# CAUSES AND REMEDIES OF SLOPE FAILURES &LANDSLIDES IN MALAYSIA

**BY**

**CHIN KHEE YONG**

**(I12001260)**



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**Faculty of Science, Technology, Engineering and Mathematics**
**INTI INTERNATIONAL UNIVERSITY**

Supervisor: Md.Munir Hayet Khan

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Lastly, I have to acknowledge to my parents. They are not giving me any moral support, but also the financial contribution that occur during my progress. I would also like to give a thanks to INTI IU on giving me an opportunity to try and do a project and hopefully that in soon.I will be make use of what I'm learned so far in INTI IU for my future work.

# DECLARATION

I declare that this project is entirely may own work except where due references are made

(CHIN KHEE YONG)
(9/4/2015)

# ABSTRACT

This project report is intended primarily to serve as an subject for the undergraduate civil engineering student to complete their Diploma In Civil Engineering Program. The purpose of this project was to enables the student to do design, research, the factor and making personal decision about a given project title that is given by supervisor. For the successful of this project, student will have applied a range of techniques for generating, evaluating and selecting design concepts to meet specified requirement. It also help student for understanding the nature of design concept and needed a range of interpersonal skill.

The common factor and remedies of landslide and slope failure that I research was a interesting topic that will happen in Malaysia. After my research the common factor that cause of the landslide are, Water, Earthquake, Wildfire and Volcanoes. These factor are the cause of the landslide and earthquake.

In this situation I going to design a cantilever wall. The cantilever wall that i design dimension of 4.5m in height , located behind the mosque in Dataran Nilai, which consistency of backfill with density $\delta$= 1400 and angle of repose $\alpha$= 10°. When i go thru the design part, I realized factor has to be consider before get it into design of cantilever wall ; soil condition,types of backfill, surcharge loads, foundation stability and other factor. I also applied a formula that i has learned in the text books when doing my design part.

# CONTENTS

# Introduction

The most common of the cause are water, because water reduces the friction between the bedrock and the overlying sediment, and gravity sends the debris sliding downhill.Example the heavy rainfall that cause so many problem in Malaysia that easy having the mud slide in the high hill city like Cameron highland and Genting highland.

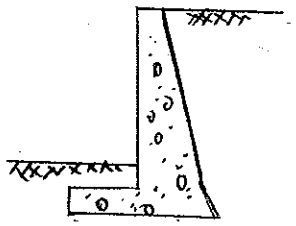
The next factor are earthquake, if the Earth's crust vibrates enough to disrupt the force of friction holding sediments in place on an incline, a landslide can strike. Next of the cause are wildfire, the plants help to stabilize the soil by holding it together like glue with their roots. When this glue is removed, the soil loosens, and gravity acts upon it much more easily. The loss of vegetation after a fire makes the razed land susceptible to slides. Lastly the volcanoes, volcanoes are the rarely happen but not in Malaysia, these cause are also can happen to landslide and slope failure.It cause a vibration to the ground and loose the grip and it has acidic ground.

The remedies of landslide that will help to reduce the cause of landslide, Design a retaining wall, improve the surface and subsurface,constructing plies and increase plant. The first and common remedies are retaining wall, these Retaining wall can provide a support for keeping soil in place,helpful in preventing flooding. Improving the surface and subsurface,to keep away from water by keeping channeling water in a line drainage.Constructing piles, it can flow out the water from keeping inside the soil,this can prevent lack of soil friction.Planting can also help to absorb water from keeping inside the soil and get to glue together by keeping in the soil together.

A retaining wall is a wall that constructed for the purpose if supporting a vertical or nearly vertical loads.It may also be used to retain water or other materials such as coal and ore,etc. It differs from other types of retaining structures because it does not required external bracing for stability. This reason , retaining wallhave been widely used in variety of purposes.

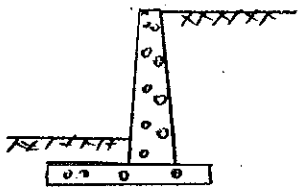
# Type of retaining wall

Retaining wall maybe classified in 6 principle types of wall shows in figure 2.These are the type of retaining wall are varied and modified to achieve the best of economy. Types of retaining wall are mentioned was gravity wall, Semi-gravity walls, Cantilever walls, Counterfort walls, buttressed walls and finally crib walls. The explanation of these wall are shown in figure 2.



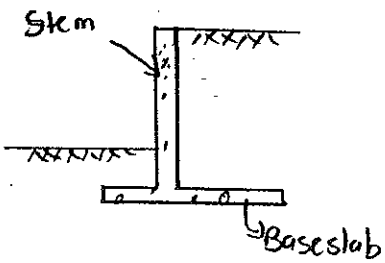
**GRAVITY WALLS**

Plain concrete, no tensile stress in any portion of wall. Rugged construction is conservative but not economical for high walls.



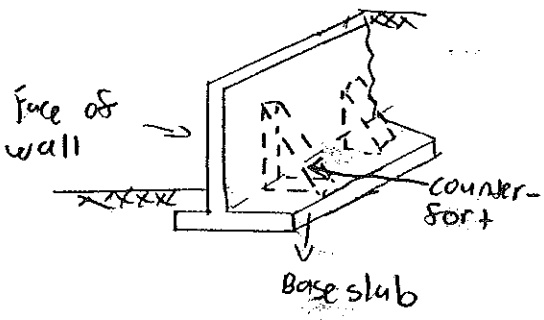
**SEMI-GRAVITY WALLS**

A small amount of reinforcement steel is used for reducing the mass of concrete



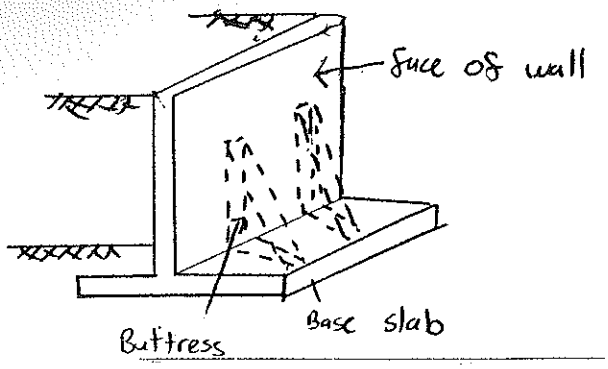

**CANTILEVER WALLS**

In the form of an inverted T, each projecting portion act as a cantilever. Generally made of reinforced concrete blocks may be used. This is a economy type of wall at small to moderate high.



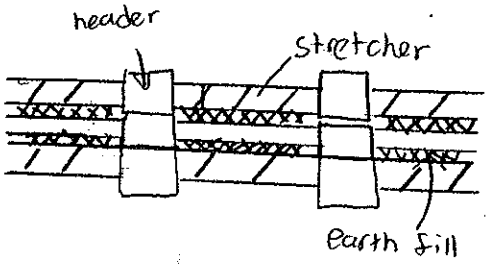

**COUNTERFORT WALLS**

Both base slab and face of wall span horizontally between vertical brackets known as counterfort. This types is suitable for high retaining walls, greater than about 18ft.




**BUTTRESSED WALLS**

Similar to counterfort wall except that the backfill is on other side of vertical brackets.




**CRIB WALLS**

Formed by timber, precast concrete or prefabricated and steel members and filled with granular soil. This type of wall is suitable for normal roadside park that are moderate height and are subjected to moderate earth pressure that are no surcharge load except earth fill

Figure 2 :Principle Type of retaining wall.

In this project , I will only design a cantilever wall. A preliminary look of the cantilever wall as shown in figure 3. Cantilever wall is a basically from by a vertical part that call face of wall, and a horizontal part are call base slab.

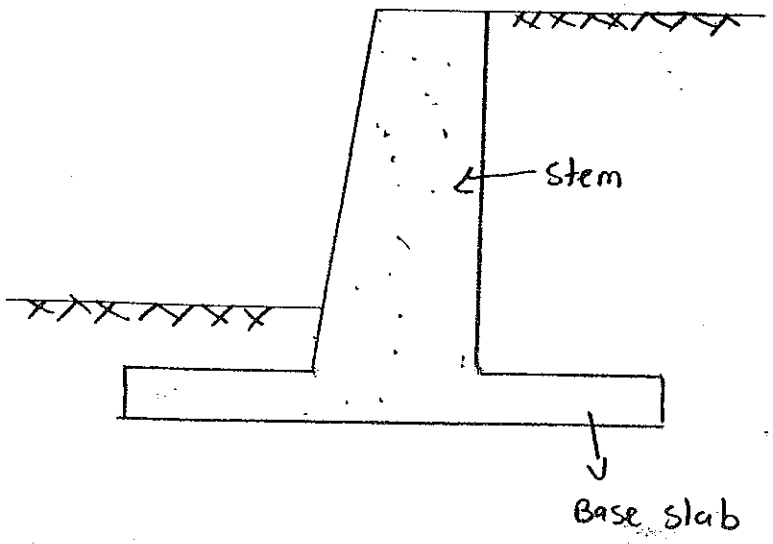



Figure 3: Cantilever retaining walls

Cantilever wall are use for moderate height wall or where there is a moderate pressure behind the wall. A cantilever wall holds back a significant amount of soil.Cantilever wall are the most common type used in retaining wall.The slab foundation is also loaded by back-fill and the weight of the back fill and surcharge also stabilize the wall against overturning and sliding.There are some of advantage and disadvantage of cantilever wall Shown in table 1

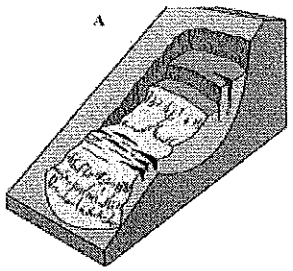
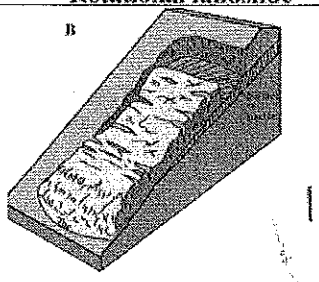
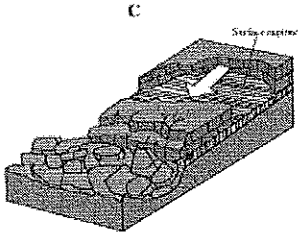
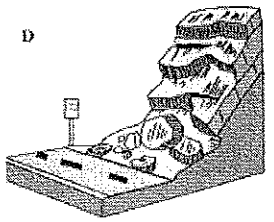
| ADVANTAGES | DISADVANTAGES |
|---|---|
| ❖ Cantilever walls offer and unobstructed open excavation<br>❖ Cantilever walls do not required installation of tiebacks below adjacent properties<br>❖ Cantilever wall offer a simpler construction procedure as the construction staging is much simpler | ❖ It can go maximum height of 18ft (6m)<br>❖ It is generally not recommended to use cantilever wall next to adjacent building<br>❖ Control of lateral wall displacements depend on the mobilization of passive earth resistance.<br>❖ Deeper cantilever excavation wall stiffness may have to be considerably increase. |

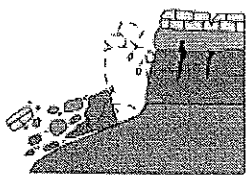
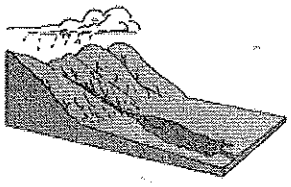
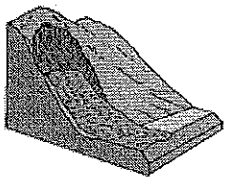
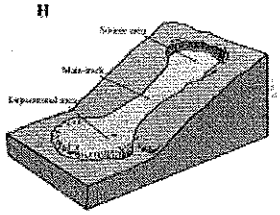
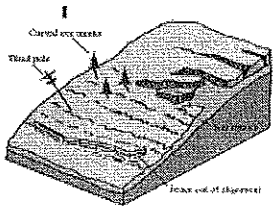
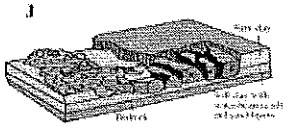
Table 1 :Advantages and disadvantages

# Type of Landslide

There are type of landslide that is happen in Malaysia.In figure 4 show the type of landslide cause.

Figure 4: Types of landslide

| | |
|---|---|
|   Rotational landslide | Rotational slide is a down-slope movement of material that occur along a distinctive surface.If slip surface is curved the slide said to be rotational.The slip surface of a rotational slide are tend to be deep.The block of failed material can be rotate as they fail and can at times be seen tilt backward and toward slope |
|   Translational landslide | In translational slides the mass displaces along a planar or undulating surface of rupture, sliding out over the original ground surface.The speed of this slide are extremely slow to extremely rapid. |
|   e Block slide | Is a translational slide in which the moving mass consists of a single unit or a few closely related units that move down slope as a relatively coherent mass. |
|   Rockfall | Falls are abrupt movements of masses of geologic materials, such as rocks and boulders, that become detached from steep slopes or cliffs. Separation occurs along discontinuities such as fractures, joints, and bedding planes, and movement occurs by free-fall, bouncing, and rolling. Falls are strongly influenced by gravity, mechanical we |

| | |
|---|---|
| E  Topple | Toppling failures are distinguished by the forward rotation of a unit or units about some pivotal point, below or low in the unit, under the actions of gravity and forces exerted by adjacent units or by fluids in cracks. |
| F  Debris flow | A debris flow is a form of rapid mass movement in which a combination of loose soil, rock, organice matter, air, and water mobilize as a slurry flows down slope.Debris flows are commonly caused by intense surface-water flow, due to heavy precipitation or rapid snow melt, that erodes and mobilizes loose soil or rock on steep slopes. |
| G  Debris avalanche | This is a variety of very rapid to extremely rapid debris flow. |
| H  Earthflow | The slope material liquefies and runs out, forming a bowl or depression at the head.A mudflow is an earthflow consisting of material that is wet enough to flow rapidly and that contains at least 50% sand, silt, and clay-sized particles. In some instances, for example in many |
| I  Creep | Creep is the imperceptibly slow, steady, downward movement of slope-forming soil and rock.The movement is within the depth of soil affected by seasonal changes in soil moisture and soil temperature.Creep is indicated by curved tree trunks, bent fences or retaining walls, tilted poles or fences, and small soil ripples or ridges. |
| J  Lateral spread | Lateral spreads are distinctive because they usually occur on very gentle slopes or flat terrain.The failure is caused by liquefaction, the process whereby saturated, loose, cohesionless sediments are transformed from a solid into a liquefied state.Failure triggered by rapid ground motion such as earthquake. |

# Design of Retaining wall (Cantilever wall)

Like any other construction of wall, several factors has to be solve before stepping into design of a structure. The procedure of retaining wall design generally comprises of the following steps :

A ) Assemble the general information : topographical and physical survey, controlling the dimensions.

B) Analyses the subsoil conditions : Soil profile.

C) Establish surcharge loads : Building highway and other structures.

D) Select type of retaining wall.

E) Compute earth pressure.

F) Check structural stability.

G) Check the foundation stability.

H) Design structural element.

I) Assume the movement of wall and settlement.

**A) General Information**

The general information that influences the design of retaining wall includes :

-Topography of the site: This includes the location of existing structures and utilities.

-Controlling dimension : These are the elevation at top of wall, the elevation and the slope , the location and batter of the face of wall, and the property line if it is close by.

-Frost line : If the wall is located at water front, including the depth of scour or erosion.

**B) Subsoil conditions**

Soil borings and tests should be made to provide sufficient information for the following purpose:

- ✧ Selecting type of foundation: Retaining wall may be supported on footings, piles or drilled caissons. Retaining walls should be supported on footings.If is supported on piles lateral earth pressure must be resisted by batter piles.
- ✧ Determination of bearing value: Footing or piles.
- ✧ Stability analysis: Determine shear strength of soil.
- ✧ Investigation of lower strata : Study the failure and settlement due to weak soil.

**C)Surcharge loads**

Retaining wall will be subjected to surcharge loads directly on the wall as well as on the backfill. The magnitude of such loads should be accurately. The load carried by a foundation should be established on the basis of the structure. For other types of structures, only a part of design live load may act. In other situation, retaining wall may be subjected to other forces such as earthquake force, seepage and water pressure.

**D) Proportions of retaining walls**

The design of a retaining wall will begin with a trial section having tentative dimensions. This section is to analyses for stability and structural. This is to design the proportion to give design conditions. The following design will give the trial section.

**Gravity walls**

Gravity wall are primarily trapezoid shape, possibly with the base projecting beyond the face and back of wall. The back of projection may be only 4 to 6 inch. The toe projection can extend further for the purpose of reducing the soil pressure. The top of the wall should not be made less than 9 inch wide to allow proper placement of concrete.

**Cantilever walls**

The wall encountered under normal conditions are shown in figure 5. Since retaining walls are designed of active earth pressure which is associated with a small batter to overcome for the forward tilting.

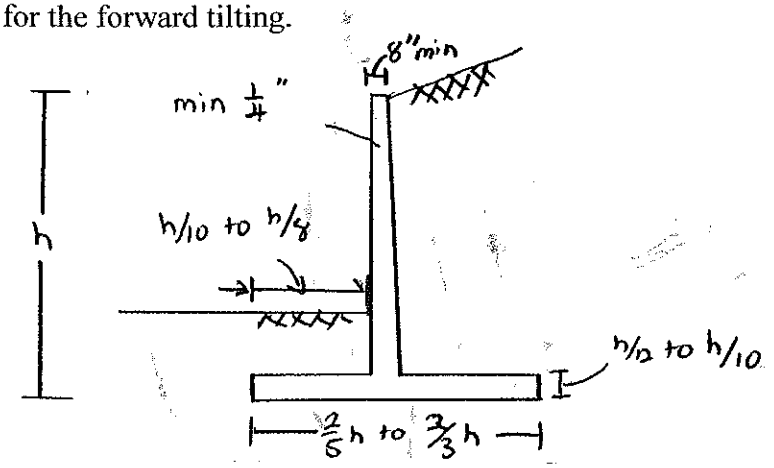



Figure 5 :Proportions of cantilever walls.

**Counterfort walls**

The proportion of counterfort walls, figure 5 vary to a greater extent than that of cantilever walls because the thickness of face and base slab depends primarily on the spacing of counterforts.

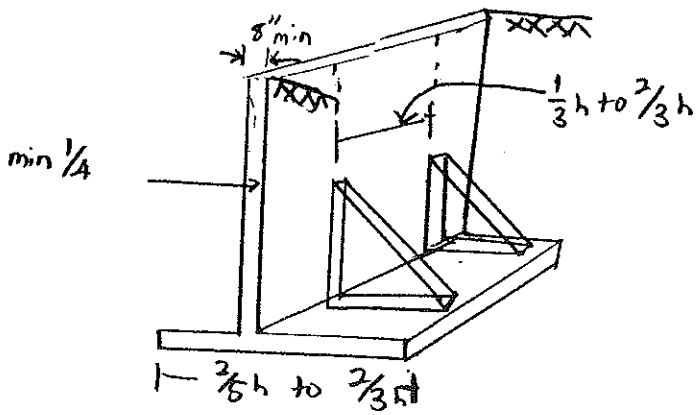



Figure 6: Proportion of counterfort walls.

**Crib walls**

Crib walls are usually constructed with a minimum batter of 2 in/12 in. The base width or depth of wall range form 50% to 100% of the height of wall. The manufacturers catalogs should be consulted before making the design analysis. Figure 7 shows the proportion of crib walls.

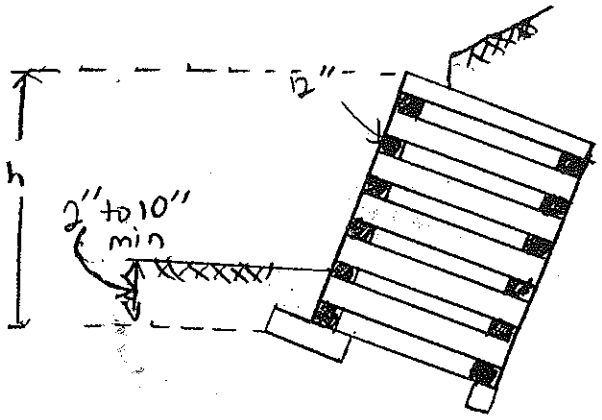



Figure 7: Proportional of Crib walls

E) **Earth pressure computation**

Since earth pressure varies considerably with the type of backfill, a careful examination of the contemplated backfill material is warranted. The soil containing a large amount of clay, and organic matter should be avoided because such soils exert excessively large earth pressure. They should be carefully compacted by the use of sheep-foot roller so that all the chunks are broken up and no voids are left in place. Free-draining granular soils should be use because it can help to save cost of retaining wall.

The lateral earth pressure against retaining wall may be computed by Rankine theory. The Rankine theory deals with lateral earth pressure against a vertical plane at inside the soil mass, figure 8 provide that the ground surface is a plane and that the shear zone, or sliding surface. Normally this is the case of cantilever wall and counterfort wall. The position of the sliding surface in terms of the angle of repose $\alpha$ may be determined by the equation show in figure 8