STUDY OF SEISMIC PRESSURE AND WIND LOAD ACTING ON RETAINING WALLS.

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***Abstract*— Retaining walls are structures designed to restrain soil to a slope that it would not naturally keep to (typically a steep, near-vertical or vertical slope). They are used to bound soils between two different elevations often in areas of terrain possessing undesirable slopes or in areas where the landscape needs to be shaped severely and engineered for more specific purposes like hillside farming or roadway overpasses.A retaining wall is a structure designed and constructed to resist the lateral pressure of soil, when there is a desired change in ground elevation that exceeds the angle of repose of the soil. The walls must resist the lateral pressures generated by loose soils or, in some cases, water pressures**

***IndexTerms*— Retaining wall, piling wall, cantilever wall, anchored wall, soil pressure, live load, dead load, seismic pressure**

1.0 INTRODUCTION

The problem of retaining soil is one the oldest in the geotechnical engineering; some of the earliest and most fundamental principles of soil mechanics were developed to allow rational design of retaining walls. Many approaches to soil retention have been developed and used successfully. In the recent years, the development of metallic, polymer, and geotextile reinforcement has also led to the development of many innovative types of mechanically stabilized earth retention system.

Retaining walls are often classified in terms of their relative mass, flexibility, and anchorage condition. The common types of the retaining wall are:

1. Gravity Retaining wall 2. Piling Retaining wall 3. Cantilever Retaining wall 4. Anchored Retaining wall.

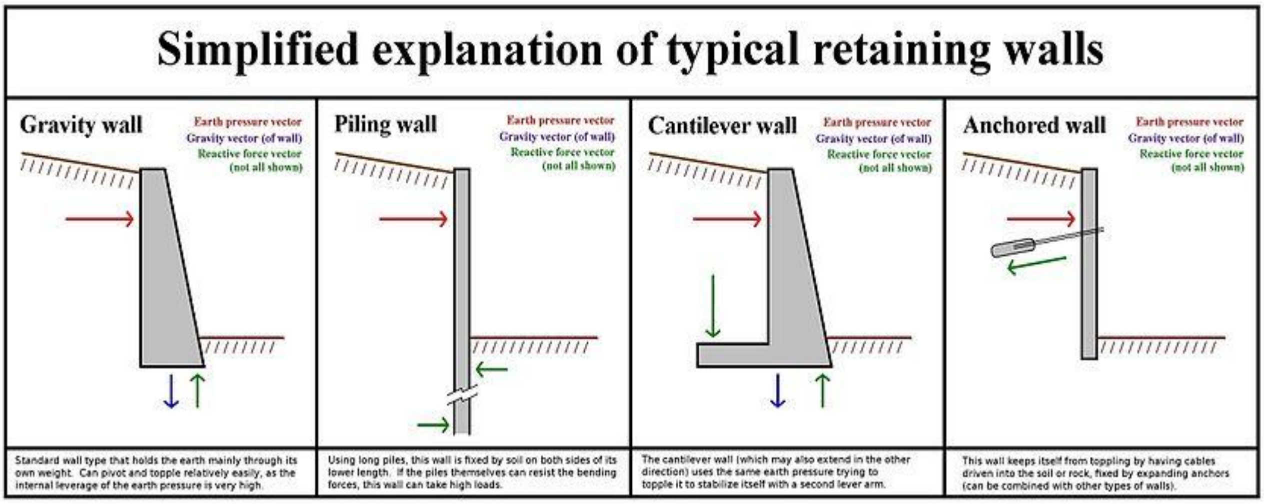

Fig. 1
Common type of Retaining Wall

Gravity Retaining walls are the oldest and simplest type of retaining walls. The gravity wall retaining walls are thick and stiff enough that they do not bend; their movement occurs essentially by rigid body translation and or by rotation.

The cantilever retaining wall bends as well as translates and rotates. They rely on the flexural strength to resist lateral earth pressures. The actual distribution of lateral earth pressure on a cantilever wall is influenced by the relative stiffness and deformation both the wall and the soil.

In the present context considering the maximum applicability of free standing gravity retaining wall the presentation is focused mainly on the seismic design and wind load analysis of gravity retaining wall.

Type of Retaining Wall Failure

To design retaining walls, it is necessary to know how wall can fail. Under static condition the retaining walls are acted upon by the forces like;

1. body forces related to mass of the wall
2. by soil pressure
3. by external forces such as those forces transmitted by braces etc.

A properly designed retaining wall will achieve equilibrium of those forces including shear stresses that approach the shear strength of soil. During earth quake, however the inertial forces and changes in the soil strength may violate the equilibrium and cause permanent deformation of the wall. Failure whether by sliding, tilting, bending or some other mechanism, occurs when these permanent deformations becomes excessive. The types of failure of retaining wall are as shown below in Fig.2.

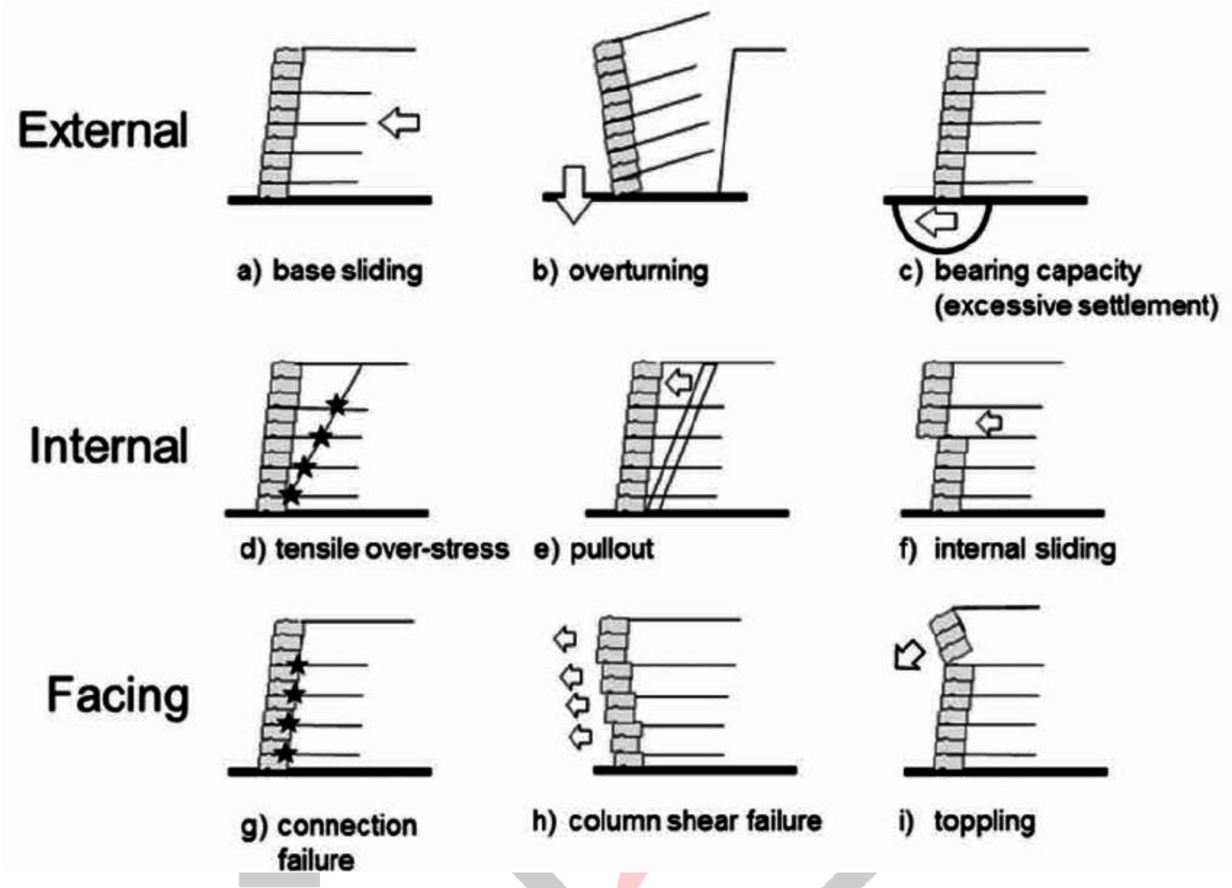

Fig.2. Typical failure mechanism of gravity wall

Gravity wall usually fail by rigid body mechanism such as sliding and/or overturning or by gross instability. Sliding occurs when horizontal force equilibrium is not maintained, that is when the lateral pressure on the back of the wall produces a thrust that exceeds the available sliding resistance of the base of wall. Overturning failure occurs, when moment equilibrium is not satisfied. In this situation bearing failure at the base are often involved.

2.0 LITERATURE REVIEW

Seismic pressure or earthquake

Earthquake loads are another lateral live load. They are very complex, uncertain, and potentially more damaging than wind loads. It is quite fortunate that they do not occur frequently. The earthquake creates ground movements that can be categorized as a "shake," "rattle," and a "roll." Every structure in an earthquake zone must be able to withstand all three of these loadings of different intensities. Although the ground under a structure may shift in any direction, only the horizontal components of this movement are usually considered critical in a structural analysis. It is assumed that a load-bearing structure which supports properly calculated design loads for vertical dead and live loads are adequate for the vertical component of the earthquake. The "static equivalent load" method is used to design most small and moderate-sized buildings.

The lateral load resisting systems for earthquake loads are similar to those for wind loads. Both are designed as if they are horizontally applied to the structural system. The wind load is considered to be more of a constant force while the earthquake load is almost instantaneous. The wind load is an external force, the magnitude of which depends upon the height of the building, the velocity of the wind and the amount of surface area that the wind "attacks." The magnitude earthquake load depends up the mass of the structure, the stiffness of the structural system and the acceleration of the surface of the earth. It can be seen that the application of these two types of loads is very different.

This movie is a representation of the movement of a free standing water tower in an earthquake. It can be seen that the as the ground moves, the initial tendency is for the water tower to remain in place. The shifting of the ground is so rapid that the tower cannot "keep up."

Wind load

The most common lateral load is a wind load. Wind against a building builds up a positive pressure on the windward side and a negative pressure (or suction) on the leeward side. Depending upon the shape of the structure it may also cause a negative pressure on the side walls or even the roof. The pressure on the walls and roof is not uniform, but varies across the surface. Winds can apply loads to structures from unexpected directions. Thus, a designer must be well aware of the dangers implied by this lateral load. The magnitude of the pressure that acts upon the surfaces is proportional to the square of the wind speed.

Wind loads vary around the world. Meteorological data collected by national weather services are one of the most reliable sources of wind data. Factors that effect the wind load include the geographic location, elevation, degree of exposure, relationship to nearby structures, building height and size, direction of prevailing winds, velocity of prevailing winds and positive or negative pressures due to architectural design features (atriums, entrances, or other openings). All of these factors are taken into account when the lateral loads on the facades are calculated. It is often necessary to examine more than one wind load case.

For this course, it will be assumed that wind loads, as well as the pressure they develop upon wall and roof elements, are static and uniform. They actually not only pound a structure with a constantly oscillating force, but also increase as a building increases in height. The loading of a tower can be very roughly approximated by an evenly distributed load. It is a vertical cantilever. The applet below allows you to investigate the variables which influence the structural behaviour of a tall, thin tower. It does not represent actual methods of calculating the total wind force on a tall building. It is intended to demonstrate the interaction between the variables of the equations which govern the structural behaviour.

3.0 CONCLUSION

The seismic behaviour of retaining wall depends on the total lateral earth pressure that develops during the earth shaking. This total pressure includes both the static gravitational pressure that exist before earthquake occurs and the transient dynamic pressure induced by the earthquake. Therefore, the static pressure on the retaining wall is of significant in the seismic design of retaining wall.

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