STRUCTURAL PERFORMANCE OF ROOF VARIANTS IN PRE ENGINEERED BUILDINGS SUBJECTED TO WIND LOADS

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ABSTRACT

Pre-Engineered Building (PEB) idea is another origination of Industrial structure development. Lately, the presentation of Pre Engineered Building (PEB) idea in the plan of structures has helped in upgrading plan. The adoptability of PEB in the spot of Conventional Steel Building (CSB) plan idea brought about numerous preferences, including economy and simpler creation. In auxiliary Engineering, aside from basic and tasteful plan necessities, the significant obstacle was the pace of development and the security standards. The significant target of the current work is to ponder the lead of the structures on incline ground and level ground. The structures laying on slant locales must be planned remarkably as opposed to level ground. Incline structures are not equivalent to those in fields. They are especially eccentric and unsymmetrical in even and vertical planes, and torsionally coupled and thusly powerless to separate damage when affected by seismic loads.

In the present study a 43.5m G+10 storage pre engineering building is designed by using Staad Pro V8i Software as per IS code. The values of deflection, shear, bending, story drift and steel take off is compared between various roof types in different wind terrain categories.

I. INTRODUCTION

Steel is a material which has top notch per unit mass. Along these lines it is used being developed of structures with enormous segment free space. Most of the Industrial Structures require this norm. An Industrial Warehouse is a limit creating and is commonly depicted as single story steel structures with or without mezzanine floors. The alcoves of these structures may be block workmanship, strong dividers or GI sheet covers. The dividers are all around non-bearing anyway enough adequately ready to withstand

As of late Sikkim (2011), Doda (2013) and Nepal seismic tremor (2015) caused gigantic obliteration. In this district there is a request of development of multistory RC confined structures because of the quick urbanization and increment in monetary development and subsequently increment in populace thickness. Because of the shortage of the plain territory in this district there is a commitment of the development of the structures on the slanting ground. In display work, atenstoried confined working with a tendency of 120°and 140° to the ground subjected to sinusoidal ground movement is demonstrated with a test by performing Response range investigation in basic examination and plan programming.

Figure 1: Buildings on sloping ground

Pre Engineering Buildings

Pre engineering buildings are those in which the members of steel are designed and installed at the site. These pre engineering structures are mainly used for industrial structures design. The shear and bending action on these structures are less as we compared with RCC buildings, the designing process is carried out with the use of IS codal provisions. The major advantage is that installation process and repairs in structures is easy as compared with the RCC building structures design. The below figure shows the pre engineering building under construction process which is used for the small workshop purpose.

Figure 2: A pre-engineered metal building under construction

Component of Pre-engineered Building:

The PEB components may be broadly classified into following parts they are as follows:

1. Main Frame
2. Secondary frame
3. Material for Sheeting (or) cladding
4. Accessories

For the development of these structures utilization of hot moved tightened areas for essential confining and cold shaped segments, for example, "Z" and "C" might be utilized according to the inner necessities for the worry for auxiliary encircling, in this way the control of wastage of steel and the own load of the structure and subsequently lighter establishments. These sorts of structures are essentially inflexible jointed structure outlines from hot rolled or cold shaped segments, the rooftops and side divider cladding is upheld by primary and auxiliary casings by purlins and sheeting rails.

Objectives of the study

For this the following objectives were made

1. To design the pre engineering building by staad pro
2. To study the seismic behavior of multi story building by using IS 1893:2002
3. To compare the pre engineering building with flat, pitched and single side slope roofs.
4. To compare the results of Story Drift, Shear force, Bending moment, Building torsion.
5. To study the buildings in Staad Pro V8i software package in Response spectrum analysis.

II. LITERATURE REVIEWS

C. M. Meera, et al.,(2013) This paper is a similar research of PEB concept and CSB concept. The investigation is performed through stooping a everyday edge of a proposed Industrial Warehouse building utilising both the ideas and breaking down the deliberate edges using the underlying examination and plan programming Staad.Pro.

From this paper it became inferred that PEB structures can be handily planned via fundamental plan technique as in line with state ideas. Considering the exam, it very well can be presumed that PEB systems are greater worthwhile than CSB systems concerning price viability, best control speed in improvement and straightforwardness in erection. The paper likewise offers trustworthy and low-cost thoughts on initial plan thoughts of PEBs. The concept portrayed is beneficial in information the plan device of PEB idea.

Sai Kiran Gone, Kailash Rao, Pradeep Kumar Ramancharla, et al.,(2014) In this investigation, a mechanical shape (Ware House) is dissected and planned through the Indian norms, IS 800-1984, IS

800-2007 and furthermore with the aid of alluding MBMA-ninety six and AISC-89. In this exam, a structure with length 187m,width 40m,with clean tallness 8m and having R-Slope 1:10,isconsidered to do evaluation& plan for 2D edges (End define, define without crane and part with 3 module cranes). The financial system of the structure is talked about as a ways as its weight examination, among Indian codes (IS800-1984, IS800-2007) and American code (MBMA-ninety six), and among Indian codes (IS800-1984, IS800-2007).

From this examination it changed into presumed that the precept comparison among the Indian Code (IS800-2007) to the next identical American Codes are inside the order of the go-section of the metal element. According to Indian code, the classes of place considered for configuration are Plastic, Compact and Semi-reduced, thin pass-section. It is superb that numerous PEB producers use regions with flimsy networks to diminish the heaviness of the section and be efficient/critical of their commercial enterprise gives, and these slender networks do not fulfill the codal preparations of IS 800: 2007.

A. SRAVAN KUMAR, SANJEEV RAO, et al.,(2014) Pre Engineering Building (PEB) is the concept of metal systems found in mid 1960's the structure here utilizations complete I segments and the elegance here in this concept is no welding cycle may be finished in website whole shape might be Designed and made in save and this may be introduced to take a seat and amasses, the complete sectional homes will relies honestly on the minutes at that specific regions so there might not be any overabundance metallic utilized within the thus it is conservative. Here I am planning this type of PEB constructing by using choosing a consistent task comprising a 69m wide and 173m period material constructing by way of IS 800-2007 Design code utilizing STAAD Pro and clarifying its every unmarried limitations and plan and enumerating method.

From this examination it become reasoned that the shape Designed in this has burned-through a closing weight of 590MT. In the occasion that the shape planned right here isn't always a PEB at the off risk that it's miles a standard the loads could have long past higher with the aid of 30%.

III. EFFECT OF WIND LOAD ON BUILDINGS AND STRUCTURES

NATURE OF WIND IN ATMOSPHERE

In general, wind speed in the atmospheric boundary layer increases with height from zero at ground level to a maximum at a height called the gradient height. There is usually a slight change in direction (Ekman effect) but this is ignored in the Code. The variation with height depends primarily on the terrain conditions. However, the wind speed at any height never remains constant and it has been found convenient to resolve its instantaneous magnitude into an average or mean value and a fluctuating component around this average value. The average value depends on the averaging time employed in analyzing the meteorological data and this averaging time can be taken to be from a few seconds to several minutes. The magnitude of fluctuating component of the wind speed, which represents the gustiness of wind, depends on the averaging time. Smaller the averaging interval, greater is the magnitude of the wind speed.

Basic wind speed

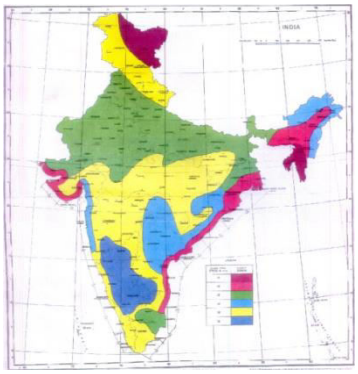
Figure gives basic wind speed map of India, as applicable at 10 m height above mean ground level for different zones of the country. Basic wind speed is based on peak gust speed averaged over a short time interval of about 3 seconds and corresponds to 10m height above the mean ground level in an open terrain (Category 2). Basic wind speeds presented in Fig. 1 have been worked out for a 50-year return period.

Design Wind Speed (Vz)

The basic wind speed for any site shall be obtained from Fig. 1 and shall be modified to include the following effects to get design wind speed, Vz at any height, Z for the chosen structure: (a) Risk level, (b) Terrain roughness and height of structure, (c) Local topography, and (d) Importance factor for the cyclonic region. It can be mathematically expressed as follows:

$$Vz = V_b K_1 K_2 K_3 K_4$$

Where Vz = design wind speed at any height z in m/s,
k1 = probability factor (risk coefficient)
k2 = terrain roughness and height factor
k3 = topography factor
k4 = importance factor for the cyclonic region



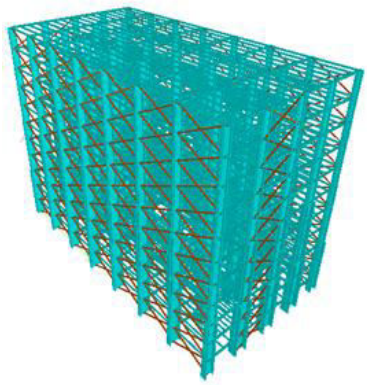
Basic wind speed in m/s (based on 50 year return period)

IV STRUCTURE MODELING

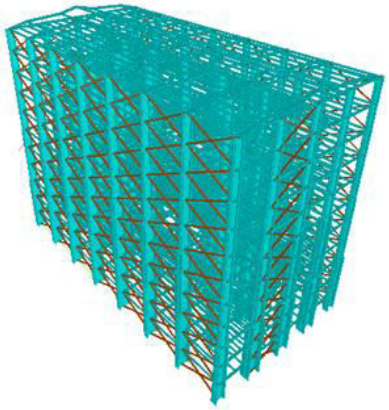
Pre Engineering structure specifications

1. Site Location : Delhi
2. Area of Storage : 56mx28m
3. Number of bays 8m
4. Type of Building : General G+10 floors
5. Wind speed :47m/s
6. Roof slope : 0^0
7. Bay spacing : 8m
8. Terrain : Category 2
9. Permeability : Medium
10. Minimum clearance, FFL to bottom Chord of Truss : 9.5 m
11. Roof Structure : To be covered with Colour Coated Steel Sheet
12. Maximum height of the building : 43.5 m
13. No. of Storage levels : 11 levels.

Models in STAAD Pro Software



Building model with flat roof



Building model with pitched roof

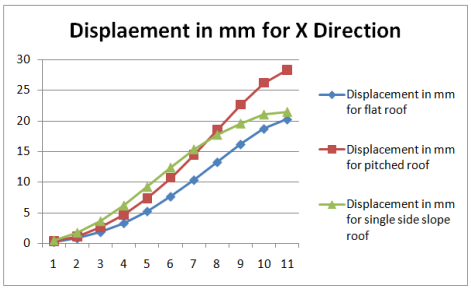
Building model with single side slope roof

V RESULTS AND ANALYSIS

Terrain 1 Results

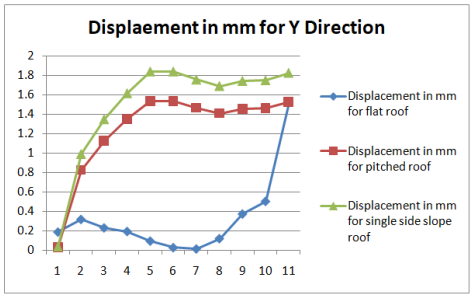
Displacement

X Direction



Comparison of displacement in X direction

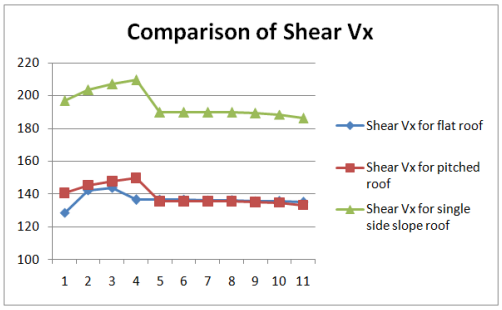
Y Direction



Comparison of displacement in Y direction

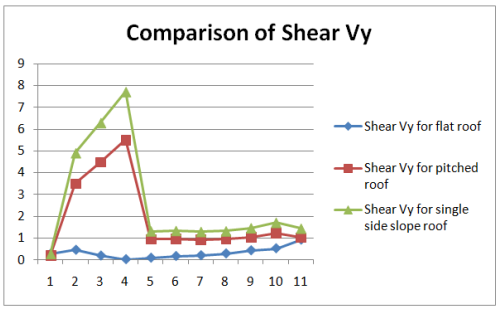
Story shear

X Direction



Comparison of shear in X direction

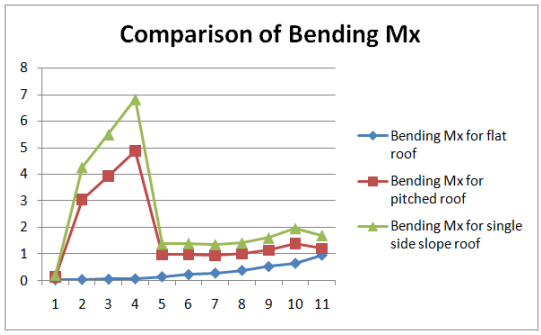
Y Direction



Comparison of shear in Y direction

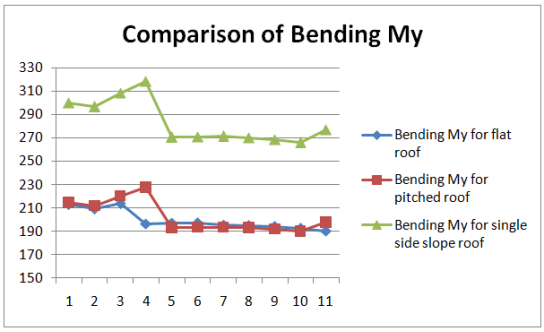
Story Bending

X Direction



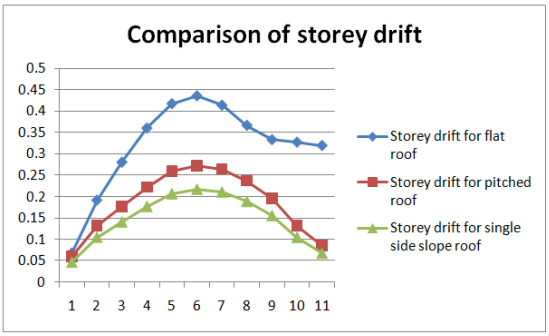
Comparison of Bending in X direction

Y Direction



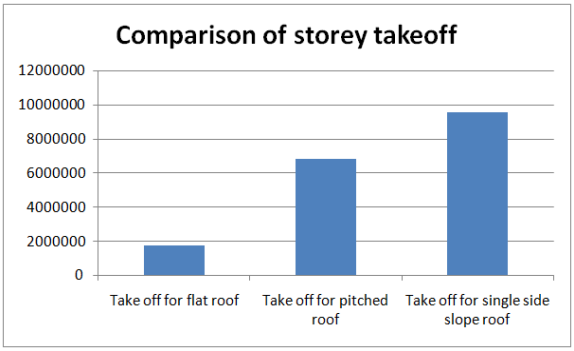
Comparison of Bending in Y direction

Story Drift



Comparison of story Drift

Story Take off

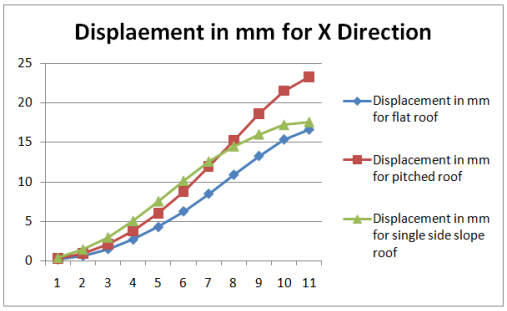


Story Take off

Terrain 2 Results

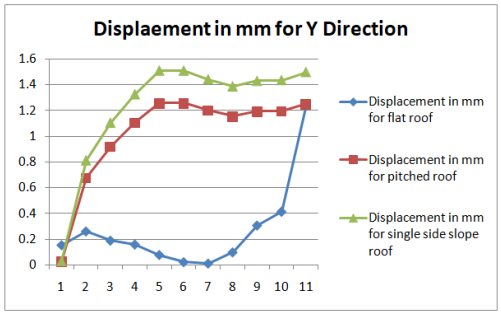
Displacement

X Direction



Comparison of displacement in X direction

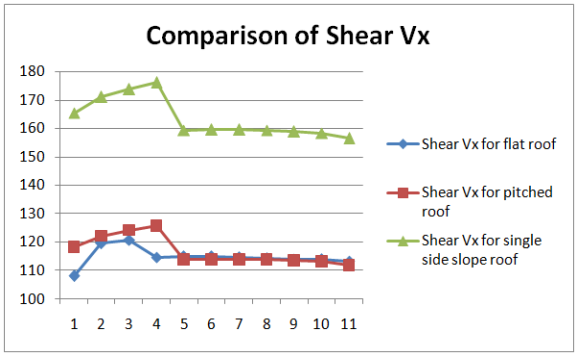
Y Direction



Comparison of displacement in Y direction

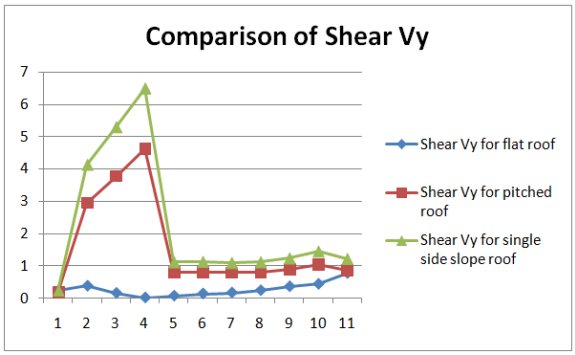
Story shear

X Direction



Comparison of shear in X direction

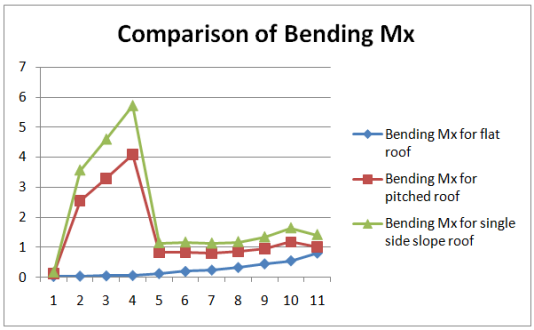
Y Direction



Comparison of shear in Y direction

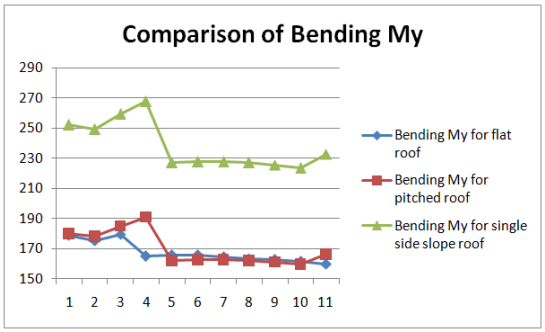
Story Bending

X Direction



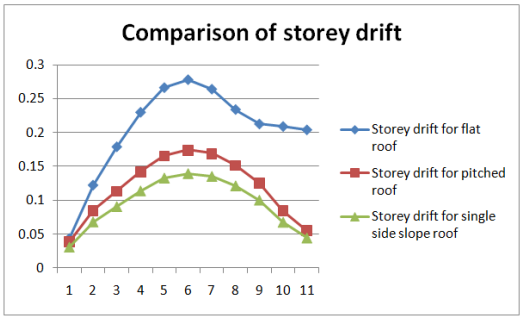
Comparison of Bending in X direction

Y Direction



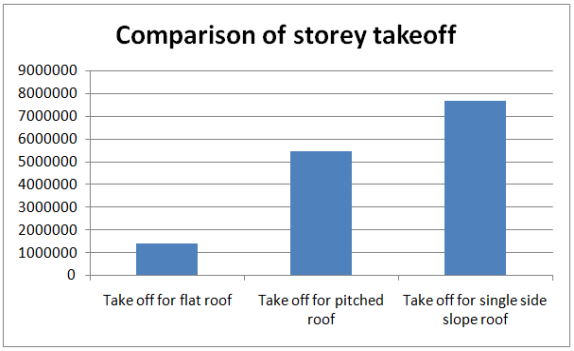
Comparison of Bending in Y direction

Story Drift



Comparison of story Drift

Story Take off

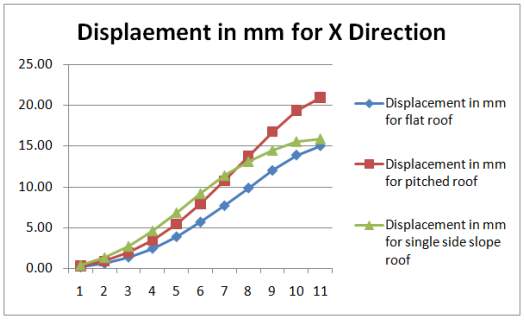


Story Take off

Terrain 3 Results

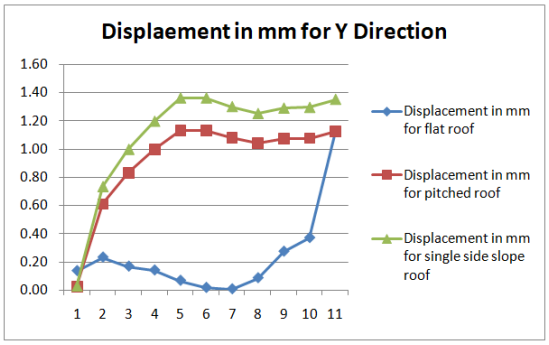
Displacement

X Direction



Comparison of displacement in X direction

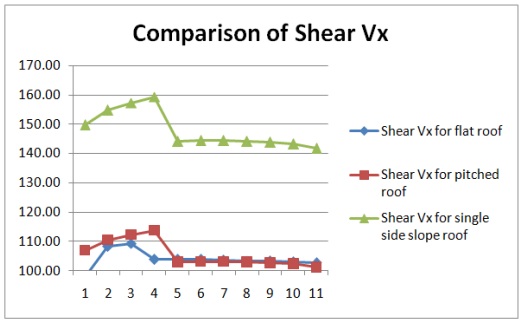
Y Direction



Comparison of displacement in Y direction

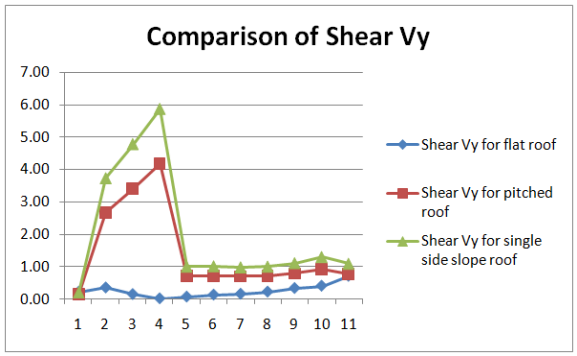
Story shear

X Direction



Comparison of shear in X direction

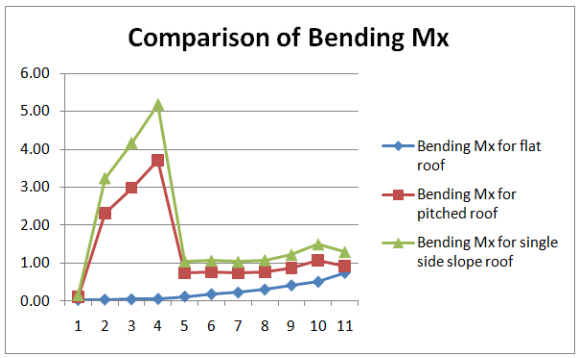
Y Direction



Comparison of shear in Y direction

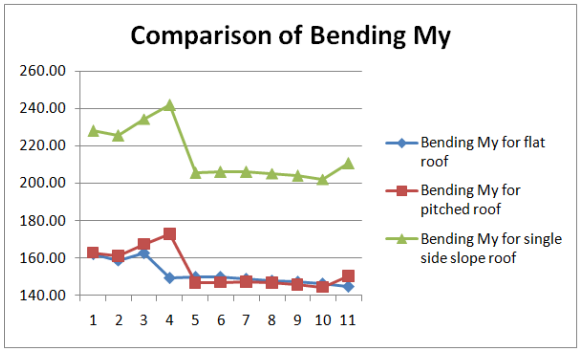
Story Bending

X Direction



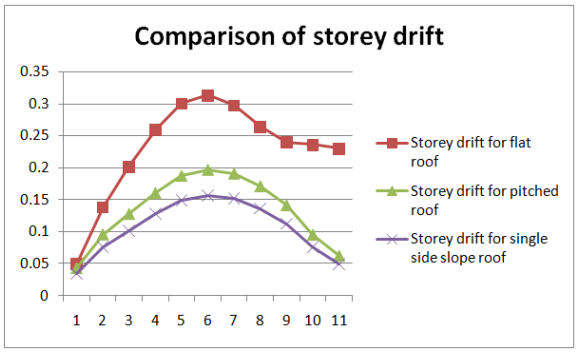
Comparison of Bending in X direction

Y Direction



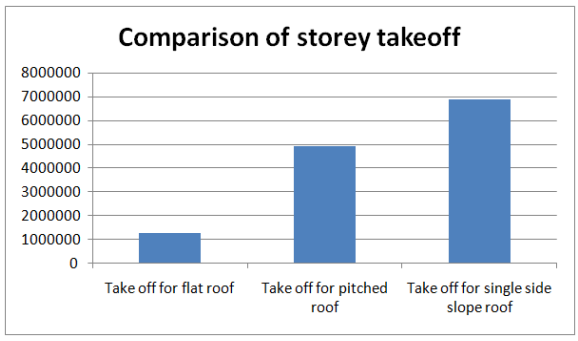
Comparison of Bending in Y direction

Story Drift



Comparison of story Drift

Story Take off

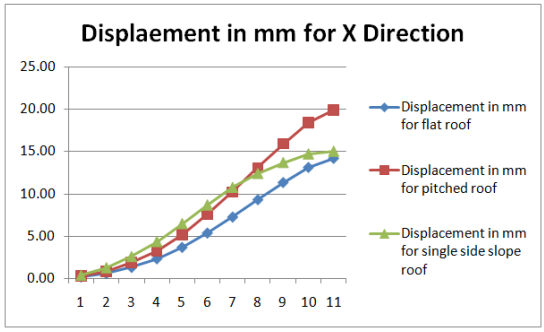


Story Take off

Terrain 4 Results

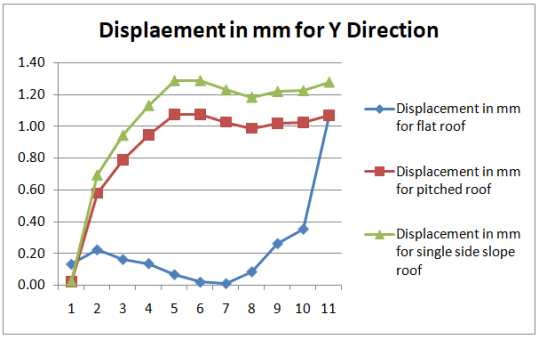
Displacement

X Direction



Comparison of displacement in X direction

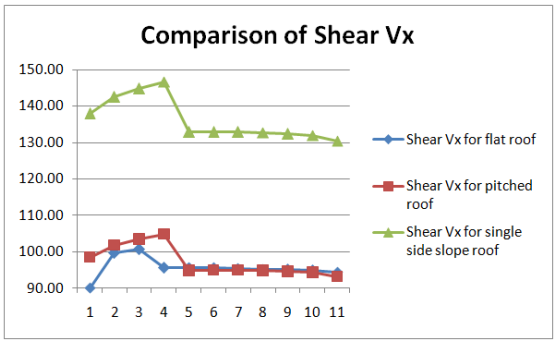
Y Direction



Comparison of displacement in Y direction

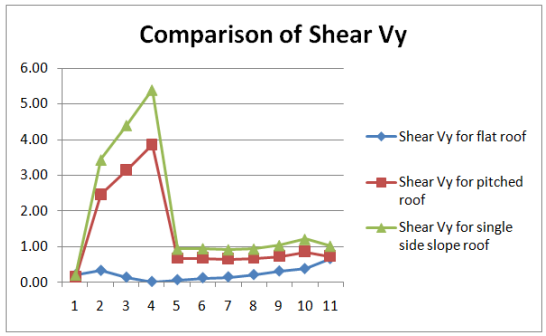
Story shear

X Direction



Comparison of shear in X direction

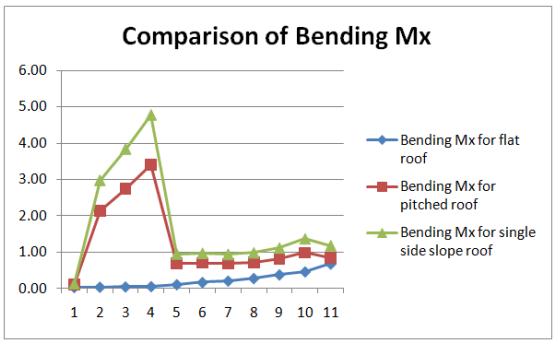
Y Direction



Comparison of shear in Y direction

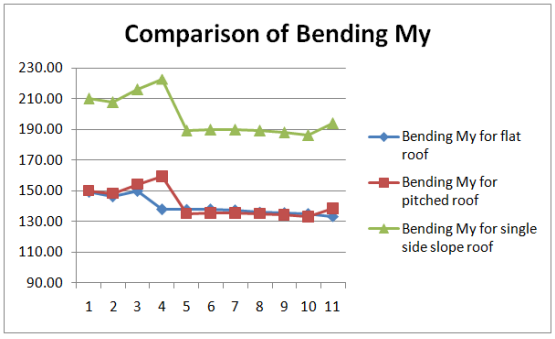
Story Bending

X Direction



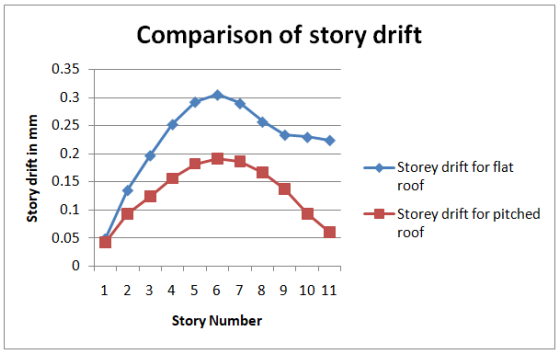
Comparison of Bending in X direction

Y Direction



Comparison of Bending in Y direction

Story Drift



Comparison of story Drift

Story Take off

Story Take off

VI CONCLUSIONS

1. This project successfully passes on that PEB structures can be handily planned by basic plan systems as per nation principles.
2. In light of the examination, it very well may be presumed that PEB structures are more worthwhile than CSB structures regarding cost adequacy, quality control speed in development and straightforwardness in erection.
3. This study additionally grants straightforward and practical thoughts on starter plan ideas of PEBs
4. The maximum value of displacement was observed for pitched roof structure than flat and single side slope structure in all wind terrains.
5. The maximum value of shear and was observed for single side slope structure than flat and pitched roof system structure in all wind terrains.
6. The higher value of story drift was observed for flat roof model than pitched or single side slope case.
7. Low weight flexible frames of PEB offer higher resistance to wind loads.
8. Steel quantity depends on primary members and purlins. As spacing of frame is increased steel consumption decreased for primary members and increased for secondary members.
9. Also material wastage plays a significant role in reducing steel quantity and cutting the cost of structure as all fabrication work for conventional steel frames are performed at site results in lots of wastage in material.
10. Reduction in Dead Load results in reducing the size of Foundation.
11. The value of steel take is higher in case of slop ground structure than flat ground building model. From this it was concluded that the cost of slop ground building model is higher than the flat ground building structure.

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