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EFFECT OF EARTHQUAKE ON DESIGN OF CANTILEVER RETAINING WALL

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I. INTRODUCTION

General

Retaining walls are constructed to retain filled earth with greater height. They are used in rail and road projects where earth filling is required or road level especially in bridges. In buildings if basements are provided retaining walls are required.

Wing walls and abutments are also acting as retaining walls to release unnecessary water pressure building up during rainy season, weep holes are provided in the retaining walls at the top on back fill and in front of retaining wall longitudinal drains are provided.Back filling near retaining wall is with broken stone gravels or sand so that drainage in is improved and water pressure on walls is released.

A retaining wall is a structure designed and constructed to resist the lateral pressure of soil when there is a desired change in ground that exceeds the angle of repose of the soil.A basement wall is thus one kind of retaining wall, They are used to bound soils of two different elevations in areas of possessing undesirable slopes or in areas where the landscape needs to be shaped and engineered for more specific purposes like hillside farming or roadway overpasses, But the term usually refers to a cantilever retaining wall, which is a freestanding structure without lateral support at its top and are cantilevered from a footing,rise above the grade on one side to retain a higher level grade on the reverse side.

The walls must resist the lateral pressures generated by loose soils or, in some caseswater pressure.Every retaining wall supports a “wedge” of soil. The wedge is defined as the soil which extends beyond the failure plane of the soil type present at the wall site,and can be calculated when the angle is known.As the setback of the wall increases, the size of the sliding wedge is reduced. This reduction lowers the pressure on the retaining wall. The most important consideration in design and installation of retaining walls is to recognize and counteract the tendency of the retained material to move down slope due to backfill.

This creates behind the wall which depends on the of internal (phi) and the cohesive strength (c) of the retained material, as well as the direction and magnitude of movement the retaining structure undergoes lateral earth pressures are 0 at the top of wall and in homogenous ground - increase proportionally to a maximum value at the lowest depth. Earth pressures push the wall forward or overturn it if not correctly addressed.

Also, any behind the wall that is not dissipated by a system causes on the wall. The total pressure may be assumed to act at one-third from lowest depth for stretches of uniform height. Unless the wall designed to retain water, it is important to have proper drainage behind the wall in order to limit the pressure to the wall.

Drainage materials will reduce or eliminate the hydrostatic pressure and improve the stability of the material. Retaining walls are normally self-draining. As an example, the requires international code retaining walls to be designed to ensure stability against overturning,sliding,excessive pressure and water uplift: and they designed for a factor of safety of 1.5 against lateral sliding and overturning.

Definition

A retaining wall is a structure that holds back soil or rock from a building, structure or area. Retaining walls prevent down slope movement or erosion and provide support for vertical or near –vertical grade changes .cofferdams and bulkheads ,structure that hold back water ,are sometimes also considered retaining walls .retaining walls generally made of masonry, stone ,brick , concrete ,vinyl steel or timber .once as an inexpensive retaining material , railroad ties have fallen out of friction occur due to environmental concerns.

Every retaining wall supports a “wedge” of soil. The wedge is defended as the soil which extends beyond the failure plane of the soil type present at the wall site which, and can be calculated once the soil friction e setback angle is known. As the setback of the wall increases, the size of the sliding wedge is reduce. This reduction lowers the pressure on the retaining wall.

The most important consideration in proper design and installation of retaining walls is to know and counteract the fact that the retained material is attempting to move forward and down slope due to gravity.This generates lateral earth pressure behind the wall which depends on the angle of internal friction and the cohesive strength(c) of the retained material as well as the direction and the magnitude of movement the retaining structure undergoes.

Lateral earth pressures are zero at the top of the wall and in homogenous ground increase proportionally to a maximum value at the lowest depth.Earth pressures will push the wall frontward or overturn it if not correctly addressed. Also, any groundwater behind the wall that is not dissipated by a drainage system cause hydrostatic pressure on the wall. The total pressure of thrust may be assumed to act at one-third from the lowest depth for length wise stretches of uniform height.

Unless the wall is designed to retain water, it is important to have appropriate drainage behind the wall in order to limit the pressure to the walls design value. Drainage materials will reduce or eliminate the hydrostatic pressure and increase the stability of the material behind the wall. Dry stone retaining wall are normally self – draying.

II. TYPES OF RETAINING WALL

The following two types of RCC retaining walls are commonly used:

- Cantilever retaining walls
- Counter fort retaining walls

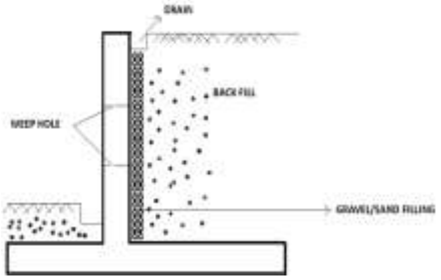


Fig 1 cantilever retaining wall

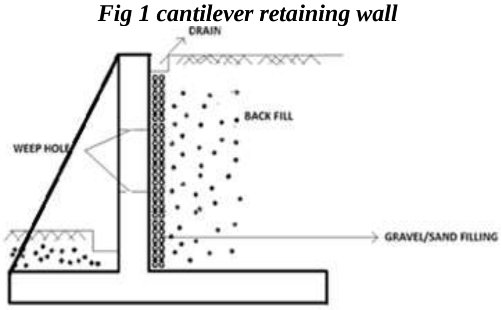


Fig 2 counter fort retaining wall

These two types of retaining walls are shown in figure 1.1 and 1.2.
It may be observed that:

- In cantilever retaining wall stem, heal slab and toe slab are all acting as cantilever due to pressure from back fill and soil pressure.
- In counter fort retaining wall counter forts are provided at regular intervals to strengthen the walls. In this case stem and heal slab act as a continuous slab.
- Since stem is strengthened with counter fort they are capable of retaining earth to greater height.

III. OTHER TYPES OF RETAINING WALL

Gravity walls

Gravity walls depend on their mass (stone, concrete or other heavy material) to resist pressure from behind and may have ato improve stability by leaning back to the retained soil. For short landscaping walls, they are often made from stone or segmental concrete units (masonry units).Dry-stacked gravity walls are somewhat flexible and do not require a rigid footing in areas.

Buttress on Cantilevered Wall

Cantilevered retaining walls are made from an internal stem of steel-reinforced, cast-in-place concrete. These walls cantilever loads to a large structural footing, changing horizontal pressures from behind the wall to vertical pressures on the ground below.

Sheet piling

Sheet pile retaining walls are usually used in easy soils and tight spaces. Sheet pile walls are made out of steel, vinyl or wood planks which are driven into the ground.

IV. REATING WALL ANALYSIS FOR EARTHQUAKES

Seismic analysis: in soil reports it is commonly stated: "for the analysis of earthquake loading, the allowable bearing pressure and passive resistance may be increase by factor of one-third." The rationale behind this recommendation is that the allowable bearing pressure and allowable passive pressure have an ample factor or safety and thus for seismic analysis, a lower factor of safety would be acceptable. Usually the above recommendation is appropriate if retaining wall bearing material and the soil in front of the wall (i.e., passive wedge area) consist of following: massive crystalline bedrock and sedimentary rocks that remains intact during the earthquake. Soil that tends to dilate during seismic shaking or example dense to very dense granular soil and heavily over consolidated cohesive soil such as very stiff to hard clays. Soils that have stress-strain curve that doesn't exhibit a significant reduction in shear strength with strain. Clay having low sensitivity. Soil located above the ground water table. These soils often have negative pore water pressure due to capillary action. These materials do not lose shear strength during seismic shaking and therefore an increase in bearing pressure and passive resistance is appropriate

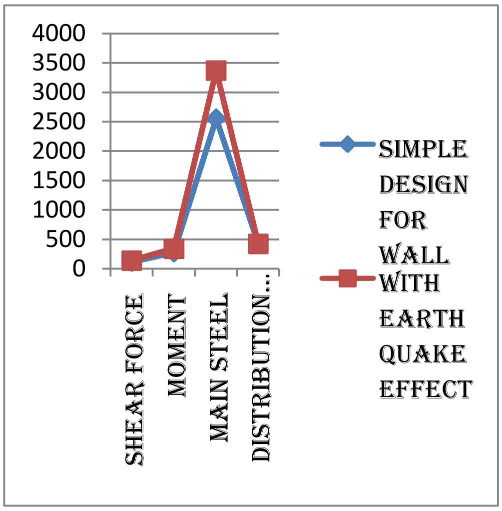
One-third increase an allowable pressure and passive pressure should not be recommended if bearing material and the soil in the front of he will consist of the following. Foliated or friable rock that breaks apart during the earthquake, causing reduction in shear strength of the rock. Loose soil located below the groundwater table and subjected to lequification or a substantial increase in pore water pressure.

These materials have a reduction in shear strength during earthquake. Since the materials are weakened by seismic shaking, the static values of allowable bearing & passive resistance should not be increased for the earthquake analysis. In fact, the allowable bearing pressure and passive pressure may actually have to be reduced to account for the weakening of the soil during earthquake.

V. GRAPHS

ZONE II

DIMENTIONS:



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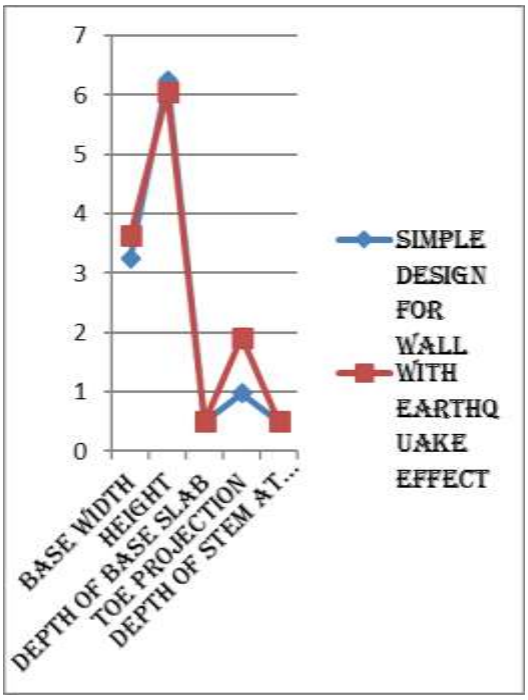
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SIMPLE DESIGN FOR WALL
WITH EARTHQUAKE EFFECT

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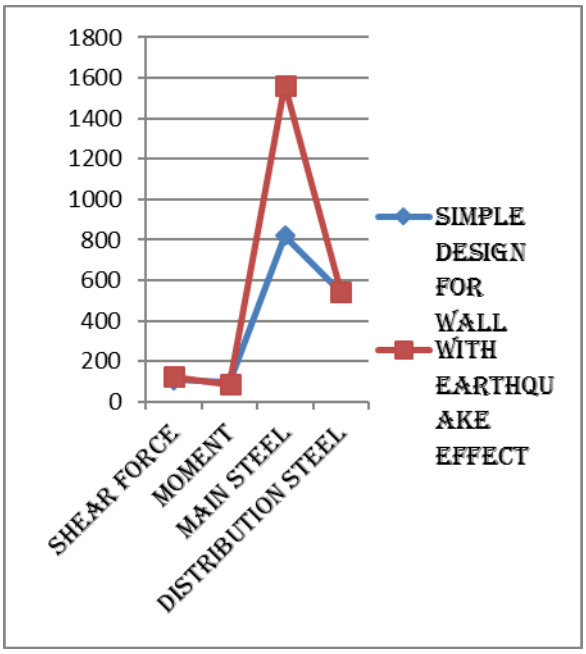
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DISTRIBUTION STEEL
SIMPLE DESIGN FOR WALL
WITH EARTHQUAKE EFFECT

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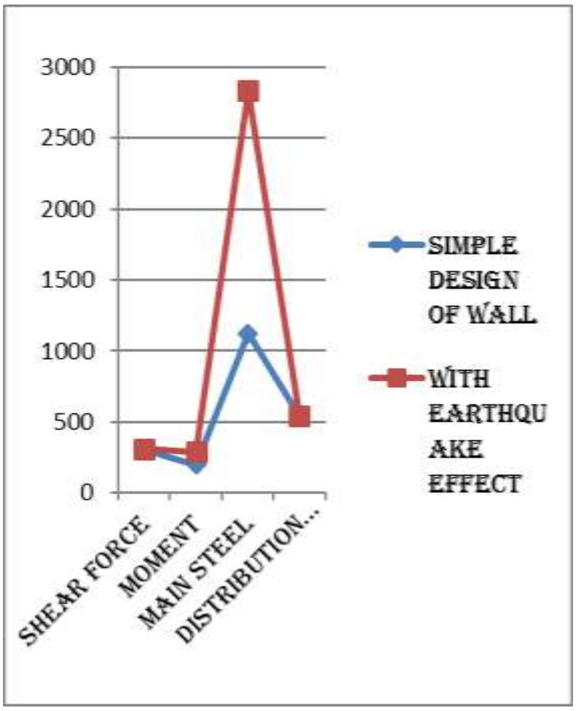

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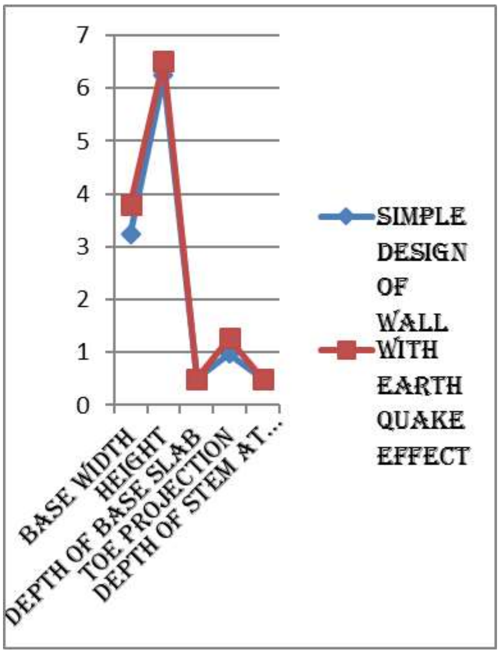

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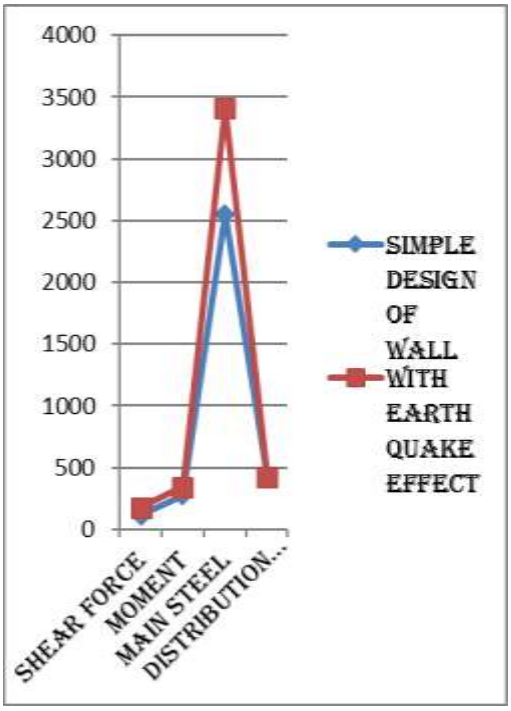
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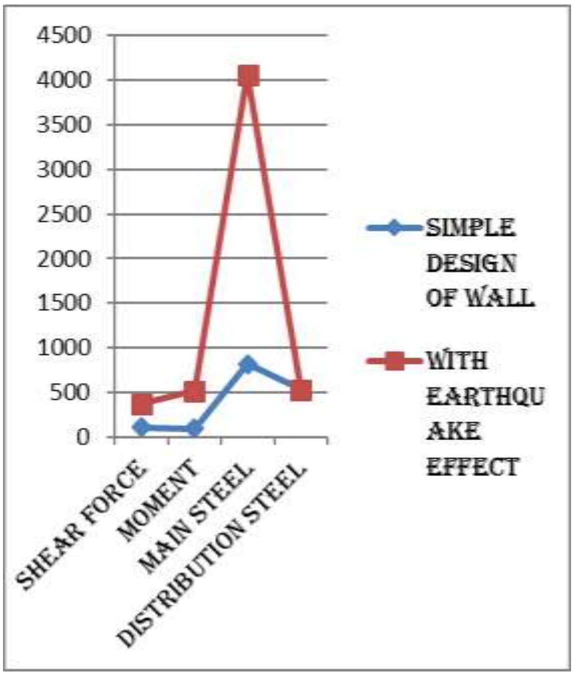
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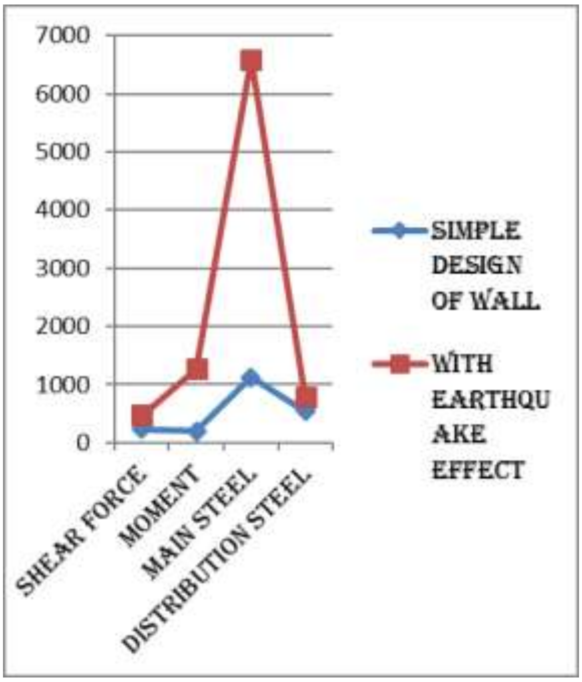

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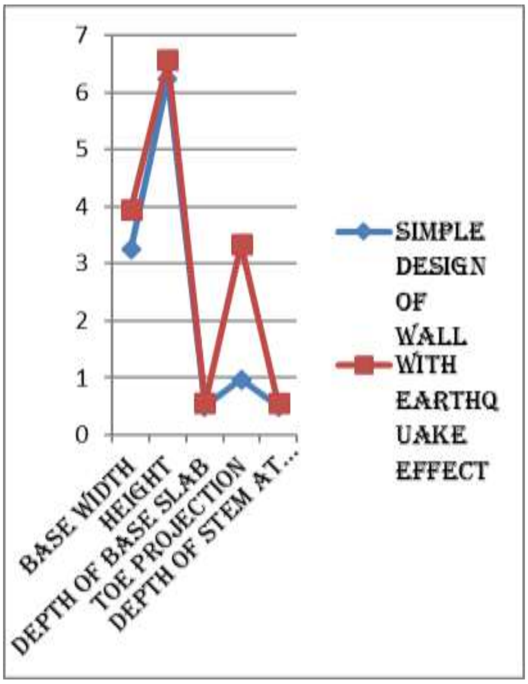

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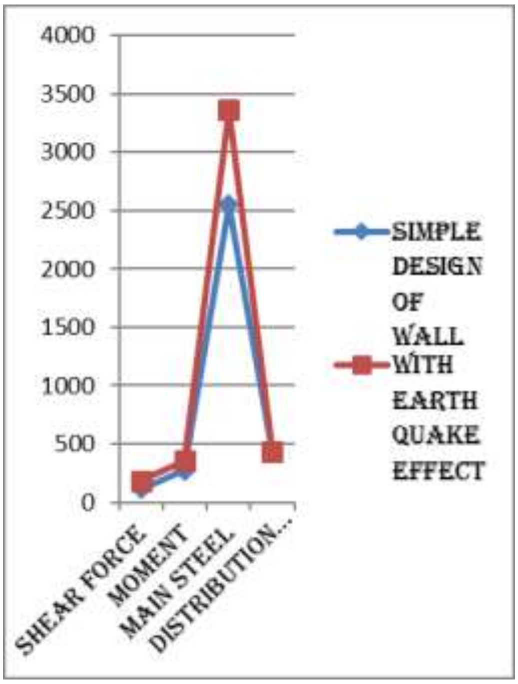
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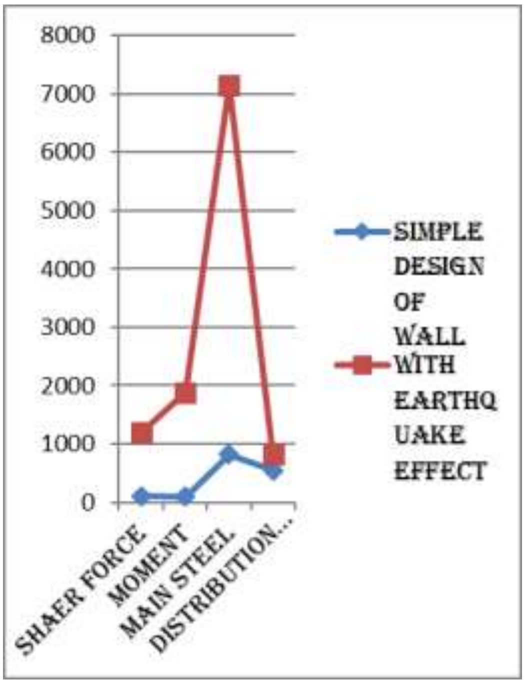
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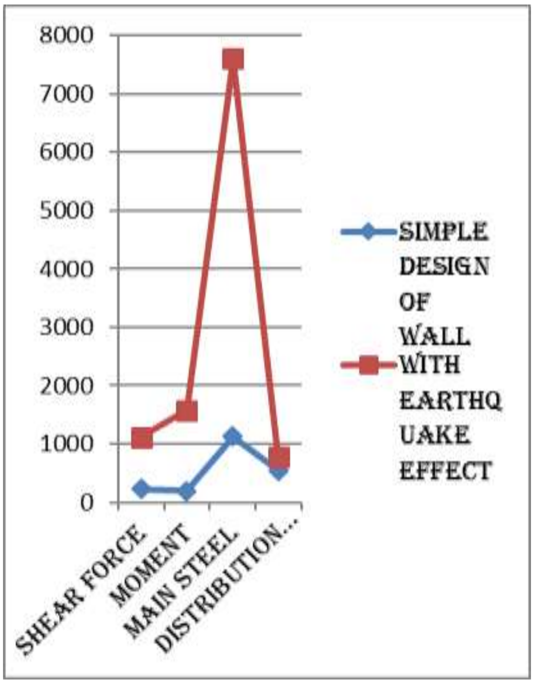

ZONE V

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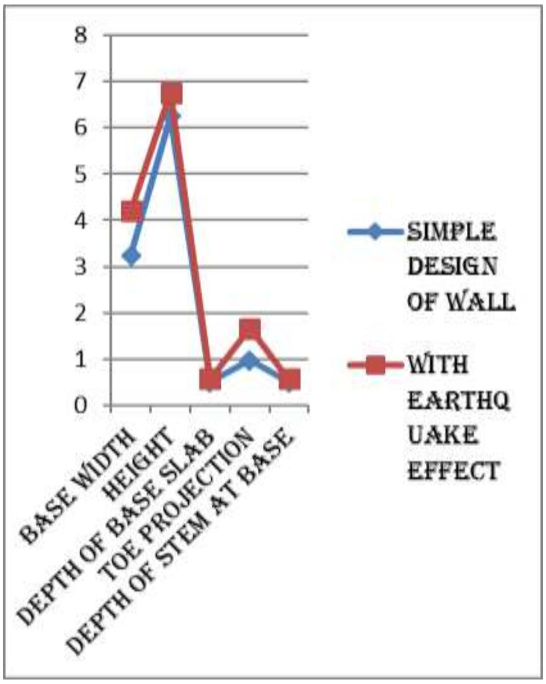

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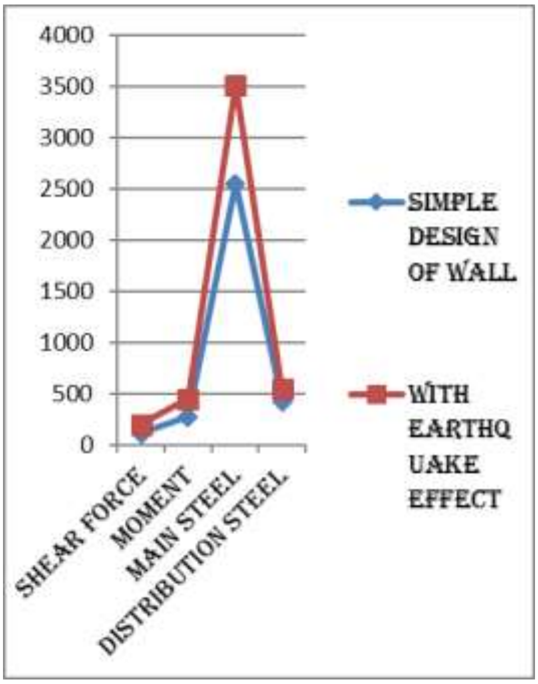
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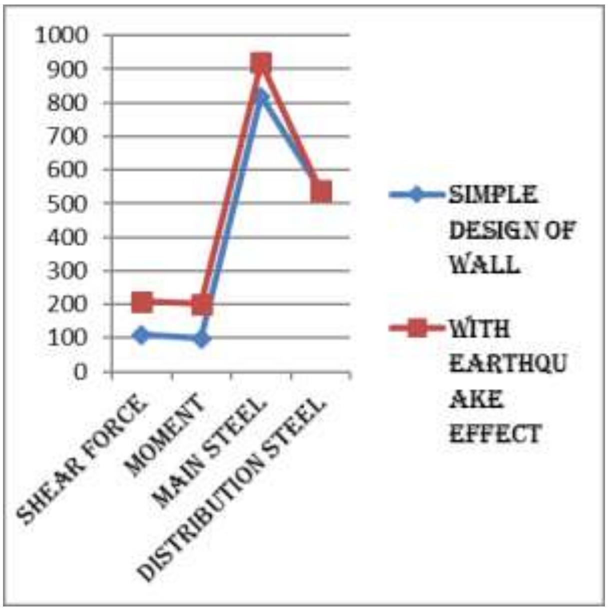
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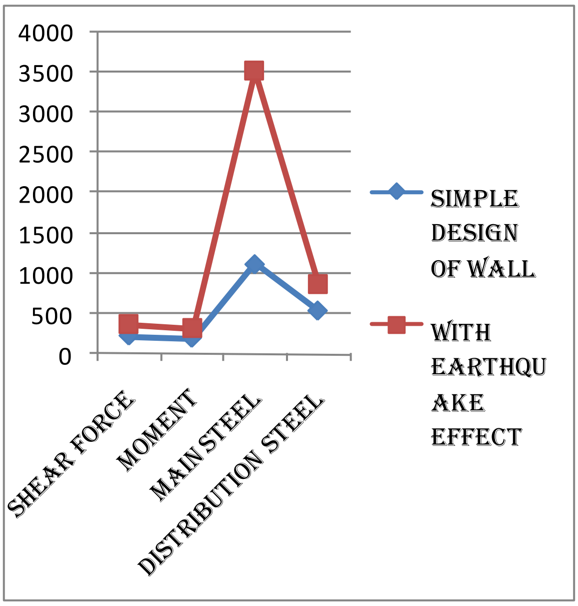

VI. CONCLUSION

The following conclusion were made from result and discussion.

ZONE II: It was observed from the graph that dimensions of the wall shows a tremendous change in length of toe projection while in case of main steel there were substantial changes from the earthquake design point of view

ZONE III: No change was observed in dimensions while there was a large change in main steel in design of heel and toe while little changes in design of stem when compared with earthquake effect

ZONE IV: Large change is observed in dimensions like height and toe projection and main steel in design of heel and stem and toe

ZONE V: Large change is observed in dimension like height and toe projection and main steel in design of heel and stem and toe and it was observed that the shear force and the moment increased by a little percentage

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