

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 Reinforced Masonry (Series 1A-450)

Report#	204
Last Updated	
Country	ARMENIA
Author(s)	
Reviewers	

Important

This encyclopedia contains information contributed by various earthquake engineering professionals around the world. All opinions, findings, conclusions & recommendations expressed herein are those of the various participants, and do not necessarily reflect the views of the Earthquake Engineering Research Institute, the International Association for Earthquake Engineering, the Engineering Information Foundation, John

General Information

Building Type:	Reinforced Masonry (Series 1A-450)
Country:	ARMENIA
Author(s):	
Last Updated:	
Regions Where Found:	This building typology can be found in all major in Armenia. Roughly estimated, around 15% of the multi-apartment building stock of the country consist of this typology.
Summary:	Stone buildings, mydis type wall. Thickness is 50cm with cement mortat, Precast concrete void slab. Seismic pands are provided around the floor slabs. Vertical reinforcement of RC members were provided for the walls. Multi-apartment buildings with 4-5 storeys, constructed at the beginning of the 1970s until 1988.
Length of time practiced:	25-60 years
Still Practiced:	Off
In practice as of:	
Building Occupancy:	Residential, 20-49 units Residential, 50+ units
Typical number of stories:	Off
Terrain-Flat:	Off
Terrain-Sloped:	4-5
Comments:	Construction type typically on both flat and sloped (hilly) terrains.

Features

Plan Shape	Rectangular, solid
Additional comments on plan shape	11
Typical plan length	2-7

(meters)	4.7
Typical plan width (meters)	35-50
Typical story height (meters)	
Type of Structural System	Masonry: Reinforced Masonry: Stone masonry in cement mortar Masonry: Reinforced Masonry: Concrete block masonry in cement mortar
Additional comments on structural system	>20%
Gravity load-bearing & lateral load-resisting systems	The typical wall density usually exceeds 20% (total wall area / plan area). Usually, this type of construction does not have common walls with adjacent buildings.
Typical wall densities in direction 1	
Typical wall densities in direction 2	>20%
Additional comments on typical wall densities	
Wall Openings	
Is it typical for buildings of this type to have common walls with adjacent buildings?	Off
Modifications of buildings	
Type of Foundation	Other Foundation
Additional comments on foundation	Belt foundation
Type of Floor System	Cast-in-place beamless reinforced concrete floor Precast concrete floor with reinforced concrete topping
Additional comments on floor system	
Type of Roof System	Cast-in-place beamless reinforced concrete roof Precast concrete roof with reinforced concrete topping Roof system, other
Additional comments on roof system	

**Additional comments
section 2**

Infill wall material

Building Materials and Construction Process

Description of Building Materials

Structural Element	Building Material (s)	Comment (s)
Wall/Frame		
Foundations		
Floors		
Roof		
Other		

Design Process

Who is involved with the design process?	Engineers are involved in the design process.
Roles of those involved in the design process	Engineer
Expertise of those involved in the design process	

Construction Process

Who typically builds this construction type?	Builder
Roles of those involved in the building process	
Expertise of those involved in building process	The construction is carried out by builders. Code Provisions had been followed in the construction process.
Construction process and phasing	
Construction issues	Off

Building Codes and Standards

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Is this construction type address by codes/standards?	The current standard is the Seismic Code of the Republic of Armenia CHPA II-2.02-94, which includes updates on SNIP 62, used for construction in all former Soviet Union countries.
Applicable codes or standards	
Process for building code enforcement	

Building Permits and Development Control Rules

Are building permits required?	Off
Is this typically informal construction?	No
Is this construction typically authorized as per development control rules?	Off
Additional comments on building permits and development control rules	

Building Maintenance and Condition

Typical problems associated with this type of construction	Construction is typically formal (with permits, plans, etc.) and authorized as per development control rules.
Who typically maintains buildings of this type?	Owner(s)
Additional comments on maintenance and building condition	

Construction Economics

Unit construction cost	The owner, if interested, is the one who maintains the building.
Labor requirements	
Additional comments section 3	

Socio-Economic Issues

Patterns of occupancy	>20
Number of inhabitants in a typical building of this construction type during the day	
Number of inhabitants in a typical building of this construction type during the evening/night	
Additional comments on number of inhabitants	>20
Economic level of inhabitants	Very low-income class (very poor)Low-income class (poor)Middle-income class
Additional comments on economic level of inhabitants	Other
Typical Source of Financing	
Additional comments on financing	Other
Type of Ownership	Off
Additional comments on ownership	
Is earthquake insurance for this construction type typically available?	
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?	Off
Additional comments on premium discounts	

**Additional comments
section 4**

Earthquakes

Past Earthquakes in the country which affected buildings of this type

Year	Earthquake Epicenter
1988	Spitak, Armenia

Past Earthquakes

Damage patterns observed in past earthquakes for this construction type	The 1988 Earthquake with epicenter in Spitak, Armenia (Mw 6.9) affected buildings of this construction typology. These constructions were heavily damaged. It has been evaluated that damages were potentially caused by the design and construction quality. As far as the construction quality was not adequate, especially reinforced-concrete portion for stone walls and the ductility was not provided as expected. Unification between pre-cast floor slabs and stone walls were not enough to transfer the seismic loads of floors to bearing walls.
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**Additional comments on
earthquake damage
patterns**

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 1/2 of the distance between the adjacent cross walls; For adobe masonry, stone masonry and brick masonry in mud mortar: less than 1/3 of the distance between the adjacent cross walls; For precast concrete wall structures: less than 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.	N/A
Building Configuration-Vertical	The building is regular with regards to the elevation. (Specify in 5.4.1)	N/A
Building Configuration-Horizontal	The building is regular with regards to the plan. (Specify in 5.4.2)	N/A
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.	N/A
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.	N/A
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.	N/A
Wall and Frame Structures-Redundancy	The number of lines of walls or frames in each principal direction is greater than or equal to 2.	N/A
Wall Proportions	Height-to-thickness ratio of the shear walls at	N/A

each floor level is: Less than 25 (concrete walls); Less than 30 (reinforced masonry walls); Less than 13 (unreinforced masonry walls);

Foundation-Wall Connection	Vertical load-bearing elements (columns, walls) are attached to the foundations; concrete columns and walls are doveled into the foundation.	N/A
Wall-Roof Connections	Exterior walls are anchored for out-of-plane seismic effects at each diaphragm level with metal anchors or straps.	N/A
Wall Openings		N/A
Quality of Building Materials	Quality of building materials is considered to be adequate per the requirements of national codes and standards (an estimate).	N/A
Quality of Workmanship	Quality of workmanship (based on visual inspection of a few typical buildings) is considered to be good (per local construction standards).	N/A
Maintenance	Buildings of this type are generally well maintained and there are no visible signs of deterioration of building elements (concrete, steel, timber).	N/A

Building Irregularities

Additional comments on structural and architectural features for seismic resistance	
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Vertical irregularities typically found in this construction type	Other
Horizontal irregularities typically found in this construction type	Other
Seismic deficiency in walls	
Earthquake-resilient features in walls	
Seismic deficiency in frames	
Earthquake-resilient features in frame	
Seismic deficiency in roof and floors	
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	0					

Retrofit Information

Description of Seismic Strengthening Provisions

Structural Deficiency	Seismic Strengthening

Additional comments on seismic strengthening provisions	
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

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