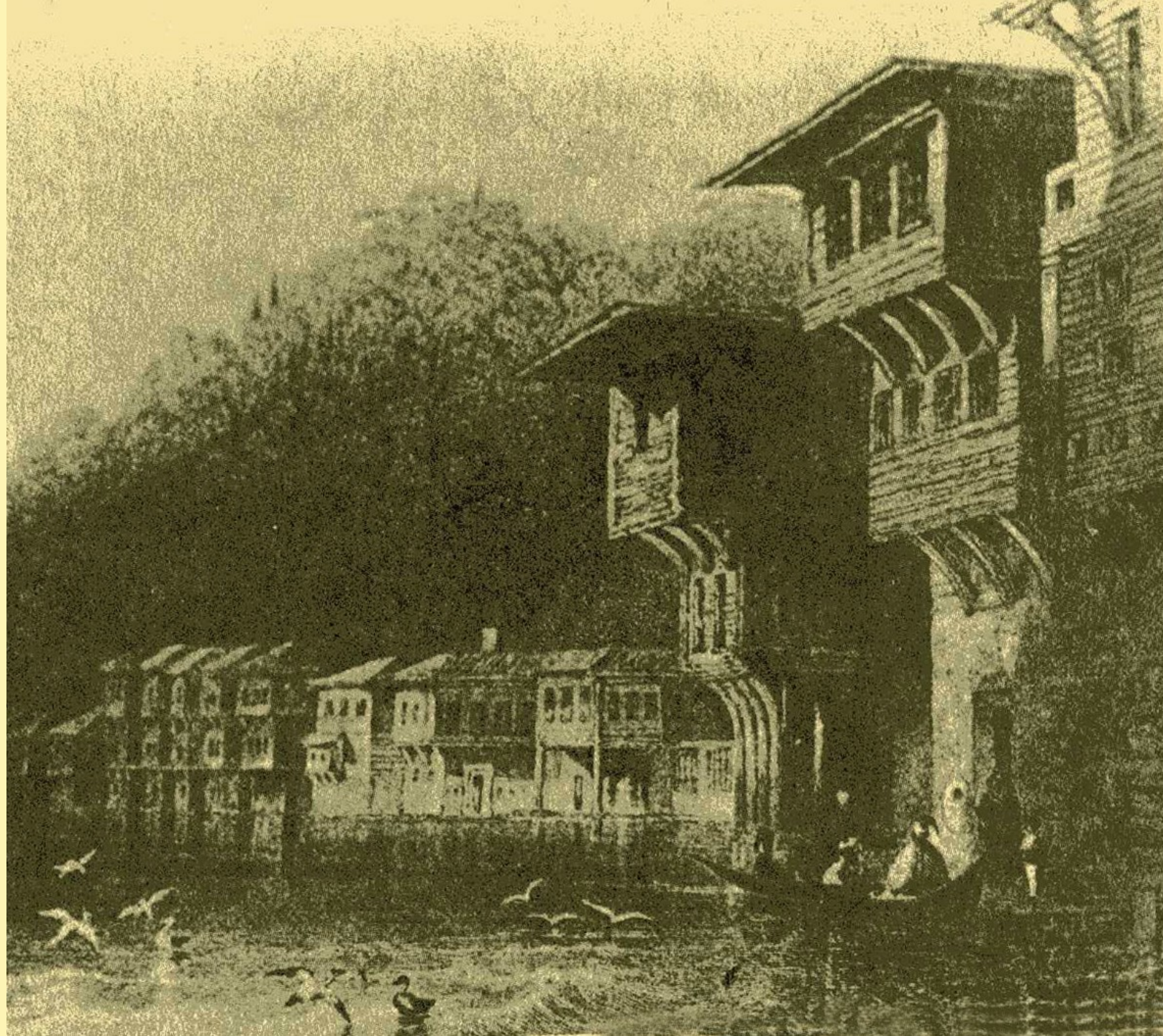
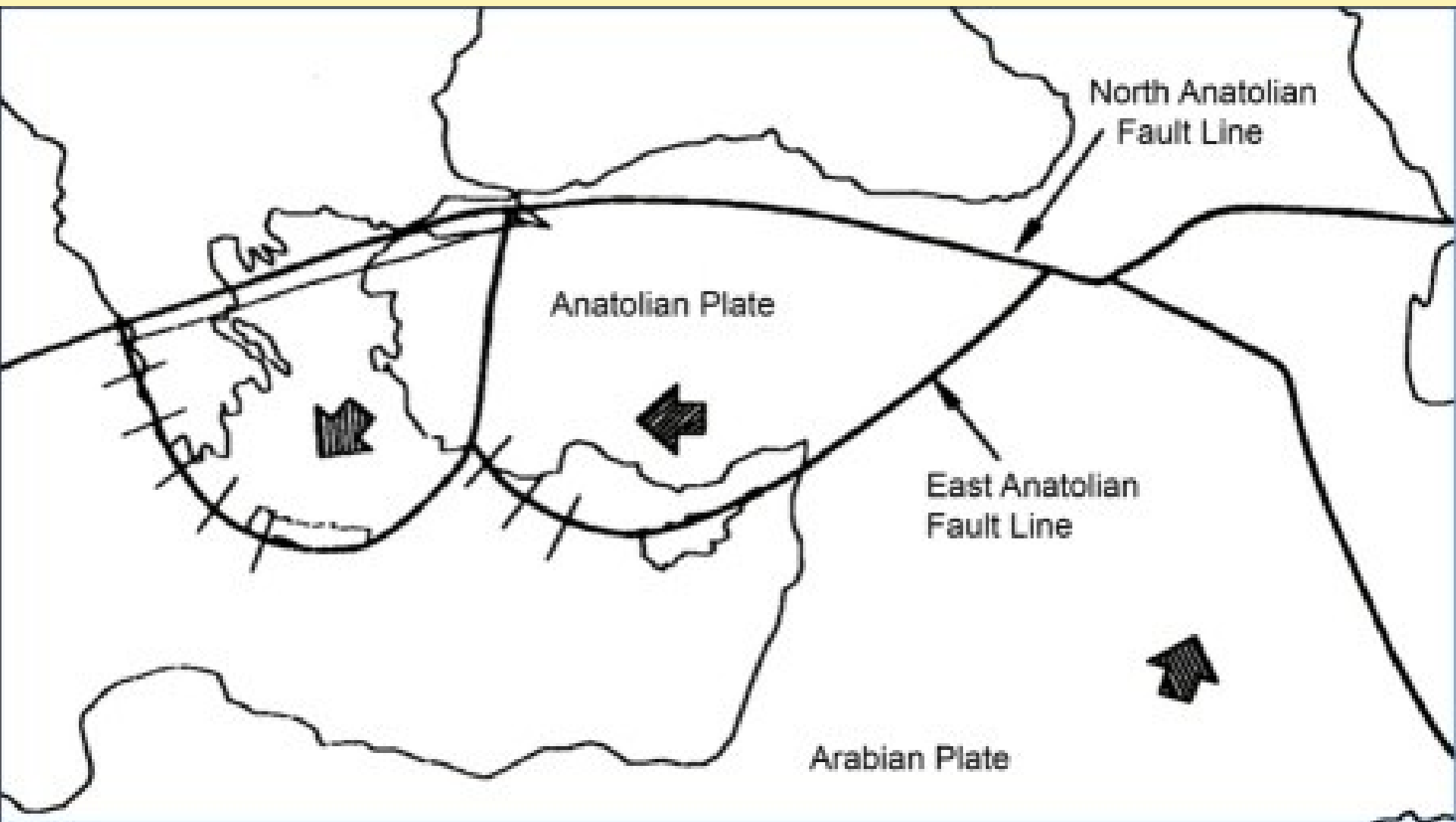


The wood species that used in the earthquake-resistant traditional timber structures in Istanbul

Assist. Prof. Dr. HÜLYA DIŞKAYA

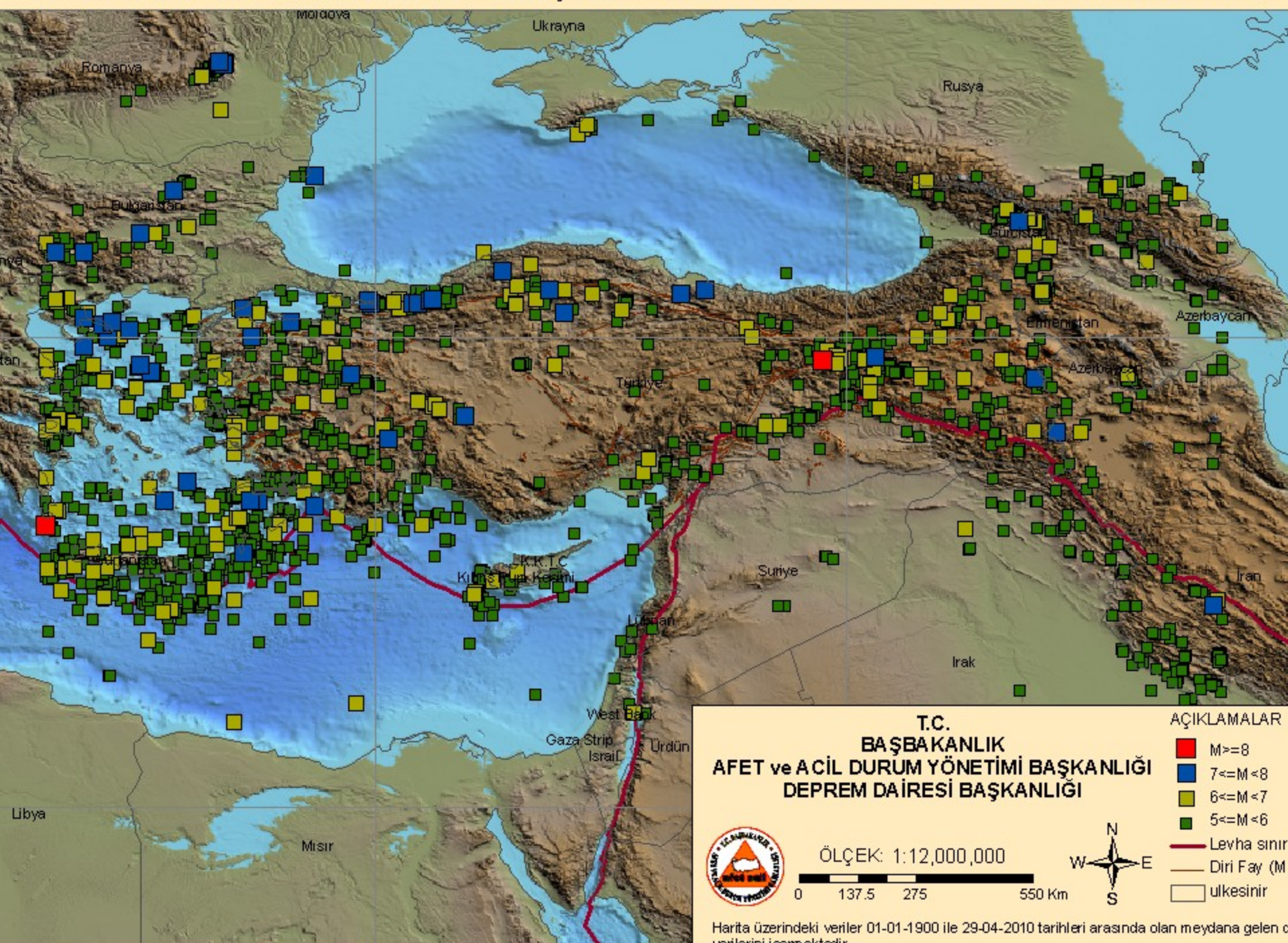
Mimar Sinan Fine Arts University, Istanbul

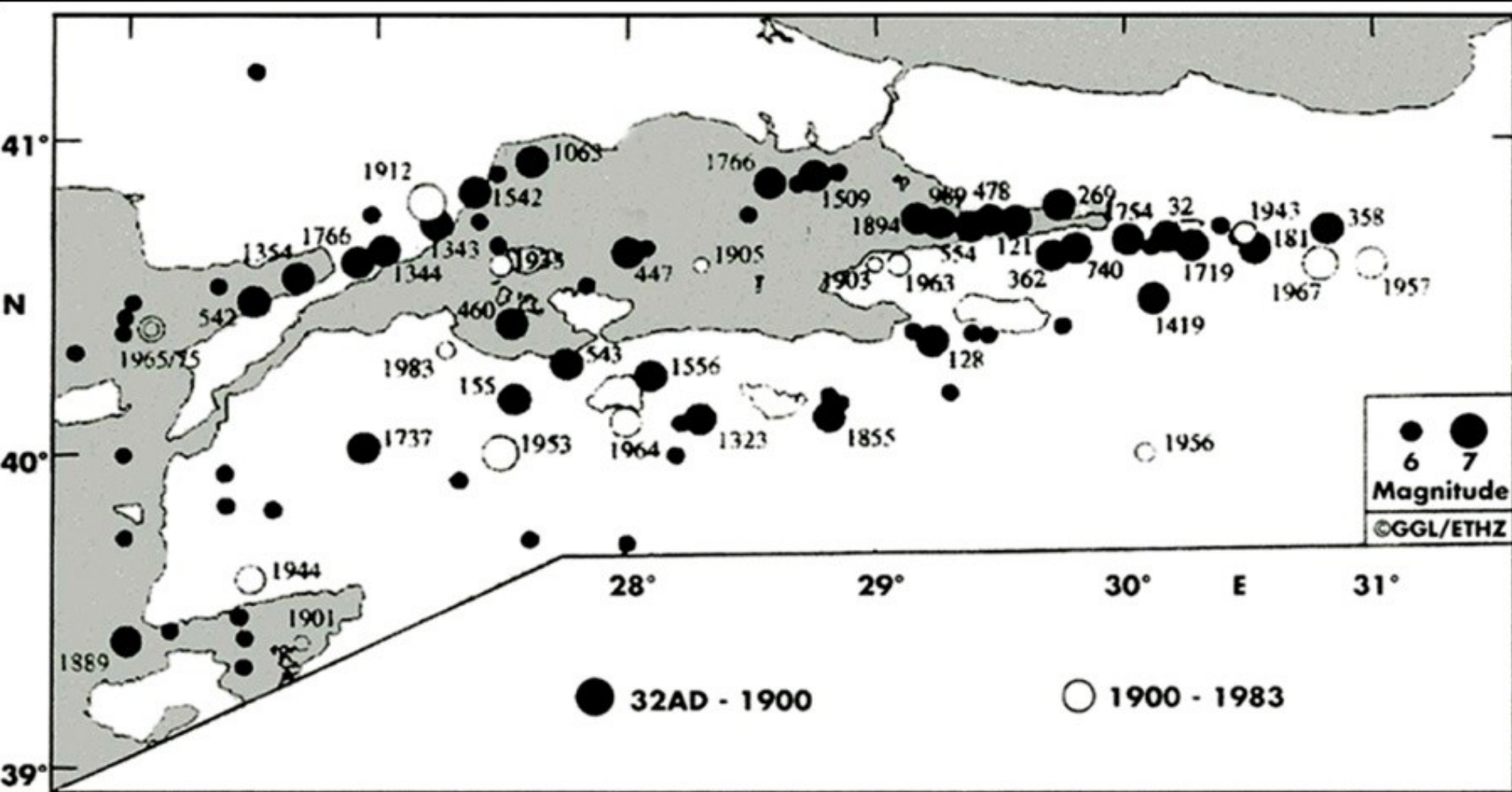




Map showing the North Anatolian Fault Line

1900'DEN GÜNÜMÜZE KADAR TÜRKİYE VE YAKIN ÇEVRESİNDE MEYDANA GELEN M>=5.0 OLAN DEPREMLERİN DAĞILIMI





Earthquakes between A.D. 32-1983 years in Marmara Region

Date (A.D.)	Earthquake damages
212	Great intensity earthquake, epidemic diseases, about 300,000 dead
444	Churches and the walls of the castles had demolished
478	Churches collapsed
538	The dome of Hagia Sophia fell down
740	Many of the churches collapsed. Thousands of people died
960	Hagia Sophia demolished
986	Important damages in Hagia Sophia
1010	Forty Saints' Church destroyed
1199	Ground split, people are buried in crevices
1295	Statue of Saint Michael's across of the Church of the Apostle collapsed
1305	Houses collapsed
1332	Great damages in the churches and the houses
1344	Great damages in Hagia Sophia and the other churches
1507	Earthquake lasted for fifty days, great damages in the palaces, thousands of dead people
1509	Domes, minarets, walls of the castles demolished
1648	Whole minarets collapsed, Fatih mosque had a great damage
1729	A severe earthquake, great heavy damages
1763	Great damages in Fatih and Bayezid Mosques
1766	Damages in Sultan Selim, Şehzade, Süleymaniye, Nur-u Osmaniye, Yeni Mosques and Hagia Sophia
1894	Great damages in Edirnekapi-Mihrimah Mosque, hammams (baths), houses
1912	Great damages in Edirne and Istanbul
1999	Great damages and loss of human life in Adapazarı, Düzce and Istanbul

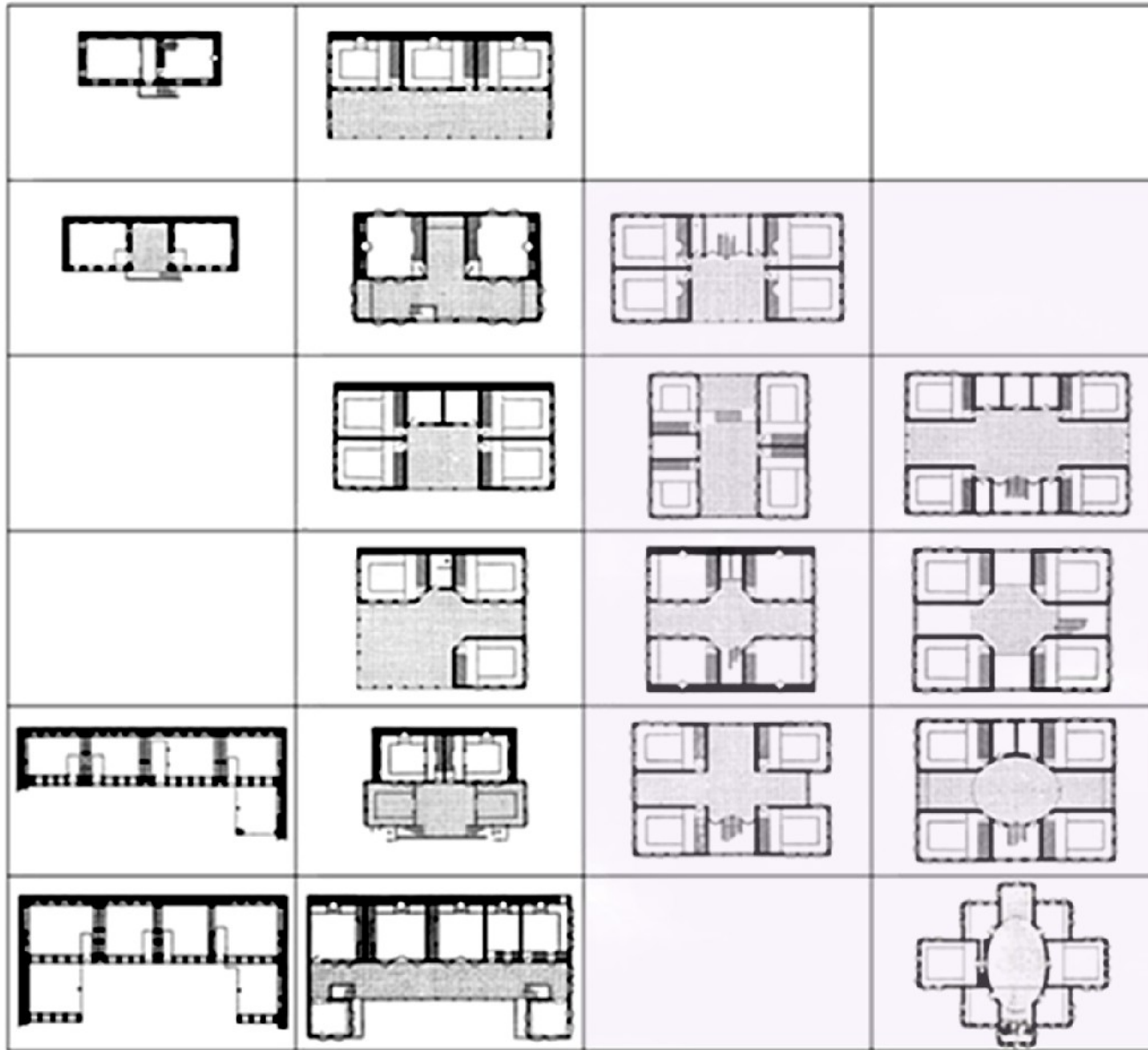
Historical Earthquake Damages in Istanbul

Without sofa


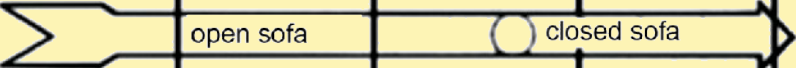

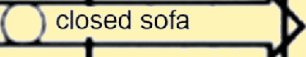







With outer sofa

With inner sofa

With central sofa



Plan types of various house samples

	BEFORE XVII. CENTURY	XVII. CENTURY	XVIII. CENTURY	XIX. CENTURY	AFTER XIX.. CENTURY	
WITHOUT SOFA (with inner garden)						SOUTH, EAST and SOUTH EAST ANATOLIA
OUTER SOFA	 	open sofa	 			SOUTH, WEST, SOUTH WEST and MIDDLE ANATOLIA ISTANBUL, MARMARA and BALKANS DISTRICTS
INNER SOFA	 		 			MIDDLE and WEST ANATOLIA ISTANBUL, MARMARA and BALKANS DISTRICTS
CENTRAL SOFA			 			MARMARA, BALKANS and CLOSE AREAS ISTANBUL



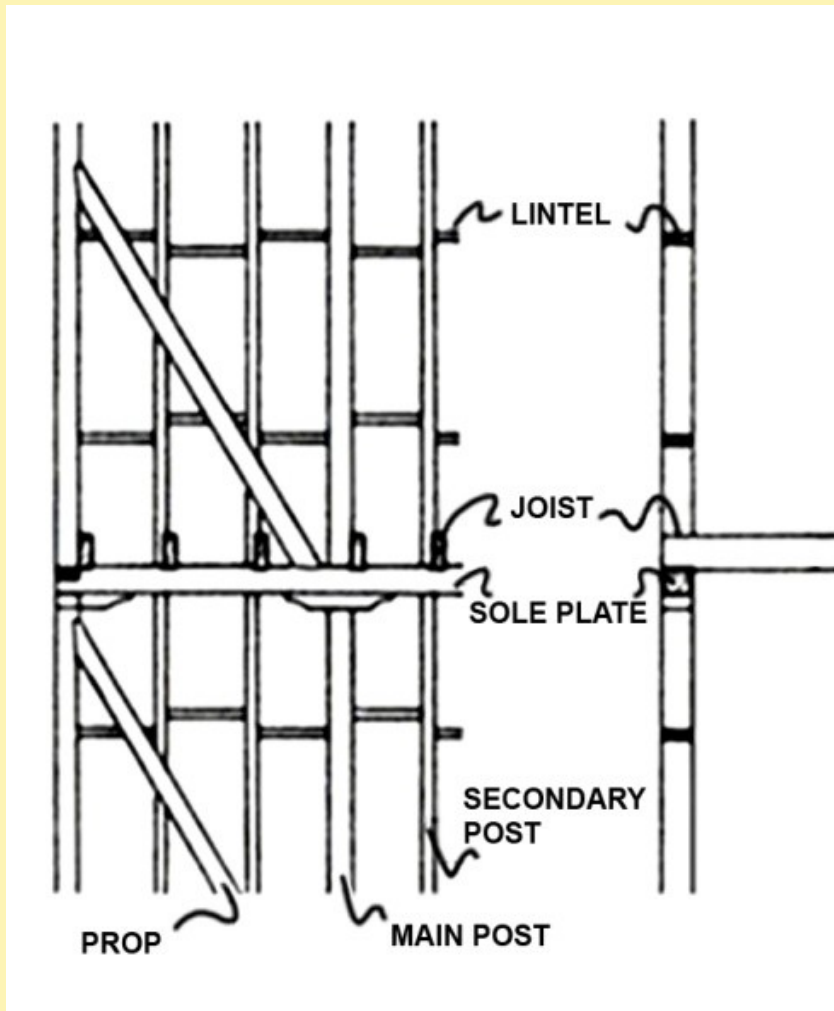
ANATOLIA

ISTANBUL and CLOSE AREAS

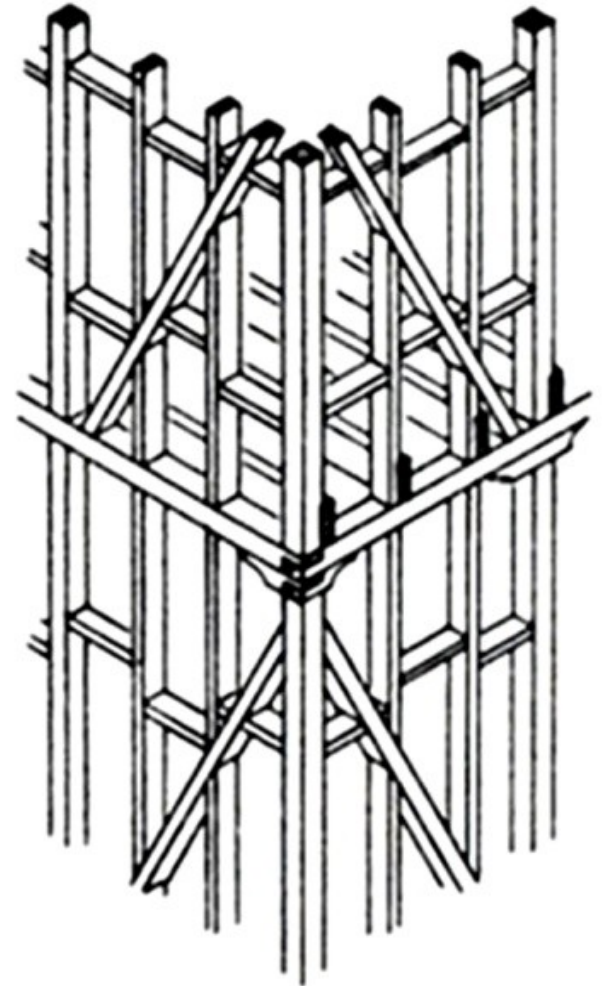
The structural features of the timber houses in Istanbul

These structures are composed of:

- Lateral load bearing elements: Sole plates, top plates, headers, lateral connection elements, joists;
- Vertical load bearing elements: Posts and secondary posts;
- Diagonals: Diagonal props and bracings.
- If the buildings were semidetached there are masonry fire walls approximately 50~60 cm in width between them and the joists are placed on these walls.

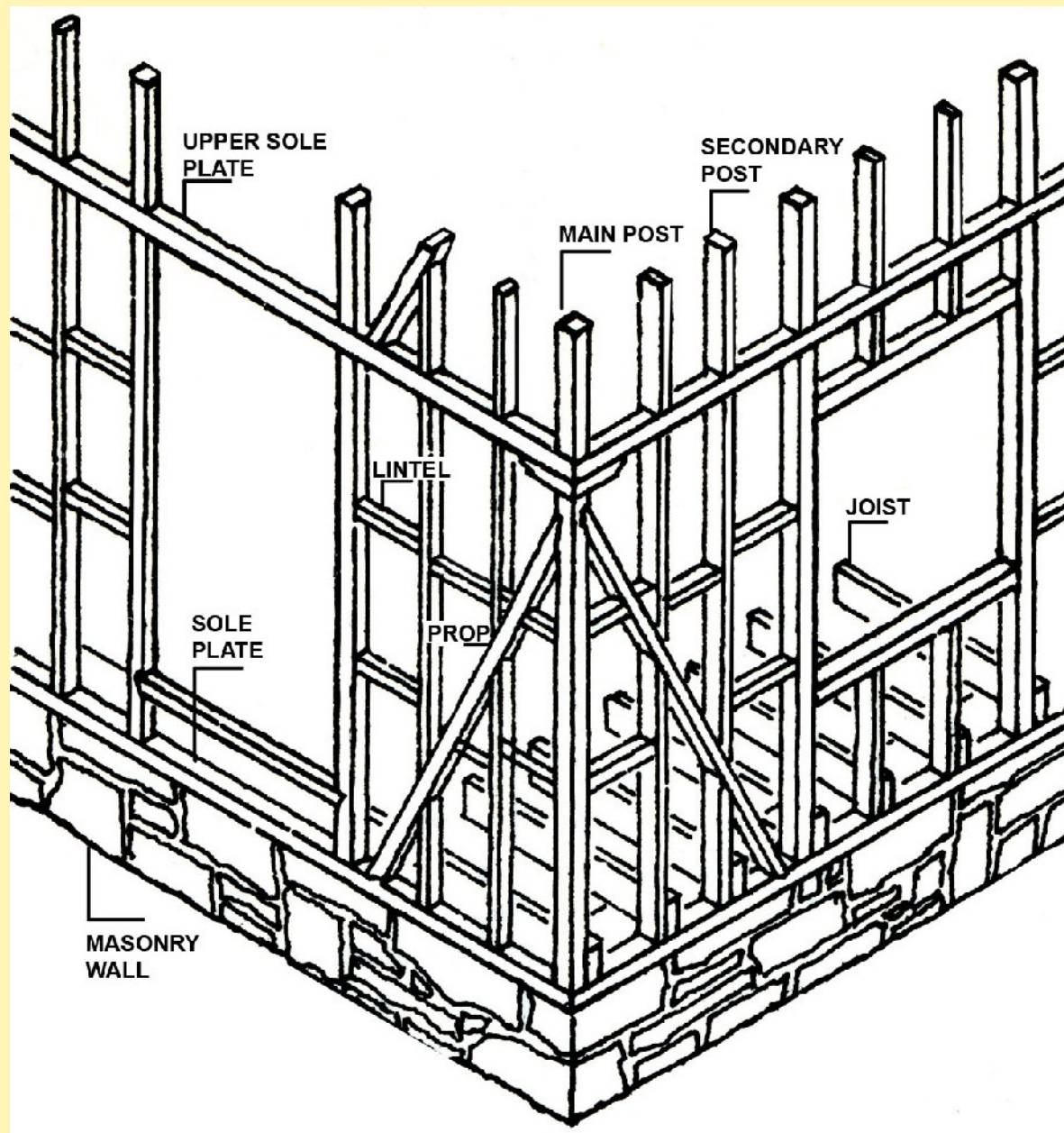


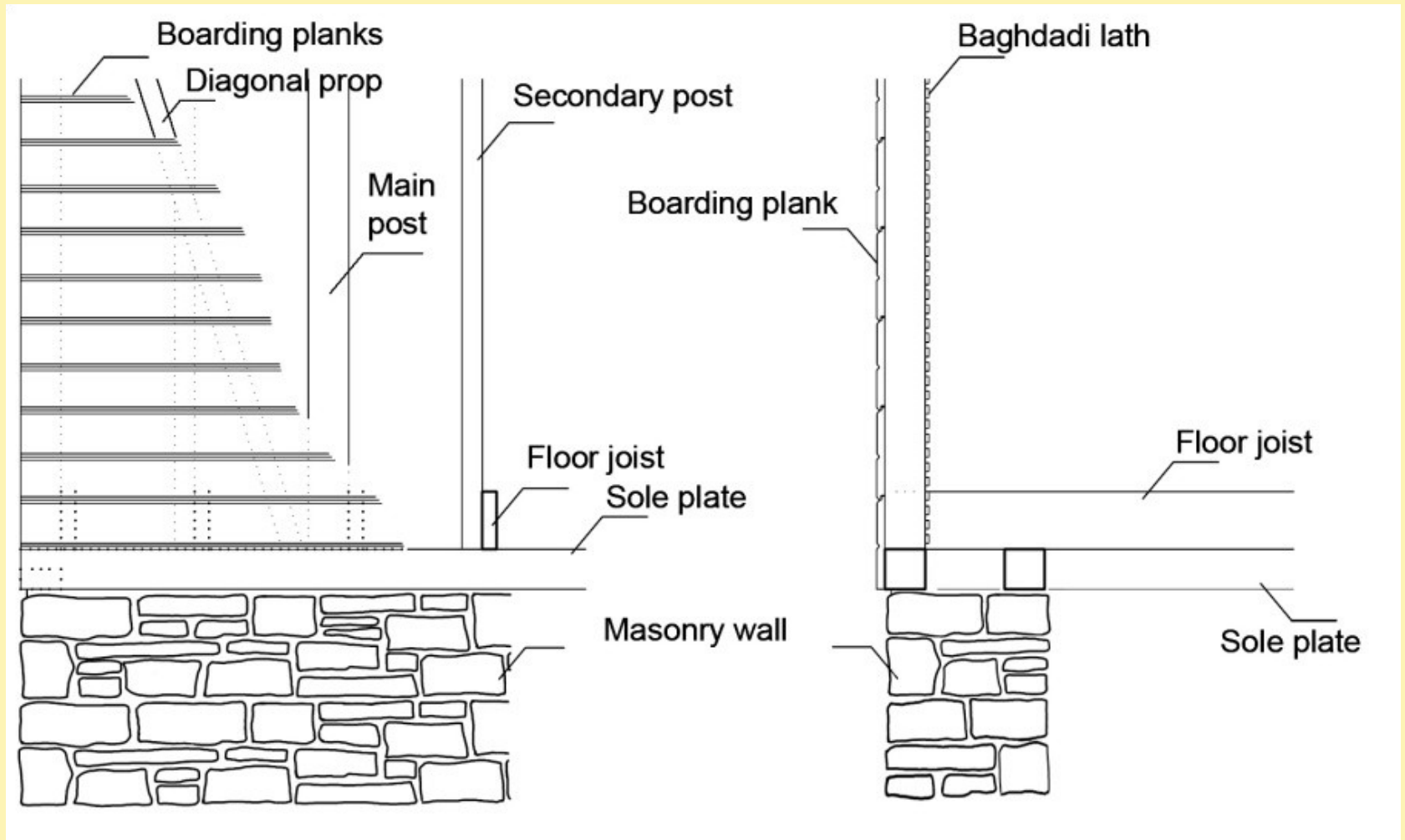
facade



perspective

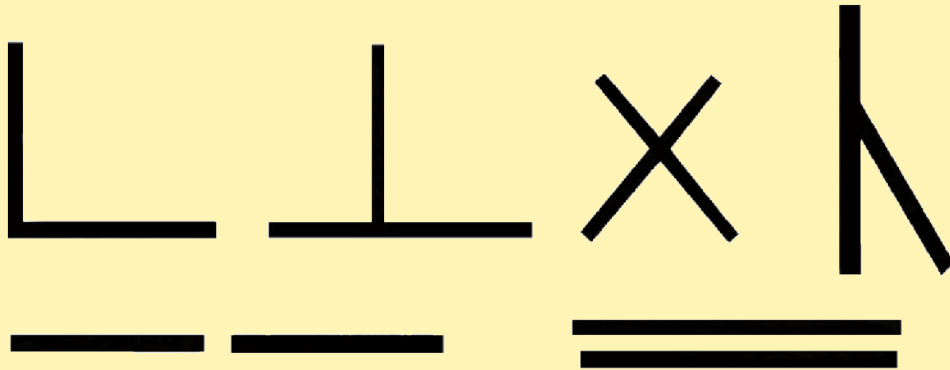
Timber-framed structure with single sole on both sides' facade and perspective



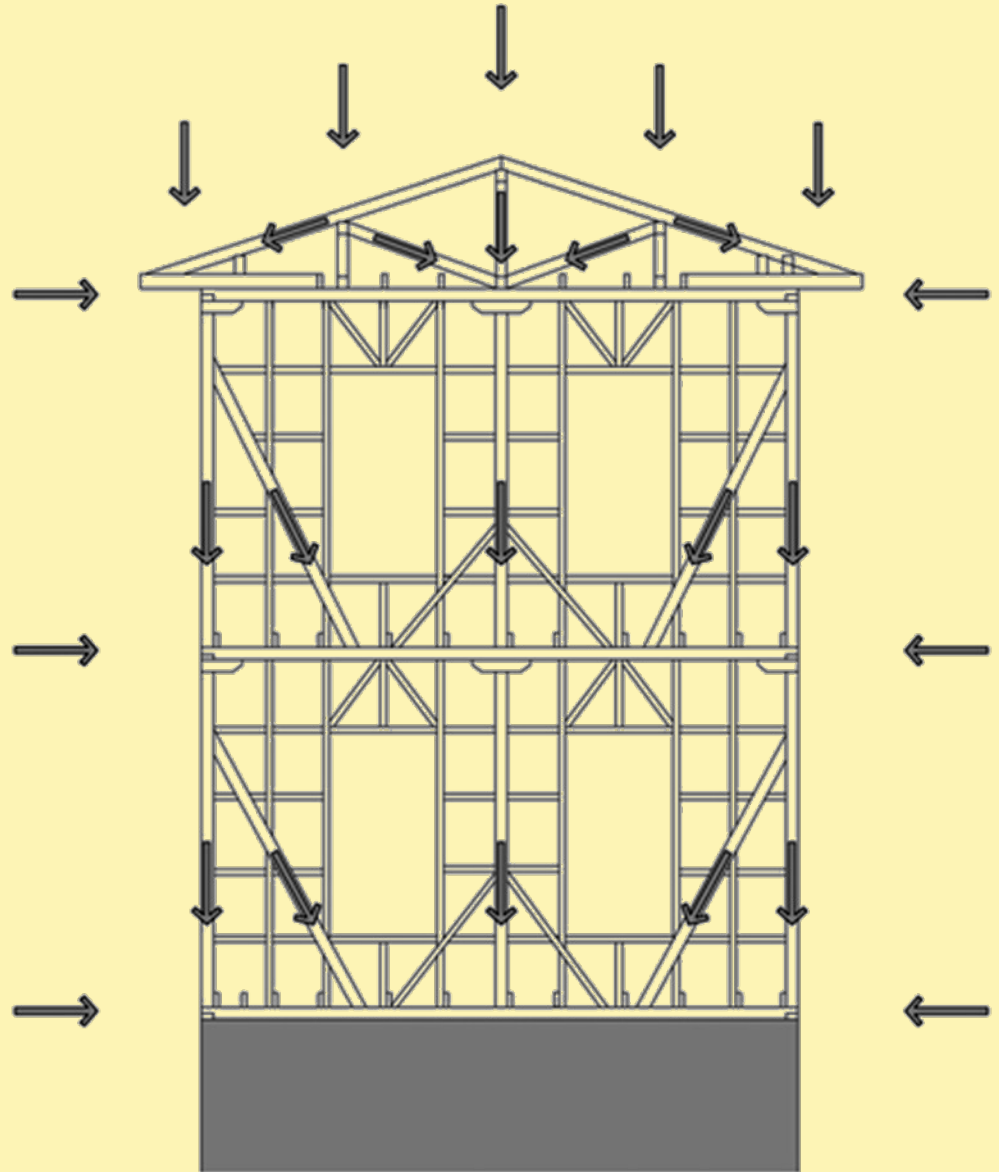
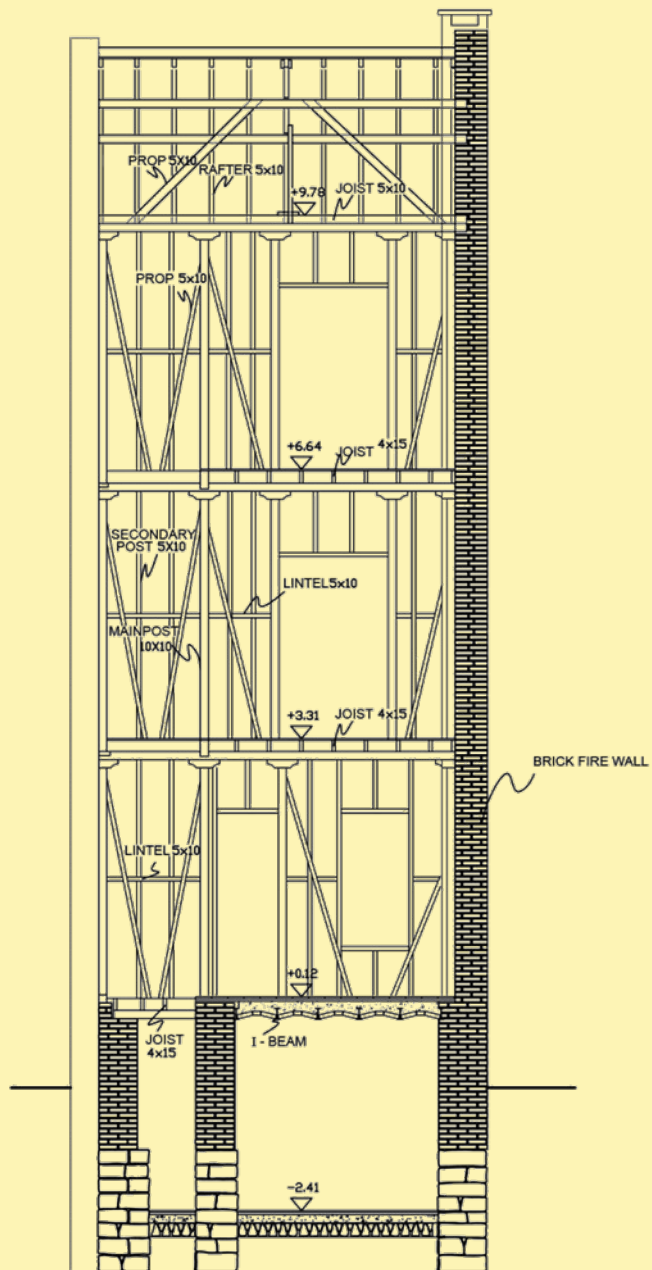


The unfilled timber frame system with boarding planks

For node connection points used
wrought iron nails







The wood species that were used in the building's structure

Members	Size cm x cm	Species
Sole plates and main posts	10 x10	Quercus robur/ patraea / Oak
Struts/ PROPS	5 x 10	Quercus robur/ patraea / Oak Fagus sylvatica / Beech
Secondary posts	5 x 10	Pinus sylvestris / Pine
Floor joists	5 x 15 / 4 x 15	Pinus sylvestris / Pine Abies alba / European Silver Fir
Lintel	5 x 10	Abies alba / European Silver Fir Pinus sylvestris / Pine
Flooring	2.2 x 15	Picea abies / European Spruce
Roof joists	5 x 10	Pinus sylvestris / Pine
Ridge beam	5 x 15	Quercus robur/ patraea / Oak
Purlins	5 x 10 ve 5 x 5	Quercus robur/ patraea / Oak
Rafters	5 x 10	Pinus sylvestris / Pine
Struts	5 x 10	Quercus robur/ patraea / Oak Fagus sylvatica / Beech
Props	5 x 10	Quercus robur/ patraea / Oak Fagus sylvatica / Beech
Under tile boarding	2.2 x 14	Pinus sylvestris / Pine

Conclusion

- Istanbul is a city has a very specific kind of timber building in Turkish house plan typology and structural system. It could be seen that these systems has a symmetry not only for the plan types also the structural systems make them strong against to the earthquakes.
- Depending on a variety of reasons like fire, lack of care these examples decreased in the course of time. For that reason understanding these buildings are becoming important for producing the correct restoration and conservation approaches and methods. In addition material and structural analysis become important beyond the architectural investigations.
- Analyzing these structures that proved themselves with the structural systems, durability and strength of their materials against time is important for reaching the past knowledge and future production of earthquake resistant timber buildings.

Acknowledgements

The determination of the wood species which used in the construction has been realized by Dr. Pina di Giulia in the laboratories of The University of Florence DISTAF - Department of Environmental and Forestry Science and Technology under the supervision of Prof. Dr. Luca Uzielli and Prof. Dr. Marco Fioravanti.

Thank you..