

Earthen Architecture with Shotcrete Construction In Cyprus - Dilekkaya

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İNŞAAT MÜHENDİSLERİ ODASI
CHAMBER OF CIVIL ENGINEERS

**3rd National Civil
Engineering Symposium**
3. Ulusal İnşaat Mühendisliği Sempozyumu

4-6 Aralık - December 2024

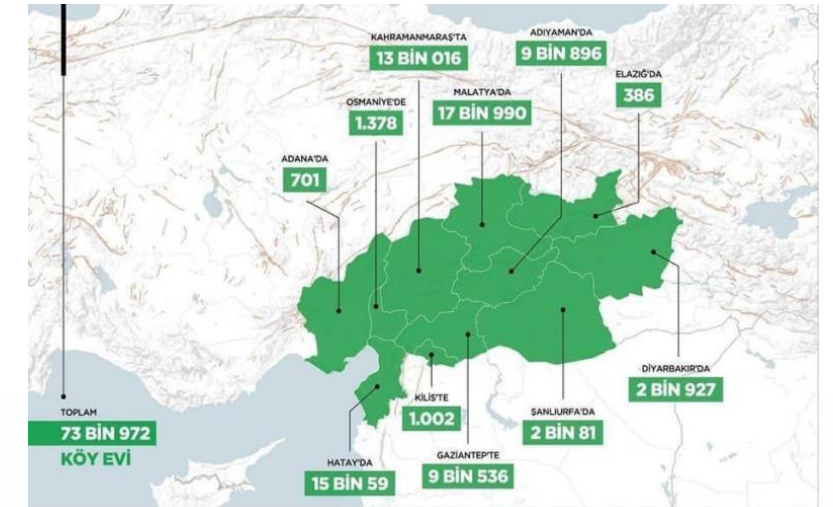
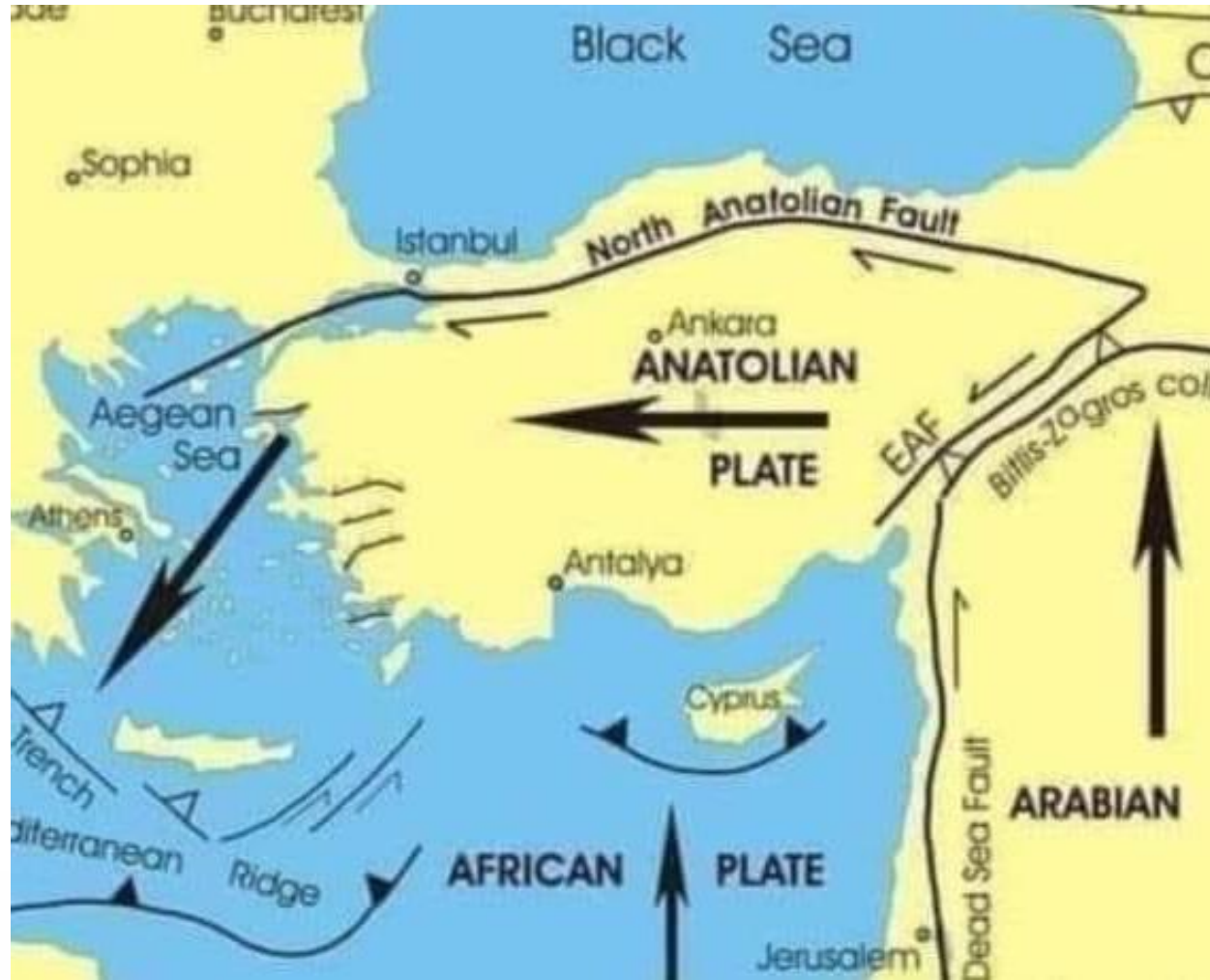
**3rd Nature Inspired
Solutions For The Built
Environment Conference
(NISE)**

3. Uluslararası yapılar için
doğadan ilham alan çözümler
konferansı



**Acapulco Resort
Convention SPA Hotel**
North Cyprus





1/3 World Population lives in Erthen Construction



2nd
century BC
Chinese
Tower



8th
century
AD
Morocco



Van Castle,
9th century
BC

Earthquake Safe Construction Technology must be known and applied



Historical Buildings are earthquake safe. Wall layers stones(strong) and bricks(low strength). Earthquake lateral force absorbed in low strength lateral areas.



The chocolate industry designs where the force will act and break.

Earthen Construction Today

Healty

Earthen wall provides natural humidity balance.
It provides natural air conditioning by balancing heat.
It protects human health (such as natural nutrition)

Sustainable

Energy Efficiency – uses less energy

Reduces fossil fuel use

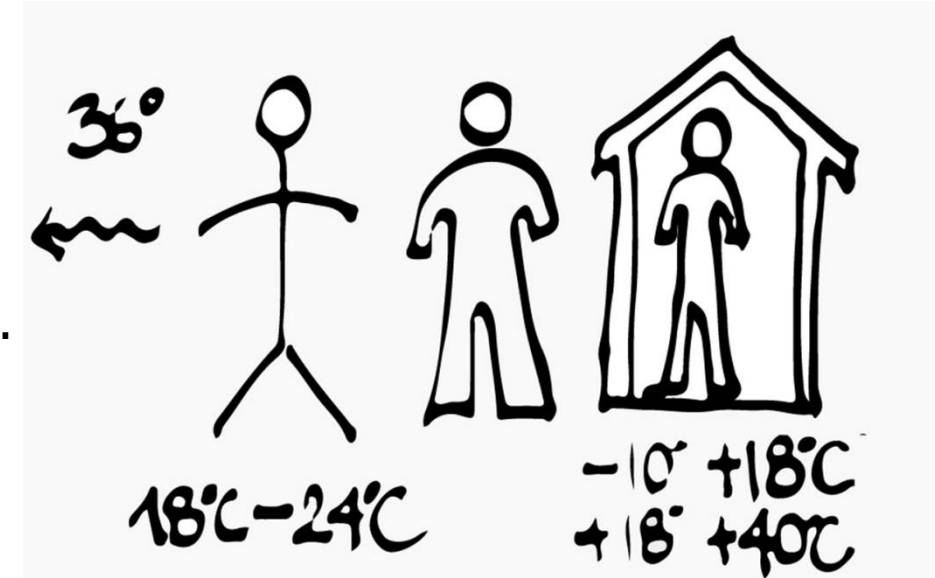
Does not pollute the natural environment – reduces plastic use

Protects family budgets and national budgets

Durable - Long-lasting

Contemporary – Industrialized Construction Technique

Earthquake Safe – Horizontal flexibility, energy dissipating

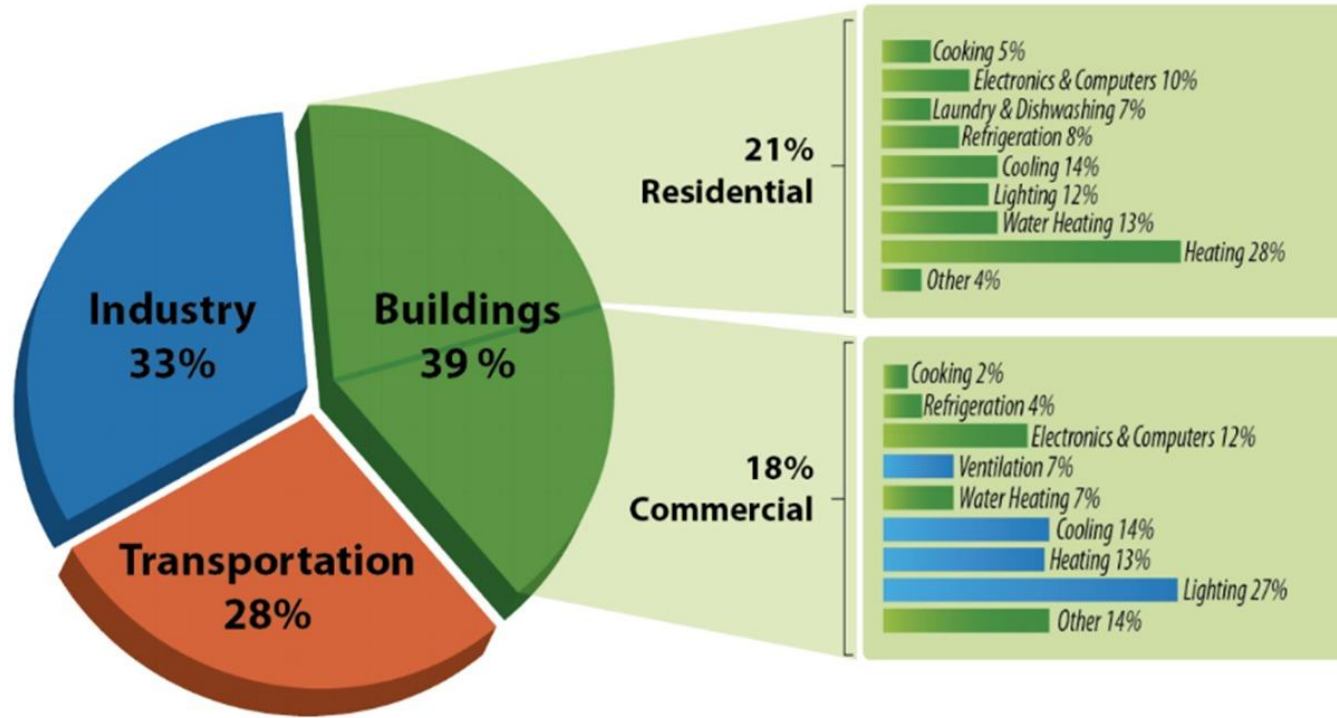




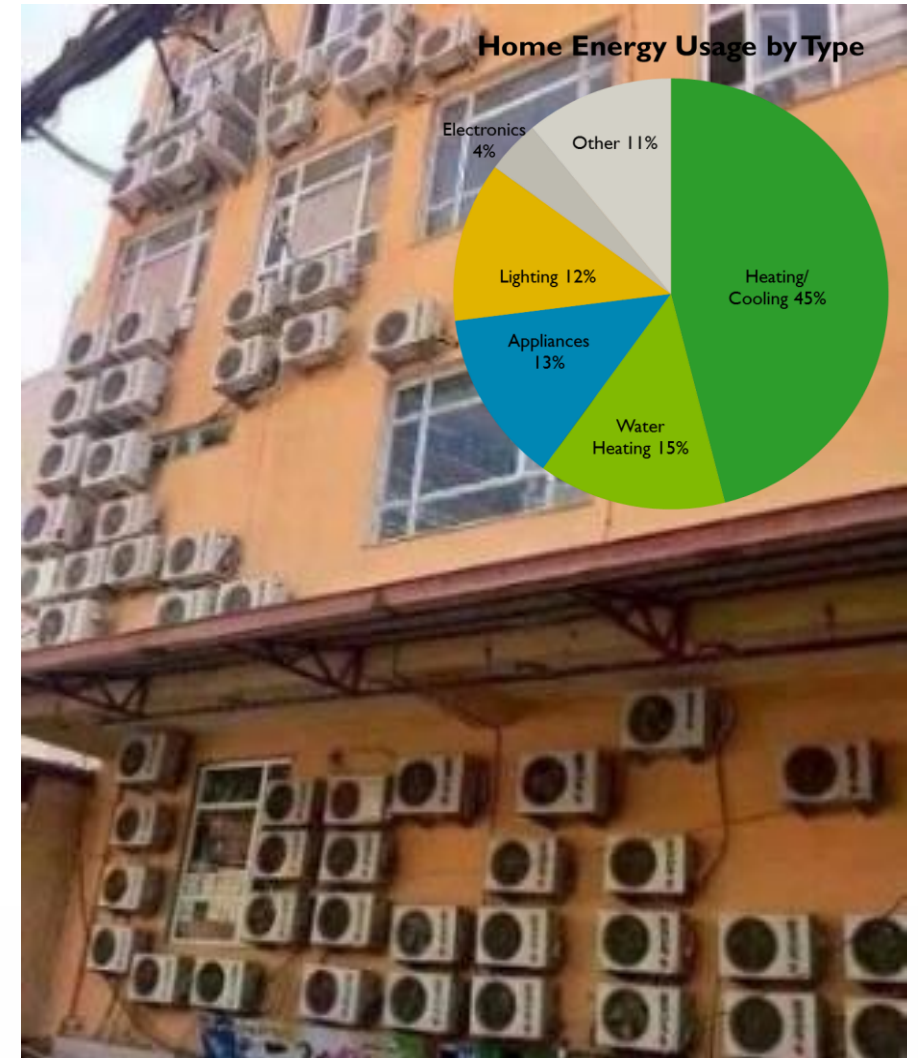
Earth Construction Creates Indoor Climate

- Heat
- Humidity

Energy Consumption in the U.S.



- The majority of the world's energy resources are used by the construction sector.
- Construction Sector energy use **in America 39%**
in Turkey 47%

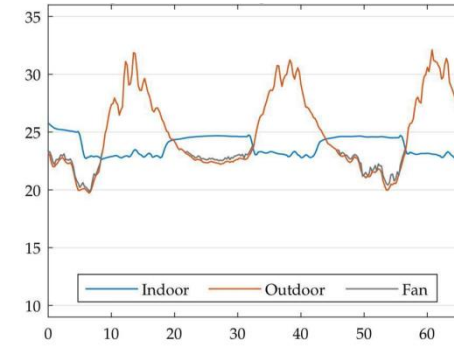




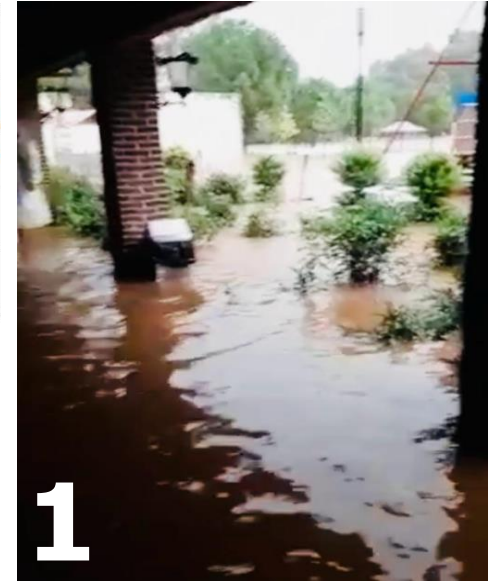
VAN Castle ; 3000 years ago

Gypsum Stabilized Earth Property

- Water, Rain and Flood Resistance **(1)**
- Snow and Frost Resistance **(2)**
- Indoor climate performance
- Industrial Construction Technology



Measurement of internal and external thermal values



Gypsum-Lime Stabilization: Percentage

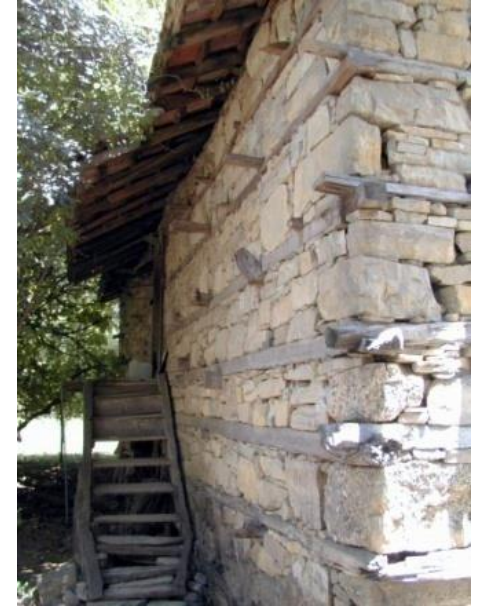
Content	% weight	Practical Dimensions
Soil	100	2 full wheelbarrow
Gypsum	10	4 full shovel
Lime	2 (time)	1 full shovel
water	18-20	1 bucket



Earth construction without stabilization is damaged by water. **(3)**



Traditional Earthquake Safety



Historical earthen wall
Horizontal Layer in Türkiye
Horizontal layers in Lima

University of PUPC in Lima, Peru:
Labor test on earth wall
without horizontal layer



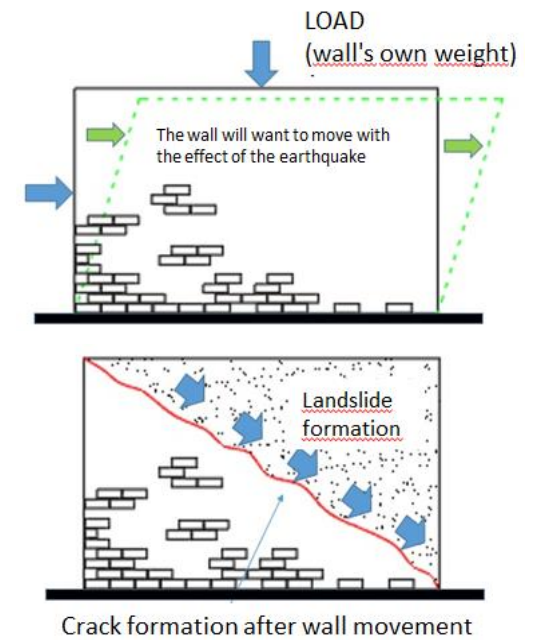
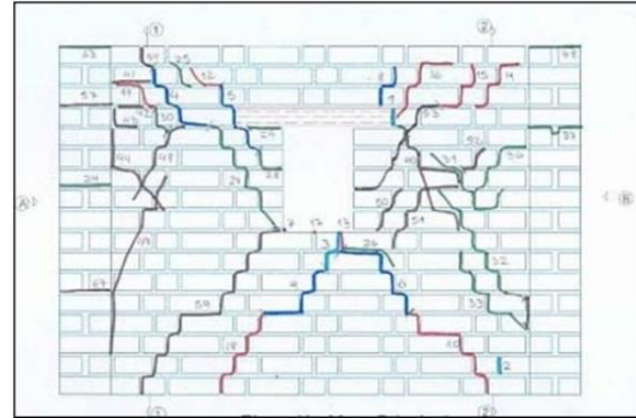
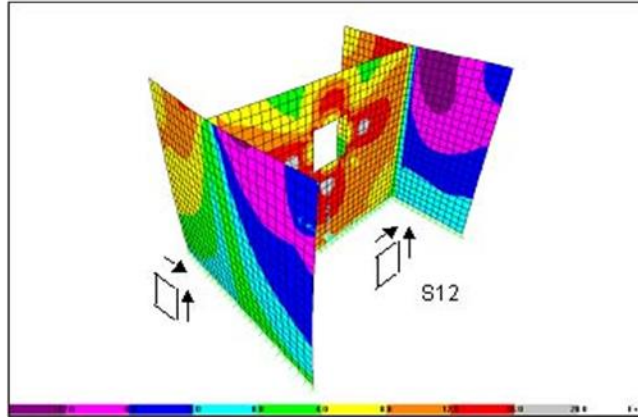
PUPC University
does not apply this
method



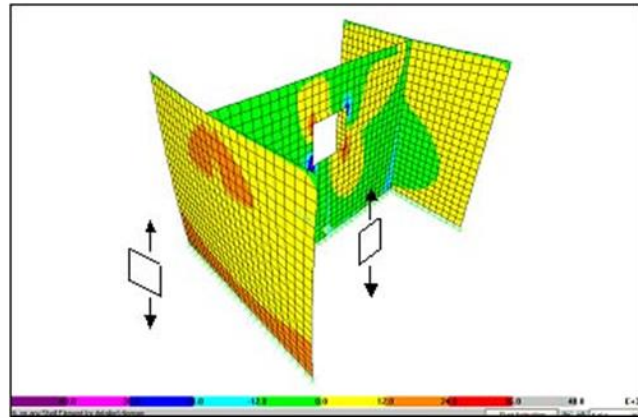
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AKIN DOĞU ÜNİVERSİTESİ

Horizontal force

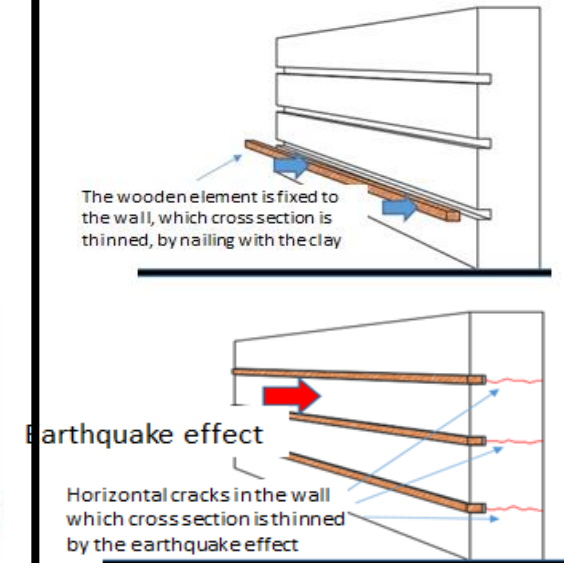


Vertical force

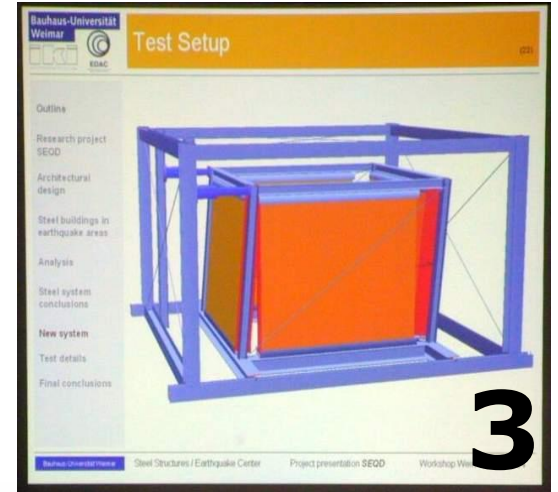


Peru - 2012 Nisan
M. Blondet, D.
Torrealva, G. Villa
García, F. Ginocchio, I.
Madueño
 (Catholic University of Peru)

Load barring wall without horizontal flexible layer



1- Jan19-21 2005 EarthBuild, Sidney, International Conferences, Bamboo Reinforces



2- Australia, 19.01.2005 "EarthBuild Conference,"
M.Blondet,D.Torrealva,G.Villa García,F.Ginocchio,I.Madueño (Peru Catholic University)"Use of Industrial Materials in the Construction of Safe Adobe Houses in Seismic Zones"

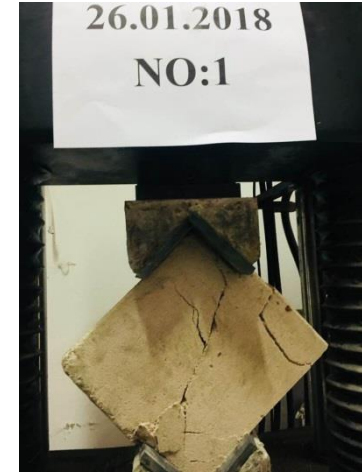


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3 1-2 November 2004,
Germany, International
Conference / Workshop:
Bauhaus-Universität Weimar
Surface reinforcement

1 - Cross crack, ITU Laboratory test (2002)
Load barring wall without horizontal flexible layer

2 - Crack in horizontal layer, ITU Laboratory test.(2002)
Load barring wall with horizontal flexible layer





Shaking Table Test 2009 – ANKARA Disaster Affairs Directorate 8 pieces 7 Richter scale after earthquake

Earthquake
damage with
diagonal fracture
in an unprepared
masonry building



1. Lateral Flexible
2. Historical Building Stone + Brich horizontal flexible diagonal crack

EARTHEN INDUSTRIALIZED CONSTRUCTION TECHNOLOGY TODAY

Healty

Earthen wall provides natural humidity balance.
It provides natural air conditioning by balancing heat.
It protects human health (such as natural nutrition)

Sustainable

Energy Efficiency – uses less energy

Reduces fossil fuel use

Does not pollute the natural environment – reduces plastic use

Protects family budgets and national budgets

1. TRADITIONAL ADOBE

2. CONTEMPORARY EARTH CONSTRUCTION

Earthquake Safe

Durable – Long lasting

Fast Construction

2.1. Rammed Earth

2.2. Earth Block

Industrial Production

2.3. Shotcrete in wall form

CONSTRUCTION TECHNOLOGY

1. TRADITIONAL ADOBE Soil + Straw + Water

- Intensive labor
- Long production period
- Costly
- Production of a house: Entire summer period

Traditional Adobe (30% clay)- straw

- Kept in pool
- Shaped
- Laid on threshing floor
- Drying top-bottom
- Ready for construction

Wallwork + mortar + labor



CONSTRUCTION TECHNOLOGY

1. TRADITIONAL ADOBE

2. CONTEMPORARY EARTH CONSTRUCTION

2.1. Rammed Earth

Soil + %10 Gypsum + %2-5 Lime

Form compaction 45 m3
house walls –

4 workers production 11
days

Gypsum Lime Soil (10% Clay)

- Dry mix
- Wet mix
- Ramming into mold

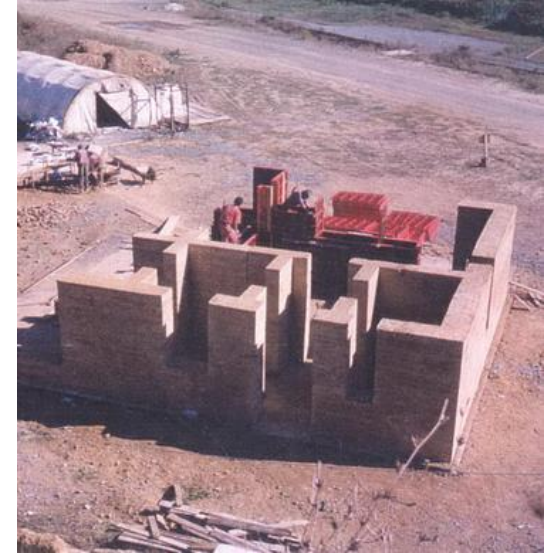
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2.1.RAMMED EARTH CONSTRUCTION

İTÜ Maslak, 1995 TÜBİTAK İNTAK TOKİ 622



CONSTRUCTION TECHNOLOGY

1. TRADITIONAL ADOBE

2. CONTEMPORARY CONSTRUCTION

2.1. Rammed Earth

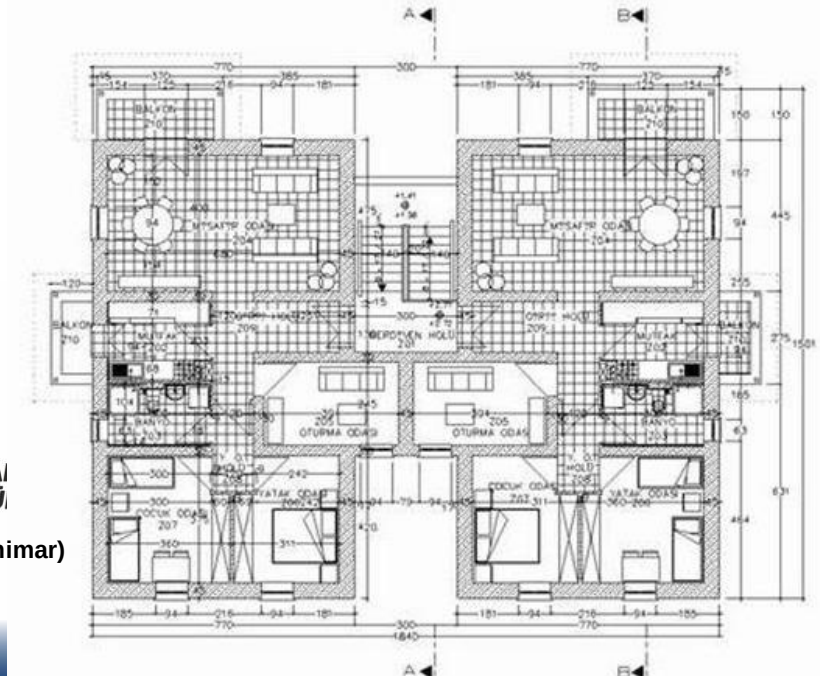
2.2. Earth Block Industrial Production

2.3. Shotcrete in wall form

2.2. INDUSTRIALIZED BLOCK PRODUCTION Earth+Gypsum 10%+Lime 2-5%



Urfa GAP Administration House 2000



2.3. SHOTCRETE Machine - Injection Earth + Gypsum + Lime



**ITU
Construction
Laboratory 1990**

**DELTA Company,
Owner Haluk
Yurttutan**



**Ankara
Disaster
Affairs 2009**



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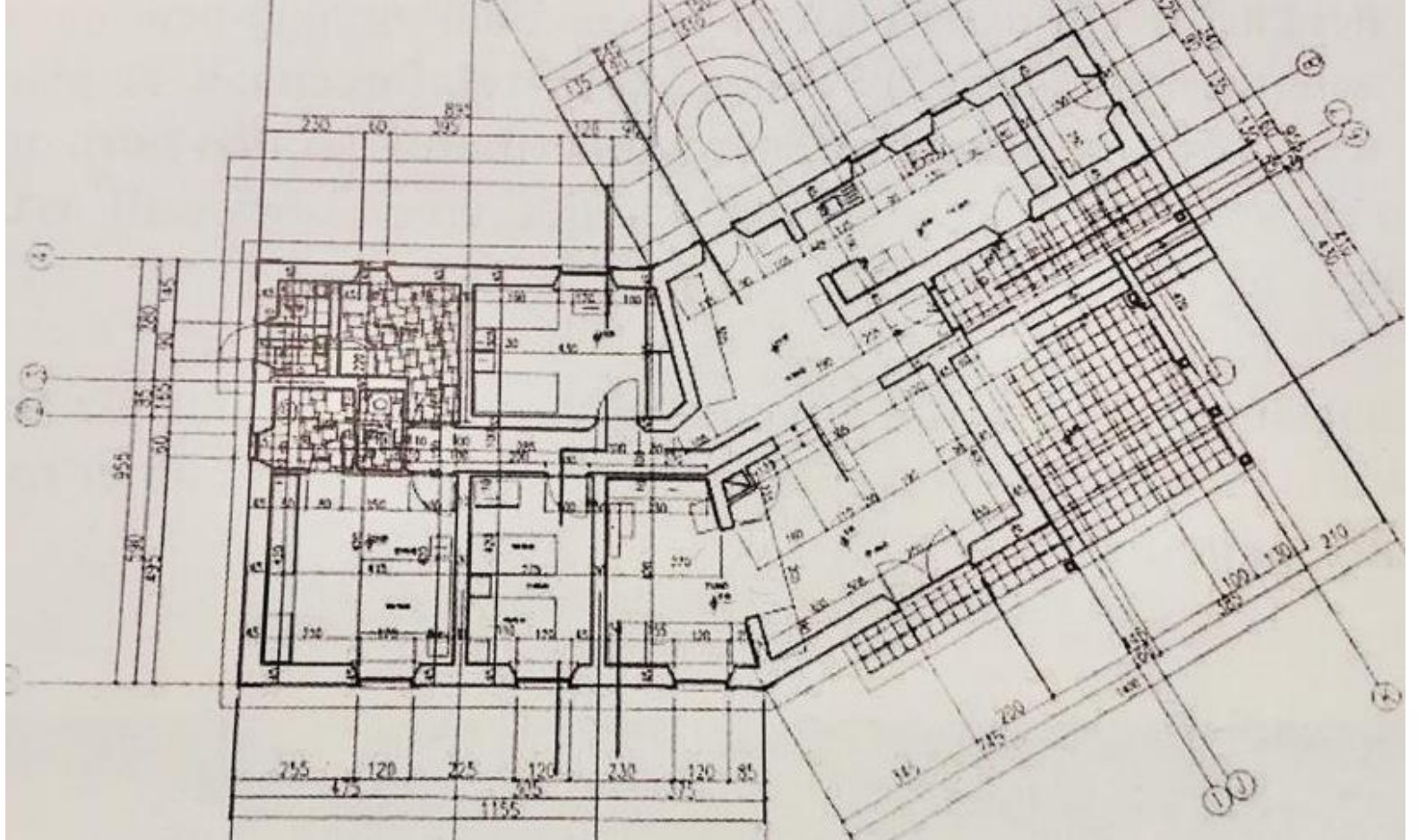
1997 - Altınoluk 180 m2

İç ekolojik yapılar inşaata uygun
dim ve alanda yapılabiliyor.
neksel kerpiç, suyla temasta
a da, yenilenen kerpiç üretimi
gine göre, toprağa alçı ve kireç
ırak, sudan zarar görme
leniyor.



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EARTH BUILDING SAMPLE



KUZEY KIBRIS
KAMPUSU
ODTÜ
METU
NORTHERN CYPRUS
CAMPUS



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ULUSLARARASI
FIRAT ÜNİVERSİTESİ

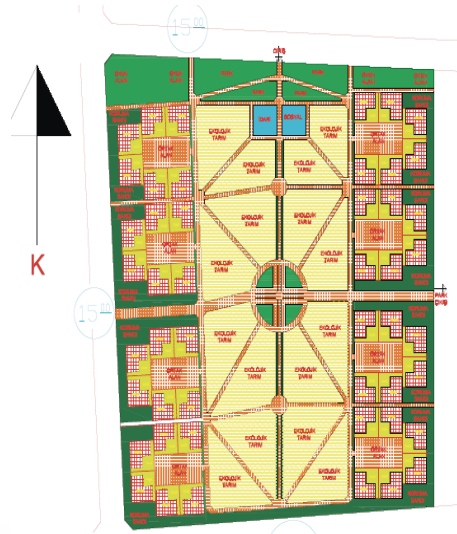


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EARTH BUILDING SAMPLE

2012- Viranşehir Earth Building, Home Owner Construction



EARTH BUILDING SAMPLE



2009 - Samsun, Earth Block filling project



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KAMPUSU
ODTÜ
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EARTH BUILDING SAMPLE

2015 -
Gobeklitepe
Visitor Center,
Project: Kreatif
Mimarlık



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EARTH BUILDING SAMPLE

2015 - Köyceğiz BKM Film Plateau, About 2000 m2



EARTH BUILDING SAMPLE

**1994 - Cengiz Bektas
Saklikoy Horse Farm
Traditional Adobe Brick**



2012 - Kıbrıs Dilekkaya
Shot-Earth

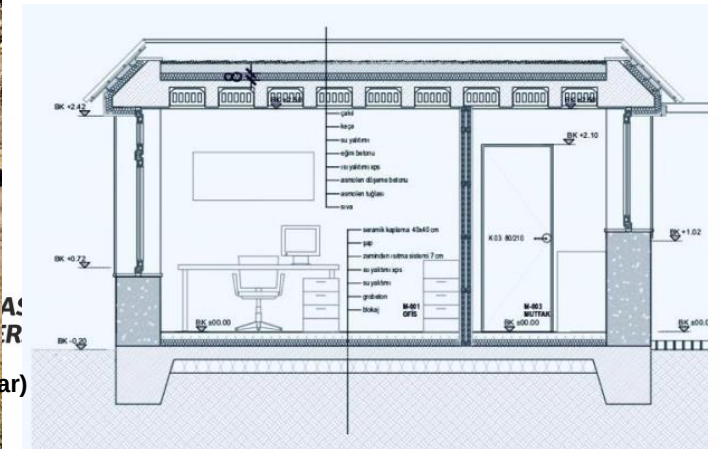
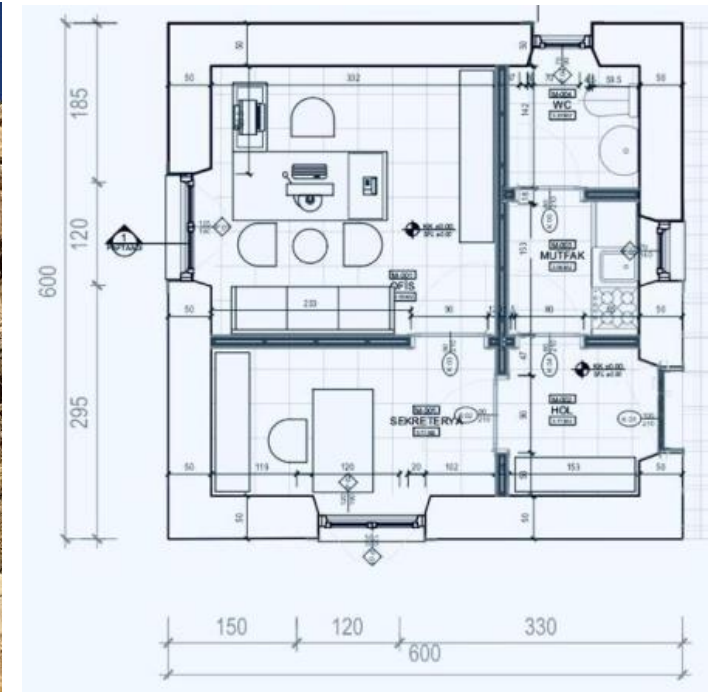
EARTH BUILDING SAMPLE



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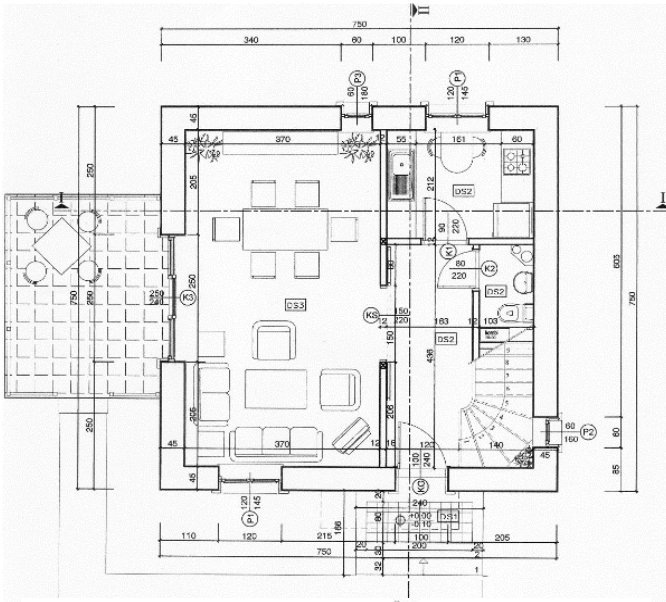
2019 - Van, Muhtar Office

EARTH BUILDING SAMPLE

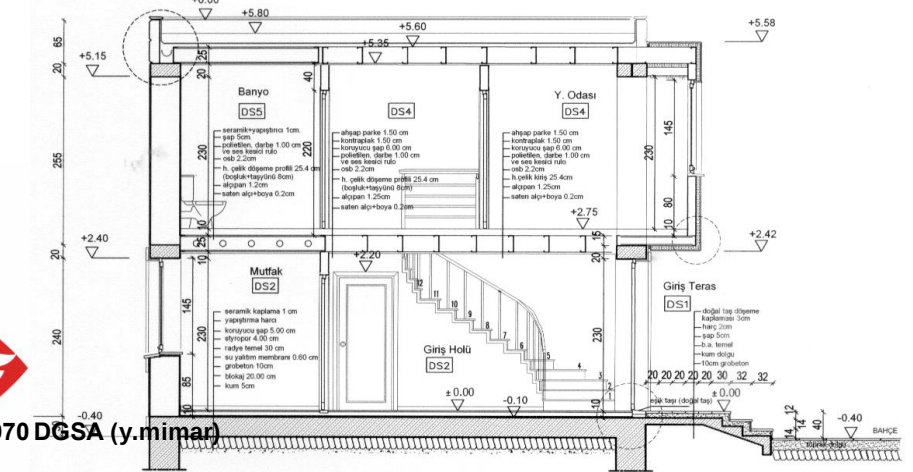
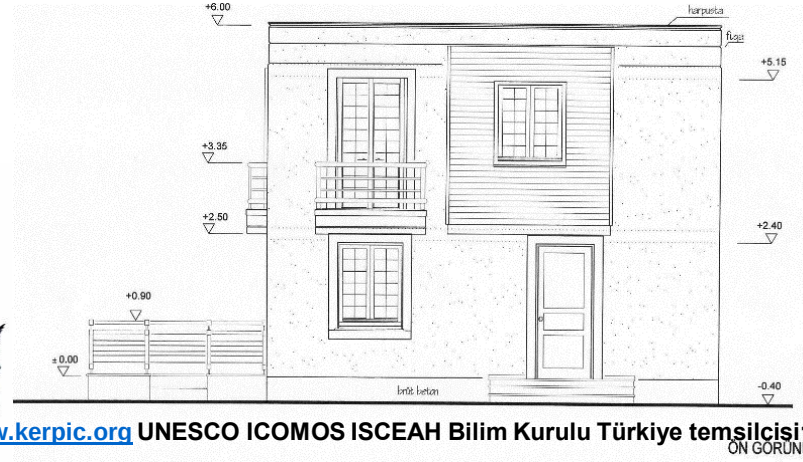
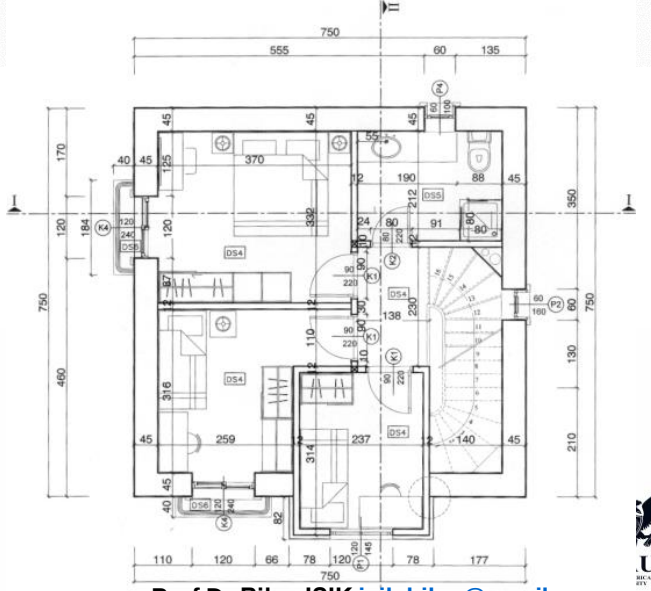


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EARTH BUILDING SAMPLE



Plan 6 x 5 m= 30 m
Height 5x30= 150 m²
Thickness 0.5 = Wall 75 m³
Sprayed concrete feature 15
m³/hour 75m³: 15= 5
Building construction Duration 5
hours = one day



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EARTH BUILDING SAMPLE

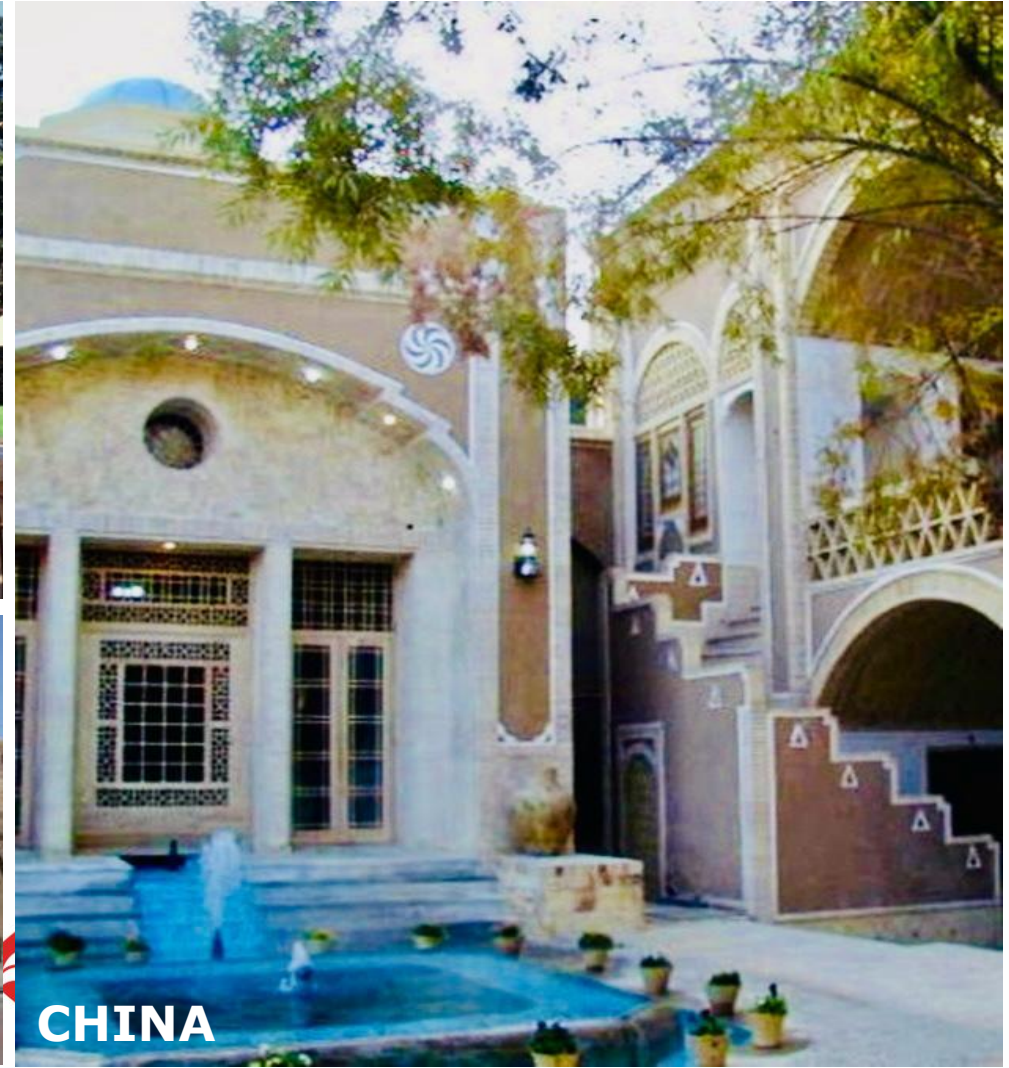
1995 - USA, NAPA Valley Villa

1995 – Australia, Villa



EARTH BUILDING SAMPLE

CHINA
USA – NAPA Valley
MEXICA
IRAN



EARTH BUILDING SAMPLE



**HOSPITAL • ENTEBBE,
UGANDA**
Architects: Renzo Piano
Building
Area : 9695 m² Year : 2020



RASI
VERSİTESİ

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EARTH BUILDING SAMPLE



2022

Perma Doğa Anaokulu, Bahçeşehir



-kerpiç atölyemiz olacak.

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