World Housing Encyclopedia

A Resource on Construction in Earthquake Regions

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

HOUSING REPORT

PC Large Panel Building (Large panel series 1-451LP)

Report#	203
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

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General Information

Building Type:	PC Large Panel Building (Large panel series 1-451LP)
Country:	Armenia
Author(s):	
Last Updated:	
Regions Where Found:	All big cities in Armenia. About 10% of Armenia's multi-apartment building stock are made of this construction typology.
Summary:	This construction typology consists of "large panels" which are precast RC wall elements. There are three types of the 9-storey buildings, either with square or rectangular plan shapes. In addition, 4- and 5-story buildings can also be found. Construction of these buildings started in the 1970s until now.
Length of time practiced:	25-60 years
Still Practiced:	Off
In practice as of:	
Building Occupancy:	Residential, 20-49 unitsResidential, 50+ units
Typical number of stories:	3-5
Terrain-Flat:	Off
Terrain-Sloped:	Off
Comments:	Construction type typically on flat terrain and occasionally on sloped (hilly) terrain.

Features

Plan Shape	Square, solidRectangular, solid
Additional comments on plan shape	
Typical plan length	

(meters)	
Typical plan width (meters)	
Typical story height (meters)	
Type of Structural System	Structural Concrete: Precast Concrete: Large panel precast walls
Additional comments on structural system	
Gravity load-bearing & lateral load-resisting systems	The typical wall densities usually exceed 20% (total wall area / plan area). Usually, buildings of this construction type do not have common walls with adjacent buildings.
Typical wall densities in direction 1	>20%
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	
Type of Floor System	Other floor system
Additional comments on floor system	
Type of Roof System	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?	Owner
Roles of those involved in the design process	
Expertise of those involved in the design process	

Construction Process

Who typically builds this construction type?	Other
Roles of those involved in the building process	
Expertise of those involved in building process	
Construction process and phasing	
Construction issues	

Building Codes and Standards

Is this construction type address by codes/standards?	Yes
	Engineers are involved in the design process; the

Applicable codes or standards	construction is carried out by builders.SNIP 62, used for construction in all countries under the former Soviet Union, modified in 1984 and the current Seismic Code of the Republic of Armenia CHPA II-2.02-94.
Process for building code enforcement	

Building Permits and Development Control Rules

Are building permits required?	Off
Is this typically informal construction?	Off
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	
Who typically maintains buildings of this type?	Other
Additional comments on maintenance and building condition	

Construction Economics

Unit construction cost	Code provisions are followed in the construction process. Construction is typically formal (with permits, plans, etc) and authorized as per development control rules.The owner, if interested, is the one who maintains the building.
Labor requirements	
Additional comments section 3	

Socio-Economic Issues

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

Past Earthquakes

Damage patterns observed in past earthquakes for this construction type	The 1988 Earthquake with epicenter in Spitak, Armenia (Mw 6.9) affected this type of constructions.These buildings performed well during the 1988 Spitak earthquake. Only slight damages, mainly minor cracking at some panel joints, were reported.
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 ½ 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	N/A

	transfer inertial forces from the building to the foundation.	
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 each floor level is: Less than 25 (concrete walls); Less than 30 (reinforced masonry walls); Less than 13 (unreinforced masonry walls);	N/A

Foundation-Wall Connection	Vertical load-bearing elements (columns, walls) are attached to the foundations; concrete columns and walls are doweled 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

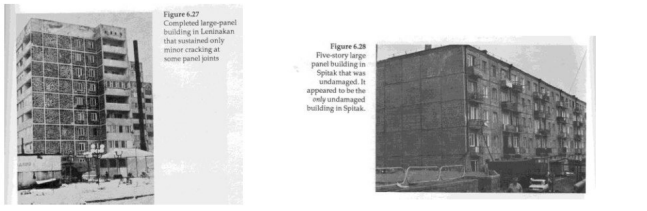
Additional comments on structural and architectural features for seismic resistance	
Vertical irregularities typically found in this construction type	Other
Horizontal irregularities typically found in this	Other

construction type	
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				o		



a) 9-story with minor damage at Gyumri b) 5-story with minor damage at Spitak

Figure 5.3-16 'Large panel' at the Spitak earthquake (ref.1)

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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