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AFFORDABLE HOUSING AGAINST EARTHQUAKE IN INDIA

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Abstract - India has been facing natural disasters like drought, flood, cyclone, storm surge and earthquake every year in different parts of the country. These disasters cause large scale damages, destructions, death, injuries to human and animals. People are often constructed of non-engineered houses were damaged due to the lack of technical guidance and affordability. Disasters due to non-engineered housing development, and considering the level of damage to homes, it is a proper model, it is necessary to resist the forces of destruction.

In the field of earthquake engineering has been in our country for over 35 years now. Seismic protection of critical infrastructure in the country, many of the Indian earthquake engineers have made significant contributions. However, as the recent earthquakes during the past earthquakes in India is less satisfied with the performance of normal structures After that followed the earthquake resistant design of the special rules that need the most practice is due to the lack of awareness among engineers. This project is the construction of earthquake-resistant houses in the village using low-cost techniques described.

Key Words: Rural Housing, Earthquake Resistant Structures, Natural Disaster.

1. INTRODUCTION

1.1 GENERAL

India has been facing natural disasters like drought, flood, cyclone, storm surge and earthquake every year in different parts of the country. After that followed the earthquake resistant design of the special rules that need the most practice is due to the lack of awareness among engineers. This project is the construction of earthquake-resistant houses in the village using low-cost techniques described.

The most successful, long-term, low-income housing projects and residents to use sustainable design, social, cultural and economic needs of those which are available in plenty. Traditionally built low-income housing projects and high crime rates are associated with high mortality rates among people living in them. The problems they face today, many of these low-income housing projects, as a result, do not serve the needs of people.

The problems of human life endangerment, from the residents that bear high pressures psychological suffering, disease epidemics based and high society from the rejection (a derogatory public health system combined) overcrowding and unsanitary living conditions and the stigma of the traditional low-income housing projects generated. Sustainable, or "green" design of many healthy living environment, residents of low-bills, the common use of safe recreational areas, the project as a sense of community that will result in higher capacity utilization systems, including issues of housing projects are now today offers solutions well alone standard stuff live with the greater community , and the beautiful surroundings. You cannot get rid of the problems are building traditional houses, but people need to connect with the needs of the sustainable design elements. In the minds of the residents demand, developers, residents, and sustained by the community as a whole benefit by implementing low-income housing projects.

1.2 NEED FOR THE STUDY

India's population lives in small houses in the world and is often short of income and thus more prone to the effects of the Earth. Thus there will be more loss of life. There are many techniques to resist earthquakes, but they are expensive and usually the ordinary people, are not used. So, here are some useful low-cost techniques to combat the effects of the earthquake.

1.3 OBJECTIVE

The main objective of this work is a single storey building for a low income people residential has plan dimensions as given. We are assuming the building is located in seismic zone on a site with medium soil. According to the 1893 IS (Part 1) : 2002 seismic loads of the building design to RCC to carry out a seismic effect on the behavior of masonry infill walls.

1.3 TYPES OF NATURAL HAZARDS

The various types of natural hazards may be classified as follows

Atmospheric Hazards

Tropical cyclones, Stun surges, Extra tropical cyclones, Tornadoes / Thunderstorms, River floods, Droughts.

Geological Hazards

Earthquakes, Tsunamis, Volcanic eruptions, Landslides, Snow avalanches

Other Hazards

River erosion
Wildfires
Locust infestation

1.5 PROBLEMS ON RURAL HOUSING

For the majority of rural houses of mud, bamboo, such as tiles and thatches built with locally available materials. These products are durable due to heavy rains and the wind blows and does not get damaged. Roof eaves plans have also been damaged due to heavy wind speed.

During the cyclone pyramid shaped roofs hurricane formed Forces for improving the river of light roof structures are sufficient, "J" bolts and wind bracing absence and relationships shortages, inadequate sheet thickness, tightening and with sufficient frequency to contribute to the damaged generals and brick walls constructed damages, permanent housing also due excessive corrosion of steel structures affected.

Rusted to the concrete, eventually causes roof collapse. When compared to its symmetry about the axis of unsymmetrical showed heavy damage. Streets and houses, wind tunnel effects of the arrangements and decide the level of damage when disasters are factors.

There are unreinforced masonry walls could be due to excessive tension. Sometimes wooden timber seals and leads to losses in its category are destroyed and broken at the time of disasters. Roof tiles, doors and windows, latches,, hinges and bolts unscientific installation of hardware and connections are vulnerable during the disaster. Parapets and light weight of the roof on the verandah railings, footings for walls with high-speed winds are very susceptible to improper connections.

Wind in the side of the mountains, the valley, the ridges of the building, such as sitting on terrain conditions, is factors affecting the level of damage to the leeward side system.

1.6 SEISMIC WAVES

Reflecting the strain energy released during an earthquake and refracting each interface, as the seismic waves travel in all directions through the layers of the earth. There are two types of these waves - body waves and surface waves; The latter restricted to the vicinity of the Earth's surface. Body waves Primary waves (P-waves) and secondary waves (S-waves) contain, and Love waves and Rayleigh waves are surface waves. Under P-waves, material particles along the direction of energy transfer and compression strains undergo extensional, but SM under the waves, it oscillated at right angles. S- waves Love waves caused by movements similar to the surface, but no vertical component.

1.7 BASIC GEOGRAPHY AND TECTONIC FEATURES

India, Australia, the Indian Ocean and other small countries, which encompasses a large portion of the Indo-Australian plate is at the northwest end. The plate under the Eurasian Plate is colliding against the Eurasian Plate; This process of getting a tectonic plate under another called subduction. A sea, Tethys, separated these plates before they crashed. Lithosphere, Earth's crust part, the rest is covered by oceans and continents. Against another tray when it is coordinated, but the latter is a float, so it tends to be at or near the surface of the former can undergo subduction at great depths.

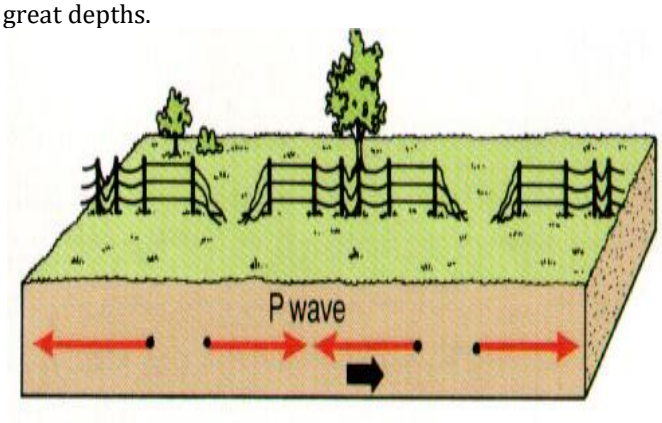

Figure 1.1 Arrival of Seismic Waves

When continents converge, shortening and thickening takes place at a high level like the Himalayas and Tibet. Head north along the three sub-regions of the Indian tectonic mighty Himalayas, the Ganges and other rivers, and in the peninsula are equal. Tethys Himalayas consist primarily of sediments accumulated in the long geological time.

Indo-Gangetic basin with deep alluvial soils occur on the continent, the Himalayas, the load is a big stress. Conflicts such as the Himalayan nation's peninsula are deformed ancient rocks. And land exposed to erosion removed most of the old roots of the mountains. Rocks will be very difficult, but in the near surface are softened by the climate. Himalayan before the collision, the tens of millions of years ago, leaving layers of volcanic basalt rock in the central part of peninsular India flowed throughout. Submergence under the sea millions of years ago, such as the coastal areas of Kachchh witness to marine deposits.

1.8 SEISMIC ZONES OF INDIA

Taking place in various parts of the country, damaging earthquakes in different places in different geographic implies different possibilities. Thus, these areas are identified in a seismic zone map is required. I, II, III, IV, and V (Figure 3) - the five zones based on the levels of damaging earthquakes occurred in the past, the 1970 edition subdivided zone. Modified Mercalli (MM), the maximum seismic intensity of the shaking expected in these regions, respectively, or less than V, VI, VII, VIII, and IX, and were

more likely. Kachchh region in the north and northeast and west of the Himalayan border areas classified as Zone V.

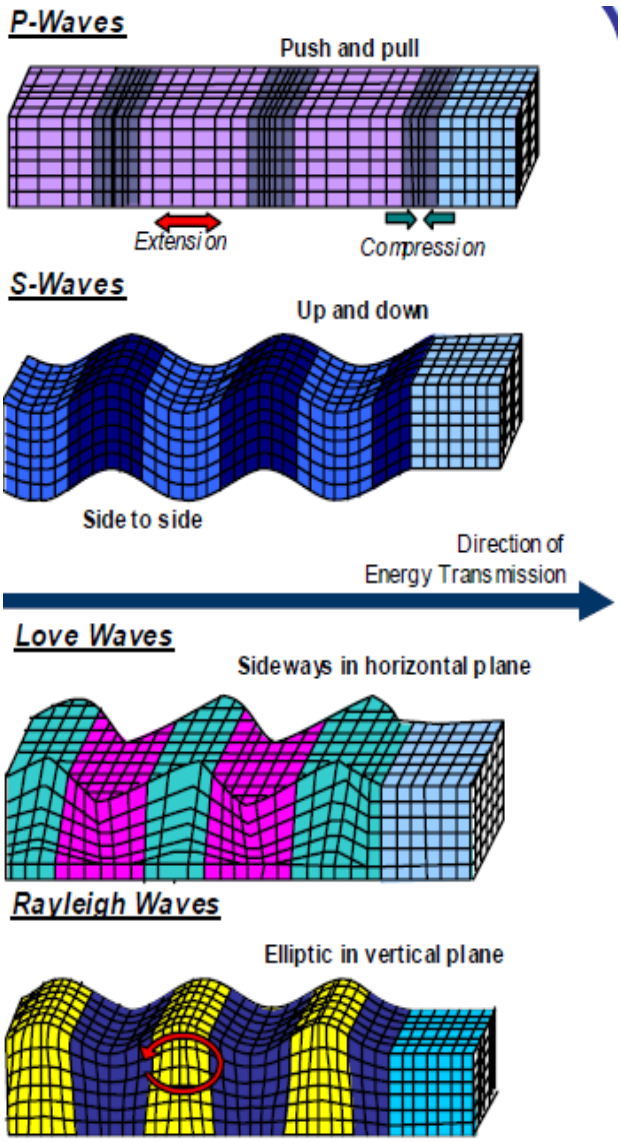

Figure 1.2 seismic waves

Standards in 1962, the first seismic zone map, and then in 1967, revised again in 1970. The map of 2002 (Figure 4) again, which are tickets for the presentation, it now only four seismic-risk areas - II, III, IV, and V map 1970 I fell down in the earthquake zone in the version of the merged seismic zone II. time. Indian Furthermore, the seismic zone map has been changed peninsula. In the 1970 edition of the map against the Madras zone II is in seismic zone III. This seismic zone map in 2002, the seismic hazard is not the final word in this regard so there can be no sense of complacency.

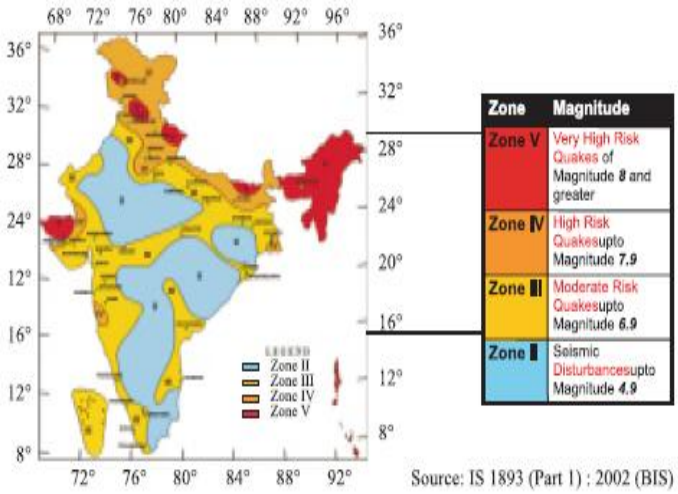

Figure 1.3 Seismic Zones of India

Interpreting them as geology, earthquake alakamaippuk and seismic activity in the country was on the seismic zone maps have been revised from time to time.

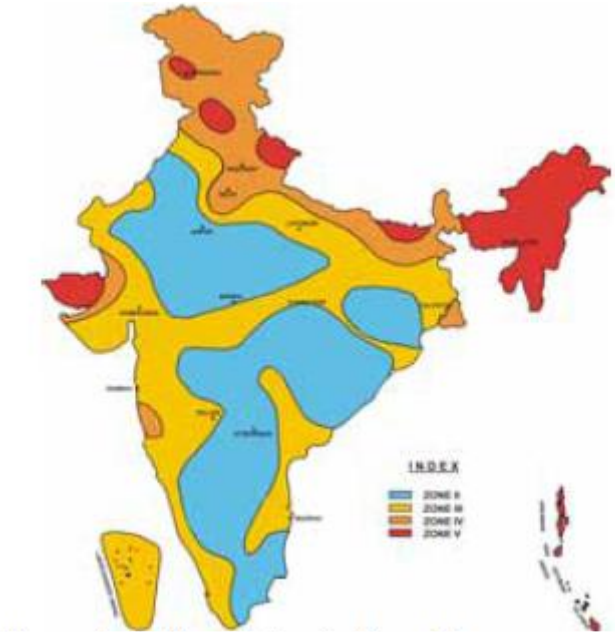

Figure 1.4 Seismic Zones of India as per the IS:1893 (Part I)-2002

1.9 PAST EARTHQUAKES IN INDIA

The number of significant earthquakes in the past century occurred in some people and urbanized areas and therefore caused major damage occurred around the country. Their deep under the earth's surface or relatively un There was a place and in residences such as the many, many went unnoticed . Himalayan plate boundary earthquakes (the inter-plate earthquakes) occurs along, but a number of

earthquakes occurred in the area of the peninsula (the intra-plate earthquakes.

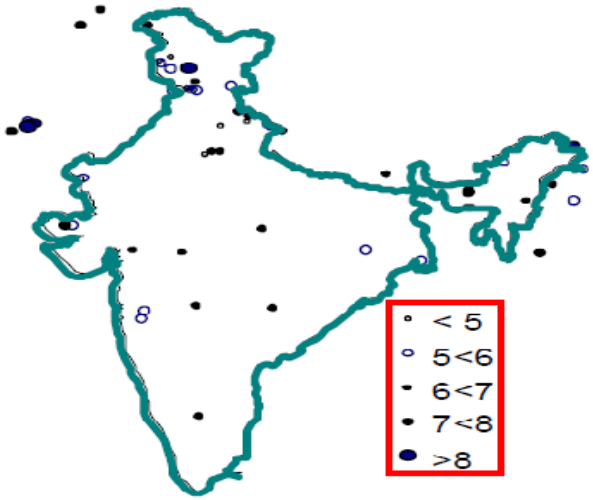

Figure 1.6 Past Earthquakes in India

Four large earthquakes (M> 8) from 1897 to 1950 was 53 years; January 2001 Bhuj earthquake (M7.7) is nearly as big. Each of these disasters, but also to learn about earthquakes and earthquake engineering have allowed to carry out. For example, in 1819 an unprecedented earthquake Cutch ~ 3M high ground over 100km Development (known as Allah Bund) produced. 1897 Assam earthquake of up to 500km cause serious damage to the radial distance; The type of damage I - XII I - led to improvements in scale from the X sustain concentration. Extensive liquefaction of the ground in which the ship visited several configurations Bihar 1934 - Nepal when Quake 300km in length (called Zone Slump) took over.

2.METHODOLOGY

2.1 INTRODUCTION

Organized activities in the field of earthquake engineering at the University of Roorkee (UOR) started at the end of the half. Indian code areas of the country after the first earthquake, earthquake engineers handled several prestigious and challenging projects in India since it was released in 1962, Bureau of Indian Standards. However, it is often an area of super specialty only be handled by researchers and professors of civil engineering in the country, on average, even today, the earthquake was felt that seems to engineering. Etir earthquake engineers in India to ensure that constructions with constructions that can withstand earthquakes themselves is the only appropriate when the earthquake - caused disaster mitigation, can be achieved.

A typical undergraduate engineering curriculum in the local civil defense does not include any of earthquake engineering; The situation is no different in the rest of the world. Even in the post-graduate level, only a small fraction of earthquake engineering and design construction engineering students a chance to study. This is when most engineers undergraduate or postgraduate studies not receiving the proper training can lead to earthquake engineering. A massive earthquake in the country such as ours, this problem needs to be fixed

Short-income people of the world are often lives in small houses, Thus more prone to the effects of the earthquake. Thus there will be more loss of life. There are many techniques to resist earthquakes, but they are expensive and usually the ordinary people, are not used. So, here are some useful low-cost techniques to combat the effects of the earthquake. Here we focus on.

2.2 ENGINEERED STRUCTURES

Ground shaking buildings designed and constructed to withstand a building by-laws want architectural and engineering inputs to improve building design and construction practices to be put together. Soil analysis should be done before the construction Building structures in soft soil should be avoided. Construction in soft soil earthquake on the Richter scale are more likely to get damaged if not stronger. Similar problems persist in buildings built on the banks of the river which will.

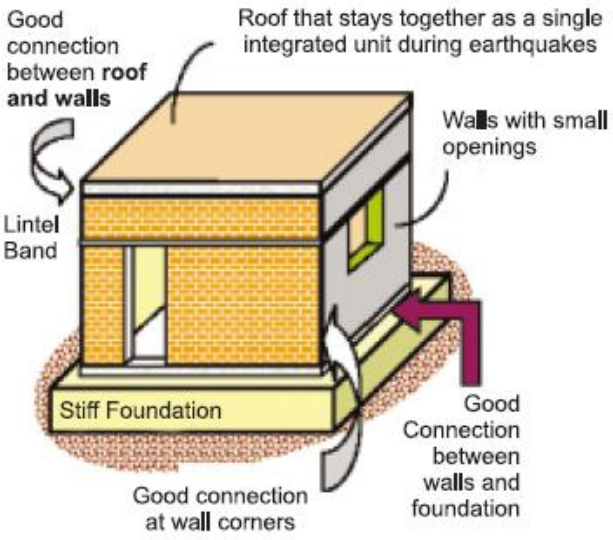

Figure 2.1 Essential Requirements in a Masonry Building

2.3 SOIL STABILIZED FOUNDATION

The building is built on the foundation upon which it depends primarily on the stability and thus the load bearing capacity of the foundation ground, and above all depends on the type of building. The low cost of construction, built in 1980 on the premises of the Institute of soil foundation stabilized using soil testing and demonstration rooms for both developed by the company and foundation are stabilized. The foundation from the ground level 26 to a depth "to be laid. The foundation, based on the maximum dry density of 90%, a density not give a mechanical compactor to remain embedded. Foundation 3% cement soil mixture in three equal layers in ground level up to the full maximum dry density up to 95%, reduced.

2.2.1 Hollow Foundation

The second kind of waves we all know and love the other earthquake waves are among the most destructible. And second waves of the water cannot pass through the media. Thus completely filled with water to a bare boat basis by reducing the effects of the earthquake could be some destructible. Some of it will be filled with viscous fluid, served as barrier to reduce the effects of the earthquake.

2.4 LOW COST EARTHQUAKE RESISTANT DESIGN

Seismic design of building, construction material that can withstand an earthquake of a certain type of material only a function of the resilience and strength, but how it is incorporated into construction. A long, straight stone wall, for example, to put in place the stones using only friction and geometry almost certainly be toppled by an earthquake. Mass, inertia, or the wall, its movement to the movement of the earth during an earthquake because it tends to keep lagging behind. This only begins to dislodge the stones from their initial resting position, but without the support of the lateral wall of the static load that starts to topple over can change the weight of the wall as far out of line.

However, a zigzag line is simply a change of course in a straight line from the wall to substantially improve its stability. Also, to improve the stability of S- transform curves straight zigzags. Interlocking grooves, cross-faces, and / or "L" posts incorporate the unique geometry of the stones on top of the platform adapts to greatly improve the integrity of the wall.

Every change in the route of the wall in a zigzag path and follow the work by providing lateral support for the building of the wall. One or more of the s - curves, ensuring almost continuous along the entire length of the lateral support. Adding weight to the wall without using a wall cap or lintel stones over the wall by binding them together helps ensure the integrity of the course. And so it goes in household structures.

Figure 2.2 Hollow Foundation

Although there is no such thing as absolutely earthquake-proof buildings, earthquake resistant construction is readily achievable. Without adequate relations between the walls in the roof of a rectangular shape, are often near the top of the walls to become unstable and topple or collapse, at least in the direction of lateral support. A more compact internal cross-walls, changing track square geometry to improve the stability. Adding a plate on top of the walls or the margin band location that helps ensure the integrity is maintained. Top plates and / or positive connection to the lightweight construction roof edges wall incorporating much more nearly continuous lateral walls provide support to improve the earthquake resistance of the building. In addition, if an appropriate basis for the relations are not enough, when an earthquake destroyed the foundation of the organization structure effective from sliding down is a good chance.

2.5 LOW COST SEISMIC REINFORCED MATERIALS

So far, all of the mentioned methods can be implemented at little or no extra cost, regardless of the specific materials used in construction. Other low-cost, subject to specific guidelines wood frame, adobe, rammed earth, shall be inserted, and masonry construction typically found in seismically active areas. For example, wood frame construction Quake enough brackets to hold, and using the right type of links are strengthened. For example, Beams, joints, corners, sill plates, shear walls and roof truss joints, brackets and gussets applications of this type are well-documented, consistent reinforcement techniques.

Due to their massive weight and fragile composition, Adobe rammed earth walls, cracks in the walls, especially the long corners by allowing larger pieces to fall or collapse of the system prone to seismic failure. The reinforcing fibers, bars, rods can be reduced by incorporating, or burst and put the pieces in place to reduce the mesh walls. The fibers can be straw, vines, and even synthetic fibers with an inner reinforcing material, a work team. Bars and rods, rope, flags, each in particular are useful and bamboo, reed, cane, vines, iron rods form, or hats, the foundations of the wall of any kind available ductile material, the space will be placed in

and can stay connected, and or rope. Purpose screen, chicken wire, etc. mesh reinforcement in the form of an earthquake, one of the walls of the building serving as distributing the horizontal forces, the corners will be especially useful. Square buttresses and greatly reduce the cost of the wall mass and can improve the resistance to lateral shaking. Finally, the apartment building when the earthquake resistance of structures designing avoiding increases with this stuff.

Hollow stone, brick, masonry walls of solid stone, and cast concrete panels, mainly due to local availability is a popular low-cost construction material. However, most of these products is subject to the stresses of vibration are likely to be incorporated as an abuse. Replacement intervals for hollow block construction inexpensively steel rebar, bamboo, rattan, or similar goods or compacted soil with a short stem and inserting the rod and then the motor can be reinforced by backfilling cavities.

Likewise cast concrete panels and blocks with rods and then tying the wires together during construction, can be reinforced at the time of manufacture. These products are used in all the corners and intersections of the wall of the L-shaped units, interlocking grooves must incorporate flat face geometry. Interestingly, some of the best historical evidence to oppose lateral displacement masonry blocks and stones, as opposed to horizontal bonding, cross points to the successful use of bonding.

2.6 DESIGN OF MODEL RURAL HOUSE

Social and economic situation in the country once the traditional format when designing structures, availability of labor and materials are considered to be developing an in-house design.

2.6.1 Plan Form

Simple square / rectangle plan has been adopted in the design. A square symmetrical and compact plan form is more stable than a zigzag plan, and is less prone to wind cyclone damages. The program is usually fabrics, attached to the rear side of the house stopped at the kitchen used for storing character, etc. But there is a door leading to the multi-purpose room, a seat out of the units provides an inviting entrance porch. A toilet in the back yard and the main house is now proposed.

2.6.2 Foundation

Strip footing with RC band of 100mm thick to the width of brick masonry is to be provided all along the portion and connected to the RC Band. 230mm x 75mm beam quality is provided at ground level and at the level offered by the Faculty of Design Faculty of the beam. Doors and windows jams vertical reinforcement corners (10mm Rod anchorage bars) are provided from the ground beam.

2.6.3 Walling

The exterior brick walls are provided with horizontal and vertical reinforcing bars connected with concrete band to resist the horizontal pressure and continuous lintel beam has been provided. The height of the building is considered to 3000mm.

2.6.4 Roofing

As per the discussion on the failure of buildings during the disasters, the suction on flat roof is much more than sloping roof and many of the roof structure are fail is due to their less weight and poor anchorage. The pyramidal or hipped roof having symmetrical slope on both areas are flat roof with more self weight are the appropriate solution for the roof. M20 grade concrete slab reinforced 100thick therefore recommended.

Table 2.1 Specification Details of Model Houses

Type	Foundation	Walling	Roofing
Model 1	Rectangular Foundation	English Bond wall	R.C.C. Slab

2.7 TECHNIQUES BANDS

Role of Horizontal Bands

Bands get the cluster of buildings is the most important feature etir earthquake. A bunch of bands together all the walls of the building by building to a unit issued, and provided around cardboard boxes are similar to a closed belt. Bands in building a common cluster of four types, namely band gable, roof, band, orchestra and faculty band are lintel. Lintel band is the most important of all, and almost all the buildings will be provided. Gable roofs of buildings have been used only in the band pitched or sloped. Brick or reinforced concrete buildings with flat roofs, roof slab roof orchestra plays the role of the band, because there is no demand.

However, the construction of flat wooden or CGI sheet roof, the roof must be provided by the band. Construction of pitched or sloped roof, the roof is very important for the band. Concerned about the uneven settlement of the soil foundation pads are used primarily when the plinth. Lintel of the band in the direction of one of the walls are loaded with strong ties and weak direction from the walls are mounted along the walls creates a support. The band also reduces the height of the walls of the destitute and thereby increased their weak direction. 1993 Latur earthquake (central India) when, Killari village MSK intensity of shaking It was on the ninth level. This band is a lintel in the village, and it was only

a bunch of building sustained no damage by shaking well.Killari village 1993 Latur earthquake (central India) - one horizontal lintel masonry house, without the band and the damage sustained by shaking.

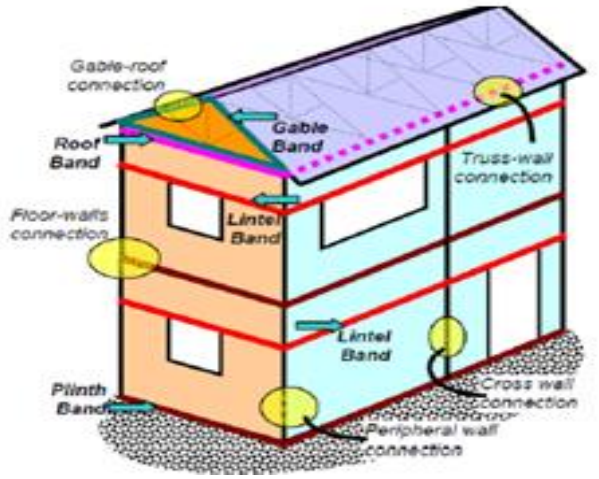

Figure 2.3 Horizontal Bands In masonry Building (Two storey with pitched roof)

2.7.1 Design of Lintel Bands

When earthquake shaking, lintel band undergoes bending and pulling operations. These actions against the lintel of the band requires special attention. Bands (including bamboo splits) or reinforced concrete (RC) made of wood; RC The best bands. The band length of the straight wall corners must be connected properly. Loaded in the direction of the band and their strong support for the walls are mounted on the walls, allowing their weak direction. Wood spacers (wooden strips) or stainless steel fasteners (RC pads) to the small length of wood in the second or the length of the straight steel bars used to act together. Wooden beams and a straight length spacers nailing important right. Similarly, RC Bands of steel with iron rods necessary for the adequate anchoring.

2.8 INDIAN STANDARDS

The Indian Standards IS: 4326-1993 and IS: 13828 (1993) provide sizes and details of the bands. When wooden bands are used, the cross-section of runners is to be at least 75mm×38mm and of spacers at least 50mm×30mm. RC Bands are used, the minimum thickness of 75mm, and 8mm diameter 150 mm centers at least twice at intervals of at least 6mm diameter steel bars throughout the building are needed.

3. METHOD OF ANALYSIS

The design, construction, and detailing of RCC buildings should be governed by the provision of Is 456; 2000, except for the modifications suggested by the provisions below and the sections to follow. To enable the elements of RCC structures to be detailed in a consistent and satisfactory manner for earthquake resistance, the following rules must be observed strictly. This information should be satisfactory in the medium and high seismic risk areas and low risk areas, relaxations may be made to the following requirements, but the principles of lapping, containment, and continuity must be retained if adequate ductility is to be obtained.

Cover

Cover to reinforcement is provided to develop the required bond strength and to protect the **reinforcement against corrosion.** When high strength deformed bars are used, especially greater than 36 mm, the development length (or bond strength) may be governed by the cover. Increased cover may have to be provided in case of members subjected to post earthquake forces. Minimum cover for reinforcement should comply with tables 16 and 16A of IS 456; 2000.

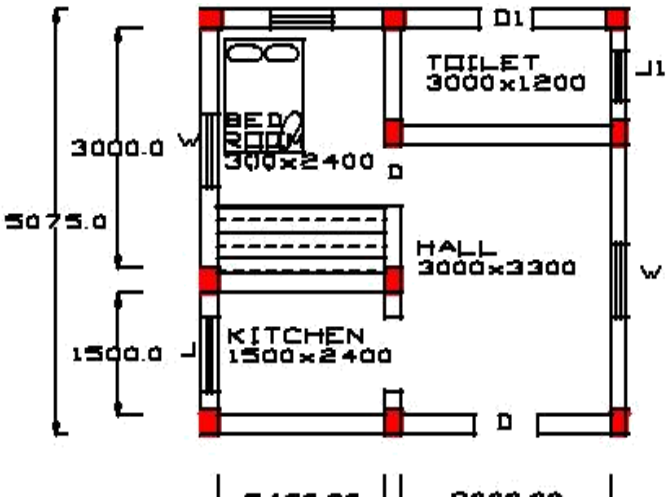

Figure 3.1 Plan

Concrete quality

The minimum recommended characteristic strength for structural concrete is 20.0 N/mm^2. However, for all buildings which are more than four storey in height in Zones IV and V, the minimum grade for concrete should be M-25. Quality control, workmanship, and supervision are of utmost importance in getting concrete against earthquake. The use of lightweight aggregates for structural purposes in seismic zones should be very cautiously proceeded with, as these may prove very brittle in earthquakes. Appropriate advice should be sought in selecting the type of aggregate, the mix proportions, and the strengths in order to obtain a suitably ductile concrete.

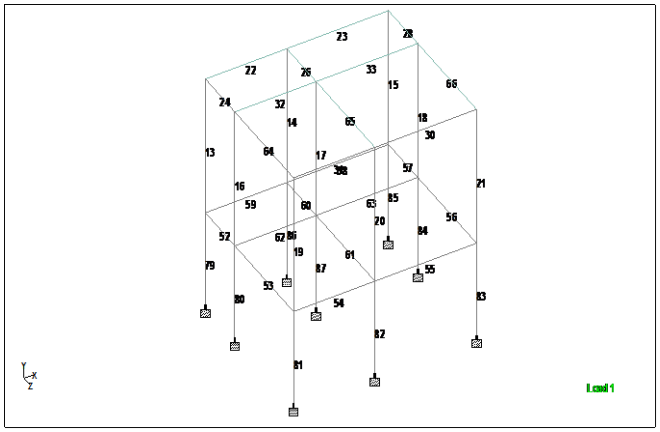

Fig 3.3 whole structure detail in stadd pro

Whole structure stadd pro detail
Footing details:
Size of the Footing = 0.96x1.34m

Over all depth of Footing = 400mm
Clear Cover to reinforcement = 50mm

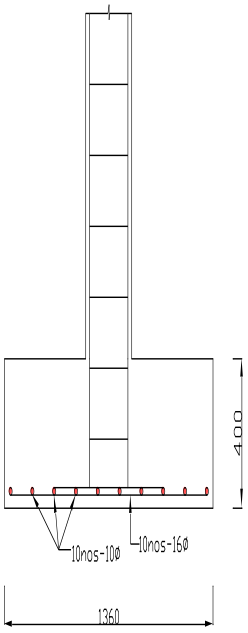

Fig 3.4 Footing design

Tab 3.1 Reaction summary analysis in stadd pro

	Node	L/C	Horizontal FX (N)	Vertical FY (N)	**Horizontal FZ (N)**
Max FX	27	11:combination load case 11	**5.95E 3**	109E 3	244.785
Min FX	27	16:combination load case 16	**-5.93E 3**	61.1E 3	-39.911
Max FY	27	6:combination load case 6	-116.589	**138E 3**	-7.295
Min FY	26	1:sesmic load in x direction	2.36E 3	**1.31E 3**	54.682
Max FZ	24	13:combination load case 13	-75.621	74.1E 3	**5.51E 3**
Min FZ	24	18:combination load case 18	-237.863	32.1E 3	**-5.25E 3**
Max MX	24	13:combination load case 13	-75.621	74.1E 3	5.51E 3
Min MX	24	18:combination load case 18	-237.863	32.1E 3	-5.25E 3
Max MY	21	11:combination load case 11	4.01E 3	52.6E 3	68.495
Min MY	23	12:combination load case 12	-3.7E 3	42E 3	660.113
Max MZ	27	11:combination load case 11	5.95E 3	109E 3	244.785
Min MZ	27	16:combination load case 16	-5.93E 3	61.1E 3	-39.911

CONCLUSION

This Paper mainly deals and also cares about the lower middle class people or Low-Income people. This will not only safeguard of the structure but also will save lot of people lives. This structure should give a sufficient warning at the time of earthquake or seismic force. And this structure also designed in favour of low soil bearing capacity (120 kN/m²). This structure have a footing type is rectangular, so this type is also in favour of against seismic force. The size of the building is (30.32m²) or (325.4ft²) and it will construct with effective cost especially for the low income people. Use ISO 9000-type control mechanisms to help improve both the design and construction practices. Implementation of ISO: 9000 is initially expensive but experiences show that it pays off in about 2 years through greater economy in operations.

❖ **Earthquake-Resistant Constructions in India Engineered and Non-Engineered Constructions**

The majority of non-engineered building constructions. However, it does not give them proper education engineered constructions. Discussions focus should be placed on non-engineered constructions.

❖ **Building technology and know-how**

The earthquake resistant construction of different building materials and technical curriculum is a need for much discussion on their application.

❖ **Code Provisional Issues**

structures design codes are the minimum expectations of the community. There is a need to ensure that the rules are complied with codal faithful. Fulfill a social obligation, because building codes, code development must be given to the costs incurred by the persons concerned. Slight technical development or other major changes to the code fixes required procedures. In order to help implement the provisions of appropriate technical innovations and developments difficult to implement.

Code compliance in our country is currently in a very bad condition. This can be enhanced through the necessary rules and regulations. Changes in the tender specifications and the introduction of city by laws are some of these strategies. Furthermore, there is need for quick action against those who fail to promote compliance. Professional societies should take the initiative to develop model codes or discuss specific issues. Codes of practice used as a basis for achieving this. These model codes should be revised regularly on the basis of continuous technical developments. This will greatly benefit from the growth in the code of professional engineers with increased interactions.

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