
- liabilities of owners, insurance companies, data providers, local administration and rulers are challenged by risk
- knowledge engages new conflicts of interests
- Dilemmas about safety call for scientific knowledge and policy orientation.

Involvement of local communities supposes trust among stakeholders. The share of information about risk, liabilities and financial aspects is not spontaneous, but calls for political courage to explain the repartition to efforts to adapt safety to local hazards.

Keywords: **France, seismic hazard Alps, rules of urbanism, control and cost decision.**

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