*International Journal of Latest Engineering and Management Research (IJLEMR)*
*ISSN: 2455-4847*
*www.ijlemr.com || Volume 03 - Issue 02(S) || PP.26-30*

# Experimental Study on Frames for Seismic Performance Assessment

Baalaje.M.N[1], Dr.I.Padmanaban[2]
[1]*student,M.E Structural Engineering, Sri Krishna College Of Technology, Coimbatore*
[2]*Head of the department, civil department, Sri Krishna College Of Technology, Coimbatore*

**Abstract:** Response of Aluminium and Timber frames against seismic forces are studied in this paper. To preserve natural resources for future generations we humans look for more number of optimum solutions for replacing concrete. This project explores the usage of Aluminium Alloys and Timber material as Structural replacement for Reinforced concrete. The component of concrete has its own environmental and social impacts particularly cement. The concrete industry releases carbon dioxide which is an primary component for climate change and global warming. River beds are continuously exploited for natural sand and quarries are additively exploited for the aggregate materials. Tons of liters of water are continuously being used for the production and curing of concrete and also for other activities. To preserve natural resources for future generations we humans look for more number of optimum solutions for replacing concrete. This experiment is to provide safer structures in seismic zones. The ductility and the energy dissipiation capacities of the structure are to be increased to resist more lateral load duringearthquake.

**Keywords:** Frames, Seismic, Response, Displacement.

## I. Introduction

Earthquakes in populated regions throughout the world create extensive damage to the built environment that results in catastrophic loss of human life & enormous economic losses. The earthquake effects primarly does not depend on the magnitude of earthquake but rather on the ductile detailing that is provided to the structure. The worst damages of the earthquake have occurred only because of the poor detailing of structures not because of higher magnitude earthquakes.

Concrete the most useful composite used by man construction also has its disadvantages. The concrete industry releases carbon dioxide which is an primary component for climate change and global warming. River beds are continuously exploited for natural sand and quarries are additively exploited for the aggregate materials. Tons of liters of water are continuously being used for the production and curing of concreteandalsoforotheractivities.Ofcourse,steelusedin construction has to be optimized. Ductility can be defined as the "ability of material to undergo large deformations without rupture before failure" To withstand huge lateral load and displacements a more ductile material than concrete is needed for construction. The objective of the this experiment is to provide safer structures in seismic zones.

The ductility and the energy dissipiation capacities of the structure are to be increased to resist more lateral load during earthquake. Recently seismic response of Aluminum & Timber as alternate sources for concrete & steel construction has gained interest. These alternate frames are being studied for its seismic characteristics against earthquake to assess its performance. Earthquakes in populated regions throughout the world create extensive damage to the built environment that results in catastrophic loss of human life & enormous economic losses.

The earthquake effects primarlydoes not depend on the magnitude of earthquake but rather on the ductile detailing that is provided to the structure.The worst damages of the earthquake have occurred only because of the poor detailing of structures not because of higher magnitude earthquakes. A World Bank and United Nations report shows estimates that around 200 million city dwellers in India will be exposed to storms and earthquakes by2050.

## II. Aluminium Frames

Aluminium alloys commonly have tensile strengths of between 70 and 700 MPa. The range for alloys used in extrusion is 150 – 300 MPa. Government of India provide services to both primary and secondary aluminium industries with a special emphasis on environmental sustenance. Aluminium Association of India is the apex body representing the entire spectrum of Indian Aluminium Industry –Primary Producers, Downstream Manufacturers, Endusers, R& D Organisations.

## III. Timber Frames

A good quality timber should be hard enough to resist deterioration. It should have sufficient strength to resist heavy structural loads. Indian Plywood Industries Research & Training Institute satisfies the need for a Research and Development infrastructure for wood and wood based panel industries in the country. The strength of the wood is fundamentally affected by the direction in which it is loaded in relation to the grain. In the direction of the grain, the bending strength is directly proportional to the density of the wood. In uniform, flawless wood, the bending strength is as great as the tensile strength.

## IV. Seismic Response

Seismic response of a building has become and it is always been an important factor of building design. Apart from structural loads seismic loads affect more number of buildings in these years. Ductile detailing is as vital as structural Detailing for buildings. Seismic design of buildings has traditionally been force-based. It is widely understood now that it is not the force but displacement, which can be directly related to damage. It is not the magnitude of earthquake that affects the building greatly but the lack or inappropriate seismic & Durability consideration factors that affect the building.

Parameters to be studied:

- Elastic waves-body waves- P and S waves.
- Elastic waves- Surface waves – Rayleigh andlove waves.
- Load versusDisplacement
- Energy dissipation capacity of eachcycle
- Stiffnessdegradation
- Strengthdegradation
- Base shear Versusdisplacement
- Inter-storey driftratio.
- Acceleration responsespectra.

### 4.1 P and S waves:

P waves are the fastest one to arrive in a seismograph. They leave behind a trail of compressions and rarefactions on the medium they move through. P waves are also called Pressure waves for this reason.

S waves are the second waves to hit the seismographs. They are shear waves. S waves can only move through solids.

### 4.2 Rayleigh and Love waves:

Rayleigh waves are a type of surface acoustic wave that travel along the surface of solids. They can be produced in materials in many ways, such as by a localized impact or by Piezo- electric transduction, and are frequently used in non- destructive testing for detecting defects.Love waves are horizontally polarized surface waves. These waves are surface seismic waves that cause horizontal shifting of the earth during an earthquake. Love waves travel with a low velocity than P or S waves, but faster than Rayleigh waves.

### 4.3 Load versus displacement

The load displacement hysteresis curves are obtained from the experiments. The load displacement hysteresis for cycle 1,cycle 2,cycle 3,cycle 4 are obtained so that load- displacement envelope is being drawn to identify the maximum displacement for the given cyclicloading.

### 4.4 Energy dissipation capacity of each cycle

The inter-storey drift energy dissipation capacity is the key performance parameter as most of the energy imparted to system during earthquake is dissipated by the joint. Energy dissipation in each cycle is found out and a cross- validation of energy dissipations of every cycle of loading is done.

### 4.5 Stiffness degradation

Stiffness Degradation is being observed during the experiment testing. The stiffness degradation for both the positive and the negative displacement cycle of loading is observed and studied.

### 4.6 Strength degradation

Strength Degradation during the experiment testing is being studied. Strength degradation is estimated for the positive and negative cycles of loading and the related curves are attained. This gives us the point where maximum strength degradation will happen.

**4.7 Base shear versus displacement**

Graph is obtained between base shear (KN) and displacement values. Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. From this base shear values, the corresponding displacement values are obtained -and are plotted to know the maximumdisplacement.

**4.8 Inter- storey drift**

Inter-storey drift ratio at the design loads for the considered frame building models are observed. Inter-storey drift ratio versus the storey height is plotted and the maximum drift values for each storey are obtained for respective loading.

**4.9 Acceleration response spectra**

Acceleration response spectrum is used to provide the most descriptive representation of the influence of a given earthquake on a structure.

## V. Analytical equations

The frames are theoretically analyzed by Response Spectrum method following IS1893:Standards for Earthquake Resistant Design. The results values are forces and their units are in Kilo newton. These forces are lateral used in StaDDPro software to obtain the displacement values of the frames. The displacements are obtained both in X and Z directions. The displacement values provides us an clearer view of the displacement that is going to happen in the Original structure. Since the model is a replica of the original structure only.

**5.1 Analytical Equations for Aluminiumframe:**

$F_{roof} = V_{roof}$

$F_i = V_i – V_{i+1}$

**5.2 Analytical Equations for Timberframe:**

$F_{roof} = V_{roof}$

$F_i = V_i – V_{i+1}$

This lateral load values are used in StaddPro software at both roof and first floor levels and corresponding Displacement values are found and are stated in figures. These values are to be compared with real time models in future and discussions will be made. This analytical values are derived according to standard Procedure for analysis of frames by Response Spectrum Method.

## VI. Results and Discusssions

The Force values obtained from analytical methods are used by the analyzing software STADD.Pro and displacement values are obtained. These values are displacements from seismic vibrations of buildings. The analytical displacement values from seismic study of aluminium and timber frames are the final results needed. All the displacement values are in millimeters. The model provides a clearer view of the original building displacements.

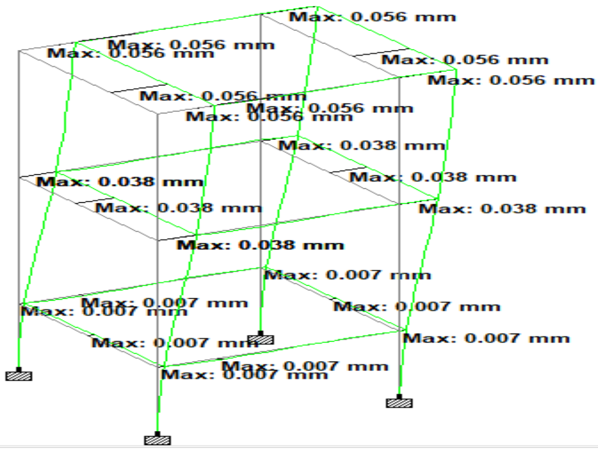


Fig 1, Seismic Response in +x direction of Aluminium Frame at First Floor level

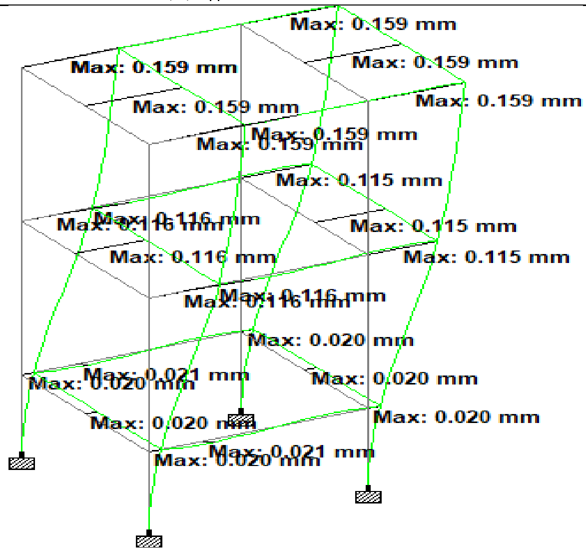


Fig 2, Seismic Response for +X Direction of Timber Frame at First Floor Level

**6.1 Analytical Displacement Values:**
**6.1.1 Analytical values for Aluminium frame by response spectrum method:**
Force at Roof level : 0.1727 KN
Force at First floor level : 0.1111 KN

**6.1.2 Analytical values for a Timber frame by response spectrum method:**
Force at Roof level : 0.0682 KN
Force at First floor level : 0.0398 KN

**6.2STADD.Pro Displacement Values:**
**6.2.1 STADD.Pro values in +X and –X Directions at Roof level for Aluminium Frames:**
Displacement of Ground floor: 0.175mm
Displacement of First floor: 0.088mm
Displacement of second floor: 0.013mm

**6.2.2 STADD.Pro values in +X and –X Directions at First floor level for Aluminium Frames:**
Displacement of Ground floor: 0.056mm
Displacement of First floor: 0.038mm
Displacement of second floor: 0.007mm

**6.2.3 STADD.Pro values in +X and –X Directions at Roof level for Timber Frames:**
Displacement of Ground floor: 0.524mm
Displacement of First floor: 0.272mm
Displacement of second floor: 0.041mm

**6.2.4 STADD.Pro values in +X and –X Directions at First floor level for Timber Frames:**
Displacement of Ground floor: 0.159mm
Displacement of First floor: 0.115mm
Displacement of second floor: 0.020mm

## VII. Conclusion

**7.1. Conclusion:**

1. Response spectrum method of anlaysis gives the most accurate value of seismic performance of structure since it characterizes structures entire motion during the time of motion.
2. Timber structure are prone to more vibrations than Aluminium structures because of their less weight.
3. So respective sections for timber structures have to be designed to reduce the displacement values.
4. Since the structure is symmetrical in shape the mode shape is symmetrical in X and Z direction

5. The displacement of the model is scaled up to get an approximate estimate of the original structure displacement.

## VIII. References

[1]. Constantine C. Spyrakosa, John Ermopoulos, Development of aluminum load-carrying space frame for building structures, Engineering Structures 27 (2005)1942–1950.

[2]. Dipti R. Sahooa,Durgesh C. Rai, Seismic strengthening of non-ductile reinforced concrete frames using aluminum shear links as energy-dissipation devices, D.R. Sahoo, D.C. Rai / Engineering Structures 32 (2010)3548–3557.

[3]. DeeptiChauhan,Analysis and design of bamboo based cowshed,M.tech Thesis Department of Civil Engineering Indian Institute of Technology, Delhi April,2012.

[4]. Gianfranco De Matteisa, Giuseppe Brando a, Federico M. Mazzolani,Pure aluminium: An innovative material for structural applicationsin seismic engineering, G. De Matteis et al. / Construction and Building Materials 26 (2012)677–686.

[5]. IS1893:1984,IndianStandardCriteriaforEarthquakeResistant Design OfStructures.

[6]. Jagadish Vengala1, B. N. Mohanthy2 and S. Raghunath, Seismic performance of Bamboo housing– an overview, Indian Plywood Industries Research and Training Institute(IPIRTI).

[7]. Mauro Sassu, Anna De Falco, Linda Giresini and Mario LucioPuppio, Structural Solutions for Low-Cost Bamboo Frames, Experimental Tests and Constructive Assessments, Materials 2016, 9,346