SEISMIC CULTURES: MYTH OR REALITY?

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Abstract

Much contemporary disasters research has focused on vulnerability and level of exposure to hazard as being the key component of losses sustained in a given event; a central characteristic of vulnerability is that relating to the built environment. In some societies, poor awareness and information provision as to the key requirements for building a 'safe house' are contributing to heavy losses in the event of disaster. This paper seeks to explore some of these ideas in two Turkish communities exposed to earthquake hazard: Yarıköy in SW Turkey and Bolu in the North of the country. In particular it will focus on the traditional building practices that have developed as a response to living with earthquake hazard and the development of a seismic culture of protection. It will also explore how these practices are being eroded due to contemporary economic and social practices (e.g. increasing population and rapid urbanisation) to leave contemporary communities in some cases more vulnerable to earthquake hazard. Finally, some suggestions for future mapping of buildings and their environments using GIS will be introduced as a possible mechanism for reducing the risk of building collapse during an earthquake.

Keywords: vulnerability; earthquakes; seismic culture; building practices; hazard reduction

INTRODUCTION

Within recent social enquiry into 'natural' disasters, the concept of vulnerability has emerged as central in understanding patterns of loss (e.g. Blaikie et al, 1994, 2004; Comfort et al, 1999). It is generally accepted that vulnerability comprises the social, cultural, economic, political and environmental characteristics of societies and that these combine in complex ways to influence people's exposure to hazard. On a global scale, a pattern becomes apparent of heavy social losses sustained in disasters occurring in less economically developed countries (LEDCs) and of greater absolute economic losses in more economically developed countries (MEDCs) (although it should be recognised that there are a number of caveats with respect to this general pattern).

Whilst vulnerability can be discerned spatially, it also has a temporal dimension. The root causes, dynamic pressures and unsafe conditions that are perceived as

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providing a sequential progression towards a vulnerable society may develop over a prolonged period (e.g. Oliver-Smith, 1999). As such, the risk reduction process not only involves understanding where vulnerability exists but also how it has developed (Blaikie et al, 2004).

The progression towards safety also necessitates the need to address different types of vulnerability. Zaman (1999) has highlighted 5 main vulnerability types: physical, economic, social, informational/educational and environmental vulnerability. Whilst this paper will be concentrating on the former, with particular focus on building types and perception of safe building practices in Turkey, the successful redressing of community exposure to hazard requires consideration of all these factors (e.g. for an overview of the need to address informational vulnerability in Turkey and the Middle East see Degg and Homan, forthcoming). As such, interdisciplinarity becomes an essential pre-requisite of vulnerability reduction, necessitating engineers, social scientists, geologists, public policy makers, as just some examples, to work together with affected communities to produce sustainable disaster management strategies.

LOOKING BACKWARDS AS WELL AS FORWARDS: THE IMPORTANCE OF TAKING A LONG-TERM VIEW

In order to develop a full contextual awareness of contemporary earthquake hazard, it is also important to explore the history of seismic activity experienced within a region. In order to do this, a range of techniques have been developed which, when combined, begin to provide a clear picture of levels of hazard. As such, these techniques are not only academically interesting but can prove critical in the development of planning tools, such as hazard zonation maps, where a longevity of earthquake recording can facilitate the more accurate identification of high risk zones (Ambraseys, 1971).

Historical records are one very important source, although coverage does tend to be partial as a result of varying levels of literacy over time and document survival. If conditions are favourable to both of these pre-requisites, however, then it is possible that there may be both a full and well-preserved seismic record. This situation is characteristic of many areas of Europe and the Arab world and the data are widely available in a number of published catalogues (e.g. Ambrasys 1978, 2002; Ambraseys and Finkel, 1991, 1995; Ambraseys et al, 1994; Guidoboni, 1994; Ambraseys and White, 1997).

Further to the written record, palaeoenvironmental and archaeological work is increasingly finding physical evidence with regard to past earthquake activity. This serves to corroborate the written accounts that are continually being discovered and re-interpreted. This field of research has been conducted through excavation (e.g. Waelkens et al, 2000), topographic survey (e.g. Meghraoui et al, 2003) and sediment

analysis both in terrestrial and lacustrine environments (e.g. Leroy et al, 2001 and Meghraoui et al, 2003).

THE EFFECTS OF TIME: SEISMIC CULTURES?

The interdisciplinary nature of hazards research has resulted in exploration of the impact of long-term exposure to earthquake hazard and community adaptation to such hazard (e.g. The European Centre for Culture Heritage, 1993; Oliver-Smith, 1994, 1999; Homan and Eastwood, 2001). In other words, if people have been living with earthquake hazard for a number of years, is there evidence that it has become 'incultured' and that this might be manifest through building practices and perceptions?

Researchers at the European Centre for Cultural Heritage (1993) have expressed the possibility of a correlation between building practices and earthquake frequency; the more frequent the event, the more likely a 'culture of prevention' (e.g. the attempted development of aseismic buildings) is to develop (Fig 1a). In cases where events are low in frequency, a 'seismic culture of repairs' may emerge where people are responsive to disaster reduction information in the immediate aftermath of an event but then tend to revert back to pre-disaster building techniques and lifestlye (Fig 1b).

Despite the temptation to accept an unproblematic relationship between patterns of earthquake occurrence and human response, Torrence and Grattan (2002) have warned against becoming too hasty in determining a cause and effect between natural disasters and cultural change; they review magnitude, frequency and perception in cautioning an assumption of correlation. In particular, the subjectivity of the researcher is identified as a potential source of error through the inadvertent drawing of some 'false' conclusions/ contriving of results - it may be easy to become carried away, having identified the occurrence of a large magnitude event, with the possibility that it might have resulted in large scale cultural changes; the reality may be much more complex. Further, the possibility that disaster has resulted in cultural change may also be dependent on past communities perceiving the hazard as a threat for which there may not be sufficient data (Torrence and Grattan, 2002). In short, any conclusions drawn based on historical, archaeological and palaeoenvironmental evidence should be done so tentatively.

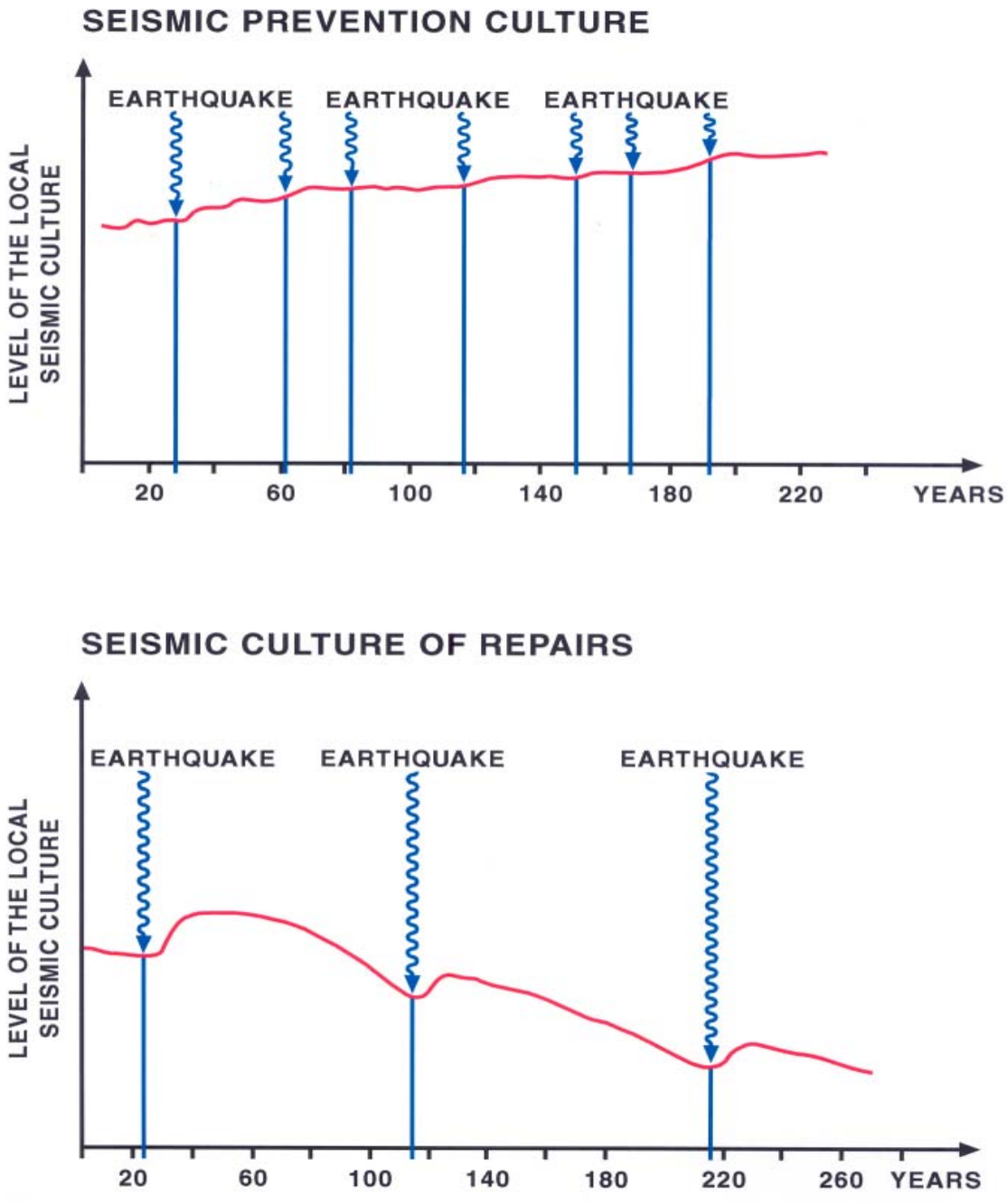

Figure 1a (above): Seismic cultures of prevention; Figure 1b (below): Seismic cultures of repair (adapted from the European University Centre for Cultural Heritage, 1993)

EVIDENCE FOR SEISMIC CULTURE IN TURKEY?

With the frequency of disasters in Turkey, both contemporary and historical, it might be reasonable to expect that evidence of seismic cultures developing in the area might be found. Indeed, there do appear to be indications in many Byzantine and Ottoman buildings, of attempts to make structures more earthquake resistant. In particular is the use of the *hatıl* [reinforcing beam] (Fig 2) (Duggan, 1999).

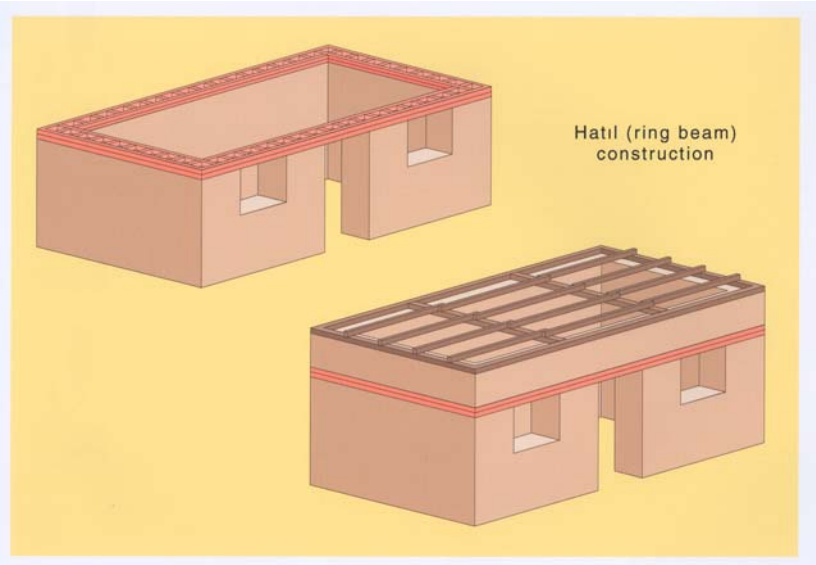

Figure 2: *Hatıl* construction and placement in a building

The *hatıl* as having the following potential functions:

- 'As both a vertical and horizontal shock absorber....;
- as a slip plane within the walls....[to] minimize(s) the tensile and the compressive forces generated in the walls by the lateral ground movement....;
- as a horizontal tie member all around the building.....[and]
- as a rigid horizontal "girder" member'.

Thus, the *hatıl* appears to in some way linked to the development of a local seismic culture whereby buildings are regularly built according to techniques which have proven effective, that is, the buildings that survive earthquakes are typically looked to as precedents for how to build in the future. This leads to the development of a seismic prevention culture, as referred to above (European University Centre for Cultural Heritage, 1993). The *hatıl* does indeed appear to have been a reasonably successful adaptation to the threat of earthquakes as there are many examples of Byzantine and Ottoman architecture including this feature remaining in Istanbul and other areas of Turkey, for example, the Land Walls of Istanbul (Figure 3).

Figure 3: Computer-generated reconstruction of the land walls in Istanbul indicating the banding of the *hatıl*.

Re-evaluating such historical methods are a possible way forward in terms of contemporary building practices. Indeed, the importance of the local seismic culture rests upon the fact that it makes use of local materials, skills and resources and becomes an effective and culturally sensitive way of building to resist earthquakes that can be added to and accumulated in the public domain as there are more events over time.

FIELD RESEARCH IN TURKEY: IN SEARCH OF SEISMIC CULTURES

Building perception and practice was explored in two communities in Turkey that have in the recent past experienced some form of earthquake activity; Yarıköy (a village in the region of Burdur, SW Turkey) and Bolu (on the North Anatolian Fault Zone). Qualitative research was conducted through brief interviews and some initial survey work was also completed.

Burdur Province

The Burdur province, with a population of 55-60,000 (interview with head of Village Services, Burdur province), is a seismically active region, with the sector to the southwest (around Yeşilova) having one of the highest frequencies of recorded earthquake activity in western Anatolia during the last 100 years (Figure 4). The province is almost wholly comprised of village settlements (206 in total) and, as such, income is predominantly based on a rural economy with livestock and arable farming being the central economic activities.

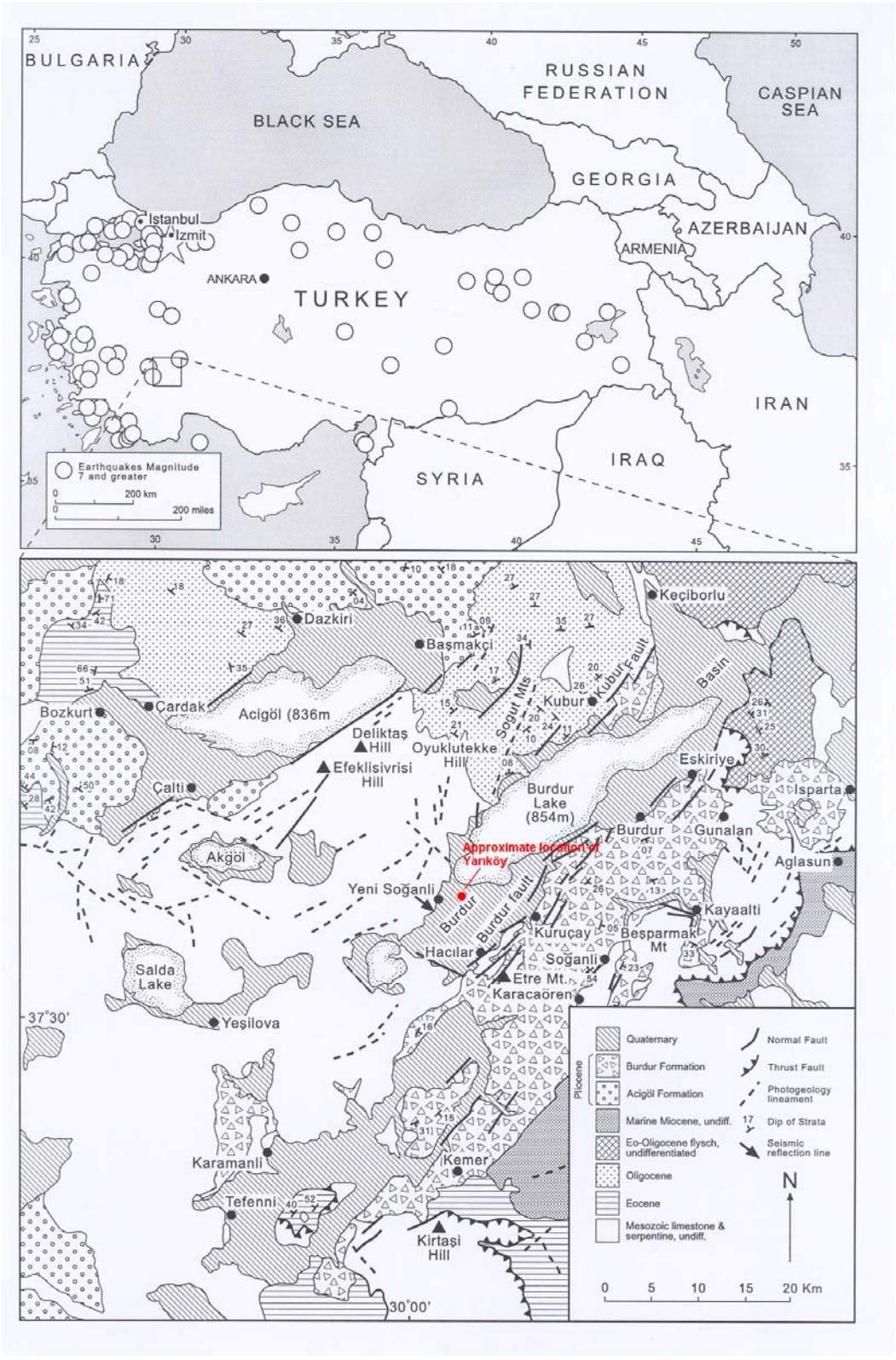

Figure 4: Location map and geology of Burdur Province and Yarıköy (adapted from Price and Scott, 1994)

In the past, the region has been prone to moderate sized earthquake events (Alsan et al, 1976; Hempton and Dewey, 1983; Price and Scott, 1991, 1994) and experienced an earthquake (M=5.5) in May 1971, which destroyed the village of Yazıköy and resulted in the relocation, to government built housing, of survivors in surrounding villages (Figures 5 and 6). Research conducted in the summer of 2002 explored perceptions of earthquakes amongst some of the villagers in the Burdur province, one of which was the village of Yarıköy.

Figure 5: An abandoned house in Yazıköy: note the wooden hatıl

Figure 6: A government-built post-earthquake house in Yarıköy

CASE STUDY: YARIKÖY

Following the earthquake in 1971, this entire village, whose inhabitants previously lived in Yazıköy, was moved into government-built housing 500m from the original site (Fig 6). This was the only sizeable earthquake (greater than M=5.0) in living memory for many of the people in this village and therefore there was little in the way of experiential knowledge of earthquake hazard. Houses in the original village of Yazıköy had been built using *hatıl* construction, indicating that at some time in the past there had been awareness and attempts to build houses resistant to earthquakes and subsequent generations had possibly copied these techniques unaware of why such architectural styles were used. However, in spite of the incorporation of the *hatıl* into buildings in Yazikoy, the fact that they had been built on alluvium meant that when the 1971 earthquake occurred there was a significant level of damage.

The rehousing of people into government built accommodation (also, it should be noted, constructed on alluvium) will contribute further to a loss of local seismic culture as no one in the village of Yarıköy has built their own house and therefore techniques of adaptation to earthquakes, and the collective community knowledge regarding earthquake response, will slowly diminish. Indeed, an interviewee in the community remarked 'We don't have to worry about future earthquakes - if these houses fell down in another earthquake the government will just build us new ones'. However, following the 1999 Izmit earthquake, Turkish government law was changed, removing statutory responsibility to rehouse those affected by future disaster and instigating mandatory earthquake insurance (Gülkan, 2002). In such cases as Yarıköy, therefore, the loss of local seismic culture could prove devastating in the event of a future earthquake.

İzmit and Duzce Earthquakes, 1999: the Absence of Seismic Culture?

On 17 August, 1999, a M=7.4 earthquake occurred in İzmit on the North Anatolian Fault Zone (NAFZ); this was followed by the 12 November Duzce earthquake (M=7.1) of the same year (USGS, 1999). The two earthquakes affected a number of towns along the western stretch of the NAFZ including Adapazarı, İzmit and Bolu and the 17 August earthquake alone resulted in 17,000 deaths and destruction/ damage of 244,500 buildings (USGS, 1999). The frequency and magnitude of earthquakes in this area, combined with the excellent historical record that exists (Ambraseys and Finkel 1991, 1995, Earthquake Engineering Department 1999) and the longevity of architectural adaptations to earthquake hazard (for example the Land Walls in Istanbul – Fig 3) potentially provide an ideal context for the development and sustenance of a local seismic culture, and yet losses from these two earthquakes suggest that this was not the case.

Some initial field research has been conducted in the town of Bolu, affected to some degree by the 17 August earthquake but more seriously by the 12 November event. Interviews were held with a number of residents, who, to this day, remain in pre-

fabricated dwellings that were erected as emergency accommodation following the earthquake, with respect to earthquake perception and safety of buildings; was there a local seismic culture prevailing in a town in one of Turkey's most seismically active regions?

Interviews revealed that people were acutely aware of earthquake hazard not merely as a result of recent events but prior to the earthquakes of 1999. Amongst the preparations that people had made for disaster were: keeping emergency supplies at hand (e.g. food, torches) and knowing what to do in the immediate event of an earthquake for self-protection. However, what people did note was that, as a general rule, they had 'forgotten how to live with earthquakes' in any long-term way. One woman noted 'It is the old people that know how to live with earthquakes; they live in wooden frame buildings of 1/2 storeys [see building in Figure 7] - we must learn from the older generations if we want to survive earthquakes'.

Figure 7: Traditional wood frame and brick building found along the North Anatolian Fault, Turkey.

Interviews would therefore indicate that people have short-term awareness regarding earthquakes in this region, but the long-term adaptation to the threat from earthquakes, that could be considered to be a 'seismic culture', appears to be languishing amongst the more elderly members of the communities. Increasing population pressure, resulting in rapid, high-rise development and post-earthquake government rebuilding schemes in this area of Turkey have distanced people from the hazards they live with; historical solutions and know-how are not being transmuted into contemporary awareness but instead are being abandoned for quick-fix solutions. This could have implications regarding losses in future disaster

events as people become alienated from locally driven social constructions of, and responses to, disaster and a homogenous culture of dependency takes its place.

FUTURE WORK

It is proposed that future work should continue both in respect to exploring spatial distribution of traditional building types in earthquake-prone areas of Turkey and also in exploring the collective community knowledge that exists with respect to living with earthquakes. This article has indicated that whilst seismic culture is physically manifest through building stock, it can also be more latently preserved in attitudes and understandings of community members towards the hazards that they face.

Fieldwork that is currently planned relates particularly to the surveying aspect, with the potential use of GIS to devise thematic hazard zonation maps linking geology, building style and building materials to identify areas of highest risk and to ascertain whether traditional buildings really are safer on a local scale. It is proposed that this work will be conducted in Gerede on the North Anatolian Fault. However, this work could be made even more substantial through the incorporation of a perceptual model of earthquake risk, e.g. creating an 'attitude' layer that asks community members to also score perceived building safety. How closely linked is actual risk and perceived risk? Perhaps this will allow for further insight into the extent to which seismic cultures are a present reality as well as an historical possibility.

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