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Different Soil Pressure Studies of Prefabricated and RCC Wall Constructions

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Abstract — The widespread use of retaining walls has stimulated research into new wall construction techniques that are acceptable, clean, fast and cost-effective. Among several innovations, the technique of joining bricks without mortar is extremely promising. This will be easiest with the concept and implementation of the sustainability of the wall against the stresses caused by land use. Retaining walls are medium-rigid structures designed to retain soil laterally so that it can be held at different levels on either side. The ANSYS software tool is used to test the strength properties of these walls. Similarly, using the unique interlocking building block below not only reduces the amount of human labor required, but also increases performance. These blocks are easily portable from one place to another. This article is developed for the construction of such interlocking masonry, specifically how to increase the speed of wall construction, the effects of brick laying on the accuracy of wall alignment and wall guidance (recommended deformation, deformation) under lateral stress. This study includes analysis of interlocking precast structural block retaining wall and evaluation of precast RCC wall for a range of design parameters.

Keyword: Retaining Wall, Integrated (Precast), SSI, ANSYS, soil Pressure.

I. INTRODUCTION

Ancient Roman engineers used mortar, which they quickly poured into molds, to build their amazing system of water pipes, canals, and roadways. Pre-engineered technologies are used in a variety of engineering and utility applications, including individual parts or even entire structural systems. Prefab frame structures were advocated in Liverpool during the peak era, an idea that was not widely accepted in Britain. In any case, it was widely adopted around the world, especially in Eastern Europe and Scandinavia. Precast concrete has grown up in the United States as two distinct sub-industries that are inextricably linked. The National Precast Concrete Association (NPCA) places great emphasis on efficiency, underground and other non-precast items in the field of precast concrete goods. Precast concrete systems. The market is dominated by precast concrete modules and other precast concrete components used in overhead structures such as installations, suspension bridges and scaffolding. The Institute of Prefabricated / Prestressed Concrete is largely involved in this sector. (PCI)

A. Soil Structure Interaction

The interaction between the soil and the structure built on it is called soil-structure interaction. Soil-structure interaction refers to the mechanism by which soil response affects structure motion and structure motion affects soil response. There are two forms of soil structure interaction. There are two types of interactions: a) kinematic interaction and b) inertial interaction. Earthquake motion creates free-field motion in the soil and foundations buried in the soil that do not follow the free-field motion. Kinematic interaction is due to the inability of the foundation to match the motion of the free field. The mass of the superstructure imparts an inertial force to the ground which causes the soil to deform, known as inertial interaction. The purpose of this study is to analyze and construct an integrated retaining wall with an emphasis on soil-structure interaction.

B. Retaining Wall

Retaining walls are relatively strong walls that are used to cover the soil laterally so that it can be retained on either side at different levels. Retaining walls are structures built to retain soil on a steep, nearly vertical, or vertical slope to which it would not normally adhere. They are used to bind soil in areas where often unfavorable hills are located between two different elevations or where the landscape must be strictly shaped and built for more specific slope management. A barrier wall behind and water in front is called a seawall or bulkhead. A retaining wall or something like the edge of a terrace or trench. A retaining wall is a built and installed prepared structure that resists the lateral pressure of the soil if the height of the terrain exceeds the rest of the angle of the terrain. However, the word commonly refers to a retaining wall, which is a standing structure without sides. They lift off the leg and climb over one side of the grain they are used to. Walls must in certain cases resist lateral pressures caused by loose soil or water pressure.

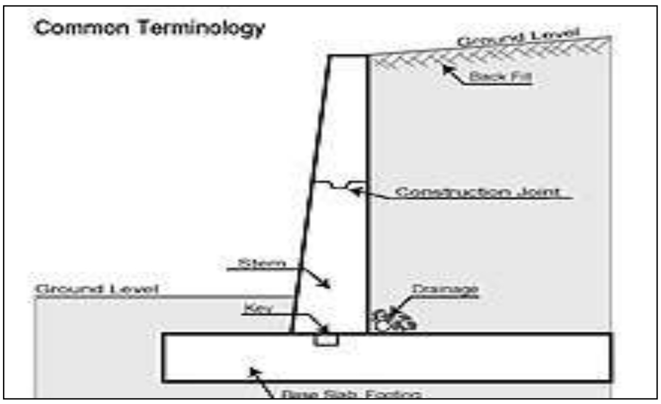


Fig. **1** Retaining wall

Each retaining wall is protected by a soil wedge. A wedge is known as the soil exceeding the adequate value of the soil pressure developed at the site and can be measured as the soil friction angle. As the wall inversion increases, the sliding wedge becomes smaller. A key factor in the proper design and construction of retaining walls is to understand and combat the tendency of retained material to move downslope due to its gravity. This creates a lateral earth pressure behind the wall that is dependent on the internal crack of the retained material and the cohesive strength (c), the direction and degree of movement of the supporting structure.

II. PRECAST RETAINING WALLS

An extended type of traditional casting method is interlocking bricks. In this type of system, the block is designed to be locked to another block without the use of mortar. Castle high-quality bricks are made of cement, sand and stone dust in suitable proportions. The components are proportionally filled and mixed. When the appropriate mixture is prepared, the bricks are pressed into the desired interlocking patterns.

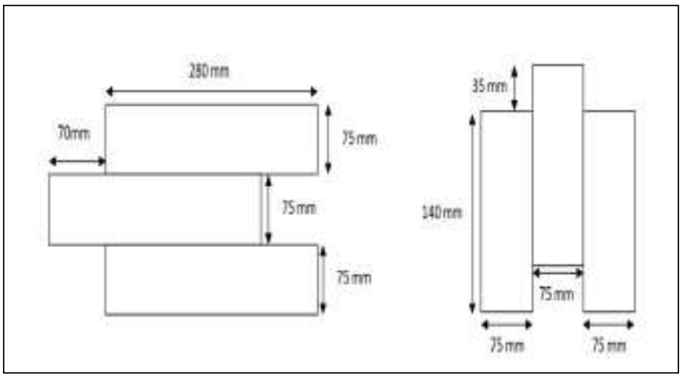


Fig. 2 Interlocking block

Fig.3 Top view of precast interlocking block

Two cases of walls are considered as follows:

- CASE A: All sides are fixed.
- CASE B: Only bottom is fixed.

This case is further analyzed for 4m height

A. CASE 1: Dry leveled back fill.

- Consider 4m Height:

H=4m

Dry cohesion less sand (Ø) = 30º

Unit weight of dry soil (ɣ) = 18 kN/m^3

Passive pressure obtained (Pp) =0.216Mpa

Active pressure obtained (Pa) =0.024Mpa

B. CASE 2: Moist leveled backfill.

Backfill is dry for height H_1 from the top and Submerged for the remaining height H_2.

- Consider 4m Height:

H_1=1.5m

H_2=2.5m

Two layered soil:

($Ø_1$)= 30º

($Ø_2$)= 28º

Unit weight of dry soil

($ɣ_1$) = 18 kN/m^3

($ɣ_2$) = 12.19 kN/m^3

Passive pressure obtained (Pp)=0.165135 Mpa

Active pressure obtained (Pa)= 0.020016 Mpa

III. RESULT'S AND CONCLUSIONS

A. Comparison of RCC and Precast Wall

In this section, different types of retaining walls subjected to different loads and soils are compared for a height of 4 m. For Research Comparison of RCC and Precast Walls for Dry Soil Pressure and Wet Backfill Pressure.

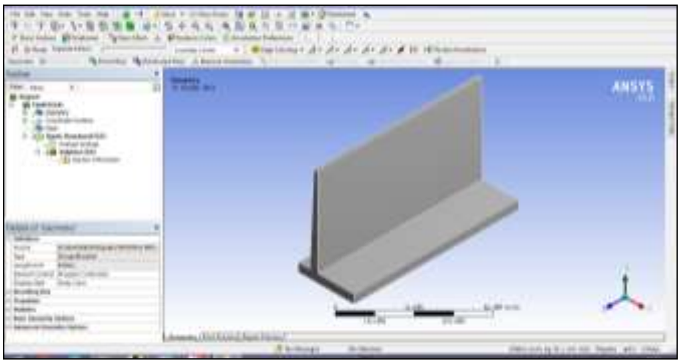


Fig.4 RCC Wall modelling in ANSYS

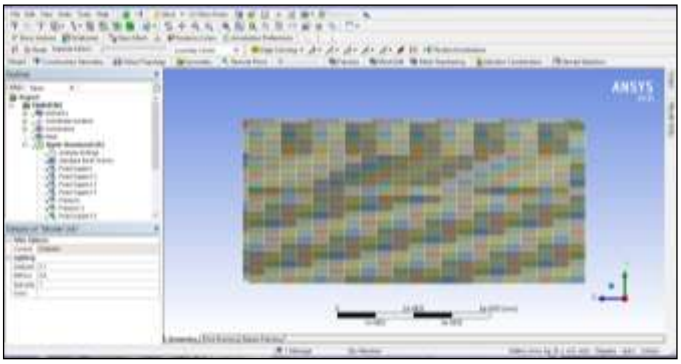
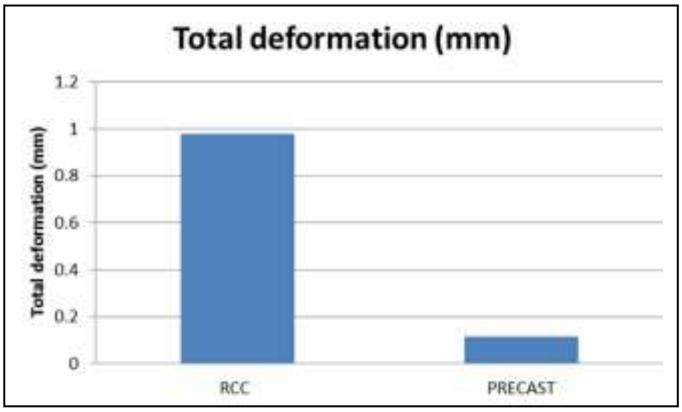


Fig.5 Precast Wall modelling in ANSYS

Table 1 Total deformation Dry soil pressure

Total deformation (mm)		
Height in m	**RCC**	**PRECAST**
4	0.98	0.116

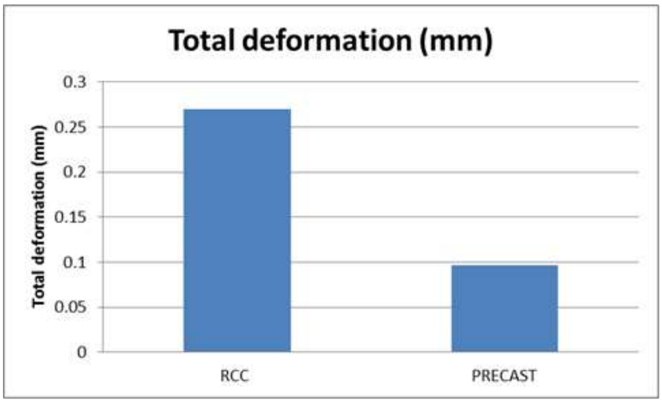


Graph 1 Total deformation Dry soil pressures

The above graph shows the total deformation result for dry soil pressure on precast and RCC retaining wall, compared to RCC wall, precast wall has less deformation by 0.88mm.

Table 2 Total deformation Moist leveled backfill soil pressure

Total deformation (mm)		
Height in m	**RCC**	**INTEGRATED**
4	0.27	0.097



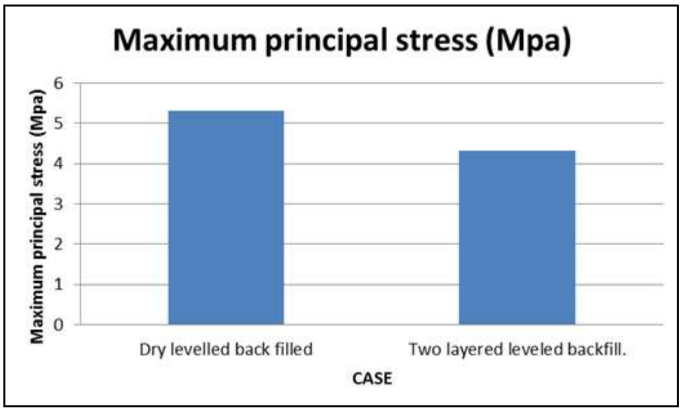
Graph 2 Total deformation Moist leveled backfill soil pressure

The above graph shows the result of total deformation for the pressure of moist leveled backfill soil on integrated and RCC retaining wall, compared to RCC wall, integrated wall has less deformation by 0.173mm

B. Case A: All Sides Of Wall Are Fixed

Table 3 Maximum principal stress (Mpa)

Maximum principal stress (Mpa)		
Height in m	**Dry levelled back filled**	**Two layered levelled backfill.**
4	5.31	4.32



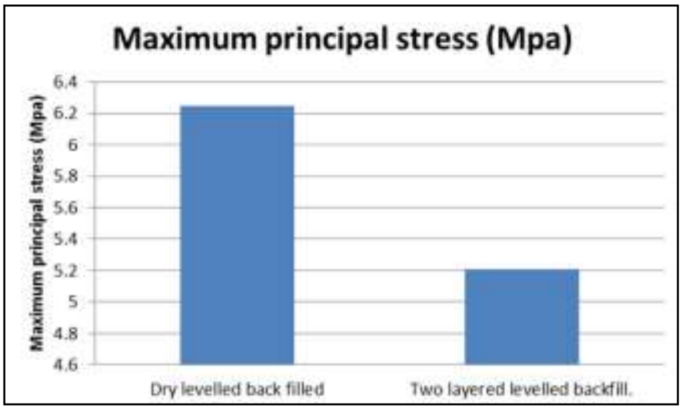
Graph 3 Maximum principal stress (Mpa)

The graph above shows the result of the case where all sides of the wall are fixed, the maximum principal stress for dry soil pressures and the two-layer soil pressure on the precast retaining wall, according to the pressure on the wall, the precast wall with Maximum principal stress for dry soil pressures is more.

C. Case B: Only Bottom Is Fixed

Table 4 Maximum principal stress (Mpa)

Maximum principal stress (Mpa)		
Height in m	**Dry levelled back filled**	**Two layered levelled backfill.**
4	6.25	5.21



Graph 4 Maximum principal stress (Mpa)

The graph above shows the result of the case where only the bottom is solid, the Maximum principal stress for dry soil pressures and the pressure of two layers of soil on the precast retaining wall, according to the pressure on the wall, the precast wall with the maximum principal stress for dry soil pressures is larger.

For this analysis, precast walls were analyzed for two soil pressures Dry soil pressures and two-layer soil pressures compared to two cases; in case A all sides of the wall are solid and in case B only the bottom is solid for a prefabricated wall. According to the analysis for both earth pressures, the precast wall with all solid sides has the best performance

IV. CONCLUSION

- The concept, design and application of block prefab design will prove to be an effective example of a sustainable approach to construction.
- According to the analysis done in ANSYS, it is clearly seen that the deformation of the precast block retaining wall is less than that of the RCC wall, which is safe enough.
- It is clearly seen that when the RCC wall is compared to the precast wall, the stresses induced in the precast wall are very less as compared to the RCC wall.
- These blocks are easy to transport and easy to build
- Precast concrete is able to monitor the key factors regulating building quality such as curing, temperature, mixing design, coating, etc. This makes it possible to improve building quality.
- An efficient construction cycle saves time, increases efficiency, quality and safety, thereby reducing costs.
- A prefabricated building has a longer lifespan and low maintenance costs. High density precast concrete is more resistant to acid, corrosion, impact, surface vacuum and remains resistant to dust accumulation.
- To compare RCC wall and precast wall for total deformation, normal stress, Max. Main stress. And we concluded that all results for precast wall average 10-15% less than RCC wall so precast wall is recommended.

V. REFRENCES

[1] Aikaterini Alexiou, Dimos Zachoset. al. "Construction Cost Analysis of Retaining Walls" International Journal of Engineering and Advanced Technology Volume-9 Issue-4, April 2020 pp 1-6

[2] SeunghoKim , Dong-Eun Lee et. al. "Development and Application of Precast Concrete Double Wall System to Improve Productivity of Retaining Wall Construction" MDPI April 2020, pp 1-12

[3] Pulatsu, Bora, et al. "Advanced Analysis of Masonry Retaining Walls Using Mixed Discrete-Continuum Approach." Proceedings of the Institution of Civil Engineers - Geotechnical Engineering, no. February, 2020, pp. 1–34, doi:10.1680/jgeen.19.00225

[4] S. S. Deshmukh, Volume, and Issue Vi. ISSN NO: 1076-5131 "Seismic Analysis Of Interlocking Blocks Of Wall." no. 1594, 2019, pp. 1594–615

[5] Hassanli, Reza, et al. "Pre-Stressed Segmental Retaining Walls (PSRWs)." 2019, pp. 187–96, doi: 10.1007/978-3-030-01944-0_14

[6] Vinay B. Chouhan et. al. "Limit analysis of retaining wall with relief shelves under static surcharge loading using FEM" (2021)

[7] B. S. Tasildar et. al. "Stability of retaining wall under seismic load" (2016)

[8] Ashoke K. Chugh et. al. "Soil structure interaction of retaining wall" (2016)

[9] V. B. Chauhan, S.M.Dasak et. al. "Numerical study on the behavior of rigid retaining wall with relief shelves" (2015)

[10] R. J. Balwan & Ajitkumar Kumbhar et. al. "Integrated retaining wall : A case study" (2011)

IS CODES:

*i. **IS 456 : 2000** -Plain and Reinforced Concrete Code of Practice. - BUREAU OF INDIAN STANDARDS, NEW DELHI.*

***ii. IS Code 1893:2002 -** Criteria For Earthquake Design of Structures*