

# TO STUDY BEHAVIOUR OF DIAMOND PIER FOUNDATION ON LOW BEARING CAPACITY OF SOIL ON FEM BASED SOFTWARE PLAXIS 2D

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*Abstract:* As our country is developing at a rapid pace and there is lack of places for construction of buildings. It is a prime need to find alternatives of hard soil and to do construction on soft soil or clayey soil with least efforts. In today's era, construction of soft soil is possible, but it is quite costly and time consuming. For that solution, we have used Diamond Pier Foundation, which can be used as foundation over soft soil. It is comparatively cheaper however giving the same desired resulted to that of conventional foundation. It is quick to fix and is detachable. We have studied the geometrics of this foundation and conducted various test over the model. The models were made with a different material than usual to check its properties and then results were found. In addition, Stimulation was used first to understand the stresses acting on the model and then later physical test were conducted by varying the batter angles and load carrying capacity of the model was checked for the permissible settlement as per local soil availability.

*IndexTerms - Pin Foundation, Diamond pier Foundation, low soil bearing capacity, Plaxis 2D.*

## I. INTRODUCTION

A Diamond Pier foundation a patented foundation system for small to medium sized structures, founded on a variety of soils. The foundation system is including of a concrete footing with 4 batter (or inclined) "pins" that benefit to resist vertical and lateral loads. Since this system makes use of the internal reinforcement mechanism provided by the combination of the pins and the surrounding soil, it has the potential to eliminate the need for larger sized concrete foundations thereby saving the need for additional materials and minimizing the footprint of the foundation. Numerical analysis involves FEM based approach for analysis in software program 'PLAXIS 2D'. Analysis of effective stress and principal stress acting on the soil due to sub-structure like foundation isolated foundation.

## Abbreviations and Acronyms (Heading 2)

To study behaviour of Diamond Pier Foundation on low bearing capacity of soil on FEM based software PLAXIS 2D.

## I. RESEARCH METHODOLOGY

The present chapter deals with the working procedure of the finite element computer program called PLAXIS 2D. Also, this chapter deals with the numerical modelling of pin foundation at different depth 5meters, 7meters, 10meters & at different position Left hand side, Right hand side of the building elements resulting in six cases respectively, using numerical method through finite element computer program Plaxis 2D.

### *Working Procedure Pin Foundation in PLAXIS 2D*

Basically, the Pin Foundation structure is modelled and analysed numerically using standard design recommendations such as NCMC, AASTHO, FHWA, BS etc. and then this model is converted in to FE model and is checked. The modelling is conducted as follows.



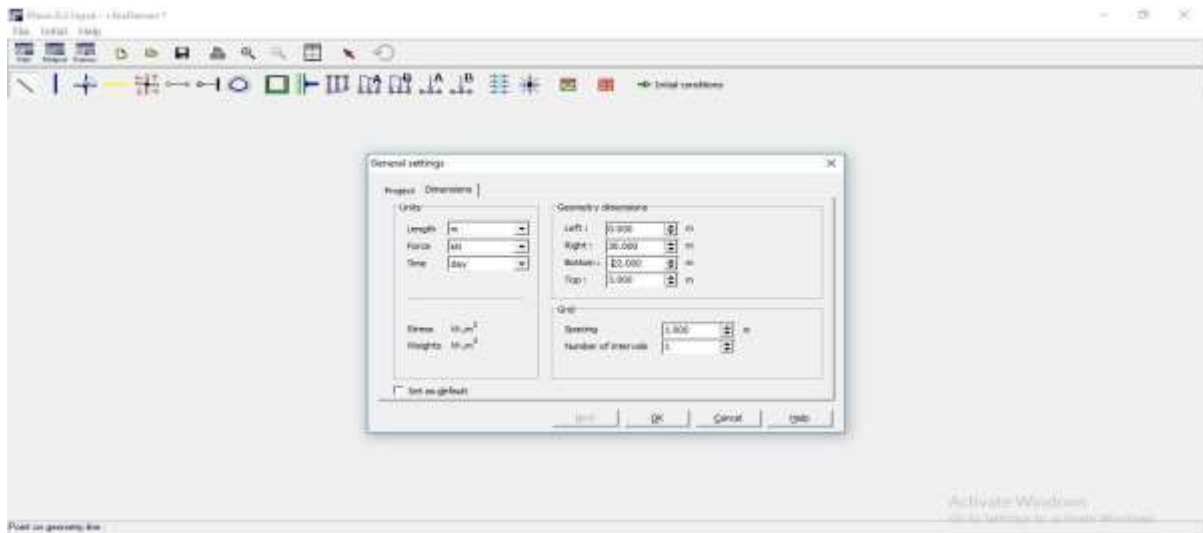


Fig. 4.3 shows General settings.

### Step 3. Working Window

The Screen shows the working space of Plaxis 2D software having three Menu bar as follows,

- 1) This menu bar facilitates us to General settings like File, Edit, Views, Geometry, Loads, Materials, Mesh, Initial and Help.
- 2) This menu bar allows us to Open, Save, Print, zoom in, and zoom out option.
- 3) This menu bar has all the tools required to create geometric models, apply various loads, and assign properties & also generation of mesh in model. And enable us to initiate initial condition.
- 4) The middle portion shows the working space and is bordered by rulers on both the sides for ease of work.

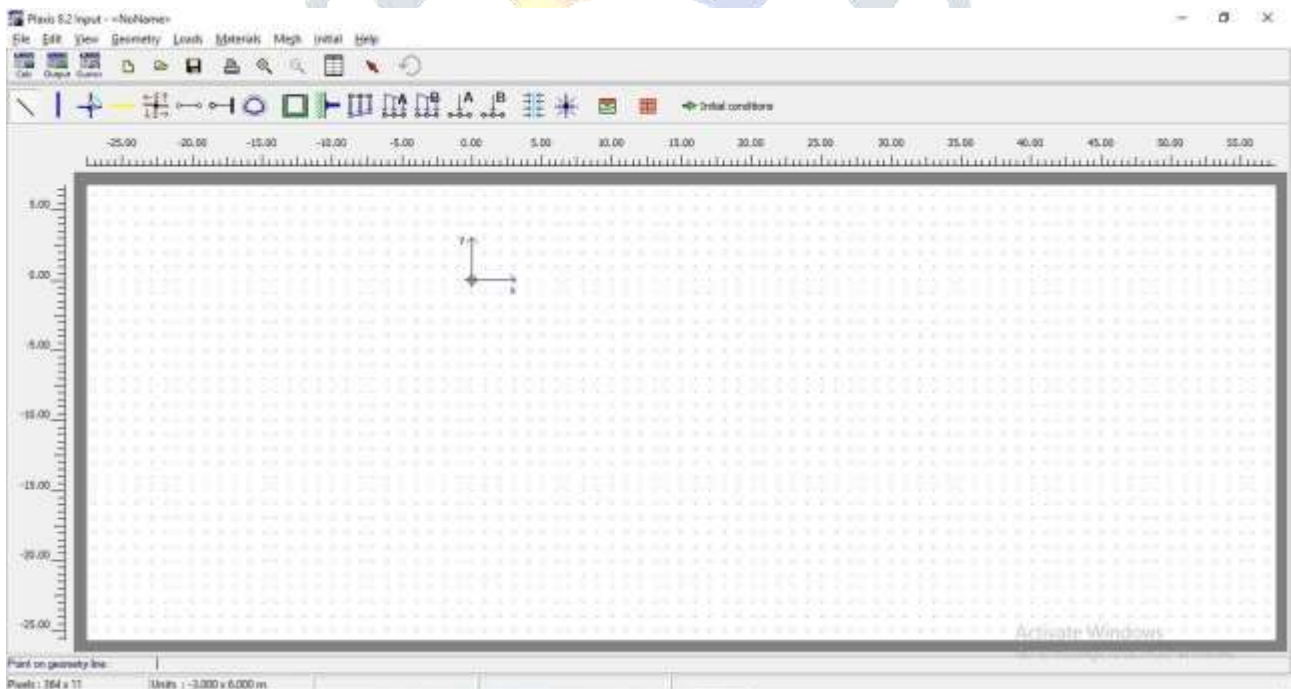


Fig. 1.4 shows Workspace.

### Step 4. Geometric Design

- In this working space using “Line tool” basic frame of model is created of total dimensions 10m X 10m

- The model is divided into different soil layers using “Line Tool”.

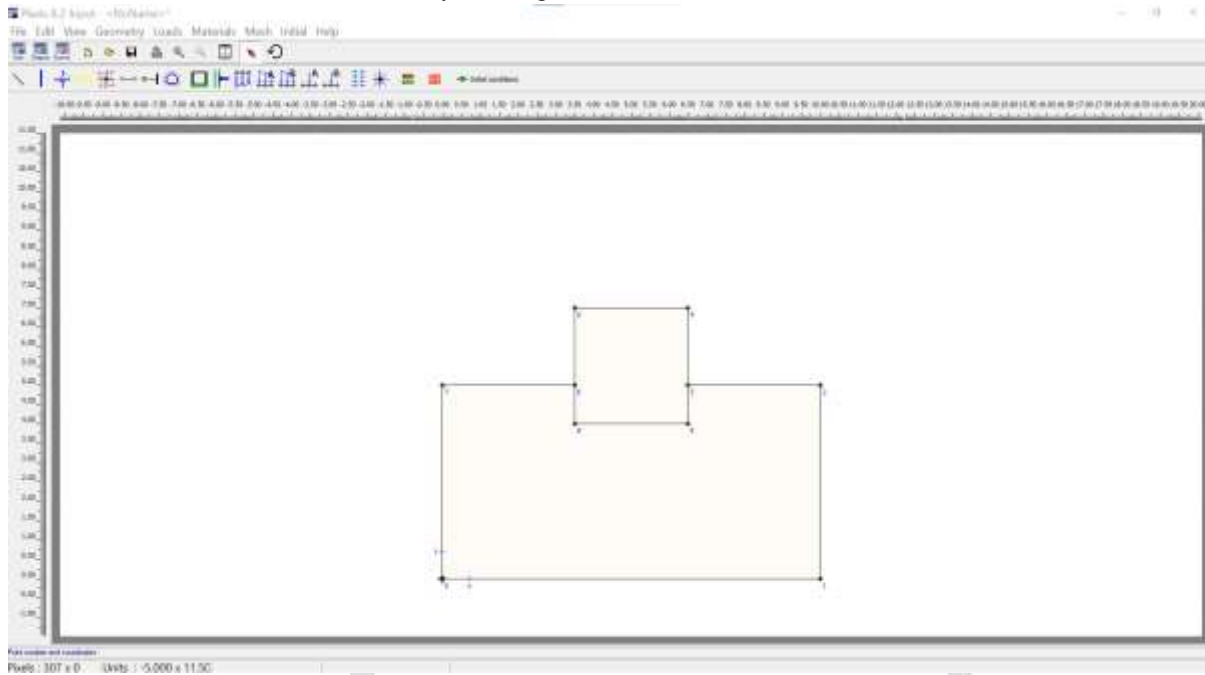


Fig. 1.5 Creating Foundation Model

- Using “Standard Fixities” the soil is confine in the model as shown in fig. 1.6.

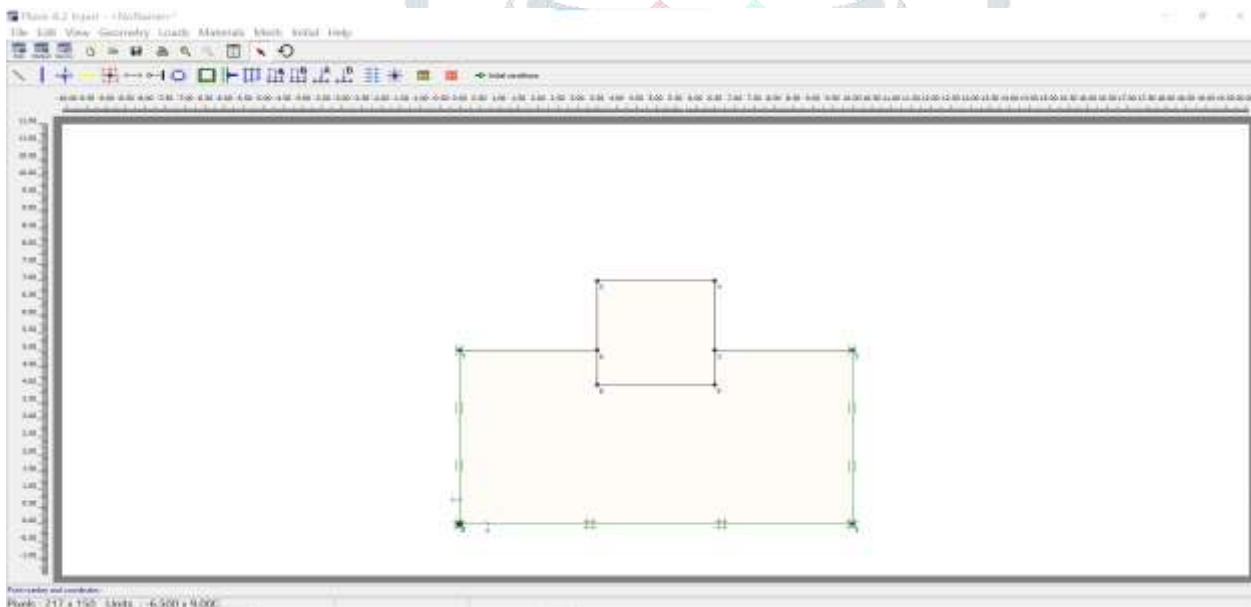


Fig. 1.6 Showing Working Place

#### Step 5. Assigning Soil Property

- After creating geometry model, horizontal layers are given different soil property and it is done by “Material Set” from the third menu bar.
- After selecting “Material Set” tool click on global to view the pre-existing soil properties to choose from and also new soil property can be defined as per requirements.

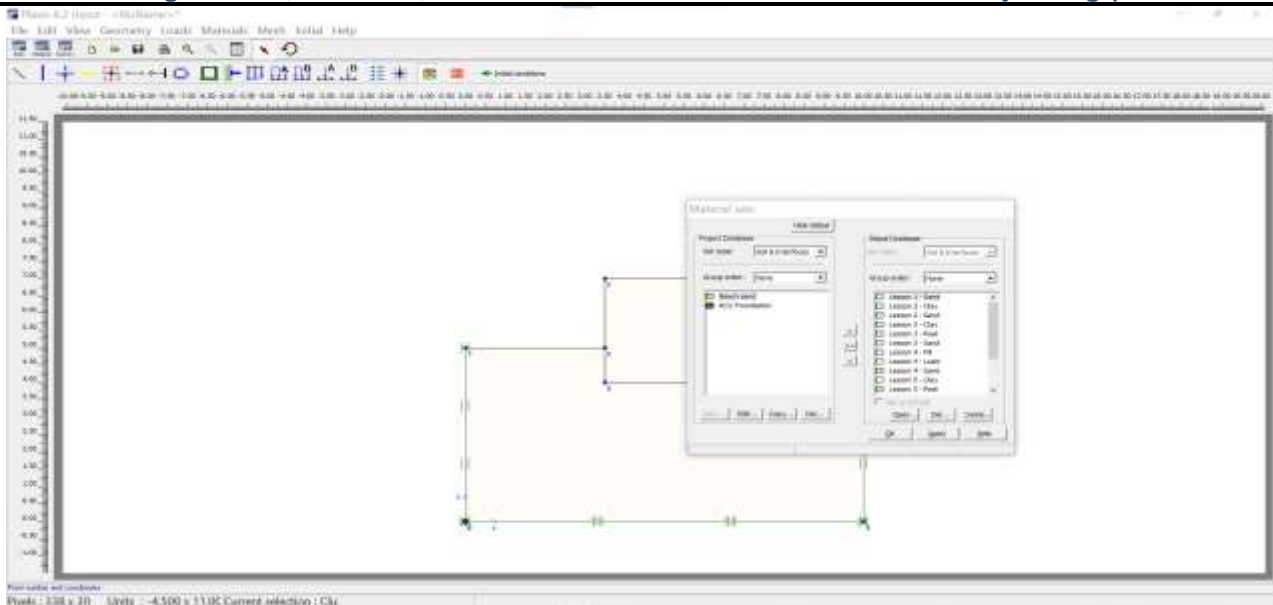


Fig. 1.7 shows Material Sets.

- The selected soil property can be drag & assign to the model as shown in the fig. 1.8.

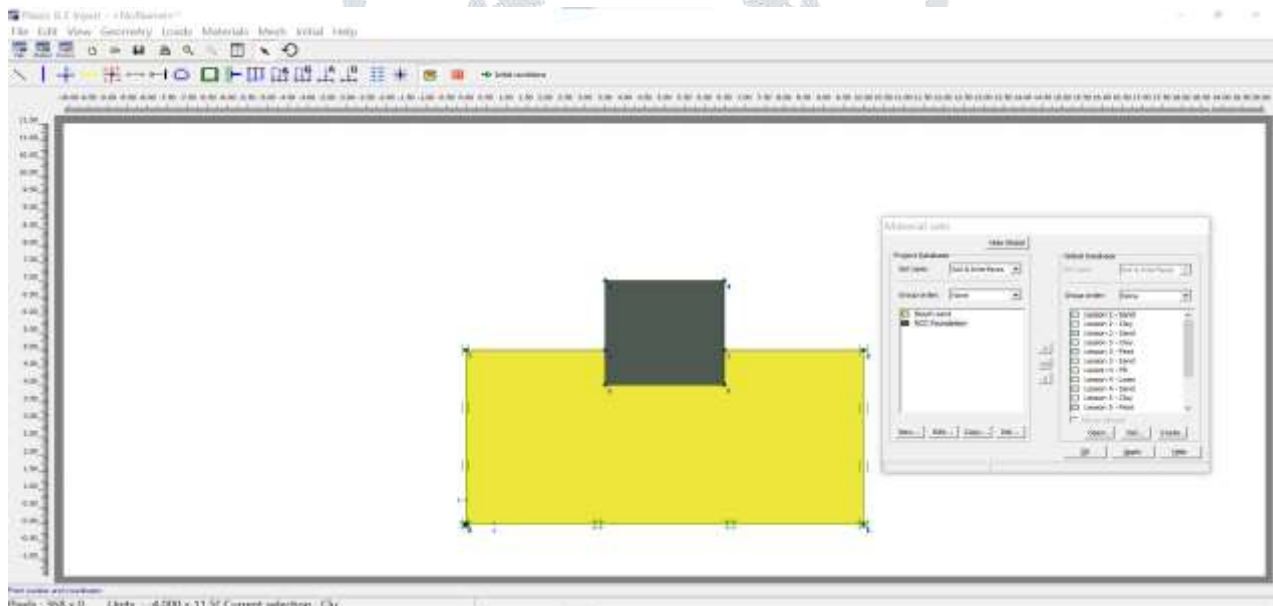
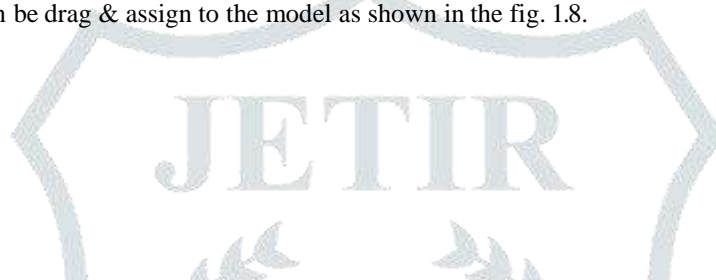


Fig. 1.8 Soil & RCC layers

#### Step 6. Generating Mesh

- **Mesh** is a measurement of particle size often used in determining the particle-size distribution of a granular material.
- In Plaxis 2D Fineness of the mesh is generated as flows: -
- Click on the mesh > Global coarseness> Element Distribution,
- This step deals with generation of modelled selecting the global coarseness as mesh generation because it gives good, deformed mesh with lesser congestion. Also, the deformation will be well visible without overlapping.
- In Element distribution various mesh size can be selected as per the sensitivity of the project, as shown in fig. 1.9.

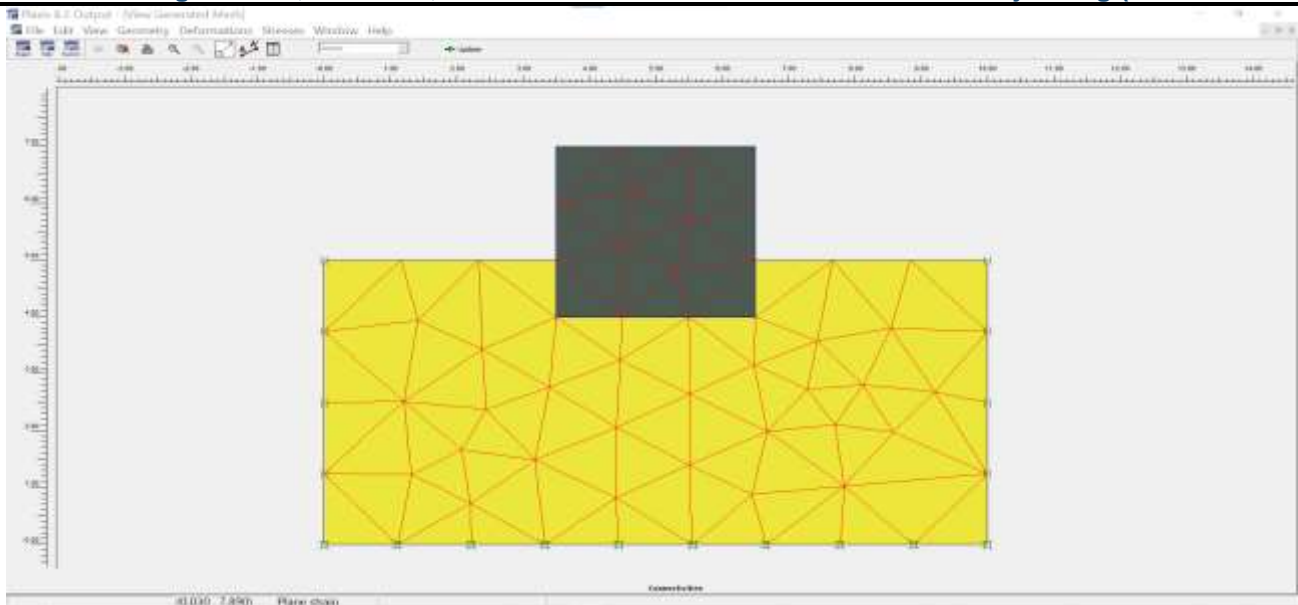


Fig. 1.9 shows Generated Mesh.

#### Step. 7 Generating Pore Water Pressure

- Click on “**Initial Condition**” to generate Initial pore water pressure and Initial Stresses & density of water can define as per requirement as shown in fig. 1.10.

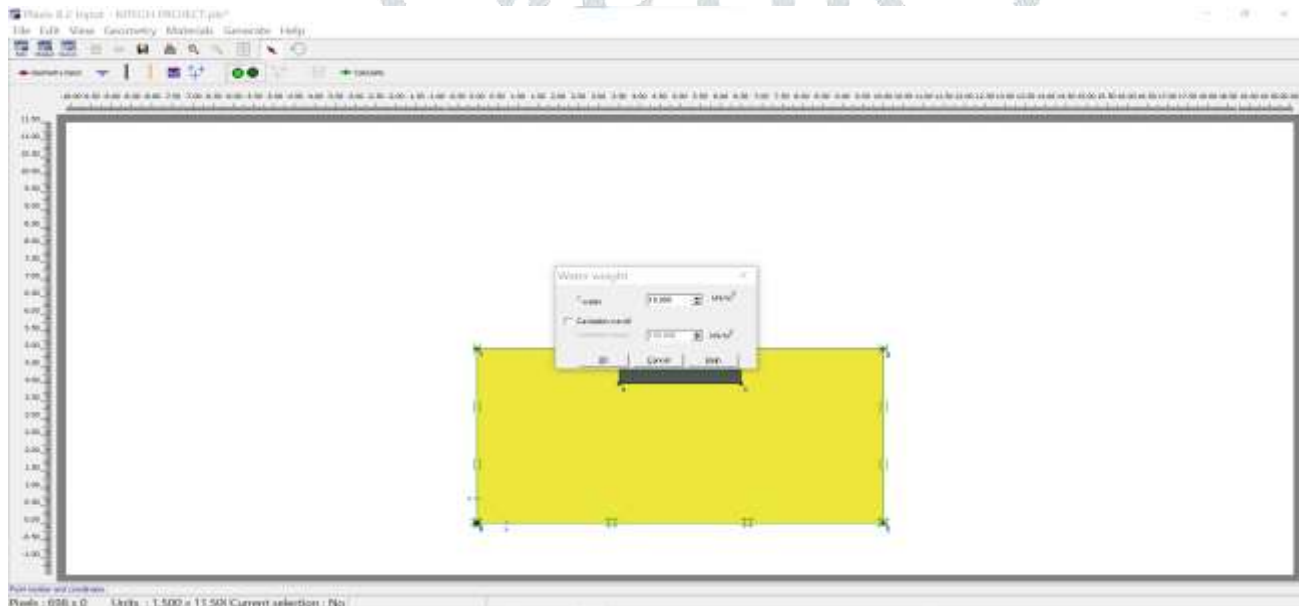


Fig. 1.10 shows Pore Water Pressure

- “**Ground water calculation**” tool is used to shown Ground Water table in the model. (Below 3m from the ground) as shown in fig. 1.11.

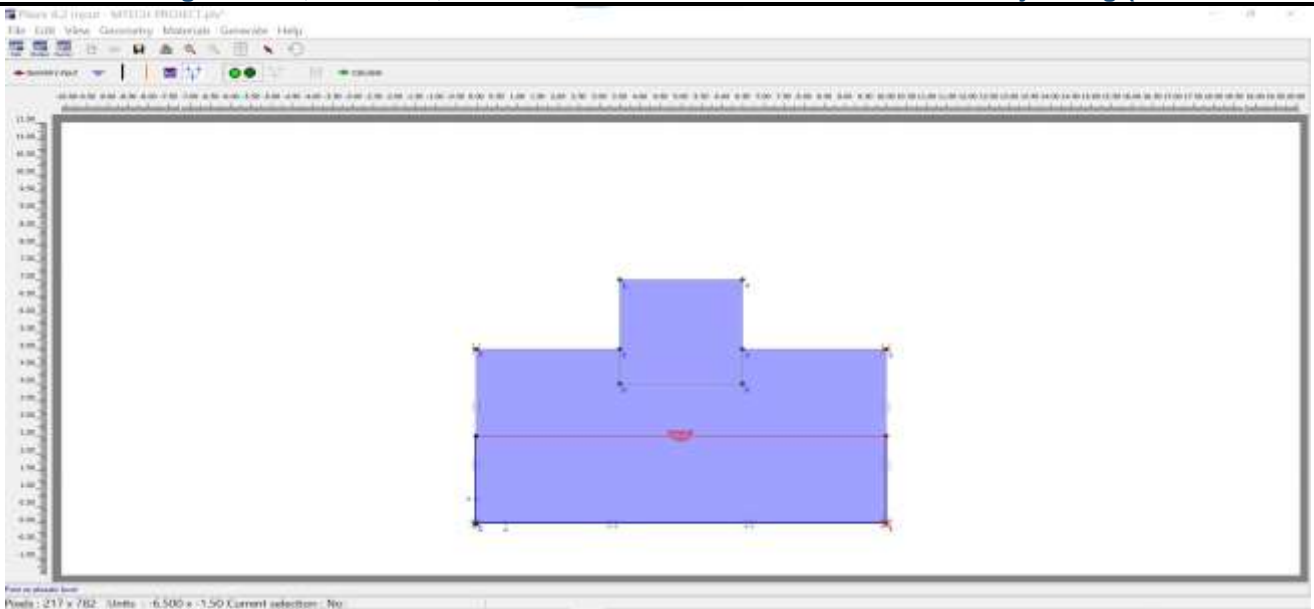


Fig. 1.11 shows Level of Groundwater.

- “Generate Water Pressure” tool is used to generate pore water pressure under the phreatic line as shown in fig. 1.12.

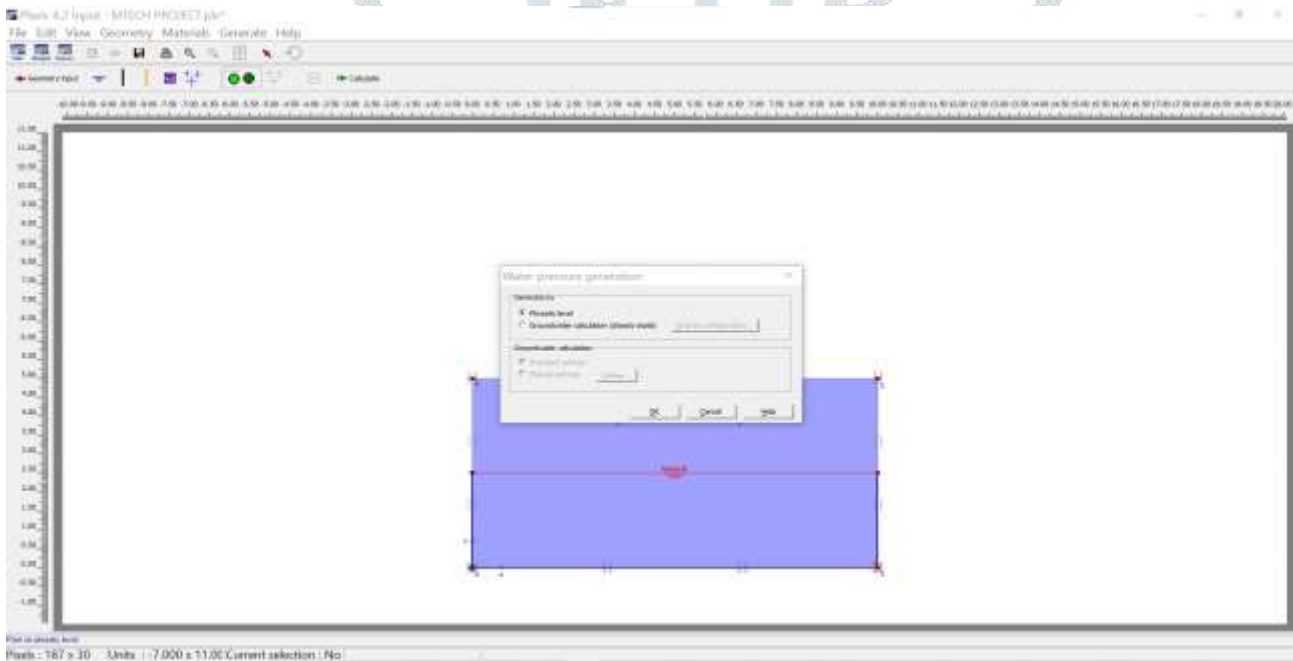


Fig. 1.12 shows Groundwater Line

Fig. 1.13 shows the Active Pore Water Pressure and click on “Update” to set the define parameters.

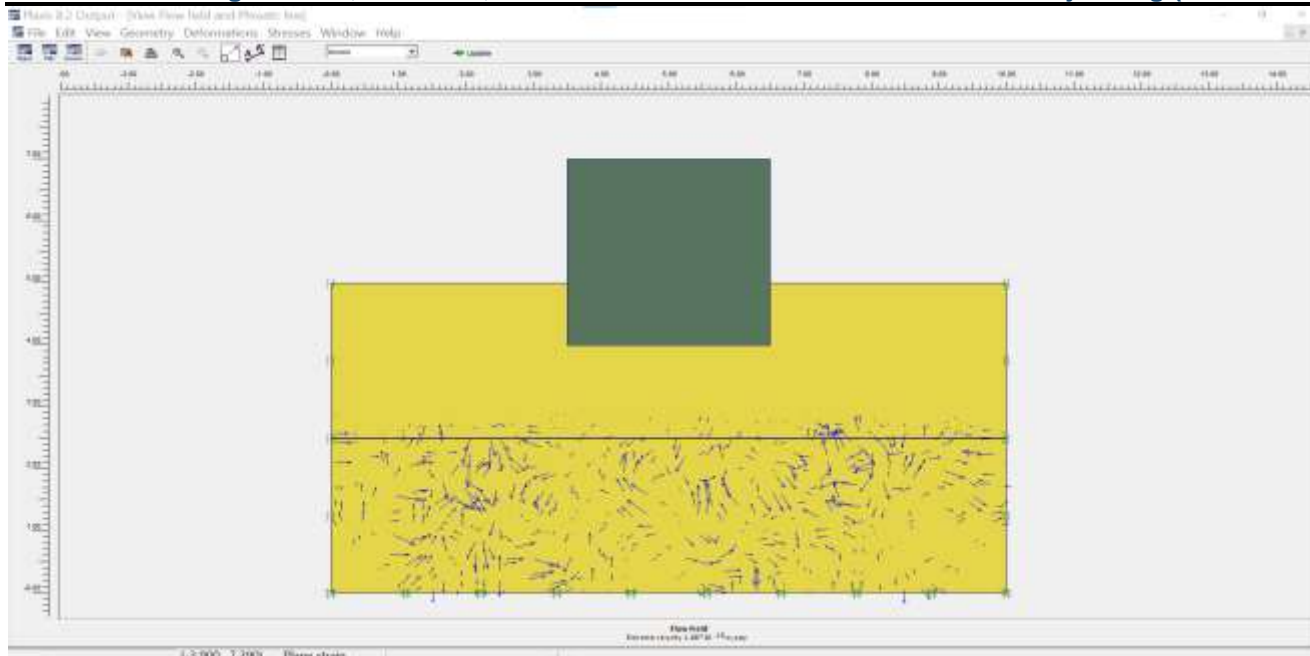


Fig. 1.13 shows Generated Pore Water Pressure

Step. 8 Generating Principal Stresses

- To generate the Principle Stresses, click on **“Initial Stresses and Geometry Configuration”** as shown in fig. 1.14.
- Click on **“Generate Initial Stresses”** to edit Stiffness Matrix Parameters.
- And The Principle Stresses are generated as shown in fig. 1.15 & to click on **“Update”** to set the parameters.

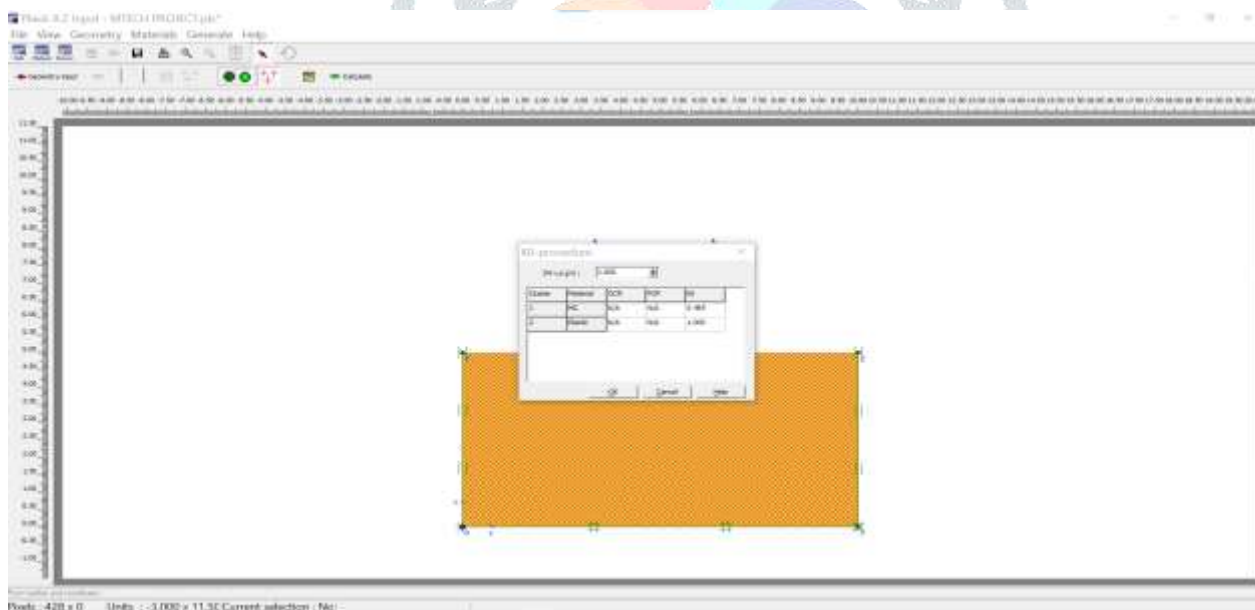


Fig. 1.14 shows Setting Principle Stresses

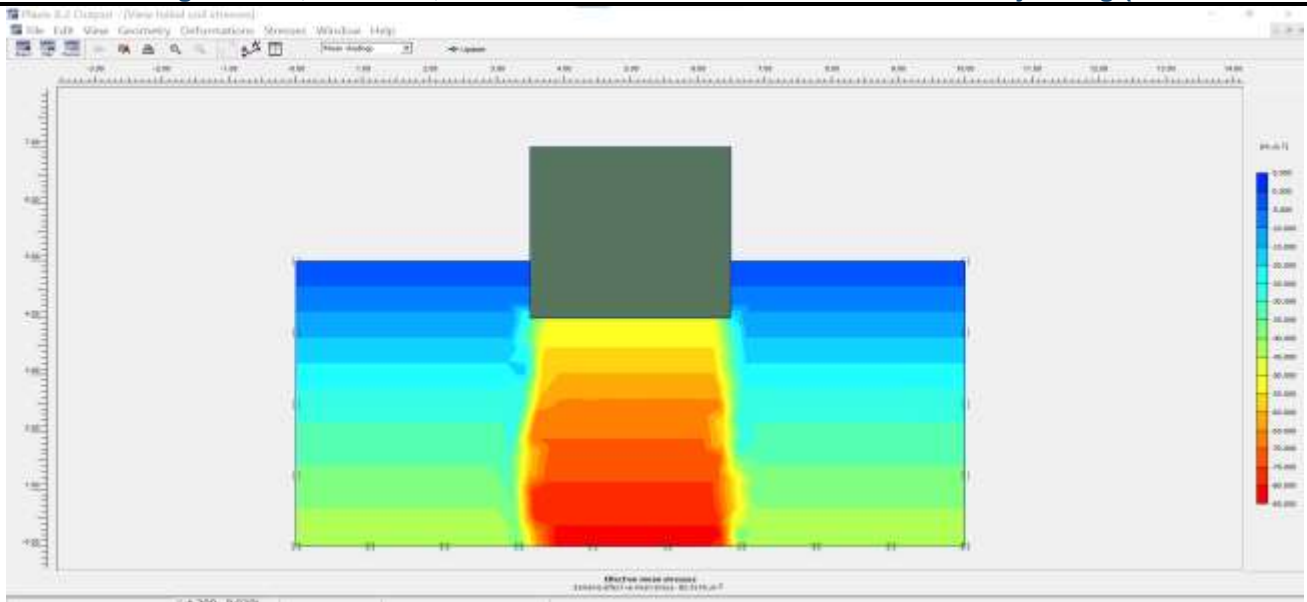


Fig. 1.15 shows Generated Principle Stresses

Step. 9 Save & Rename.

- Click on “**Calculate**” and save the file.
- We can also Rename and Change the Location of save file as shown in fig. 1.16.

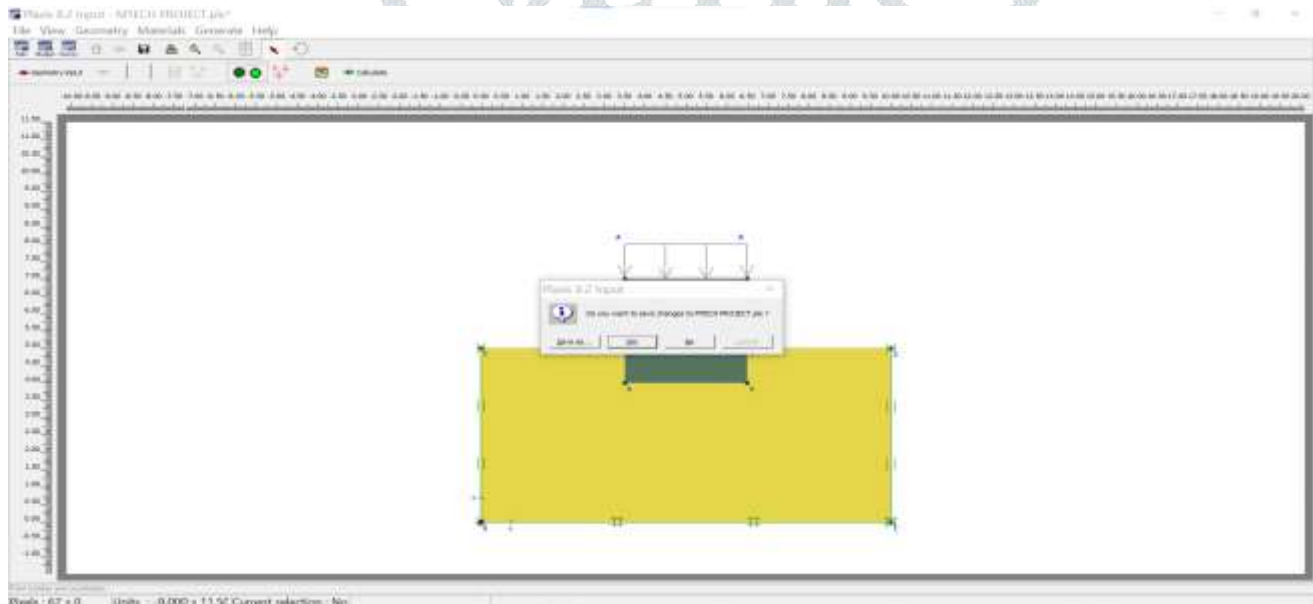


Fig. 1.16 shows Saving Option

Step. 10 Calculations

- After activation of all the elements click on “**Select point on curves**” & select Building Pin foundation elements.
- Click on “**Update**” as shown in fig. 1.17

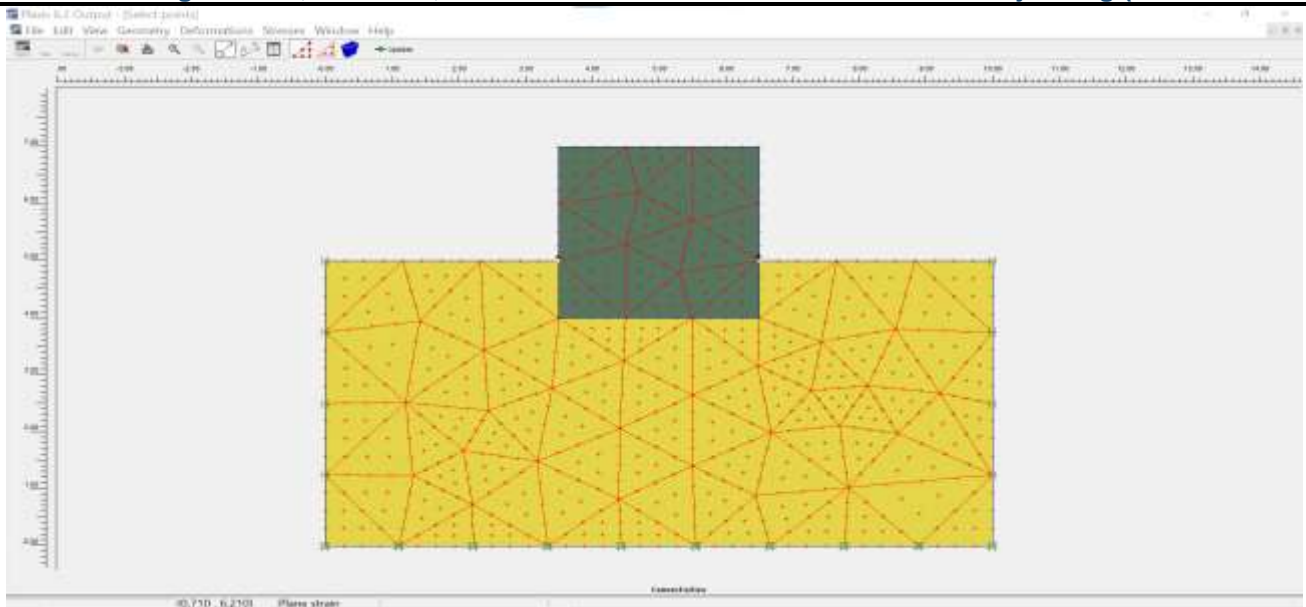


Fig. 1.17 shows Select Point on curve

- Click on “calculate...” to start the calculation procedure.

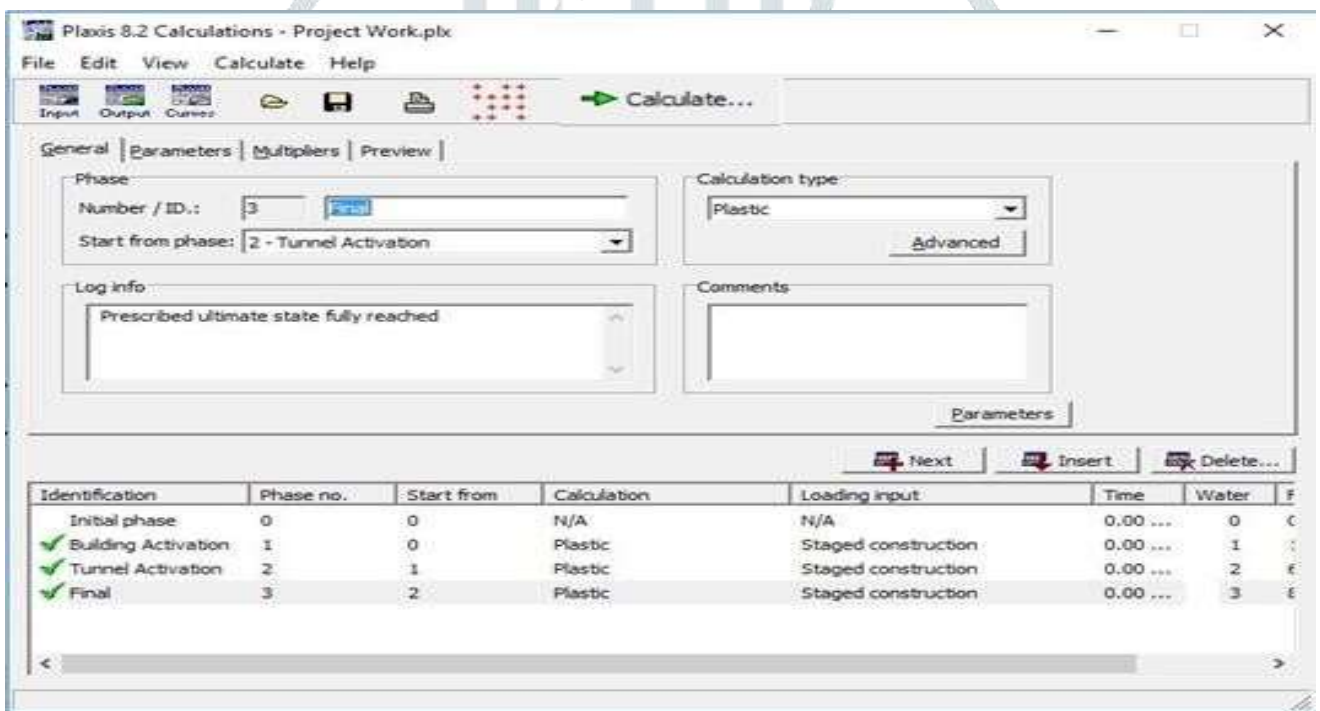


Fig. 1.18 shows Calculation Window

- Click on “Output” to see the Results of Foundation analyses.

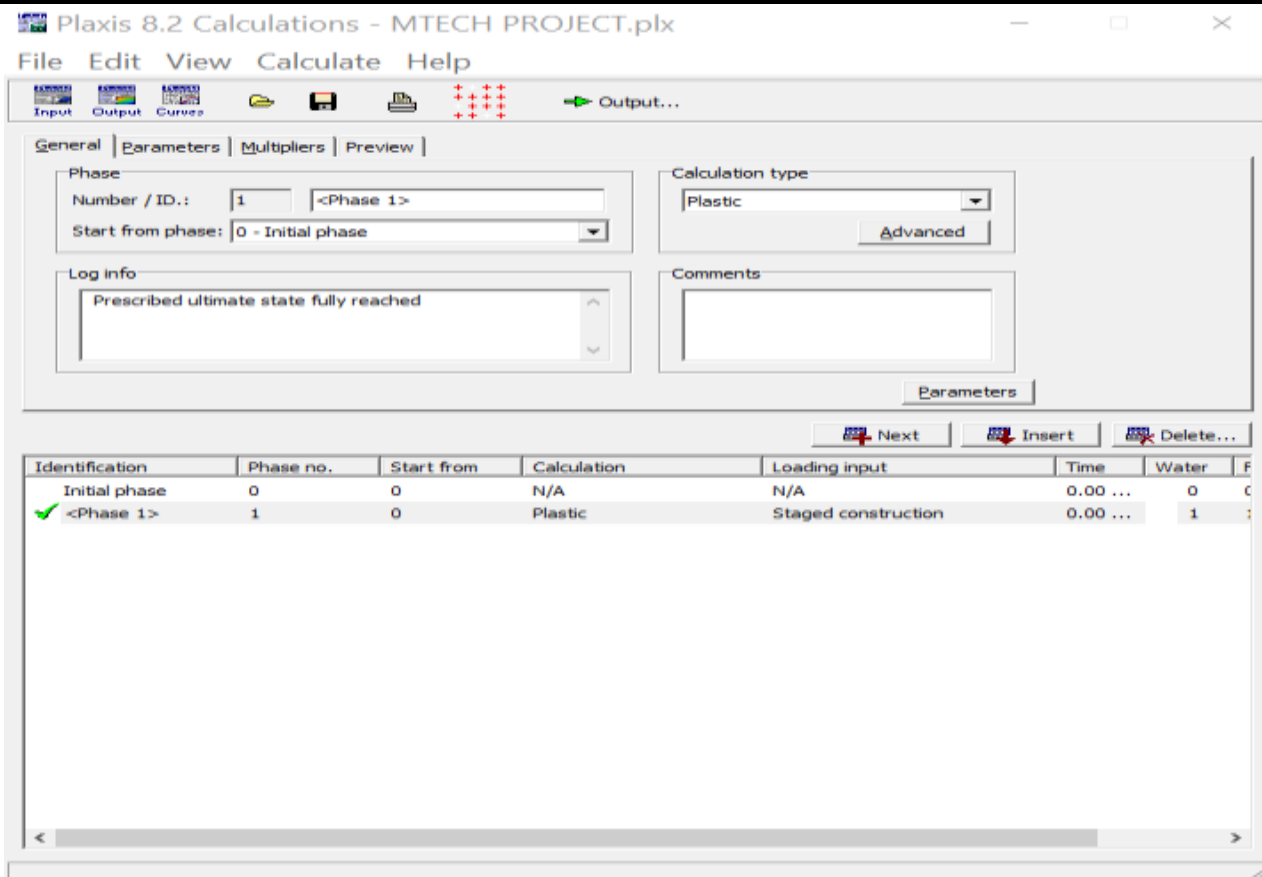


Fig. 1.18 shows Output Window.

## IV. RESULTS AND DISCUSSION

### 4.1 Results of Descriptive Statics of Study Variables

- 1) The average effective stress developed due diamond pier foundation in soil is  $82.41 \text{ KN/M}^2$  which is in permissible limit.
- 2) From the above result it is advisable that diamond pier foundation is suitable for low bearing capacity of soil like beach sand and clay.

## REFERENCES

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