IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 7.105 ⁜ Vol. 9, Issue 6, June 2022

DOI: 10.17148/IARJSET.2022.9641

ANALYSIS & DESIGN OF CANTILEVER RATAINING WALL

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Abstract: Structures which are used to hold back a soil mass are called retaining structures. Our project is to design retaining wall for a minor bridge. As the metro Road project is running through Latur Almala Roadway, there is a need for the extension of 4 lane carriage way to 6 lane carriage way. But the carriage way includes a minor bridge, which too has to be extended for facilitating the traffic flow. Thus, this project focuses on the design of retaining wall for the modified section of the minor bridge.

Retaining walls are the structures designed to restrain soil to unnatural slopes. They are used to bound soils between two different elevations in areas of terrain possessing undesirable slopes. They are also used in areas where the landscape needs to be shaped severely and engineered for more specific purposes like hillside farming or roadway overpasses. They are also used in bridge abutments and wing walls.
The design of structures like retaining wall requires the knowledge of the earth pressure acting on the back of the wall because of the soil backfill in contact with it. Hence relation between the earth pressure on the retaining wall and strains within a backfill is a prerequisite. The project also includes the estimation of safe bearing capacity of soil and its properties, earth pressure calculations and design criteria of a modified section of a retaining wall. The design criteria includes: check for stability against sliding, overturning and bearing capacity.

INTRODUCTION

A soil mass is stable when the slope of the surface of the soil mass is flatter than the safe slope. At some locations where the space is limited, it is not possible to provide flat slope & the soil is to be retained at a slope steeper than the surface one. In such cases, a retaining structure is required to provide lateral support to the soil mass. Retaining walls are relatively rigid walls used for supporting the soil mass laterally so that the soil can be retained at different levels on the two sides. Generally, the soil masses are vertical or nearly vertical behind the retaining structure. Thus, a retaining wall maintains the soil at different elevations on its either side. In the absence of a retaining wall, the soil on the higher side would have a tendency to slide and may not remain stable. However for a minor bridge of span 15 m a retaining wall is constructed without considering the slope factor but only the soil properties.

The project concentrates on the designing of a retaining wall located on Latur Almala Roadway the road in this region is extended for two lanes, from four lane road ways to six lane road way to accommodate free traffic flow because of road construction process. The minor bridge located in this region is also to be extended. Thus, our project is been cleared with the design of a retaining wall to this bridge on one side and hence replicating it to remaining.

Structures which are used to hold back a soil mass are called retaining structures. Retaining walls, sheet pile walls, crib walls, sheeting in excavations, basement walls, etc., are examples of retaining structures. A retaining wall helps in maintaining the ground surface at different elevations on either side of it. Without such a structure, the soil at higher elevation would tend to move down till it acquires its natural, stable configuration. Consequently, the soil that is retained at a slope steeper than it can sustain by virtue of its shearing strength, exerts a force on the retaining wall. This force is called the earth pressure and the material that is retained by the wall is referred to as backfill. The gravity retaining wall is the simplest type of retaining wall along with other common types of retaining walls such as the cantilever, and the counter fort walls.

LITERATURE REVIEW

Literature 1 - Design of Free Cantilever, Counter fort and T-flanged Cantilever Type Retaining Wall.
ISSN: 2249-8958 (Online), Volume-8 Issue-6, August 2019 … (IJEAT)

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Retaining walls are widely used as permanent structures for retaining soils at different levels. Type of the wall depends on the soil pressure, such as active or passive earth pressure and earth pressure at rest and drainage conditions. Types of walls generally used are gravity walls, RCC walls, counterfort walls and buttress retaining walls. Retaining walls behavior depends on the wall height and retention heights of the soil at its backfill. Retaining walls are used with tying with more than one wall at perpendicular joints to retain liquids, water storage and materials storages such as dyke walls and tanks. Retaining walls excessively used in culverts and as well as in the bridges for construction of abutment wing walls supposed to resist soil pressures laterally applied perpendicular to the axis of the walls.Based on the present scenario used in retaining structures within the civil industries there requirements of height of walls are being increased due to lake of land and cost of sub structures being incurred in the project work, higher height of walls develops huge bending moment at the base because of the cantilever action of the walls, thus resulting in higher sections at the base which deploys into a uneconomical zone so different wall systems are required in different arrangements so as to transfer the loads with limited sections. In the present study retaining walls of height 6m, 9m and 12m are considered for study and the length of the walls considered as 30m and the material properties considered are M20 and Fe415 steel bars and the supports considered to be fixed at the base.

AREA OF STUDY

RETAINING WALL

A retaining wall is a structure that retains holds back any material usually earth and prevents it from sliding or eroding away. It is designed so that to resist the material pressure of the material that it is holding back.

TYPES OF RETAINING WALLS

There are five common types of retaining walls. They are

Gravity Retaining wall
Cantilever Retaining Wall
Counter-fort Retaining Wall
Piling Retaining wall
Anchored Retaining Wall

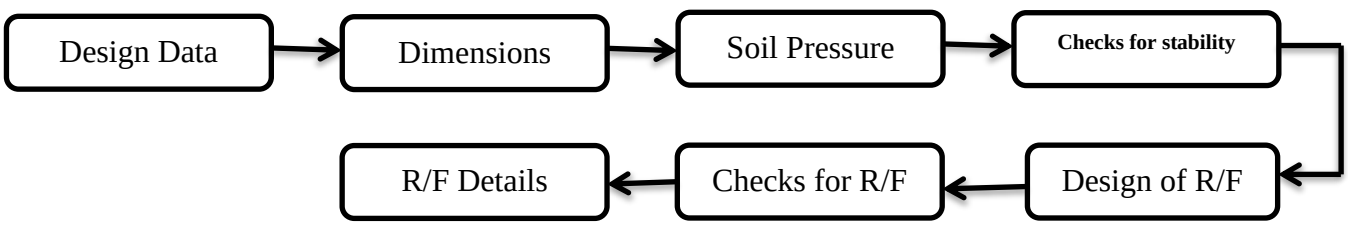
Loads acting on the retaining walls can be classified based on load categories such as self weight of the wall, lateral loads from the soil, water table effect, the superimposed load with the provision of vehicles transportation and the earthquake loads originating from the vibrations of the ground

1. Dead load
2. Soil pressure
3. Surcharge load
4. Seismic loads

When a soil mass is retained at a higher level by a retaining wall, the retained mass of the soil tends to slide and assume a flat slope for equilibrium, which is resisted by the retaining wall.

1. Active earth pressure
2. Passive earth pressure
3. earth pressure at rest

METHODOLOGY



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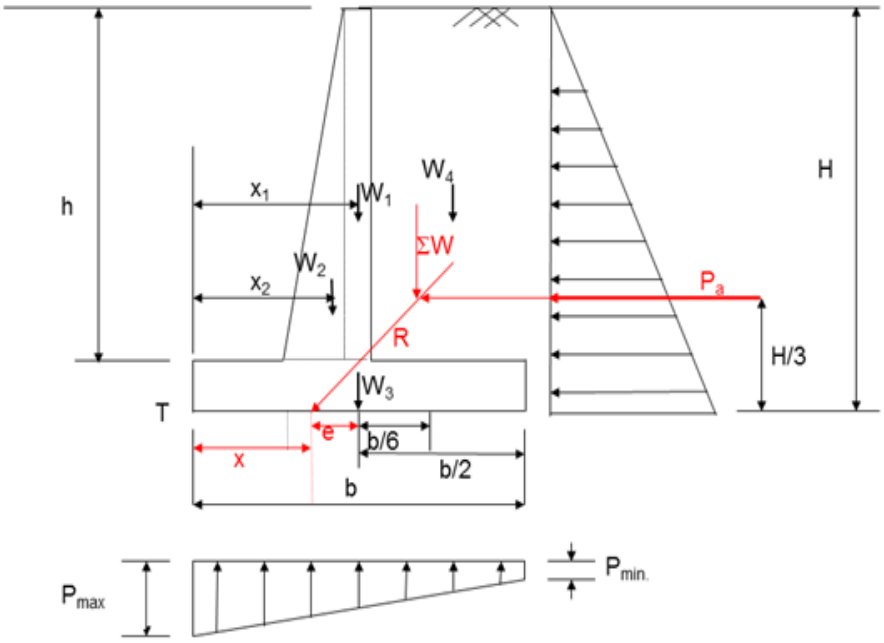
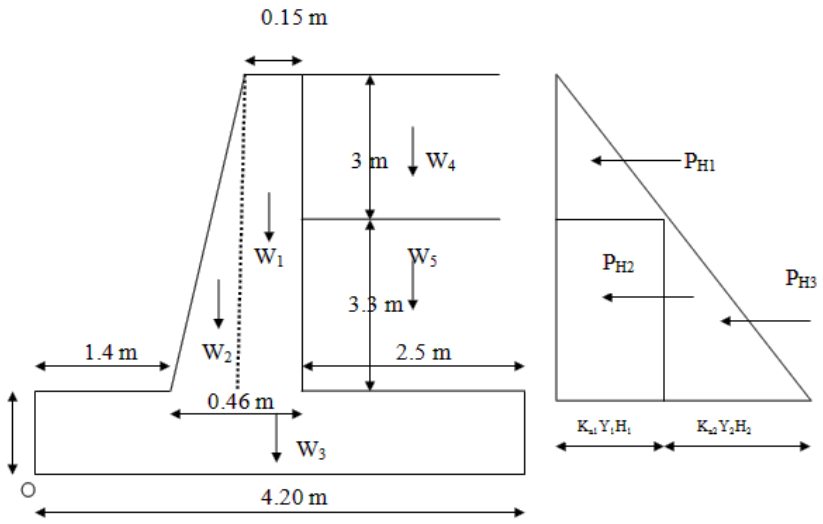
DESIGN OF CANTILEVER SHAPE RETAINING WALL:

Location : Latur – Nanded Highway Road Way Bridge over Manjra River.



Soil Layer – Two Layer Soil.
Upper layer height = 3m, Φ=30°, γ=18 kn/m³
Lower layer height = 3m,Φ =30° , γ =19kn/m³.
Safe Bearing Capacity of strata = 160 Kn/ m².
The coefficient of friction between slab & strata = 0.52.
Concrete grade = M20.
Grade of Steel = Fe 415.

Design Details –



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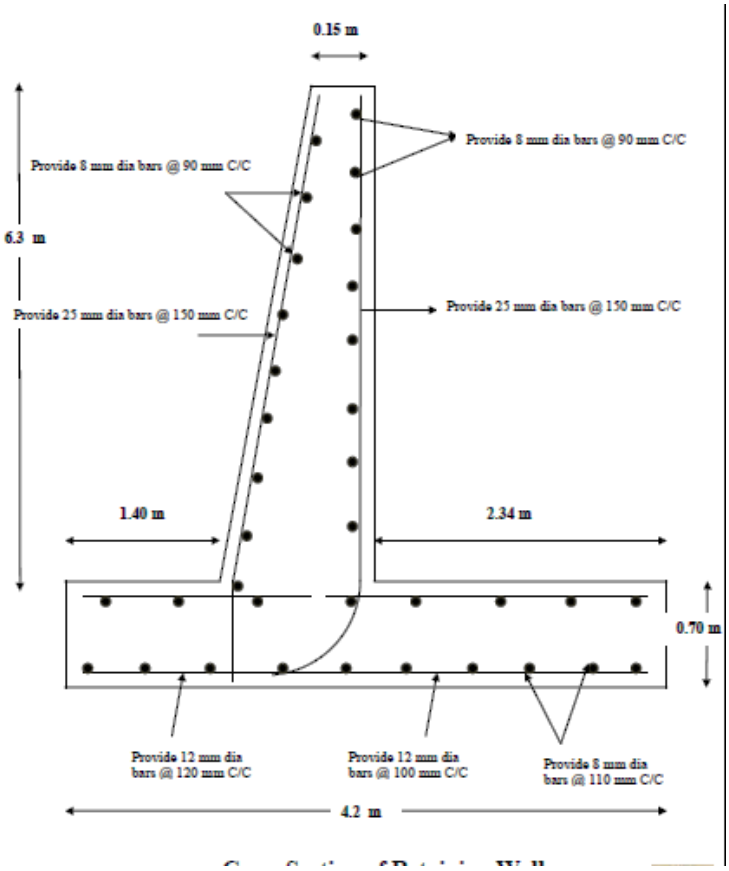
S.N.	Particular	Design BM (KN-M)	Design SF (KN)	Main R/F	Distribution R/F
01	**Stem**	374.256	179.505	Provide 25 mm dia bars @ 150 mm C/C	Provide 8 mm dia bars @ 90 mm C/C
02	**Toe**	141.52	196.245	Provide 12 mm dia bars @ 120 mm C/C	Provide 8 mm dia bars @ 110 mm C/C.
03	**Heel**	211.66	180.93	Provide 12 mm dia bars @ 100 mm C/C	Provide 8 mm dia bars @ 110 mm C/C

Check against Overturning

F.O.S. $= \frac{M_R}{M_0} = \frac{1063.14}{309.38}$ = **3.43 > 1.55 = safe**

Check against Sliding

F.O.S. $= \frac{\mu \sum W}{P_H} = \frac{0.52 \text{ X } 394.6}{119.67}$ = **1.71 > 1.55 = safe**



CONCLUSION

We took existing four lane retaining wall as an example and designed retaining wall for the six lane road way. Each section has been analyzed for failure against sliding, overturning, tension and bearing capacity. After doing trials for many sections, we got a section satisfying all the safety conditions, approximating the standard dimensions of a gravity retaining wall.

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The location of minor bridge being in rocky strata, with mourm soil, we got a high bearing capacity value. Taking this as a reference, we also designed two economical sections with reduced dimensions. Hence, apart from the main modified section other two sections can also be considered to make the project economical, which is the main philosophy behind the project.

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