# 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

**Wood panel wall buildings (typical seria 181-115-77cm of #Giprolesprom#)**

| | |
|---|---|
| **Report#** | 57 |
| **Last Updated** | |
| **Country** | Russia |
| **Author(s)** | Mark Klyachko, Andrey Benin, Janna Bagdanova, |
| **Reviewers** | Svetlana Uranova, |

### 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 A, Martin & Associates, Inc. or the

participant’s organizations.

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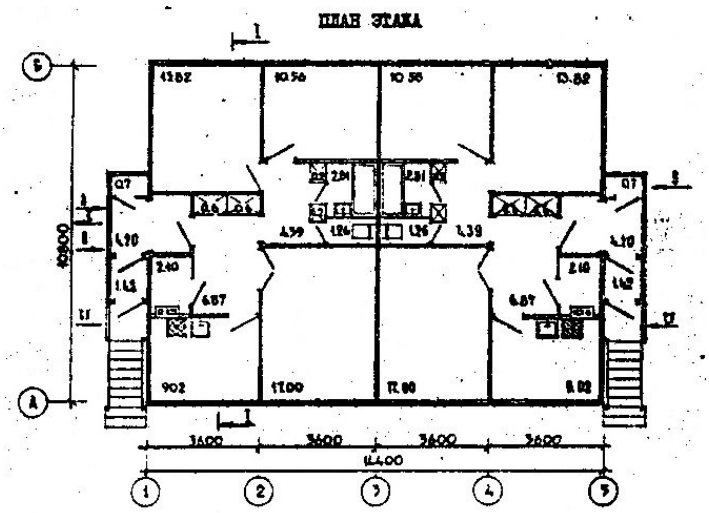
## General Information

| | |
|---|---|
| **Building Type:** | Wood panel wall buildings (typical seria 181-115-77cm of #Giprolesprom#) |
| **Country:** | Russia |
| **Author(s):** | Mark Klyachko<br>Andrey Benin<br>Janna Bagdanova |
| **Last Updated:** | |
| **Regions Where Found:** | Buildings of this construction type can be found in several seismically prone areas of Russia (including Far East, Siberia, Baikal Lake Region) where this construction accounts for 5 to 100% of the housing stock. This type of housing construction is commonly found in rural areas. |
| **Summary:** | This is a rural housing construction practice widespread in the Russian forest areas. Buildings of this type are common in seismically prone areas of Russia (Far East, Siberia, Baikal Lake Region). The load-bearing structure is made of wood panel walls. Buildings have timber roof and fieldstone or concrete strip foundations. Typical seria 181-115-77 cm of #Giprolesprom# for seismic regions is an example of this building type. Seismic resistance is relatively high, provided the quality of materials and the construction are satisfactory. |
| **Length of time practiced:** | 76-100 years |
| **Still Practiced:** | Yes |
| **In practice as of:** | |
| **Building Occupancy:** | Residential, 2 units |
| **Typical number of stories:** | 1 |
| **Terrain-Flat:** | Typically |
| **Terrain-Sloped:** | 3 |
| **Comments:** | |

## Features

| | |
|---|---|
| **Plan Shape** | Rectangular, solid |

| | |
|---|---|
| **Additional comments on plan shape** | |
| **Typical plan length (meters)** | 14.4 |
| **Typical plan width (meters)** | 10.8 |
| **Typical story height (meters)** | 2.7 |
| **Type of Structural System** | Wooden Structure: Load-bearing Timber Frame: Wooden panel walls |
| **Additional comments on structural system** | Wood panel walls. |
| **Gravity load-bearing & lateral load-resisting systems** | |
| **Typical wall densities in direction 1** | 10-15% |
| **Typical wall densities in direction 2** | 10-15% |
| **Additional comments on typical wall densities** | The typical structural wall density is 8-12%. |
| **Wall Openings** | Windows: 10-15%; Doors: 5-8%. |
| **Is it typical for buildings of this type to have common walls with adjacent buildings?** | No |
| **Modifications of buildings** | Modifications in buildings of this type are not common. |
| **Type of Foundation** | Shallow Foundation: Rubble stone, fieldstone strip footingShallow Foundation: Reinforced concrete 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** | Wood planks or beams supporting natural stones slates; Wood planks or beams that support slate, metal, asbestos-cement or plastic corrugated sheets or tiles |
| **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 | wooden (larch) panels | 500-800kg/cm.sq. |
| Foundations | concrete | 10 MPa (cube compressive strength) |
| Floors | wooden (larch) beam | 800kg/cm.sq. |
| Roof | wooden (larch) beam | 800kg/cm.sq. |
| Other | | |

### Design Process

| | |
|---|---|
| **Who is involved with the design process?** | EngineerArchitect |
| **Roles of those involved in the design process** | The design is carried out by Professional Engineers and Architects. |
| **Expertise of those involved in the design process** | Expertise for design of buildings of this type was available, including the construction quality procedure developed by the author of this contribution. |

### Construction Process

| | |
|---|---|
| **Who typically builds this construction type?** | Contractor |
| **Roles of those involved in the** | Typically contractor builds construction of this type |

| | |
|---|---|
| **building process** | Typically contractor builds construction of this type. |
| **Expertise of those involved in building process** | |
| **Construction process and phasing** | Wood panels are fabricated in the workshop. For building assembly, in addition to the carpentry tools, auto-cranes and concrete mixers are also required. The construction of this type of housing takes place in a single phase. Typically, the building is originally designed for its final constructed size. |
| **Construction issues** | |

## Building Codes and Standards

| | |
|---|---|
| **Is this construction type address by codes/standards?** | Yes |
| **Applicable codes or standards** | Seria 181-115-77cm according to the Building Catalog of Typical Housing Projects, Vol.1, Part 2, Div.1, Seria 115, #15, 1984; SNiP II-7-81. Building in Seismic Regions-Design Code. The most recent code/standard addressing this construction type issued was 1981. |
| **Process for building code enforcement** | The process consists of issuing permits for the design & construction, including the architectural permits and urban planning/municipal permits. Designers need to have licence to practice and are responsible to follow the building codes. Building inspection is performed and the permit is issued. |

## Building Permits and Development Control Rules

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

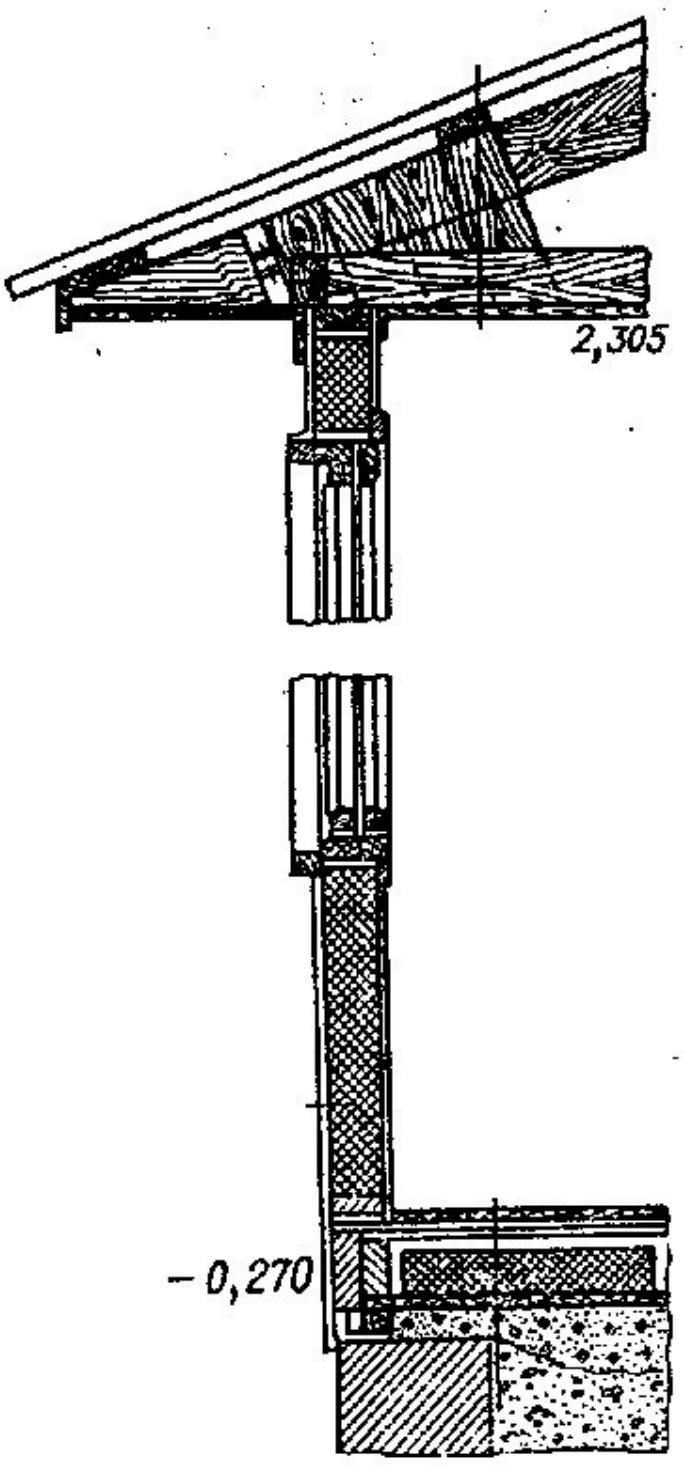
## Building Maintenance and Condition

| | |
|---|---|
| **Typical problems associated with this type of construction** | - Fire-resistance; - Inadequate quality of (roof and wall) panels, joints and construction in general. |
| **Who typically maintains buildings of this type?** | Owner(s) |

| | |
|---|---|
| **Additional comments on maintenance and building condition** | The maintenance is performed either by the owner (city) or (periodically) by a contractor # a maintenance firm. |

## Construction Economics

| | |
|---|---|
| **Unit construction cost** | 160 rub /m.sq. (50-100 $US/m.sq.)- per the official rate. |
| **Labor requirements** | 376 person-hours/building |
| **Additional comments section 3** | |




***Critical Structural Details - Vertical Sections Through the Wall***

## Socio-Economic Issues

| | |
|---|---|
| **Patterns of occupancy** | One family per unit (apartment). Each building typically has 2 housing unit(s). |
| **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** | Government-owned housing |
| **Additional comments on financing** | |
| **Type of Ownership** | Own outrightLong-term leaseOther |
| **Additional comments on ownership** | Own outright (applies to a housing unit), Long-term lease (typical). |
| **Is earthquake insurance for this construction type typically available?** | Yes |
| **What does earthquake insurance typically cover/cost** | The insurance is available as a part of the usual property insurance. The Insurance covers about 3-5% of the total estimated property value. |
| **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** | The insurance is available as a part of the usual property insurance. |

## 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** | Performance of this type of construction under destructive earthquakes has not been reported as yet. |
| **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 transfer inertial forces from the building to the foundation. | TRUE |
| Building Configuration-Vertical | The building is regular with regards to the elevation. (Specify in 5.4.1) | TRUE |
| Building Configuration-Horizontal | The building is regular with regards to the plan. (Specify in 5.4.2) | TRUE |
| 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. | TRUE |

| | | |
|---|---|---|
| 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. | TRUE |
| 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); | 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. | FALSE |
| Wall-Roof Connections | Exterior walls are anchored for out-of-plane seismic effects at each diaphragm level with metal anchors or straps. | TRUE |
| 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). | TRUE |
| Quality of Workmanship | Quality of workmanship (based on visual inspection of a few typical buildings) is considered to be good (per | FALSE |

| | | |
|---|---|---|
| | local construction standards). | |
| 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** | Inadequate wood panel connections. |
| **Earthquake-resilient features in walls** | |
| **Seismic deficiency in frames** | |
| **Earthquake-resilient features in frame** | |
| **Seismic deficiency in roof and floors** | Inadequate quality of roof#to-ceiling or roof-to-tie beam joints |
| **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 | -\| | | |

## Retrofit Information

### Description of Seismic Strengthening Provisions

| Structural Deficiency | Seismic Strengthening |
|---|---|
| Wood panels | Strengthening of joints |
| | |
| | |
| | |
| | |

| | |
|---|---|
| **Additional comments on seismic strengthening provisions** | |
| **Has seismic strengthening described in the above table been performed?** | No. In general, seismic strengthening of this construction is not considered feasible. |
| **Was the work done as a mitigation effort on an undamaged building or as a repair following earthquake damages?** | N/A |
| **Was the construction inspected in the same manner as new construction?** | N/A |
| **Who performed the construction: a contractor or owner/user? Was an architect or engineer involved?** | N/A |
| **What has been the performance of retrofitted buildings of this type in subsequent earthquakes?** | N/A |
| **Additional comments section 6** | |

## References

Manual on Certification of Buildings and Structures in the Seismic-Prone Areas, Second Edition CENDR, Petropavlovsk, Kamchatka, Russia 1990

Building Catalog of Typical Housing Projects, Vol.1, Part 2, Div.1, Seria 115, #15

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