



## Historic timber skeleton structures and the local seismic culture

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This presentation deals with the employment of timber skeleton structure and the local seismic culture.

After the 1755 earthquake in the reconstruction of Lisbon a type of building with timber skeleton and masonry infill called "gaiola pombalina" was promoted, since this was designed to better resist earthquakes. "Gaiola" means cage, and it was also named after the Marques de Pombal who introduced it in the reconstruction following the earthquake. The „gaiola pombalina“ presents a timber skeleton with Saint Andrew crosses in the interior walls with masonry infill and thick masonry load bearing walls loosing in thickness to the upper floors in the exterior walls. The masonry can fall out during earthquakes but the building remains staying given the interior timber skeleton. The type of buildings with timber structure and (masonry) infill behaved well in earthquakes in various parts of the earth, like Nepal (the dhaji dewary type), Pakistan, Turkey (the himiş type after the 1999 earthquake) [both latter types were researched by Langenbach, [www.conservationtech.com](http://www.conservationtech.com) and [www.traditional-is-modern.net](http://www.traditional-is-modern.net)] and also in Germany after the 1356 earthquake (the Southern German subtype of Fachwerk). Also in Italy a subtype called "casa baraccata" was promoted in a construction code to a similar time (following the 1783 earthquake in Southern Italy, see Tobriner 1983) as that of the "gaiola pombalina", the time of the Baroque, when town planning acquired another status. Unlike at the "gaiola pombalina" the "casa baraccata" the timber skeleton is at the exterior walls. For this reason this type of buildings is considered to be an expression of the local seismic culture.

However, this type of buildings is common also for areas where seismic risk is not an issue, like half-timbered in England and the northern subtype of Fachwerk in Northern Germany, and in some high seismic risk regions with mountains and timber resources like Romania is not spread.

Given these premises the author looked for an alternative explanation for the origins of this construction type.

Two expressions of the type were closer analysed: the "gaiola pombalina" from Portugal and the Fachwerk from Germany, in both its forms: the northern and the southern German type. The "gaiola pombalina" building type will be presented in this contribution, together with options for contemporary restoration, given that the author had the opportunity to visit such a building site.

The Fachwerk buildings are integrally out of timber skeleton in both their interior and exterior walls. Infill is done with adobe on basketry, masonry or wood planks. The southern subtype was the object of a detailed analysis of the author which resulted in a report for the World Housing Encyclopedia ([www.world-housing.net](http://www.world-housing.net), report #108/Switzerland), but it is the northern subtype which is interesting for the argumentative discourse in this presentation.

These two subtypes are one placed in a seismic risk region, while the other is not. Common to the "gaiola pombalina" and the Northern subtype of Fachwerk is the inspiration from ship-like structures, as some authors (Cardoso et. al. 2004 and Lachner 1887) noted. In their most pure form, the Northern German subtype, Fachwerk buildings present a ship like structure in the way the consoles on which the upper floors are built are done. Also the "gaiola pombalina" was generated in areas with knowledge of building of ships.

However, this is not true for some other locations where this type is spread, like for dhaji dewari in Nepal. So the explanation might have to be looked for in other aspects of local architecture, like the availability of timber resources. The half timbered type in all its regional varieties may be a result of using efficiently timber resources. It is the theory of the author that the use of timber in half timbered way is to be attributed to more than to the local seismic culture.

It may be that the urban use, promulgated in codes like in Portugal and Italy, is inspired from the vernacular type which resisted well in earthquakes, but the reasons of appearance for the vernacular type are different.