Use of Bio-based Building Materials in Turkey- Present situation and future challenges

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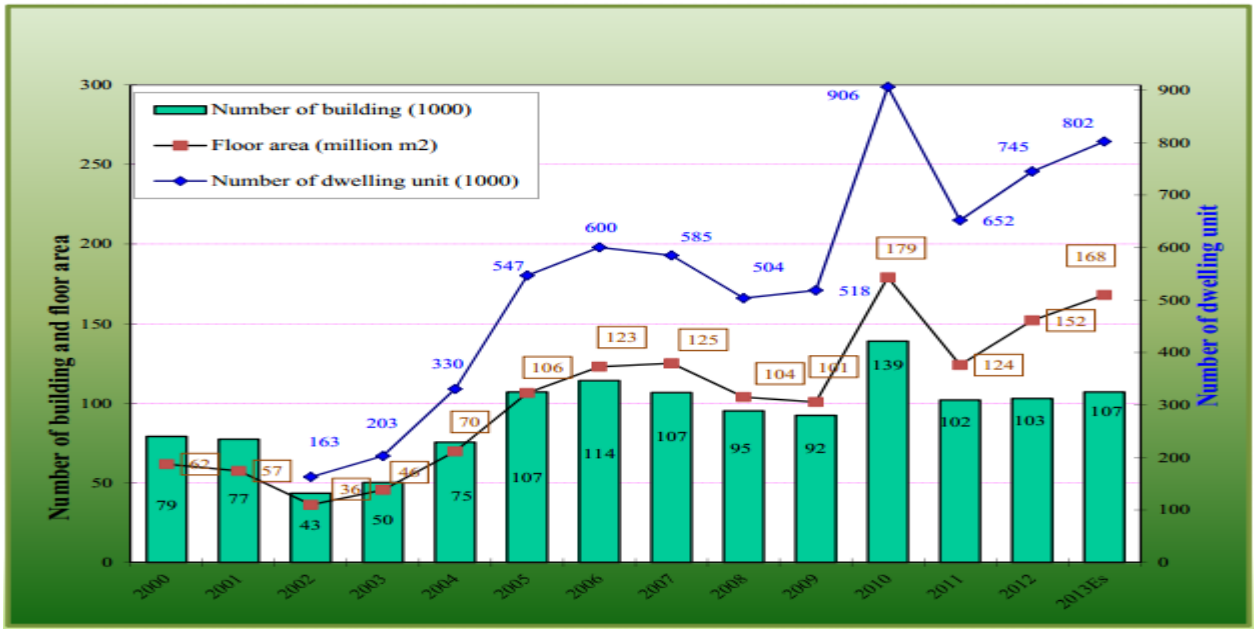
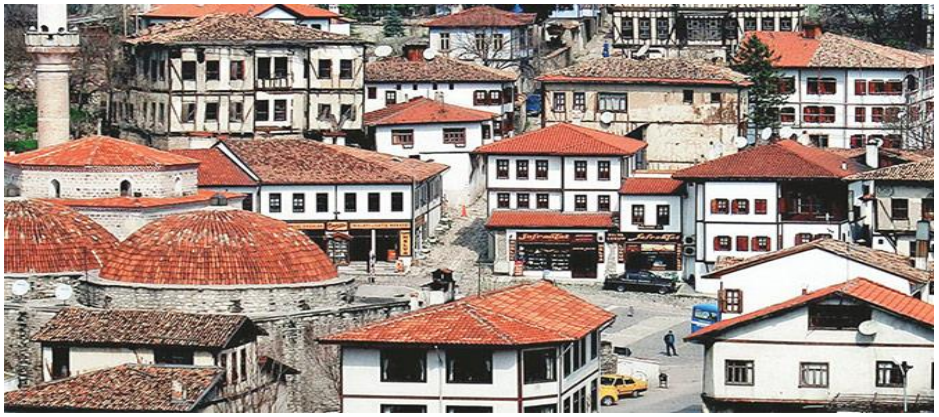
Construction Facts about Turkey:

- Among the top 12 producers of building materials in the world
- The 2nd country (following China) in terms of the number of top contracting companies in the world construction industry
- Ranks 4th among cement manufacturers in the world, 10th in steel production
- The construction sector is the 3rd largest economic sector, after the food and textile industries



Traditionally…

- The traditional Turkish houses in Anatolia date back to in the 15th century and spread to Rumelia within the boundaries of the Ottoman Empire. Remaining examples which are still in good condition have been taken under conservation by Ministry of Culture and Tourism, UNESCO and the Council of Europe.



- Different architectural construction systems emerged based on environmental factors, convenient materials, easily obtainable, distinctive cultures, which are all infact interrelated and integrating regional features as different elements of the whole Turkish building concept.

- The construction technique and the materials provide the opportunity of care, repair, change-development of the needs. The construction materials used in the traditional houses were wood, stone and adobe.

Traditional Architectural Construction Systems and Used Materials in Turkey

- The historical method of construction is called as “**canti” (log house)** in which logs slightly processed are overlapped and anchored at the ends.

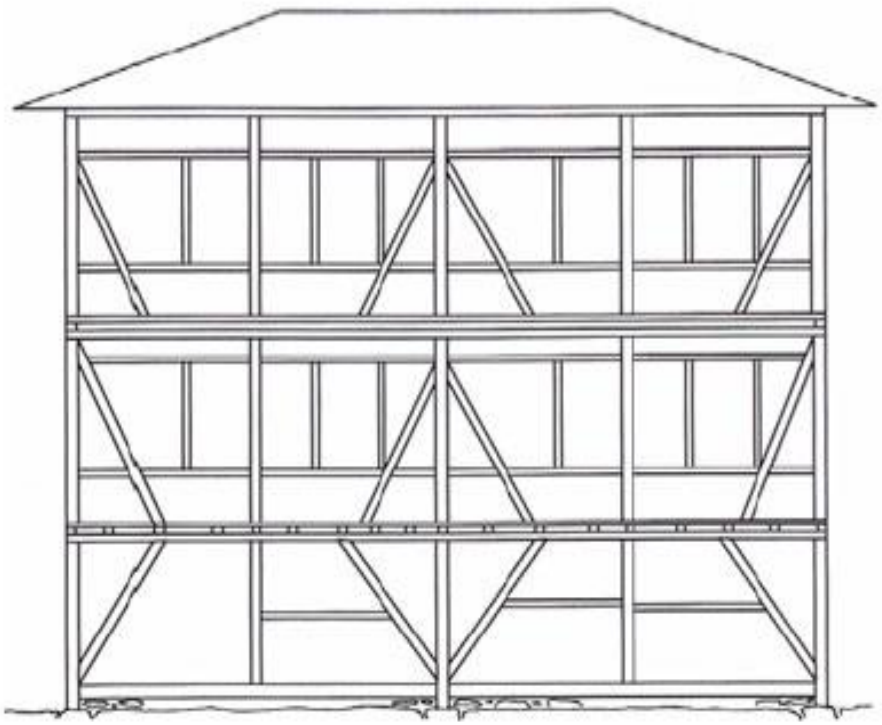
- In the **Hatil** construction, horizontal timbers embedded into bearing wall masonry. The hatils when tied around the facade-side wall junctions did aid in reducing the significance of corner wedge failures.

- **Himis** construction is a timber frame with masonry infill such as bricks, adobes or stones. In Britain, where it became one of the identity markers of the Elizabethan Age. In Germany it was called ‘‘fachwerk,’’ in France, ‘‘colombage’’

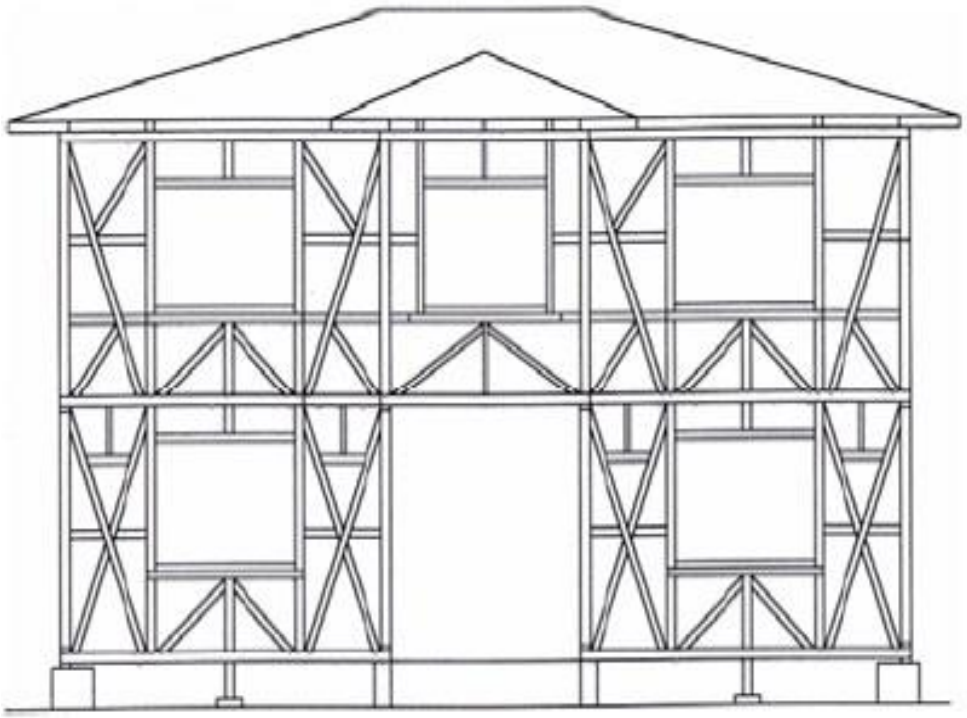
- **Dizeme construction-**wood were used as infill materials instead of masonry. Short rough timbers elements called as “dizeme” were used as infill and they were nailed studs or horizontal framing elements. The purpose of wood infill usage to avoid their common early shear failure and falling out of the frame occurred for masonry infill. Load paths are considered structurally redundant and provide safety in earthquakes

- **Bagdadi construction-**the voids between timber framing members is filled lighter materials or with trunk shells are transformed into a filling material by sand and lime mortar. The interior surfaces of walls are covered by lath and plaster work or wood, whereas the outer surfaces are either non-plastered or wooden plastered

The frames of traditional wooden house



More recent frames of a wooden house



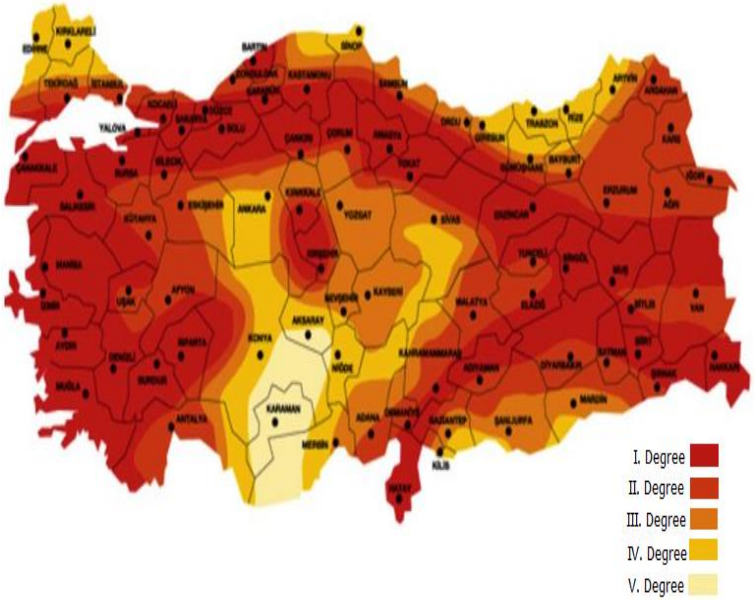
- **Stone Houses-**This Arab-style architecture located in a volcanic area, the basic input used is easily workable calcareous stone , also has a strategic position on a rocky mountain overlooking the plains of northern Syria. From the point of view of the structural property, it is the weakest wall type. The peripheral ties used between the walls increase the strength of the stone walls.

- **Beehive mud houses-** located in Harran. The design of these mud houses is believed to have stayed for at least 3,000 years, until about the 1980s, when they officially stopped being used as living space.

- **Adobe Building:** having less and insufficient resistance against earthquake is a material which does not have any elastic and ductile properties.

One of the largest Traditional Wooden Buildings of Turkey - Buyukada, Istanbul (erected in 1898)

- But, in *1999, Marmara earthquakes* reminded traditional buildings. Houses having been built with traditional construction techniques had little damage and did not cause too much life loss due to lightness and spatial character elements. Structural weaknesses are cracking and falling of plaster, failure of mortar, failing of connections, large lateral displacements, dislodgement of the masonry infill, and failure of connections to foundation.



Seismic hazard zones of Turkey

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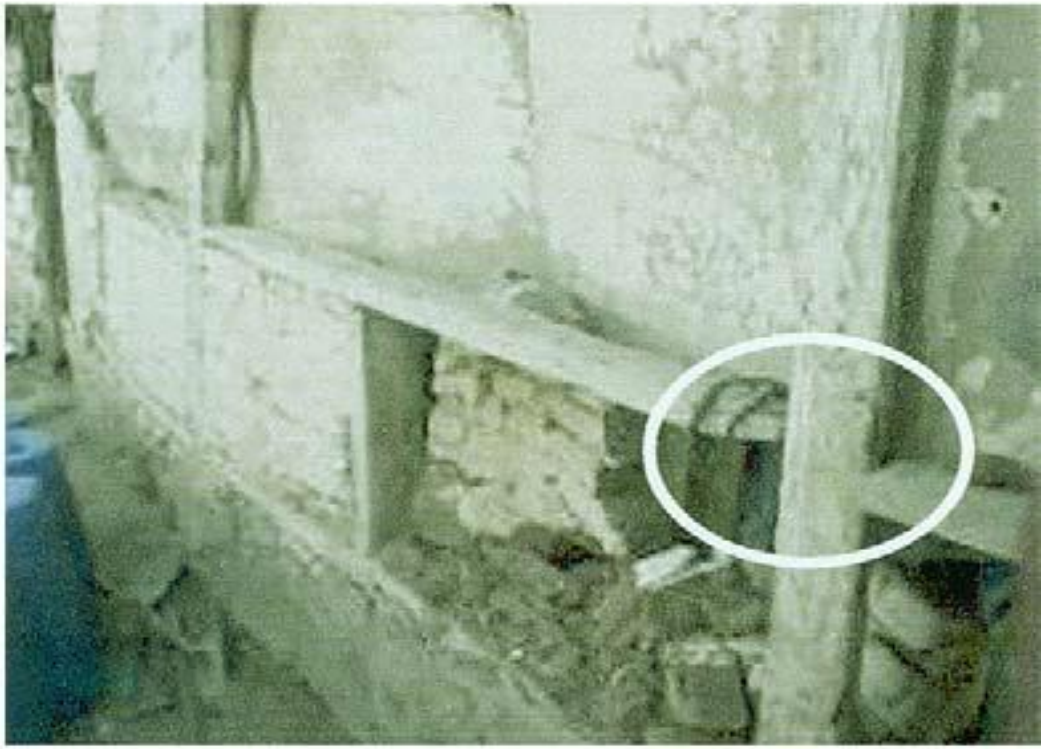

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Failure of connections in traditional timber buildings during earthquakes

Seismic

Market realities

Durability, Fire

Processing problems

Perception of high maintenance costs

Building Regulations

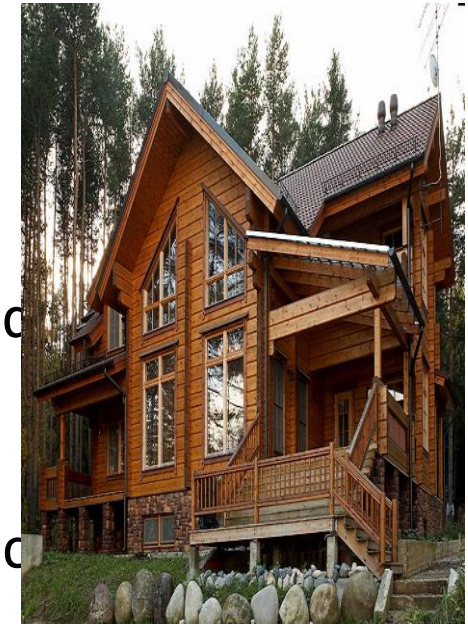
Reasons for limited use of biobased materials construction in Turkey

Current situation of the Building products in Turkey

- Compared to other European countries, the use of bio based building products in Turkey is quite low.
- *Reinforced concrete and steel* are used in the vast majority of existing and new buildings.
- The use of timber in, wall panel, flooring and roof truss systems, have recently started in Turkey and the industry is still at the forming stage.
- Wooden structured housing gained pace in the last five years (upscale villa market) and the future is promising.

Challenges

- Technical aspects
  - -Understanding these materials' properties
  - -Developing appropriate engineering design stand
  - -Implementation of technologies
  - -Lightweight Construction (CLT, Finger-Joint, etc)
  - -Standardization, improvement of the design proc quality control



- Bureaucracy
  - -Building code enforcement and inspections

- Dissemination
  - -Educating building officials, builders, owners
- Society
  - -Encourage people to prefer biobased materials ir constructions

Thank you

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Turkey