Earthquake Resistant Design in Rural Area: Architectural Planning

Rajendra B. Koli* ,A. K. Sharma**& A. B. Kulkarni***

***Asst.Professor, Dept.of Architecture, D.Y.Patil College of Engg. &Tech.,K| Bavada,Kolhapur. **Reader, Seismology center, Physics Dept., Shivaji University, Kolhapur. ***Former HOD, Applied Mechanics Dept., Walchand College of Engg.**

ABSTRACT:

Majority of the houses in Rural Area are built by traditionally used materials & methods. To avoid & minimize the loss of human life & property in disasters, we have to apply technologically sound & Scientific methods. IS 13827-1993, IS 13828-1993 code for masonry construction & various updated research in Earthquake Resistant Design will help to achieve the goal of safer, strong & standardized built forms in Rural Area. "Architectural Planning" plays very vital role in all these systems, which involve life style, socio economic status, environment, building material & methods of local area. wisdom of tradition & experiences combined with scientific approach of Earthquake Resistant Design will give a better, sustainable built environment in Rural Area.

Keywords : Rural House- Architectural Planning- Life Style- Climate- Building Material & Techniques- Earthquake Resistance Design

INTRODUCTION:

"Rural Houses" has been always a tradition & experience based practice that has been passed down over the years by local craftsman. Years of experience & wisdom has taught these people the art of using the appropriate materials & methodologies, according to life style. Accordingly the building materials are mostly dictated by availability, cost effectiveness, comfort, less maintenance & ease of construction. As a result, constructions came up with many innovative materials & techniques which are best suited for the rural ethos.

The traditionally used building materials include earth, mud, burnt / unburnt bricks, granite, laterite, stones, timber, bamboo, thatch, grass, country tiles and Mangalore tiles. Many of these materials are used based on experience & have no technical backup. The design properties, strength of such materials are either not available or in the process of being researched. These materials are used most on the basis of common sense & experience, which may lead to unsafe buildings at one extreme or unnecessarily expensive building at the other. What needs to be done is a standardization of these materials & their properties & the design

procedures for earthquake resistance, so as to ensure safe, comfort & economical buildings in rural areas.

MATERIAL & METHODS

1. Site Selection :

In year 1967, Dec. 10th earthquake in Koyana (Region of Western Maharashtra), affected most of the rural residential area, Richter scale was 6.5 with epicenter at Koyananagar & 200 deaths & intensity VIII.

This region is Sahydri Ghat area & having entrance way to Kokan area of Maharashtra. Important Koyana Hydro – Electric project with its all infrastructure is very nearby. This area comes in Earthquake Zone No. III. I have taken site in this area for proposed, rural housing with earthquake resistance design. Seismology observatory located in Shivaji University Campus will help to record & study the data required for design.

2. Data for Design

Location – Site is located on Karad – Chiplun Road at Helwak, near Koyananagar Sahyadri hill Range.

Population – 3000

Occupation – Agriculture, on the banks of river koyana.

Climate – Hot – dry, cold in winter.

Temperature - Max. 35^0C Min. 13.5^0C

Rain Fall – Avg. 1500 mm.

Wind Direction – South West

Strata – Red – soil at surface ground. Hard strata - @ 1.5 m depth

Local Materials – Red soil, Bricks, stone, wood, bamboo, grass.

3. **Case Study** – To study the rural houses, first we have studied the life style of the people, climate & surrounding. To achieve the better solution for a house of this area, I have done several studies of different villages in Satara & Ratnagiri district. Namely

4. Madur (Tal. Shirala), Helwak, Kondawade (Tal. Patan), Gimbhawane, Dubalewade, Zagadewadi (Tal. Dapoli).

Housing typology differs on the following aspects –

1. Socio Economic status
2. Availability of local materials
3. Family size
3. Climate

4. Education & employment (Occupation)
5. Space availability

Study of above houses at different locations in the same area, which help us, to arrive at common solutions for house in rural area. After detailed study of all these case studies two (2) types of housing designs, which are very common in rural area are finalized for the project work.

4. Design of a typical Rural House

The first step is the functional design of the building. This is very peculiar to the rural community & is based on their socio – cultural characteristics & needs. Climates, topography, availability of materials are also other factors which plays important role in the designing stage.

Since privacy is not a prime thing in rural areas houses usually offer into living cum living cum bedroom. Good combination of indoor & outdoor spaces is done in planning, which reflects the vibrant activities, their interaction of rural life style. House is divided into two (2) parts front yard & back yard. The various detailed spaces in this are as follows –

a) Front Yard – Verandah, cattle shed, grain store, court yard, living room etc.

a) Back Yard – Kitchen, sanitary unit, washing are, cattle shed, fuel store, bed space etc. After detailed case study of life style of rural area following two (2) house types are designed.

RESULTS & DISSCUSSIONS

1. Farm Labours House –

This class normally works in the fields for farmers having enough land for cultivation. They are paid daily or monthly as the case may be. Normally

their prime income is from work in fields & cattle. Two (2) room unit having living cum bed space & small outdoor is verandah for different activities & back yard for cattle & bath room & space for cooking & store.

2. Farmers House –

This class is very common in all rural areas. They are having their own fields for agriculture & cattle for farming. Their prime income is from agriculture & milk & poultries. They require enough indoor space as well as large outdoor spaces for all activities related to agriculture.

Indoor Spaces –

1. Living space 2. Bed room 3. Kitchen
4. Grain stone 5. Cattle shed 5. Sanitary unit

Outdoor Spaces –

1. Verandah 2. Drying area 3. Storage for fuel & cattle feed
4. Water storage tank

Materials of construction –

Importance is given for group housing in cluster form, self – made with technical support & locally available materials. This will achieve homogeneity with environmentally & rural life style.

a. Foundation and Plinth – Stone Masonry with cement sand mortar.
b. Super Structure – Compressed earth blocks & mud mortar.
c. Roof – Mangalore tile roof or A. C. Sheet roofing
d. Doors & Windows – M. S. frame with wooden planks or plywood.
e. Flooring – Compressed earth with cement concrete coba.
f. Finishes – Internal – Mud plaster mixed with cow dung
External – Cement sand plaster

As most of the above material is locally & with proper technical support, self-help housing is possible on large scale. This will provide major employment to the local rural labor & houses form & design will be accepted widely as it is self-made & suits to their life style & local climate.

METHODOLOGY:

As materials selected for construction is of brick & stone, masonry construction with load bearing structure will be adopted. All structures will be of ground floor only & prime attention is given for light weight material. IS 13827-1993, IS 13828-1993 code for masonry construction will be used for design. Following features shall minimize the earthquake disaster.

1. Compact & simple form of a residence (Square or Rectangle)
2. Homogeneity of the material, with ductile characteristic.
3. Length of the wall should not exceed 6.0 m & height should not exceed 3.2 m
4. Lateral & vertical tiles (bands) with reinforcement at plinth, sill, lintel & roof level & all corners.

5. Door & window openings should be framed with RCC band.
6. Distance between two openings & from the edge of the wall should not be less than 600 mm.
7. Do not use too long projections at roof or lintel levels without adequate support.
8. Minimum depth of foundation in murum or rocky soil should not be less than 600 mm.
9. In black soil, use normal foundation for depth up to 1200mm to 2000 mm.
10. Trusses & rafters should be used with bearings in sloped & tiled roofs. Proper Anchorage at wall level with gable band.

IMPORTANT FEATURES OF ARCHITECTURAL PLANNING

Following features will provide a good living standard for houses in rural area with safety, security, good strength & easy maintenance. House designs are formed considering following needs of the rural area & involvement of users at all stages of development.

1. Rural life style
2. Climate & locally available building material
3. Self-buildable & easy maintenance
4. Spaces designed after requirement of day to day of rural people, group discussion.
5. Flexibility for expansion for future additions.

EATURES IN DETAIL

1. Life Style – As per life style of the rural areas, spaces like outdoor verandah, court yard, back yard, grain stone, cattle shed are provided in addition to living, bed & kitchen spaces.
2. Flexibility in Planning – Spaces is provided such that in future, addition can be possible to existing structure as per demands & increase I activity.
3. Spacious – Enough indoor-outdoor spaces are provided as per day to day activity & requirements. Good sized door & window openings, height of rooms & finishes, form spacious environment, Natural light & ventilation.
4. Cluster planning – As peoples in rural area prefer to live in a group as per their community & income group, cluster planning is done. This will provide adjacent common walls to each other, big central common open space, front & outdoor open spaces for individual houses common space for tree plantation, sanitary units, drinking water biogas plant & storage for cattle feeds, rain water storage.

5. Incremental area – Additional plinth space is provided for future extension to house as per demand. Incremental space with plinth will provide additional out door space for house extended activity like sit outs drying area, sleeping in summer storage for fuel etc.

6. Light & ventilation – Sufficient openings provided in the walls will provide good natural light & ventilation to all rooms. Cross ventilation can be achieved by placing opening across the wall, which will provide comfort zone, healthy environment & good breeze.

7. Building material – Building material used for house construction is locally available & manufactured on the site. This will provide employment to the local peoples. Construction is easy for maintenance and future extension, as of simple nature & economical. Most of the material used is environment friendly. Colour, texture & shape of the building material suits to rural life & provide attachment to the nature of people living in.

8. Climate – Local climate conditions are considered for house planning to provide natural light & ventilation & good comfort zone. Small size openings for doors & windows, high plinth. Thick walls & sloping roof provides comfort & safety in moderate climate & heavy rainfall.

9. Environment friendly – Use of local building materials, sloping roof with rain water harvesting system, bio-gas plant system for cattle waste & sanitary units combined together, smokeless chullah, common space for tree plantation, fire wood & cattle feedings, natural drinking water all together presents environment friendly group hosing. Use of renewable energy can also be done for cooking. Lighting water in the form of solar energy, wind energy & rain water storage.

10. Economy – As most of the material is locally available & self-made house construction greater reduction in the cost. As group housing & cluster planning common walls, common outdoor spaces for cattle sheds, cattle feeding & sanitary units will reduce construction cost. Sustainable & affordable construction technology for walls, roof, floor, doors & window & finishes will provide cost reduction. As most of the building material is manufactured & assembled on site, transportation cost is reduced. Use of local materials & finishes will achieve low maintenance cost.

CONCLUSION:

Self-supported community housing , father of nation Mahatma Gandhi's dream for rural area will come in reality in true sense, if we provide all above features in housing for rural area. Peoples do not have to depend upon any outside agency for their needs for drinking water, electricity, fuel & cattle feed & sanitation. Group housing will form

togetherness, responsibility, awareness about natural resources, education, health & increase co-operation between each-other. As most of the hosing is self-supported, they will not depend on government help. They can work together for small business like poultry, milk dairy, local handicrafts, food processing, house construction, hand looms etc. This will provide them employment, which will improve their living standard. These altogether will solve problems of pollution, employment, education, health, poverty, natural resources, drinking water & large scale migration to urban areas. All this will help to build a good & healthy India through Rural Housing Development.

REFRENCES:

1) Low Cost Housing Study – H.U. Bijlani, M.N. Joglekar , Y.K.Garg
Pg. no. 3,5,8,18,21
2) IS 13827 – (1993), IS 13828 (1993) For Masonry Building guidelines pg. no. 1- 10
3) Building in Rural areas – A Project Report by Aruna Siva Kumar- IIT, Madras,
Dept. of Civil Engg. (1999) Pg. No.-2, 3,100,101
4) Rural Housing & HUDCO's contribution Pg. No. 2, 3, 4
5) A Typical Settlement – A Bhunga Layout. Notes By Manav-Sadhana, Ahmedabad
6) Alternative Building Methods – Notes by ASTRA, IISC, Bangalore

ILLUSTRARTIONS

A farm labors house

A farmers House