DESIGNING OF RETAINING WALLS

A Project Report Submitted in partial fulfilment of the requirements for the award of the degree

of

BACHELOR IN

TECHNOLOGYIN

CIVIL ENGINEERING

Under the

supervisionof

Dr. ASHOK KUMAR GUPTA

(Professor & Head)

by

UDAY VERMA [161672]

ADITYA RANA [171618]

to

JAYPEE UNIVERSITY OF INFORMATIO TECHNOLOGY,

WAKNAGHAT, SOLAN –

173234 HIMACHAL-

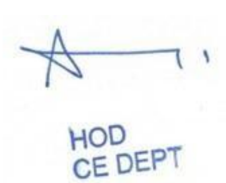
PRADESH, INDIA

May, 2021

CERTIFICATE

This is to certify that the work which is being presented in the project report titled "**DESIGN OF RETAINING WALLS"** in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering submitted to the Department of Civil Engineering,**Jaypee University of Information Technology, Waknaghat** is an authentic record of work carried out by **UDAY VERMA [161672], ADITYA RANA [171618]** during a period from September, 2020 to December, 2020 under the supervision of **Dr. Ashok Kumar Gupta.** Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

Date:-16-05-2021



Signature of supervisor	**Signature of HOD**	**Signature of**
Dr. Ashok Kumar Gupta	**Dr. Ashok Kumar Gupta**	**External Examiner**
Professor and Head	Professor and Head	
Civil Engineering Department	Civil Engineering Department	
JUIT, Waknaghat	JUIT, Waknaghat	

STUDENT DECLARATION

I hereby declare that the work presented in the Project report entitled **"DESIGN ON RETAINING WALLS"** submitted for partial fulfilment of the requirements for the degree of Bachelor of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Dr. Ashok Kumar Gupta.** This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.

Signature of Students

Name

Roll no:-

Uday Verma [161672] **Aditya Rana [171618]**

Department of Civil Engineering

Jaypee University of Information Technology,

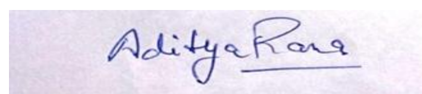
Waknaghat, India

Date :- 16-05-2021

ACKNOWLEDGEMENT

We like to share our sincere gratitude to all those who help us in completion of this project. During the work we faced many challenges due to our lack of knowledge and experience but these people help us to get over from all the difficulties and in final compilation of our idea to ashaped sculpture. We would like to thank **Dr. Ashok Kumar Gupta** sir for his guidance, monitoring and continuous help during the project work. In the last we would like to thank staff of department of civil engineering **JUIT** for providing us such an opportunity to learn from these experience. We are also thankful to our whole class and most of all to our parents who have inspired us to face all the challenges and win all the hurdles in life.

Thank you all



UDAY VERMA **ADITYA RANA**

[161672] **[171618]**

LIST OF FIGURES

TABLE OF CONTENTS

CONTENTS **PAGE NO.**

LIST OF ABBREVIATIONS

A	Area
Ast	Area of steel
b	Breadth of beam or shorter dimension of rectangular column
D	Overall depth of beam or slab
DL	Dead load
d1	Effective depth of slab or beam
D	Overall depth of beam or slab
Mu,max	Moment of resistance factor
Fck	Characters tic compressive strength
Fy	Characteristic strength of of steel
Ld	Devlopment length
LL	Live load
Lx	Length of shorter side of slab
Ly	Length of longer side of slab B.M. Bending moment
Mu	Factored bending moment
Md	Design moment
Mf	Modification factor
Mx	Mid span bending moment along short span
My	Mid span bending moment along longer span
M’x	Support bending moment along short span
M’y	Support bending moment along longer span

pt	Percentage of steel
W	Total design load
Wd	Factored load
Tc max	Maximum shear stress in concrete with shear
Tv	Shear stress in concrete
Tv	Nominal shear stress
ϕ	Diameter of bar
$M_{u,lim}$	Limiting moment of resistance of a section without compression reinforcement
M_{ux},M_u	Moment about X and Y axis due to design loads
M_{ux1},M_{uy1}	Maximum uniaxial moment capacity for an axial load of p_u, bending moment x and Y axis respectively
A_c	Area of concrete
A_{sc}	Area of longitudinal reinforcement for column
Pu	Factored axial load

ABSTRACT

The main goal of this project is to use Staad Pro to study and build retaining walls. Manual measurements and an examination of the structure using Staad Pro are part of the plan. The Indian Standard Code of Practice is followed by using the Limit State Design approach in Staad Pro for study. A state-of-the-art user interface, simulation tools, efficient analysis, and design are all attributes of Staad Pro. The method has been considered he professional's option for modelling, research, and architecture, as well as simulation and outcome checking. The outcomes turned out to be spot-on. We first calculated and constructed a retaining wall for all potential load configurations (dead and live loads). The user interface in Staad Pro is very immersive, allowing users to draw the frame and input the load values and measurements. The configuration is then analysed and participants with reinforcement information for RCC frames are designed based on the given parameters. The proper study and construction of retaining walls was our final project.

CHAPTER 1

INTRODUCTION

Retaining walls are usually constructed to keep soil mass contained. Retaining walls are frameworks that are built to keep materials that are unable to stand upright on their own in place. They're also on hand to keep the grounds in good shape on two separate occasions. The aim of this thesis is to improve the'retaining structure,' which is an essential feature of civil construction projects, particularly all types of bridges, high walls in hilly terrain, and so on, with the appropriate form, proper design, and rational estimate. A retaining wall with a pressure relief shelve is a rare retaining wall type. The pressure relief shelf on the backfill side of the retaining wall decreases gross earth pressure on the stem wall, improving the wall's overall stability. Since the retaining wall has shelves, less material falls into the stem wall, and some material works vertically on the pressure relieving shelves, resulting in a more cost-effective build.

These new reinforced concrete buildings may seem to have a complicated architecture. Most of these buildings, on the other hand, are made up of a variety of simple structural elements including pillars, columns, slabs, walls, and foundations. As a result, the artist must learn how to build these fundamental reinforced concrete components. The joints and ties are then formed with care. Reinforced concrete construction design began in the early twentieth century using a strictly scientific approach. Following that came the so-called rigorous elastic principle, in which stress amounts in concrete and steel are reduced and stress-deformations are assumed to be linear. . However, although being a semi-empirical technique, the limit state procedure has been found to be the best for the construction of reinforced concrete structures. Beams, Columns, Staircase, and Slab are the main components of this structure, with beams and columns constructed using Staad software and slab and staircase designs performed manually using I.S Codes. This structure is subjected to a variety of loads, including dead, live, and earthquake loads. I.S Codes may be used to measure these loads. The acting of these loads is caused by a variety of causes.

Traditional retaining walls are usually divided into four types:

Gravity retaining wall

Simple concrete or stone masonry was used to construct gravity retaining walls (Figure a). They depend on their own weight and any soil resting on the masonry for support. For high walls, this method of design is not cost-effective.

Semi-gravity retaining wall

In certain cases, only a limited volume of steel is used to create gravity walls, resulting in smaller wall portions. Semi-gravity walls are the name given to such structures.

Cantilever retaining wall

Reinforced concrete cantilever retaining walls (Figure c) are made up of a thin stem and a foundation slab. This style of wall is cost-effective up to a height of around 8 metres (25 ft).

Counterfort retaining wall

Cantilever walls are identical to counterfort retaining walls (Figure d). They do, however, have thin vertical concrete labs known as counterforts that connect the wall and the base lab at regular intervals. The counterforts' aim is to minimise shear and bending moments.

To properly build retaining walls, an architect must understand the specific parameters of the soil maintained behind the wall and the soil underneath the foundation slab (unit weight, angle of friction, and cohesion). The engineer will calculate the lateral pressure distribution by knowing the properties of the soil behind the wall.

The construction of a traditional retaining wall is divided into two stages:

First, the system as a whole is tested for stability with the lateral earth pressure known. Overturning, slipping, and bearing power defects are all investigated throughout the structure. Second, the strength of each part of the frame is determined, as well as the steel reinforcing of each component.

The procedures for deciding the retaining wall's stability are described in this chapter. Power tests can be used in every reinforced concrete textbook.

Gravity and Cantilever Wall

An architect must make assumptions about the proportions of retaining walls when constructing them. Such assumptions, known as proportioning, enable the engineer to test the stability of trial parts of the walls. The parts may be modified and rechecked if the stability tests return unfavourable results. This diagram depicts the general proportions of different retaining wall elements that can be used as a starting point. For proper concrete positioning, the peak of the stem of any retaining wall should not be less than 0.3 m (12 in).

The bottom of the foundation slab, though, should be at least 0.6 m (2 ft). The bottom of the foundation slab, on the other hand, should be below the seasonal frost line. The stem and foundation slab proportions for counterfort retaining walls are the same as for cantilever walls. The counterfort slabs, on the other hand, may be around 0.3 m (12 in) thick and spaced at 0.3H to 0.7H centre-to-centre lengths.

Application of Lateral Earth Pressure Theories to Design Rankine theory

The wall's face AB lateral pressure can t be calculated using Rankine active earth pressure equations. The force Pa(Rankine), the weight of soil above the heel, and the weight Wc of the mortar should all be considered when analysing the wall's stability.

Stability of Retaining Walls

A retaining wall cain fail in any of the following conditions:

- Overturning through toe.
- The base may slide.
- May fail if the bearing capacity of the soil is low.
- Deep seated shear failure condition is also responsible for failure.
- May fail through excessive settlement.

Need of Study

Structural engineer has been proved as a successful tool in ever-growing competent industry, as it saves time. Resulting, an effort is made to analyse and design a retaining wall using a software programme called Staad Pro.

Objectives

- Analyses and design the RCC Structure using Staad Pro.

Chapter 2

Literature and Review

Rehnman and Broms investigated in 1972 that the lateral pressure by t thesurcharge loading on the base of wall by full scale test. A 6m long and 2.5 m high heavyRCC wall with thickness of 0.23 m was constructed for tests. The wall was built on a 0.1 m thick concrete slab which extend uptlo 6 m from the wall. The wall, which hinged at bottom,was supported laterally by hydraulic jack and a rigid frame of steel. The steel frame is fixed in RC slab in the front of the wall. For some tests, the wall surface was covered with 0.5 m thick rockwool insulated mats. The purpose of these tests was to observed the how a compressible layer affects the magnitude and distribution of the earth pressure on a rigid wall. In the series of experiments conducted, two different materials of backfill were investigated, namely a gravel sand and the silt fine sand, and each were either placed loose behind the wall without compaction or was compacted in layers. The pressure of earth caused by heavy concentrated load were checked by driving heavy-wheel loaders close to the wall.

Van Den Berg (1991) used small laboratory experiments of homogeneous dry Eastern-Scheldt sand to study the effect of surface loading on retaining walls. The measurements were conducted in a rectangular test pit measuring 2 m x 1 m with a height of 1 m. A rigid, but shifting, wall was put in the soil bin. The wall was fixed and the backfill behind the wall was put in this first stage of the test. The horizontal pressure on the wall was determined during the backfilling process. A vertical strip loading Fv was added in the second stage of the test, and the rise in pressure on the fixed wall was measured. The measurements were run with different sand densities (Dr = 30% and 60%), surface loading distances (m = x/L = 0.4 and 0.8), and loading magnitudes (Fv = 2.5 kN and 5.0 kN).

The factor Fh,sl / Fv varies from 0.18 to 0.31 depending on the distance of load to the wall and density of the sand.

Pseudo-Static and Pseudo-Dynamic Methods for Seismic Earth Pressure on Retaining Walls were contrasted by Choudhary (2006). The analysis and evaluation of these two methods shows that the pseudodynamic method's time dependent non-linear behaviour of the pressure distribution is superior.

Tafrehi and Nouri (2008) investigated pseudo-static methods for determining the thrust of soil on retaining walls during earthquakes. They devised a novel method, concluding that the key distinction from conventional solutions is that the existence of the wall is taken into account in the equilibrium equations. For a given reinforced soil-wall structure, this method allows the necessary overall cumulative geosynthetic force and the corresponding critical inclination of the failure plane angle to be calculated directly.

A retaining wall, according to Patil (2015), is one of the most significant styles of retaining structures. Highway infrastructure, railway engineering, bridge engineering, and drainage engineering are only a few examples of where it's used. In reinforced concrete retaining walls, a vertical or inclined stem is cast with the foundation slab. These are suitable for use up to a maximum height of 6 metres. To endure lateral earth pressure, the stem, toe slab, and heel slab cantilever. The wall's proclivity for slipping forward due to lateral earth friction should be studied, and a safety factor of 1.5 should be applied to keep the wall from sliding. Up to a height of 6 metres, cantilever retaining walls are most powerful. The ground pressure will be higher relative to the lever arm because of the retained fill. At the root, higher moments form, resulting in a higher segment for stabilisation. This plan turns out to be unprofitable. An option is to use a retaining wall counter, which requires a wider base area as well as steel. A new solution to this problem has been developed.short strengthened concerete balance the approach that is to reduce the impact of foeces coming from retained fill.Lesser moment and shear forces will arise from locally appearing forces.

Tamadher Abood et. al (2015) discovered that when there is a sudden shift in ground elevation, retaining systems keep back soil or other loose material. The backfill or retained material pushes against the structure, causing it to overturn or slip, or both. The cantilever retaining wall is the most common form of retaining wall.for walls ranging in height from 3 to 6 metres. This paper examines and designs a cantilever retaining wall made of a steel-reinforced, cast-in-place concrete internal stem (often in the form of an inverted T). A thorough analysis and design for this type of wall was done in this work, which included estimating the primary dimensions of the wall and then checking those dimensions.

When building property, Singla (2015) discovered that the challenge of generating a difference in terrain elevation over an arbitrary horizontal distance is common. This is the case all of the time. This can be obtained by constructing retaining walls or shaping slopes. Retaining walls are systems designed to keep back water, dirt, or other materials that can't withstand v. The behavior and optimum design of three types of reinforced concrete walls of differing heights are studied in this paper. It has been completed the retaining wall, counterfort retaining wall, and retaining wall with relieving platforms. Expenses for eachThe volume of concrete and the amount of cement are used to determine the best wall design for a given height stainless steel.

Study by Naman Agarwal reported that stone dust had an impact on some geotechnical properties of soil, according to Naman Agarwal (2015). He discovered that adding 50% stone dust to soils reduces the optimum wet material, which is beneficial in reducing the amount of water required during compaction reveals the fact that as the proportion of stone dirt in the soil increases, the MDD of the soil will increase. It's also been discovered that mixing soil with stone dust boosts cosmic radiation. When stone dust is combined with them, relative density of soil enhances significantly. In case of density, a thirty percent addition of stone dirt is considered to be optimal.

According to Soosan et al., a study found that crusher dust has a high shear strength and can be used as a geotechnical material (2001). The term "stone dust" refers to a mixture of pozzolanic and coarser components. It has only pozzolanic properties and no coarser soil particulates, unlike other compounds like ash. Different people are speculating on a significant alteration in soil properties. During this analysis 100 percent, 20%, 30%, 40%, and fifty percent of stone by dry weight of soil were taken is mixed.

.

with the soil to see how blending affected OMC, MDD, and other factors and soil CBR properties.

Firoozi et al (2016) reported that the geotechnical properties of the soil such as grain size distribution,the shear strength, softness,the plastic limit, and liquid limit. Furthermore, the in- situ determination of soil strength and deformation properties was developed, as a result of this technique avoiding sample perturbation during field analysis. There are two major mechanisms that may require any minor physical activity. Colloids include clay minerals and organic matter in the soil. Colloids' most significant characteristics are their compact scale and large surface area. It was proven beyond a shadow of a doubt that the clay. Particles play a critical role in the chemical processes that occur in soil and affect the environment. Contaminants, metals,and nutrients transfer and are retained in the soil.

Study by Mathur (2017) reported that the properties of soil indexes were analysed. A simple check called classification check was needed for index properties. The check required for determining engineering properties was discovered to be time consuming and inefficient. Some engineering properties, such as permeability, compressibility, and shear strength, are given to the index properties.

CHAPTER 3

MATERIAL AND METHODS

3.1.Introduction

The materials and methods used for analysis are discussed in this chapter. The present work was structured in the following way to achieve the goals:

- Analyses and design the RCC Structure using Staad Pro.

3.1.1 Assumptions and Notations used

IS-456-2000 notations has been used in the present work.

Assumptions in Design

- Using t=1.5 as a partial protection factor for loads in compliance with IS-456-2000 clause 36.4.
- In compliance with clause 36.4.2 of IS-456-2000, the partial protection ratio for materials is 1.5 for concrete and 1.15 for steel.
- Usage of partial factors for safety in accordance with the clause 36.4 of IS-456-2000 combinations of load.

Dead load + Live load	1.5
Dead load +Live load +Wind load	1.2

Density of materials used

MATERIAL:	DENSITY
Plain concrete	24.0KN/m^3
Reinforced	25.0KN/m^3

LIVE LOAD: by following IS. 875-86

Live load on slabs = 20.0KN/m^3

3.1.2 DESIGN CONSTANTS

For the retaining wall, concrete and steel grades M30 and Fe 415 were used.

Therefore f_{ck} = Characteristic strength for M30-30N/mm^2

f_y = Characteristic strength of steel 415N/mm^2

Assumptions Regarding Design:

- By following monolithic architecture and construction of walls over it, the slab is believed to be continuous over internal support and partly set on edges.
- Beams are considered to be constant over the internal support and frame the column ends.

Assumptions on design:-

1) M20 grade is used in design unless specified.

2) For main reinforcement FE415 steel is used.

3) Fe 415 tor steel has been used for distributing the reinforcement.

4) Fe 230 Mild steel has been used for the reinforcing of shear.

3.2. SOFTWARE USED

The main softwares used in this project are

1. Staad pro(v8i)

2. Staad foundations 5(v8i)

3. Auto cad

Staad pro **Staad Auto** **CadFoundations**

3.2.1 STAAD

Bentley developed and created Staad, a versatile design programme. Staad is an acronym that stands for structural analysis and architecture. Structure can be described as any object that is stable under a given load. Thus first determine the structure's shape, while measurement is the determination of what kind of load is acting on the beam, as well as the measure of shear force and bending moment. The design process entails determining the form of materials and their proportions in order to withstand the load. This is what we do once we've completed the research. It takes about an hour to measure the SFD and BMD of a complex loading beam. As a result, bringing it into the building with other participants would take about a week. Staad pro is an extremely effective and useful tool that can complete this task in under an hour. Staad is a high-rise housing option. Most new buildings are now constructed by staad, making it necessary for a civil engineer to be familiar with this programme. According to different countries codes these softwares are used to carry reinforcemenr ,Steel, Bridge, Truss etc.

3.2.1.1 Alternatives for staad

Struts, computer, sap, and adds pro are examples of software that provides detailed information about reinforcement and manual calculations. However, these softwares are limited to a few architectures, while staad can work with a variety of structures.

Staad Editor

Staad has a lot of advantages over other applications, such as the staad editor. The programming is done in the Staad editor. All specifics are provided in programming format in the staad editor for the structure and loads we designed. By making a few changes to the software, it can be used to study other constructs as well, but programming abilities are needed. As a result, load cases generated for one structure can be used for another using the staad editor.

Limitations of Staad pro:

- High data of output.
- Even analyzing of small beams gives large output.
- Do not to show plinth beams.

3.3.1.2 Staad foundation

The Staad base is a valuable instrument for calculating the various forms of foundations. Bentley corporation tech licences it as well. All Bentley tech costs about ten lakhs, so it is out of reach for most engineers. Staad is used for analysis and design, as well as post-processing, to determine the load. These supports must be incorporated into the programme to measure the structure's footing details, such as geometry and strengthening details.
This programme is capable of dealing with a wide range of foundations.
we can construct various variant of footings using this software

SHALLOW (D<B)

1) Isolated Footing

2) Combination Footing

3) Raft Foundation

DEEP (D>B)

1) Pile Cap

2) Driller Pier

Stretched footing is a most common type of footing that is isolated. When two columns are very close to each other, either through combination footing or single footing is usually laid. Mat (Raft) foundations are typically used in areas where the soil bearing potential is low. Pile foundations are used in areas where there are loose deposits and deep excavations are needed. As a result, the type of foundation needed must be determined based on the soil type. In addition, soil data, and materials used, all of which should be included in the appropriate units for safety factors.

After the data is entered, the programme creates the specifics on each footing and provides information about the foundation:-

a. Geometry of the footing

b. Reinforcement

c. Layout of column

d. Graphs representation

e. Manual calculations

These details will be given for each and every column.

Another benefit of foundations is that the properties of the members can be modified after the concept is complete if necessary.

The properties mentioned below can be modified.

1)Column Position

2)Column Shape

3)Column Size

4)Load Cases

5)Support List

Its very easy to deal with this software and there is no other good alternative than this.

3.2.2 AutoCAD

AutoCAD is a most common software programme developed by the Autodesk corporation in the United States of America. CAD stands for Computer Aided Design or Drafting, and the term Auto comes from the Autodesk Company. AutoCAD is used to create various configurations, details, schedules, elevations, and parts, as well as to display different parts. Interior designers, civil, mechanical, and electrical engineers would find this program extremely useful

Because of the usefulness of this programme, it is a must for any engineer to study it. For drawings (plan and height) of a residential or commercial house, AutoCAD has used. We have used AutoCAD to demonstrate the specifics of a staircase's reinforcement and construction. AutoCAD is a very simple and user-friendly app that everyone can pick up easily. To draw in AutoCAD, you'll need to learn a few commands.

3.2.2.1 Load Conditions and Structural System Response

The concepts presented in this section explain loads and how they influence the structural stability of a typical wood-framed home. Building loads are classified as vertical or horizontal (i.e. lateral) by considering the direction of the structural action that they involved. The following parts describe how loads are classified.

Loads Categorized by Orientation

Types of loads on a hypothetical building are as follows.

- Vertical Loads
- Dead
- Live
- Snow
- Wind
- Seismic and wind
- Seismic

Horizontal (Lateral) Loads:

Direction of loads is horizontal w.r.t to the wall

- Wind
- Seismic(horizontal ground motion)
- Flood(static and dynamic hydraulic forces
- Soil(active lateral pressure)

Vertical Loads

The dead, living, and snow loads are examples of loads that behaved likewise gravity (i.e. downward or vertically). They're mostly stagnant, and they're often thought of as a uniformly dispersed and condensed load. Area details helps in allocation to structural components, which includes dead load and any added loads, calculating The force of gravity acting on a beam or column is called a potentially easy exercise (i.e., live load). The standardised load used to the area of floor held by a single joist, for instance, would be included in the gravity load on a floor. The structural builder probably chooses a typical beam in order to investigate bearing attachment forces, internal stresses, and structural member or structure beam equations stability.

The choice of a suitable analytic model is critical, especially if the structural structure differs from conventional engineering assumptions, which are mostly the same for structural systems that include many parts of a building, but vary in degrees. Negative pressures acts in external direction from the lower surface of the roof produce wind uplift In addition to the aerodynamics of wind blowing over and around the building frame, there are other forces at work.

Wind up lift forces on a frame or other assembly (such as a roof) are calculated using the same principles as gravity loads: areas and uniformly distributed loads.Wind forces work perpendicular to the building surface rather than in the direction of gravity and that pressures mostly depends on the size of the region and its position, particularly as the geometry changes. The architecture method is established on a maximum static load equality, despite the fact that the wind loads are complex and highly variable. Wind up lift forces on a frame or other assembly (i.e., roof) are analysed using the principle of areas and evenly spreading loads, much as gravity loads. Wind up lift forces on a frame or other assembly (such as a roof) are calculated using the same principles as gravity loads: areas and uniformly distributed loads. The architecture strategy is based on a maximal static load (i.e., pressure) equality construction, despite the fact that wind loads are complex and highly variable.

Lateral Loads

Loads that is caused lateral forces on buildings attributed by various forces such as wind, earthquakes, and floods. The entire system is subject to wind and seismic lateral loads. Windward face bears positive wind pressures. However, structure's leeward face bears negative wind pressures create lateral forces, resulting in a mixed push and pull effect. The dynamic inertial reaction of a body to cyclic surface or ground movement produces seismic lateral forces. The magnitude of the seismic shear load is often examined by the magnitude of the surface motion, the mass of the building or foundation, and the dynamic structural reaction characteristics (i.e., dampening, ductility , atural time of vibration ,etc). A generalised seismic load analysis equal static forces using the fundamentals of Newtonian mechanics (F=ma) for homes and other related structures, with adjustments for inelastic and ductile reaction characteristics of different building structure systems. The majority of flood loads are reduced by elevating the building on a well-designed base.

Loads flowing laterally due to flood water or static hydraulic resistance may also be sustained. Soil lateral loads are used in base wall and retaining wall construction, most of the times “out-of-plane” bending load on the wall. Lateral loads often generate a moment, which must be compensated for by the dead load and structural relations. As a result, overturning pressures on ties intended to keep parts from spinning or the building from overturning must be taken into account.

Roof uplift and lateral loads generated by wind, the uplift components of the wind load intensify the friction forces caused by the lateral elements of the wind load. As a result, in lower design wind conditions and certain seismic design conditions, the dead load can be sufficient to cease overturning and uplift forces.

Structural systems

“Conventions in use for timber, steel, and concrete structures are not useful for constructing the structures since few are applicable,” it was often thought as early as 1948. The NBS paper, in particular, promotes the use of more structural analysis techniques for houses. The research in question, as well as all subsequent findings on the subject of structure efficiency in housing, have not resulted in any substantial change in the codified architecture practise as applied to housing.

The lack of implementation is partly due to the difficulties of applying the findings of less oriented structural systems research to general design implementations, and partly due to the conservative picture or you might tell essence of the engineering method. Since the purpose of this paper is limited to residential development, applicable device information is not included.

Based research and housing design knowledge are addressed, cited, and implemented as required. When a structural member is part of a structure, as is often the case in light frame residential construction, its reaction is influenced by the system's overall strength and stiffness. In general, load sharing and composite action are two fundamental principles in machine performance. Load sharing is a term used in repetitive member structures (such as wood framing) to describe the ability of one member's load to be shared, in the case of a uniform load, the ability of certain members to share the load.

The load on a weaker member is distributed among neighbouring members. Composite activity can be seen in assemblies of components that, when joined together, form a "composite member" with greater ability and stiffness than the number of the individual parts.

The amount of composite operation in a structure, on the other hand, is determined by how the different elements are linked. The objectives is to obtain a higher effective segment modulus than the individual part. When floor sheathing is nailed & bonded to floor joists, for instance, the floor structure achieves a higher level of composite action as compared to sheathing is just nailed; by using a solid adhesive, the adhesive between the elements helps to prevent shear slippage. Shear stresses transferred between component parts, partial composite operation, or stiffness assembly contacts may both cause slippage.. As a result, considering the completely composite T-beam floor structure can result in a conservative solution.

The traditional method of only contemplating the floor joist member without taking into account the composite device effect would result in a conservative design. When knowledge is required for realistic design advice, this document discusses the strength-enhancing impact (sharing and partial composite action). It's difficult to establish repetitive member increase factors (also known as system factors) for general design use because the amount of system impact varies a lot depending on the system assembly and materials.

As a result, several device factors for design must be used in order to cover a wide range of issues. Those that most effectively represent device effects often necessitate a more detailed explanation of basic assembly specifics and material requirements, as well as adherence to them. However, device effects have an impact on more than just the power and stiffness of light-frame assemblies (including walls, floors and roofs). They also challenge conventional wisdom on loads distribution at the different assemblies of a complex wood-framed house. For instance, under non-load-bearing partition walls, floor joists are often doubled "because of the applied dead load and subsequent stresses," as determined by agreed engineering practice.

This method is based on a conservative premise about the load path and structural reaction. In other words, although the partition wall adds to the weight, it is relatively rigid as a deep beam, usually when the top and bottom are connected to the ceiling and floor framing, respectively. The inner wall helps withstand the load when the floor is primed and deflects. The extent of the impact, of course, is dependent on the wall structure (i.e., the number of openings) and other factors. The strengthened structural reaction of the floor structure as a result of the interaction of different structural structures or subassemblies, as seen above, allows it to hold more dead and live as compared to the partition wall were absent. During a whole-house assembly exam, this influence was demonstrated (Hurst,1965).

As a result, a double joist might not be expected beneath a standard non-load-bearing partition, a single joist might be sufficient to sustain the partition between the joists if the floor sheeting is properly defined. Although this condition is yet to be replicated in a typical analytic form that can be used for basic engineering analysis. When making structural assumptions about light frame residential constructions, a planner should be mindful of the principle. The reader should bear in mind at this point that how a structure distributes and absorbs horizontal and vertical loads is determined by the response of a structural framework, not individual components. The divergence from classical engineering mechanics equations (i.e., single members with normal tributary areas and expected elastic behaviour) and simplistic load path assumptions can be significant in wood framed structures.

3.3 Design loads for retaining walls

External forces must resist to have a satisfactory output (i.e., protection and serviceability) during the structure's useful life are described by loads, which are a primary factor of any retaining architecture. The planned usage (occupancy and function), design (size and shape), and position of a building all affect the expected loads (climate and site conditions). Finally, design loads have an effect on crucial decisions like content selection, building details, and architectural configuration.

As a result, realistically applying design loads is critical for optimising the finished product's worth (i.e., output against economy). While this guide focuses on nuclear-family detached and attached homes, rules and ideas mostly related to building loads can also be applied to other forms of housing, such as low-rise apartment buildings. The design loads suggested in this guide are based on the ASCE 7 standard-Minimum Design Loads for Buildings and Other Structures in general (ASCE,1999). The ASCE 7 specification is accepted in nearly all U.S. building codes as an appropriate procedure for building loads in the United States. As a result, the reader is urged to familiarise themselves with the ASCE 7 standard's provisions, commentary, and technical references. In general, housing structural architecture has not been viewed as a distinct engineering field or exposed to a concentrated attempt to improve and streamline design processes. As a result, the emphasis of the guide is on the aspects of ASCE 7 and other technological tools that are especially important to the determination of design loads for residential structures. The guide offers design help for areas of residential architecture where current practice is either quiet or needs to be improved. The methods for calculating design loads in residential buildings are comprehensive but tailored to standard residential conditions. The planner, like any other design feature, must eventually understand and accept the loads for a given project as well as the overall design process, with all of its inherent strengths and weaknesses. Since building codes handle design loads differently, the planner should find variances from both local agreed standard and the relevant code in relation to design loads as outlined in this document as a matter of due diligence, even though the variances are legally sound. The evaluation of many various types of materials is usually needed for the complete construction of a house. Allowable stress design (ASD) is used in some material configurations, while load and resistance factor design is used in others (LRFD).

3.3.1 Dead Loads

The cumulative load of all elements of the building that don't alter with time, like steel columns, concrete floors, tiles, roofing material, and so on, is known as the dead load. The assignment of dead load in staad pro is done assigning by giving the member's property.

In the case of a load, we have a feature called self-weight that automatically determines weights based on the material's properties, such as mass, and after applying a dead load, the skeletal structure turns red, as seen in the figure.

Calculation for dead load

Weight=Volume x Density

Self weight floor finish=0.12*25+1=3kn/m^2

The above example shows a calculation of dead load. Dead load is calculated as per IS 875 part 1

3.3.2 Live Loads

The utilisation and occupancy of a building generate live loads. Human inhabitants, storage, and building loads are all examples of loads. Loads are represnted in terms of standardised area loads, concentrated loads, and uniform loads, as required to properly characterise the loading environment. line loads. In a structural assessment, standardised and concentrated live loads should not be used. Concentrated loads should be added to a small region or surface that is appropriate for the operation and placed so that the load effect is maximised in end-use conditions. As an example. The 300-pound stair load can be applied between the supports in the middle of the stair tread.

We delegate live load in terms of U.D.L. in staad. We must build a load case for live load and pick all the beams that can bear such load. The configuration appears as seen below after the live load is assigned. For this structure live load used is 25 N/mm for design.

3.3.3 Wind load

Wind load is present in both vertical and horizontal loads in this system. Since the wind load allows the roof to uplift by generating a suction effect on the roof's tip.

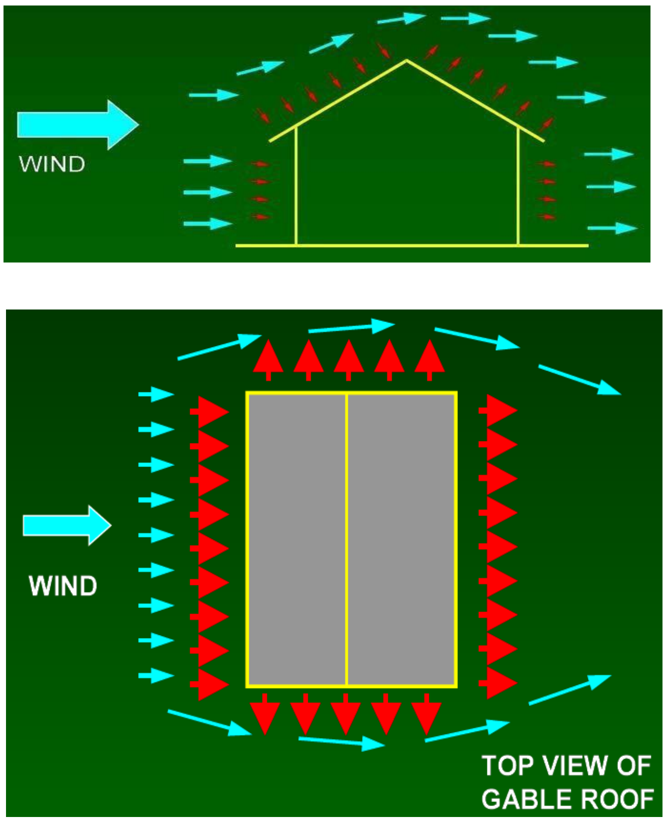


Fig.3.1. A diagram of wind load

Wind energy causes very large non-static loads on a system. The difference in pressures at various points on a building frame is so complicated that pressures are measured in millimetres.may become too intensive for precise consideration in the designing. Therefore,

Wind load requirements aim to simplify the design issue by using basic static pressure zones on a building to reflect high loads likely to be encountered in the structure. However, high pressures in one region for a given wind direction may not appear simultaneously in other areas. The high pressure in several other pressure areas is determined by an arrow distribution of wind direction. As a result, wind directions must be considered when assessing the probability of predictable wind loads on building structures.

In particular, in some basic form, most advanced wind load properties account for wind load directionality and nominal design loads (sbcci,1999; ASCe,1999). This urther expands on wind load design features to include a simple but efficient method for constructing modern residential structures and they differ significantly over a structure's surface. The load generated on the overall structure is on major structural systems that withstand wind loads from more than one surface of the building structure, and they are considered the main wind force resisting systems on a large scale (MWFRS). Shear walls or retaining walls, as well as diaphragms that build lateral force resisting mechanisms, are all part of a home's MWFRS (LFRS). Structures that undergo loads from two surfaces, such as trusses, are often subject to regimes of the structure.

The wind loads added to the MWFRS take into account the significant effects of time-varying wind forces on the structure's surfaces. In a smaller scale, stresses are significantly greater on the surface area and geometry of the building frame (i.e., eaves, ridges, and corners). Smaller regions are affected by these wind speeds, which have an effect on loads on sections and cladding in particular (e.g., sheathing, windows, doors, purling, studs).

The MWFRS receives localised time-varying loads from the modules and cladding, which are balanced both spatially and temporally. There are some pieces that beat at near-peak loads, while others beat at slightly lower levels.

The following section outlines a simpler approach for defining MWFRS as well as part and cladding wind loads. The loads in section are also calculated for individual purposes, and the values given are used to calculate MWFRS and parts, as well as cladding wind loads illustration of a design World design modernism evolved during the twentieth century, becoming an aesthetic epitomised in many ways. Many architects are looking for modernism without regard for the consistency of the styles available. However, as the trend faded in the late 1920s, postmodernism emerged as a backlash to Modernism's austerity. This method can be seen in Robert Ventures'.

Wind load can be designed in two ways

- Gathering regular load intensities for given heights and accredit the loads to the appropriate height.

• Wind load results or calculations as per IS 875 section 3.

We used the second approach to construct our structure, which includes calculating wind load based on wind speed. In Hyderabad, the wind speed for a 10 m height is 45 kmph, and this value is used in the calculation.

3.3.4 Basic wind speed

For various zones of the area or world, the basic wind speed is applied to 1m height above mean surface level. Wind speed is calculated using peak velocity over a 3 second time interval, which compliment to heights above ground level in open terrain.

The table below shows the wind speed for several major cities and towns.

Design wind speed

To design wind velocity at any height (Vz) for the defined structure, the following effects should be applied to the basic wind speed (Vb) for any spot.

a) Risk level

b) Terrain roughness, height and size of the structure and

c) Local topography

It can be expressed mathematically as follows:Vs. = Vb* K1* K2* K3

Where

Vz = design wind speed in m/s K1= probability factor

CHAPTER 4
RESULTS AND DISCUSSION

4.2 ANALYSIS OF RETAINING WALL ON STAADPRO

GEOMETRY

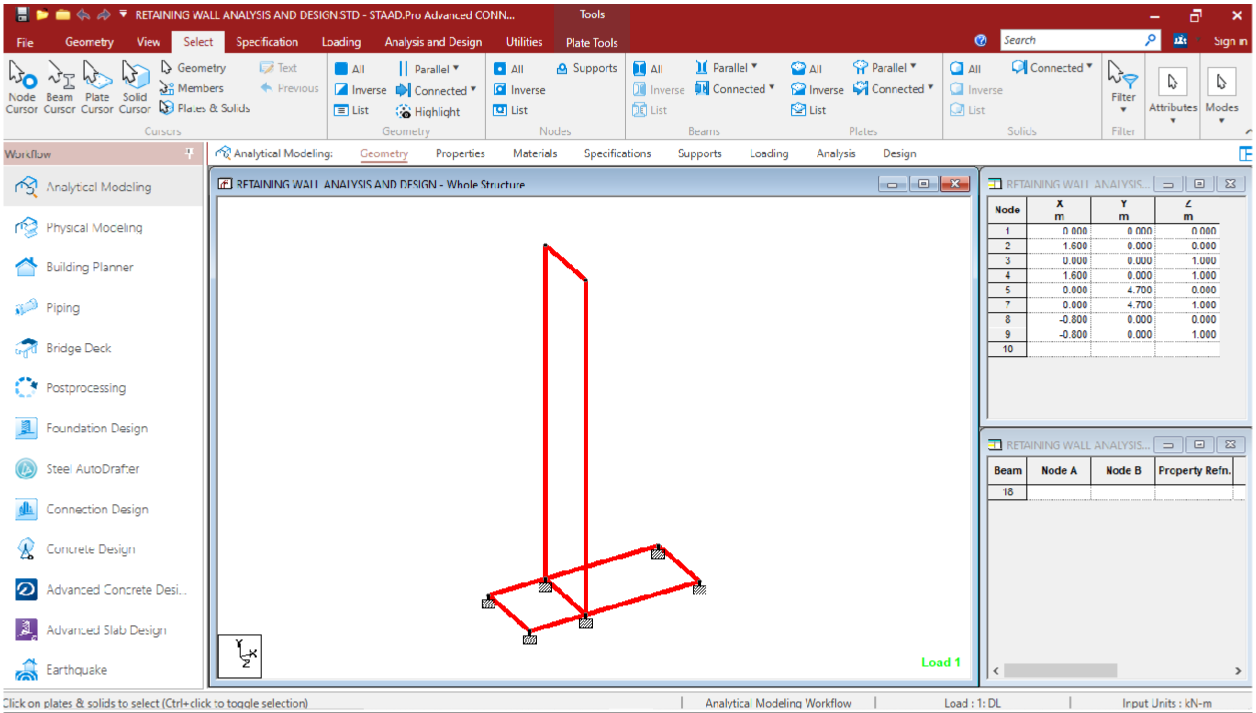


Fig.4.1 Basic structure of retaining wall

PROPERTIES

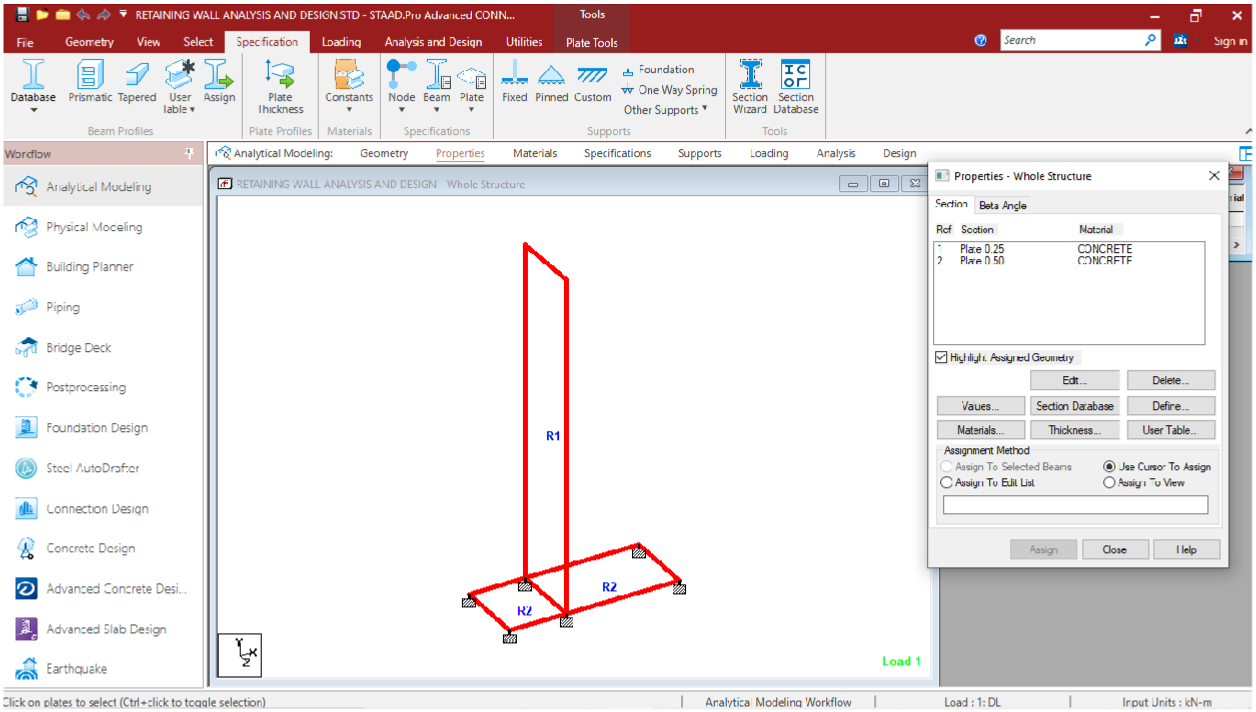


Fig.4.2. Assigning of the plates

SUPPORTS

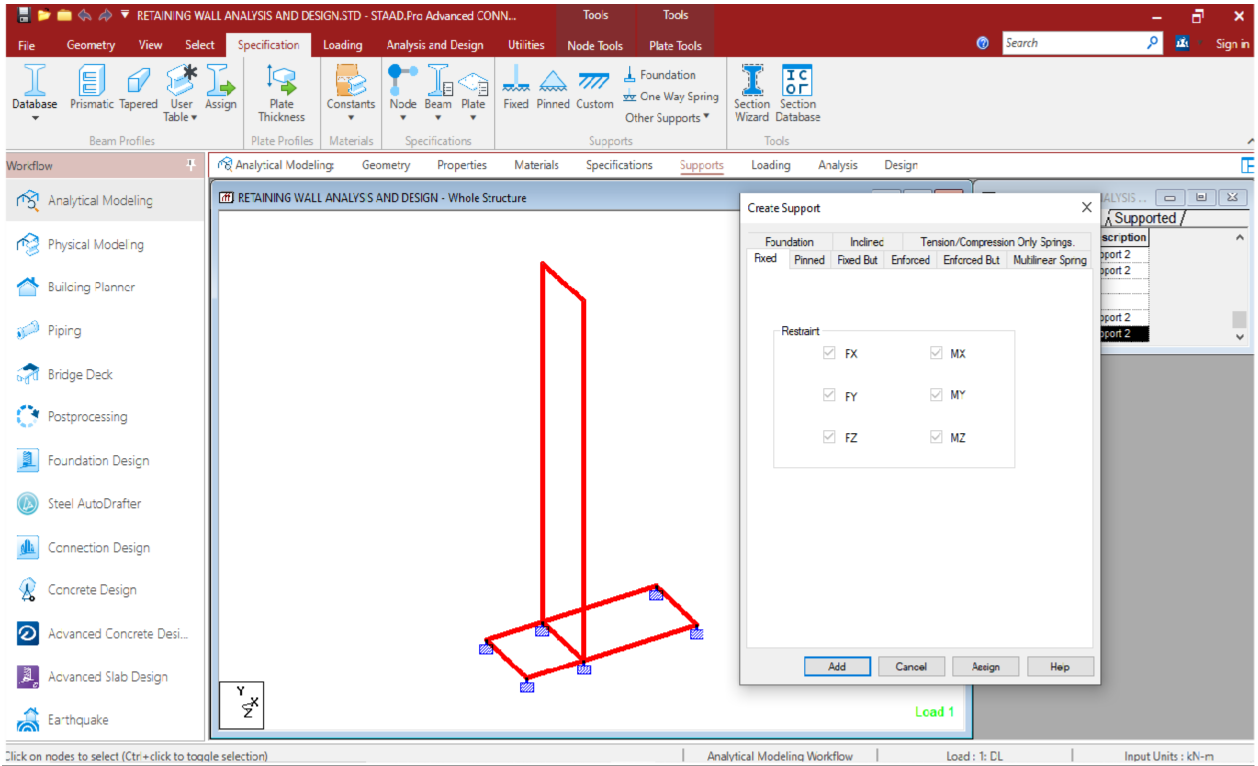


Fig 4.3 Assigning of the fixed supports to the plates

MATERIAL

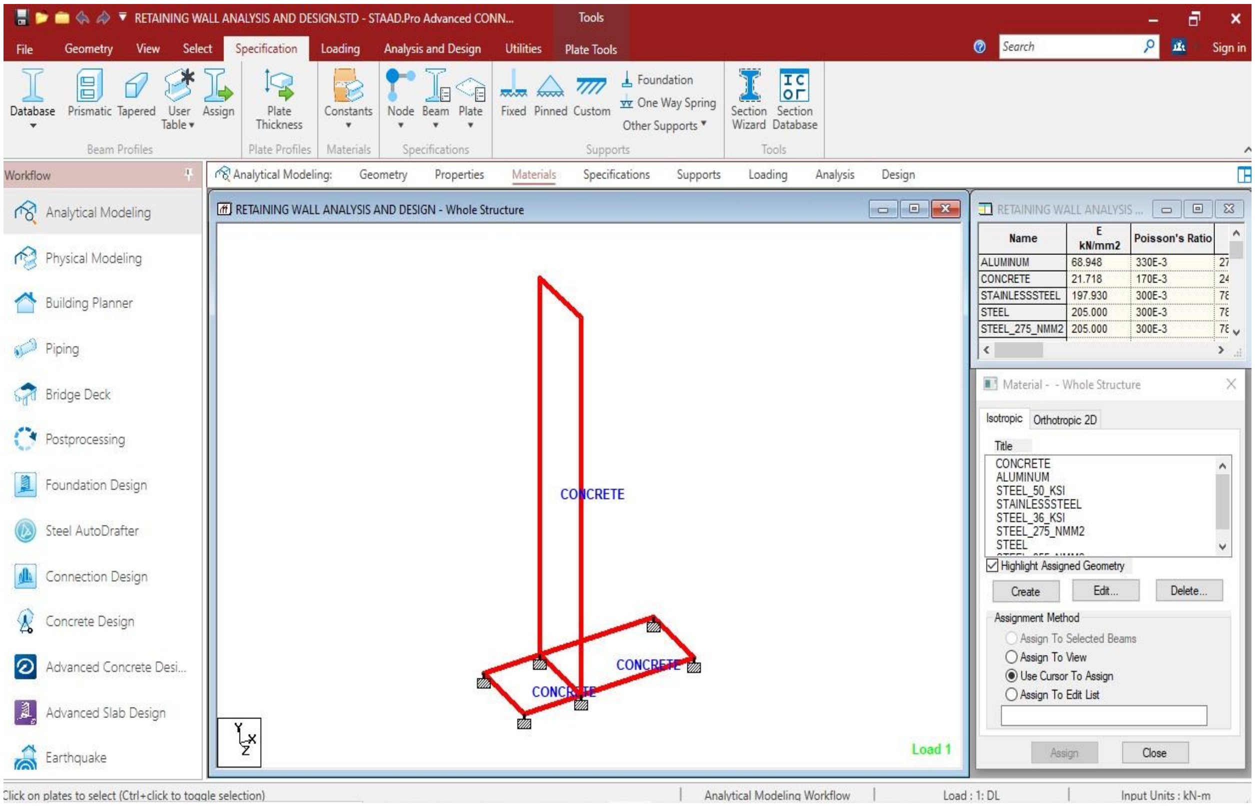


Fig 4.4. Assigning of the material to the structure (concrete)

LOADING

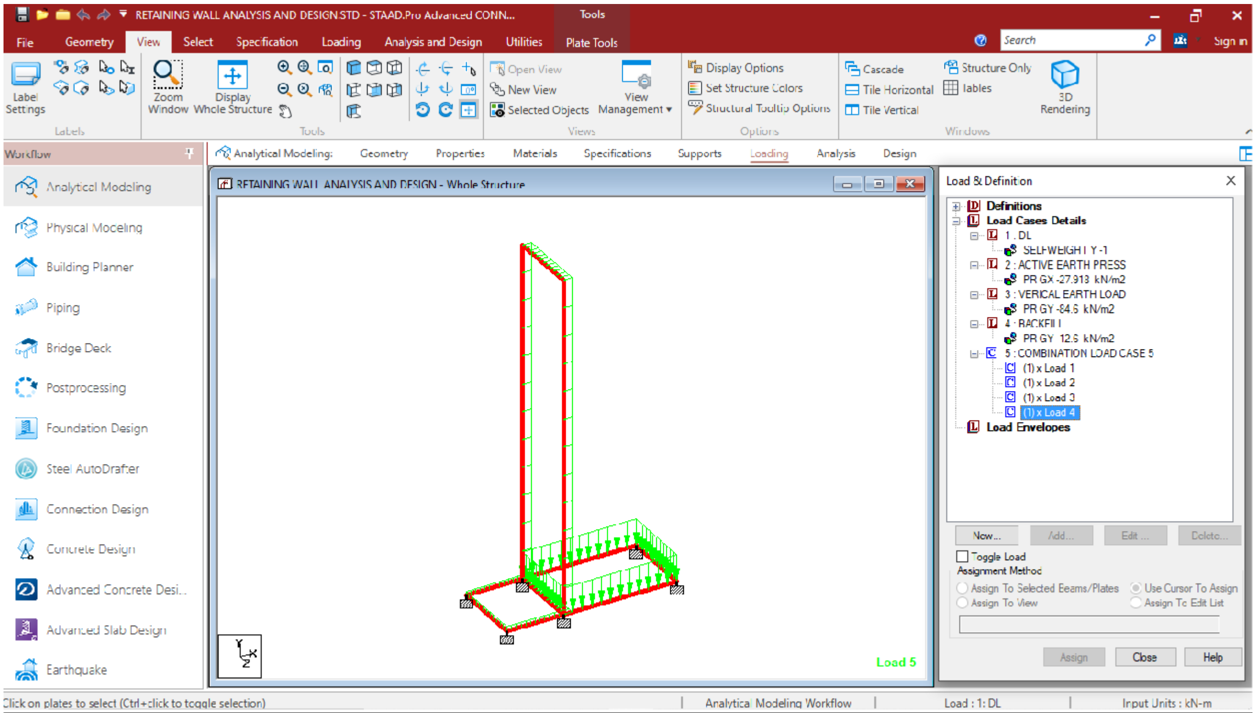
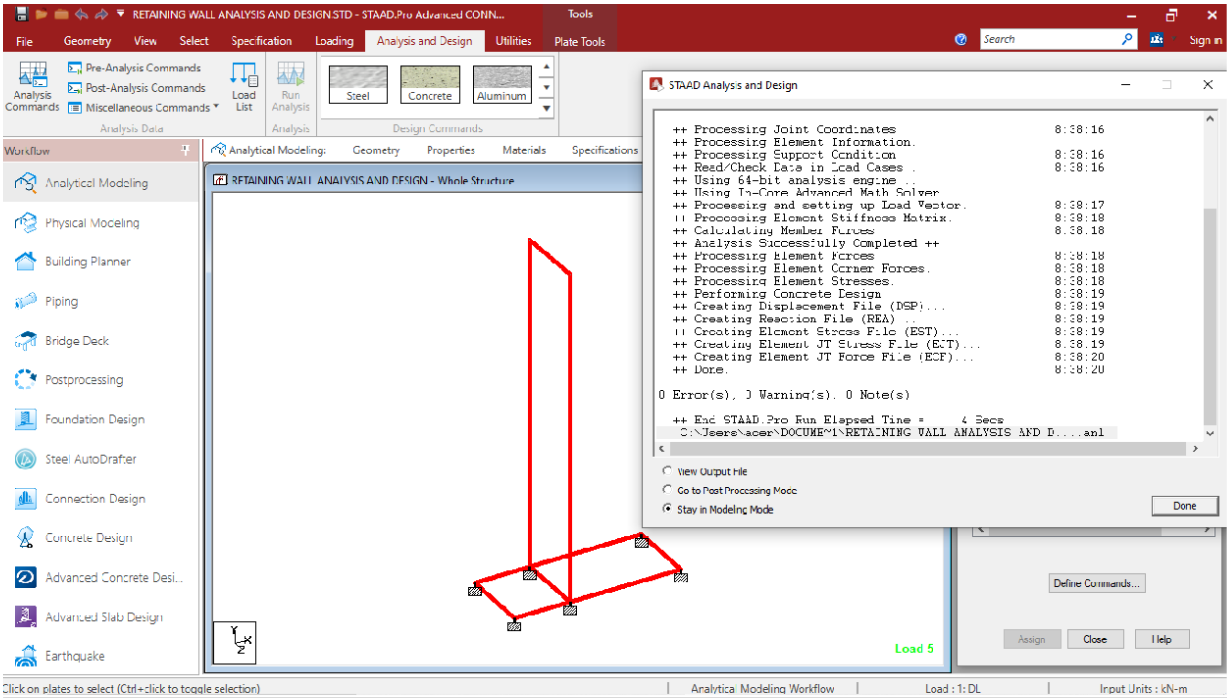
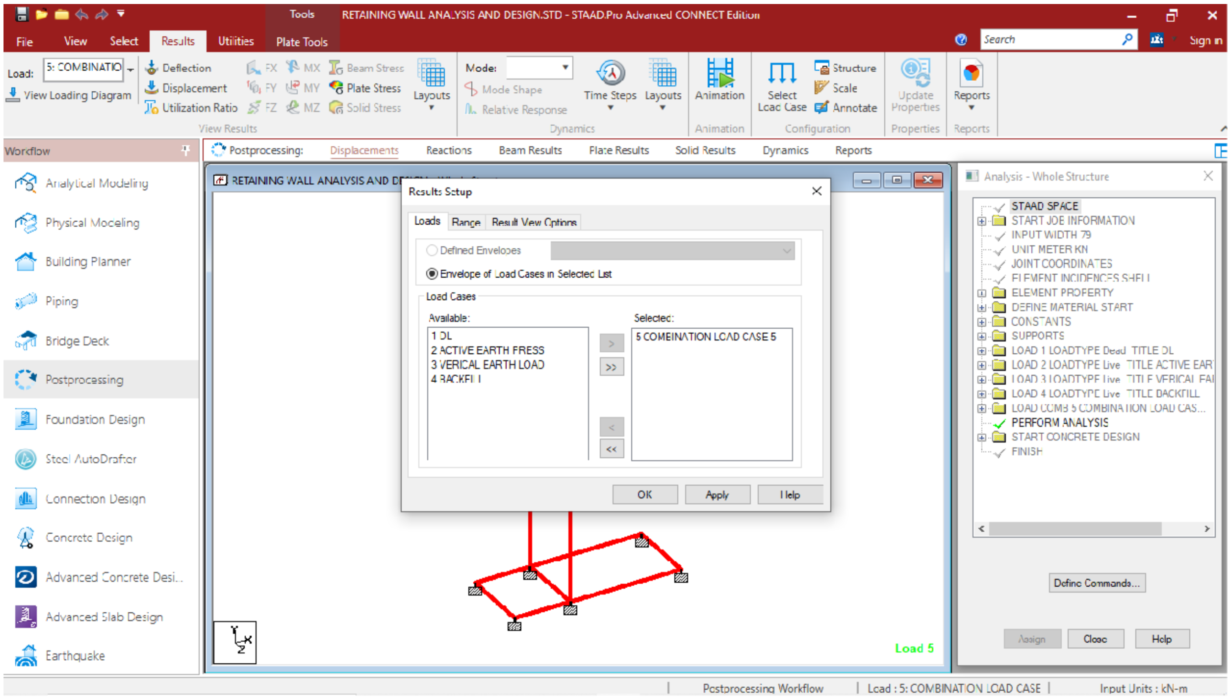


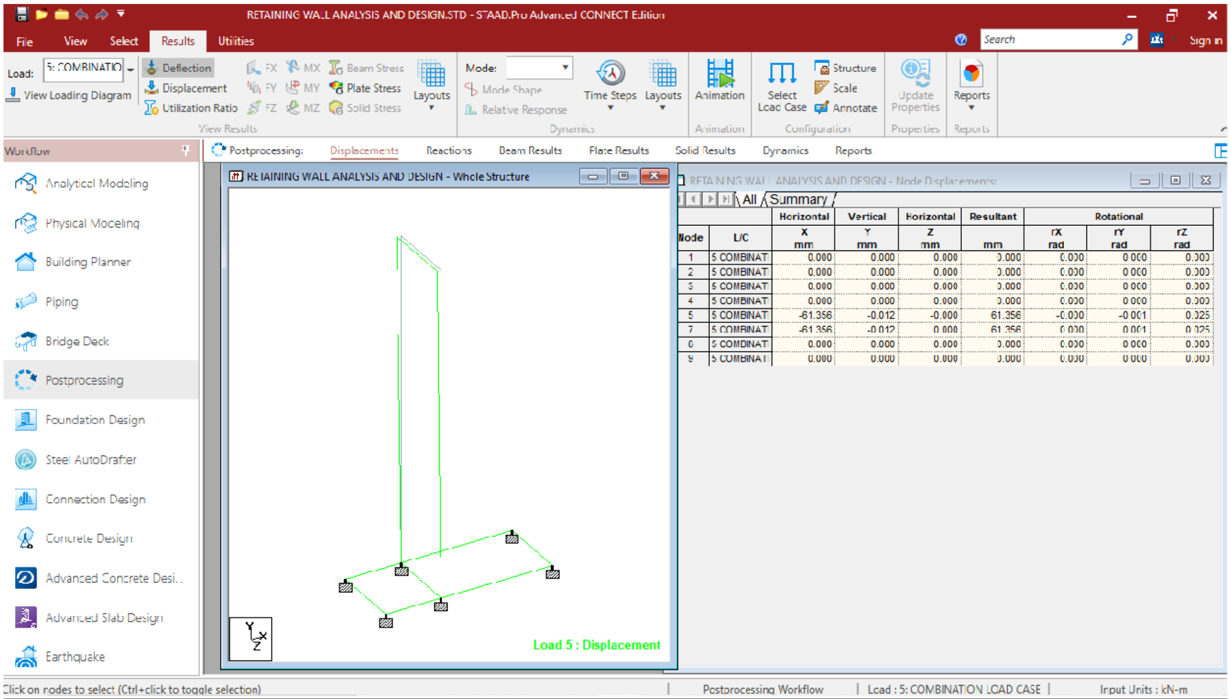
Fig 4.5. Assigning of loads to the structure

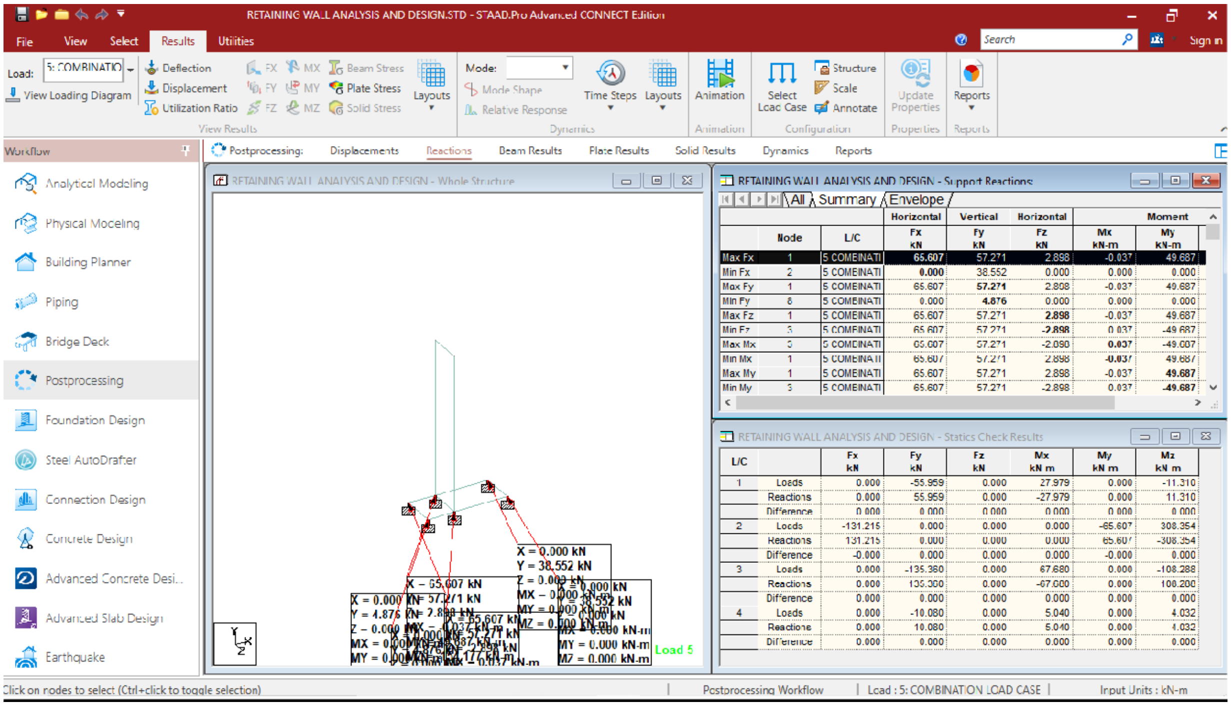
ANALYSIS

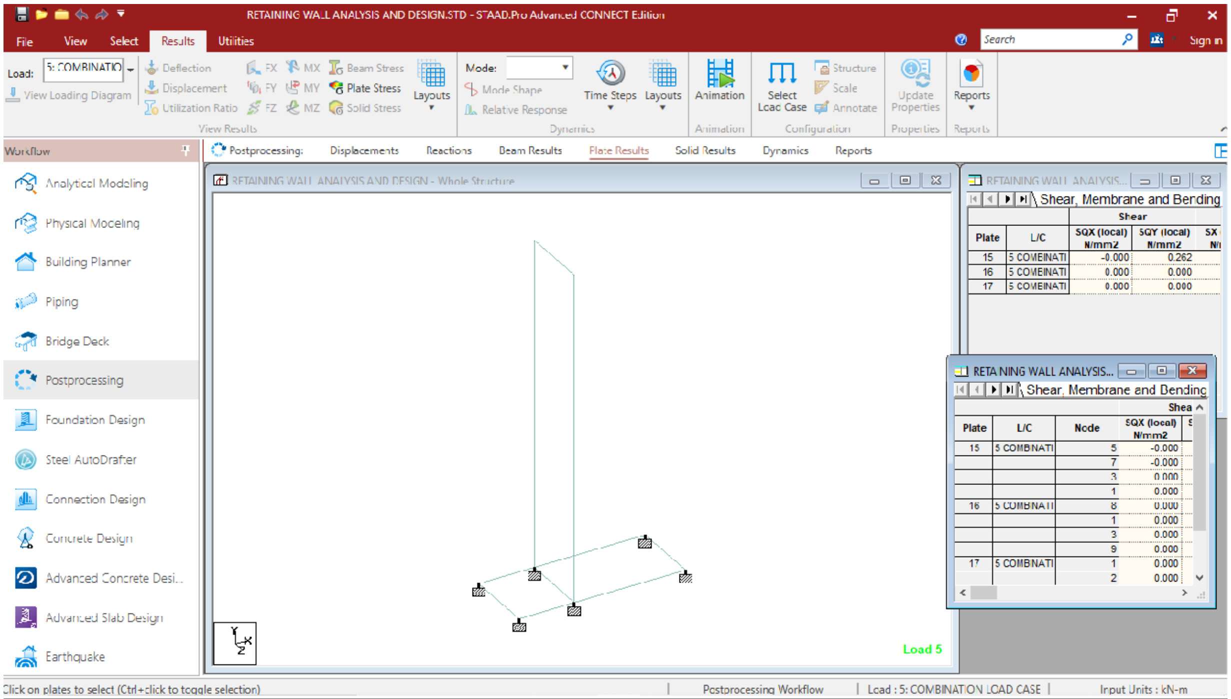

RETAINING WALL ANALYSIS AND DESIGN.STD - STAAD.Pro Advanced CONN...
File
Geometry
View
Select
Specification
Loading
Analysis and Design
Utilities
Plate Tools
Analysis Commands
Pre-Analysis Commands
Post-Analysis Commands
Miscellaneous Commands
Load List
Run Analysis
Steel
Concrete
Aluminum
Workflow
Analytical Modeling
Physical Modeling
Building Planner
Piping
Bridge Deck
Postprocessing
Foundation Design
Steel AutoDrafter
Connection Design
Concrete Design
Advanced Concrete Desi...
Advanced Slab Design
Earthquake
RETAINING WALL ANALYSIS AND DESIGN - Whole Structure
STAAD Analysis and Design
++ Processing Joint Coordinates
++ Processing Element Information.
++ Processing Support Condition
++ Read/Check Data in Load Cases .
++ Using 64-bit analysis engine ..
++ Processing and setting up Load Vector.
++ Analysis Successfully Completed ++
++ Performing Concrete Design
++ Creating Displacement File (DSP)...
++ Creating Reaction File (REA) ..
++ Done.
0 Error(s), 0 Warning(s), 0 Note(s)
View Output File
Go to Post Processing Mode
Stay in Modeling Mode
Done
Define Commands...
Assign
Close
Help
Load 5
Click on plates to select (Ctrl+click to toggle selection)
Analytical Modeling Workflow
Load : 1: DL
Input Units : kN-m

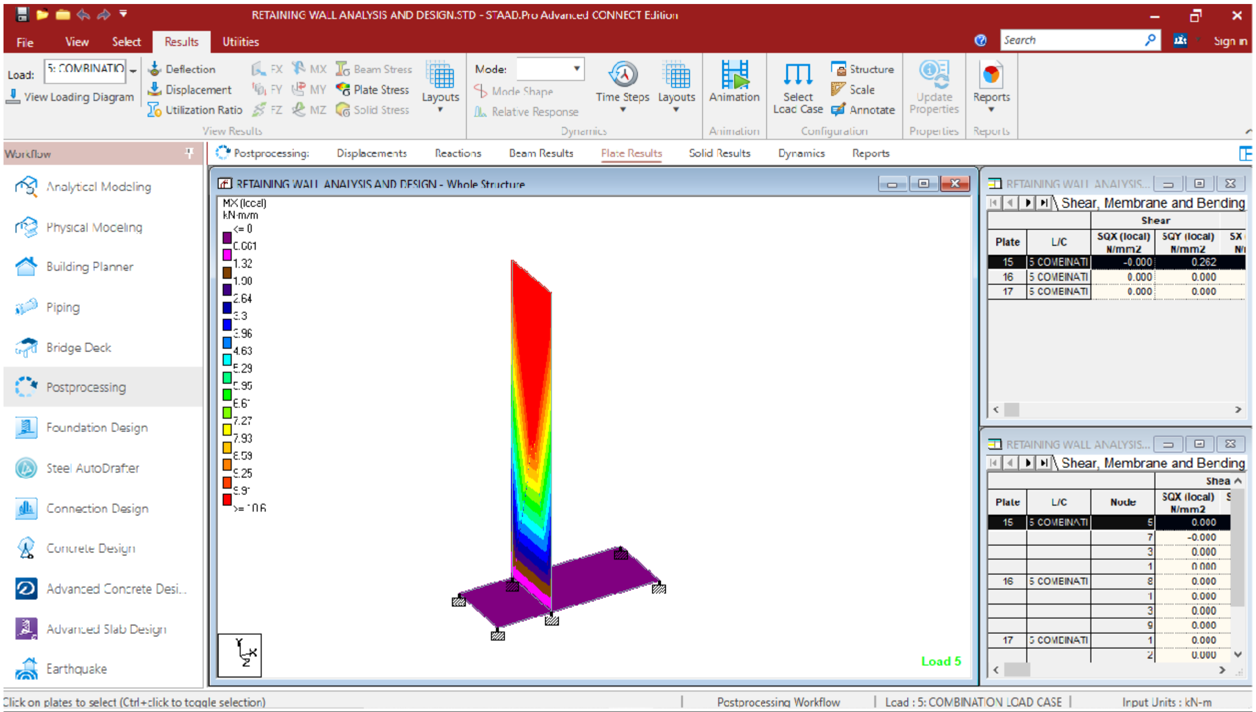
ANALYSIS RESULTS

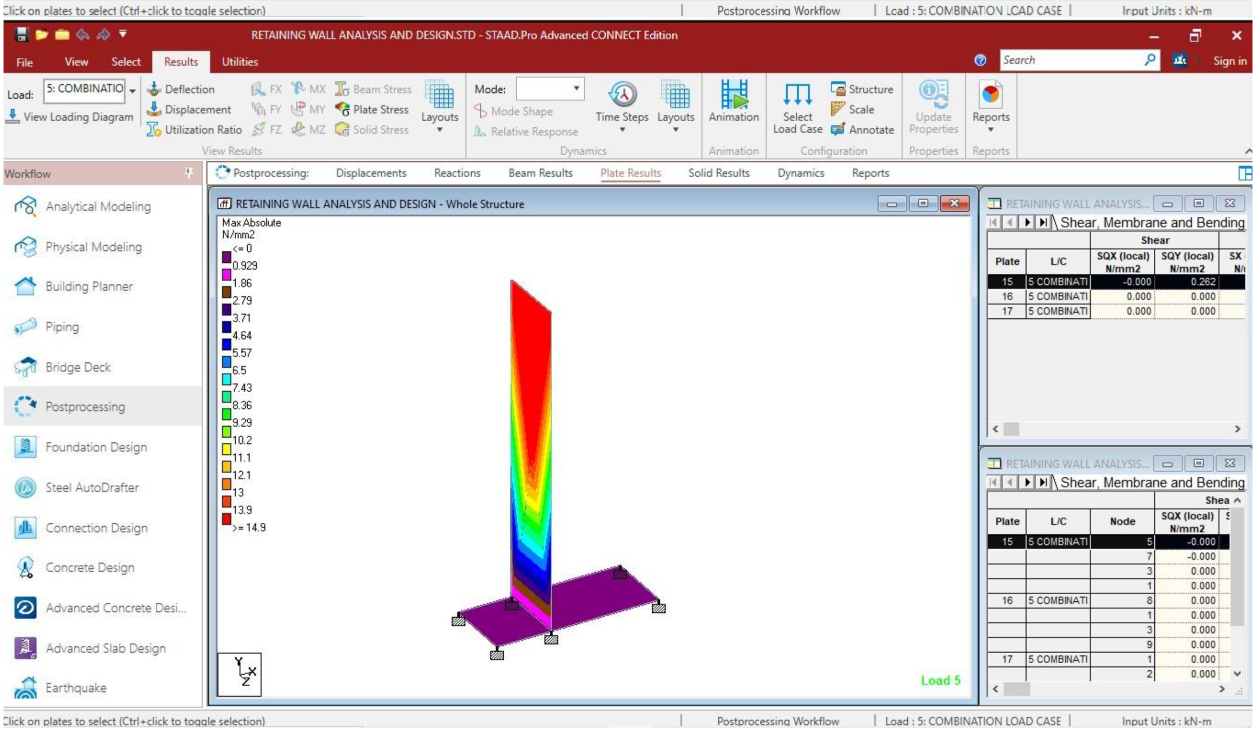


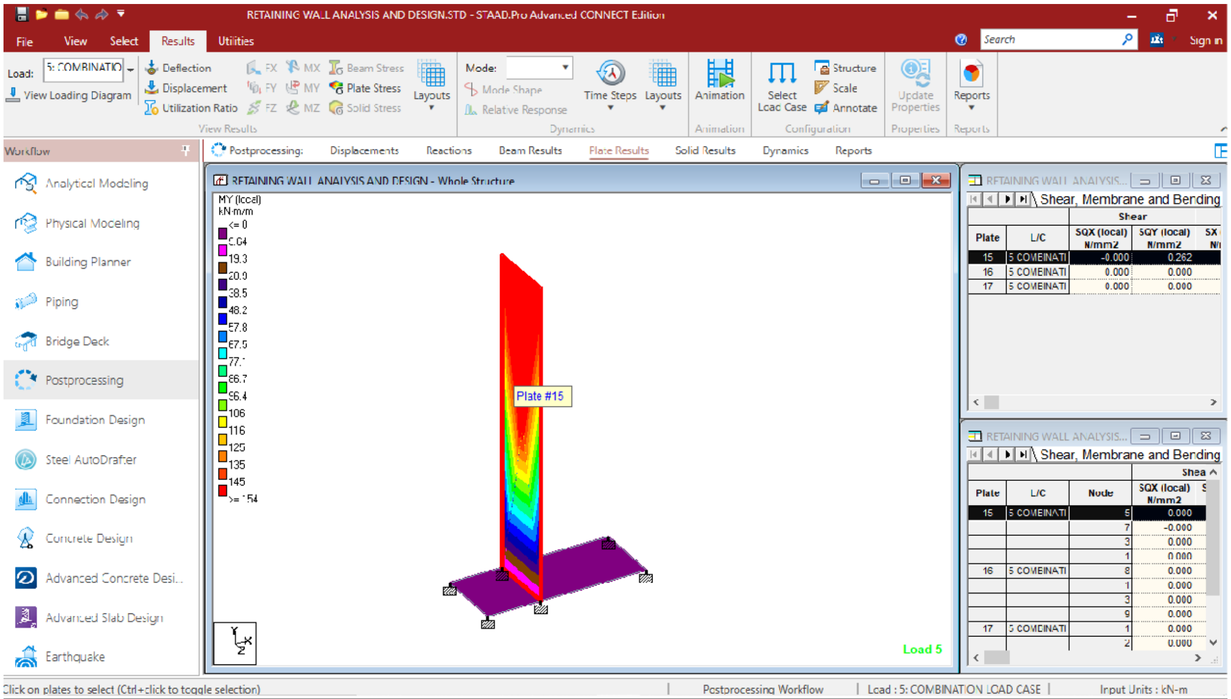

RETAINING WALL ANALYSIS AND DESIGN.STD - STAAD.Pro Advanced CONNECT Edition
File
View
Select
Results
Utilities
Load: 5: COMBINATIO
View Loading Diagram
Deflection
Displacement
Utilization Ratio
View Results
Beam Stress
Plate Stress
Solid Stress
Layouts
Mode:
Mode Shape
Relative Response
Dynamics
Time Steps
Animation
Select Load Case
Structure
Scale
Annotate
Configuration
Update Properties
Reports
Workflow
Analytical Modeling
Physical Modeling
Building Planner
Piping
Bridge Deck
Postprocessing
Foundation Design
Steel AutoDrafter
Connection Design
Concrete Design
Advanced Concrete Desi...
Advanced Slab Design
Earthquake
Postprocessing:
Displacements
Reactions
Beam Results
Plate Results
Solid Results
Dynamics
Reports
RETAINING WALL ANALYSIS AND DESIGN - Whole Structure
Load 5 : Displacement
RETAINING WALL ANALYSIS AND DESIGN - Node Displacements:
All
Summary
Node | L/C | Horizontal X mm | Vertical Y mm | Horizontal Z mm | Resultant mm | Rotational rX rad | rY rad | rZ rad
1 | 5 COMBINAT | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000
2 | 5 COMBINAT | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000
3 | 5 COMBINAT | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000
4 | 5 COMBINAT | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000
5 | 5 COMBINAT | -61.356 | -0.012 | -0.000 | 61.356 | -0.000 | -0.001 | 0.025
7 | 5 COMBINAT | -61.356 | -0.012 | 0.000 | 61.356 | 0.000 | 0.001 | 0.025
6 | 5 COMBINAT | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000
9 | 5 COMBINAT | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000
Click on nodes to select (Ctrl+click to toggle selection)
Postprocessing Workflow
Load : 5: COMBINATION LOAD CASE
Input Units : kN-m




RETAINING WALL ANALYSIS AND DESIGN.STD - STAAD.Pro Advanced CONNECT Edition
File
View
Select
Results
Utilities
Load:
Deflection
Displacement
Utilization Ratio
View Loading Diagram
Beam Stress
Plate Stress
Solid Stress
Layouts
Mode:
Mode Shape
Relative Response
Time Steps
Animation
Select Load Case
Structure
Scale
Annotate
Update Properties
Reports
Workflow
Analytical Modeling
Physical Modeling
Building Planner
Piping
Bridge Deck
Postprocessing
Foundation Design
Steel AutoDrafter
Connection Design
Concrete Design
Advanced Concrete Desi...
Advanced Slab Design
Earthquake
Postprocessing:
Displacements
Reactions
Beam Results
Plate Results
Solid Results
Dynamics
Reports
Shear, Membrane and Bending
Load 5
Click on plates to select (Ctrl+click to toggle selection)
Postprocessing Workflow
Load : 5: COMBINATION LOAD CASE
Input Units : kN-m


RETAINING WALL ANALYSIS AND DESIGN.STD - STAAD.Pro Advanced CONNECT Edition
File
View
Select
Results
Utilities
Load:
5: COMBINATIO
View Loading Diagram
Deflection
Displacement
Utilization Ratio
Beam Stress
Plate Stress
Solid Stress
Layouts
Mode:
Mode Shape
Relative Response
Time Steps
Animation
Select Load Case
Structure
Scale
Annotate
Update Properties
Reports
Workflow
Analytical Modeling
Physical Modeling
Building Planner
Piping
Bridge Deck
Postprocessing
Foundation Design
Steel AutoDrafter
Connection Design
Concrete Design
Advanced Concrete Desi...
Advanced Slab Design
Earthquake
Postprocessing: Displacements Reactions Beam Results Plate Results Solid Results Dynamics Reports
RETAINING WALL ANALYSIS AND DESIGN - Whole Structure
MX (local)
kN-m/m
Load 5
Shear, Membrane and Bending
Plate
L/C
SQX (local) N/mm2
SQY (local) N/mm2
Click on plates to select (Ctrl+click to toggle selection)
Postprocessing Workflow
Load : 5: COMBINATION LOAD CASE
Input Units : kN-m


RETAINING WALL ANALYSIS AND DESIGN.STD - STAAD.Pro Advanced CONNECT Edition
File
View
Select
Results
Utilities
Load:
5: COMBINATIO
View Loading Diagram
Deflection
Displacement
Utilization Ratio
Beam Stress
Plate Stress
Solid Stress
Layouts
Mode:
Mode Shape
Relative Response
Time Steps
Animation
Select Load Case
Structure
Scale
Annotate
Update Properties
Reports
Workflow
Analytical Modeling
Physical Modeling
Building Planner
Piping
Bridge Deck
Postprocessing
Foundation Design
Steel AutoDrafter
Connection Design
Concrete Design
Advanced Concrete Desi...
Advanced Slab Design
Earthquake
Postprocessing: Displacements Reactions Beam Results Plate Results Solid Results Dynamics Reports
RETAINING WALL ANALYSIS AND DESIGN - Whole Structure
Max Absolute
N/mm2
<= 0
0.929
1.86
2.79
3.71
4.64
5.57
6.5
7.43
8.36
9.29
10.2
11.1
12.1
13
13.9
>= 14.9
Load 5
Shear, Membrane and Bending
Plate
L/C
SQX (local) N/mm2
SQY (local) N/mm2
Node
Click on plates to select (Ctrl+click to toggle selection)
Postprocessing Workflow
Load : 5: COMBINATION LOAD CASE
Input Units : kN-m


RETAINING WALL ANALYSIS AND DESIGN.STD - STAAD.Pro Advanced CONNECT Edition
RETAINING WALL ANALYSIS AND DESIGN - Whole Structure
Plate #15
Load 5
Shear, Membrane and Bending
Click on plates to select (Ctrl+click to toggle selection)
Postprocessing Workflow
Load : 5: COMBINATION LOAD CASE
Input Units : kN-m

Software licensed to STAAD.Pro Advanced CONNECTED User: Not signed in	Job No	Sheet No 1	Rev
	Part		
Job Title RETAINING WALL ANALYSIS AND DESIGN	Ref		
	By	Date 13-May-21	Chd
Client	File RETAINING WALL ANAL	Date/Time 13-May-2021 02:15	

Job Information

	Engineer	Checked	Approved
Name:			
Date:	13-May-21		

Project ID	
Project Name	

Structure Type	SPACE FRAME

Number of Nodes	8	Highest Node	9
Number of Plates	3	Highest Plate	17

Number of Basic Load Cases	4
Number of Combination Load Cases	1

Included in this printout are data for:

All	The Whole Structure

Included in this printout are results for load cases:

Type	L/C	Name
Primary	1	DL
Primary	2	ACTIVE EARTH PRESS
Primary	3	VERICAL EARTH LOAD
Primary	4	BACKFILL
Combination	5	COMBINATION LOAD CASE 5

Nodes

Node	X (m)	Y (m)	Z (m)
1	0	0	0
2	1.600	0	0
3	0	0	1.000
4	1.600	0	1.000
5	0	4.700	0
7	0	4.700	1.000
8	-0.800	0	0
9	-0.800	0	1.000

Plates

Plate	Node A	Node B	Node C	Node D	Property
15	5	7	3	1	1

Print Time/Date: 13/05/2021 03:02 STAAD.Pro CONNECT Edition 22.00.00.15 Print Run 1 of 8

Plate Thickness

Prop	Node A (cm)	Node B (cm)	Node C (cm)	Node D (cm)	Material
1	25.000	25.000	25.000	25.000	CONCRETE
2	50.000	50.000	50.000	50.000	CONCRETE

Materials

Mat	Name	E (kN/mm^2)	ν	Density (kg/m^3)	α (/°C)
1	CONCRETE	21.718	0.170	2.4E+3	10E -6
2	ALUMINUM	68.948	0.330	2.71E+3	23E -6
3	STEEL_50_KSI	199.948	0.300	7.83E+3	11.7E -6
4	STAINLESSSTEEL	197.930	0.300	7.83E+3	18E -6
5	STEEL_36_KSI	199.948	0.300	7.83E+3	11.7E -6
6	STEEL_275_NMM2	205.000	0.300	7.85E+3	12E -6
7	STEEL	205.000	0.300	7.83E+3	12E -6
8	STEEL_355_NMM2	205.000	0.300	7.85E+3	12E -6

Supports

Node	X (kN/mm)	Y (kN/mm)	Z (kN/mm)	rX (kN˙m/deg)	rY (kN˙m/deg)	rZ (kN˙m/deg)
1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
2	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
3	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
4	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
8	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
9	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed

Primary Load Cases

Number	Name	Type
1	DL	Dead
2	ACTIVE EARTH PRESS	Live
3	VERICAL EARTH LOAD	Live
4	BACKFILL	Live

Software licensed to STAAD.Pro Advanced CONNECTED User: Not signed in	Job No	Sheet No 3	Rev
	Part		
Job Title RETAINING WALL ANALYSIS AND DESIGN	Ref		
	By	Date 13-May-21	Chd
Client	File RETAINING WALL ANAL	Date/Time 13-May-2021 02:15	

Combination Load Cases

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
5	COMBINATION LOAD CASE 5	1	DL	1.00
		2	ACTIVE EARTH PRESS	1.00
		3	VERICAL EARTH LOAD	1.00
		4	BACKFILL	1.00

Load Generators

There is no data of this type.

1 DL : Selfweight

Direction	Factor	Assigned Geometry
Y	-1.000	ALL

2 ACTIVE EARTH PRESS : Plate Loads

Plate	Type	Direction	Fa	Fb	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)
15	PRE N/mm2	GX	-0.028	-	-	-	-	-

3 VERICAL EARTH LOAD : Plate Loads

Plate	Type	Direction	Fa	Fb	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)
17	PRE N/mm2	GY	-0.0846	-	-	-	-	-

4 BACKFILL : Plate Loads

Plate	Type	Direction	Fa	Fb	X1 (m)	Y1 (m)	X2 (m)	Y2 (m)
16	PRE N/mm2	GY	-0.0126	-	-	-	-	-

Node Displacement Summary

	Node	L/C	X (mm)	Y (mm)	Z (mm)	Resultant (mm)	rX (rad)	rY (rad)	rZ (rad)
Max X	1	1:DL	**0**	0	0	0	0	0	0
Min X	5	2:ACTIVE EAR	**-61.356**	0	0	61.356	0	-0.001	0.025
Max Y	1	1:DL	0	**0**	0	0	0	0	0
Min Y	5	1:DL	0	**-0.012**	-0.000	0.012	-0.000	0	0
Max Z	7	1:DL	0	-0.012	**0.000**	0.012	0.000	0	0
Min Z	5	1:DL	0	-0.012	**-0.000**	0.012	-0.000	0	0
Max rX	7	1:DL	0	-0.012	0.000	0.012	**0.000**	0	0
Min rX	5	1:DL	0	-0.012	-0.000	0.012	**-0.000**	0	0
Max rY	7	2:ACTIVE EAR	-61.356	0	0	61.356	0	**0.001**	0.025
Min rY	5	2:ACTIVE EAR	-61.356	0	0	61.356	0	**-0.001**	0.025
Max rZ	5	2:ACTIVE EAR	-61.356	0	0	61.356	0	-0.001	**0.025**
Min rZ	1	1:DL	0	0	0	0	0	0	**0**
Max Rst	5	5:COMBINATI	-61.356	-0.012	-0.000	**61.356**	-0.000	-0.001	0.025

Plate Center Stress Summary

			Shear		Membrane			Bending		
	Plate	L/C	Qx (N/mm²)	Qy (N/mm²)	Sx (N/mm²)	Sy (N/mm²)	Sxy (N/mm²)	Mx (kN·m/m)	My (kN·m/m)	Mxy (kN·m/m)
Max Qx	15	1:DL	**0**	0	-0.002	-0.055	0.000	0	0	0
Min Qx	15	2:ACTIVE EAR	**-0.000**	0.262	0	0	0	10.572	154.177	0.000
Max Qy	15	2:ACTIVE EAR	-0.000	**0.262**	0	0	0	10.572	154.177	0.000
Min Qy	15	1:DL	0	**0**	-0.002	-0.055	0.000	0	0	0
Max Sx	16	1:DL	0	0	**0**	0	0	0	0	0
Min Sx	15	1:DL	0	0	**-0.002**	-0.055	0.000	0	0	0
Max Sy	16	1:DL	0	0	0	**0**	0	0	0	0
Min Sy	15	1:DL	0	0	-0.002	**-0.055**	0.000	0	0	0
Max Sxy	15	1:DL	0	0	-0.002	-0.055	**0.000**	0	0	0
Min Sxy	16	1:DL	0	0	0	0	**0**	0	0	0
Max Mx	15	2:ACTIVE EAR	-0.000	0.262	0	0	0	**10.572**	154.177	0.000
Min Mx	15	1:DL	0	0	-0.002	-0.055	0.000	**0**	0	0
Max My	15	2:ACTIVE EAR	-0.000	0.262	0	0	0	10.572	**154.177**	0.000
Min My	15	1:DL	0	0	-0.002	-0.055	0.000	0	**0**	0
Max Mxy	15	2:ACTIVE EAR	-0.000	0.262	0	0	0	10.572	154.177	**0.000**
Min Mxy	15	1:DL	0	0	-0.002	-0.055	0.000	0	0	**0**

Plate Center Principal Stress Summary

	Plate	L/C	Principal Top (N/mm²)	Principal Bottom (N/mm²)	Von Mis Top (N/mm²)	Von Mis Bottom (N/mm²)	Tresca Top (N/mm²)	Tresca Bottom (N/mm²)
Max (t)	15	2:ACTIVE EAR	**14.801**	-1.015	14.321	14.321	14.801	14.801
Max (b)	15	2:ACTIVE EAR	14.801	**-1.015**	14.321	14.321	14.801	14.801
Max VM (t)	15	2:ACTIVE EAR	14.801	-1.015	**14.321**	14.321	14.801	14.801
Max VM (b)	15	5:COMBINATI	14.746	-1.017	14.266	**14.375**	14.746	14.856
Tresca (t)	15	2:ACTIVE EAR	14.801	-1.015	14.321	14.321	**14.801**	14.801
Tresca (b)	15	5:COMBINATI	14.746	-1.017	14.266	14.375	14.746	**14.856**

Reaction Summary

	Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kN·m)	Moment MY (kN·m)	Moment MZ (kN·m)
Max FX	1	2:ACTIVE EAR	**65.607**	0	0	0	49.687	-154.177
Min FX	1	1:DL	**0**	20.911	2.898	-0.037	0	0
Max FY	1	5:COMBINATI	65.607	**57.271**	2.898	-0.037	49.687	-154.177
Min FY	1	2:ACTIVE EAR	65.607	**0**	0	0	49.687	-154.177
Max FZ	1	1:DL	0	20.911	**2.898**	-0.037	0	0
Min FZ	3	1:DL	0	20.911	**-2.898**	0.037	0	0
Max MX	3	1:DL	0	20.911	-2.898	**0.037**	0	0
Min MX	1	1:DL	0	20.911	2.898	**-0.037**	0	0
Max MY	1	2:ACTIVE EAR	65.607	0	0	0	**49.687**	-154.177
Min MY	3	2:ACTIVE EAR	65.607	0	0	0	**-49.687**	-154.177
Max MZ	1	1:DL	0	20.911	2.898	-0.037	0	**0**
Min MZ	1	2:ACTIVE EAR	65.607	0	0	0	49.687	**-154.177**

Statics Check Results

L/C		FX (kN)	FY (kN)	FZ (kN)	MX (kN·m)	MY (kN·m)	MZ (kN·m)
1:DL	Loads	0	-55.959	0	27.979	0	-11.310
1:DL	Reactions	0	55.959	0.000	-27.979	0	11.310
	Difference	0	0.000	0.000	0.000	0	0
2:ACTIVE EART	Loads	-131.215	0	0	0	-65.607	308.354
2:ACTIVE EART	Reactions	131.215	0	0	0	65.607	-308.354
	Difference	-0.000	0	0	0	-0.000	0.000
3:VERICAL EART	Loads	0	-135.360	0	67.680	0	-108.288
3:VERICAL EART	Reactions	0	135.360	0	-67.680	0	108.288
	Difference	0	0	0	0	0	0
4:BACKFILL	Loads	0	-10.080	0	5.040	0	4.032
4:BACKFILL	Reactions	0	10.080	0	-5.040	0	-4.032
	Difference	0	0	0	0	0	0

Base Pressure Summary

	Node	L/C	FX (N/mm²)	FY (N/mm²)	FZ (N/mm²)
Max FX	1	1:DL	**0**	0	0
Min FX	1	1:DL	**0**	0	0
Max FY	1	1:DL	0	**0**	0
Min FY	1	1:DL	0	**0**	0
Max FZ	1	1:DL	0	0	**0**
Min FZ	1	1:DL	0	0	**0**

CHAPTER 5

CONCLUSION

The present study suggests that bending moment of a retaining wall with and without shelve must be in near alignment with Staad-Pro, according to the findings. Owing to the presence of racks, the pressure flow diagram shifts dramatically. Theshelve should have width up to the failure plane to achieve the best reduction in active earth pressure force. Between H/3 and 2H/3, the maximal successful earth pressure force reduction is achieved. At H/2 height, the active earth pressure force reaches its highest value. Because of the relief racks, the overturning moment is minimised. By adding a relief shelve to the cantilever retaining wall, the amount of concrete and steel used is minimised. It's also been discovered that using relief shelves instead of a traditional cantilever retaining wall saves between 15% and 25% on building costs. Concrete is 35 percent cheaper, and steel is 11 percent cheaper.

REFERENCES

Choudhury D, Singh S, Choudhury D, Singh S, Choudhury D, Singh S, Choudhury D, Singh S. New method for estimating static and seismic active earth pressure, 24: 117–127 in Geotech. Geol. Eng.

Firoozi, A.A., Firoozi, A.A. and Baghini, M.S., 2016. A Review of Clayey Soils. Asian Journal of Applied Sciences (ISSN: 2321–0893), 4(06).

IS 14458 (1998): Guidelines for retaining wall for hill area, part-1: selection of type of wall

IS 14458 (1998): Guidelines for retaining wall for hill area, part-2: Design of retaining/ breast walls

IS 14458 (1998): Guidelines for retaining wall for hill area, part-3: Construction of Dry stone walls

S. S.Patil and A. A. R. Babgan, "analysis and design of reinforced concrete stepped cantilever retaining wall", IJRET, vol. 04, Feb-2015, page 46-67

Sarita Singla and Er. Sakshi Gupta, "Optimisation of reinforced concrete walls of varing heights using relieving platform", IJERT, Vol. 4, June 2015, pp 1071-1077

Shravya Donkada and Devdas Menon, "Optimal design of reinforced concrete retaining walls", The Indian concrete journal. April 2012, page 9-18

Soosan, T.G., Sridharan, A., Jose, B.T. and Abraham, B.M., 2005. Utilization of quarry dust to improve the geotechnical properties of soils in highway construction. Geotechnical Testing Journal, 28(4), pp.391-400.

Swati Nagare, Rutuja Shinde, Sushma Ladkat and Komal Mahisare, "Case study of retaining wall", April 2017

Tamadher abood, Haten E. Younis Eldawi, Faeza R. Elnaji Abdulrahim, "Design of Cantilever retaining wall with 4m height ", Imternational journal of civil and structural engineering research, vol. 3, April 2015, pp 318-326

Van den Berg J. 1995. Prediction of alluvial channel pattern of peren-nial rivers.Geomorphology12: 259–279

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

PLAGIARISM VERIFICATION REPORT

Date:16-May-2021

Type of Document (Tick): PhD Thesis | M.Tech Dissertation/ Report | B.Tech Project Report | Paper

Name: Aditya Rana **Department:** Civil Engineering **Enrolment No** 171618, 161672

Contact No.7018654535 **E-mail.**adityarana323@gmail.com

Name of the Supervisor: Prof Ashok Kumar Gupta

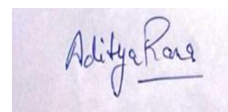
Title of the Thesis/Dissertation/Project Report/Paper (In Capital letters): Design of Retaing Walls on STADD Pro

UNDERTAKING

I undertake that I am aware of the plagiarism related norms/ regulations, if I found guilty of any plagiarism and copyright violations in the above thesis/report even after award of degree, the University reserves the rights to withdraw/revoke my degree/report. Kindly allow me to avail Plagiarism verification report for the document mentioned above.

Complete Thesis/Report Pages Detail:

- Total No. of Pages = 50
- Total No. of Preliminary pages = 9
- Total No. of pages accommodate bibliography/references = 1



(Signature of Student)

FOR DEPARTMENT USE

We have checked the thesis/report as per norms and found **Similarity Index** at 26(%). Therefore, we are forwarding the complete thesis/report for final plagiarism check. The plagiarism verification report may be handed over to the candidate.

(Signature of Guide/Supervisor)

Signature of HOD

FOR LRC USE

The above document was scanned for plagiarism check. The outcome of the same is reported below:

Copy Received on	**Excluded**	**Similarity Index (%)**	**Generated Plagiarism Report Details** (Title, Abstract & Chapters)	
	• All Preliminary Pages • Bibliography/Images/Quotes • 14 Words String		Word Counts	
Report Generated on			Character Counts	
		Submission ID	Total Pages Scanned	
			File Size	

Checked by
Name & Signature **Librarian**

....

Please send your complete thesis/report in (PDF) with Title Page, Abstract and Chapters in (Word File) through the supervisor at plagcheck.juit@gmail.com