

World Housing Encyclopedia

A Resource on Construction in Earthquake Regions



an initiative of
Earthquake Engineering Research Institute (EERI) and
International Association for Earthquake Engineering (IAEE)

HOUSING REPORT

Houses with mud walls and thatch roofs

Report#	42
Last Updated	
Country	Kyrgyzstan
Author(s)	Svetlana Uranova, Ulugbek T. Begaliev ,
Reviewers	Svetlana N. Brzev,

Important

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participant's organizations.

General Information

Building Type:	Houses with mud walls and thatch roofs
Country:	Kyrgyzstan
Author(s):	Svetlana Uranova Ulugbek T. Begaliev
Last Updated:	
Regions Where Found:	Buildings of this construction type can be found in all regions of Kyrgyzstan. This type of housing construction is commonly found in both rural and urban areas.
Summary:	<p>This building type is widespread in the rural areas of Kyrgyzstan, and also in some urban areas. It is nonengineered construction. Due to its low cost, it is mainly used by poor people. Various building materials are used for this type of construction e.g. clay and straw for walls, wood for the roof structure, and stone for the foundations. In order to achieve adequate flexibility or plasticity, a small amount of clay is mixed with water. Straw is added to achieve an improved consistency. Small panel boards are used as formwork for casting mud walls. The walls are cast in lifts - a new lift is cast after the previous one has set. Windows and doors have wood lintels. Floors are made out of wood planks. Buildings of this type do not have any earthquake-resistant features and are considered to be highly vulnerable to seismic effects.</p>
Length of time practiced:	101-200 years
Still Practiced:	Yes
In practice as of:	
Building Occupancy:	Single dwelling
Typical number of stories:	1
Terrain-Flat:	Typically
Terrain-Sloped:	Typically
Comments:	

Features

Plan Shape	Rectangular, solid
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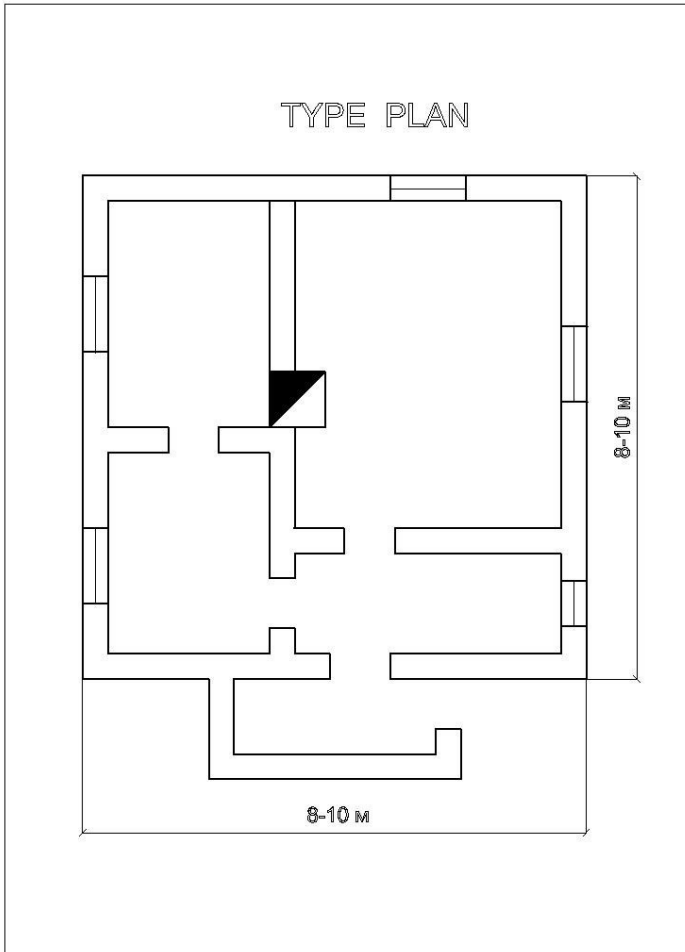
Additional comments on plan shape	Typical shape of a building plan for this housing type is rectangular.
Typical plan length (meters)	10
Typical plan width (meters)	10
Typical story height (meters)	3
Type of Structural System	Masonry: Earthen/Mud/Adobe/Rammed Earth Walls: Mud walls
Additional comments on structural system	Lateral load-resisting system: Lateral load-resisting system for buildings of this type consist of clay walls and wood roof and floor structures. Gravity load-bearing system: The gravity load-bearing structure consists of the same elements as lateral load-resisting structure..
Gravity load-bearing & lateral load-resisting systems	There are several subtypes related to this structural system: adobe block walls, cast-in-place mud walls, and cast-in-place mud walls with timber elements (sinch).
Typical wall densities in direction 1	5-10%
Typical wall densities in direction 2	5-10%
Additional comments on typical wall densities	Total wall area/plan area is 0.2. Wall density in each principal direction is on the order of 8-10%.
Wall Openings	Typical size of windows: 1.2m (height) X 1-1.2 m (width), doors: 2m (height) X 1m (width). There are 5-6 windows in a building. Overall window and door areas account for around 12-15% of the overall wall surface area.
Is it typical for buildings of this type to have common walls with adjacent buildings?	No
Modifications of buildings	There are lots of modifications to buildings of this type. The modifications are more common in urban than in rural areas. Typical modifications include installation of new door openings, deleting the existing window openings and expansion (addition of rooms).
Type of Foundation	Shallow Foundation: Rubble stone, fieldstone strip footing
Additional comments on foundation	
Type of Floor System	Other floor system
Additional comments on floor system	
Type of Roof System	Roof system, other

Additional comments on roof system

Timber: wood shingle roof

Additional comments section 2

When separated from adjacent buildings, the typical distance from a neighboring building is 10 meters.



Plan of a Typical Building

Building Materials and Construction Process

Description of Building Materials

Structural Element	Building Material (s)	Comment (s)
Wall/Frame	Wall: Clay	
Foundations	Stone	
Floors	Wood	
Roof	Wood	
Other		

Design Process

Who is involved with the design process?	Owner
Roles of those involved in the design process	Buildings of this type are usually constructed by owners.
Expertise of those involved in the design process	Buildings are constructed by owners without any engineered building technique.

Construction Process

Who typically builds this construction type?	Owner
Roles of those involved in the building process	
Expertise of those involved in building process	Buildings of this type are constructed by unskilled persons.
Construction process and phasing	This building is typically constructed incrementally and is not designed for its final constructed size.
Construction issues	This construction type is very vulnerable to seismic effects. The construction is not performed according to the building code requirements- it is a nonengineered construction practice. However, it is a widely used construction due to its low cost, mainly by the poor sections of society.

Building Codes and Standards

Is this construction type address by codes/standards?	No
Applicable codes or standards	This is a traditional type of construction which had been practiced before the introduction of building codes. As this is a non-engineered construction, current building codes do not address this type of construction. The most recent code/standard addressing this construction type issued was Construction standards do not address this type of construction.
Process for building code enforcement	

Building Permits and Development Control Rules

Are building permits required?	No
Is this typically informal construction?	Yes

Is this construction typically authorized as per development control rules?	No
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Additional comments on building permits and development control rules	
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Building Maintenance and Condition

Typical problems associated with this type of construction	
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Who typically maintains buildings of this type?	Owner(s)
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Additional comments on maintenance and building condition	
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Construction Economics

Unit construction cost	Load-bearing structure only approximately 10-15 US\$/sq m
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Labor requirements	In order to construct one building of this type, 4-5 people need to work for 3-4 months.
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Additional comments section 3	This is a traditional type of construction which had been practiced before the introduction of building codes. As this is a non-engineered construction, current building codes do not address this type of construction.
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An Illustration of Key Seismic Features and/or Deficiencies



Illustration of Key Seismic Features

Socio-Economic Issues

Patterns of occupancy	Typically, one family per building.
Number of inhabitants in a typical building of this construction type during the day	<5
Number of inhabitants in a typical building of this construction type during the evening/night	5-10
Additional comments on number of inhabitants	
Economic level of inhabitants	Very low-income class (very poor)Low-income class (poor)
Additional comments on economic level of inhabitants	Ratio of housing unit price to annual income: 1:1 or better
Typical Source of Financing	Personal savings
Additional comments on financing	
Type of Ownership	Own outright
Additional comments on ownership	
Is earthquake insurance for this construction type typically available?	No
What does earthquake insurance typically cover/cost	
Are premium discounts or higher coverages available for seismically strengthened buildings or new buildings built to incorporate seismically resistant features?	No
Additional comments on premium discounts	
Additional comments section 4	

Earthquakes

Past Earthquakes in the country which affected buildings of this type

Year	Earthquake Epicenter
1992	Suusamir, Kyrgyz Republic
1986	Kairakuum, Kyrgyz Republic/Tajikistan border

Past Earthquakes

Damage patterns observed in past earthquakes for this construction type	Most buildings suffered damages to walls or total collapse.
Additional comments on earthquake damage patterns	Overall damage patterns observed in past earthquakes for this type of construction included damaged or collapsed walls due to in-plane and out-of-plane seismic effects and collapse of buildings.

Structural and Architectural Features for Seismic Resistance

The main reference publication used in developing the statements used in this table is FEMA 310 "Handbook for the Seismic Evaluation of Buildings-A Pre-standard", Federal Emergency Management Agency, Washington, D.C., 1998.

The total width of door and window openings in a wall is: For brick masonry construction in cement mortar : less than $\frac{1}{2}$ of the distance between the adjacent cross walls; For adobe masonry, stone masonry and brick masonry in mud mortar: less than $\frac{1}{3}$ of the distance between the adjacent cross walls; For precast concrete wall structures: less than $\frac{3}{4}$ of the length of a perimeter wall.

Structural/Architectural Feature	Statement	Seismic Resistance
Lateral load path	The structure contains a complete load path for seismic force effects from any horizontal direction that serves to transfer inertial forces from the building to the foundation.	FALSE
Building Configuration-Vertical	The building is regular with regards to the elevation. (Specify in 5.4.1)	FALSE
Building Configuration-Horizontal	The building is regular with regards to the plan. (Specify	FALSE

	in 5.4.2)	
Roof Construction	The roof diaphragm is considered to be rigid and it is expected that the roof structure will maintain its integrity, i.e. shape and form, during an earthquake of intensity expected in this area.	FALSE
Floor Construction	The floor diaphragm(s) are considered to be rigid and it is expected that the floor structure(s) will maintain its integrity during an earthquake of intensity expected in this area.	FALSE
Foundation Performance	There is no evidence of excessive foundation movement (e.g. settlement) that would affect the integrity or performance of the structure in an earthquake.	FALSE
Wall and Frame Structures-Redundancy	The number of lines of walls or frames in each principal direction is greater than or equal to 2.	TRUE
Wall Proportions	Height-to-thickness ratio of the shear walls at each floor level is: Less than 25 (concrete walls); Less than 30 (reinforced masonry walls); Less than 13 (unreinforced masonry walls);	TRUE
Foundation-Wall Connection	Vertical load-bearing elements (columns, walls) are attached to the foundations; concrete columns and walls are doveled into the foundation.	FALSE
Wall-Roof Connections	Exterior walls are anchored for out-of-plane seismic effects at each diaphragm level with metal anchors or straps.	FALSE
Wall Openings		TRUE

Quality of Building Materials	Quality of building materials is considered to be adequate per the requirements of national codes and standards (an estimate).	FALSE
Quality of Workmanship	Quality of workmanship (based on visual inspection of a few typical buildings) is considered to be good (per local construction standards).	FALSE
Maintenance	Buildings of this type are generally well maintained and there are no visible signs of deterioration of building elements (concrete, steel, timber).	FALSE

Building Irregularities

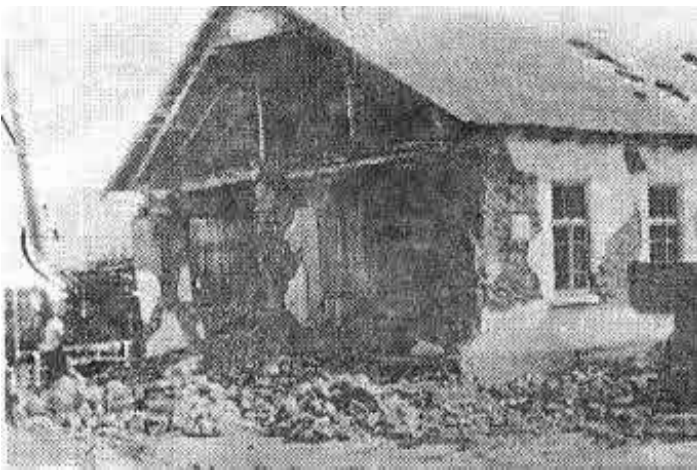
Additional comments on structural and architectural features for seismic resistance	
Vertical irregularities typically found in this construction type	Other
Horizontal irregularities typically found in this construction type	Other
Seismic deficiency in walls	Wall material (clay) is characterized with low compressive and shear strength.
Earthquake-resilient features in walls	
Seismic deficiency in frames	
Earthquake-resilient features in frame	
Seismic deficiency in roof and floors	Wood beams are not joined together in the horizontal diaphragm.
Earthquake resilient features in roof and floors	
Seismic deficiency in foundation	

Earthquake-resilient features in foundation

Seismic Vulnerability Rating

For information about how seismic vulnerability ratings were selected see the [Seismic Vulnerability Guidelines](#)

	High vulnerability		Medium vulnerability		Low vulnerability	
	A	B	C	D	E	F
Seismic vulnerability class	o					



A Photograph Illustrating Typical Earthquake Damage

Retrofit Information

Description of Seismic Strengthening Provisions

Structural Deficiency	Seismic Strengthening

Additional comments on seismic strengthening provisions

Seismic strengthening is not economically feasible. It is more cost-effective to reconstruct buildings of this type rather than strengthen them to resist earthquake effects.

Has seismic strengthening described in the above table been performed?

Was the work done as a mitigation effort on an undamaged building or as a repair following earthquake damages?	
Was the construction inspected in the same manner as new construction?	
Who performed the construction: a contractor or owner/user? Was an architect or engineer involved?	
What has been the performance of retrofitted buildings of this type in subsequent earthquakes?	
Additional comments section 6	

References

Seismic Hazard and Buildings Vulnerability in Post-Soviet Central Asia Republics. Edited by Stephanie A. King, Vitaly I. Khalturin and Brian E. Tucker. Kluwer Academic Publishers, P.O. Box 17, 3300 AA Dordrecht, The Netherlands. (Proceeding of the NATO Advanced Research Workshop on Earthquake Risk Management Strategies for Post-Soviet Central Asian Republics. Almaty, Kazakhstan, 22-25 October 1996)

Building and Construction Design in Seismic Regions. Handbook. Uranova S.K., Imanbekov S.T. #KyrgyzNIIPStroitelstva, Building Ministry Kyrgyz Republic. Bishkek. 1996.

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