PERFORMANCE ANALYSIS OF FOUNDATION SOIL REINFORCED WITH GEOTEXTILE

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This is to attest that the project entitled "PERFORMANCE ANALYSIS OF FOUNDATION SOIL REINFORCED WITH GEOTEXTILE" submitted by Mr. ASSOGBA, Dou Rached (Roll No. 2K20/GTE/22) in partial fulfillment of the requirements for the award of Master of Technology Degree in Civil Engineering at DTU is an authentic work carried out by him under my supervision and guidance.

To the best of my knowledge, the matter embodied in this report has not been submitted to any other university/institute for the award of any degree or diploma.

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ABSTRACT

This study looks into how Abaqus software is evolving for numerical simulation of the strip of sand foundation soil reinforced with geotextile. Limit load calculations are obtained from a sand strip charged by the footing. There is an equal distance distribution from left to right at the level of the central axis, resulting in model symmetry. The results are generated by Mohr-Coulomb model. At the element type section of Abaqus model, CPE8R elements are used in the left region of the pattern, and finite element CINPE5R types are used for stimulation on the right side where acoustic material is used to prevent any boundary reflects. On the way to estimate the improvement in bearing capacity of reinforced soil using Abaqus model, a numerical model without geotextile and with geotextile elements were developed. The purpose of these two experiments after stimulation in the Abaqus model is to observe a remarkable variation by changing the values of friction angle, dilation angle parameters and also to observe the effect of the load when increasing it progressively. The results determined that due to a progressive bearing capacity load obtained there is at the level of the mesh the failure envelope for unreinforced soil. Also, the soil friction angle with the dilation angle has an important effect on the foundation soil when both parameters are changed, especially the friction angle, which causes more settlements at the beginning of the unreinforced foundation then lowers the bearing capacity value when the consolidation is completed. The reinforced foundation capacity of soil rises once geotextile layers increases. Reinforcement with geotextiles reduces settlements from the beginning of the reinforced foundation soil to the end of the consolidation stages, while also increasing bearing capacity, according to numerical results varying the friction angle. Bearing capacity pressure optimal value retained is 209 Psi with three layers at the depth of 0.82B, N=4 in accordance with the technical, resistant and economic regulations of structures in Civil Engineering.

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List of Abbreviation and symbol

Abaqus CAE model finite-element package

B width of the square footing

CPE8R Finite Element code used for stress

CINPE5R Finite Element code used to prevent boundary reflections

C **Cohesion yield stress**

Cr Rigidity factor

D_f Depth of foundation

EA Normal stiffness

H Total foundation depth

μ = *Poisson's ratio,*

Es Tri-axial stiffness

IS code Idian Standard Code

N_c' Terzaghi's bearing capacity factor

N_q' Terzaghi's bearing capacity factor

N_y' Terzaghi's bearing capacity factor

Ncor Corrected standard penetration value

FLAC code Free Lossless Audio **Codec**

Plaxis 2D finite-element package

q_u Utimate bearing Capacity for local shear failure

$\mathbf{q_{nu}}$ Net ultimate bearing capacity

$\mathbf{q_{ns}}$ Net safe bearing capacity

If=F1=F2

S_{ef} *effective Settlement*

S_e *Settlement*

Θ *Fiction angle*

$\gamma_{d=}\ \gamma$ **Soil Unit Weight**

CHAPTER ONE

1.0 INTRODUCTION

1.1 Study Background

Soil improvement stands a viable option when foundation soils with poor engineering properties are encountered prior to construction. Literature has investigated several ground improvement methods. In recent years, a variety of geosynthetics have been used to improve soil engineering properties. Structures are also reinforced with geotextile, a type of geosynthetic.

Reinforced soil denotes to a soil that has been added reinforcing material with the addition of strips, bars, sheets, or grids. These materials resist tensile strains that progress in the reinforced soil mass once a load is applied. Once tensile ability is suitable then strain extend is elevated, the soil may have moved or settled significantly due to the soil reinforcement system's lack of stiffness. For performing foundations bearing capacity and settlement, geosynthetic materials have become increasingly popular. In the preceding three decades, numerous studies have looked into the significant outcomes of such materials affecting soil load capacity in highway, slant stabilisation and shallow foundations.

Few previous studies compared the effects of different footing shapes on reinforcement. **Omer et al**. looked into geogrid reinforcement for sand-based band and four-sided footings.

Since the 17th century, various technologies have developed to improve soil. Modern methods have made soil improvement with geotextile relatively easier. The main in addition maximum varied group of geosynthetic materials is geotextiles. Interactions with surrounding soil are required for geosynthetics separation, filtration, and reinforcement functions. In this paper we will present with detail the Performance analysis of foundation soil reinforced with geotextile.

1.2 Problem Statement

A structure built on slack soil layers is prone to structural damage. These slack soil layers cannot support the structural load of the structures. The structures settle and crack as a result, and the structure eventually collapses. Few researchers have looked into how four-sided footings rest on reinforced soils, including **Akinmusuru** and **Akinbolade, Adams and Collins**, **Lavasan and Ghazavi**, **Somwanshi and Latha** and**, Kaur and Kumar, Farsakh et al., and Ronal.**

1.3 Aim and Objectives of the Study

This study looks into how Abaqus software is evolving for numerical simulation of strip foundation soil strengthened with geotextile. The following are the study's objectives:

(i) To calculate the bearing capacity and settlement of the shallow foundation analytically,
(ii)) To estimate the improvement in bearing capacity of reinforced soil using Abaqus model.
(iii) To determine the ideal space and numeral layers of reinforcement.

1.4 Justification of the Study

Useful properties of soil strengthening come from (a) amplified soil workable capacity and (b) shear struggle developed by friction at the soil strengthening boundaries. It results that, geosynthetics are becoming more common in geotechnical structures like foundations, embankments, and retaining walls.

When modelling a shallow foundation, bearing capacity in addition displacement are two parameters to consider. Bearing capacity and settlement are determined by the soil's strength and compressibility **(Das, 2007).** Geosynthetic strengthening can help to perform bearing capacity and decrease displacement in weak soil **(Shukla and Yin, 2006**). The pullout and rupture (break out) failures of geosynthetics are considered in the analysis of reinforced foundations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Preamble

Geosynthetics have long been used to support embankments built on uniformly weak foundation soils. Researchers have proposed using geogrid and geotextile to reinforce the foundations of certain structures. These stimulations are made with a finite element method, for example Plaxis 2D software, the FLAC code, and some laboratory experiments. My goal by using the Abaqus model is to see if the difference is considerable among unreinforced foundation soil and reinforced foundation soil by geotextile when the friction angle and dilation angle are changed, as well as the effect of the load as it is increased progressively.

According to some researchers**:**

- (**Benmebarek et al., 2015b)** used the PLAXIS code to numerically simulate a geosynthetic strengthened levee ended nearby feeble regions. They found that large displacement computations are better for this problem, and that the effects of membrane strength and differential settlement combine to improve differential settlement.
- **(Wulandari and Tjandra, 2015)** study on Investigation of geotextile strengthened road embankment by PLAXIS 2D. Geotextiles are progressively being suitable to reinforce soft-soil road embankments. Researchers have aimed to find the best geotextile tensile strength for use as an embankment reinforcement. Safety and displacement take safety and displacement into account.
- **Surajit Pal worked** on mathematical simulation of geosynthetic strengthened ground structures via finite element model. An interface model and a geosynthetic reinforced wall finite element model have been developed by researchers at Aberystwyth University in the

UK. The findings reveal some inconsistencies and conservatism in the assumptions of current design methods, according to the study published in the journal applied physics.

- **(Lal et al., 2017)** studied on the consequence of strengthening procedure proceeding the way of coir geotextile strengthened sand beds**.** Coir geocell reinforcement outperforms planar forms when the same amount of material is applied. Plate load test results for a four-sided method footing proceeding sand couches strengthened by geocell and planar coir geotextile were explained by researchers at Aberystwyth University. Coir geocells improved bearing capacity by 7.92 percent for a 15% foundation width settlement, compared to 5.83 percent for planar forms.
- **(Ibrahim AlAbdullah, 2017)** were conducted research proceeding Estimation of soil strengthened by geogrid in subgrade section by finite element techniques. Physical and mechanical characteristics of pavement construction mechanisms are determined by laboratory experiments, with repetitive charge tests by geogrid strengthening. It may precisely expect perpetual distortion in the roadway.
- (**Shukla et al., 2009) w**ere studied the basic concepts of soil reinforcement. Fiber strengthened soils are classified as either methodically strengthened or fiber reinforced soil with a random distribution of fibers. There can't be just one mechanism that reinforces the behaviour of all reinforced soils. The basic concept of soil reinforcement, however, applies to all types of reinforcement.
- **(Portelinha et al., 2013) investigated** an improvement of nonwoven geotextile strengthened walls under moistening situations: research surveys**.** The findings were published in the journal applied and environmental metrology and support the use of nonwoven materials to repair poorly drained soils.

- **Srinivasula and M. Krishnaswamy (1988)** informed the impact of the interval among reinforced materials in addition to the humidity of materials experienced by triaxial apparatus without being drained. Geotextile reinforcements were used in the soil.
- **Srivastava et al. (1988)** have done the experiment of unconfined and triaxial tests to explore on silty soil strengthened by geotextiles. The numeral of strengthening layers in addition the sample ratio was premeditated by means of the confining pressure.
- **(Noorzad and Mirmoradi, 2010)** investigated consistent soil strengthened attitude by geotextile using soil through diverse humidity contents. Highest strength in both reinforced and non-reinforced samples decreases as moisture content rises. Peak strong point and axial stress failure are both amplified as reasonable compaction rises. Growth in reliability of soils with an advanced flexibility was discovered to be the main cause of increased strength.
- (**Aria et al., 2021)** worked on attitude of sandy soil strengthened by geotextile taking partly and entirely enfolded ends. They've created a wraparound geotextile strengthened sand bed, which they call "revolutionary" in terms of desert development and resilience. The effect of wraparound end lap length coverage proceeding the charge displacement attitude of strengthened sand was studied using laboratory model tests. In addition, a pressure-cell-based instrumentation programme was developed to investigate the compression supply in the depth sand under the geotextile bed. Fully wrapped models outperform reinforced models without wraparound ends by 50% in load and 50% part of breadth working by strengthening.
- **(Raja and Shukla, 2021**) tested the usefulness of covering geotextile strengthened dirty soil below band footing at various embedment foundations. Research test model below static load discovered better-quality foundation soil attitude capacity because of less soil movement and more confining effects.

- **Ahmed M. Gamal, Adel M. Belal, S. A. Elsoud**, by the finite element investigation used to model the geogrid strengthened soil bed under strip footings. The soil, geogrid, and boundary form are investigated by finite element results and validation. Among consecutive strengthening bed, the ideal spacing (h/B) is 0.75 B.
- (**Ramjiram Thakur et al., 2021)** investigated on perfection in CBR rate of soil strengthened by nonwoven geotextile layers. Geosynthetics are described as a material that was explored to strengthen argillaceous soil. Clayey soils were used to prepare laboratory California Bearing Ratio (CBR) test. Bearing ratio of strengthened soils by heated merged nonwoven geotextiles growths, according to these tests.
- (**Bergado et al., 2002**) investigated geotextile strengthened levee ground. High-strength geotextile reduces flexible distortion in the ultimate foundation soil, increases embankment breakdown elevation on soft foundation, and creates a two-stage disappointment device. The critical strain equivalent to the principal weak soil ground may be occupied as 2.5–3 percent.
- **A. B. Salahudeen and Ja'Afar Abubakar Sadeeq** worked on a Numerical modelling of soil strengthening with geogrids by using PLAXIS software. Geosynthetics are materials with good tensile and compressive strengths. Subsequently strengthening the soil, the Plaxis model output presented an important settlement reduction. Unreinforced slope has a total displacement of 569 mm progressively decrease to 65.80 mm once strengthened.
- **(Lovisa et al., 2010) conducted** pre-loaded geotextile strengthened attitude sand couch caring a charged spherical footing. Geotextile strengthened sand bed supportive a charged spherical footing improves displacement and load capacity.

- **(Kazi et al., 2014)** were found that capacity of soil in addition stiffness of geotextile structure has significantly improved. The study's experimental results are related to mathematical outcomes from a finite-element model performed with Plaxis 2D software.
- **(Benmebarek et al., 2017) used** the FLAC to improve strip footing charge capacity on strengthened sand wrap-around ends for reinforced sand bed systems provide the best results in links of increasing load capacity then reducing land space.

CHAPTER THREE

3.0 METHODOLOGY AND MATERIALS

3.1 Analytical Calculations

The analytical calculations were done in accordance with Indian Standards for determining bearing capacity (IS 6403:1981) and for determining settlement of footing (IS:8009 Part-1 1976). Case of the shallow foundation.

3.1.1 Calculation of bearing capacity problem

Soil capacity is the aptitude of soil to sustenance loads charged to above ground. It is primarily determined by the soil type, his shear resistance, density in addition. It similarly rests on load's embedment depth; deeper charge is anchored, the larger the bearing capacity. Once the ground has insufficient bearing capacity, it may ameliorate, otherwise the load can be spread up to the area with a view to reduce the soil stress at a level that is below the bearing capacity. Spread foundations made of reinforced with the geotextile, for example, can achieve this.

Based on the shear criterion (*IS* code 6403:1981), Ultimate bearing capacity for local shear failure:

$q_u = 0.867CN_c' + \gamma D_f N_q' + 0.4\gamma B N_y'$ ……3.1

For C = 0,

$q_u = \gamma D_f N_q' + 0.4\gamma B N_y'$ ……3.2

where D_f = 2 m and H= 5m

3.1.2 Calculation of Settlement of Foundation problem *(IS: 8009 Part 1 1976*)

The vertical movement of the ground caused by variations in the ground's stresses is described as settlement.

Es = 250 (Ncor +15) ……3.3

$\mu = 0.3,\ If = F1 + \frac{(1-\mu-2\mu^2)F_2}{1-\mu^2}$ ……3.4

$S_e = \frac{q_n B(1-\mu^2)I_F}{E_s}$ ……3.5

$S_{ef} = C_r d_f S_e$ ……3.6

Where Cr = Rigidity factor = 1 for flexible footing,

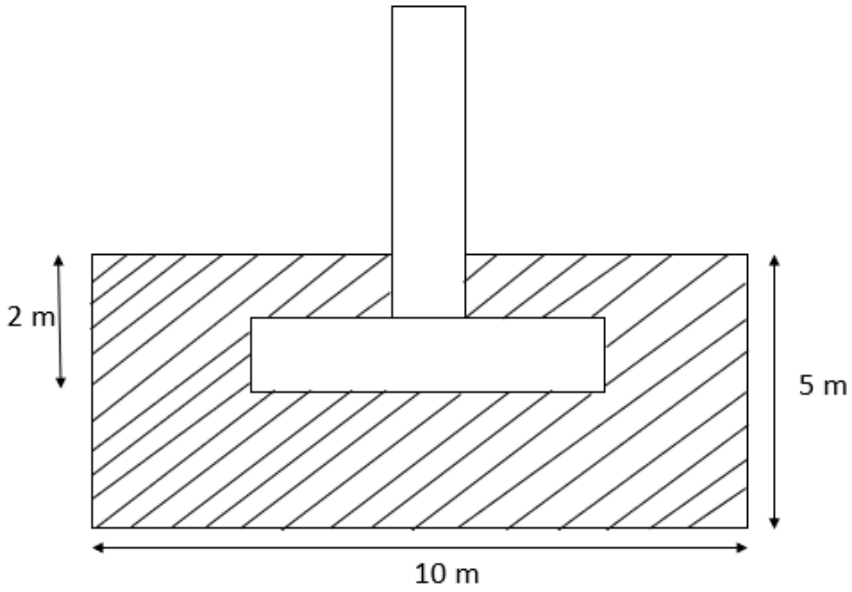

Figure 3.1 Case of shallow foundation used

3.2 Bearing Capacity Behavior of Reinforced Soil by Using Abaqus Model

3.2.1 Abaqus CAE model

A strip of sand foundation soil explored in this study was studied by **Menétrey and Willam's smooth deviatoric section (1995**). The linear stiffness of $207*10^6$ kN/m2 was used. Limit load calculations are obtained from a sand strip charged by the footing.There is an equal distance distribution from left to right at the level of the central axis, resulting in model symmetry. Mohr Coulomb model is chosen to generate results. In the Abaqus model's element type section, CPE8R elements are used in the left region of the pattern, and infinite CINPE5R types are used for stimulation on the right side. To measure the amelioration in bearing capacity of reinforced soil using Abaqus model, a numerical model without geotextile and with geotextile elements were developed. The purpose of these two experiments after stimulation in the Abaqus model is to observe a remarkable variation by changing the values of friction angle, dilation angle parameters and also to observe the effect of the load when increasing it progressively.

Chen, W. F., Elsevier, Amsterdam, Limit Analysis and Soil Plasticity, 1975.

Menétrey, Ph., and K. J. Willam, "The Generalization of the Triaxial Failure Criterion for Concrete" ACI Structural Journal, vol. 92, pp. 311–318, May/June 1995.

3.2.2. Procedure for Analysis

For this fact we used the same characteristics of soil by varying during the first experiment four Displacement namely 0.250mm,0.30mm, 0.350mm, 0.400 mm applied to this soil which then generates four other types of soil namely I, II, III and IV. Then we varied three different friction angle values namely 16°, 14° and 12° to these four types of soil which generate twelve others namely A, B, C, D, E, F, G, H, I, J, K, and that were generated with Abaqus model to give 12 stimulations. For the second experiment, the same scenario was repeated by varying the dilation angle, namely 5°, 10° and 15° on soil types V, VI, VII and VIII and then obtaining twelve other types, namely soils M, N, O, P, Q, R, S, T, U, V, W and X were produced 12 others stimulations.

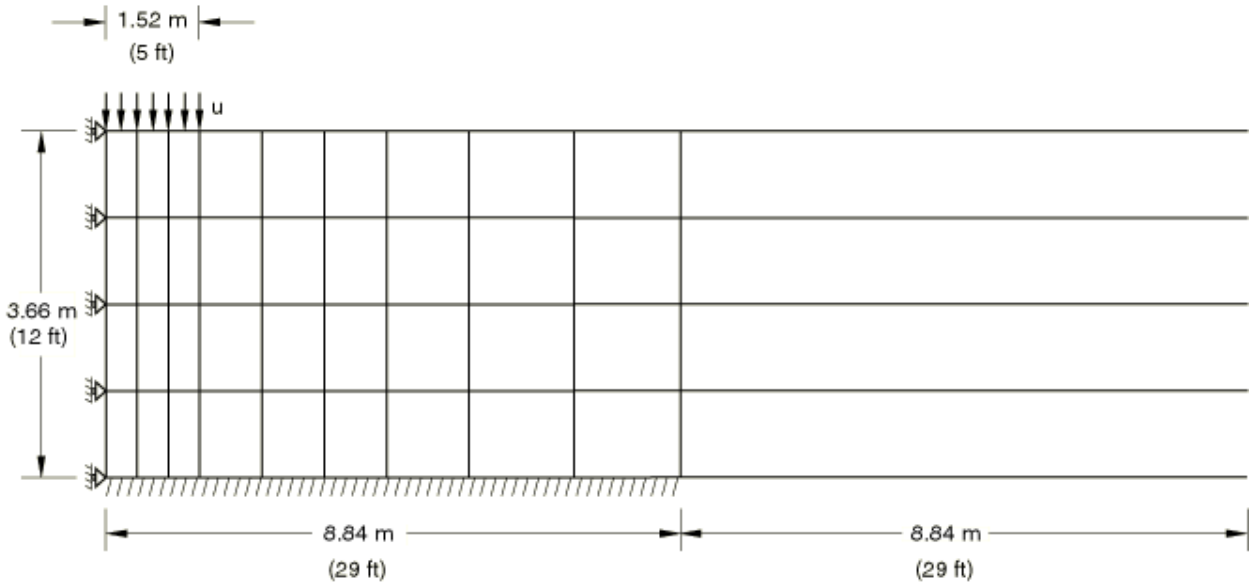

Figure 3.2 Pattern for limit load estimation on sand strip.

Menétrey and Willam's smooth deviatoric section (1995).

3.3 Determination of the ideal space and numeral layers of reinforcement.

Twelve soils types were generated and used to reinforce the foundation soil, revealing a remarkable variety of angles then evaluated the significance of the numeral of Geotextile beds on the Bearing capacity of square footing on Geotextile reinforced soil for different values of N namely N=3, N=4 then N=5.

The application of the Geotextile for each value of N will be made on the twelve types of soil of the selected experiment.

After stimulation, the optimum spacing and number of layers of reinforcement would be confirmed according to the soil having the greatest value of Bearing Capacity.

Table 3.1 Material Properties of Geotextile used

Unit Weight (ɣ) (KN/m^2)	Young Modulus (Pa) *10^6	Poisson's ratio (μ)
2335	1200	0.35

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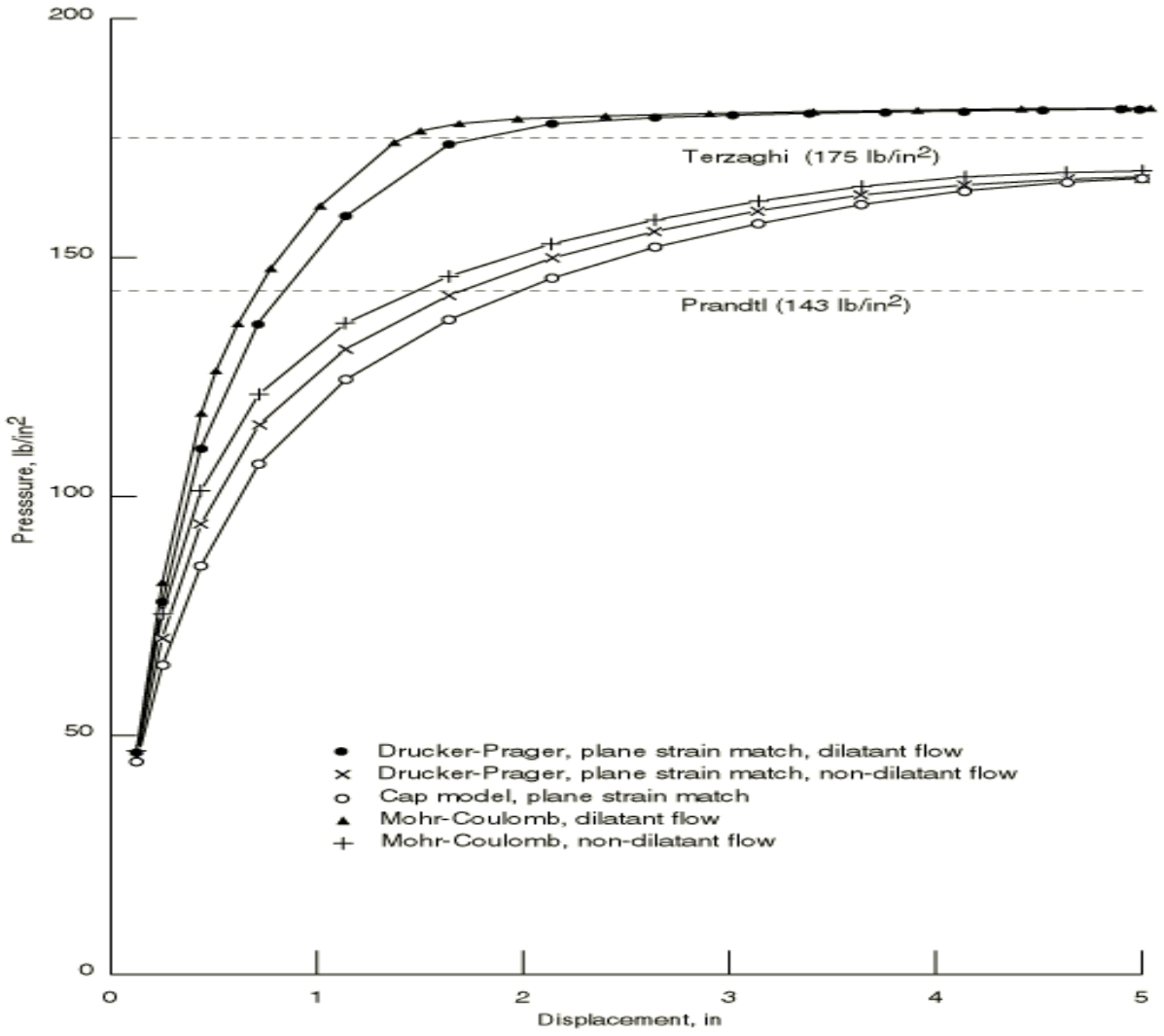


Figure 3.3 Limit load results obtained by **Chen (1975)**

MATERIALS PROPERTIES OF SOIL USED

Table 3.2 Case 1 Mohr-Coulomb with Variation of Friction angle

N°	Soils Types	Displacement (mm)	Friction Angle (°)	Dilation Angle (°)	Cohesion (C) (Pa)*10^6	Young Modulus (Pa) *10^6	Poisson's ratio (μ)	Soil Unit Weight (ɣ) (KN/m^2)	Abs Plastic strain
I	A	0.250	12	10	0.069	207	0.3	17.5	0
	B	0.250	14	10	0.069	207	0.3	15.5	0
	C	0.250	16	10	0.069	207	0.3	17.5	0
II	D	0.300	12	10	0.069	207	0.3	17.5	0
	E	0.300	14	10	0.069	207	0.3	17.5	0
	F	0.300	16	10	0.069	207	0.3	17.5	0
III	G	0.350	12	10	0.069	207	0.3	17.5	0
	H	0.350	14	10	0.069	207	0.3	17.5	0
	I	0.350	16	10	0.069	207	0.3	17.5	0
IV	J	0.400	12	10	0.069	207	0.3	17.5	0
	K	0.400	14	10	0.069	207	0.3	17.5	0
	L	0.400	16	10	0.069	207	0.3	17.5	0

Table 3.3 Case 2 Mohr-Coulomb with Variation of Dilation angle

N°	Soils Types	Displacement (mm)	Friction Angle (°)	Dilation Angle (°)	Cohesion (C) (Pa)*10^6	Young Modulus (Pa) *10^6	Poisson's ratio (μ)	Soil Unit Weight (ɣ) (KN/m^2)	Abs Plastic strain
V	M	0.250	20	5	0.069	207	0.3	17.5	0
	N	0.250	20	10	0.069	207	0.3	15.5	0
	O	0.250	20	15	0.069	207	0.3	17.5	0
VI	P	0.300	20	5	0.069	207	0.3	17.5	0
	Q	0.300	20	10	0.069	207	0.3	17.5	0
	R	0.300	20	15	0.069	207	0.3	17.5	0
VII	S	0.350	20	5	0.069	207	0.3	17.5	0
	T	0.350	20	10	0.069	207	0.3	17.5	0
	U	0.350	20	15	0.069	207	0.3	17.5	0
VIII	V	0.400	20	5	0.069	207	0.3	17.5	0
	W	0.400	20	10	0.069	207	0.3	17.5	0
	X	0.400	20	15	0.069	207	0.3	17.5	0

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 RESULTS

4.2 Analytical Calculations

4.2.1 Calculation of bearing capacity problem

Based on the shear criterion (*IS* code 6403:1981), Ultimate bearing capacity for local shear failure:

$q_u = 0.867CN_c' + \gamma D_f N_q' + 0.4\gamma B N_y'$…….3.1

For C = 0,

$q_u = \gamma D_f N_q' + 0.4\gamma B N_y'$……3.2

$\theta' = \tan^{-1}(0.67 \tan \Theta) = 21.15°$

From linear interpolation, for Nc = 19.745; Nq = 7.38; Nγ = 6.653

From equation (3.2), $qu = \gamma D_f N_q' + 0.4\gamma B N_y'$

$= 409.38\ kN/m^2$

$q_{nu} = q_{u-\gamma D}$ =373.38 kN/ m²

Assuming a factor of safety of 2 so **q_{ns} = 186.69 kN/ m²**

4.2.2 Calculation of Settlement of Foundation problem *(IS: 8009 Part 1 1976*)

N_{cor} = 21

$\gamma_d = 18\ kN/m^2$

μ =0.3

C =0

Θ=30°

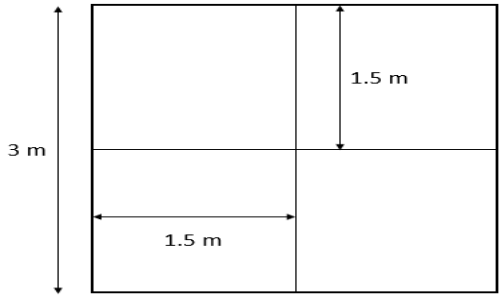


Figure 4.1 Square footing

Es = 250 ($Ncor$ +15) ……3.3

= 250 (21+15) = 9000 kN/m^2

$\frac{H}{B} = \frac{5}{1.5} = 3.33$, $\frac{L}{B} = 1$

F1 = If = 0.36 for μ =0.5, F2= If = 0.04 for μ =0.5.

μ =0.3, $If = F1 + \frac{(1-\mu-2\mu^2)F_2}{1-\mu^2}$ ……*3.4*

= .0383

$S_e = \frac{q_n B(1-\mu^2)I_F}{E_s}$ ……*3.5*

S_e = 0.0108 m

$S_{ef} = C_r d_f S_e$ ……*3.6*

Where Cr = Rigidity factor = 1 for flexible footing

$\frac{D_f}{\sqrt{BL}}$ = 1.33

$\frac{L}{B} = 1$

From the equation 3.6, $S_{ef} = C_r d_f S_e$ = 1 × 0.68 × 0.0108 = 0.00734 m

So, we get Total Settlement, S_{ef} = 0.00734 × 4 = 30 mm

From IS code, permissible settlement for isolated footing = 50 mm, therefore the q_u is sufficient for this design.

4.3 Bearing capacity behavior of reinforced soil using Abaqus Model

4.3.1 Variation of the friction angle and the dilation angle with different values of Displacement.

According to Table 3.2 the stimulation through the Abaqus model give results for the soils namely A, B, C, D, E, F, G, H, I, J, K, and L according to the friction angle.

Pressure=$\frac{Force}{Area}$ …… 4.1

1inch=0.0254 m and 1Psi= 6894.8 Pa

- **RESULTS.**

I) Friction angle Variation

➢ SOIL A

Table 4.1 Soil A displacement, load and pressure values via Abaqus model

Displacements (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.00625	7.82E+05	514479.6053	0.246062992	74.61849586
0.0125	1.07E+06	707210.5263	0.492125984	102.5715795
0.01875	1.21E+06	792796.0526	0.738188976	114.9846337
0.025	1.29E+06	845756.5789	0.984251969	122.6658611
0.034375	1.37E+06	898638.1579	1.353346457	130.3356381
0.04375	1.42E+06	933776.3158	1.722440945	135.4319655
0.053125	1.45E+06	956230.2632	2.091535433	138.6886151
0.0625	1.46E+06	963414.4737	2.460629921	139.7305903
0.0695312	1.47E+06	966250	2.737448819	140.141846
0.0765625	1.47E+06	968177.6316	3.014271654	140.4214236
0.0835937	1.47E+06	969467.1053	3.291090551	140.6084448
0.090625	1.48E+06	970631.5789	3.567913386	140.7773364
0.101172	1.48E+06	971980.2632	3.983149606	140.9729453
0.105127	1.48E+06	972427.6316	4.138858268	141.0378302
0.11106	1.48E+06	972986.8421	4.372440945	141.1189363
0.115509	1.48E+06	973467.1053	4.547598425	141.1885922
0.122183	1.48E+06	974000	4.810354331	141.2658815
0.128857	1.48E+06	974519.7368	5.073110236	141.3412625
0.135532	1.48E+06	974986.8421	5.335905512	141.40901
0.138034	1.48E+06	975157.8947	5.434409449	141.4338189
0.141789	1.48E+06	975296.0526	5.582244094	141.4538569
0.14742	1.48E+06	975526.3158	5.803937008	141.4872536
0.155867	1.48E+06	975789.4737	6.136496063	141.5254211
0.164314	1.48E+06	976065.7895	6.469055118	141.5654971
0.172761	1.48E+06	976276.3158	6.801614173	141.5960312
0.181208	1.48E+06	976453.9474	7.134173228	141.6217943
0.184376	1.48E+06	976539.4737	7.258897638	141.6341988
0.189127	1.48E+06	976644.7368	7.445944882	141.6494658
0.196254	1.48E+06	976796.0526	7.726535433	141.6714122
0.198927	1.48E+06	976828.9474	7.831771654	141.6761831
0.202936	1.48E+06	976921.0526	7.989606299	141.6895418
0.20895	1.49E+06	977026.3158	8.226377953	141.7048088
0.21346	1.49E+06	977092.1053	8.403937008	141.7143507
0.220225	1.49E+06	977250	8.670275591	141.7372513

0.22699	1.49E+06	977322.3684	8.936614173	141.7477473
0.233756	1.49E+06	977480.2632	9.202992126	141.7706479
0.236293	1.49E+06	977460.5263	9.302874016	141.7677853
0.240098	1.49E+06	977559.2105	9.452677165	141.7820982
0.245806	1.49E+06	977585.5263	9.677401575	141.7859149
0.25	1.49E+06	977703.9474	9.842519685	141.8030904

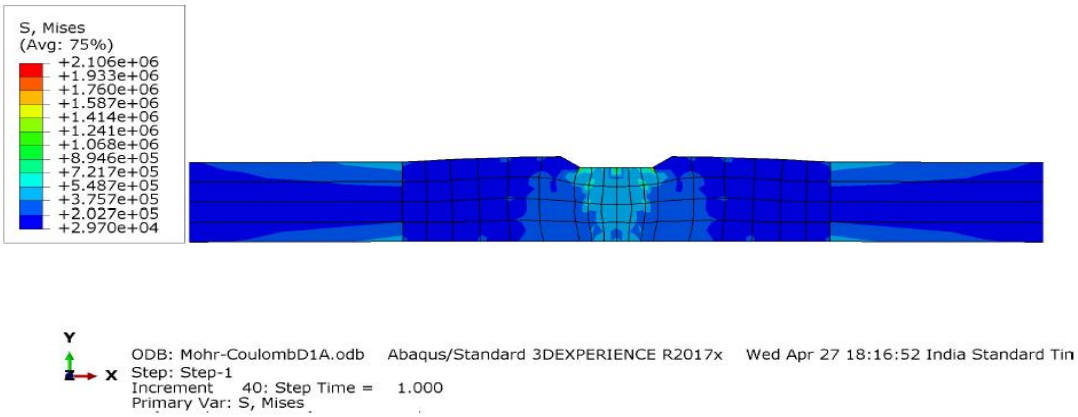


Figure 4.2. Failure mesh of unreinforced soil A

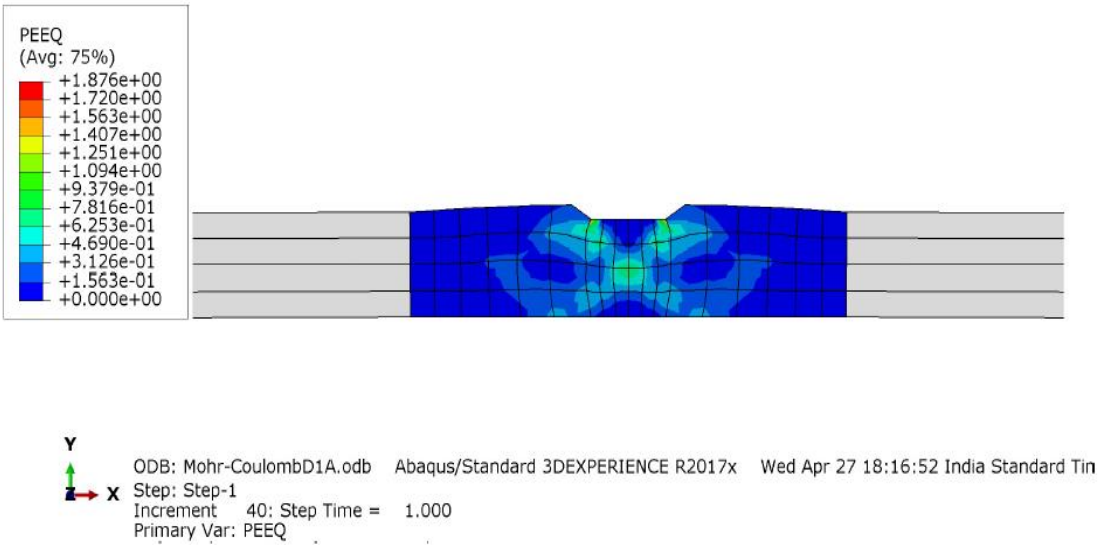
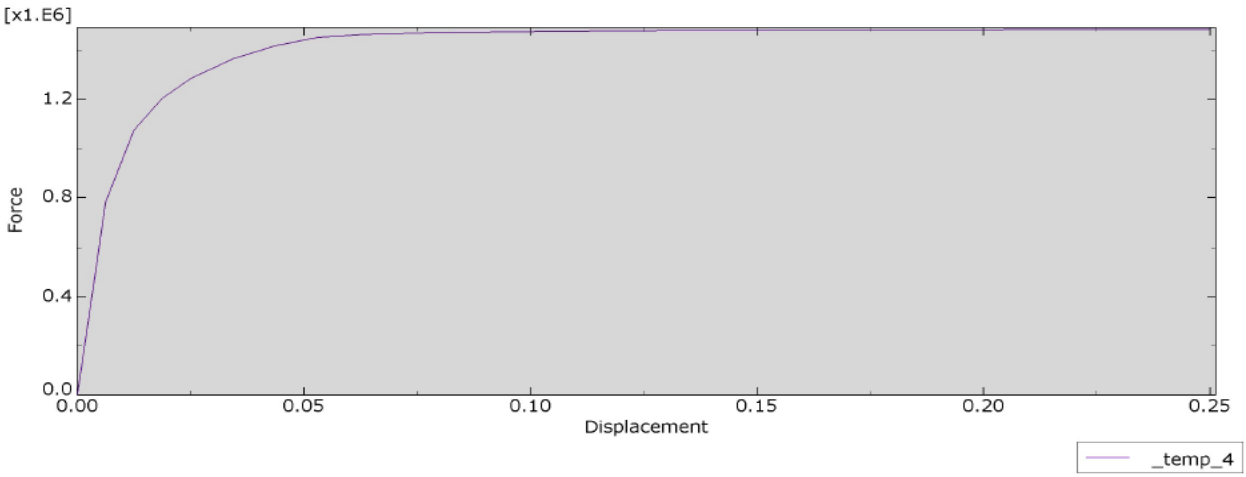


Figure 4.3. Normal stresses of unreinforced soil A



Graph 4.1 Force against Displacement of unreinforced soil A obtained from Abaqus model

- SOIL B

Table 4.2 Soil B displacement, load and pressure values via Abaqus model

.

Displacement (m)	Force(N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.00625	753428	495676.3158	0.246062992	71.89132619
0.0125	1.01E+06	662828.9474	0.492125984	96.13461556
0.01875	1.11E+06	733092.1053	0.738188976	106.3253619
0.025	1.18E+06	776026.3158	0.984251969	112.5524041
0.034375	1.25E+06	819835.5263	1.353346457	118.9063535
0.0484375	1.30E+06	856171.0526	1.906988189	124.1763434
0.0625	1.31E+06	864447.3684	2.460629921	125.3767141
0.0765625	1.32E+06	867690.7895	3.014271654	125.8471296
0.090625	1.32E+06	869625	3.567913386	126.1276614
0.111719	1.32E+06	871585.5263	4.398385827	126.41201
0.136719	1.33E+06	873151.3158	5.382637795	126.6391071
0.161719	1.33E+06	873980.2632	6.366889764	126.759335
0.186719	1.33E+06	874493.4211	7.351141732	126.8337618
0.211719	1.33E+06	874914.4737	8.335393701	126.89483
0.236719	1.33E+06	875269.7368	9.319645669	126.9463562
0.25	1.33E+06	875493.4211	9.842519685	126.9787987

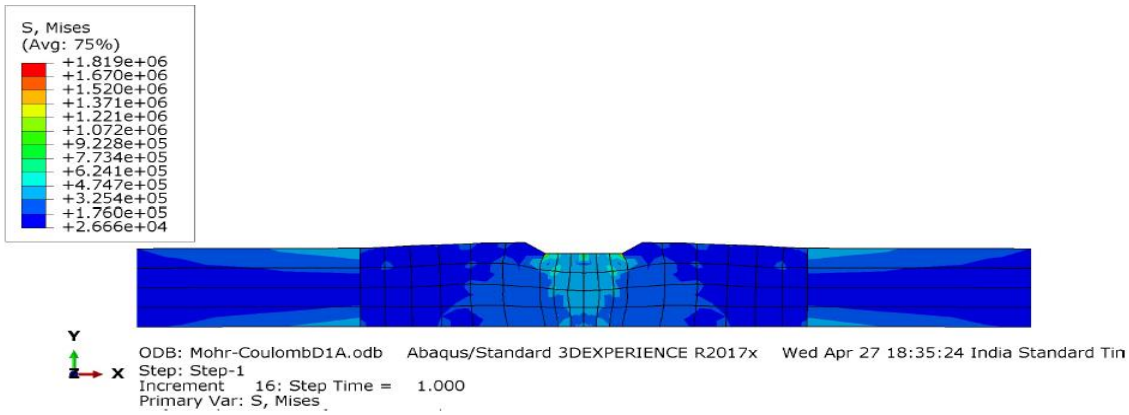


Figure 4.4. Failure mesh of unreinforced soil B.

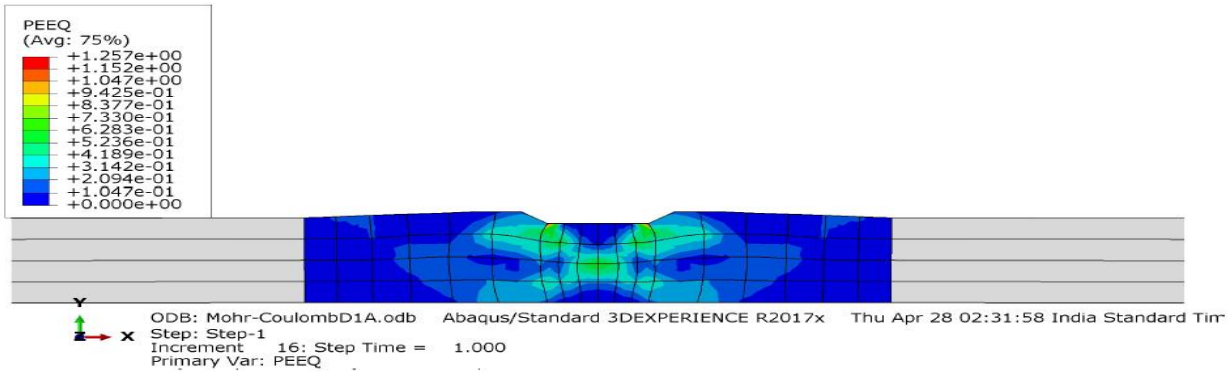
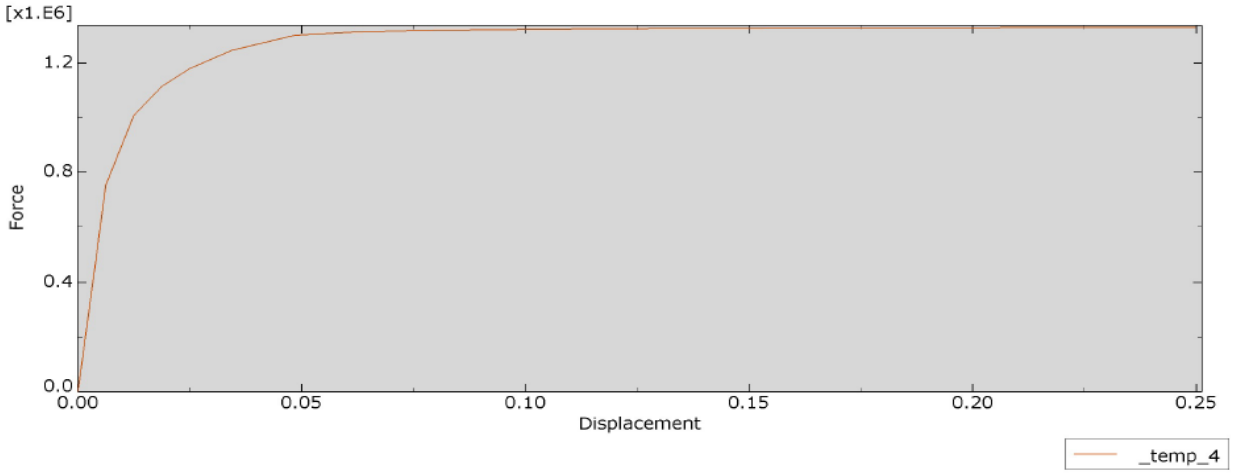


Figure 4.5. Normal stresses of unreinforced soil B.



Graph 4.2. Force against Displacement of unreinforced soil B obtained from Abaqus model

- SOIL C

Table 4.3 Soil C displacement, load and pressure values via Abaqus model

Displacement (m)	Force(N)	Pressure (Pa)	Displacement (in)	Force (Psi)
0	0	0	0	0
0.00625	724087	476373.0263	0.246062992	69.09163809
0.0125	942689	620190.1316	0.492125984	89.95041648
0.01875	1.03E+06	677559.2105	0.738188976	98.27104637
0.028125	1.10E+06	726440.7895	1.107283465	105.3606761
0.0421875	1.16E+06	766019.7368	1.660925197	111.1010815
0.0474609	1.18E+06	773519.7368	1.86853937	112.1888578
0.0553711	1.18E+06	777302.6316	2.179964567	112.7375169
0.0672363	1.19E+06	779993.4211	2.647098425	113.1277805
0.0850342	1.19E+06	782289.4737	3.34780315	113.4607927
0.110034	1.19E+06	784407.8947	4.332047244	113.7680418
0.135034	1.19E+06	785921.0526	5.316299213	113.9875055
0.160034	1.20E+06	786730.2632	6.300551181	114.1048708
0.185034	1.20E+06	787190.7895	7.28480315	114.1716641
0.210034	1.20E+06	787539.4737	8.269055118	114.2222361
0.235034	1.20E+06	787815.7895	9.253307087	114.2623121
0.25	1.20E+06	787973.6842	9.842519685	114.2852127

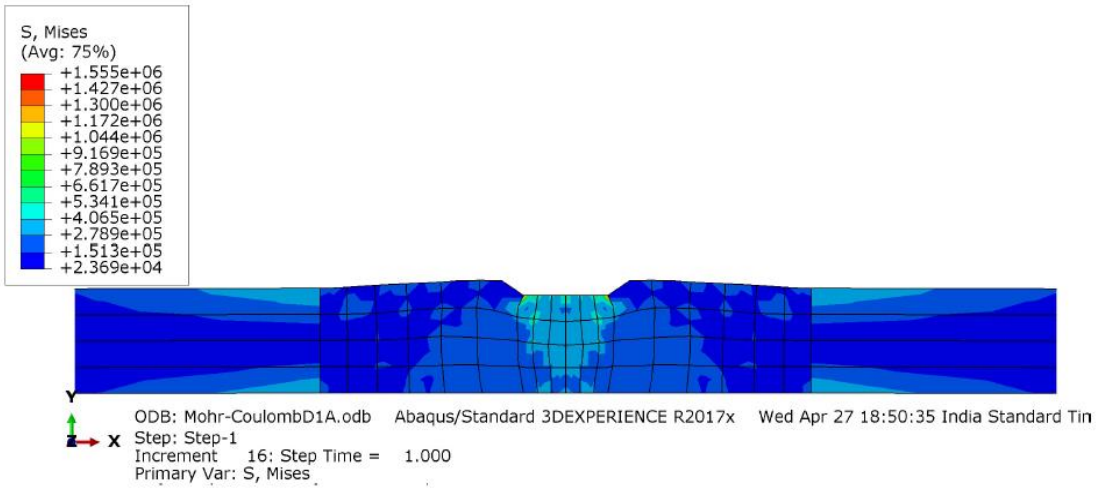


Figure 4.6. Failure mesh of unreinforced soil C.

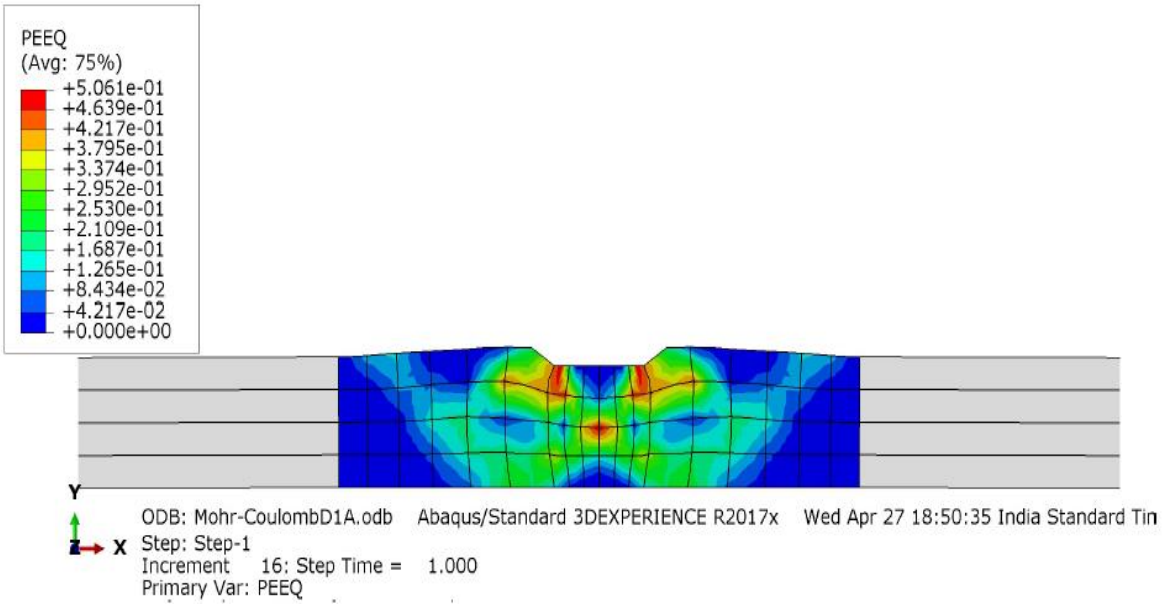
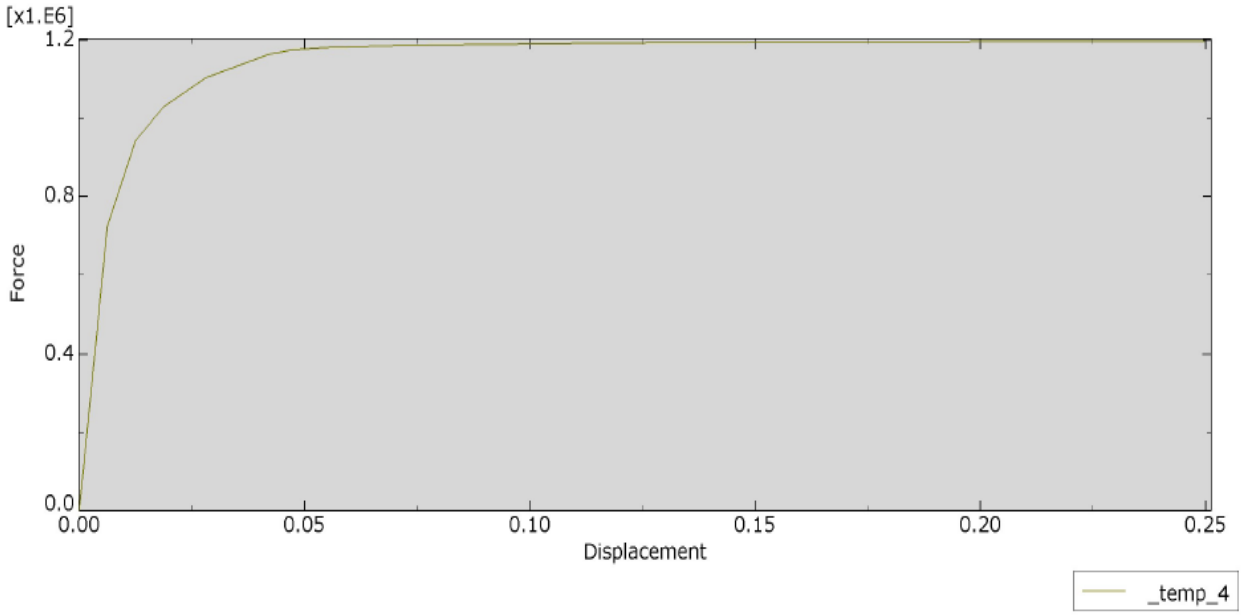
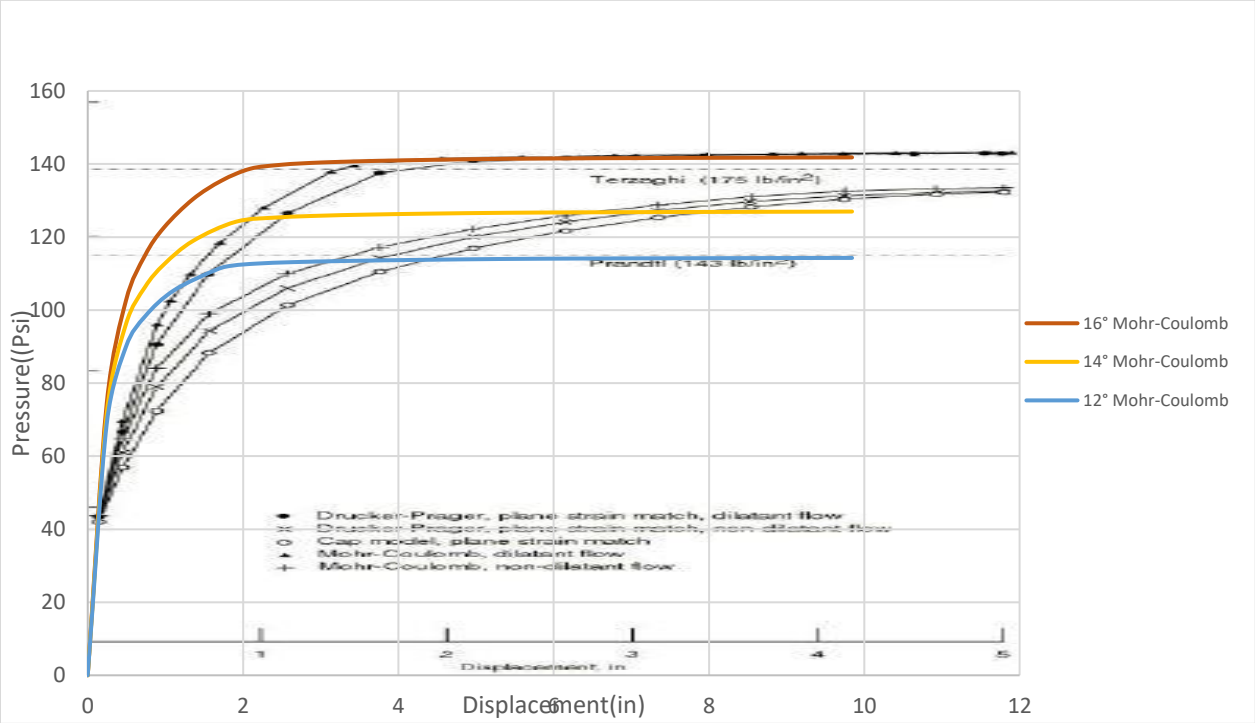


Figure 4.7. Normal stresses of unreinforced soil C.



Graph 4.3. Force against Displacement of unreinforced soil C obtained from Abaqus model



Graph 4.4. Friction angle variation curves of the soil A, B and C Comparing with the one as given by Chen (1975)

- SOIL D

Table 4.4. Soil D displacement, load and pressure values via Abaqus model.

Displacement(m)	Force (N)	Pressure (Pa)	Displacement(in)	Pressure (Psi)
0	0	0	0	0
0.0075	862308	567307.8947	0.295275591	82.280544
0.015	1.15E+06	754585.5263	0.590551181	109.4426998
0.0225	1.27E+06	838335.5263	0.885826772	121.5895351
0.03	1.36E+06	891572.3684	1.181102362	129.3108384
0.0375	1.41E+06	928460.5263	1.476377953	134.6609802
0.045	1.45E+06	952802.6316	1.771653543	138.1914822
0.04875	1.46E+06	957967.1053	1.919291339	138.9405212
0.0525	1.46E+06	961210.5263	2.066929134	139.4109367
0.05625	1.46E+06	963414.4737	2.214566929	139.7305903
0.061875	1.47E+06	965644.7368	2.436023622	140.0540606
0.0703125	1.47E+06	967848.6842	2.768208661	140.3737141
0.07875	1.47E+06	969460.5263	3.100393701	140.6074906
0.0871875	1.48E+06	970796.0526	3.43257874	140.8011911
0.095625	1.48E+06	971789.4737	3.76476378	140.9452738

0.104062	1.48E+06	972690.7895	4.096929134	141.0759978
0.1125	1.48E+06	973513.1579	4.429133858	141.1952715
0.116719	1.48E+06	973855.2632	4.59523622	141.2448894
0.123047	1.48E+06	974414.4737	4.844370079	141.3259955
0.129375	1.48E+06	974881.5789	5.093503937	141.393743
0.135703	1.48E+06	975236.8421	5.342637795	141.4452692
0.140449	1.48E+06	975493.4211	5.529488189	141.4824826
0.147568	1.48E+06	975789.4737	5.80976378	141.5254211
0.150238	1.48E+06	975881.5789	5.91488189	141.5387798
0.154243	1.48E+06	975980.2632	6.072559055	141.5530926
0.160249	1.48E+06	976157.8947	6.309015748	141.5788558
0.169259	1.48E+06	976375	6.663740157	141.610344
0.17827	1.48E+06	976565.7895	7.018503937	141.6380155
0.18728	1.48E+06	976796.0526	7.373228346	141.6714122
0.200795	1.49E+06	976980.2632	7.905314961	141.6981295
0.205863	1.49E+06	977171.0526	8.10484252	141.725801
0.213466	1.49E+06	977210.5263	8.404173228	141.7315261
0.216316	1.49E+06	977348.6842	8.516377953	141.7515641
0.220593	1.49E+06	977348.6842	8.68476378	141.7515641
0.227007	1.49E+06	977460.5263	8.937283465	141.7677853
0.236629	1.49E+06	977657.8947	9.316102362	141.796411
0.240237	1.49E+06	977671.0526	9.458149606	141.7983194
0.245649	1.49E+06	977769.7368	9.671220472	141.8126323
0.249708	1.49E+06	977815.7895	9.831023622	141.8193116
0.255797	1.49E+06	977888.1579	10.07074803	141.8298077
0.261886	1.49E+06	977967.1053	10.31047244	141.8412579
0.267975	1.49E+06	978072.3684	10.55019685	141.856525
0.277108	1.49E+06	978151.3158	10.90976378	141.8679753
0.290807	1.49E+06	978282.8947	11.44909449	141.887059
0.3	1.49E+06	978427.6316	11.81102362	141.9080512

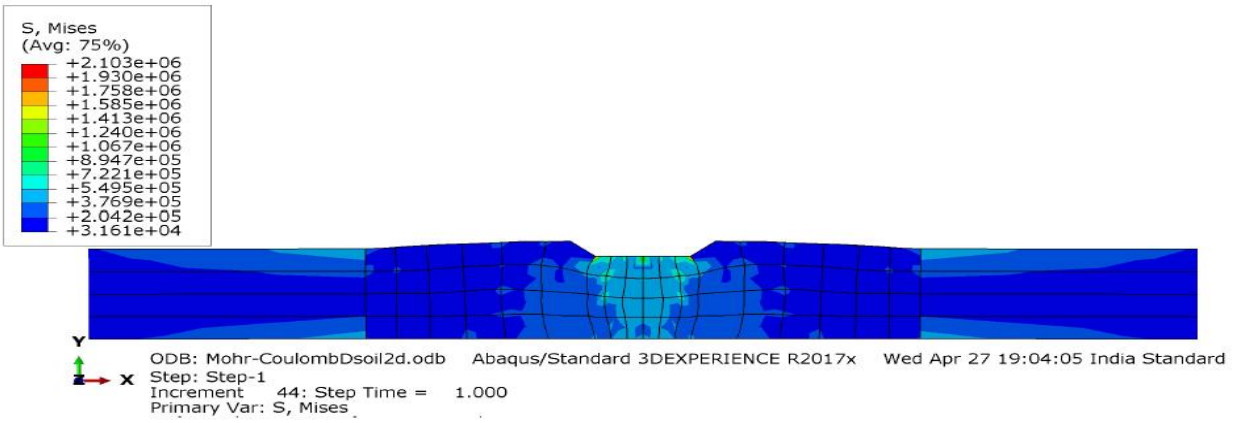


Figure 4.8. Failure mesh of unreinforced soil D.

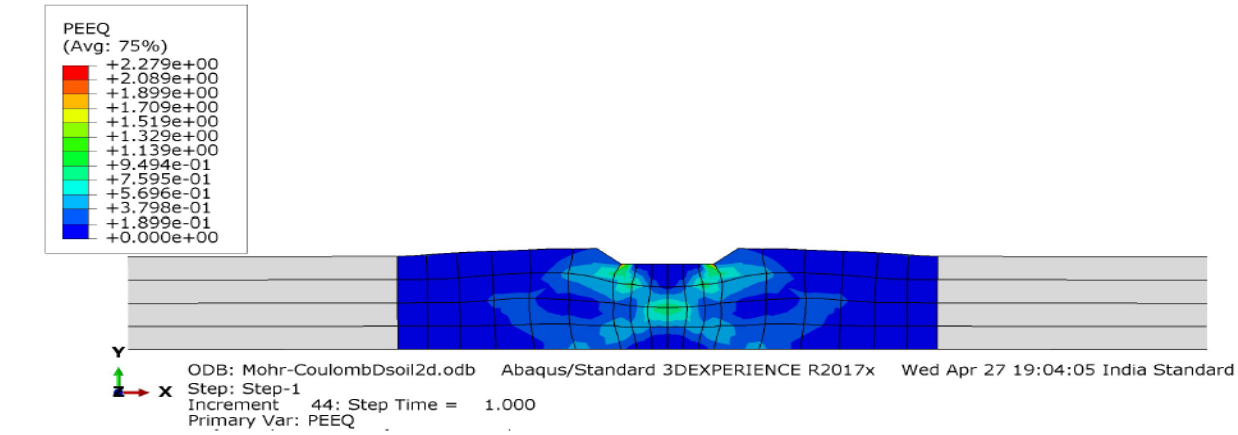
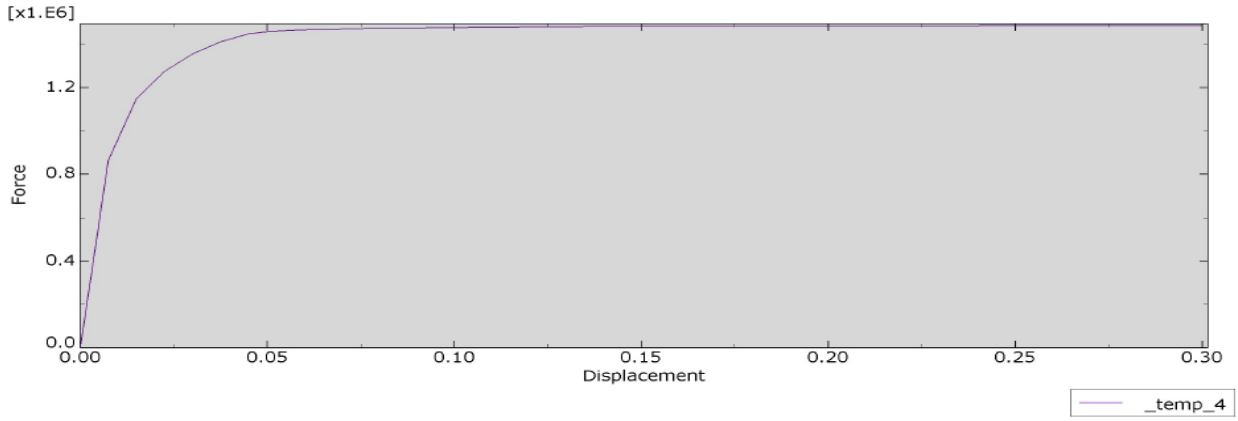


Figure 4.9. Normal stresses of unreinforced soil D.



Graph 4.4. Force against Displacement of unreinforced soil D obtained from Abaqus model.

➢ SOIL E

Table 4.5. Soil E displacement, load and pressure values via Abaqus model.

Displacement(m)	Force (N)	Pressure (Pa)	Displacement(in)	Pressure (Psi)
0	0	0	0	0
0.0075	824524	542450	0.295275591	78.67523351
0.015	1.07E+06	702118.4211	0.590551181	101.8330366
0.0225	1.17E+06	770335.5263	0.885826772	111.72703
0.03	1.24E+06	813717.1053	1.181102362	118.0189571
0.04125	1.30E+06	852493.4211	1.624015748	123.6429514
0.0454688	1.30E+06	858532.8947	1.790110236	124.5188975
0.0517969	1.31E+06	862526.3158	2.039248031	125.0980907
0.0612891	1.32E+06	865644.7368	2.412956693	125.5503766
0.0755273	1.32E+06	868250	2.973515748	125.9282358
0.0968848	1.32E+06	870631.5789	3.814362205	126.2736525
0.126885	1.33E+06	872868.4211	4.995472441	126.598077
0.156885	1.33E+06	873980.2632	6.176574803	126.759335
0.186885	1.33E+06	874585.5263	7.357677165	126.8471205
0.216885	1.33E+06	875092.1053	8.538779528	126.9205931
0.246885	1.33E+06	875486.8421	9.71988189	126.9778445
0.276885	1.33E+06	875828.9474	10.90098425	127.0274623
0.3	1.33E+06	876046.0526	11.81102362	127.0589506

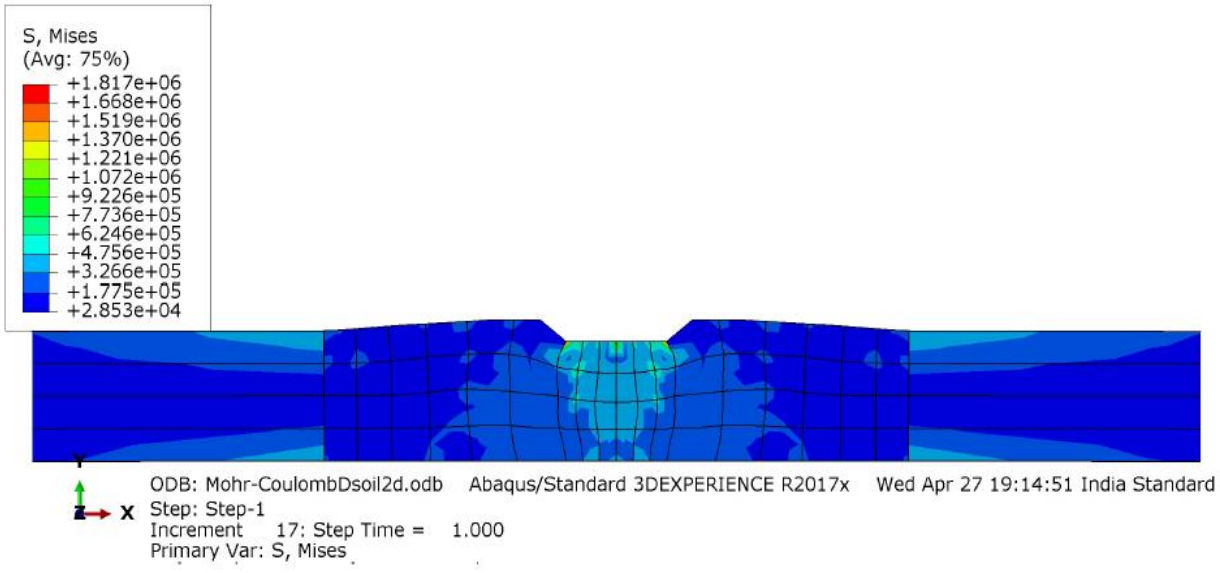


Figure 4.10. Failure mesh of unreinforced soil E.

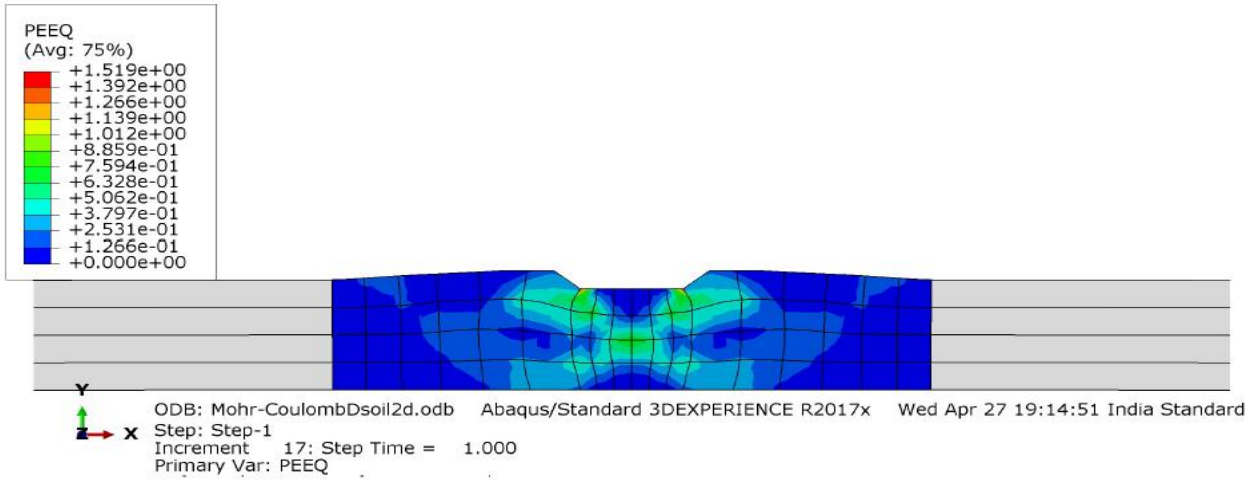
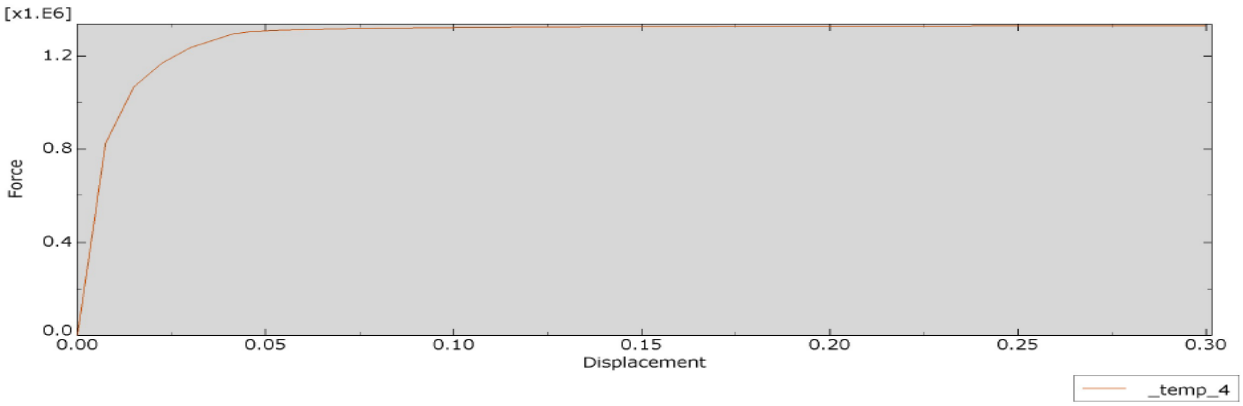


Figure 4.11. Normal stresses of unreinforced soil E.



Graph 4.5. Force against Displacement of unreinforced soil E obtained from Abaqus model

- SOIL F

Table 4.6. Soil F displacement, load and pressure values via Abaqus model

Displacement (m)	Force (N)	Pressure (Pa)	Displacement(in)	Pressure (Pa)
0	0	0	0	0
0.0075	786578	517485.5263	0.295275591	75.05446515
0.015	992612	653034.2105	0.590551181	94.71401789
0.0225	1.08E+06	708506.5789	0.885826772	102.7595549
0.03375	1.15E+06	754993.4211	1.328740157	109.5018595
0.0379688	1.17E+06	766500	1.494834646	111.1707374
0.0442969	1.18E+06	773598.6842	1.743972441	112.2003081

0.0537891	1.18E+06	777677.6316	2.117681102	112.7919057
0.0680273	1.19E+06	780532.8947	2.678240157	113.2060241
0.0893848	1.19E+06	782980.2632	3.519086614	113.5609826
0.119385	1.19E+06	785210.5263	4.70019685	113.884453
0.149385	1.20E+06	786572.3684	5.881299213	114.0819702
0.179385	1.20E+06	787177.6316	7.062401575	114.1697557
0.209385	1.20E+06	787598.6842	8.243503937	114.2308238
0.239385	1.20E+06	787921.0526	9.424606299	114.2775791
0.269385	1.20E+06	788190.7895	10.60570866	114.3167009
0.299385	1.20E+06	788434.2105	11.78681102	114.3520059
0.3	1.20E+06	788440.7895	11.81102362	114.3529601

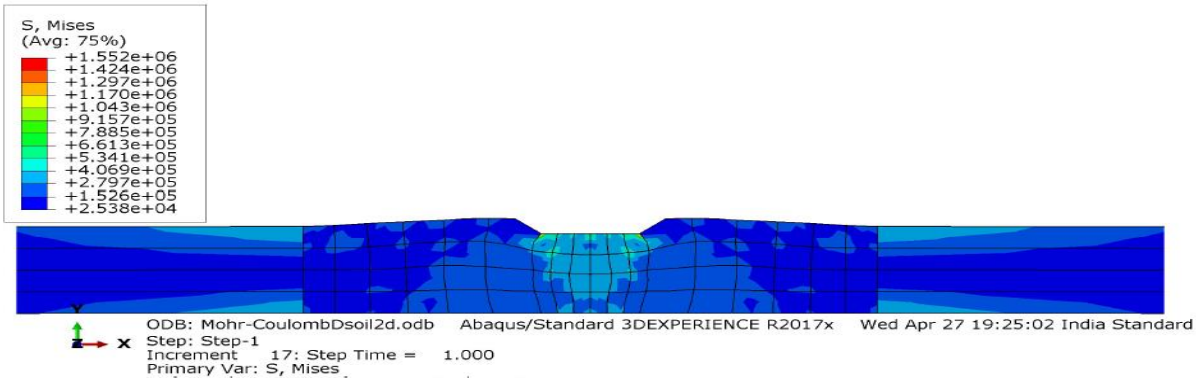


Figure 4.12. Failure mesh of unreinforced soil F.

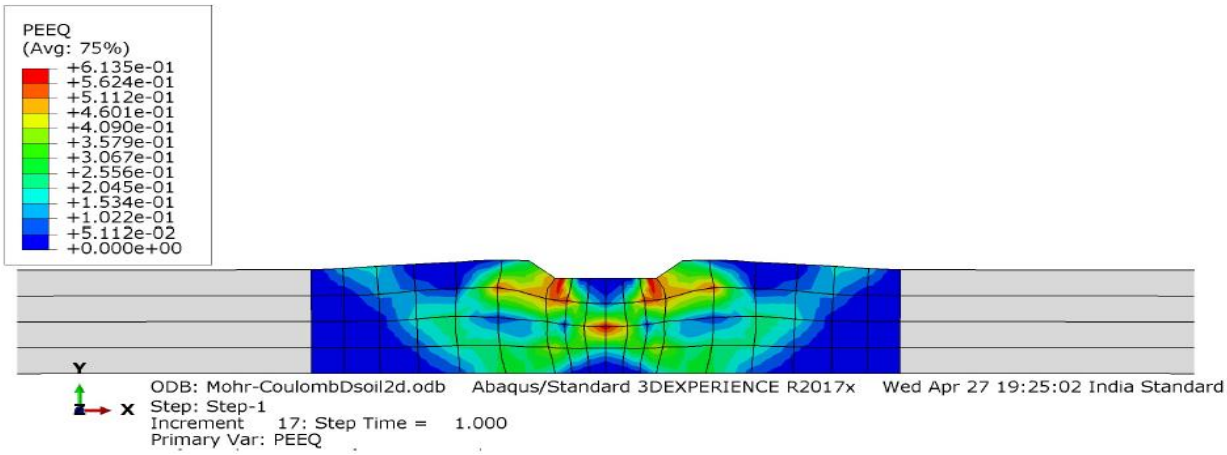


Figure 4.13. Normal stresses of unreinforced soil F.

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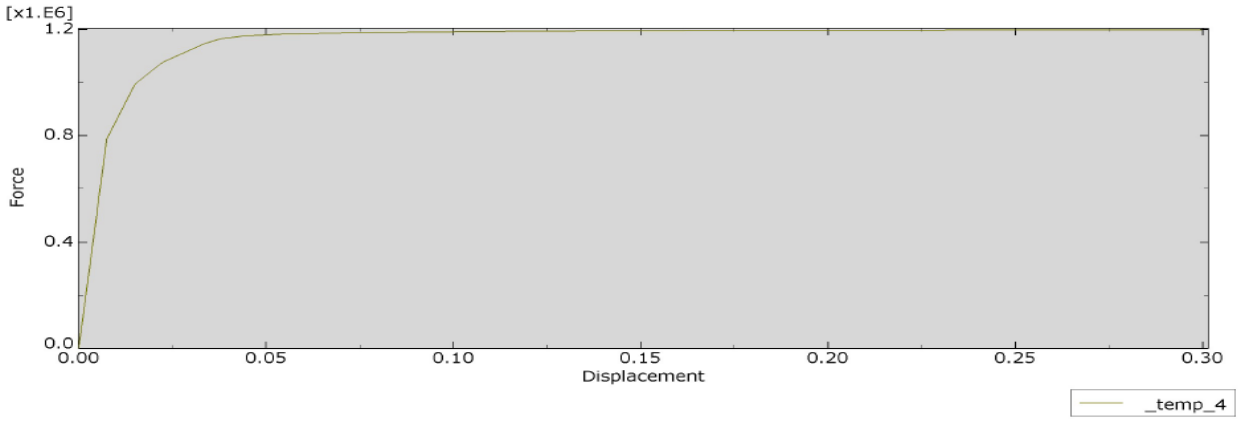
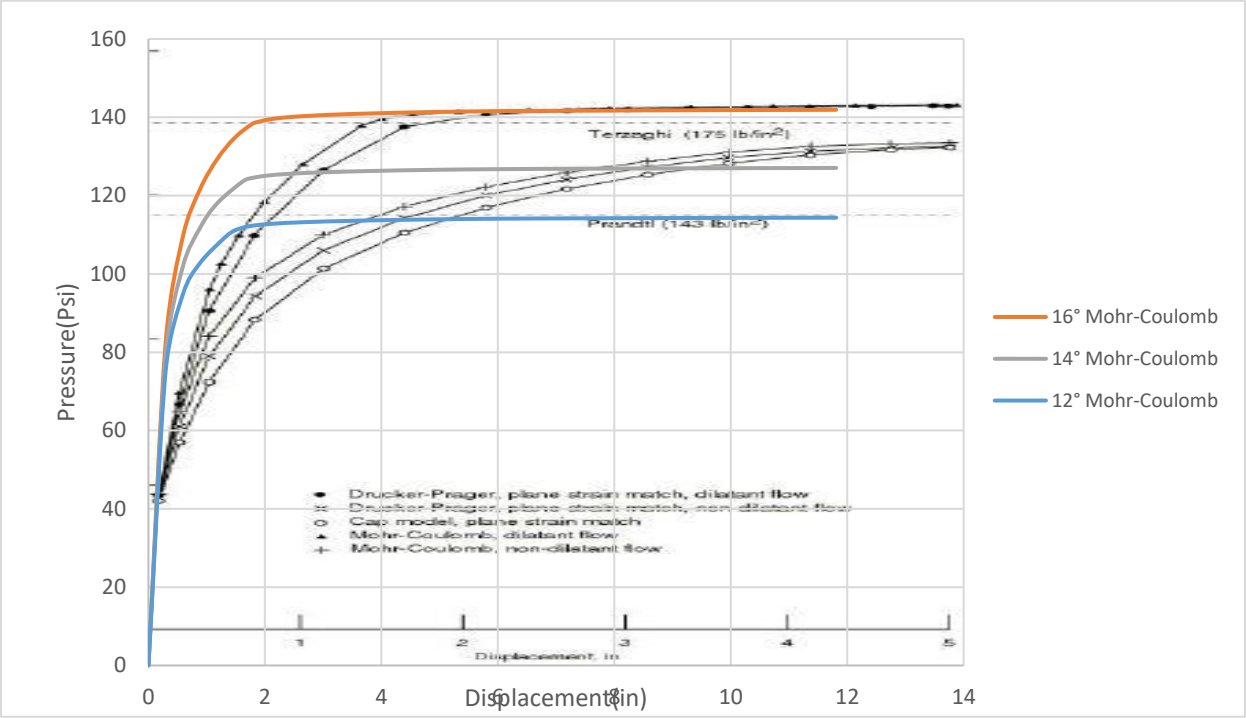


Graph 4.6. Force against Displacement of unreinforced soil F obtained from Abaqus model



Graph 4.7. Friction angle variation curves of the soil D, E and F Comparing with the one as given by Chen (1975)

- SOIL G

Table 4.7. Soil G displacement, load and pressure values via Abaqus model

Displacement(m)	Force (N)	Pressure (Pa)	Displacement(in)	Pressure (Psi)
0	0	0	0	0
0.00875	927551	610230.9211	0.344488189	88.50596407
0.0175	1.18E+06	778565.7895	0.688976378	112.9207213
0.02625	1.30E+06	853184.2105	1.033464567	123.7431413
0.035	1.37E+06	901177.6316	1.377952756	130.7039554
0.04375	1.42E+06	933723.6842	1.722440945	135.424332
0.0525	1.45E+06	955335.5263	2.066929134	138.5588453
0.06125	1.46E+06	962638.1579	2.411417323	139.6179959
0.065625	1.47E+06	964947.3684	2.583661417	139.9529165
0.07	1.47E+06	966467.1053	2.755905512	140.1733343
0.0765625	1.47E+06	968217.1053	3.014271654	140.4271488
0.0864063	1.47E+06	970078.9474	3.401822835	140.6971845
0.09625	1.48E+06	971256.5789	3.789370079	140.8679844
0.101172	1.48E+06	972006.5789	3.983149606	140.976762
0.108555	1.48E+06	972776.3158	4.273818898	141.0884022
0.115938	1.48E+06	973460.5263	4.564488189	141.187638
0.12332	1.48E+06	974125	4.85511811	141.2840111
0.134395	1.48E+06	974842.1053	5.291141732	141.3880178
0.138547	1.48E+06	975138.1579	5.454606299	141.4309564
0.144777	1.48E+06	975375	5.69988189	141.4653072
0.15412	1.48E+06	975730.2632	6.067716535	141.5168334
0.157624	1.48E+06	975848.6842	6.205669291	141.5340088
0.16288	1.48E+06	976000	6.412598425	141.5559552
0.170764	1.48E+06	976203.9474	6.722992126	141.5855351
0.178648	1.48E+06	976401.3158	7.033385827	141.6141608
0.186532	1.48E+06	976585.5263	7.343779528	141.6408781
0.189489	1.48E+06	976657.8947	7.46019685	141.6513742
0.193923	1.48E+06	976717.1053	7.63476378	141.6599619
0.200575	1.48E+06	976907.8947	7.896653543	141.6876334
0.210553	1.49E+06	977000	8.289488189	141.7009921
0.214295	1.49E+06	977144.7368	8.436811024	141.7219842
0.219908	1.49E+06	977236.8421	8.657795276	141.7353429
0.228327	1.49E+06	977322.3684	8.989251969	141.7477473
0.231484	1.49E+06	977421.0526	9.113543307	141.7620602
0.236219	1.49E+06	977493.4211	9.29996063	141.7725563
0.243323	1.49E+06	977605.2632	9.579645669	141.7887775
0.253978	1.49E+06	977717.1053	9.999133858	141.8049987
0.257974	1.49E+06	977782.8947	10.15645669	141.8145406
0.263968	1.49E+06	977848.6842	10.39244094	141.8240825
0.272958	1.49E+06	977993.4211	10.74637795	141.8450747
0.281948	1.49E+06	978059.2105	11.10031496	141.8546166

0.290939	1.49E+06	978236.8421	11.45429134	141.8803797
0.299929	1.49E+06	978236.8421	11.80822835	141.8803797
0.3033	1.49E+06	978348.6842	11.94094488	141.8966009
0.308358	1.49E+06	978335.5263	12.14007874	141.8946926
0.315943	1.49E+06	978414.4737	12.43870079	141.9061428
0.327322	1.49E+06	978605.2632	12.88669291	141.9338143
0.331589	1.49E+06	978552.6316	13.05468504	141.9261808
0.337989	1.49E+06	978611.8421	13.30665354	141.9347685
0.34759	1.49E+06	978789.4737	13.68464567	141.9605317
0.35	1.49E+06	978730.2632	13.77952756	141.951944

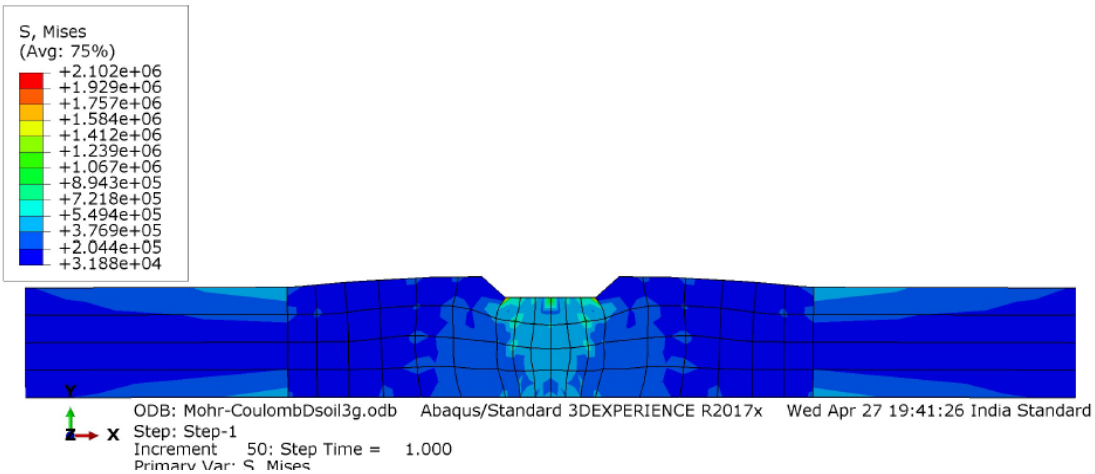


Figure 4.14. Failure mesh of unreinforced soil G

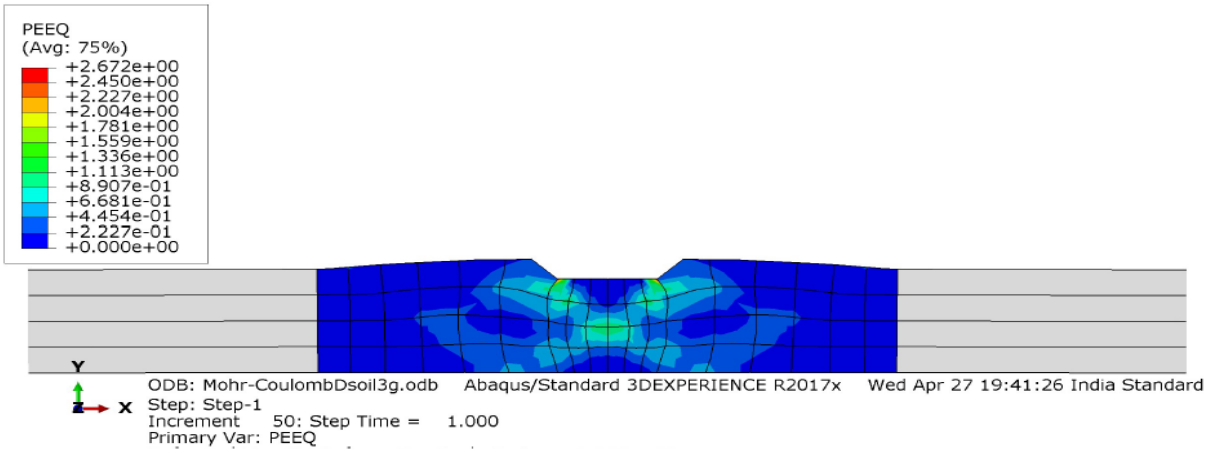
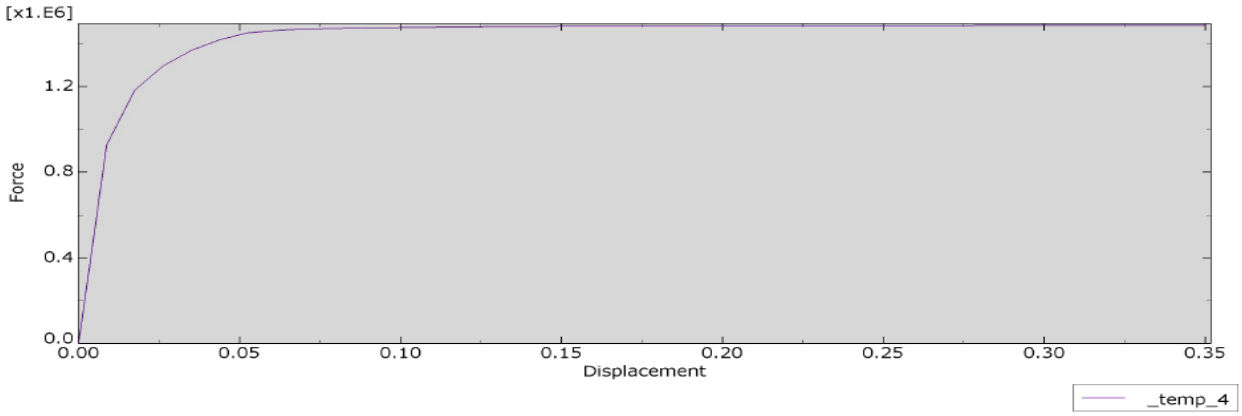


Figure 4.15. Normal stresses of unreinforced soil G.



Graph 4.8. Force against Displacement of unreinforced soil G obtained from Abaqus model

- SOIL H

Table 4.8. Soil H displacement, load and pressure values via Abaqus model

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure(Psi)
0	0	0	0	0
0.00875	882170	580375	0.344488189	84.17575564
0.0175	1.10E+06	721375	0.688976378	104.62595
0.02625	1.19E+06	782203.9474	1.033464567	113.4483883
0.035	1.25E+06	821848.6842	1.377952756	119.1983356
0.048125	1.30E+06	855631.5789	1.894685039	124.0980999
0.06125	1.31E+06	864078.9474	2.411417323	125.3232795
0.074375	1.32E+06	867342.1053	2.928149606	125.7965576
0.0875	1.32E+06	869276.3158	3.44488189	126.0770894
0.107188	1.32E+06	871223.6842	4.22	126.3595295
0.136719	1.33E+06	873151.3158	5.382637795	126.6391071
0.16625	1.33E+06	874065.7895	6.545275591	126.7717395
0.195781	1.33E+06	874618.4211	7.707913386	126.8518914
0.230781	1.33E+06	875157.8947	9.085866142	126.930135
0.265781	1.33E+06	875598.6842	10.4638189	126.9940657
0.300781	1.33E+06	875953.9474	11.84177165	127.0455919
0.335781	1.33E+06	876269.7368	13.21972441	127.0913931
0.35	1.33E+06	876407.8947	13.77952756	127.111431

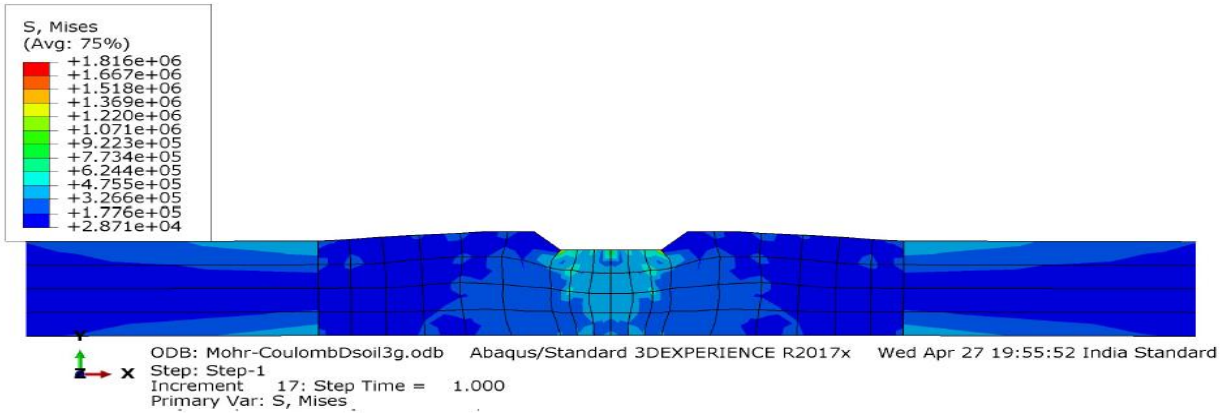


Figure 4.16. Failure mesh of unreinforced soil H.

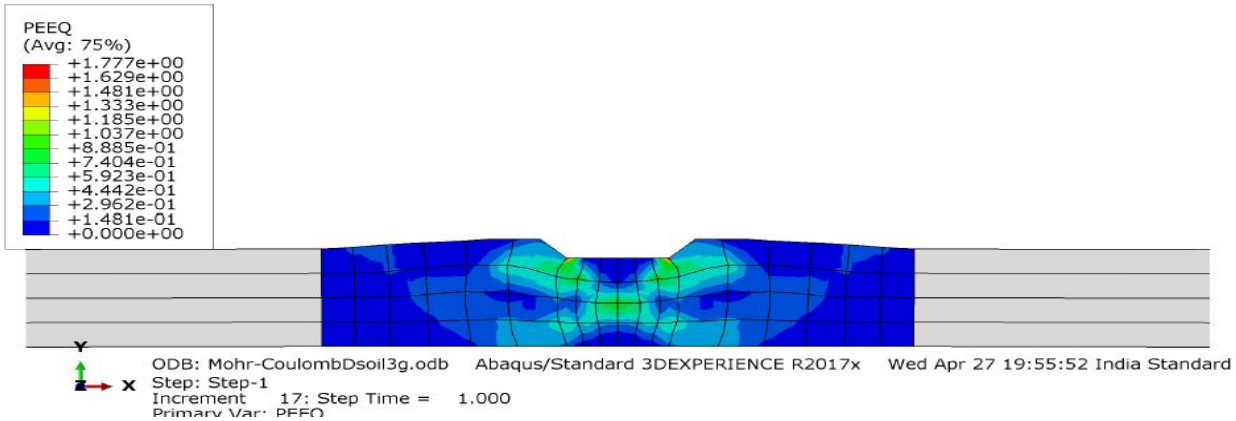
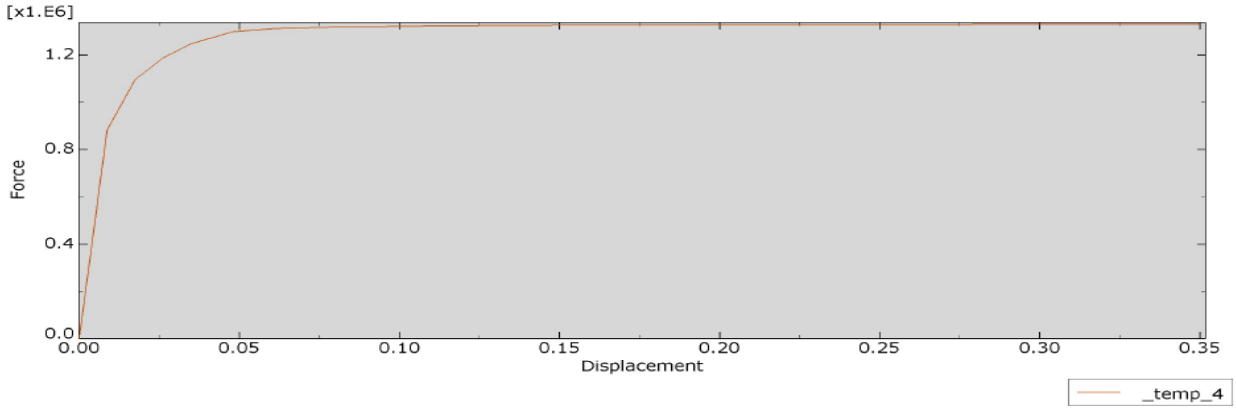


Figure 4.17. Normal stresses of unreinforced soil H.



Graph 4.9. Force against Displacement of unreinforced soil H obtained from Abaqus model

➢ SOIL I

Table 4.9. Soil I displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.00875	836970	550638.1579	0.344488189	79.86281805
0.0175	1.02E+06	668407.8947	0.688976378	96.94376845
0.02625	1.09E+06	718269.7368	1.033464567	104.1755724
0.039375	1.16E+06	760302.6316	1.55019685	110.2718906
0.0442969	1.17E+06	770315.7895	1.743972441	111.7241674
0.0516797	1.18E+06	775973.6842	2.034633858	112.5447706
0.0627539	1.18E+06	779164.4737	2.470625984	113.0075526
0.0793652	1.19E+06	781657.8947	3.124614173	113.3691905
0.104282	1.19E+06	783960.5263	4.105590551	113.7031569
0.139282	1.19E+06	786065.7895	5.483543307	114.0084976
0.174282	1.20E+06	787006.5789	6.861496063	114.1449468
0.209282	1.20E+06	787513.1579	8.239448819	114.2184194
0.244282	1.20E+06	787894.7368	9.617401575	114.2737624
0.279282	1.20E+06	788217.1053	10.99535433	114.3205177
0.314282	1.20E+06	788493.4211	12.37330709	114.3605936
0.349282	1.20E+06	788736.8421	13.75125984	114.3958987
0.35	1.20E+06	788743.4211	13.77952756	114.3968529

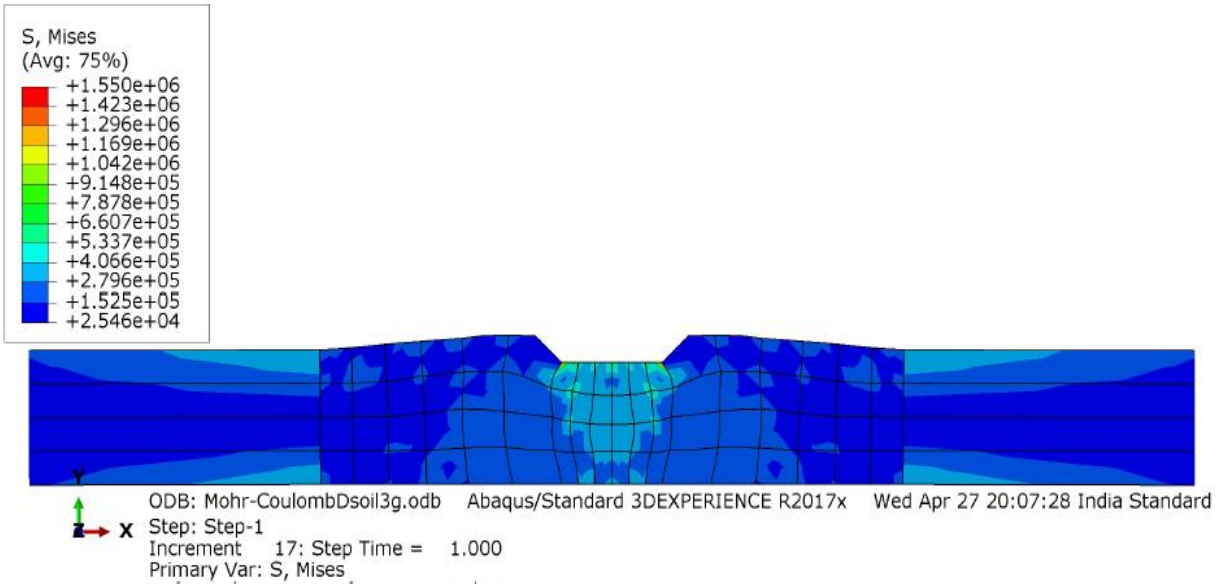


Figure 4.18. Failure mesh of unreinforced soil I.

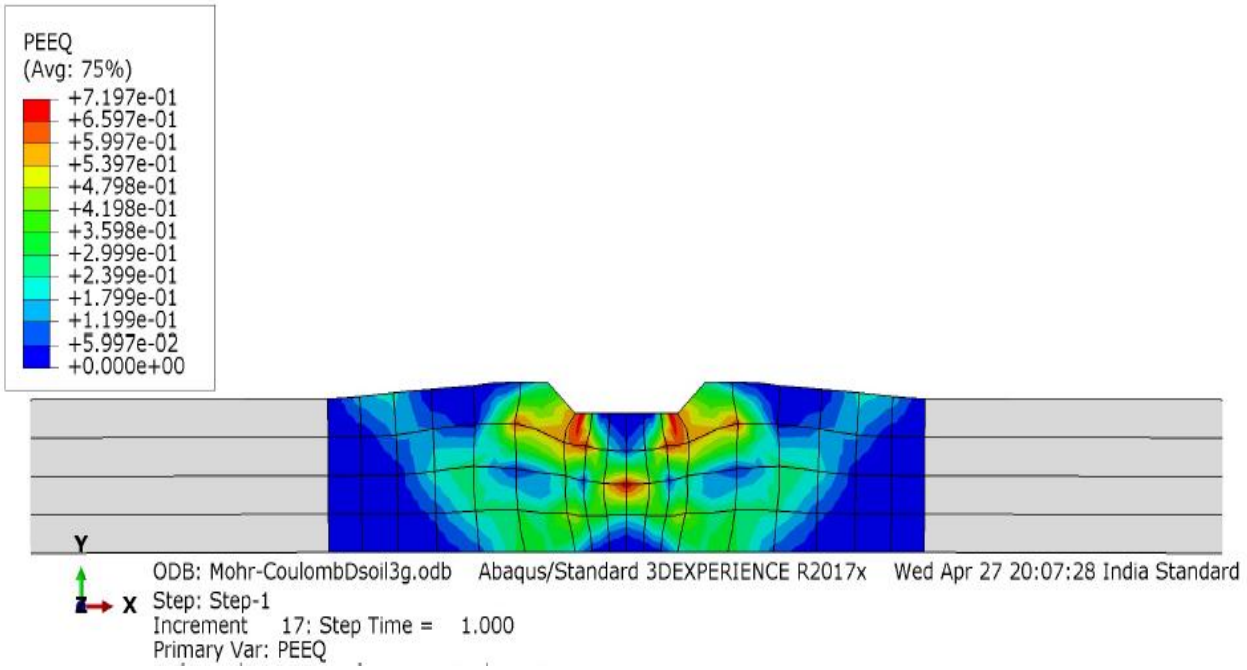
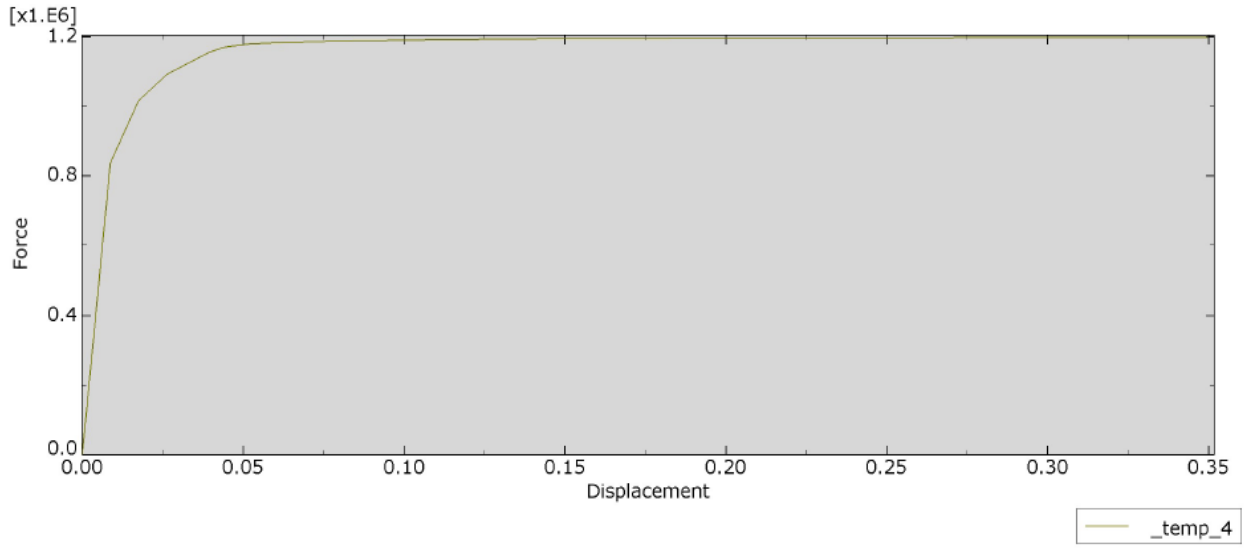
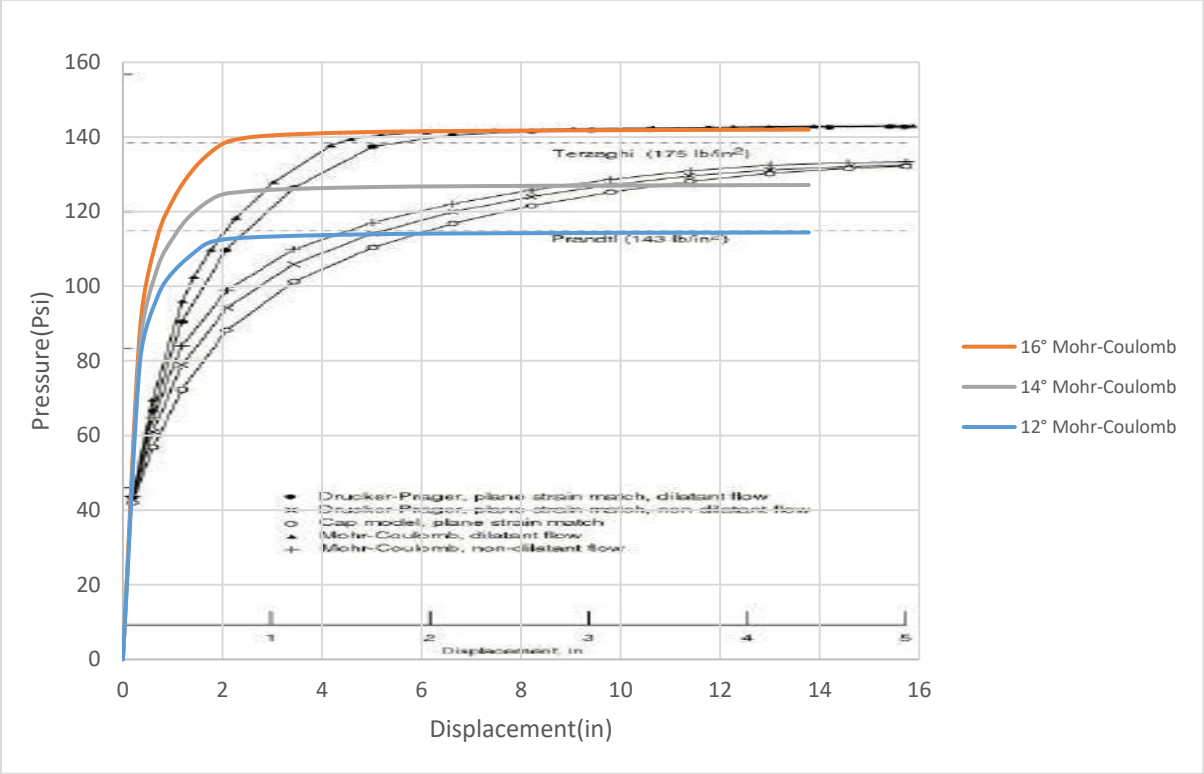


Figure 4.19. Normal stresses of unreinforced soil I.



Graph 4.10. Force against Displacement of unreinforced soil I obtained from Abaqus model



Graph 4.11. Friction angle variation curves of the soil G, H and I Comparing with the one as given by Chen (1975)

- SOIL J

Table 4.10. Soil J displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.004	587661	386619.0789	0.157480315	56.07400925
0.008	889732	585350	0.31496063	84.89731392
0.012	1.06E+06	698578.9474	0.472440945	101.3196826
0.016	1.16E+06	762513.1579	0.62992126	110.5924984
0.02	1.23E+06	806131.5789	0.787401575	116.9187763
0.024	1.28E+06	839657.8947	0.94488189	121.7813272
0.028	1.32E+06	866611.8421	1.102362205	125.6906425
0.032	1.35E+06	889210.5263	1.25984252	128.9682843
0.036	1.38E+06	908065.7895	1.417322835	131.702992
0.04	1.40E+06	923914.4737	1.57480315	134.0016351
0.044	1.42E+06	936638.1579	1.732283465	135.847038
0.048	1.44E+06	947467.1053	1.88976378	137.4176343
0.052	1.45E+06	956078.9474	2.047244094	138.6666687
0.056	1.46E+06	960375	2.204724409	139.2897546

0.06	1.46E+06	963118.4211	2.362204724	139.6876517
0.064	1.47E+06	964986.8421	2.519685039	139.9586416
0.068	1.47E+06	966355.2632	2.677165354	140.1571131
0.072	1.47E+06	967473.6842	2.834645669	140.3193253
0.076	1.47E+06	968388.1579	2.992125984	140.4519577
0.08	1.47E+06	969177.6316	3.149606299	140.5664605
0.084	1.47E+06	969835.5263	3.307086614	140.6618794
0.088	1.48E+06	970513.1579	3.464566929	140.760161
0.092	1.48E+06	970980.2632	3.622047244	140.8279084
0.096	1.48E+06	971546.0526	3.779527559	140.9099688
0.1	1.48E+06	971993.4211	3.937007874	140.9748537
0.104	1.48E+06	972440.7895	4.094488189	141.0397386
0.108	1.48E+06	972842.1053	4.251968504	141.0979441
0.112	1.48E+06	973217.1053	4.409448819	141.152333
0.116	1.48E+06	973585.5263	4.566929134	141.2057676
0.12	1.48E+06	973901.3158	4.724409449	141.2515687
0.124	1.48E+06	974256.5789	4.881889764	141.3030949
0.128	1.48E+06	974506.5789	5.039370079	141.3393541
0.132	1.48E+06	974842.1053	5.196850394	141.3880178
0.136	1.48E+06	975138.1579	5.354330709	141.4309564
0.14	1.48E+06	975250	5.511811024	141.4471776
0.144	1.48E+06	975427.6316	5.669291339	141.4729407
0.148	1.48E+06	975572.3684	5.826771654	141.4939329
0.152	1.48E+06	975717.1053	5.984251969	141.5149251
0.156	1.48E+06	975828.9474	6.141732283	141.5311463
0.16	1.48E+06	975967.1053	6.299212598	141.5511843
0.164	1.48E+06	976059.2105	6.456692913	141.5645429
0.168	1.48E+06	976164.4737	6.614173228	141.57981
0.172	1.48E+06	976276.3158	6.771653543	141.5960312
0.176	1.48E+06	976335.5263	6.929133858	141.6046189
0.18	1.48E+06	976467.1053	7.086614173	141.6237027
0.184	1.48E+06	976546.0526	7.244094488	141.635153
0.188	1.48E+06	976644.7368	7.401574803	141.6494658
0.192	1.48E+06	976703.9474	7.559055118	141.6580535
0.196	1.48E+06	976809.2105	7.716535433	141.6733205
0.2	1.48E+06	976855.2632	7.874015748	141.6799999
0.204	1.48E+06	976960.5263	8.031496063	141.6952669
0.208	1.49E+06	977006.5789	8.188976378	141.7019462
0.212	1.49E+06	977111.8421	8.346456693	141.7172133
0.216	1.49E+06	977144.7368	8.503937008	141.7219842
0.22	1.49E+06	977250	8.661417323	141.7372513
0.224	1.49E+06	977269.7368	8.818897638	141.7401138

0.228	1.49E+06	977388.1579	8.976377953	141.7572892
0.232	1.49E+06	977414.4737	9.133858268	141.761106
0.236	1.49E+06	977506.5789	9.291338583	141.7744647
0.24	1.49E+06	977526.3158	9.448818898	141.7773272
0.244	1.49E+06	977611.8421	9.606299213	141.7897317
0.248	1.49E+06	977644.7368	9.763779528	141.7945026
0.252	1.49E+06	977723.6842	9.921259843	141.8059529
0.256	1.49E+06	977750	10.07874016	141.8097697
0.26	1.49E+06	977835.5263	10.23622047	141.8221741
0.264	1.49E+06	977855.2632	10.39370079	141.8250367
0.268	1.49E+06	977940.7895	10.5511811	141.8374412
0.272	1.49E+06	977953.9474	10.70866142	141.8393496
0.276	1.49E+06	978046.0526	10.86614173	141.8527082
0.28	1.49E+06	978046.0526	11.02362205	141.8527082
0.284	1.49E+06	978138.1579	11.18110236	141.8660669
0.288	1.49E+06	978157.8947	11.33858268	141.8689294
0.292	1.49E+06	978230.2632	11.49606299	141.8794255
0.296	1.49E+06	978243.4211	11.65354331	141.8813339
0.3	1.49E+06	978322.3684	11.81102362	141.8927842
0.304	1.49E+06	978322.3684	11.96850394	141.8927842
0.308	1.49E+06	978401.3158	12.12598425	141.9042345
0.312	1.49E+06	978401.3158	12.28346457	141.9042345
0.316	1.49E+06	978486.8421	12.44094488	141.9166389
0.32	1.49E+06	978467.1053	12.5984252	141.9137764
0.324	1.49E+06	978519.7368	12.75590551	141.9214099
0.328	1.49E+06	978578.9474	12.91338583	141.9299976
0.332	1.49E+06	978618.4211	13.07086614	141.9357227
0.336	1.49E+06	978644.7368	13.22834646	141.9395395
0.34	1.49E+06	978671.0526	13.38582677	141.9433562
0.344	1.49E+06	978730.2632	13.54330709	141.951944
0.348	1.49E+06	978769.7368	13.7007874	141.9576691
0.352	1.49E+06	978756.5789	13.85826772	141.9557607
0.356	1.49E+06	978828.9474	14.01574803	141.9662568
0.36	1.49E+06	978848.6842	14.17322835	141.9691194
0.364	1.49E+06	978901.3158	14.33070866	141.9767529
0.368	1.49E+06	978907.8947	14.48818898	141.9777071
0.372	1.49E+06	978973.6842	14.64566929	141.987249
0.376	1.49E+06	978967.1053	14.80314961	141.9862948
0.38	1.49E+06	979039.4737	14.96062992	141.9967909
0.384	1.49E+06	979026.3158	15.11811024	141.9948825
0.388	1.49E+06	979098.6842	15.27559055	142.0053786
0.392	1.49E+06	979105.2632	15.43307087	142.0063328

0.396	1.49E+06	979157.8947	15.59055118	142.0139663
0.4	1.49E+06	979157.8947	15.7480315	142.0139663

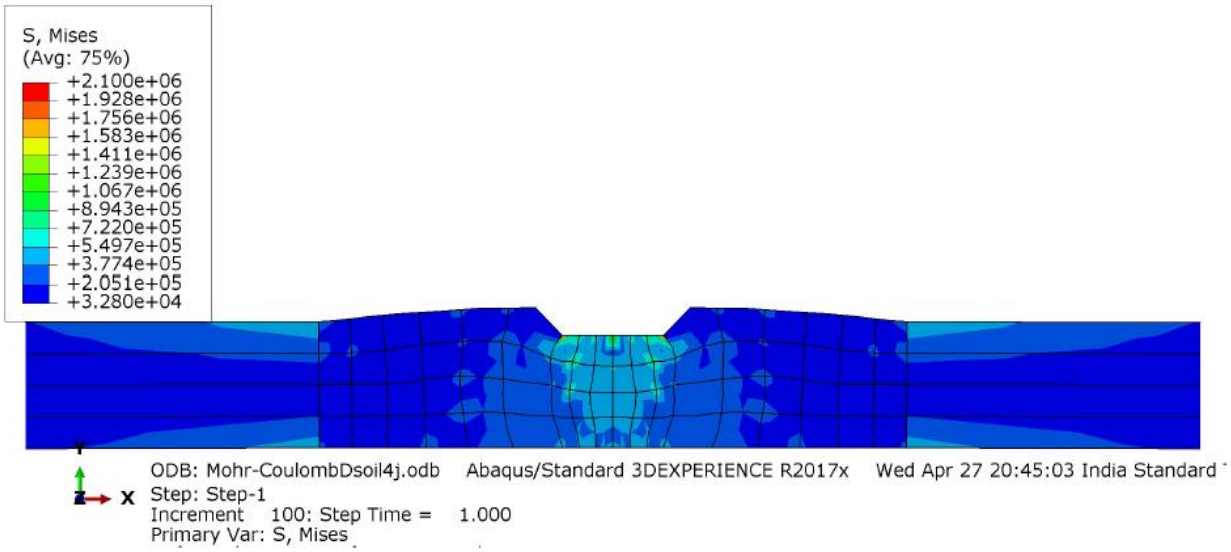


Figure 4.20. Failure mesh of unreinforced soil J.

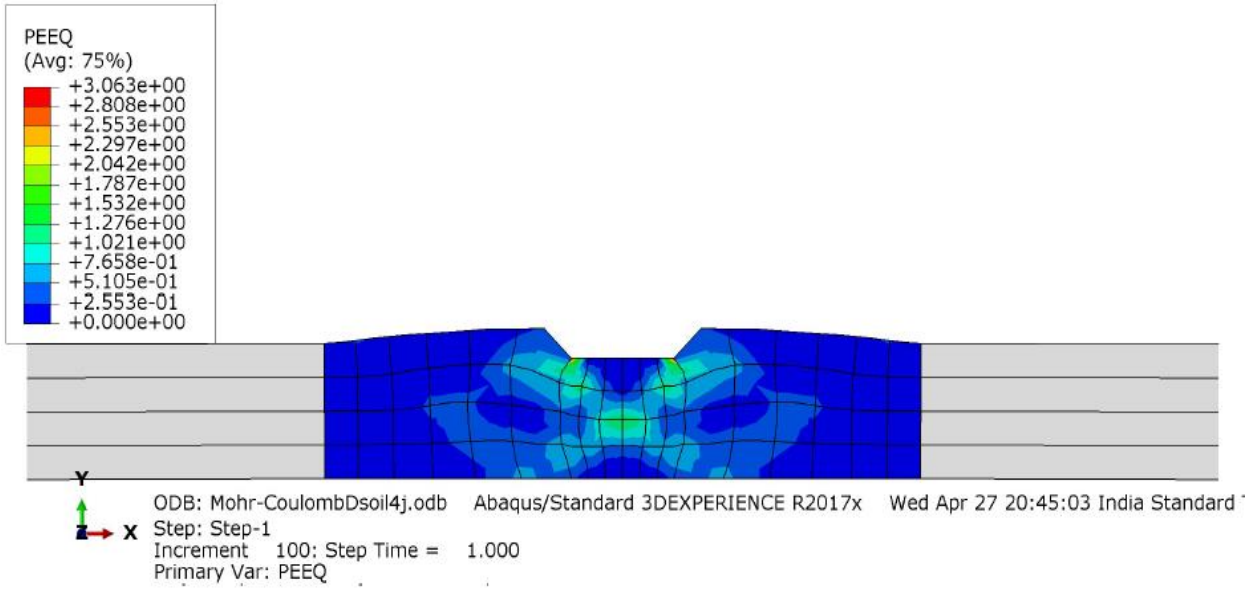
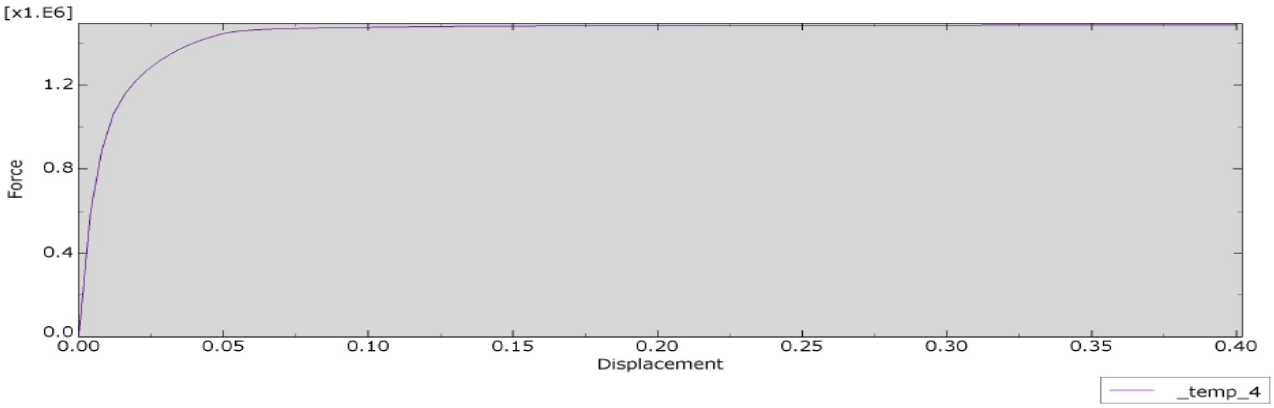


Figure 4.21. Normal stresses of unreinforced soil J.



Graph 4.12. Force against Displacement of unreinforced soil J obtained from Abaqus model

- SOIL K

Table 4.11. Soil K displacement, load and pressure values via Abaqus model.

Displacement(m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0.00E+00	0.00E+00	0	0.00E+00
0.004	5.75E+05	3.78E+05	0.157480315	5.48E+01
0.008	8.49E+05	5.59E+05	0.31496063	8.10E+01
0.012	9.97E+05	6.56E+05	0.472440945	9.51E+01
0.016	1.08E+06	7.08E+05	0.62992126	1.03E+02
0.02	1.13E+06	7.44E+05	0.787401575	1.08E+02
0.024	1.17E+06	7.71E+05	0.94488189	1.12E+02
0.028	1.21E+06	7.94E+05	1.102362205	1.15E+02
0.032	1.23E+06	8.12E+05	1.25984252	1.18E+02
0.036	1.26E+06	8.27E+05	1.417322835	1.20E+02
0.04	1.28E+06	8.39E+05	1.57480315	1.22E+02
0.044	1.29E+06	8.49E+05	1.732283465	1.23E+02
0.048	1.30E+06	8.57E+05	1.88976378	1.24E+02
0.052	1.31E+06	8.61E+05	2.047244094	1.25E+02
0.056	1.31E+06	8.63E+05	2.204724409	1.25E+02
0.06	1.31E+06	8.65E+05	2.362204724	1.25E+02
0.064	1.32E+06	8.66E+05	2.519685039	1.26E+02
0.068	1.32E+06	8.67E+05	2.677165354	1.26E+02
0.072	1.32E+06	8.67E+05	2.834645669	1.26E+02
0.076	1.32E+06	8.68E+05	2.992125984	1.26E+02
0.08	1.32E+06	8.69E+05	3.149606299	1.26E+02
0.084	1.32E+06	8.69E+05	3.307086614	1.26E+02
0.088	1.32E+06	8.70E+05	3.464566929	1.26E+02
0.092	1.32E+06	8.70E+05	3.622047244	1.26E+02

0.096	1.32E+06	8.70E+05	3.779527559	1.26E+02
0.1	1.32E+06	8.71E+05	3.937007874	1.26E+02
0.104	1.32E+06	8.71E+05	4.094488189	1.26E+02
0.108	1.32E+06	8.72E+05	4.251968504	1.26E+02
0.112	1.33E+06	8.72E+05	4.409448819	1.26E+02
0.116	1.33E+06	8.72E+05	4.566929134	1.26E+02
0.12	1.33E+06	8.72E+05	4.724409449	1.27E+02
0.124	1.33E+06	8.73E+05	4.881889764	1.27E+02
0.128	1.33E+06	8.73E+05	5.039370079	1.27E+02
0.132	1.33E+06	8.73E+05	5.196850394	1.27E+02
0.136	1.33E+06	8.73E+05	5.354330709	1.27E+02
0.14	1.33E+06	8.73E+05	5.511811024	1.27E+02
0.144	1.33E+06	8.74E+05	5.669291339	1.27E+02
0.148	1.33E+06	8.74E+05	5.826771654	1.27E+02
0.152	1.33E+06	8.74E+05	5.984251969	1.27E+02
0.156	1.33E+06	8.74E+05	6.141732283	1.27E+02
0.16	1.33E+06	8.74E+05	6.299212598	1.27E+02
0.164	1.33E+06	8.74E+05	6.456692913	1.27E+02
0.168	1.33E+06	8.74E+05	6.614173228	1.27E+02
0.172	1.33E+06	8.74E+05	6.771653543	1.27E+02
0.176	1.33E+06	8.74E+05	6.929133858	1.27E+02
0.18	1.33E+06	8.74E+05	7.086614173	1.27E+02
0.184	1.33E+06	8.75E+05	7.244094488	1.27E+02
0.188	1.33E+06	8.75E+05	7.401574803	1.27E+02
0.192	1.33E+06	8.75E+05	7.559055118	1.27E+02
0.196	1.33E+06	8.75E+05	7.716535433	1.27E+02
0.2	1.33E+06	8.75E+05	7.874015748	1.27E+02
0.204	1.33E+06	8.75E+05	8.031496063	1.27E+02
0.208	1.33E+06	8.75E+05	8.188976378	1.27E+02
0.212	1.33E+06	8.75E+05	8.346456693	1.27E+02
0.216	1.33E+06	8.75E+05	8.503937008	1.27E+02
0.22	1.33E+06	8.75E+05	8.661417323	1.27E+02
0.224	1.33E+06	8.75E+05	8.818897638	1.27E+02
0.228	1.33E+06	8.75E+05	8.976377953	1.27E+02
0.232	1.33E+06	8.75E+05	9.133858268	1.27E+02
0.236	1.33E+06	8.75E+05	9.291338583	1.27E+02
0.24	1.33E+06	8.75E+05	9.448818898	1.27E+02
0.244	1.33E+06	8.75E+05	9.606299213	1.27E+02
0.248	1.33E+06	8.75E+05	9.763779528	1.27E+02
0.252	1.33E+06	8.76E+05	9.921259843	1.27E+02
0.256	1.33E+06	8.76E+05	10.07874016	1.27E+02
0.26	1.33E+06	8.76E+05	10.23622047	1.27E+02

0.264	1.33E+06	8.76E+05	10.39370079	1.27E+02
0.268	1.33E+06	8.76E+05	10.5511811	1.27E+02
0.272	1.33E+06	8.76E+05	10.70866142	1.27E+02
0.276	1.33E+06	8.76E+05	10.86614173	1.27E+02
0.28	1.33E+06	8.76E+05	11.02362205	1.27E+02
0.284	1.33E+06	8.76E+05	11.18110236	1.27E+02
0.288	1.33E+06	8.76E+05	11.33858268	1.27E+02
0.292	1.33E+06	8.76E+05	11.49606299	1.27E+02
0.296	1.33E+06	8.76E+05	11.65354331	1.27E+02
0.3	1.33E+06	8.76E+05	11.81102362	1.27E+02
0.304	1.33E+06	8.76E+05	11.96850394	1.27E+02
0.308	1.33E+06	8.76E+05	12.12598425	1.27E+02
0.312	1.33E+06	8.76E+05	12.28346457	1.27E+02
0.316	1.33E+06	8.76E+05	12.44094488	1.27E+02
0.32	1.33E+06	8.76E+05	12.5984252	1.27E+02
0.324	1.33E+06	8.76E+05	12.75590551	1.27E+02
0.328	1.33E+06	8.76E+05	12.91338583	1.27E+02
0.332	1.33E+06	8.76E+05	13.07086614	1.27E+02
0.336	1.33E+06	8.76E+05	13.22834646	1.27E+02
0.34	1.33E+06	8.76E+05	13.38582677	1.27E+02
0.344	1.33E+06	8.76E+05	13.54330709	1.27E+02
0.348	1.33E+06	8.76E+05	13.7007874	1.27E+02
0.352	1.33E+06	8.76E+05	13.85826772	1.27E+02
0.356	1.33E+06	8.77E+05	14.01574803	1.27E+02
0.36	1.33E+06	8.77E+05	14.17322835	1.27E+02
0.364	1.33E+06	8.77E+05	14.33070866	1.27E+02
0.368	1.33E+06	8.77E+05	14.48818898	1.27E+02
0.372	1.33E+06	8.77E+05	14.64566929	1.27E+02
0.376	1.33E+06	8.77E+05	14.80314961	1.27E+02
0.38	1.33E+06	8.77E+05	14.96062992	1.27E+02
0.384	1.33E+06	8.77E+05	15.11811024	1.27E+02
0.388	1.33E+06	8.77E+05	15.27559055	1.27E+02
0.392	1.33E+06	8.77E+05	15.43307087	1.27E+02
0.396	1.33E+06	8.77E+05	15.59055118	1.27E+02
0.4	1.33E+06	8.77E+05	15.7480315	1.27E+02

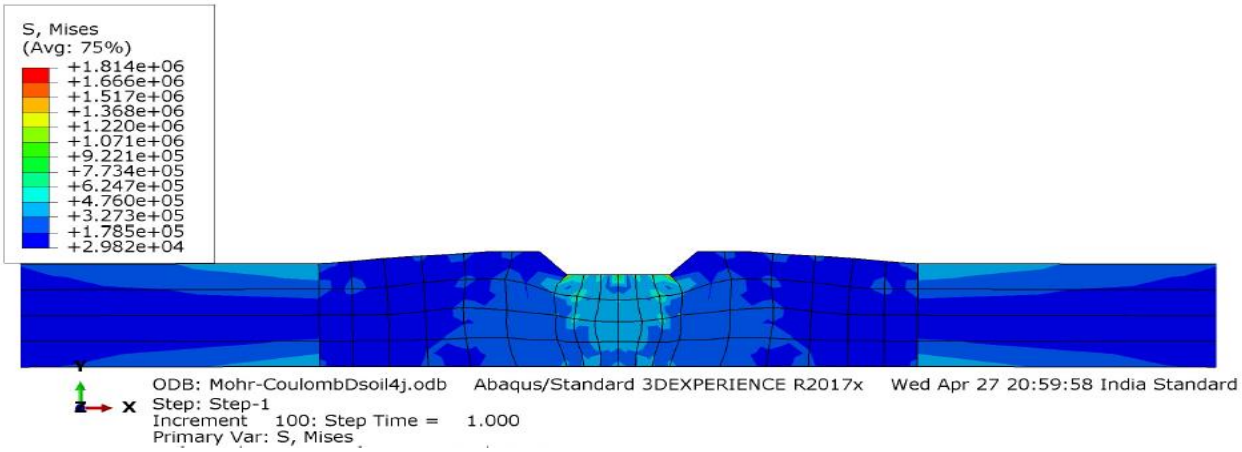


Figure 4.22. Failure mesh of unreinforced soil K.

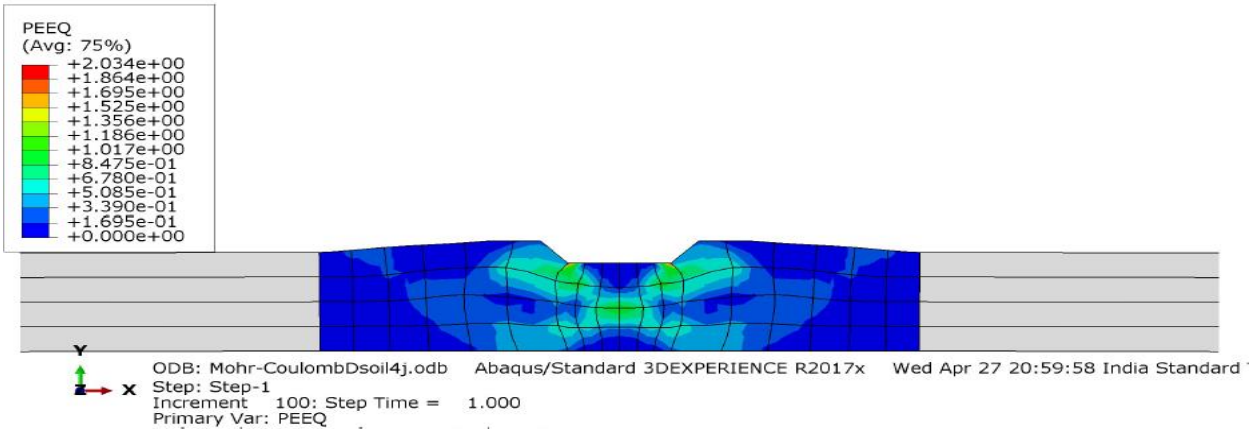
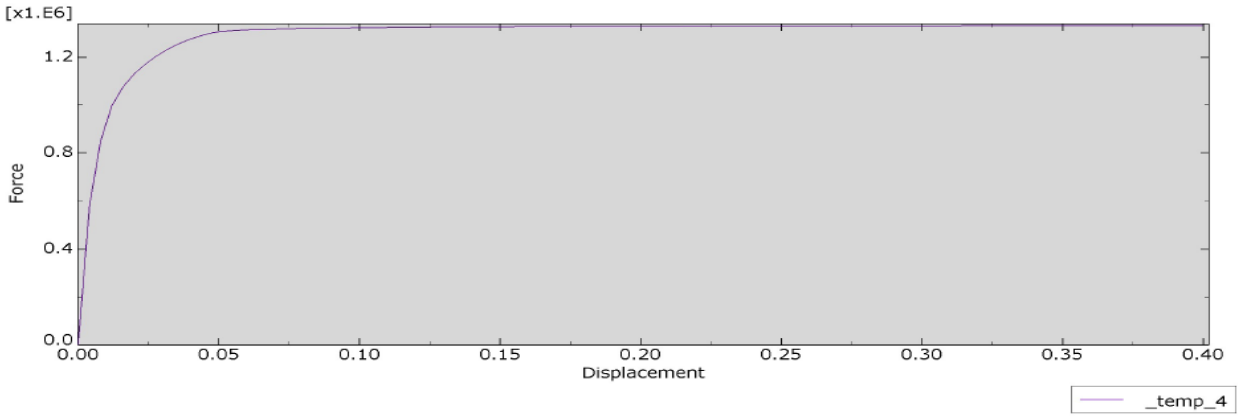


Figure 4.23. Normal stresses of unreinforced soil K.



Graph 4.13. Force against Displacement of unreinforced soil K obtained from Abaqus model

- SOIL L

Table 4.12. Soil L displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement(in)	Pressure (Psi)
0	0	0	0	0
0.004	561290	369269.7368	0.157480315	53.5577155
0.008	808574	531956.5789	0.31496063	77.15330089
0.012	933504	614147.3684	0.472440945	89.07399322
0.016	999033	657258.5526	0.62992126	95.32670311
0.02	1.04E+06	686348.6842	0.787401575	99.54584385
0.024	1.08E+06	708743.4211	0.94488189	102.7939057
0.028	1.11E+06	727460.5263	1.102362205	105.5085755
0.032	1.13E+06	742355.2632	1.25984252	107.668861
0.036	1.15E+06	754480.2632	1.417322835	109.4274327
0.04	1.16E+06	764059.2105	1.57480315	110.816733
0.044	1.17E+06	771309.2105	1.732283465	111.8682501
0.048	1.18E+06	774875	1.88976378	112.3854209
0.052	1.18E+06	776743.4211	2.047244094	112.6564108
0.056	1.18E+06	778032.8947	2.204724409	112.843432
0.06	1.18E+06	779019.7368	2.362204724	112.9865604
0.064	1.19E+06	779789.4737	2.519685039	113.0982006
0.068	1.19E+06	780447.3684	2.677165354	113.1936196
0.072	1.19E+06	781019.7368	2.834645669	113.2766341
0.076	1.19E+06	781532.8947	2.992125984	113.3510609
0.08	1.19E+06	781993.4211	3.149606299	113.4178542
0.084	1.19E+06	782421.0526	3.307086614	113.4798765
0.088	1.19E+06	782815.7895	3.464566929	113.5371279
0.092	1.19E+06	783190.7895	3.622047244	113.5915167
0.096	1.19E+06	783539.4737	3.779527559	113.6420888
0.1	1.19E+06	783861.8421	3.937007874	113.6888441
0.104	1.19E+06	784177.6316	4.094488189	113.7346452
0.108	1.19E+06	784467.1053	4.251968504	113.7766295
0.112	1.19E+06	784750	4.409448819	113.8176597
0.116	1.19E+06	785019.7368	4.566929134	113.8567815
0.12	1.19E+06	785269.7368	4.724409449	113.8930407
0.124	1.19E+06	785513.1579	4.881889764	113.9283457
0.128	1.19E+06	785743.4211	5.039370079	113.9617423
0.132	1.19E+06	785960.5263	5.196850394	113.9932306

0.136	1.19E+06	786144.7368	5.354330709	114.0199479
0.14	1.20E+06	786296.0526	5.511811024	114.0418943
0.144	1.20E+06	786414.4737	5.669291339	114.0590697
0.148	1.20E+06	786519.7368	5.826771654	114.0743367
0.152	1.20E+06	786625	5.984251969	114.0896038
0.156	1.20E+06	786717.1053	6.141732283	114.1029624
0.16	1.20E+06	786802.6316	6.299212598	114.1153669
0.164	1.20E+06	786888.1579	6.456692913	114.1277713
0.168	1.20E+06	786960.5263	6.614173228	114.1382674
0.172	1.20E+06	787039.4737	6.771653543	114.1497177
0.176	1.20E+06	787111.8421	6.929133858	114.1602138
0.18	1.20E+06	787177.6316	7.086614173	114.1697557
0.184	1.20E+06	787236.8421	7.244094488	114.1783434
0.188	1.20E+06	787302.6316	7.401574803	114.1878853
0.192	1.20E+06	787348.6842	7.559055118	114.1945646
0.196	1.20E+06	787407.8947	7.716535433	114.2031523
0.2	1.20E+06	787460.5263	7.874015748	114.2107859
0.204	1.20E+06	787513.1579	8.031496063	114.2184194
0.208	1.20E+06	787565.7895	8.188976378	114.2260529
0.212	1.20E+06	787611.8421	8.346456693	114.2327322
0.216	1.20E+06	787657.8947	8.503937008	114.2394115
0.22	1.20E+06	787703.9474	8.661417323	114.2460909
0.224	1.20E+06	787743.4211	8.818897638	114.251816
0.228	1.20E+06	787789.4737	8.976377953	114.2584953
0.232	1.20E+06	787828.9474	9.133858268	114.2642205
0.236	1.20E+06	787875	9.291338583	114.2708998
0.24	1.20E+06	787914.4737	9.448818898	114.2766249
0.244	1.20E+06	787953.9474	9.606299213	114.2823501
0.248	1.20E+06	787986.8421	9.763779528	114.287121
0.252	1.20E+06	788026.3158	9.921259843	114.2928462
0.256	1.20E+06	788065.7895	10.07874016	114.2985713
0.26	1.20E+06	788098.6842	10.23622047	114.3033423
0.264	1.20E+06	788138.1579	10.39370079	114.3090674
0.268	1.20E+06	788171.0526	10.5511811	114.3138383
0.272	1.20E+06	788203.9474	10.70866142	114.3186093
0.276	1.20E+06	788236.8421	10.86614173	114.3233802
0.28	1.20E+06	788269.7368	11.02362205	114.3281512
0.284	1.20E+06	788302.6316	11.18110236	114.3329221
0.288	1.20E+06	788335.5263	11.33858268	114.3376931

0.292	1.20E+06	788368.4211	11.49606299	114.342464
0.296	1.20E+06	788401.3158	11.65354331	114.347235
0.3	1.20E+06	788427.6316	11.81102362	114.3510517
0.304	1.20E+06	788460.5263	11.96850394	114.3558227
0.308	1.20E+06	788486.8421	12.12598425	114.3596395
0.312	1.20E+06	788519.7368	12.28346457	114.3644104
0.316	1.20E+06	788546.0526	12.44094488	114.3682272
0.32	1.20E+06	788578.9474	12.5984252	114.3729981
0.324	1.20E+06	788605.2632	12.75590551	114.3768149
0.328	1.20E+06	788631.5789	12.91338583	114.3806316
0.332	1.20E+06	788657.8947	13.07086614	114.3844484
0.336	1.20E+06	788690.7895	13.22834646	114.3892193
0.34	1.20E+06	788717.1053	13.38582677	114.3930361
0.344	1.20E+06	788743.4211	13.54330709	114.3968529
0.348	1.20E+06	788769.7368	13.7007874	114.4006696
0.352	1.20E+06	788796.0526	13.85826772	114.4044864
0.356	1.20E+06	788822.3684	14.01574803	114.4083031
0.36	1.20E+06	788848.6842	14.17322835	114.4121199
0.364	1.20E+06	788875	14.33070866	114.4159366
0.368	1.20E+06	788901.3158	14.48818898	114.4197534
0.372	1.20E+06	788921.0526	14.64566929	114.422616
0.376	1.20E+06	788947.3684	14.80314961	114.4264327
0.38	1.20E+06	788973.6842	14.96062992	114.4302495
0.384	1.20E+06	789000	15.11811024	114.4340663
0.388	1.20E+06	789019.7368	15.27559055	114.4369288
0.392	1.20E+06	789046.0526	15.43307087	114.4407456
0.396	1.20E+06	789072.3684	15.59055118	114.4445623
0.4	1.20E+06	789092.1053	15.7480315	114.4474249

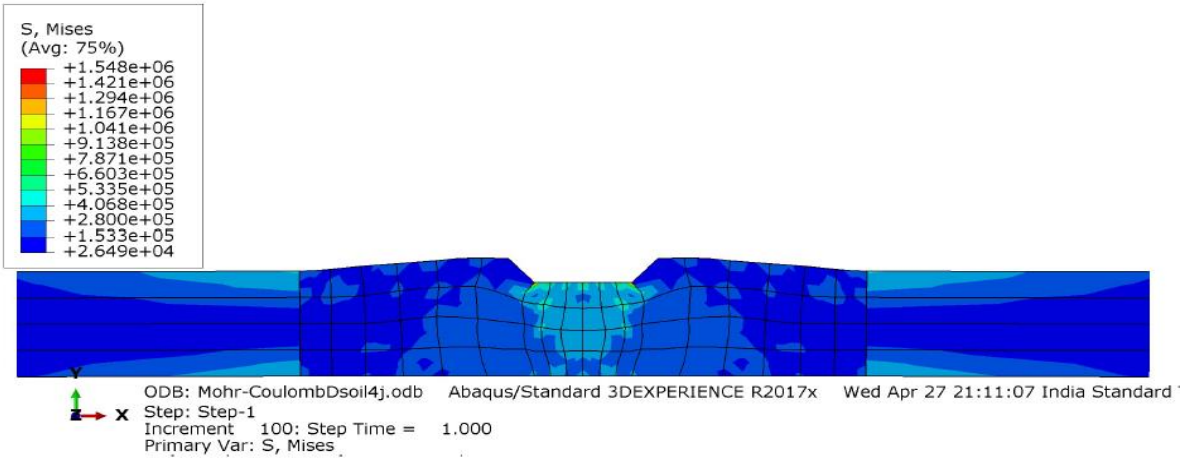


Figure 4.24. Failure mesh of unreinforced soil L.

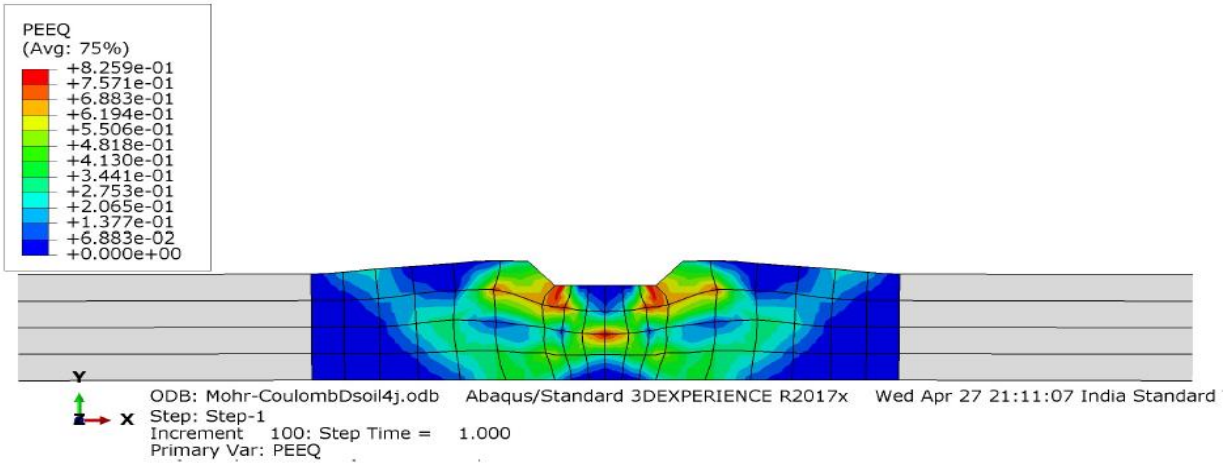
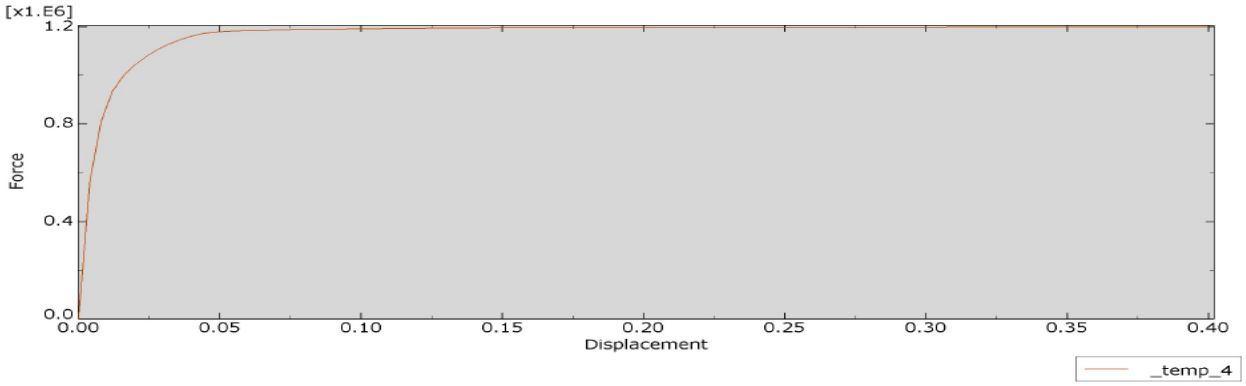
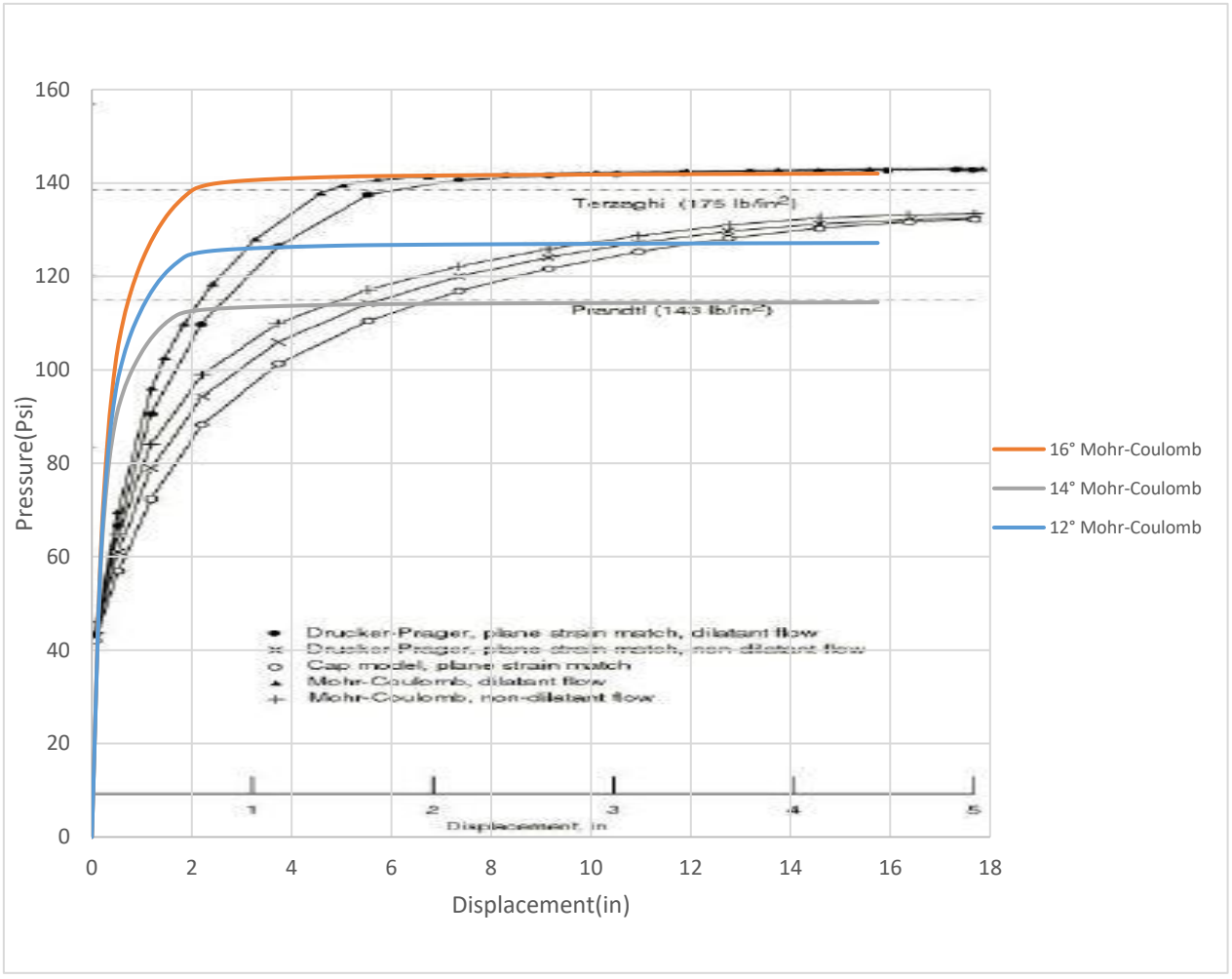


Figure 4.25. Normal stresses of unreinforced soil L.



Graph 4.14. Force against Displacement of unreinforced soil L obtained from Abaqus model



Graph 4.15. Friction angle variation curves of the soil J, K and L Comparing with the one as given by Chen (1975)

A progressive variation was observed after applying different values of friction angle parameter based on the results obtained through the Abaqus Model stimulations. Theses variations curves of Mohr-Coulomb follow the same trajectory as the graph obtained by Chen, W. F., Amsterdam, Limit study and soil plasticity, 1975.This variation has an impact on the foundation and increase progressively the settlement.

II) Dilation angle Variation

Based on the Table 3.3 the stimulation through the Abaqus model give results for the soils namely M, N, O, P, Q, R, S, T, U, V, W and X according to the dilation angle.

SOIL M, N and O gave the same results

- SOIL M, N and O

Table 4.13. Soil M, N and O displacement, load and pressure values via Abaqus model

Displacement(m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.00625	848935	558509.8684	0.246062992	81.00450607
0.0125	1.26E+06	831210.5263	0.492125984	120.5561476
0.01875	1.47E+06	968078.9474	0.738188976	140.4071108
0.025	1.60E+06	1055302.632	0.984251969	153.0577582
0.034375	1.74E+06	1141638.158	1.353346457	165.5795901
0.04375	1.83E+06	1202723.684	1.722440945	174.4392418
0.053125	1.86E+06	1226835.526	2.091535433	177.9363471
0.0625	1.88E+06	1235059.211	2.460629921	179.1290843
0.071875	1.88E+06	1239210.526	2.829724409	179.731178
0.0859375	1.89E+06	1243164.474	3.383366142	180.3046461
0.107031	1.90E+06	1247131.579	4.213818898	180.8800225
0.132031	1.90E+06	1250335.526	5.198070866	181.3447129
0.157031	1.90E+06	1252375	6.182322835	181.6405117
0.182031	1.91E+06	1253539.474	7.166574803	181.8094033
0.207031	1.91E+06	1254302.632	8.150826772	181.9200893
0.232031	1.91E+06	1254973.684	9.13507874	182.0174166
0.25	1.91E+06	1255394.737	9.842519685	182.0784848

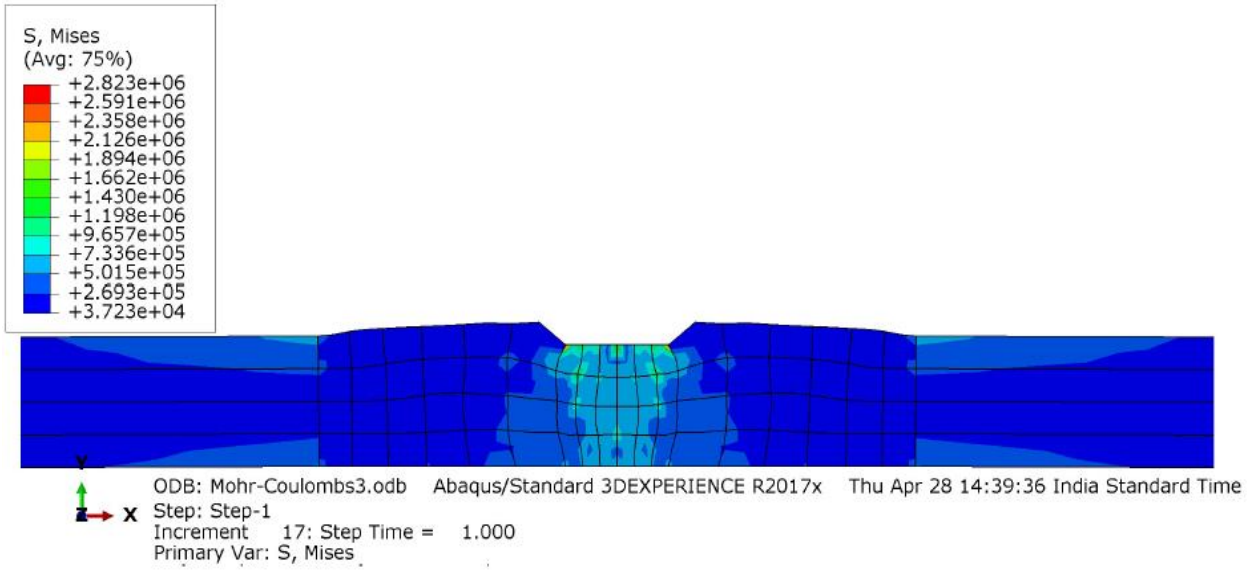


Figure 4.26. Failure mesh of unreinforced soils M, N and O

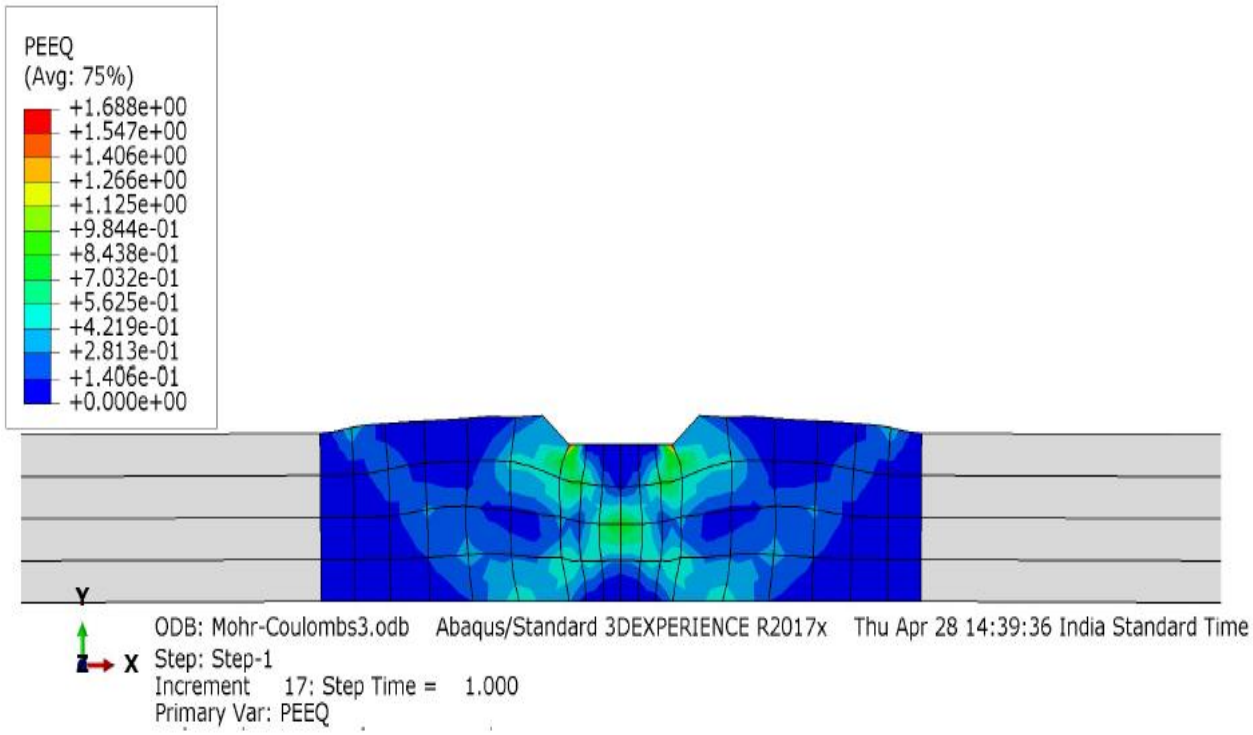
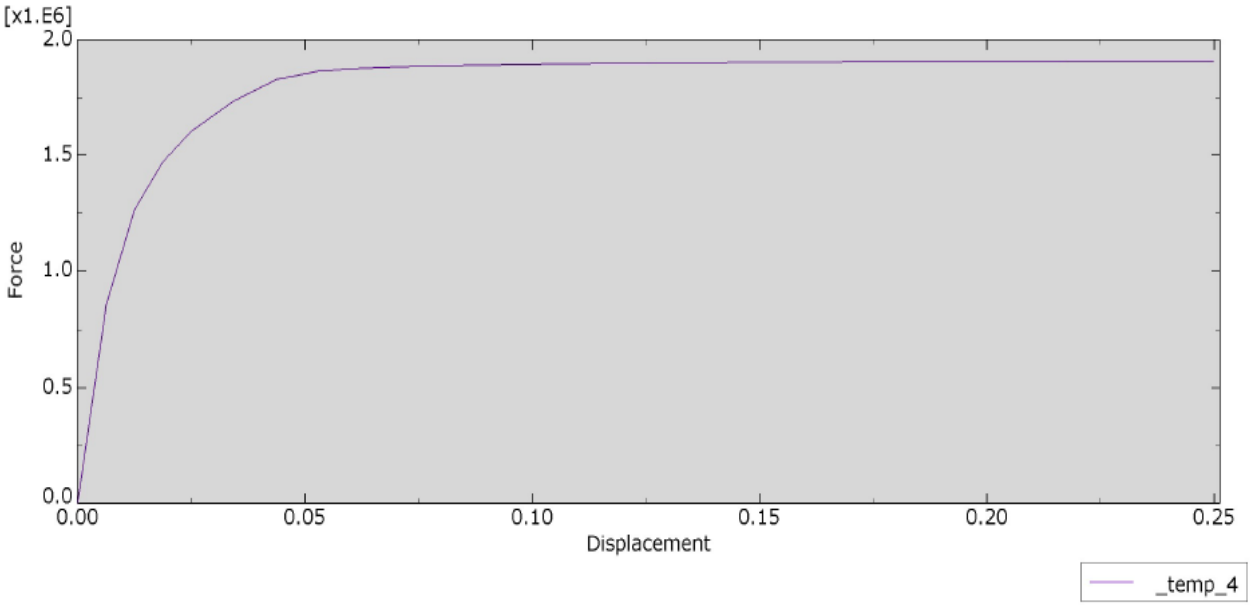
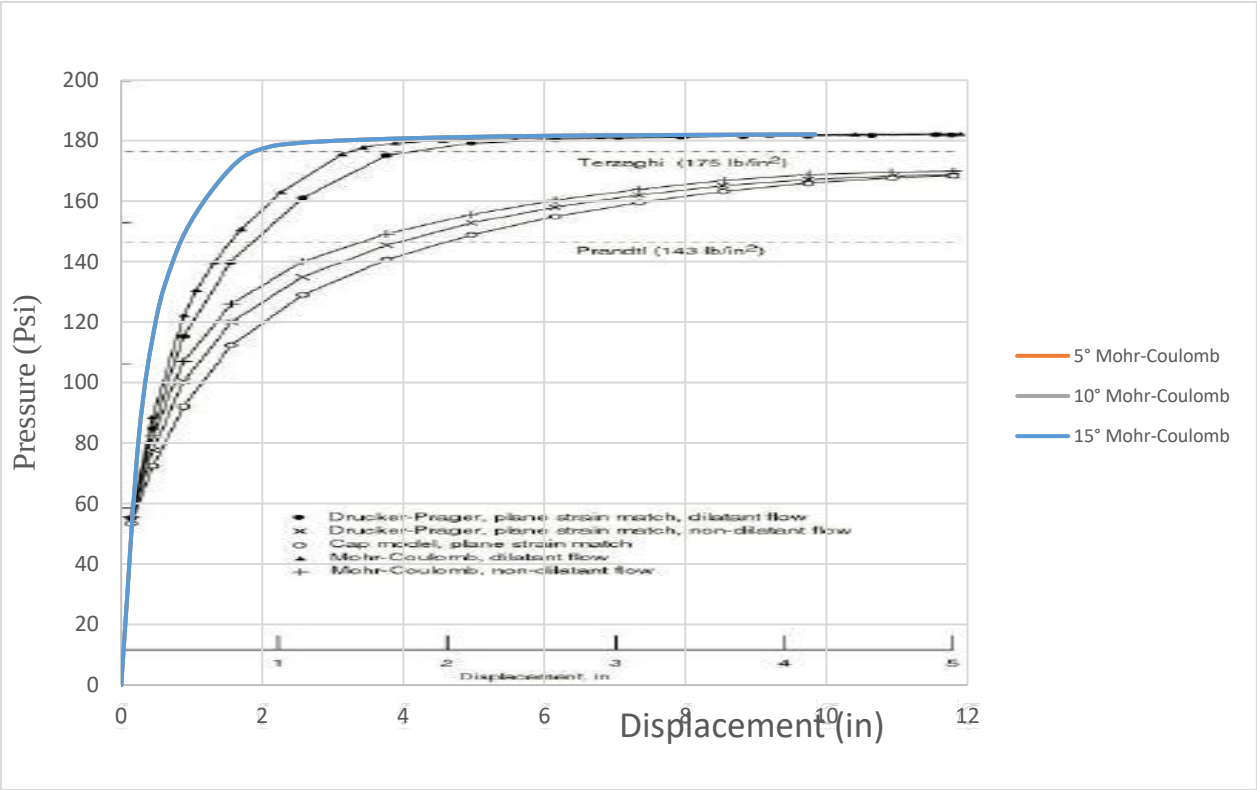


Figure 4.27. Normal stresses of unreinforced soils M, N and O



Graph 4.16. Force against Displacement of unreinforced soils M, N and O obtained from Abaqus model



Graph 4.17. Dilation angle variation curves of the soil M, N and O Comparing with the one as given by Chen (1975)

SOIL P, Q and R gave the same results

- **SOIL P, Q and R**

Table 4.14. Soil P, Q and R displacement, load and pressure values via Abaqus model

Displacement(m)	Force(N)	Pressure (Pa)	Displacement(in)	Pressure (Psi)
0	0	0	0	0
0.0075	957170	629717.1053	0.295275591	91.33217864
0.015	1.36E+06	895546.0526	0.590551181	129.887169
0.0225	1.56E+06	1023894.737	0.885826772	148.5024565
0.03	1.68E+06	1105078.947	1.181102362	160.2771578
0.04125	1.81E+06	1187578.947	1.624015748	172.242697
0.0525	1.86E+06	1225210.526	2.066929134	177.7006623
0.06375	1.88E+06	1235500	2.50984252	179.193015
0.075	1.89E+06	1240151.316	2.952755906	179.8676272
0.091875	1.89E+06	1244401.316	3.617125984	180.4840337
0.117188	1.90E+06	1248519.737	4.613700787	181.0813565
0.147188	1.90E+06	1251631.579	5.79480315	181.5326883
0.177188	1.91E+06	1253322.368	6.975905512	181.777915

0.207188	1.91E+06	1254381.579	8.157007874	181.9315396
0.237188	1.91E+06	1255131.579	9.338110236	182.0403172
0.267188	1.91E+06	1255710.526	10.5192126	182.1242859
0.297188	1.91E+06	1256171.053	11.70031496	182.1910792
0.3	1.91E+06	1256236.842	11.81102362	182.2006211

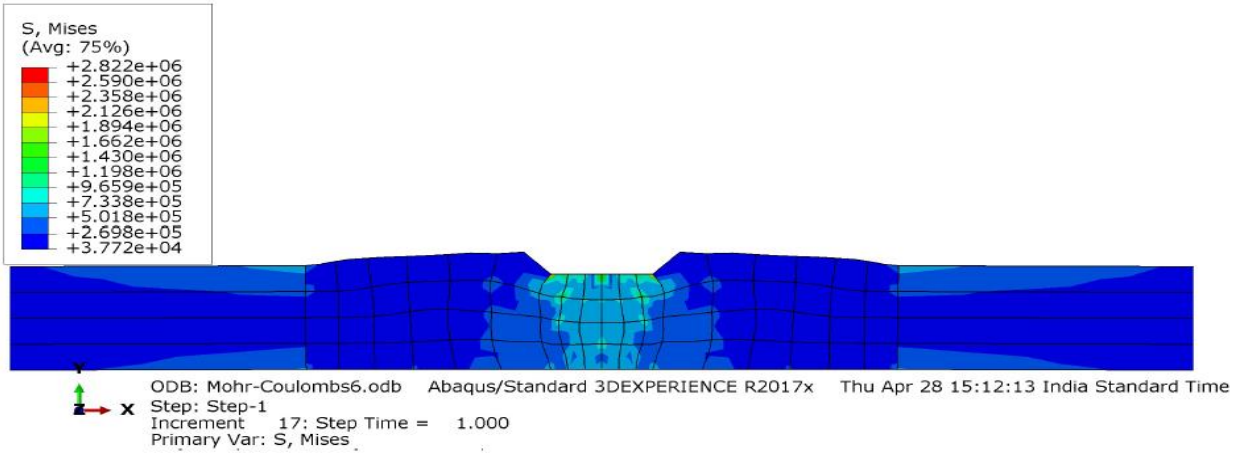


Figure 4.28. Failure mesh of unreinforced soils P, Q and R

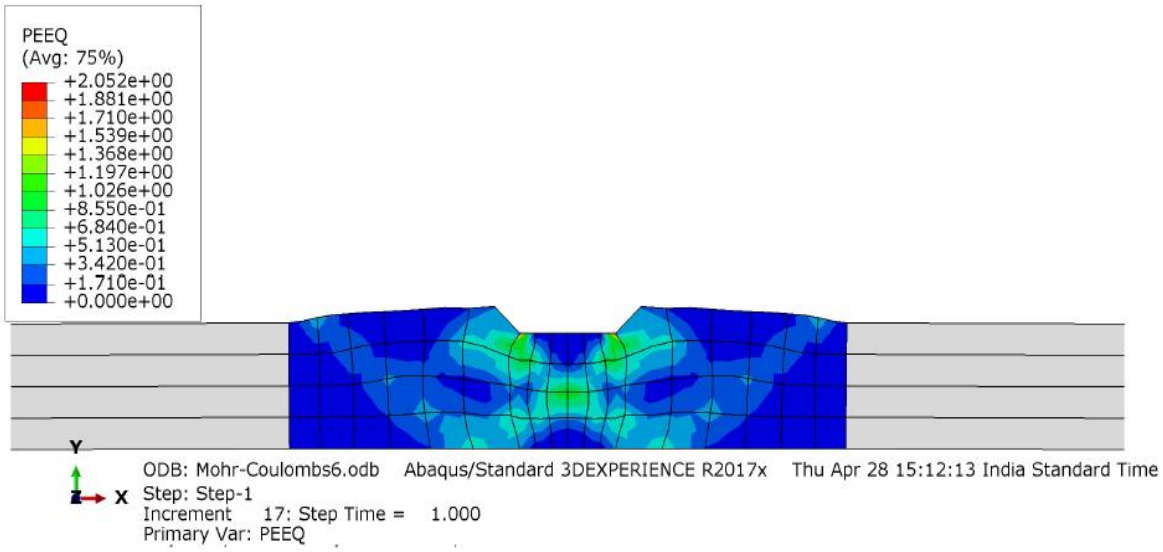
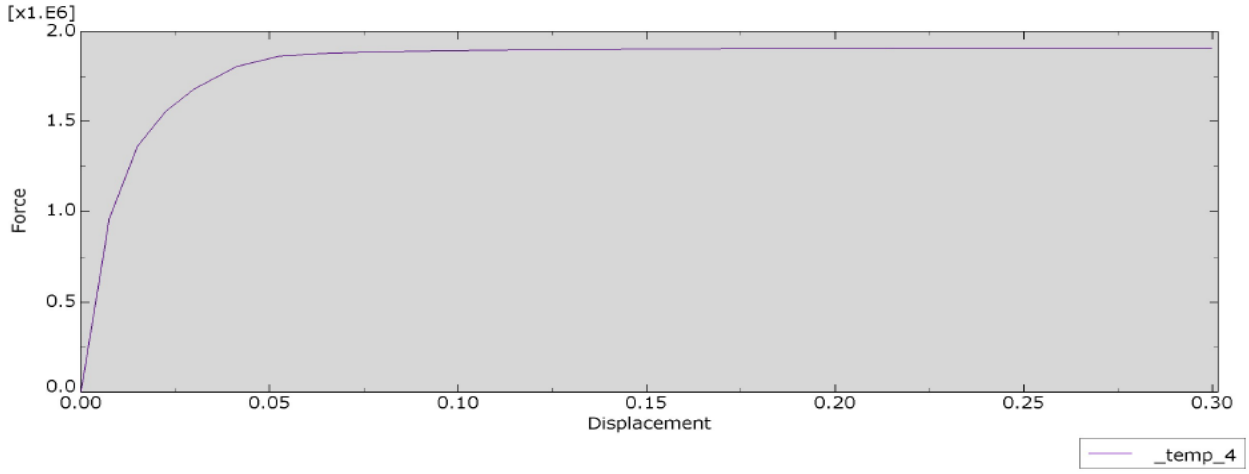
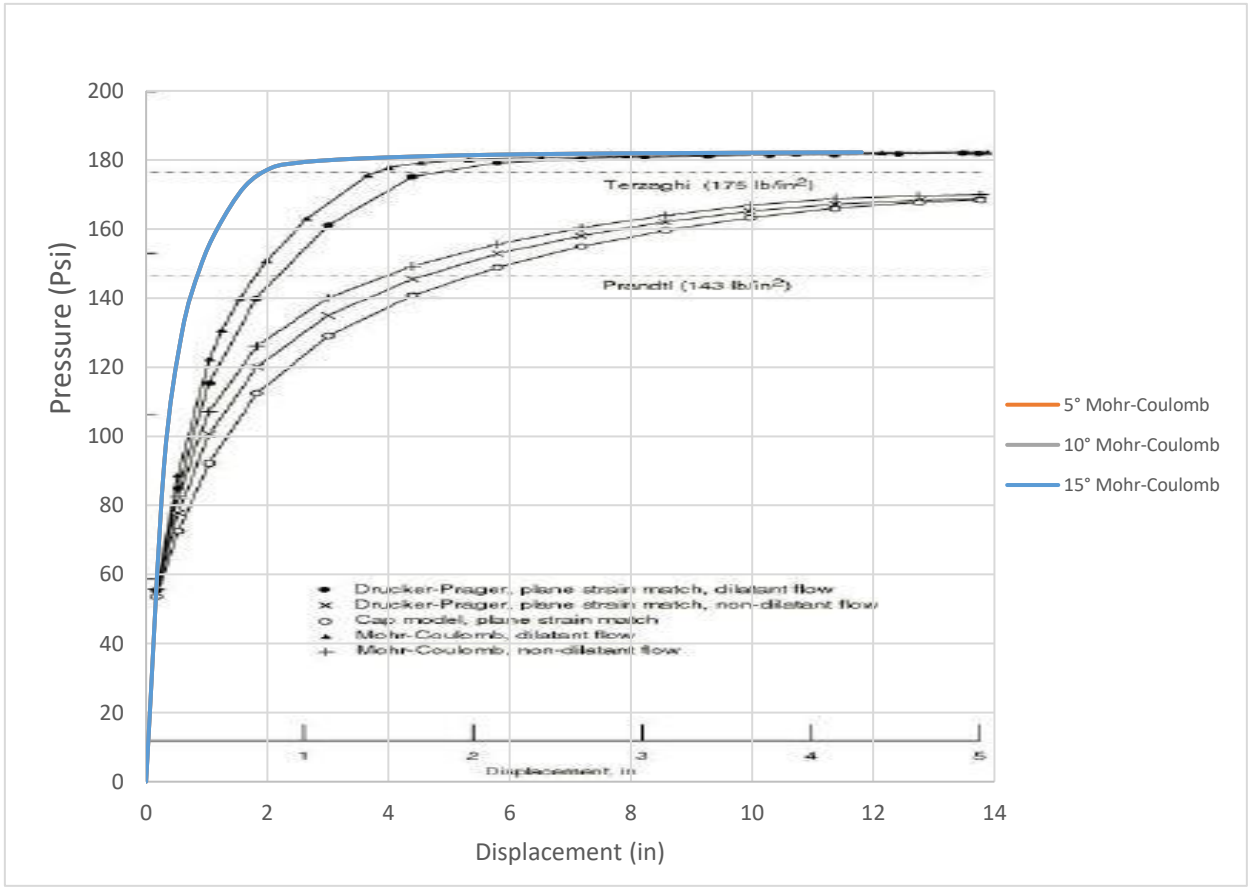


Figure 4.29. Normal stresses of unreinforced soils P, Qand R



Graph 4.18. Force against Displacement of unreinforced soils P, Q and R obtained from Abaqus model



Graph 4.19. Dilation angle variation curves of the soil P, Q and R Comparing with the one as given by Chen (1975)

SOIL S, T and U gave the same results

- **SOIL S, T and U**

Table 4.15. Soil S, T and U displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.00875	1.05E+06	690921.0526	0.344488189	100.2090057
0.0175	1.44E+06	944986.8421	0.688976378	137.0579048
0.02625	1.62E+06	1067157.895	1.033464567	154.7772081
0.035	1.74E+06	1145934.211	1.377952756	166.202676
0.04375	1.83E+06	1202611.842	1.722440945	174.4230206
0.0525	1.86E+06	1226138.158	2.066929134	177.835203
0.06125	1.88E+06	1234401.316	2.411417323	179.0336653
0.07	1.88E+06	1238572.368	2.755905512	179.6386216
0.083125	1.89E+06	1242519.737	3.272637795	180.2111355
0.102812	1.89E+06	1246480.263	4.047716535	180.7855577
0.132344	1.90E+06	1250276.316	5.210393701	181.3361252
0.161875	1.90E+06	1252611.842	6.373031496	181.6748625
0.191406	1.91E+06	1253875	7.535669291	181.8580669
0.226406	1.91E+06	1254881.579	8.913622047	182.004058
0.261406	1.91E+06	1255605.263	10.2915748	182.1090188
0.296406	1.91E+06	1256171.053	11.66952756	182.1910792
0.331406	1.91E+06	1256638.158	13.04748031	182.2588266
0.35	1.91E+06	1256822.368	13.77952756	182.2855439

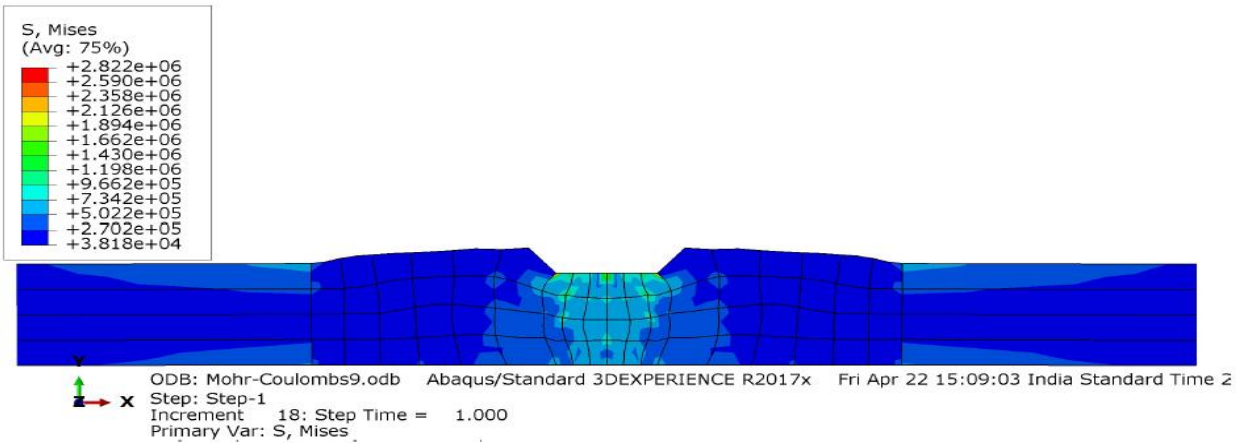


Figure 4.30. Failure mesh of unreinforced soils S, T and U

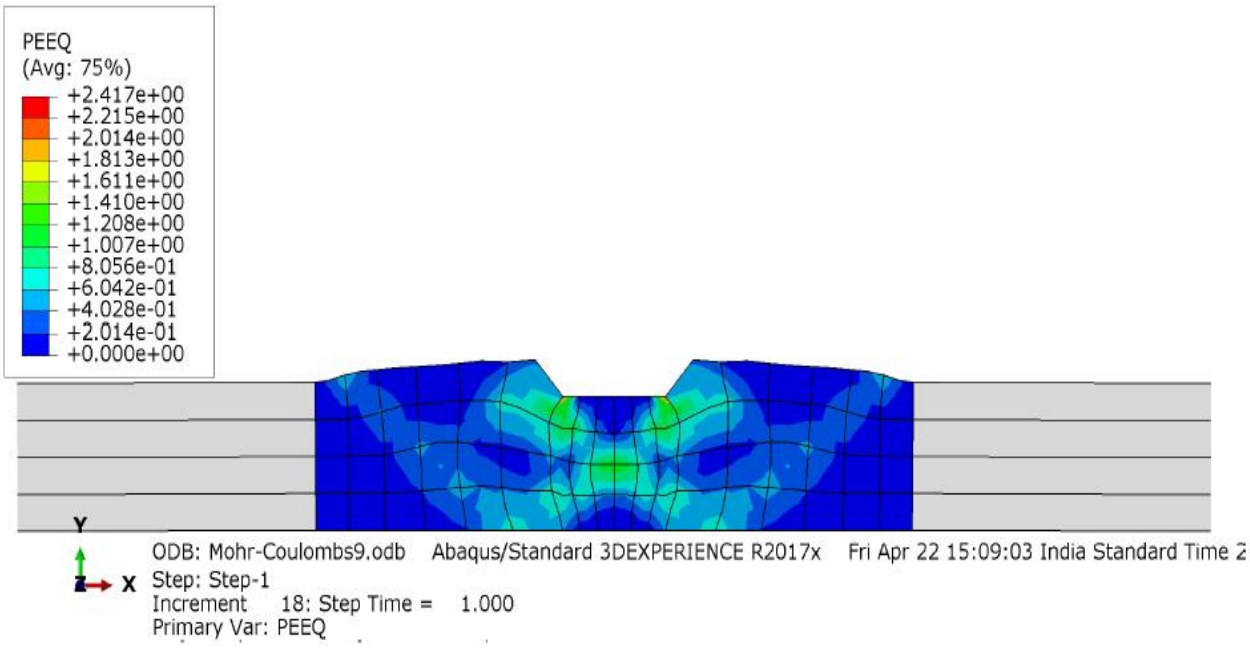
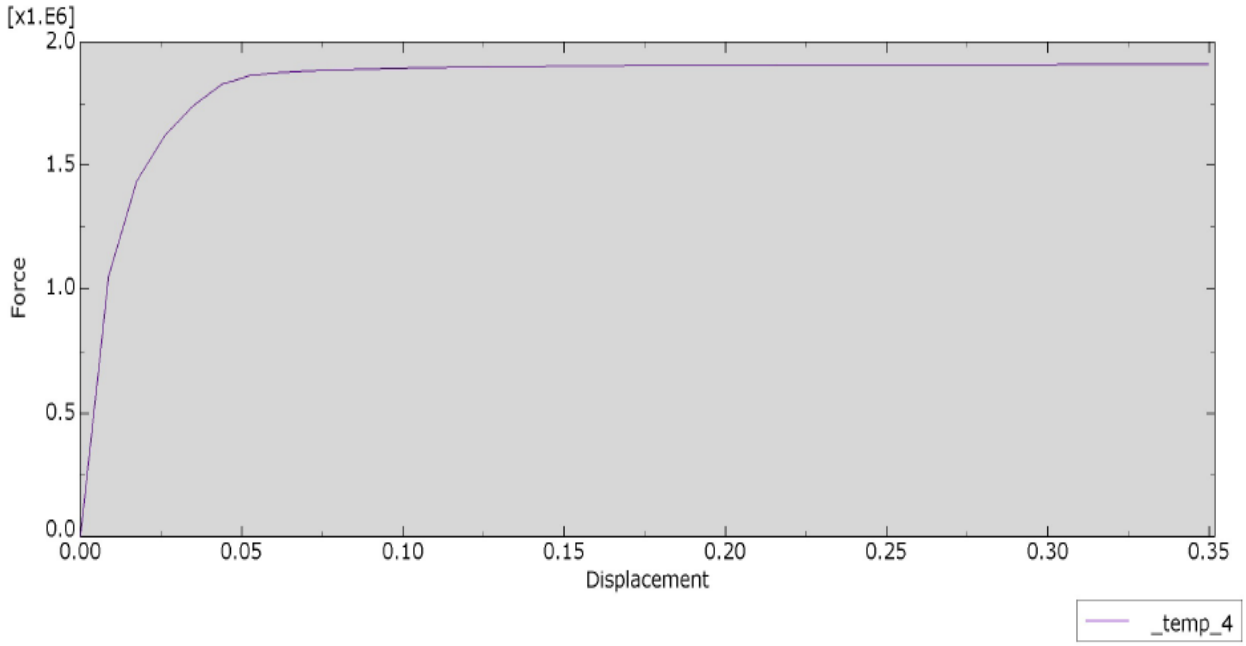
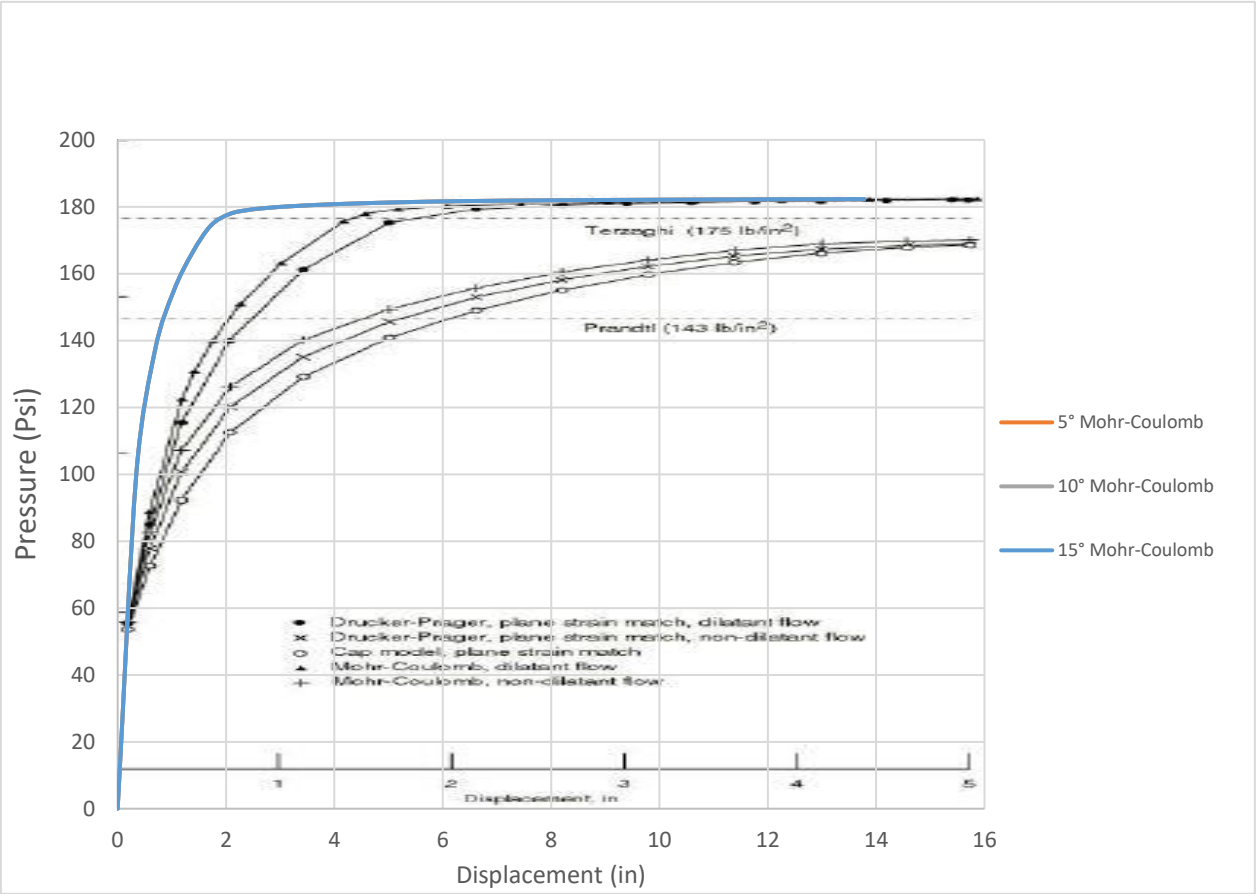


Figure 4.31. Normal stresses of unreinforced soils S, T and U



Graph 4.20. Force against Displacement of unreinforced soils S, T and U obtained from Abaqus model.



Graph 4.21. Dilation angle variation curves of the soil S, T and U Comparing with the one as given by Chen (1975).

SOIL V, W and X gave the same results

- **SOIL V, W and X**

Table 4.16. Soil V, W and X displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.01	1.13E+06	744328.9474	0.393700787	107.955118
0.02	1.50E+06	986039.4737	0.787401575	143.0120487
0.03	1.68E+06	1103210.526	1.181102362	160.0061679
0.04	1.79E+06	1179480.263	1.57480315	171.0680895
0.05	1.86E+06	1221717.105	1.968503937	177.1939875
0.06	1.87E+06	1233427.632	2.362204724	178.8924453
0.07	1.88E+06	1238434.211	2.755905512	179.6185836
0.085	1.89E+06	1242940.789	3.346456693	180.2722036

0.1075	1.90E+06	1247171.053	4.232283465	180.8857476
0.14125	1.90E+06	1251131.579	5.561023622	181.4601698
0.175	1.90E+06	1253171.053	6.88976378	181.7559686
0.20875	1.91E+06	1254190.789	8.218503937	181.9038681
0.2425	1.91E+06	1255210.526	9.547244094	182.0517675
0.27625	1.91E+06	1255822.368	10.87598425	182.1405071
0.31	1.91E+06	1256335.526	12.20472441	182.2149339
0.35	1.91E+06	1256828.947	13.77952756	182.2864981
0.39	1.91E+06	1257151.316	15.35433071	182.3332534
0.4	1.91E+06	1257276.316	15.7480315	182.351383

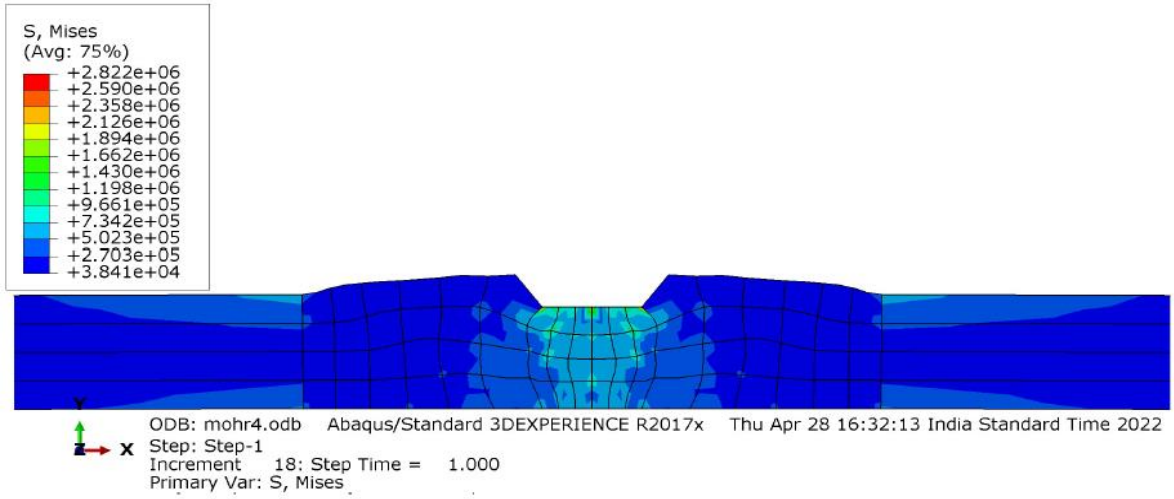


Figure 4.32. Failure mesh of unreinforced soils V, W and X

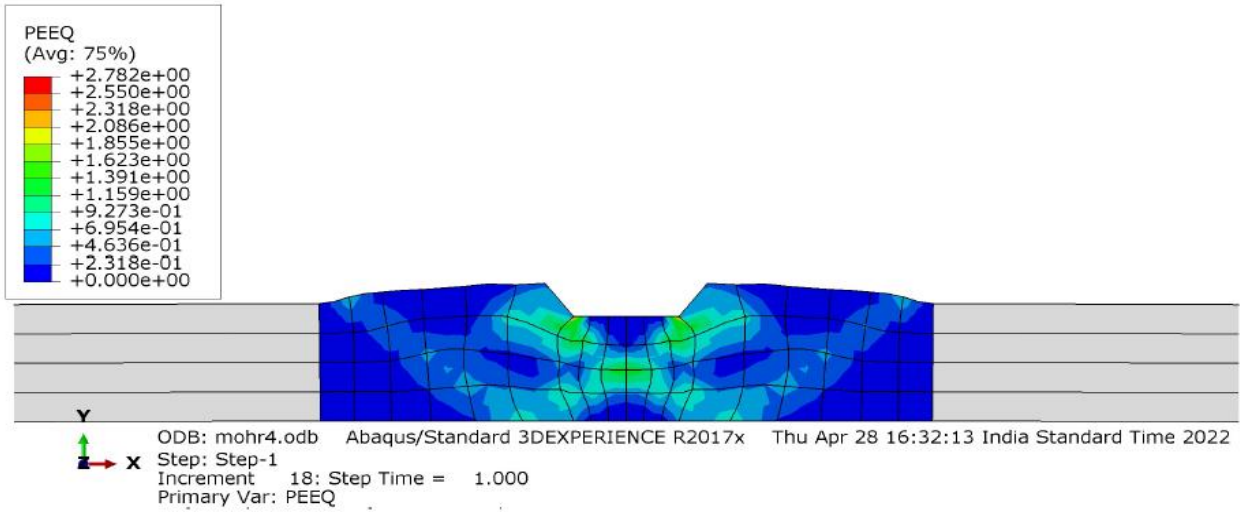
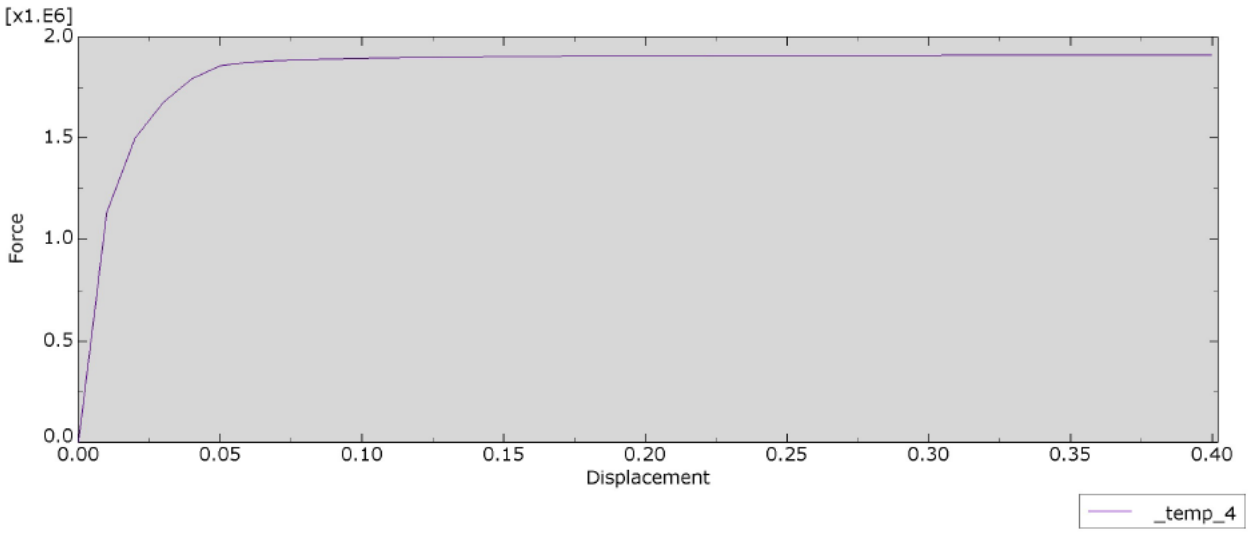
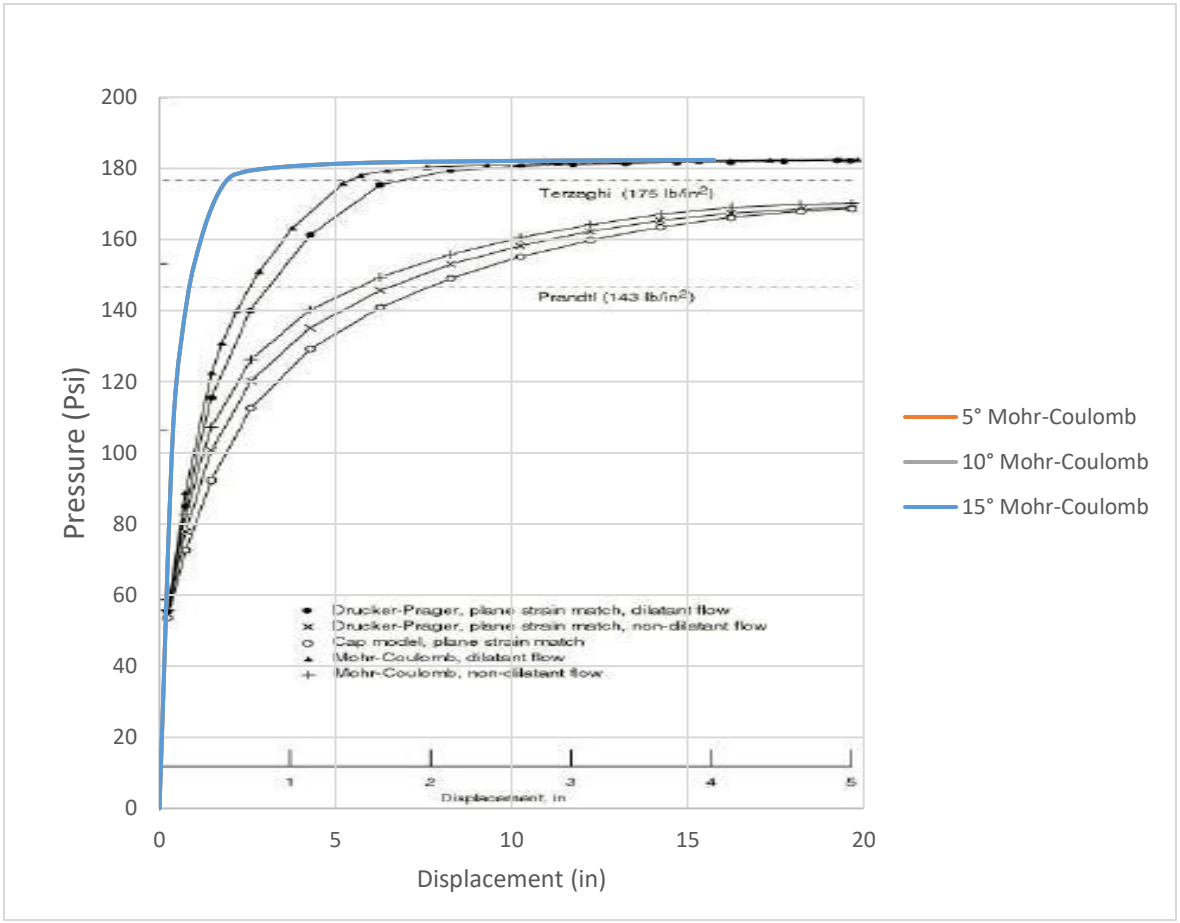


Figure 4.33. Normal stresses of unreinforced soils V, W and X



Graph 4.22. Force against Displacement of unreinforced soils V, W and X obtained from Abaqus model



Graph 4.23. Dilation angle variation curves of the soil V, W and X Comparing with the one as given by Chen (1975)

It follows that after varying the dilation angle parameter, Mohr-Coulomb graph shows no variation. All of the graphs are identical and jumbled, and they appear to be the same as the graph obtained by Chen, W. F Amsterdam, Limit Analysis and Soil Plasticity, 1975. Therefore, the dilation angle does not affect the foundation soil as the friction angle.

Considering the results found during the changing of the friction angle and dilation angle, different loads were obtained and the results were showing at the level of the mesh the failure envelope for unreinforced soil. This means as much as the load increases there will be a crack in the foundation. So, the load affecting the foundation soil.

4.4 Determination of the ideal space and numeral layers of reinforcement.

It concerns to reinforce the unreinforced soil obtained from the friction angle variation by each N value with Geotextile.

- For N = 3

➢ SOIL A

Table 4.17. Reinforced soil A displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0015625	213639	140551.9737	0.061515748	20.38521403
0.003125	428643	282001.9737	0.123031496	40.90067496
0.00546875	688847	453188.8158	0.215305118	65.72907347
0.00898437	992313	652837.5	0.353715354	94.68548761
0.0142578	1.32E+06	868486.8421	0.561330709	125.9625866
0.0195313	1.49E+06	983519.7368	0.768948819	142.6465941
0.0248047	1.54E+06	1013980.263	0.976562992	147.0644925
0.0327148	1.56E+06	1028151.316	1.287984252	149.1198172
0.0445801	1.57E+06	1033815.789	1.755122047	149.9413746
0.0564453	1.57E+06	1035809.211	2.222255906	150.2304941
0.0683105	1.58E+06	1037526.316	2.689389764	150.4795376
0.0861084	1.58E+06	1039631.579	3.390094488	150.7848783
0.111108	1.58E+06	1041388.158	4.374330709	151.039647
0.136108	1.58E+06	1042421.053	5.358582677	151.1894548
0.161108	1.59E+06	1043098.684	6.342834646	151.2877363
0.186108	1.59E+06	1043651.316	7.327086614	151.3678882
0.211108	1.59E+06	1044059.211	8.311338583	151.427048
0.236108	1.59E+06	1044361.842	9.295590551	151.4709407
0.25	1.59E+06	1044500	9.842519685	151.4909787

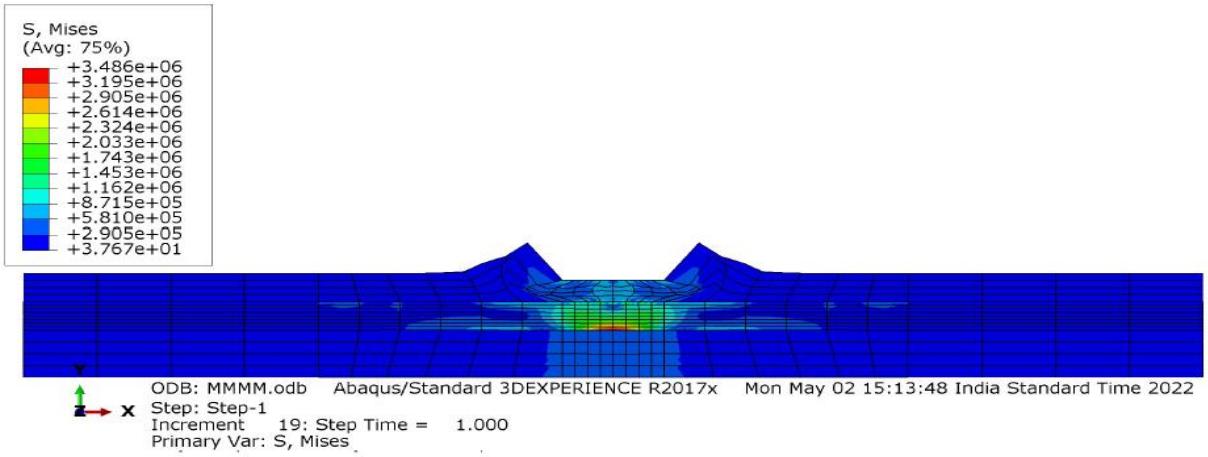


Figure 4.34. Mesh of reinforced soil A

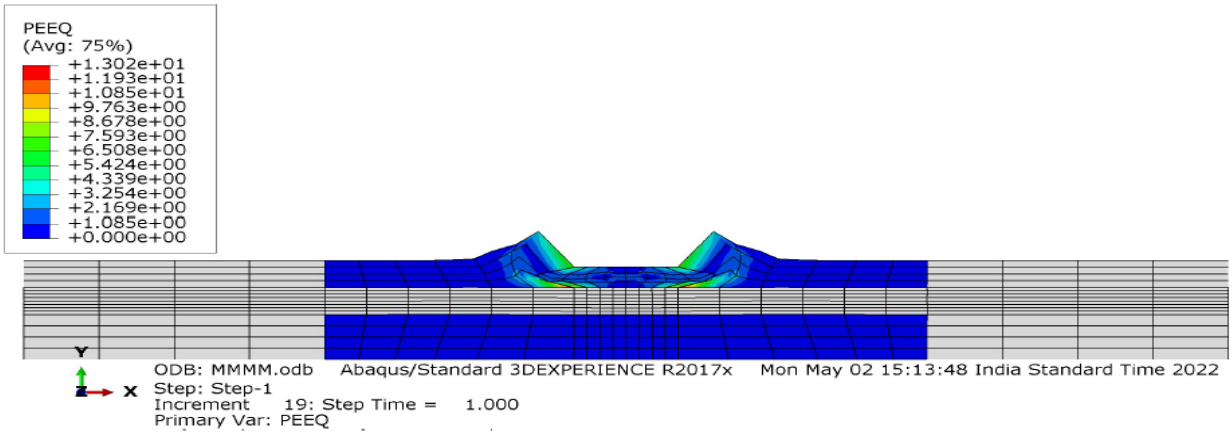
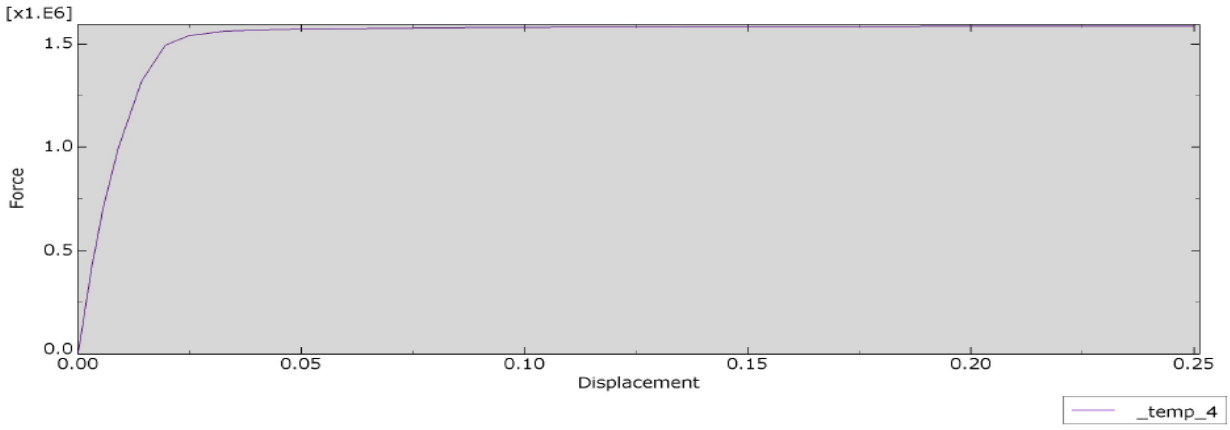


Figure 4.35. Normal stresses of reinforced soil A



Graph 4.24. Force against Displacement of reinforced soils A obtained from Abaqus model

- SOIL B

Table 4.18. Reinforced soil B displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0015625	213217	140274.3421	0.061515748	20.34494722
0.003125	431211	283691.4474	0.123031496	41.14571088
0.00546875	710272	467284.2105	0.215305118	67.77342498
0.0078125	939680	618210.5263	0.30757874	89.66330079
0.0101562	1.14E+06	752677.6316	0.399850394	109.1659847
0.0136719	1.41E+06	925322.3684	0.53826378	134.2058317
0.0171875	1.62E+06	1065697.368	0.676673228	154.565378
0.0207031	1.78E+06	1171190.789	0.815082677	169.8658104
0.0242187	1.86E+06	1222421.053	0.953492126	177.2960858
0.0259766	1.88E+06	1235046.053	1.022700787	179.1271759
0.0277344	1.89E+06	1243046.053	1.091905512	180.2874706
0.0294922	1.90E+06	1249177.632	1.161110236	181.1767755
0.03125	1.91E+06	1253769.737	1.230314961	181.8427999
0.0338867	1.91E+06	1259282.895	1.334122047	182.6424109
0.0378418	1.92E+06	1264789.474	1.489834646	183.4410677
0.0417969	1.93E+06	1269677.632	1.645547244	184.1500307
0.045752	1.94E+06	1273309.211	1.801259843	184.6767434
0.0516846	1.94E+06	1275407.895	2.034826772	184.9811299
0.0576172	1.94E+06	1277605.263	2.268393701	185.2998293
0.0635498	1.94E+06	1279210.526	2.50196063	185.5326516
0.0724487	1.95E+06	1281052.632	2.852311024	185.7998247
0.0813477	1.95E+06	1282671.053	3.202665354	186.0345554
0.0902466	1.95E+06	1284309.211	3.553015748	186.2721487
0.0935837	1.95E+06	1284592.105	3.684397638	186.3131788
0.0985893	1.95E+06	1285322.368	3.881468504	186.4190939
0.106098	1.95E+06	1286171.053	4.177086614	186.5421843
0.11736	1.96E+06	1287171.053	4.620472441	186.6872212
0.128623	1.96E+06	1288065.789	5.063897638	186.816991
0.139886	1.96E+06	1288486.842	5.507322835	186.8780591
0.148333	1.96E+06	1289118.421	5.83988189	186.9696613
0.161003	1.96E+06	1289618.421	6.338700787	187.0421798
0.165755	1.96E+06	1289927.632	6.525787402	187.0870267
0.172882	1.96E+06	1290210.526	6.806377953	187.1280568
0.183573	1.96E+06	1290638.158	7.227283465	187.1900792
0.187582	1.96E+06	1290842.105	7.38511811	187.2196591
0.193595	1.96E+06	1290986.842	7.621850394	187.2406512
0.202616	1.96E+06	1291322.368	7.977007874	187.2893149

0.216146	1.96E+06	1291690.789	8.509685039	187.3427495
0.22122	1.96E+06	1291967.105	8.709448819	187.3828255
0.228831	1.96E+06	1292013.158	9.009094488	187.3895048
0.240248	1.96E+06	1292368.421	9.458582677	187.4410311
0.242686	1.96E+06	1292467.105	9.554566929	187.4553439
0.246343	1.96E+06	1292625	9.698543307	187.4782445
0.25	1.96E+06	1292631.579	9.842519685	187.4791987

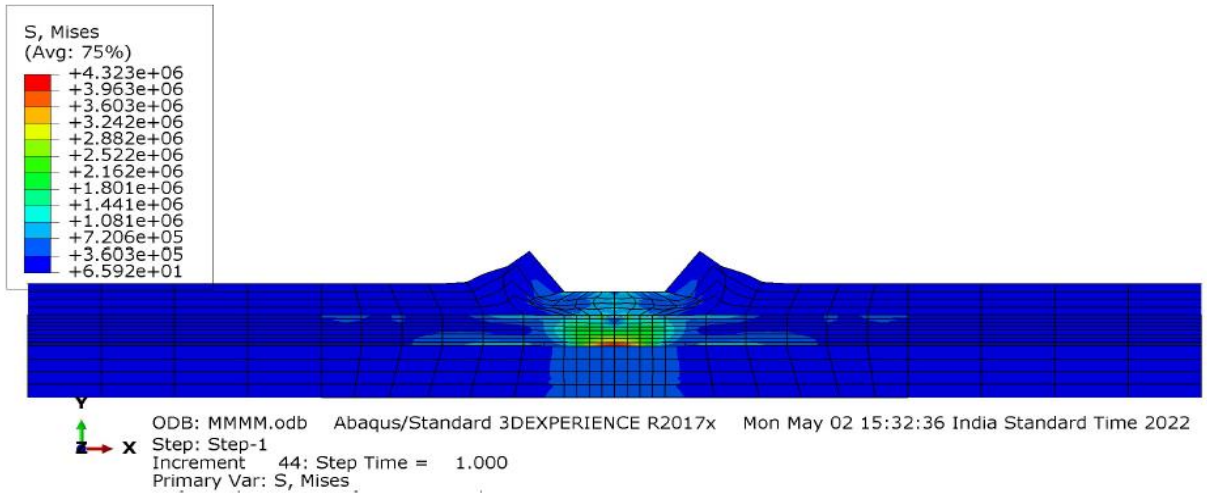


Figure 4.36. Mesh of reinforced soil B

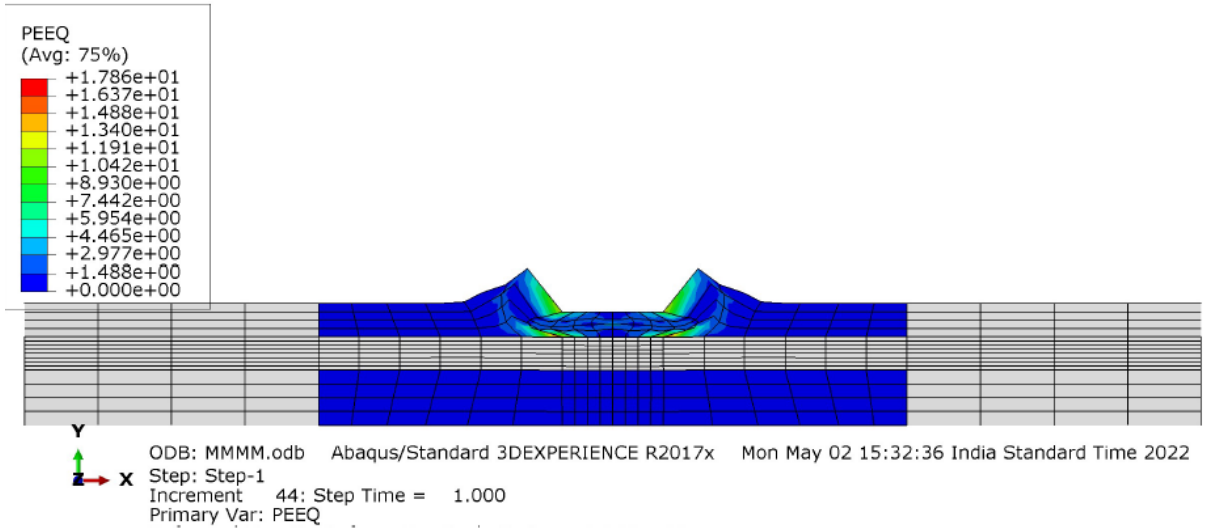
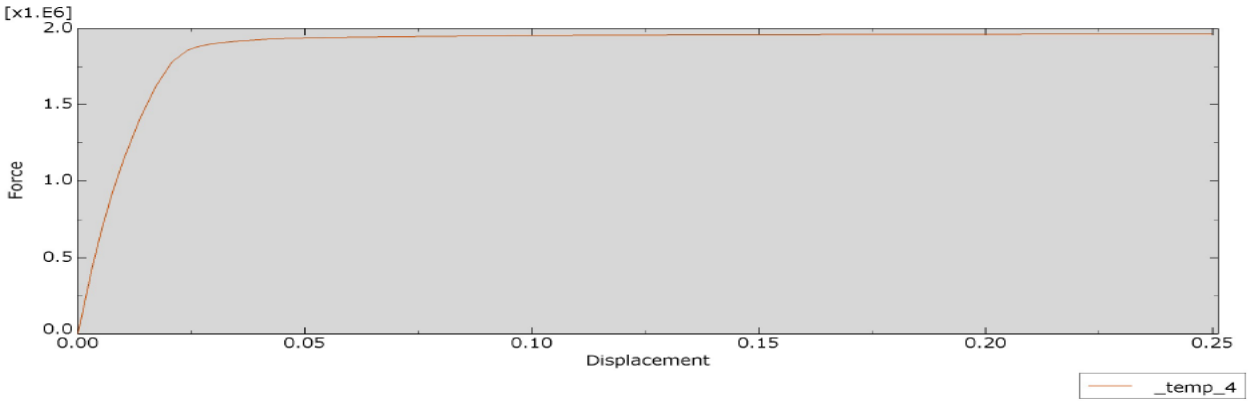


Figure 4.37. Normal stresses of reinforced soil B



Graph 4.25. Force against Displacement of reinforced soils B obtained from Abaqus model

- SOIL C

Table 4.19. Reinforced soil C displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0015625	213090	140190.7895	0.061515748	20.33282901
0.003125	431955	284180.9211	0.123031496	41.2167026
0.00546875	717713	472179.6053	0.215305118	68.48343756
0.0078125	955148	628386.8421	0.30757874	91.13924147
0.0101562	1.17E+06	767592.1053	0.399850394	111.3291329
0.0125	1.36E+06	895243.4211	0.492125984	129.8432762
0.0148437	1.53E+06	1007125	0.584397638	146.0702268
0.0171875	1.68E+06	1107019.737	0.676673228	160.5586437
0.0195313	1.82E+06	1195171.053	0.768948819	173.343832
0.021875	1.93E+06	1267756.579	0.861220472	183.8714073
0.0230469	1.97E+06	1295381.579	0.907358268	187.87805
0.0242187	2.00E+06	1315973.684	0.953492126	190.8646638
0.0253906	2.02E+06	1330717.105	0.999629921	193.003003
0.0265625	2.04E+06	1341164.474	1.045767717	194.5182563
0.0277344	2.05E+06	1348519.737	1.091905512	195.5850404
0.0289063	2.06E+06	1353361.842	1.138043307	196.2873241
0.0300781	2.06E+06	1358157.895	1.184177165	196.9829284
0.03125	2.07E+06	1361710.526	1.230314961	197.4981909
0.0330078	2.08E+06	1366953.947	1.299519685	198.2586801
0.0356445	2.09E+06	1373618.421	1.403326772	199.2252743
0.0369629	2.09E+06	1376131.579	1.455232283	199.5897748
0.0382813	2.09E+06	1378098.684	1.507137795	199.8750775
0.0402588	2.10E+06	1379690.789	1.584992126	200.1059914

0.0417419	2.10E+06	1381802.632	1.64338189	200.4122863
0.0439667	2.11E+06	1384907.895	1.730972441	200.8626639
0.0456352	2.11E+06	1387072.368	1.796661417	201.1765923
0.048138	2.11E+06	1388921.053	1.89519685	201.4447196
0.0506409	2.11E+06	1391335.526	1.99373622	201.7949072
0.0531437	2.12E+06	1393315.789	2.092271654	202.0821183
0.0543951	2.12E+06	1393986.842	2.14153937	202.1794457
0.0556465	2.12E+06	1394447.368	2.190807087	202.246239
0.0575236	2.12E+06	1394664.474	2.264708661	202.2777272
0.0603393	2.12E+06	1395842.105	2.375562992	202.4485272
0.063155	2.12E+06	1396447.368	2.486417323	202.5363126
0.0659707	2.12E+06	1397434.211	2.597271654	202.6794411
0.0701942	2.13E+06	1398578.947	2.763551181	202.8454701
0.071778	2.13E+06	1399407.895	2.825905512	202.965698
0.0741537	2.13E+06	1400039.474	2.919437008	203.0573002
0.0765294	2.13E+06	1400256.579	3.012968504	203.0887885
0.0789052	2.13E+06	1400960.526	3.106503937	203.1908868
0.0812809	2.13E+06	1401618.421	3.200035433	203.2863058
0.0836566	2.13E+06	1401565.789	3.293566929	203.2786723
0.0860323	2.13E+06	1402236.842	3.387098425	203.3759996
0.0884081	2.13E+06	1402789.474	3.480633858	203.4561515
0.0907838	2.13E+06	1402809.211	3.574165354	203.4590141
0.0943474	2.13E+06	1404019.737	3.714464567	203.634585
0.0996928	2.13E+06	1403289.474	3.924913386	203.52867
0.101697	2.13E+06	1403986.842	4.003818898	203.6298141
0.104704	2.14E+06	1404710.526	4.122204724	203.7347749
0.107711	2.14E+06	1405105.263	4.240590551	203.7920263
0.110718	2.14E+06	1405578.947	4.358976378	203.860728
0.115228	2.14E+06	1405815.789	4.536535433	203.8950788
0.116919	2.14E+06	1406427.632	4.603110236	203.9838185
0.119456	2.14E+06	1406046.053	4.702992126	203.9284755
0.123262	2.14E+06	1407552.632	4.852834646	204.1469849
0.126116	2.14E+06	1407427.632	4.96519685	204.1288553
0.130397	2.14E+06	1407335.526	5.133740157	204.1154967
0.134678	2.14E+06	1408065.789	5.302283465	204.2214117
0.138959	2.14E+06	1407723.684	5.470826772	204.1717938
0.14217	2.14E+06	1408046.053	5.597244094	204.2185491
0.146986	2.14E+06	1408776.316	5.786850394	204.3244642
0.148792	2.14E+06	1408598.684	5.857952756	204.2987011
0.151501	2.14E+06	1408763.158	5.964606299	204.3225558
0.155565	2.14E+06	1409296.053	6.124606299	204.3998452
0.161661	2.14E+06	1409394.737	6.364606299	204.414158

0.163947	2.14E+06	1409796.053	6.454606299	204.4723636
0.167375	2.14E+06	1409986.842	6.589566929	204.5000351
0.172519	2.14E+06	1410171.053	6.792086614	204.5267524
0.174447	2.14E+06	1410078.947	6.867992126	204.5133938
0.17734	2.14E+06	1410552.632	6.981889764	204.5820954
0.18168	2.14E+06	1410427.632	7.152755906	204.5639658
0.186019	2.14E+06	1410776.316	7.323582677	204.6145379
0.190359	2.14E+06	1411118.421	7.494448819	204.6641557
0.194698	2.14E+06	1411000	7.665275591	204.6469803
0.199038	2.14E+06	1411171.053	7.836141732	204.6717893
0.205547	2.15E+06	1411782.895	8.092401575	204.7605289
0.212057	2.15E+06	1411677.632	8.348700787	204.7452619
0.218566	2.15E+06	1412421.053	8.60496063	204.8530853
0.220193	2.15E+06	1412039.474	8.669015748	204.7977423
0.222634	2.15E+06	1412671.053	8.76511811	204.8893445
0.226296	2.15E+06	1412690.789	8.909291339	204.8922071
0.227669	2.15E+06	1412388.158	8.963346457	204.8483144
0.229728	2.15E+06	1412598.684	9.044409449	204.8788484
0.231788	2.15E+06	1412789.474	9.125511811	204.9065199
0.233848	2.15E+06	1412842.105	9.206614173	204.9141535
0.236937	2.15E+06	1412828.947	9.328228346	204.9122451
0.241571	2.15E+06	1412848.684	9.510669291	204.9151076
0.243309	2.15E+06	1413092.105	9.579094488	204.9504127
0.245915	2.15E+06	1412927.632	9.681692913	204.9265579
0.249825	2.15E+06	1413500	9.835629921	205.0095724
0.25	2.15E+06	1413138.158	9.842519685	204.957092

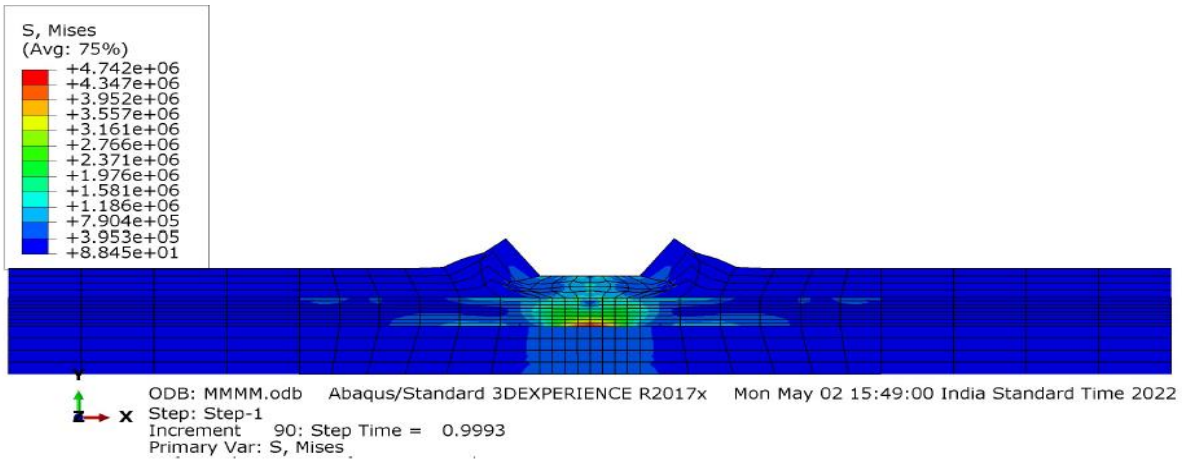


Figure 4.38. Mesh of reinforced soil C

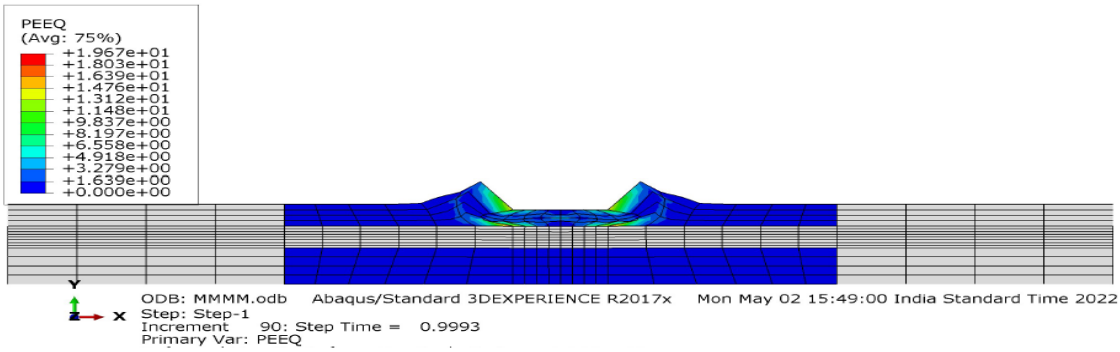
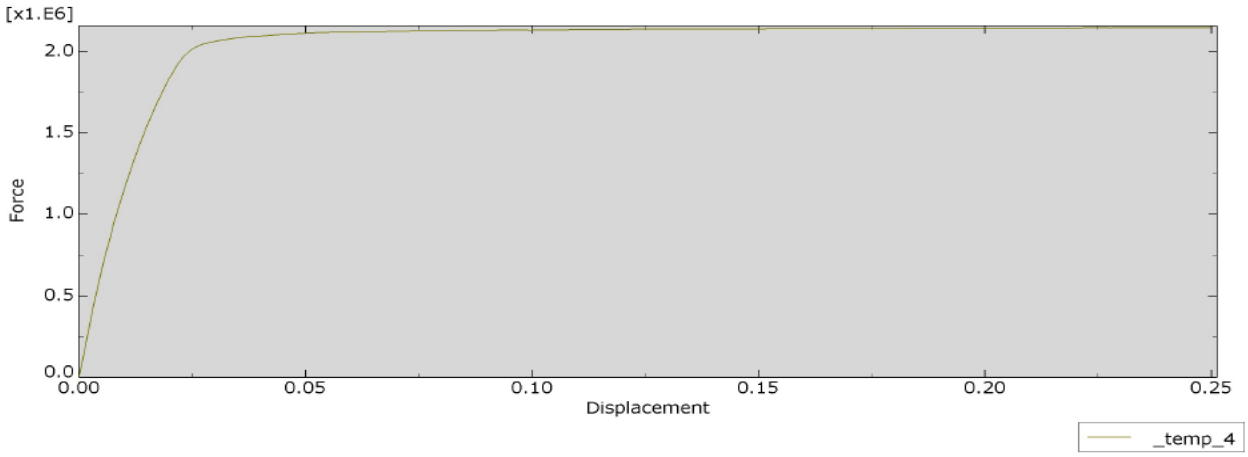
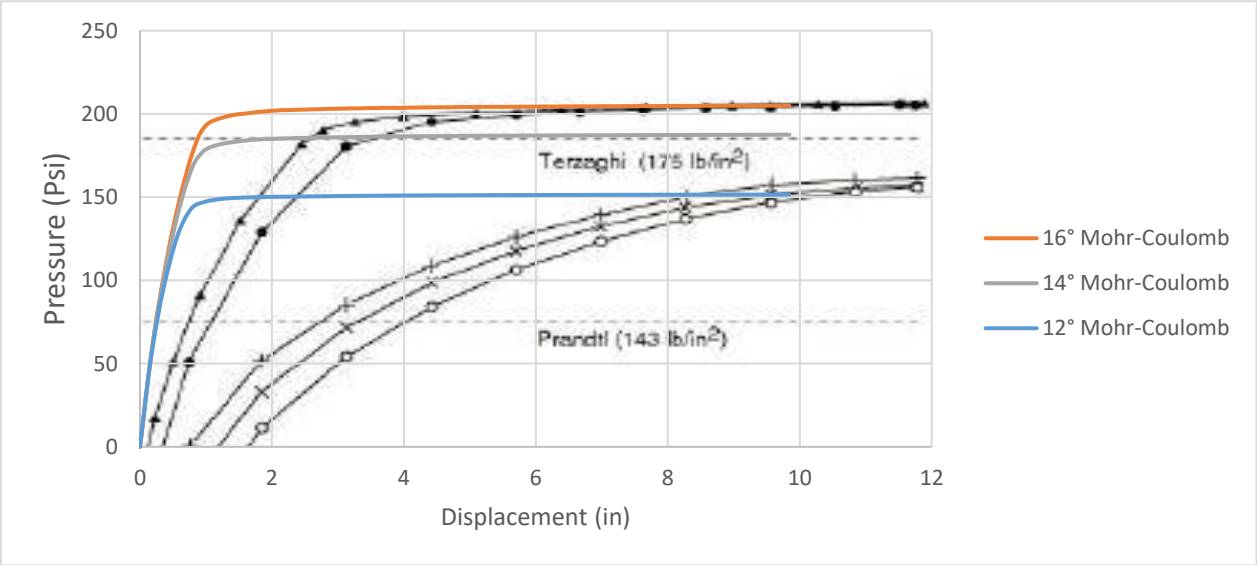


Figure 4.39. Normal stresses of reinforced soil C



Graph 4.26. Force against Displacement of reinforced soils C obtained from Abaqus model



Graph 4.27. Friction angle variation curves of the reinforced soil A, B and C Comparing with the one the one as given by Chen (1975)

➢ SOIL D

Table 4.20. Reinforced soil D displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.001875	258183	169857.2368	0.073818898	24.63555677
0.00375	506238	333051.3158	0.147637795	48.30471019
0.0065625	789885	519661.1842	0.258366142	75.37001569
0.0107812	1.12E+06	738980.2632	0.424456693	107.1793617
0.0123633	1.22E+06	805572.3684	0.486744094	116.8376702
0.0147363	1.35E+06	888967.1053	0.580169291	128.9329792
0.0182959	1.48E+06	970868.4211	0.720311024	140.8116872
0.0236353	1.54E+06	1010539.474	0.930523622	146.5654513
0.0256375	1.55E+06	1016782.895	1.009350394	147.4709774
0.0286409	1.56E+06	1023144.737	1.127594488	148.3936788
0.033146	1.56E+06	1029414.474	1.30496063	149.3030217
0.0399036	1.57E+06	1032776.316	1.571007874	149.7906126
0.05004	1.57E+06	1034888.158	1.97007874	150.0969075
0.0652447	1.58E+06	1037151.316	2.568688976	150.4251488
0.0880517	1.58E+06	1039769.737	3.466602362	150.8049163
0.118052	1.58E+06	1041677.632	4.647716535	151.0816313
0.148052	1.58E+06	1042677.632	5.828818898	151.2266682
0.178052	1.59E+06	1043453.947	7.00992126	151.3392625
0.208052	1.59E+06	1043980.263	8.191023622	151.4155977
0.238052	1.59E+06	1044355.263	9.372125984	151.4699865
0.268052	1.59E+06	1044638.158	10.55322835	151.5110167
0.298052	1.59E+06	1044868.421	11.73433071	151.5444133
0.3	1.59E+06	1044888.158	11.81102362	151.5472759

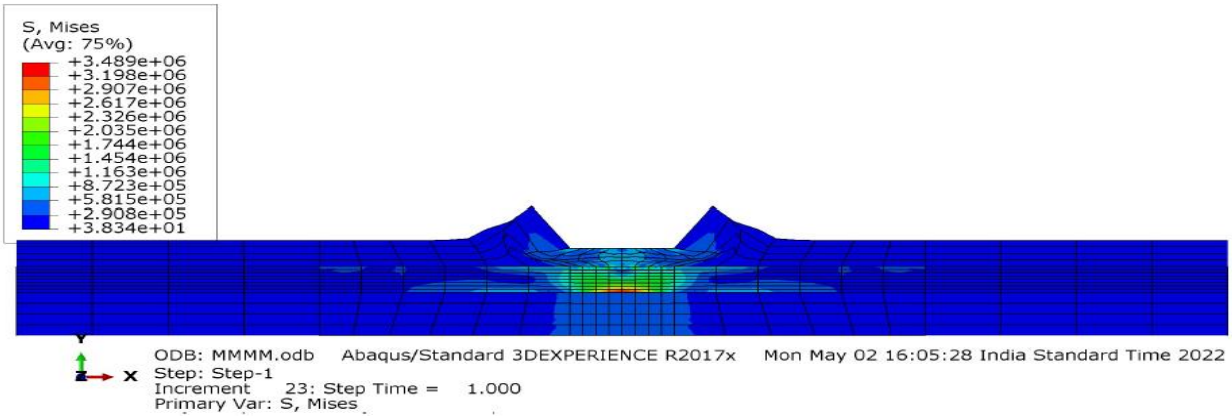


Figure 4.40. Mesh of reinforced soil D

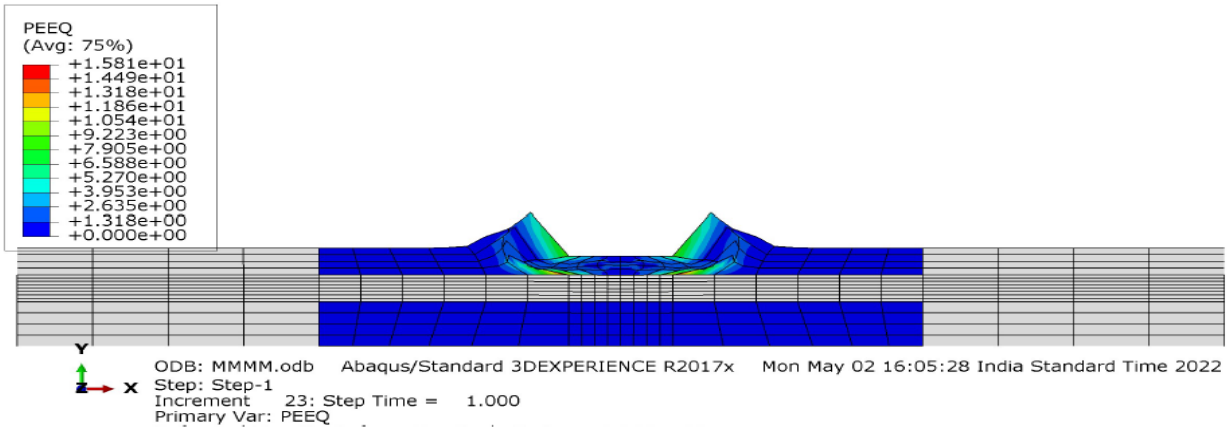
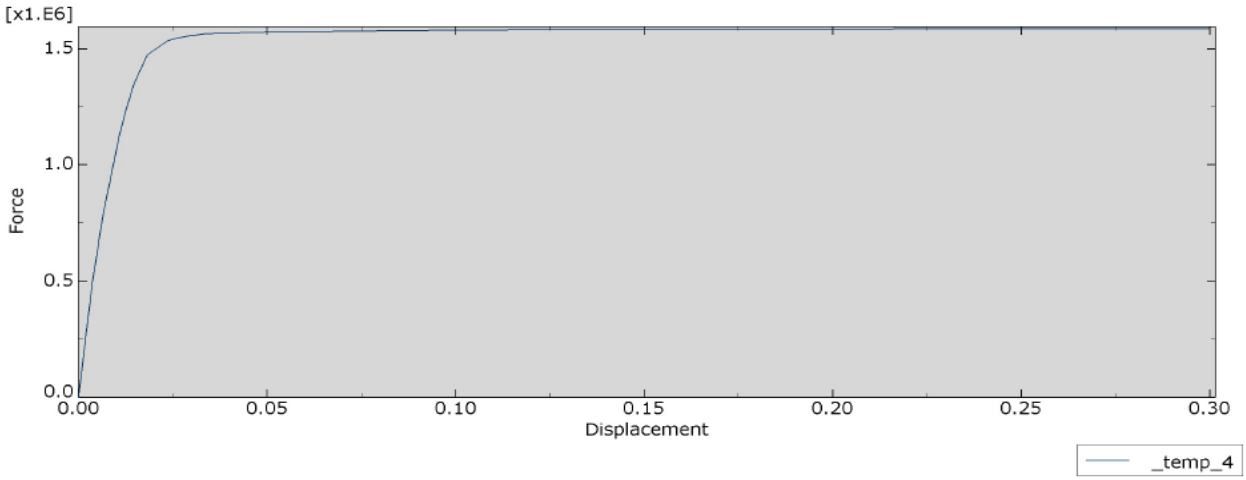


Figure 4.41. Normal stresses of reinforced soil D



Graph 4.28. Force against Displacement of reinforced soils D obtained from Abaqus model

- SOIL E

Table 4.21. Reinforced soil E displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.001875	257307	169280.9211	0.073818898	24.55196975
0.00375	512616	337247.3684	0.147637795	48.9132924
0.00445312	598701	393882.2368	0.175319685	57.12743471
0.00550781	716171	471165.1316	0.216842913	68.3363015
0.00708984	874279	575183.5526	0.279127559	83.42280452
0.00946289	1.09E+06	715131.5789	0.372554724	103.7204239
0.0130225	1.36E+06	896480.2632	0.51269685	130.0226639
0.016582	1.59E+06	1044026.316	0.652834646	151.422277

0.0201416	1.76E+06	1157611.842	0.792976378	167.8963628
0.0237012	1.85E+06	1217684.211	0.93311811	176.6090692
0.025481	1.87E+06	1232730.263	1.003188976	178.7913011
0.0272607	1.89E+06	1241296.053	1.073255906	180.0336562
0.0290405	1.90E+06	1247927.632	1.143326772	180.9954794
0.0308203	1.90E+06	1252796.053	1.213397638	181.7015798
0.03349	1.91E+06	1258592.105	1.318503937	182.542221
0.0374945	1.92E+06	1264335.526	1.476161417	183.3752286
0.041499	1.93E+06	1269368.421	1.633818898	184.1051838
0.0455035	1.94E+06	1273131.579	1.791476378	184.6509803
0.0515103	1.94E+06	1275342.105	2.027964567	184.971588
0.0575171	1.94E+06	1277592.105	2.264452756	185.2979209
0.0635239	1.94E+06	1278934.211	2.500940945	185.4925756
0.0695306	1.95E+06	1280552.632	2.737425197	185.7273063
0.0755374	1.95E+06	1281861.842	2.973913386	185.9171901
0.0845476	1.95E+06	1283519.737	3.328645669	186.1576459
0.0913052	1.95E+06	1284473.684	3.594692913	186.2960034
0.101442	1.95E+06	1285710.526	3.993779528	186.4753911
0.105243	1.95E+06	1286026.316	4.143425197	186.5211922
0.110945	1.96E+06	1286506.579	4.367913386	186.590848
0.119497	1.96E+06	1287322.368	4.704606299	186.7091675
0.132326	1.96E+06	1288210.526	5.209685039	186.8379832
0.137137	1.96E+06	1288500	5.399094488	186.8799675
0.144353	1.96E+06	1288894.737	5.683188976	186.9372189
0.155178	1.96E+06	1289447.368	6.109370079	187.0173708
0.159237	1.96E+06	1289671.053	6.269173228	187.0498133
0.165325	1.96E+06	1289914.474	6.508858268	187.0851183
0.174459	1.96E+06	1290335.526	6.868464567	187.1461864
0.188158	1.96E+06	1290848.684	7.407795276	187.2206132
0.195008	1.96E+06	1291157.895	7.677480315	187.2654602
0.201858	1.96E+06	1291276.316	7.947165354	187.2826356
0.212133	1.96E+06	1291677.632	8.351692913	187.3408412
0.215986	1.96E+06	1291750	8.503385827	187.3513372
0.221765	1.96E+06	1291782.895	8.730905512	187.3561082
0.230434	1.96E+06	1292269.737	9.072204724	187.4267182
0.243438	1.96E+06	1292453.947	9.584173228	187.4534355
0.246689	1.96E+06	1292546.053	9.712165354	187.4667942
0.24994	1.96E+06	1292690.789	9.84015748	187.4877864
0.254817	1.96E+06	1292756.579	10.03216535	187.4973283
0.262132	1.97E+06	1292986.842	10.32015748	187.5307249
0.264875	1.97E+06	1292927.632	10.42814961	187.5221372
0.268989	1.97E+06	1293177.632	10.59011811	187.5583964

0.275161	1.97E+06	1293250	10.83311024	187.5688925
0.284419	1.97E+06	1293440.789	11.19759843	187.596564
0.298305	1.97E+06	1293657.895	11.74429134	187.6280523
0.3	1.97E+06	1293756.579	11.81102362	187.6423651

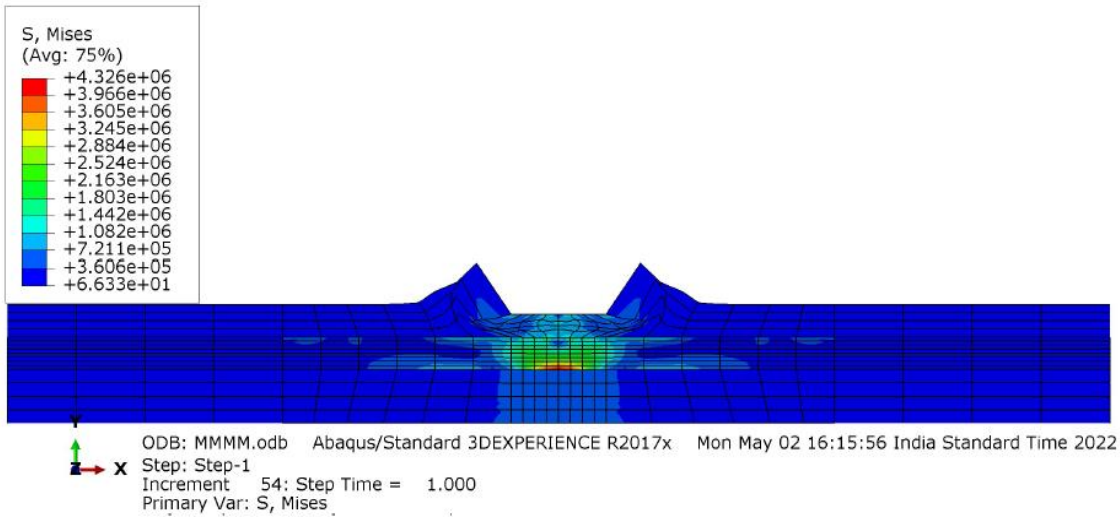


Figure 4.42. Mesh of reinforced soil E

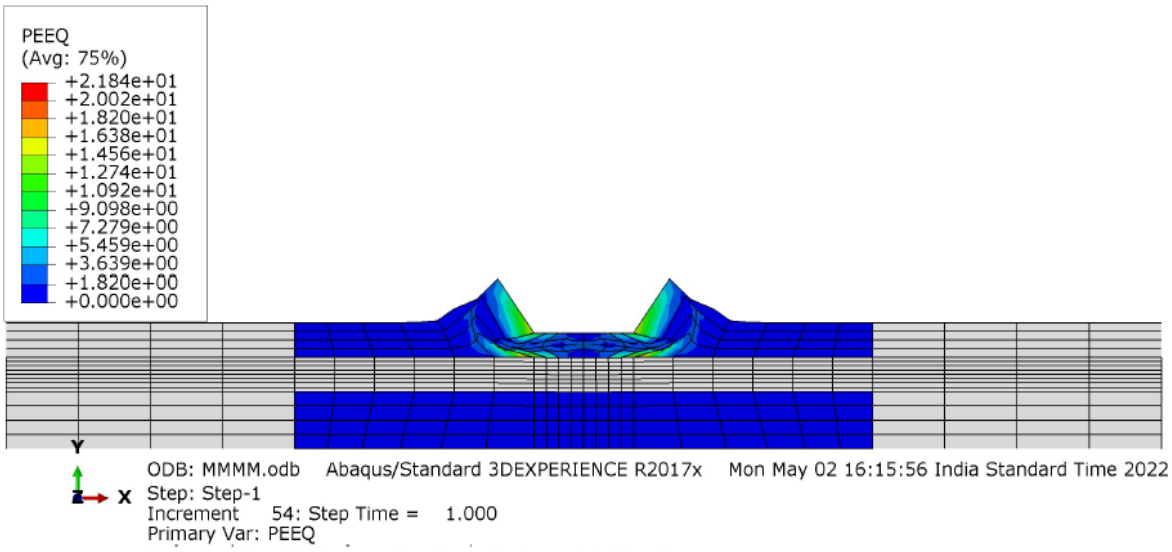
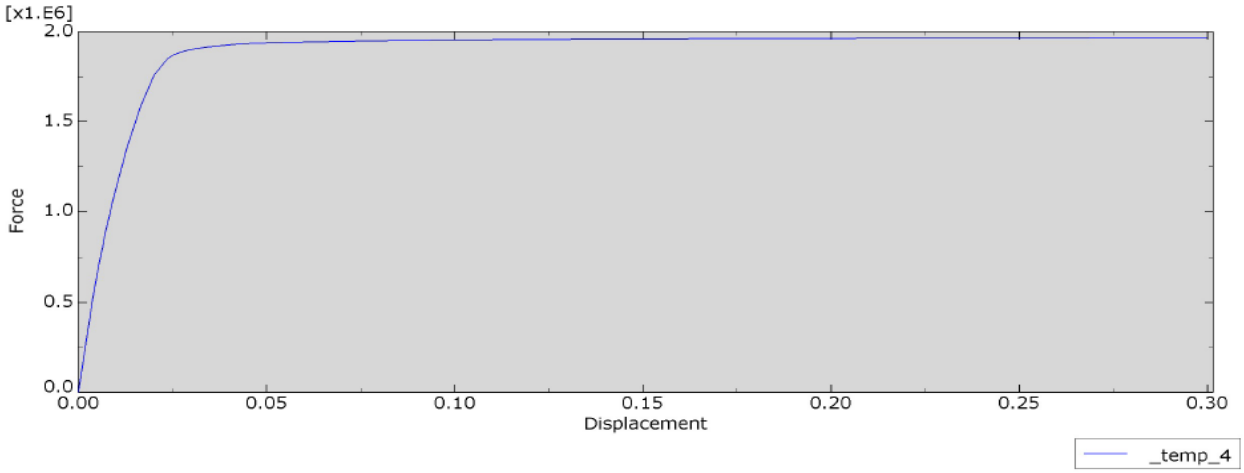


Figure 4.43. Normal stresses of reinforced soil E



Graph 4.29. Force against Displacement of reinforced soils E obtained from Abaqus model

- SOIL F

Table 4.22. Reinforced soil F displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.001875	257098	169143.4211	0.073818898	24.53202719
0.00375	514190	338282.8947	0.147637795	49.06348186
0.00445312	602332	396271.0526	0.175319685	57.473901
0.00550781	722854	475561.8421	0.216842913	68.9739865
0.00708984	885783	582751.9737	0.279127559	84.52050439
0.00946289	1.11E+06	726980.2632	0.372554724	105.4389196
0.0118359	1.31E+06	859092.1053	0.465980315	124.6000037
0.014209	1.48E+06	974947.3684	0.559409449	141.4032849
0.016582	1.64E+06	1078144.737	0.652834646	156.370705
0.0189551	1.78E+06	1169210.526	0.74626378	169.5785993
0.0213281	1.89E+06	1245328.947	0.839688976	180.6185745
0.0225146	1.94E+06	1275190.789	0.886401575	184.9496417
0.0237012	1.97E+06	1297493.421	0.93311811	188.1843449
0.0248877	2.00E+06	1313506.579	0.979830709	190.5068427
0.0260742	2.01E+06	1324743.421	1.026543307	192.1365987
0.0272607	2.03E+06	1332552.632	1.073255906	193.269222
0.0284473	2.03E+06	1337822.368	1.119972441	194.0335279
0.0296338	2.04E+06	1342440.789	1.166685039	194.7033691
0.0308203	2.05E+06	1346559.211	1.213397638	195.3006919
0.0326001	2.05E+06	1351118.421	1.283468504	195.9619454

0.0352698	2.06E+06	1358197.368	1.388574803	196.9886535
0.037272	2.07E+06	1360750	1.467401575	197.3588792
0.0392743	2.07E+06	1364092.105	1.546232283	197.8436075
0.0412766	2.08E+06	1366480.263	1.625062992	198.1899784
0.0442799	2.08E+06	1370552.632	1.74330315	198.7806219
0.0465325	2.09E+06	1373210.526	1.831988189	199.1661145
0.0499113	2.09E+06	1376197.368	1.965011811	199.5993166
0.0516007	2.09E+06	1377309.211	2.031523622	199.7605747
0.0532901	2.09E+06	1377723.684	2.098035433	199.8206887
0.0549795	2.10E+06	1378697.368	2.164547244	199.9619087
0.0566689	2.10E+06	1379414.474	2.231059055	200.0659154
0.059203	2.10E+06	1380289.474	2.330826772	200.1928227
0.0630042	2.10E+06	1381565.789	2.480480315	200.3779355
0.0658551	2.10E+06	1382322.368	2.592720472	200.4876673
0.0701314	2.10E+06	1382960.526	2.76107874	200.5802237
0.0765458	2.11E+06	1385019.737	3.013614173	200.8788851
0.0797531	2.11E+06	1385348.684	3.139885827	200.9265946
0.0829603	2.11E+06	1386217.105	3.266153543	201.0525476
0.0861675	2.11E+06	1386401.316	3.39242126	201.0792649
0.0909784	2.11E+06	1387822.368	3.581826772	201.2853699
0.0927824	2.11E+06	1387434.211	3.652850394	201.2290727
0.0954885	2.11E+06	1388677.632	3.759389764	201.4094146
0.0995477	2.11E+06	1389085.526	3.919200787	201.4685743
0.105636	2.11E+06	1389539.474	4.158897638	201.5344134
0.111725	2.11E+06	1389868.421	4.398622047	201.5821229
0.114769	2.11E+06	1390440.789	4.518464567	201.6651374
0.117814	2.11E+06	1390855.263	4.638346457	201.7252514
0.12238	2.11E+06	1391177.632	4.818110236	201.7720067
0.126947	2.11E+06	1391381.579	4.997913386	201.8015866
0.131513	2.12E+06	1391763.158	5.177677165	201.8569296
0.138363	2.12E+06	1392342.105	5.447362205	201.9408983
0.140932	2.12E+06	1392447.368	5.548503937	201.9561653
0.144785	2.12E+06	1392855.263	5.70019685	202.0153251
0.150565	2.12E+06	1393269.737	5.927755906	202.075439
0.152732	2.12E+06	1393197.368	6.013070866	202.0649429
0.155983	2.12E+06	1393361.842	6.141062992	202.0887977
0.160859	2.12E+06	1393815.789	6.333031496	202.1546368
0.164517	2.12E+06	1393809.211	6.477047244	202.1536826
0.170003	2.12E+06	1394342.105	6.693031496	202.2309719
0.175489	2.12E+06	1394421.053	6.909015748	202.2424222
0.180975	2.12E+06	1394848.684	7.125	202.3044445
0.186461	2.12E+06	1394953.947	7.340984252	202.3197116

0.191947	2.12E+06	1395328.947	7.556968504	202.3741004
0.197433	2.12E+06	1395519.737	7.772952756	202.4017719
0.202919	2.12E+06	1395710.526	7.988937008	202.4294434
0.208405	2.12E+06	1395953.947	8.20492126	202.4647484
0.213891	2.12E+06	1396144.737	8.420905512	202.4924199
0.219377	2.12E+06	1396375	8.636889764	202.5258166
0.224863	2.12E+06	1396565.789	8.852874016	202.5534881
0.230349	2.12E+06	1396644.737	9.068858268	202.5649383
0.235835	2.12E+06	1397046.053	9.28484252	202.6231439
0.237893	2.12E+06	1397026.316	9.365866142	202.6202813
0.240978	2.12E+06	1397256.579	9.487322835	202.653678
0.245607	2.12E+06	1397368.421	9.669566929	202.6698992
0.249079	2.12E+06	1397375	9.806259843	202.6708534
0.254286	2.12E+06	1397506.579	10.01125984	202.6899372
0.262098	2.12E+06	1397769.737	10.3188189	202.7281048
0.265027	2.12E+06	1397789.474	10.43413386	202.7309673
0.269421	2.12E+06	1397881.579	10.60712598	202.744326
0.276011	2.13E+06	1398210.526	10.8665748	202.7920355
0.278483	2.13E+06	1398125	10.96389764	202.779631
0.28219	2.13E+06	1398184.211	11.10984252	202.7882187
0.28358	2.13E+06	1398381.579	11.16456693	202.8168444
0.285666	2.13E+06	1398256.579	11.24669291	202.7987148
0.288794	2.13E+06	1398335.526	11.36984252	202.8101651
0.293486	2.13E+06	1398651.316	11.55456693	202.8559662
0.295114	2.13E+06	1398539.474	11.61866142	202.839745
0.297557	2.13E+06	1398789.474	11.71484252	202.8760042
0.3	2.13E+06	1398598.684	11.81102362	202.8483327

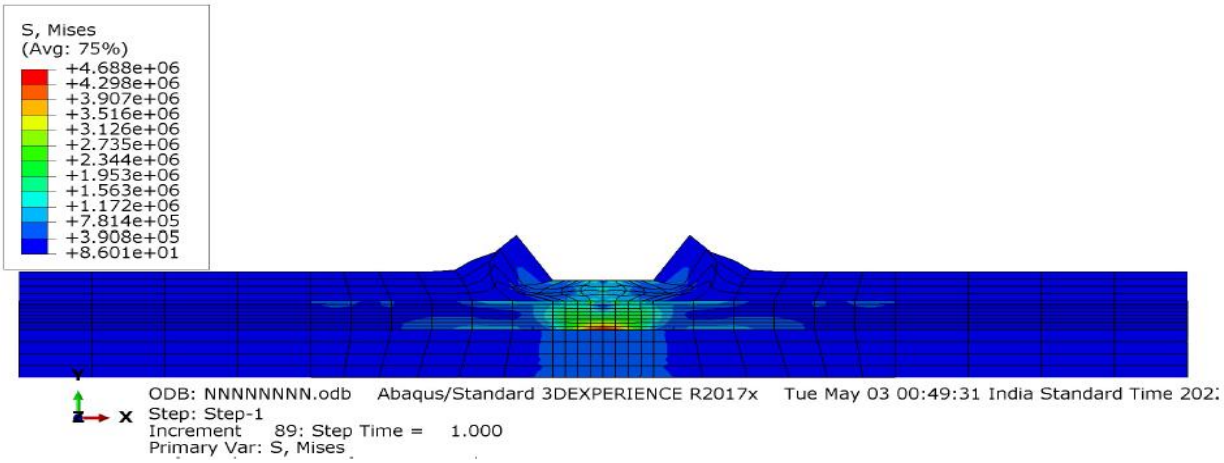


Figure 4.44. Mesh of reinforced soil F

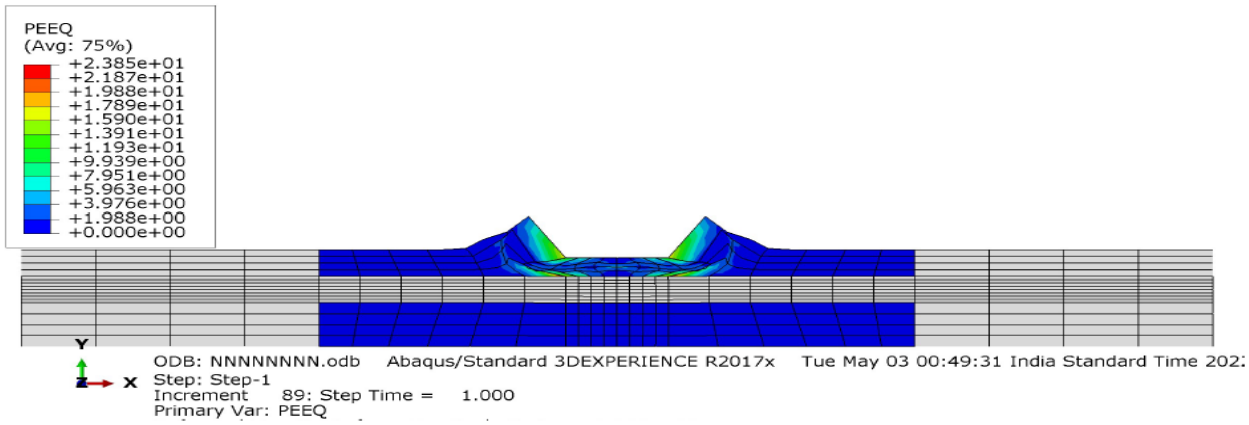
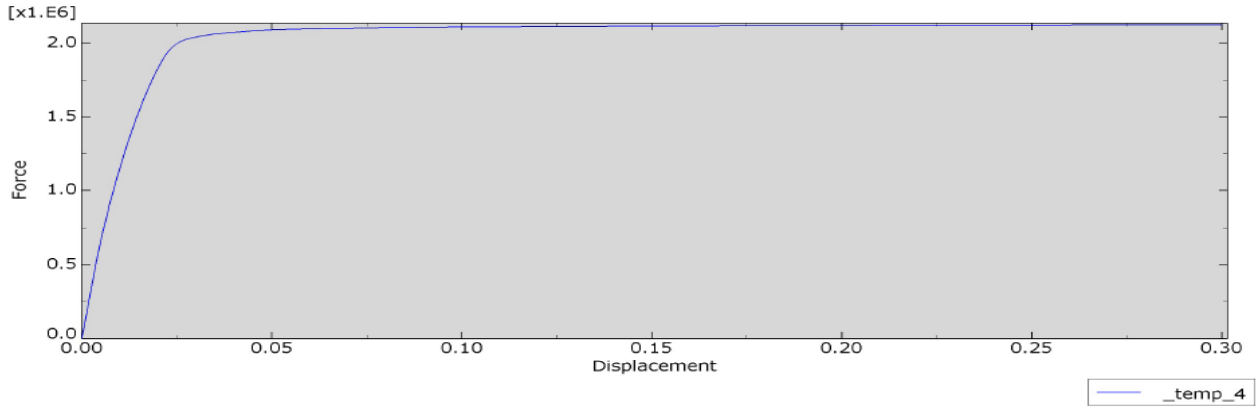
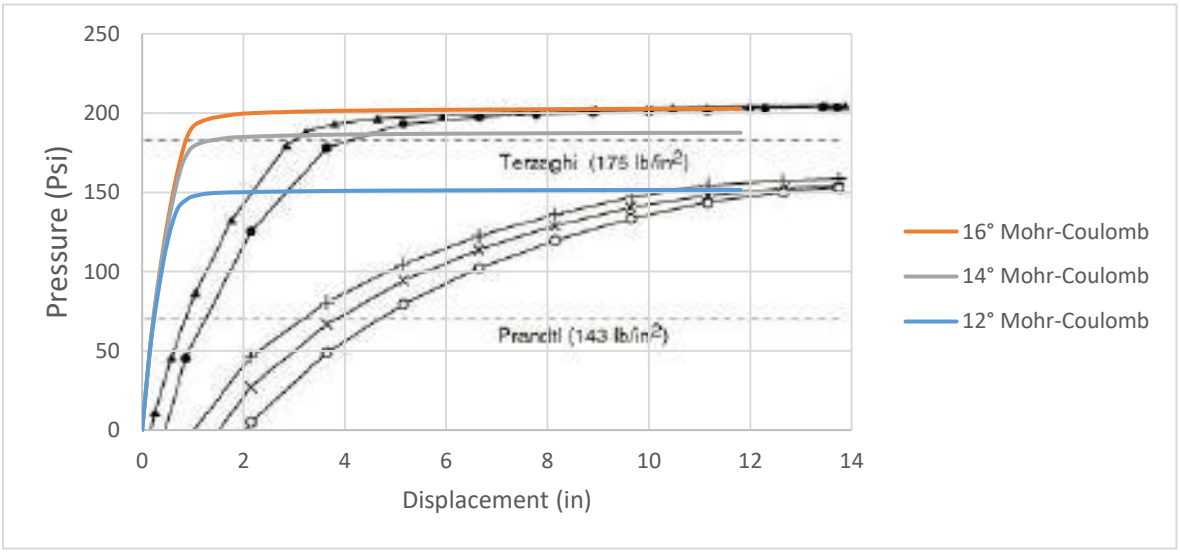


Figure 4.45. Normal stresses of reinforced soil F



Graph 4.30. Force against Displacement of reinforced soils F obtained from Abaqus model



Graph 4.31. Friction angle variation curves of the reinforced soil D, E and F Comparing with the one as given by Chen (1975)

- SOIL G

Table 4.23. Reinforced soil G displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	302998	199340.7895	0.086122047	28.91175806
0.004375	576880	379526.3158	0.172244094	55.04529729
0.00765625	884546	581938.1579	0.301427165	84.40247112
0.0125781	1.23E+06	810638.1579	0.495200787	117.5723963
0.0144238	1.33E+06	877460.5263	0.567866142	127.2641014
0.0171924	1.45E+06	950901.3158	0.676866142	137.9157214
0.0213452	1.52E+06	1000473.684	0.840362205	145.105541
0.0275745	1.55E+06	1020526.316	1.085610236	148.0139113
0.0369183	1.57E+06	1031401.316	1.453476378	149.591187
0.0509341	1.57E+06	1034921.053	2.005279528	150.1016785
0.0561901	1.57E+06	1035750	2.212208661	150.2219064
0.064074	1.58E+06	1036921.053	2.522598425	150.3917521
0.0758998	1.58E+06	1038552.632	2.988181102	150.6283912
0.0936386	1.58E+06	1040289.474	3.686559055	150.8802973
0.120247	1.58E+06	1041828.947	4.734133858	151.1035777
0.155247	1.59E+06	1042875	6.112086614	151.2552938
0.190247	1.59E+06	1043677.632	7.49003937	151.371705
0.225247	1.59E+06	1044197.368	8.867992126	151.447086
0.260247	1.59E+06	1044559.211	10.24594488	151.4995664
0.295247	1.59E+06	1044835.526	11.62389764	151.5396424
0.330247	1.59E+06	1045059.211	13.00185039	151.5720848
0.35	1.59E+06	1045171.053	13.77952756	151.5883061

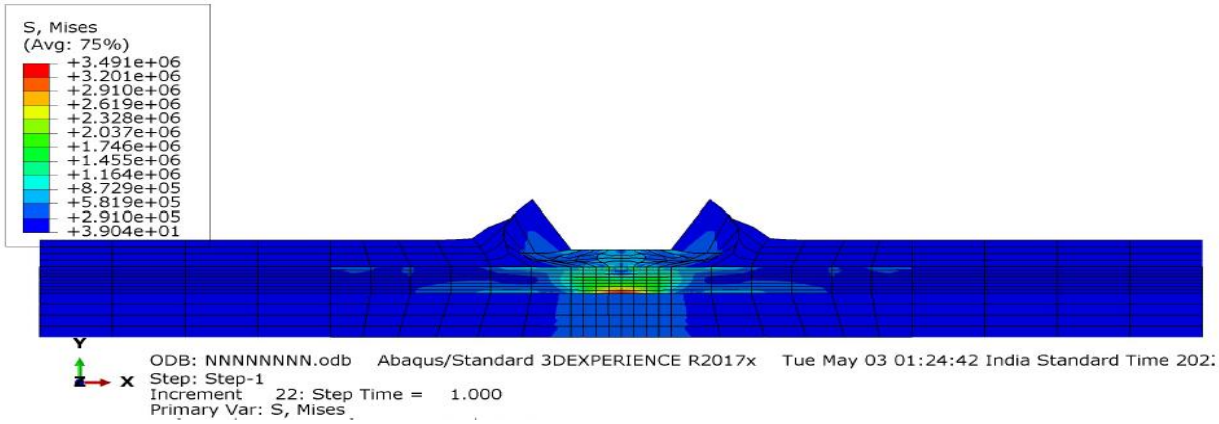


Figure 4.46. Mesh of reinforced soil G

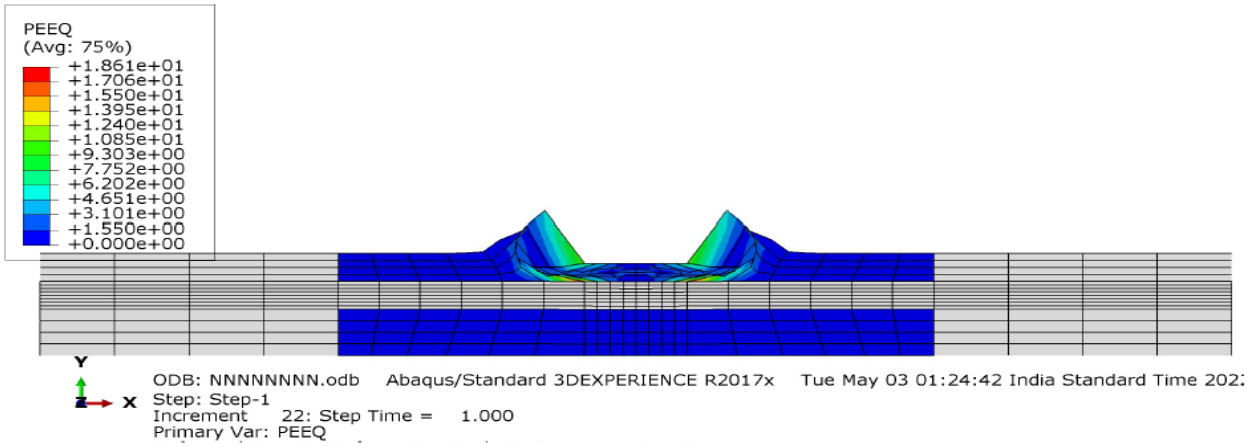
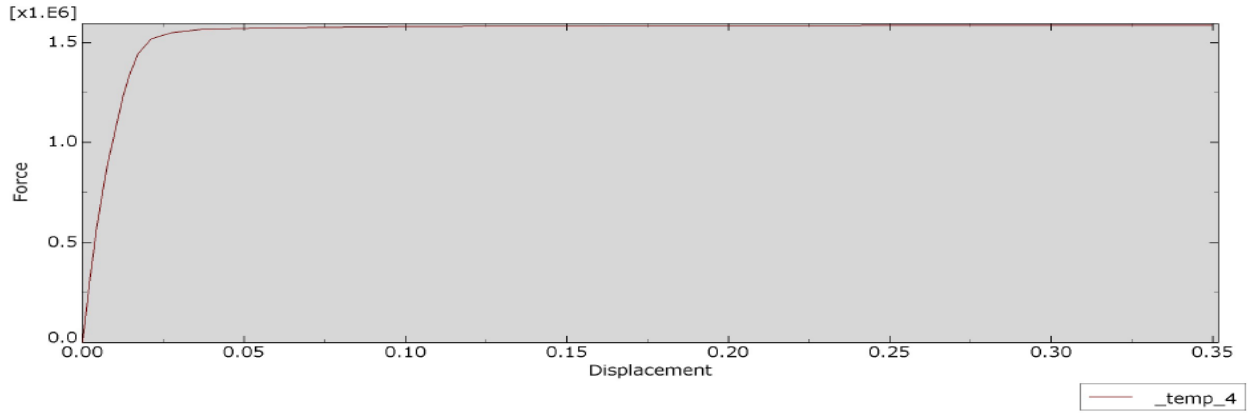


Figure 4.47. Normal stresses of reinforced soil G



Graph 4.31. Force against Displacement of reinforced soils G obtained from Abaqus model

- SOIL H

Table 4.24. Reinforced soil H displacement, load and pressure values via Abaqus model..

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	302381	198934.8684	0.086122047	28.85288455
0.004375	588540	387197.3684	0.172244094	56.15788252
0.00765625	923891	607823.0263	0.301427165	88.15673063
0.0109375	1.21E+06	793243.4211	0.430610236	115.0495186
0.0142188	1.44E+06	948611.8421	0.559795276	137.5836634
0.0175	1.64E+06	1076473.684	0.688976378	156.1283408
0.0207813	1.78E+06	1173138.158	0.818161417	170.1482506
0.0240625	1.86E+06	1221375	0.94734252	177.1443697

0.0273438	1.89E+06	1241098.684	1.076527559	180.0050305
0.030625	1.90E+06	1251098.684	1.205708661	181.4553989
0.0339063	1.91E+06	1259019.737	1.334893701	182.6042433
0.0371875	1.92E+06	1264190.789	1.464074803	183.3542364
0.0421094	1.93E+06	1269657.895	1.657850394	184.1471681
0.0470312	1.94E+06	1273611.842	1.851622047	184.7206361
0.0519531	1.94E+06	1275565.789	2.045397638	185.0040305
0.056875	1.94E+06	1277342.105	2.239173228	185.2616617
0.0617969	1.94E+06	1278684.211	2.432948819	185.4563164
0.0691797	1.95E+06	1280539.474	2.723610236	185.7253979
0.0802539	1.95E+06	1282710.526	3.159602362	186.0402805
0.0913281	1.95E+06	1284223.684	3.595594488	186.2597442
0.102402	1.95E+06	1285723.684	4.031574803	186.4772994
0.113477	1.96E+06	1286651.316	4.467598425	186.6118402
0.124551	1.96E+06	1287611.842	4.903582677	186.7511519
0.135625	1.96E+06	1288151.316	5.339566929	186.8293955
0.146699	1.96E+06	1289019.737	5.775551181	186.9553485
0.163311	1.96E+06	1289559.211	6.429566929	187.0335921
0.16954	1.96E+06	1290125	6.67480315	187.1156524
0.178884	1.96E+06	1290342.105	7.042677165	187.1471406
0.192899	1.96E+06	1291032.895	7.594448819	187.2473306
0.198155	1.96E+06	1291085.526	7.801377953	187.2549641
0.206039	1.96E+06	1291480.263	8.111771654	187.3122155
0.217865	1.96E+06	1291671.053	8.577362205	187.339887
0.226735	1.96E+06	1292092.105	8.926574803	187.4009551
0.240039	1.96E+06	1292440.789	9.450354331	187.4515272
0.253343	1.96E+06	1292651.316	9.974133858	187.4820612
0.259995	1.97E+06	1292921.053	10.23602362	187.521183
0.269973	1.97E+06	1293125	10.62885827	187.5507629
0.279951	1.97E+06	1293375	11.02169291	187.5870221
0.289929	1.97E+06	1293565.789	11.41452756	187.6146936
0.293671	1.97E+06	1293592.105	11.56185039	187.6185104
0.299283	1.97E+06	1293631.579	11.78279528	187.6242355
0.307702	1.97E+06	1293894.737	12.11425197	187.6624031
0.310859	1.97E+06	1293894.737	12.23854331	187.6624031
0.315595	1.97E+06	1293993.421	12.425	187.6767159
0.322699	1.97E+06	1294039.474	12.70468504	187.6833953
0.333354	1.97E+06	1294243.421	13.12417323	187.7129751
0.344009	1.97E+06	1294421.053	13.54366142	187.7387383
0.35	1.97E+06	1294513.158	13.77952756	187.7520969

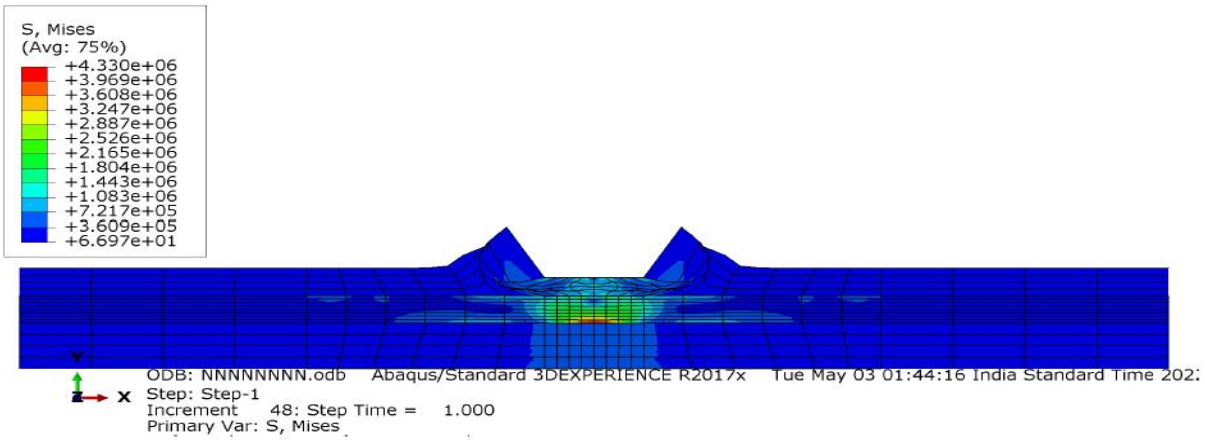


Figure 4.48. Mesh of reinforced soil H

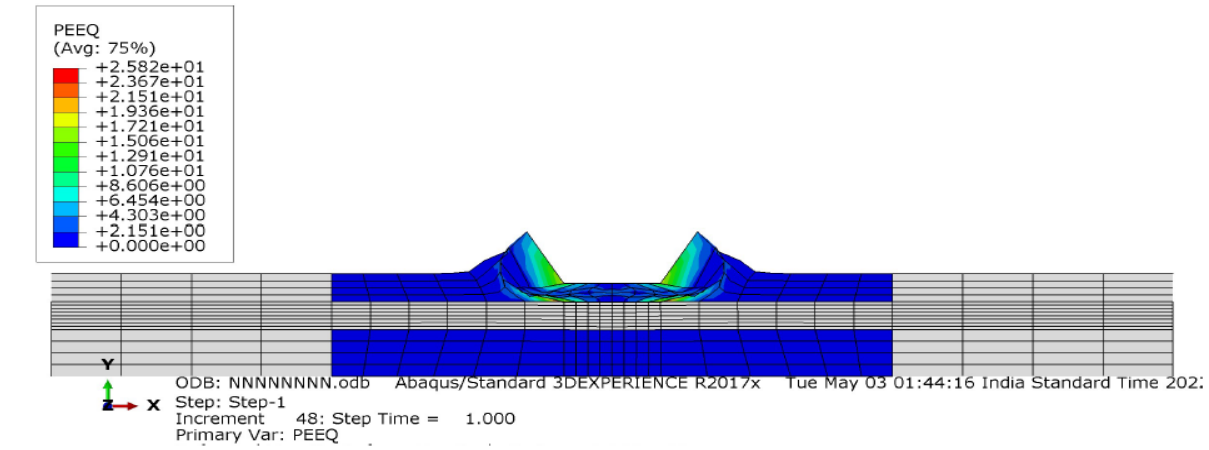
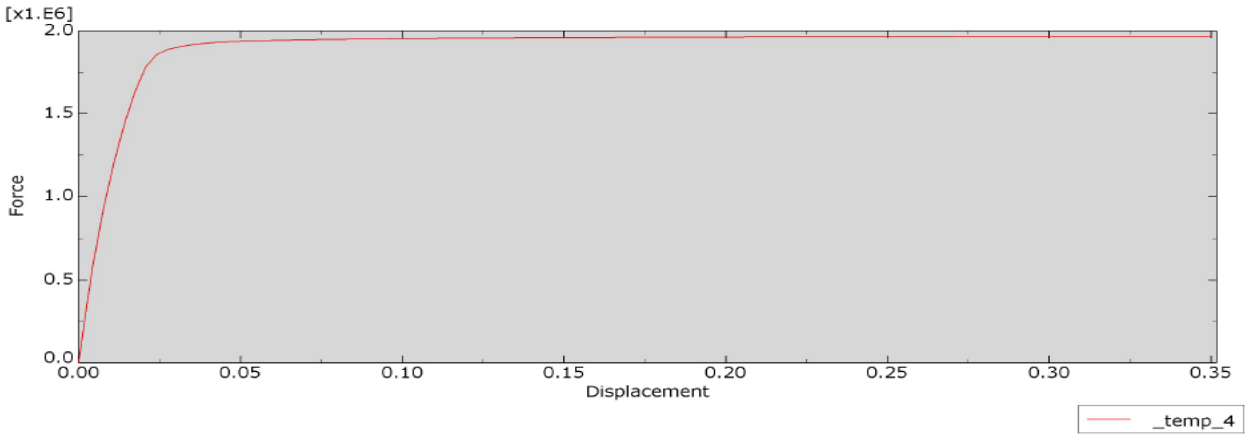


Figure 4.49. Normal stresses of reinforced soil H



Graph 4.32. Force against Displacement of reinforced soils H obtained from Abaqus model

- SOIL I

Table 4.25. Reinforced soil I displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	302084	198739.4737	0.086122047	28.82454512
0.004375	592083	389528.2895	0.172244094	56.49595195
0.0065625	831468	547018.4211	0.258366142	79.33782286
0.00875	1.04E+06	684644.7368	0.344488189	99.29870871
0.0109375	1.23E+06	809664.4737	0.430610236	117.4311762
0.0142188	1.48E+06	974190.7895	0.559795276	141.293553
0.0175	1.69E+06	1113098.684	0.688976378	161.4403151
0.0207813	1.87E+06	1227078.947	0.818161417	177.9716522
0.0240625	1.97E+06	1298105.263	0.94734252	188.2730845
0.0248828	1.99E+06	1310322.368	0.979637795	190.0450149
0.0257031	2.01E+06	1319592.105	1.011933071	191.3894682
0.0265234	2.02E+06	1327315.789	1.044228346	192.5096869
0.0273438	2.02E+06	1331914.474	1.076527559	193.1766656
0.0281641	2.03E+06	1336263.158	1.108822835	193.807385
0.0289844	2.04E+06	1339782.895	1.14111811	194.3178765
0.0302148	2.04E+06	1344282.895	1.189559055	194.9705423
0.0320605	2.05E+06	1350815.789	1.262224409	195.9180527
0.0334448	2.06E+06	1354532.895	1.316724409	196.4571699
0.0355212	2.06E+06	1357769.737	1.398472441	196.9266312
0.0375977	2.07E+06	1361710.526	1.480224409	197.4981909
0.0396741	2.07E+06	1364059.211	1.561972441	197.8388366
0.0427887	2.08E+06	1369013.158	1.684594488	198.5573415
0.0451247	2.09E+06	1372000	1.776562992	198.9905436
0.0486286	2.09E+06	1375184.211	1.914511811	199.4523714
0.0521326	2.09E+06	1377559.211	2.052464567	199.7968339
0.0538845	2.09E+06	1377901.316	2.121437008	199.8464518
0.0556365	2.10E+06	1378973.684	2.190413386	200.0019847
0.0573885	2.10E+06	1379697.368	2.259389764	200.1069456
0.0600165	2.10E+06	1380559.211	2.362854331	200.2319444
0.0639584	2.10E+06	1381868.421	2.518047244	200.4218282
0.0669149	2.10E+06	1381947.368	2.634444882	200.4332785
0.0713496	2.10E+06	1383282.895	2.80903937	200.626979
0.0757842	2.10E+06	1384644.737	2.983629921	200.8244963
0.0802189	2.11E+06	1385848.684	3.158224409	200.999113
0.0835449	2.11E+06	1385861.842	3.289169291	201.0010214
0.0860395	2.11E+06	1386828.947	3.38738189	201.1412873
0.088534	2.11E+06	1386907.895	3.485590551	201.1527375

0.0910285	2.11E+06	1387447.368	3.583799213	201.2309811
0.093523	2.11E+06	1387690.789	3.682007874	201.2662861
0.0972648	2.11E+06	1388388.158	3.829322835	201.3674302
0.101007	2.11E+06	1388960.526	3.976653543	201.4504447
0.104748	2.11E+06	1389052.632	4.123937008	201.4638034
0.110361	2.11E+06	1389638.158	4.34492126	201.5487263
0.112466	2.11E+06	1390046.053	4.427795276	201.607886
0.115623	2.11E+06	1390434.211	4.552086614	201.6641832
0.120359	2.11E+06	1390835.526	4.738543307	201.7223888
0.127462	2.12E+06	1391572.368	5.018188976	201.8292581
0.138117	2.12E+06	1392032.895	5.437677165	201.8960513
0.142113	2.12E+06	1392980.263	5.595	202.0334547
0.148107	2.12E+06	1393388.158	5.830984252	202.0926144
0.1541	2.12E+06	1393000	6.066929134	202.0363172
0.160094	2.12E+06	1393236.842	6.302913386	202.0706681
0.162341	2.12E+06	1394072.368	6.391377953	202.1918502
0.165713	2.12E+06	1393447.368	6.524133858	202.1012021
0.17077	2.12E+06	1394578.947	6.723228346	202.2653228
0.175827	2.12E+06	1394822.368	6.922322835	202.3006278
0.180884	2.12E+06	1394552.632	7.121417323	202.261506
0.184677	2.12E+06	1395197.368	7.270748031	202.3550166
0.190366	2.12E+06	1394993.421	7.494724409	202.3254367
0.196055	2.12E+06	1395282.895	7.718700787	202.3674211
0.201745	2.12E+06	1395763.158	7.942716535	202.4370769
0.207434	2.12E+06	1395927.632	8.166692913	202.4609317
0.213123	2.12E+06	1396125	8.390669291	202.4895573
0.218812	2.12E+06	1396348.684	8.614645669	202.5219998
0.224501	2.12E+06	1396552.632	8.838622047	202.5515797
0.230191	2.12E+06	1396717.105	9.062637795	202.5754344
0.23588	2.12E+06	1396914.474	9.286614173	202.6040601
0.241569	2.12E+06	1397111.842	9.510590551	202.6326858
0.247258	2.12E+06	1397269.737	9.734566929	202.6555864
0.252948	2.12E+06	1397453.947	9.958582677	202.6823037
0.258637	2.12E+06	1397625	10.18255906	202.7071126
0.264326	2.12E+06	1397815.789	10.40653543	202.7347841
0.270015	2.12E+06	1397914.474	10.63051181	202.749097
0.271438	2.13E+06	1398032.895	10.68653543	202.7662724
0.273571	2.13E+06	1398210.526	10.77051181	202.7920355
0.276771	2.13E+06	1398328.947	10.89649606	202.8092109
0.281572	2.13E+06	1398355.263	11.08551181	202.8130277
0.283372	2.13E+06	1398289.474	11.15637795	202.8034858
0.286072	2.13E+06	1398473.684	11.26267717	202.8302031

0.287084	2.13E+06	1398361.842	11.30251969	202.8139819
0.288603	2.13E+06	1398407.895	11.36232283	202.8206612
0.290881	2.13E+06	1398592.105	11.45200787	202.8473785
0.294299	2.13E+06	1398460.526	11.5865748	202.8282947
0.299425	2.13E+06	1398526.316	11.78838583	202.8378366
0.307114	2.13E+06	1398868.421	12.09110236	202.8874545
0.309036	2.13E+06	1399105.263	12.16677165	202.9218053
0.310959	2.13E+06	1398828.947	12.24248031	202.8817293
0.313842	2.13E+06	1399269.737	12.35598425	202.94566
0.318167	2.13E+06	1399309.211	12.52625984	202.9513852
0.324655	2.13E+06	1399164.474	12.78169291	202.930393
0.327088	2.13E+06	1399447.368	12.87748031	202.9714232
0.330737	2.13E+06	1399539.474	13.02114173	202.9847818
0.336211	2.13E+06	1399500	13.23665354	202.9790567
0.338264	2.13E+06	1399421.053	13.31748031	202.9676064
0.341343	2.13E+06	1399789.474	13.43870079	203.021041
0.345962	2.13E+06	1399401.316	13.62055118	202.9647438
0.35	2.13E+06	1400138.158	13.77952756	203.0716131

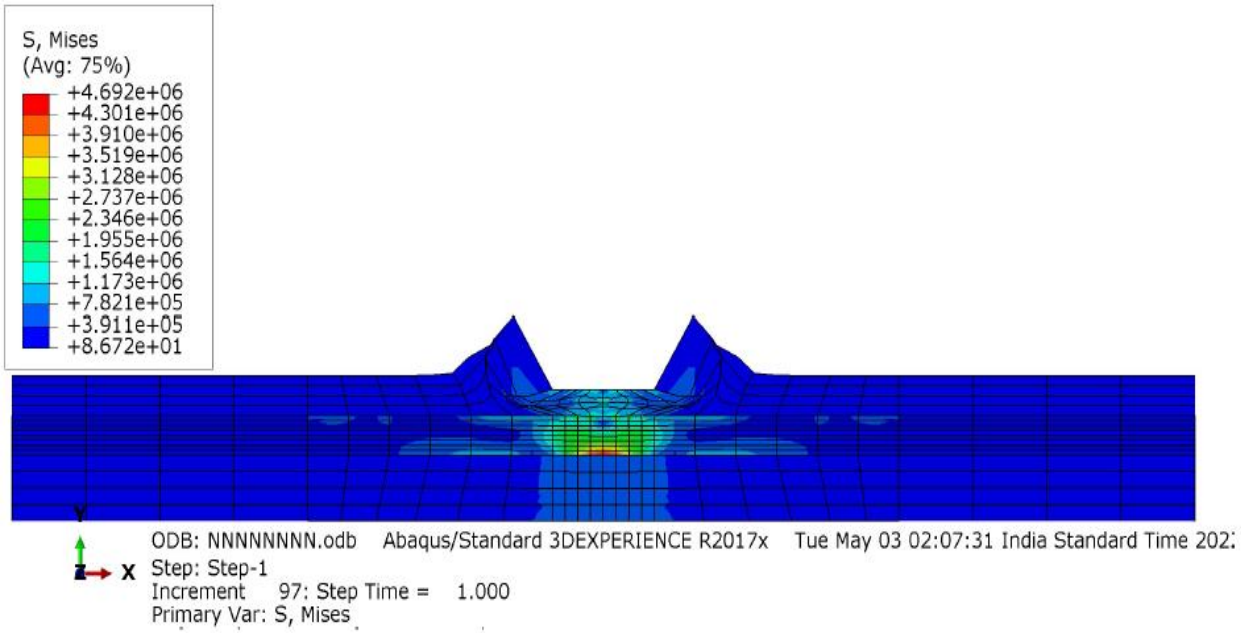


Figure 4.50. Mesh of reinforced soil I

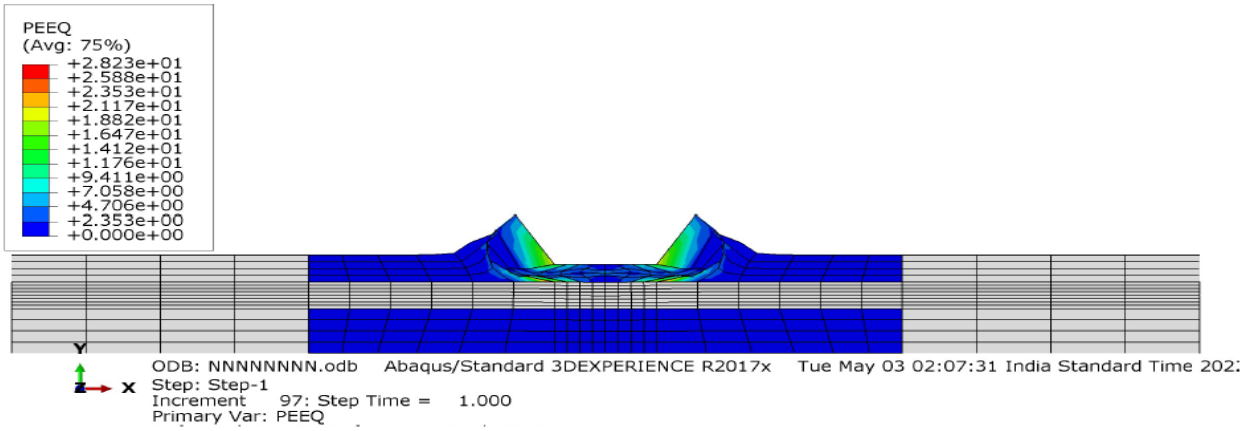
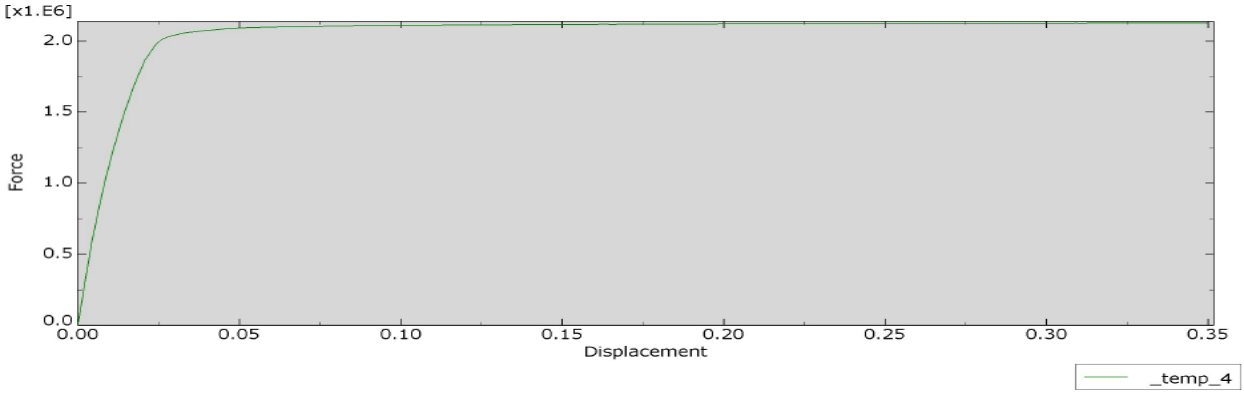
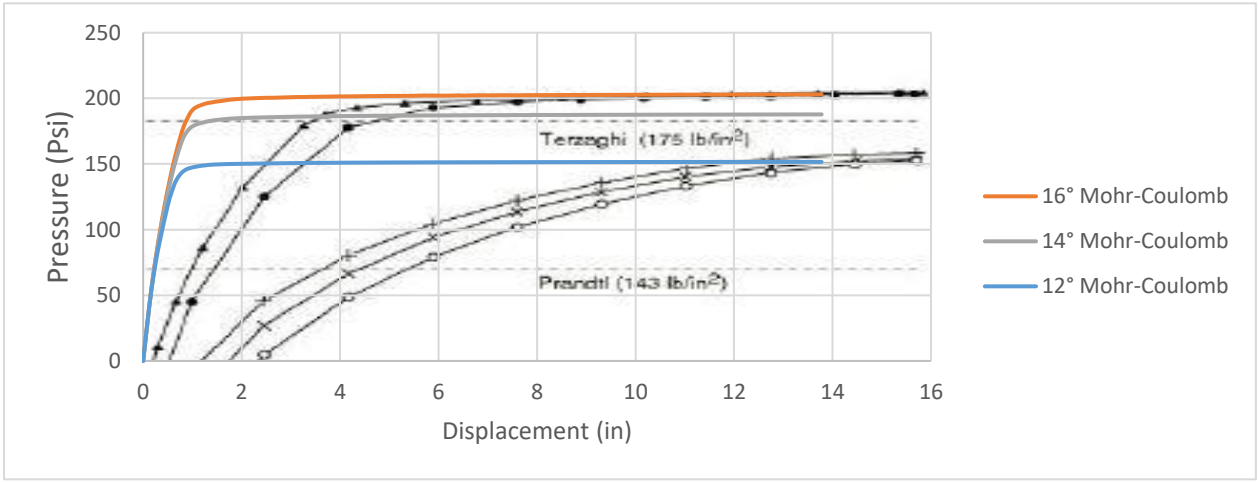


Figure 4.51. Normal stresses of reinforced soil I



Graph 4.33. Force against Displacement of reinforced soil I obtained from Abaqus model



Graph 4.34. Friction angle variation curves of the reinforced soil G, H and I Comparing with the one as given by Chen (1975)

- SOIL J

Table 4.26. Reinforced soil J displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	346552	227994.7368	0.098425197	33.06763602
0.005	641957	422340.1316	0.196850394	61.25487782
0.0075	872326	573898.6842	0.295275591	83.23645127
0.01	1.07E+06	705111.8421	0.393700787	102.267193
0.01375	1.30E+06	855736.8421	0.541338583	124.1133669
0.019375	1.49E+06	982276.3158	0.762795276	142.4662522
0.0278125	1.55E+06	1020131.579	1.094980315	147.9566599
0.0404687	1.57E+06	1032493.421	1.593255906	149.7495824
0.0436328	1.57E+06	1033486.842	1.717826772	149.8936651
0.0467969	1.57E+06	1034164.474	1.842397638	149.9919466
0.051543	1.57E+06	1035019.737	2.029251969	150.1159913
0.0586621	1.57E+06	1036151.316	2.309531496	150.2801119
0.0693408	1.58E+06	1037671.053	2.729952756	150.5005298
0.0853589	1.58E+06	1039605.263	3.360586614	150.7810615
0.109386	1.58E+06	1041328.947	4.306535433	151.0310593
0.145427	1.58E+06	1042684.211	5.725472441	151.2276223
0.155427	1.59E+06	1042973.684	6.119173228	151.2696067
0.170427	1.59E+06	1043348.684	6.709724409	151.3239955
0.192927	1.59E+06	1043782.895	7.595551181	151.386972
0.226677	1.59E+06	1044243.421	8.924291339	151.4537653
0.266677	1.59E+06	1044631.579	10.49909449	151.5100625
0.276677	1.59E+06	1044723.684	10.89279528	151.5234212
0.291677	1.59E+06	1044842.105	11.48334646	151.5405966
0.314177	1.59E+06	1044986.842	12.36917323	151.5615887
0.347927	1.59E+06	1045171.053	13.69791339	151.5883061
0.387927	1.59E+06	1045342.105	15.27271654	151.613115
0.4	1.59E+06	1045401.316	15.7480315	151.6217027

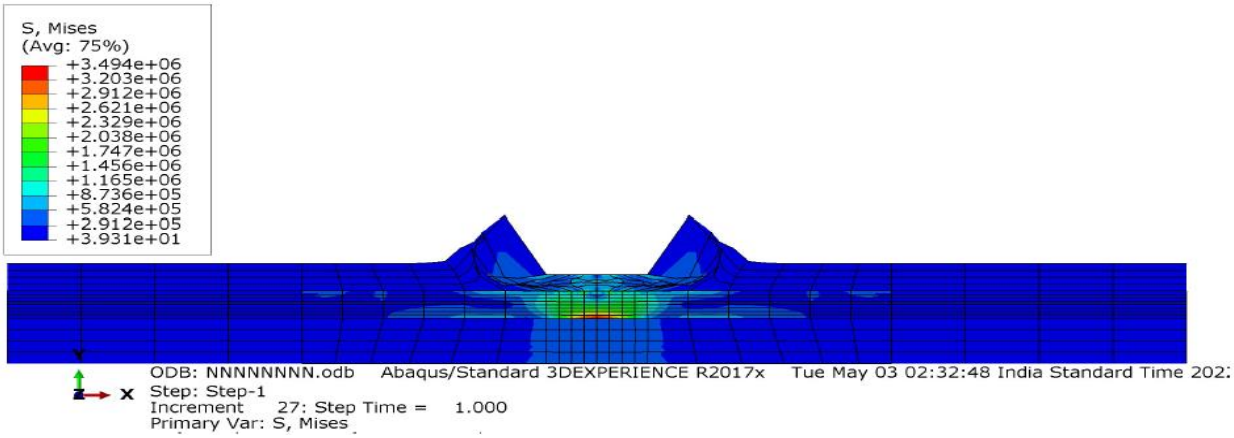


Figure 4.52. Mesh of reinforced soil J

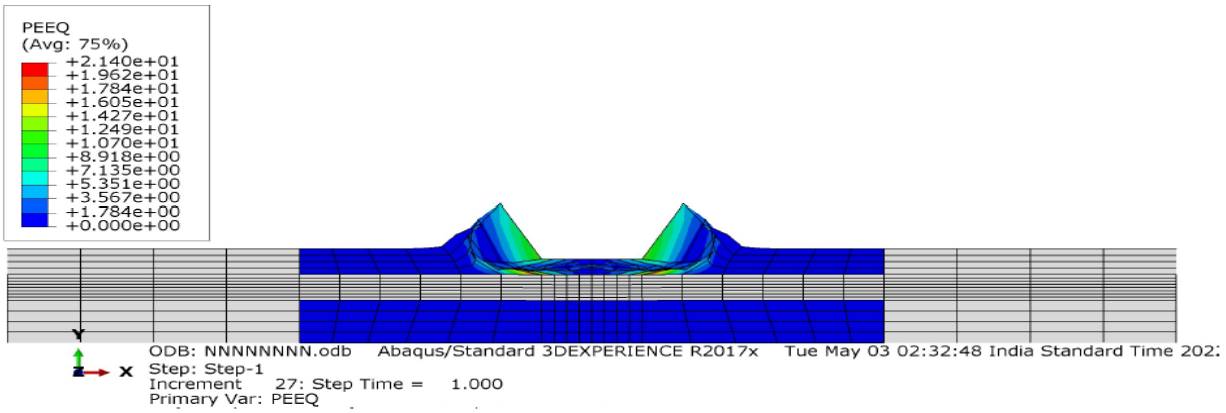
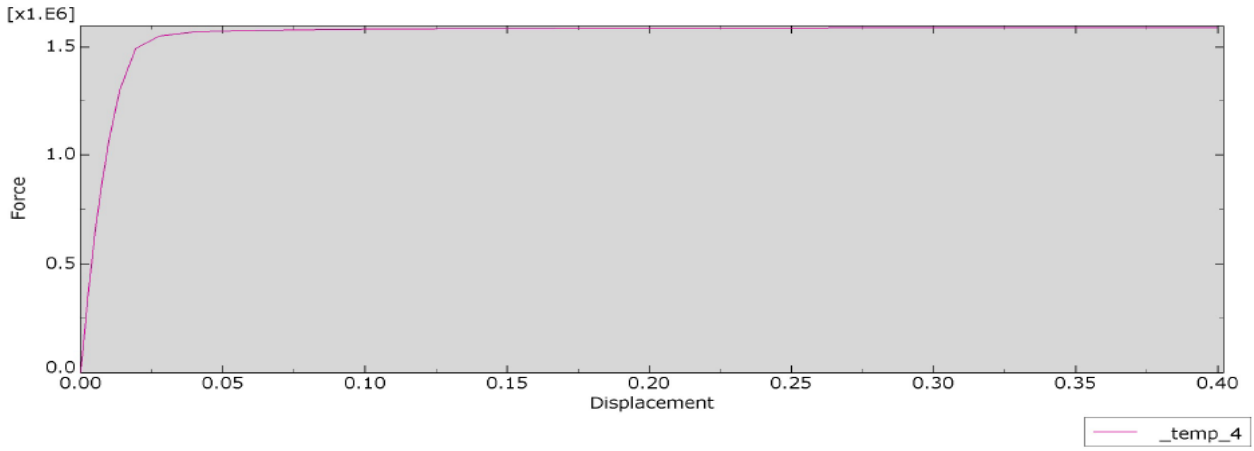


Figure 4.53. Normal stresses of reinforced soil J



Graph 4.35. Force against Displacement of reinforced soil J obtained from Abaqus model

- SOIL K

Table 4.27. Reinforced soil K displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	346463	227936.1842	0.098425197	33.05914373
0.005	659253	433719.0789	0.196850394	62.90524438
0.0075	910371	598928.2895	0.295275591	86.86666611
0.01	1.13E+06	743763.1579	0.393700787	107.8730577
0.01375	1.41E+06	928250	0.541338583	134.6304461
0.0175	1.64E+06	1075907.895	0.688976378	156.0462805
0.02125	1.80E+06	1182302.632	0.836614173	171.4774368
0.025	1.87E+06	1228026.316	0.984251969	178.1090555
0.02875	1.89E+06	1245875	1.131889764	180.6977722
0.0325	1.91E+06	1255322.368	1.279527559	182.0679887
0.03625	1.92E+06	1262703.947	1.427165354	183.1385896
0.04	1.93E+06	1267625	1.57480315	183.8523235
0.045625	1.93E+06	1272565.789	1.796259843	184.56892
0.05125	1.94E+06	1275250	2.017716535	184.9582294
0.056875	1.94E+06	1277407.895	2.239173228	185.2712036
0.0625	1.94E+06	1278907.895	2.460629921	185.4887589
0.0709375	1.95E+06	1280703.947	2.792814961	185.7492527
0.079375	1.95E+06	1282335.526	3.125	185.9858917
0.0878125	1.95E+06	1283953.947	3.457185039	186.2206224
0.0941406	1.95E+06	1284546.053	3.706322835	186.3064995
0.103633	1.95E+06	1285809.211	4.08003937	186.4897039
0.107192	1.96E+06	1286190.789	4.22015748	186.5450469
0.112532	1.96E+06	1286684.211	4.430393701	186.6166111
0.120541	1.96E+06	1287394.737	4.745708661	186.7196636
0.132554	1.96E+06	1288203.947	5.218661417	186.837029
0.137059	1.96E+06	1288500	5.396023622	186.8799675
0.143817	1.96E+06	1288855.263	5.662086614	186.9314938
0.153953	1.96E+06	1289381.579	6.061141732	187.0078289
0.157755	1.96E+06	1289526.316	6.210826772	187.0288211
0.163456	1.96E+06	1289875	6.435275591	187.0793932
0.172009	1.96E+06	1290184.211	6.772007874	187.1242401
0.178423	1.96E+06	1290493.421	7.024527559	187.169087
0.188045	1.96E+06	1290776.316	7.403346457	187.2101172
0.197667	1.96E+06	1291217.105	7.782165354	187.2740479
0.207289	1.96E+06	1291480.263	8.160984252	187.3122155
0.221721	1.96E+06	1291894.737	8.729173228	187.3723294
0.227133	1.96E+06	1292085.526	8.942244094	187.4000009

0.235252	1.96E+06	1292256.579	9.261889764	187.4248098
0.247429	1.96E+06	1292572.368	9.741299213	187.470611
0.259606	1.97E+06	1292848.684	10.22070866	187.5106869
0.262651	1.97E+06	1292973.684	10.34059055	187.5288165
0.265695	1.97E+06	1293065.789	10.46043307	187.5421752
0.270262	1.97E+06	1293105.263	10.64023622	187.5479003
0.277112	1.97E+06	1293309.211	10.90992126	187.5774802
0.287386	1.97E+06	1293421.053	11.31440945	187.5937014
0.291239	1.97E+06	1293625	11.46610236	187.6232813
0.297019	1.97E+06	1293657.895	11.69366142	187.6280523
0.305688	1.97E+06	1293835.526	12.03496063	187.6538154
0.31219	1.97E+06	1293907.895	12.29094488	187.6643115
0.321943	1.97E+06	1294125	12.67492126	187.6957997
0.3256	1.97E+06	1294157.895	12.81889764	187.7005707
0.331086	1.97E+06	1294190.789	13.03488189	187.7053416
0.339316	1.97E+06	1294414.474	13.35889764	187.7377841
0.351659	1.97E+06	1294552.632	13.84484252	187.7578221
0.356288	1.97E+06	1294717.105	14.02708661	187.7816768
0.363231	1.97E+06	1294605.263	14.30043307	187.7654556
0.373646	1.97E+06	1294842.105	14.71047244	187.7998064
0.377552	1.97E+06	1294815.789	14.86425197	187.7959897
0.38341	1.97E+06	1294828.947	15.09488189	187.797898
0.392198	1.97E+06	1295013.158	15.44086614	187.8246153
0.4	1.97E+06	1294967.105	15.7480315	187.817936

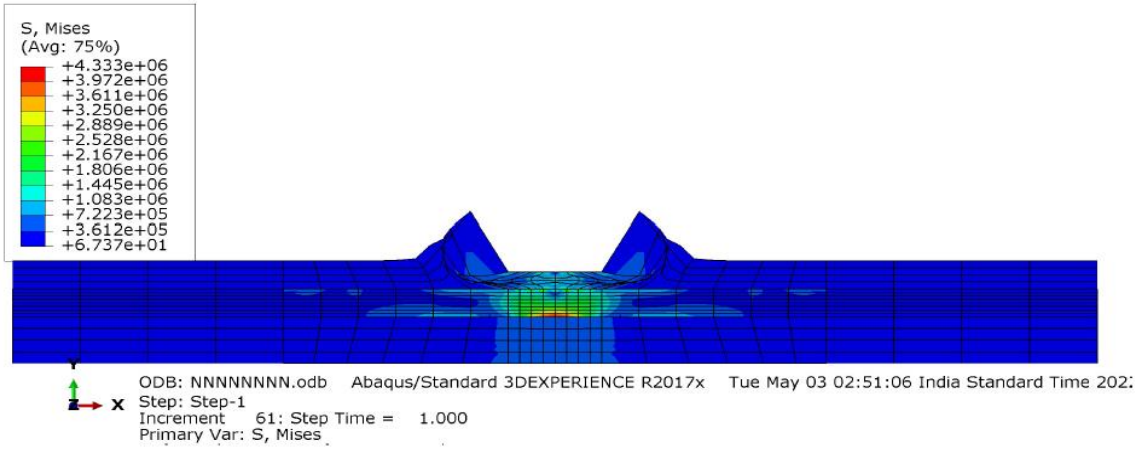


Figure 4.54. Mesh of reinforced soil K

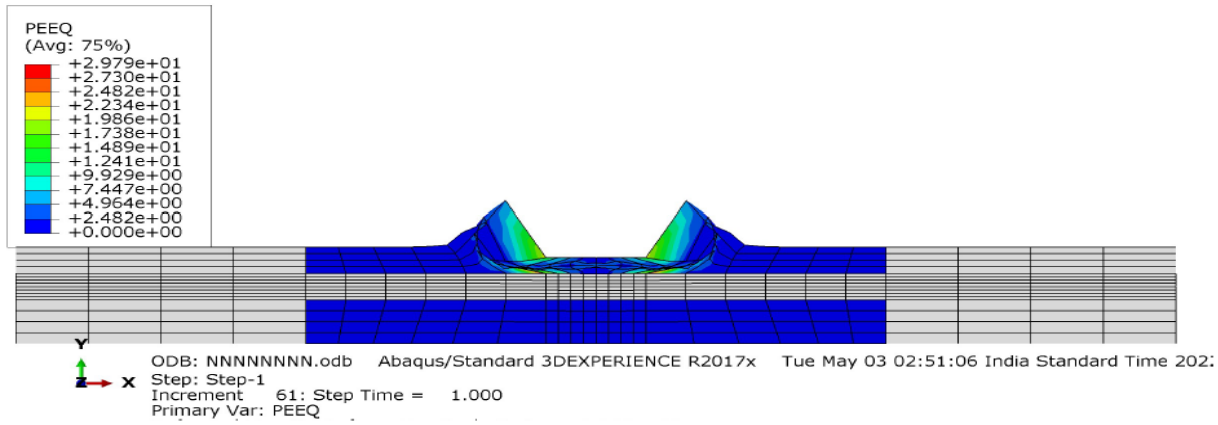
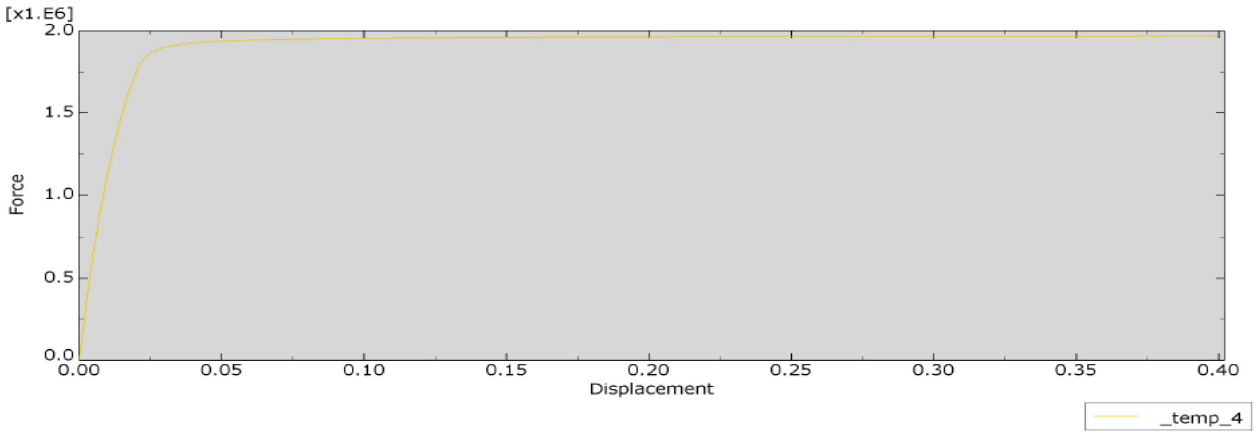


Figure 4.55. Normal stresses of reinforced soil K



Graph 4.36. Force against Displacement of reinforced soil K obtained from Abaqus model

- SOIL L

Table 4.28. Reinforced soil L displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	346394	227890.7895	0.098425197	33.05255982
0.005	663648	436610.5263	0.196850394	63.32461077
0.00875	1.04E+06	681236.8421	0.344488189	98.80443843
0.0125	1.35E+06	887578.9474	0.492125984	128.7316452
0.01625	1.61E+06	1056684.211	0.63976378	153.2581381
0.02	1.81E+06	1194000	0.787401575	173.1739862
0.02375	1.95E+06	1281618.421	0.93503937	185.8818851
0.0246875	1.97E+06	1295730.263	0.971948819	187.928622
0.025625	1.99E+06	1306131.579	1.008858268	189.437196

0.0265625	2.00E+06	1314453.947	1.045767717	190.644246
0.0275	2.01E+06	1319269.737	1.082677165	191.3427129
0.0284375	2.01E+06	1323717.105	1.119586614	191.9877452
0.029375	2.02E+06	1327434.211	1.156496063	192.5268623
0.0307813	2.02E+06	1331973.684	1.211862205	193.1852533
0.0328906	2.03E+06	1338598.684	1.294905512	194.1461223
0.0360547	2.04E+06	1345217.105	1.419476378	195.1060372
0.0392187	2.05E+06	1348756.579	1.544043307	195.6193913
0.0423828	2.06E+06	1353361.842	1.668614173	196.2873241
0.0455469	2.06E+06	1356085.526	1.793185039	196.6823586
0.050293	2.07E+06	1361065.789	1.98003937	197.4046803
0.052666	2.07E+06	1362105.263	2.073464567	197.5554422
0.0550391	2.07E+06	1363250	2.166893701	197.7214713
0.0574121	2.07E+06	1364328.947	2.260318898	197.8779584
0.0609717	2.08E+06	1365644.737	2.40046063	198.0687963
0.066311	2.08E+06	1366500	2.610669291	198.192841
0.0716504	2.08E+06	1368059.211	2.82088189	198.4189839
0.0769897	2.08E+06	1369440.789	3.031090551	198.6193638
0.0849988	2.08E+06	1371519.737	3.346409449	198.9208877
0.0880022	2.08E+06	1371203.947	3.464653543	198.8750866
0.0925073	2.09E+06	1372065.789	3.642019685	199.0000855
0.0970123	2.09E+06	1372835.526	3.81938189	199.1117257
0.101517	2.09E+06	1373342.105	3.996732283	199.1851983
0.108275	2.09E+06	1374197.368	4.262795276	199.309243
0.118411	2.09E+06	1375552.632	4.661850394	199.5058061
0.120946	2.09E+06	1375269.737	4.761653543	199.4647759
0.12348	2.09E+06	1375967.105	4.861417323	199.56592
0.127281	2.09E+06	1376210.526	5.011062992	199.601225
0.132983	2.09E+06	1376348.684	5.235551181	199.621263
0.135121	2.09E+06	1376710.526	5.319724409	199.6737434
0.138328	2.09E+06	1376921.053	5.445984252	199.7042775
0.143139	2.09E+06	1377118.421	5.635393701	199.7329032
0.150355	2.09E+06	1377519.737	5.919488189	199.7911088
0.153061	2.09E+06	1377822.368	6.026023622	199.8350015
0.15712	2.09E+06	1378065.789	6.185826772	199.8703065
0.163209	2.09E+06	1378276.316	6.425551181	199.9008406
0.165492	2.10E+06	1378486.842	6.515433071	199.9313747
0.168917	2.10E+06	1378657.895	6.650275591	199.9561836
0.174055	2.10E+06	1378868.421	6.852559055	199.9867177
0.177908	2.10E+06	1379078.947	7.004251969	200.0172518
0.183687	2.10E+06	1379203.947	7.231771654	200.0353814
0.189467	2.10E+06	1379743.421	7.459330709	200.1136249

0.195246	2.10E+06	1379842.105	7.686850394	200.1279378
0.201026	2.10E+06	1380210.526	7.914409449	200.1813724
0.206805	2.10E+06	1380342.105	8.141929134	200.2004562
0.208973	2.10E+06	1380401.316	8.227283465	200.2090439
0.212224	2.10E+06	1380552.632	8.355275591	200.2309903
0.2171	2.10E+06	1380684.211	8.547244094	200.250074
0.220757	2.10E+06	1380855.263	8.691220472	200.274883
0.226243	2.10E+06	1380855.263	8.907204724	200.274883
0.228301	2.10E+06	1381177.632	8.988228346	200.3216383
0.231387	2.10E+06	1381282.895	9.109724409	200.3369053
0.236016	2.10E+06	1381282.895	9.291968504	200.3369053
0.242959	2.10E+06	1381684.211	9.565314961	200.3951109
0.245563	2.10E+06	1381598.684	9.667834646	200.3827064
0.249468	2.10E+06	1381526.316	9.821574803	200.3722103
0.255326	2.10E+06	1382203.947	10.05220472	200.4704919
0.257523	2.10E+06	1381815.789	10.13870079	200.4141947
0.260819	2.10E+06	1382388.158	10.26846457	200.4972092
0.265762	2.10E+06	1381822.368	10.46307087	200.4151489
0.269469	2.10E+06	1382697.368	10.60901575	200.5420561
0.27503	2.10E+06	1382776.316	10.82795276	200.5535064
0.277115	2.10E+06	1382421.053	10.91003937	200.5019801
0.280243	2.10E+06	1382855.263	11.03318898	200.5649567
0.284935	2.10E+06	1382427.632	11.21791339	200.5029343
0.288454	2.10E+06	1383092.105	11.35645669	200.5993075
0.293733	2.10E+06	1383138.158	11.56429134	200.6059868
0.30165	2.10E+06	1382986.842	11.87598425	200.5840405
0.30462	2.10E+06	1383289.474	11.99291339	200.6279332
0.309073	2.10E+06	1383368.421	12.16822835	200.6393835
0.315754	2.10E+06	1383328.947	12.43125984	200.6336583
0.318259	2.10E+06	1383539.474	12.52988189	200.6641924
0.322017	2.10E+06	1383407.895	12.67783465	200.6451086
0.327654	2.10E+06	1383671.053	12.89976378	200.6832762
0.333291	2.10E+06	1383651.316	13.12169291	200.6804136
0.338927	2.10E+06	1383842.105	13.34358268	200.7080851
0.341041	2.10E+06	1383940.789	13.42681102	200.722398
0.344212	2.10E+06	1384019.737	13.55165354	200.7338482
0.348968	2.10E+06	1384006.579	13.73889764	200.7319399
0.356102	2.10E+06	1384190.789	14.01976378	200.7586572
0.358777	2.10E+06	1384197.368	14.12507874	200.7596114
0.36279	2.10E+06	1384263.158	14.28307087	200.7691533
0.368809	2.10E+06	1384453.947	14.52003937	200.7968248
0.371067	2.10E+06	1384368.421	14.60893701	200.7844203

0.374452	2.10E+06	1384302.632	14.74220472	200.7748784
0.379531	2.10E+06	1384348.684	14.94216535	200.7815577
0.387149	2.10E+06	1384730.263	15.24208661	200.8369007
0.390006	2.10E+06	1384473.684	15.35456693	200.7996873
0.394291	2.10E+06	1384677.632	15.52326772	200.8292672
0.4	2.10E+06	1384750	15.7480315	200.8397633

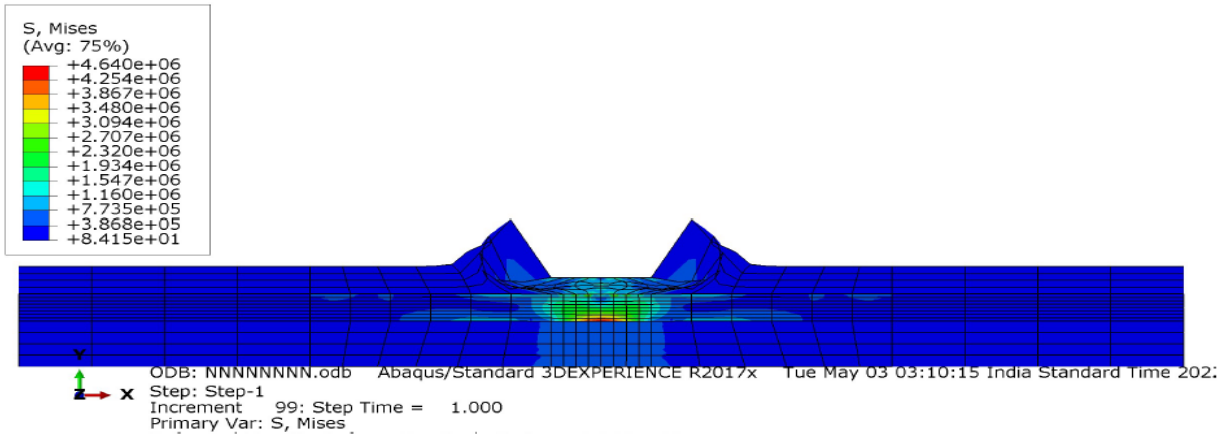


Figure 4.56. Mesh of reinforced soil L

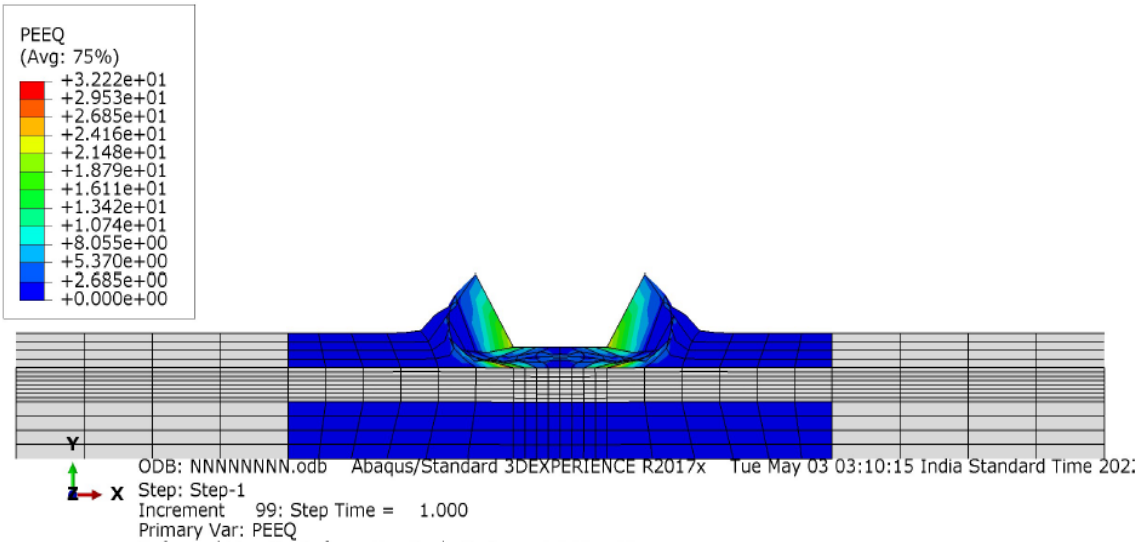
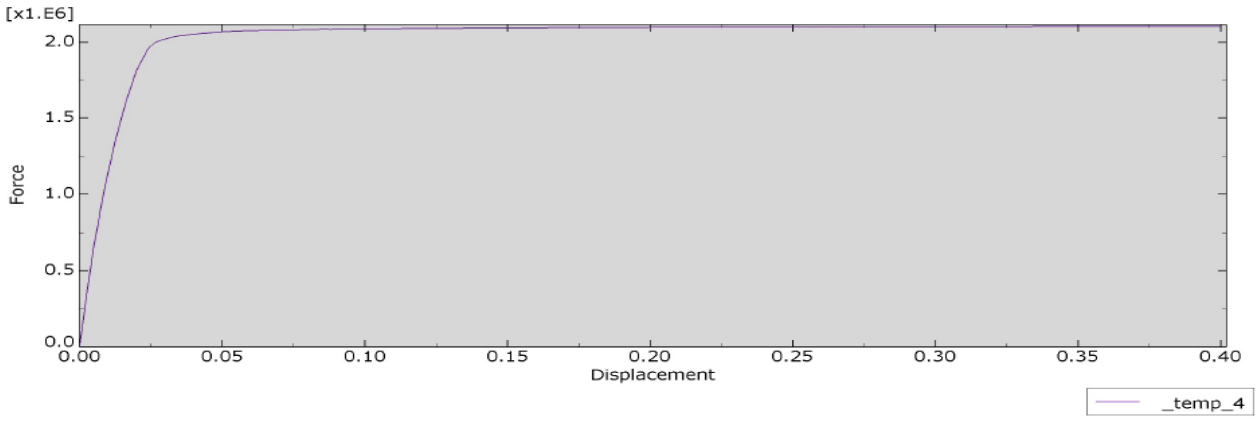
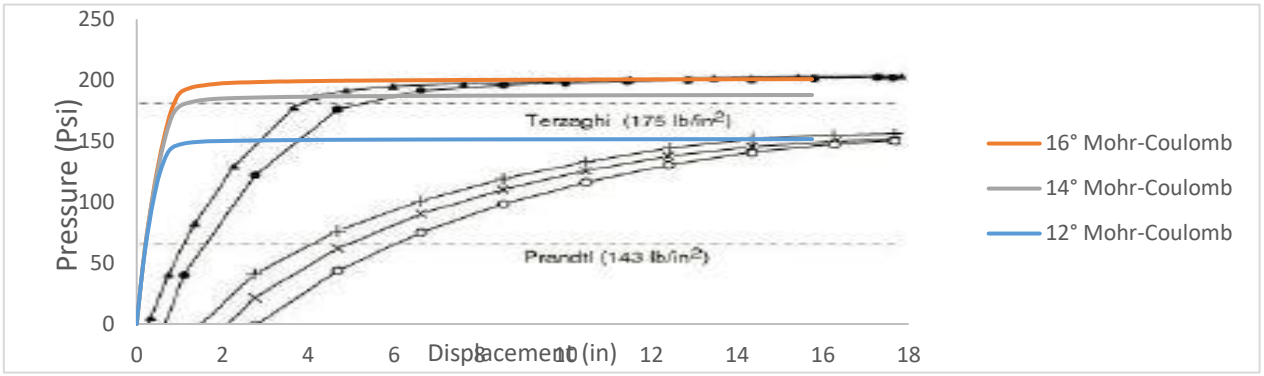


Figure 4.57. Normal stresses of reinforced soil L



Graph 4.37. Force against Displacement of reinforced soil L obtained from Abaqus model



Graph 4.38. Friction angle variation curves of the reinforced soil J, K and L Comparing with the one as given by Chen (1975)

Pour N= 4

- SOIL A'

Table 4.29. Reinforced soil A' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0015625	252795	166312.5	0.061515748	24.12143935
0.003125	504722	332053.9474	0.123031496	48.16005502
0.00546875	807214	531061.8421	0.215305118	77.02353108
0.0078125	1.05E+06	693572.3684	0.30757874	100.5935442
0.0101562	1.25E+06	819131.5789	0.399850394	118.8042552
0.0136719	1.43E+06	939690.7895	0.53826378	136.2897821
0.0189453	1.53E+06	1004526.316	0.745877953	145.6933219

0.0242187	1.55E+06	1020782.895	0.953492126	148.0511247
0.0294922	1.56E+06	1028697.368	1.161110236	149.199015
0.0374023	1.57E+06	1033006.579	1.472531496	149.8240092
0.0492676	1.57E+06	1035243.421	1.939669291	150.1484338
0.0670654	1.58E+06	1037750	2.640370079	150.51198
0.0920654	1.58E+06	1040355.263	3.624622047	150.8898392
0.117065	1.58E+06	1041796.053	4.608858268	151.0988067
0.142065	1.58E+06	1042657.895	5.593110236	151.2238056
0.167065	1.59E+06	1043322.368	6.577362205	151.3201787
0.192065	1.59E+06	1043809.211	7.561614173	151.3907888
0.217065	1.59E+06	1044164.474	8.545866142	151.442315
0.242065	1.59E+06	1044440.789	9.53011811	151.482391
0.25	1.59E+06	1044519.737	9.842519685	151.4938413

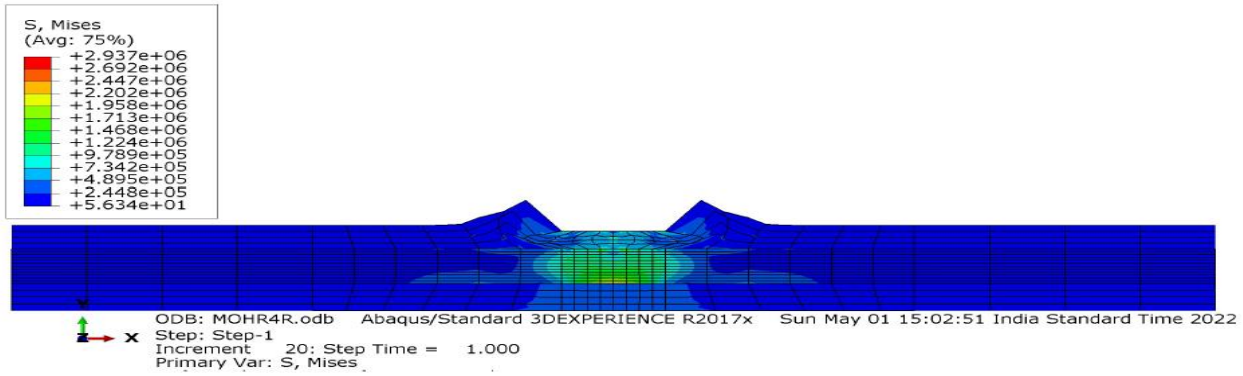


Figure 4.58. Mesh of reinforced soil A’

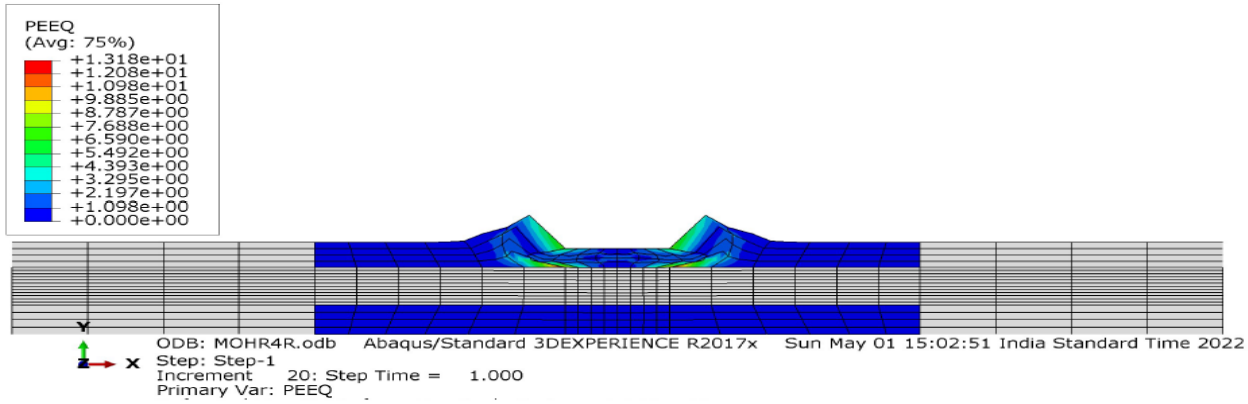
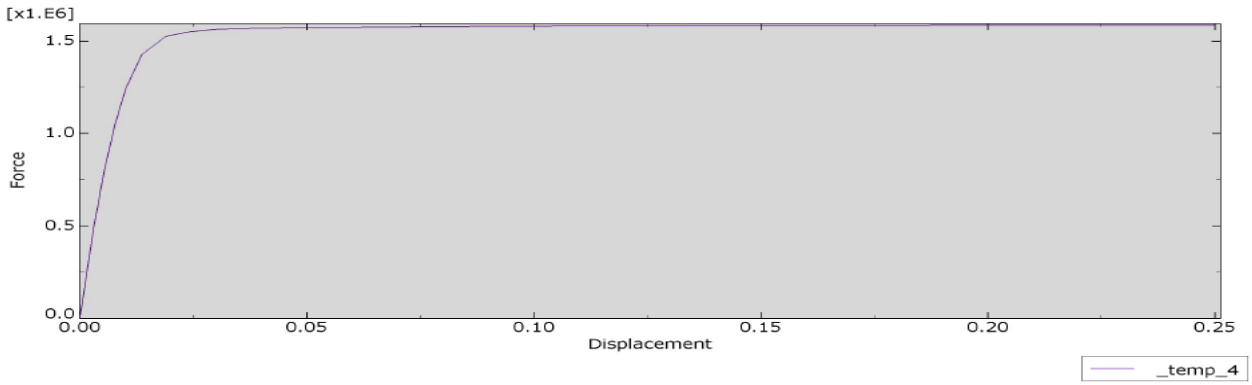


Figure 4.59. Normal stresses of reinforced soil A’



Graph 4.39. Force against Displacement of reinforced soil A' obtained from Abaqus model

- SOIL B'

Table 4.30. Reinforced soil B' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0015625	252159	165894.0789	0.061515748	24.06075288
0.003125	508249	334374.3421	0.123031496	48.49659774
0.00371094	599078	394130.2632	0.1461	57.16340766
0.00458984	724013	476324.3421	0.180702362	69.08457709
0.0059082	893000	587500	0.232606299	85.20914312
0.00788574	1.12E+06	736467.1053	0.310462205	106.8148612
0.0108521	1.40E+06	922585.5263	0.427248031	133.8088888
0.0138184	1.62E+06	1064526.316	0.544031496	154.3955323
0.0167847	1.77E+06	1167289.474	0.660814961	169.2999759
0.019751	1.85E+06	1218546.053	0.777598425	176.7340681
0.0227173	1.88E+06	1239157.895	0.89438189	179.7235445
0.0256836	1.90E+06	1249407.895	1.011165354	181.2101721
0.0286499	1.91E+06	1256835.526	1.127948819	182.2874523
0.0316162	1.92E+06	1261914.474	1.244732283	183.0240868
0.0360657	1.93E+06	1267447.368	1.419909449	183.8265604
0.0405151	1.93E+06	1271894.737	1.595082677	184.4715926
0.0449646	1.94E+06	1274789.474	1.770259843	184.8914361
0.0494141	1.94E+06	1276098.684	1.945437008	185.0813199
0.0538635	1.94E+06	1277506.579	2.120610236	185.2855165
0.058313	1.94E+06	1278697.368	2.295787402	185.4582248
0.0649872	1.95E+06	1280375	2.558551181	185.7015432
0.0749985	1.95E+06	1282361.842	2.95269685	185.9897085
0.0775013	1.95E+06	1282684.211	3.051232283	186.0364638

0.0800041	1.95E+06	1283296.053	3.149767717	186.1252034
0.0837584	1.95E+06	1283822.368	3.297574803	186.2015386
0.0893897	1.95E+06	1284578.947	3.519279528	186.3112704
0.0978367	1.95E+06	1285506.579	3.851838583	186.4458112
0.110507	1.96E+06	1286875	4.350669291	186.6442826
0.123178	1.96E+06	1287782.895	4.849527559	186.7759608
0.135848	1.96E+06	1288585.526	5.348346457	186.892372
0.148519	1.96E+06	1289407.895	5.847204724	187.0116457
0.161189	1.96E+06	1289921.053	6.346023622	187.0860725
0.17386	1.96E+06	1290447.368	6.84488189	187.1624077
0.186531	1.96E+06	1290934.211	7.343740157	187.2330177
0.199201	1.96E+06	1291348.684	7.842559055	187.2931317
0.211872	1.96E+06	1291717.105	8.341417323	187.3465663
0.215039	1.96E+06	1291868.421	8.466102362	187.3685127
0.219791	1.96E+06	1291947.368	8.653188976	187.3799629
0.226918	1.96E+06	1292203.947	8.933779528	187.4171763
0.237609	1.96E+06	1292407.895	9.354685039	187.4467562
0.25	1.97E+06	1292763.158	9.842519685	187.4982825

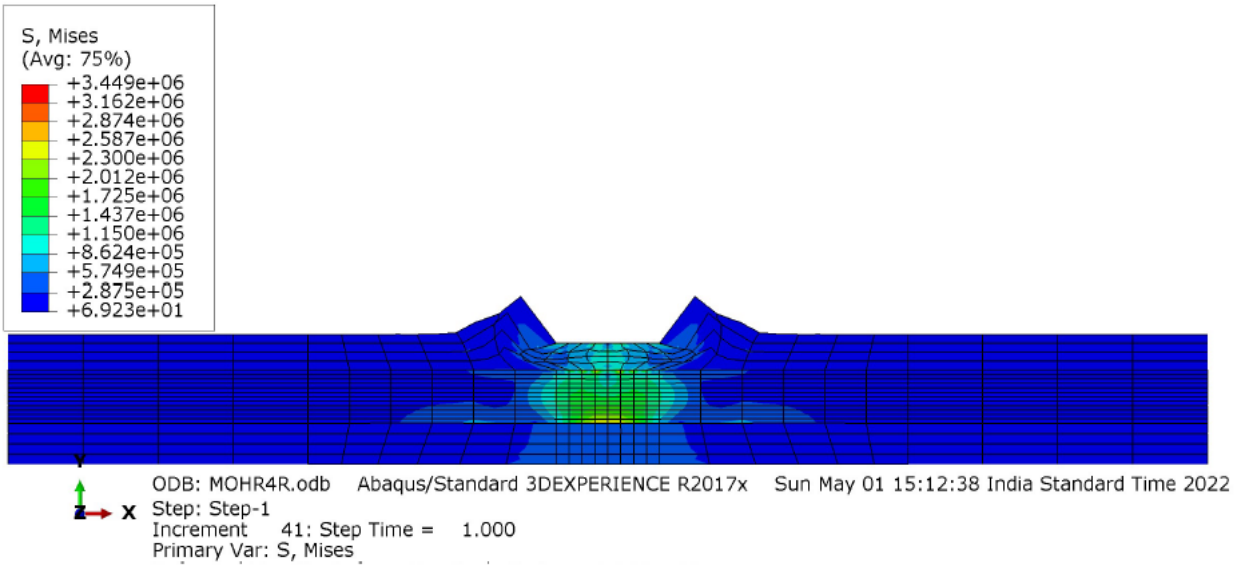


Figure 4.60. Mesh of reinforced soil B’

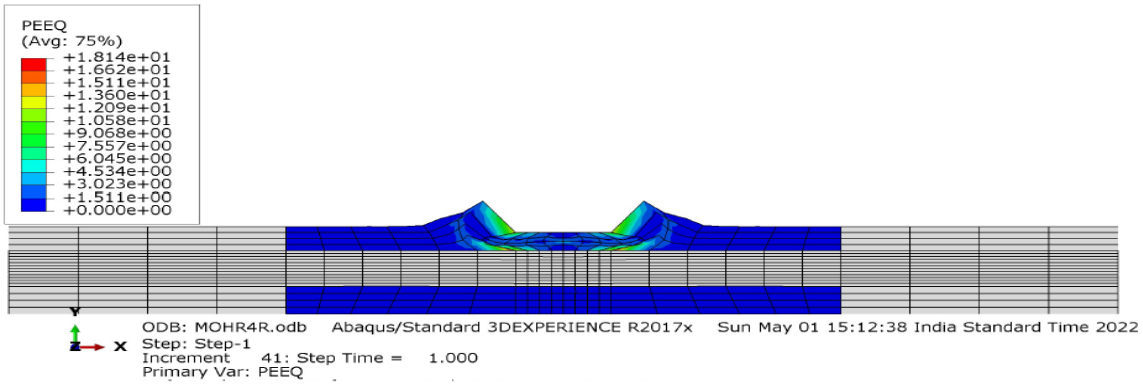
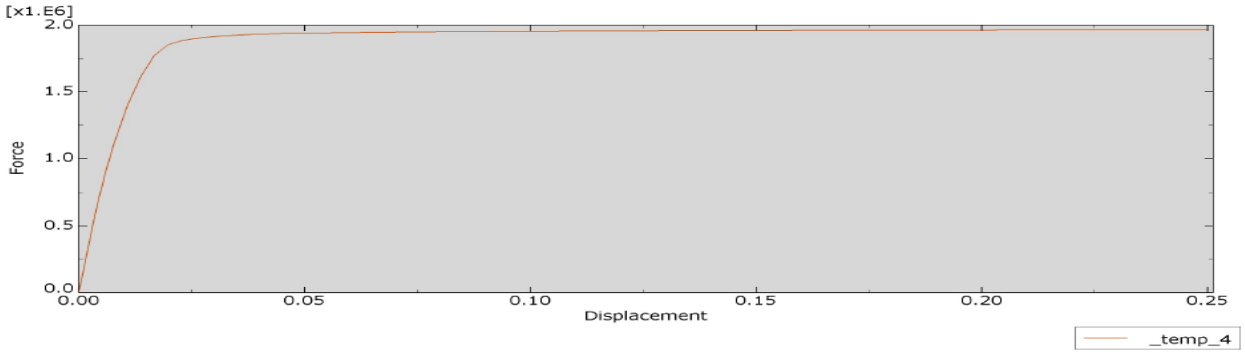


Figure 4.61. Normal stresses of reinforced soil B'



Graph 4.40. Force against Displacement of reinforced soil B' obtained from Abaqus model

- SOIL C'

Table 4.31. Reinforced soil C' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0015625	251881	165711.1842	0.061515748	24.0342264
0.003125	509293	335061.1842	0.123031496	48.59621515
0.00371094	602508	396386.8421	0.1461	57.49069474
0.00458984	731499	481249.3421	0.180702362	69.79888352
0.0059082	907860	597276.3158	0.232606299	86.62706907
0.00788574	1.14E+06	752927.6316	0.310462205	109.2022439
0.00986328	1.36E+06	893657.8947	0.38831811	129.6133165
0.0118408	1.54E+06	1014118.421	0.466173228	147.0845305
0.0138184	1.70E+06	1119151.316	0.544031496	162.3181696
0.0157959	1.84E+06	1208750	0.621885827	175.3132796
0.0177734	1.95E+06	1283223.684	0.699740157	186.1147073
0.0187622	1.99E+06	1311750	0.738669291	190.252074
0.019751	2.03E+06	1334078.947	0.777598425	193.490594

0.0207397	2.05E+06	1350907.895	0.816523622	195.9314113
0.0217285	2.07E+06	1363065.789	0.855452756	197.6947539
0.0227173	2.09E+06	1371782.895	0.89438189	198.9590553
0.0237061	2.10E+06	1378986.842	0.933311024	200.0038931
0.0246948	2.10E+06	1384171.053	0.97223622	200.7557946
0.026178	2.11E+06	1390236.842	1.030629921	201.6355575
0.0284027	2.12E+06	1395894.737	1.118216535	202.4561607
0.0306274	2.13E+06	1401921.053	1.20580315	203.3301985
0.0328522	2.14E+06	1406684.211	1.293393701	204.0210319
0.0345207	2.14E+06	1409197.368	1.359082677	204.3855323
0.0370235	2.15E+06	1412769.737	1.45761811	204.9036574
0.0389007	2.15E+06	1413967.105	1.531523622	205.0773199
0.0417163	2.15E+06	1417355.263	1.642374016	205.5687276
0.0438281	2.16E+06	1419717.105	1.725515748	205.9112817
0.0469957	2.16E+06	1422842.105	1.850224409	206.3645219
0.0501634	2.17E+06	1424592.105	1.974937008	206.6183363
0.053331	2.17E+06	1426552.632	2.099645669	206.9026849
0.0564986	2.17E+06	1427328.947	2.224354331	207.0152792
0.0596663	2.17E+06	1428690.789	2.349066929	207.2127965
0.0628339	2.17E+06	1429815.789	2.473775591	207.375963
0.0675854	2.17E+06	1430730.263	2.66084252	207.5085953
0.0723368	2.18E+06	1432157.895	2.847905512	207.7156545
0.0770883	2.18E+06	1432993.421	3.034972441	207.8368366
0.0818397	2.18E+06	1434052.632	3.222035433	207.9904612
0.0865912	2.18E+06	1434546.053	3.409102362	208.0620254
0.0913426	2.18E+06	1435460.526	3.596165354	208.1946578
0.0960941	2.18E+06	1436072.368	3.783232283	208.2833974
0.100846	2.18E+06	1436789.474	3.970314961	208.3874041
0.102627	2.18E+06	1437032.895	4.040433071	208.4227091
0.1053	2.18E+06	1437250	4.145669291	208.4541974
0.109309	2.19E+06	1437907.895	4.303503937	208.5496163
0.115323	2.19E+06	1438309.211	4.540275591	208.6078219
0.117578	2.19E+06	1438677.632	4.629055118	208.6612565
0.12096	2.19E+06	1438842.105	4.762204724	208.6851113
0.126034	2.19E+06	1439585.526	4.961968504	208.7929347
0.133645	2.19E+06	1439684.211	5.261614173	208.8072476
0.136499	2.19E+06	1440526.316	5.373976378	208.9293839
0.14078	2.19E+06	1440875	5.542519685	208.9799559
0.142386	2.19E+06	1440618.421	5.605748031	208.9427425
0.144794	2.19E+06	1440776.316	5.700551181	208.9656431
0.148406	2.19E+06	1441203.947	5.842755906	209.0276654
0.151115	2.19E+06	1441355.263	5.949409449	209.0496118

0.155179	2.19E+06	1441532.895	6.109409449	209.0753749
0.161275	2.19E+06	1441848.684	6.349409449	209.121176
0.162799	2.19E+06	1441940.789	6.409409449	209.1345346
0.164322	2.19E+06	1441940.789	6.469370079	209.1345346
0.166608	2.19E+06	1442342.105	6.559370079	209.1927402
0.170037	2.19E+06	1442144.737	6.694370079	209.1641145
0.171323	2.19E+06	1442631.579	6.745	209.2347246
0.173252	2.19E+06	1442717.105	6.820944882	209.247129
0.176145	2.19E+06	1442671.053	6.93484252	209.2404497
0.180484	2.19E+06	1442894.737	7.105669291	209.2728922
0.184824	2.19E+06	1443164.474	7.276535433	209.3120139
0.189163	2.19E+06	1443335.526	7.447362205	209.3368229
0.193503	2.19E+06	1443572.368	7.618228346	209.3711737
0.197842	2.19E+06	1443723.684	7.789055118	209.3931201
0.202182	2.19E+06	1443960.526	7.95992126	209.4274709
0.206521	2.20E+06	1444085.526	8.130748031	209.4456005
0.210861	2.20E+06	1444322.368	8.301614173	209.4799513
0.2152	2.20E+06	1444427.632	8.472440945	209.4952184
0.21954	2.20E+06	1444671.053	8.643307087	209.5305234
0.22388	2.20E+06	1444756.579	8.814173228	209.5429279
0.226049	2.20E+06	1445000	8.899566929	209.5782329
0.228219	2.20E+06	1444822.368	8.985	209.5524697
0.230389	2.20E+06	1445203.947	9.070433071	209.6078128
0.233644	2.20E+06	1445309.211	9.198582677	209.6230798
0.236085	2.20E+06	1445157.895	9.294685039	209.6011334
0.239746	2.20E+06	1445447.368	9.438818898	209.6431178
0.243408	2.20E+06	1445434.211	9.582992126	209.6412094
0.247069	2.20E+06	1445651.316	9.727125984	209.6726977
0.25	2.20E+06	1445736.842	9.842519685	209.6851021

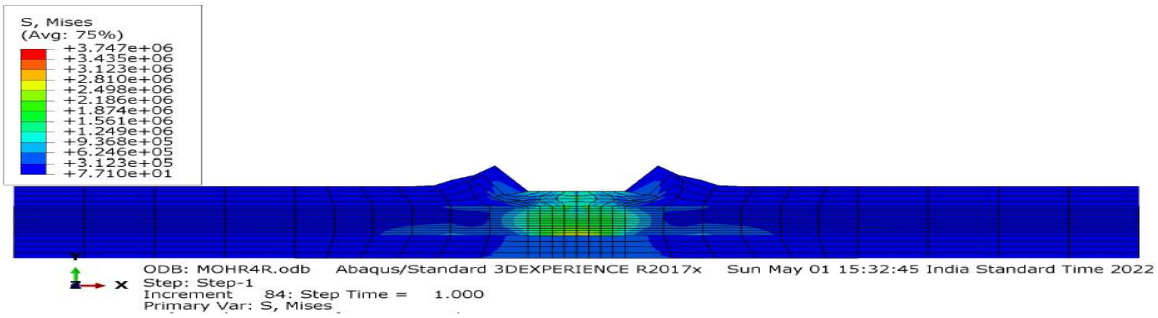


Figure 4.62. Mesh of reinforced soil C’

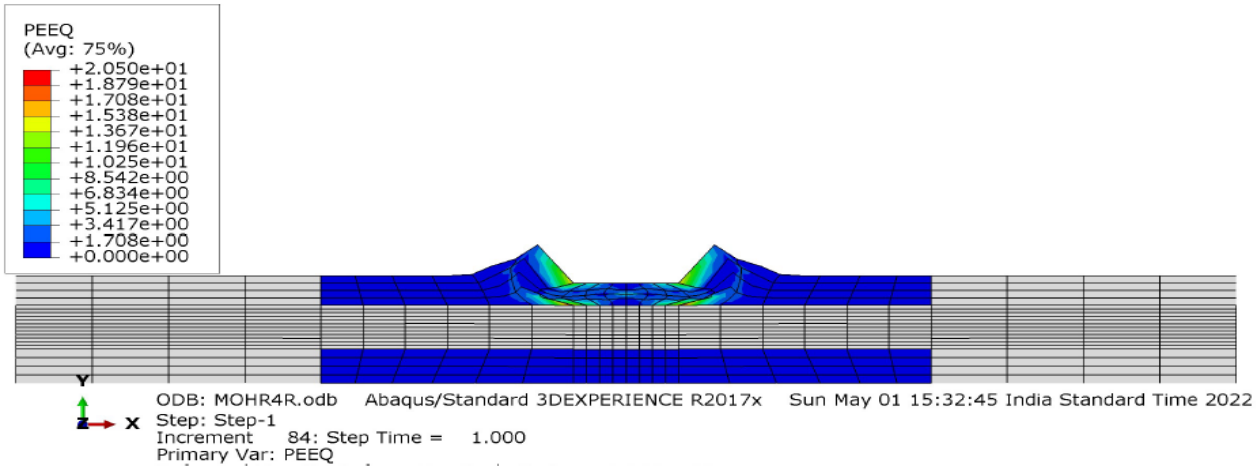
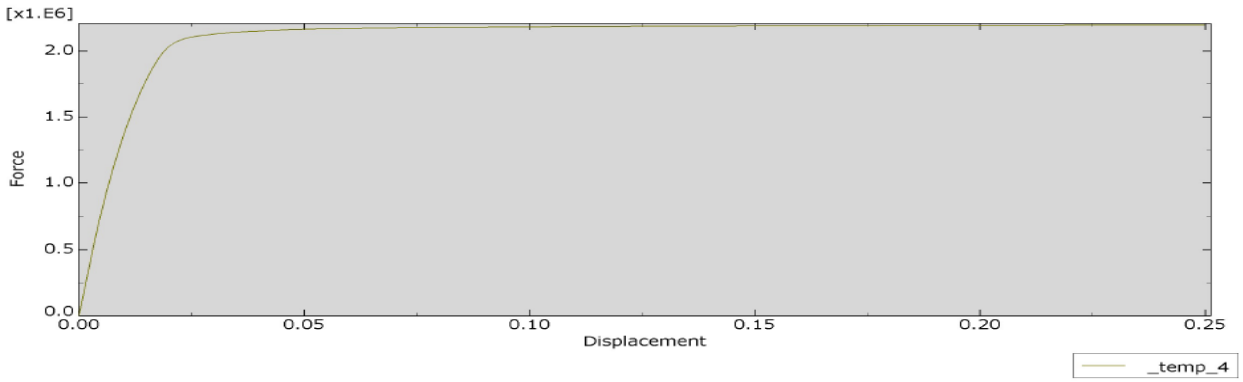
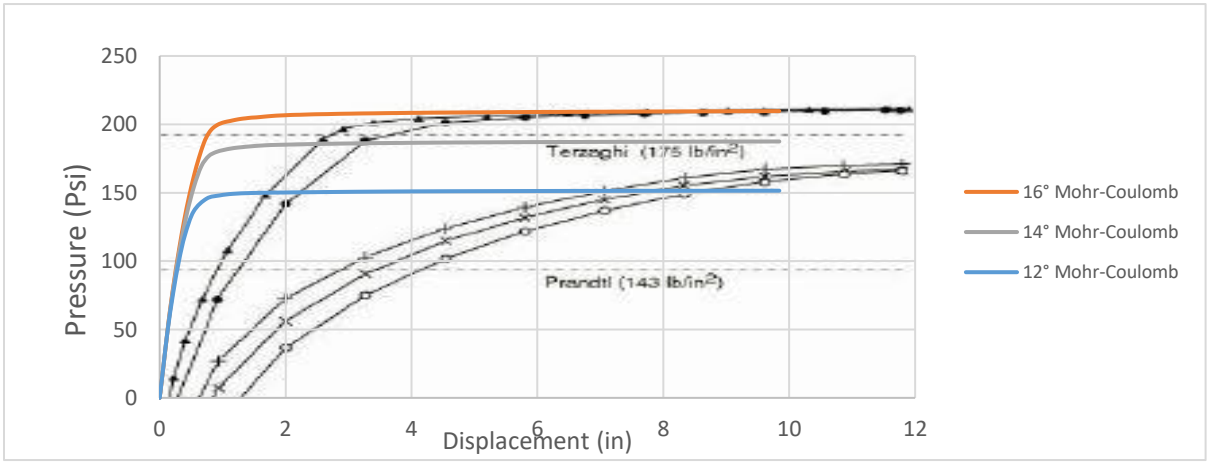


Figure 4.63. Normal stresses of reinforced soil C'



Graph 4.42. Force against Displacement of reinforced soil C' obtained from Abaqus model



4.43. Graph Friction angle variation curves of the reinforced soil A', B'and C' Comparing with the one as given by Chen (1975)

➢ SOIL D’

Table 4.32. Reinforced soil D’ displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.001875	305379	200907.2368	0.073818898	29.13895064
0.00375	594131	390875.6579	0.147637795	56.69137
0.0065625	927199	609999.3421	0.258366142	88.47237659
0.0107812	1.28E+06	840460.5263	0.424456693	121.8977383
0.015	1.47E+06	965407.8947	0.590551181	140.0197097
0.0192188	1.53E+06	1006296.053	0.756645669	145.9499989
0.0255469	1.55E+06	1022986.842	1.005783465	148.3707783
0.0279199	1.56E+06	1026756.579	1.099208661	148.917529
0.0314795	1.57E+06	1030677.632	1.239350394	149.4862261
0.0368188	1.57E+06	1032894.737	1.449559055	149.807788
0.0448279	1.57E+06	1034526.316	1.764877953	150.0444271
0.0568414	1.58E+06	1036309.211	2.237850394	150.3030125
0.0748618	1.58E+06	1038743.421	2.947314961	150.6560627
0.101892	1.58E+06	1040940.789	4.011496063	150.9747621
0.131892	1.58E+06	1042355.263	5.192598425	151.1799129
0.161892	1.59E+06	1043164.474	6.373700787	151.2972782
0.191892	1.59E+06	1043776.316	7.55480315	151.3860178
0.221892	1.59E+06	1044197.368	8.735905512	151.447086
0.251892	1.59E+06	1044513.158	9.917007874	151.4928871
0.281892	1.59E+06	1044763.158	11.09811024	151.5291463
0.3	1.59E+06	1044894.737	11.81102362	151.5482301

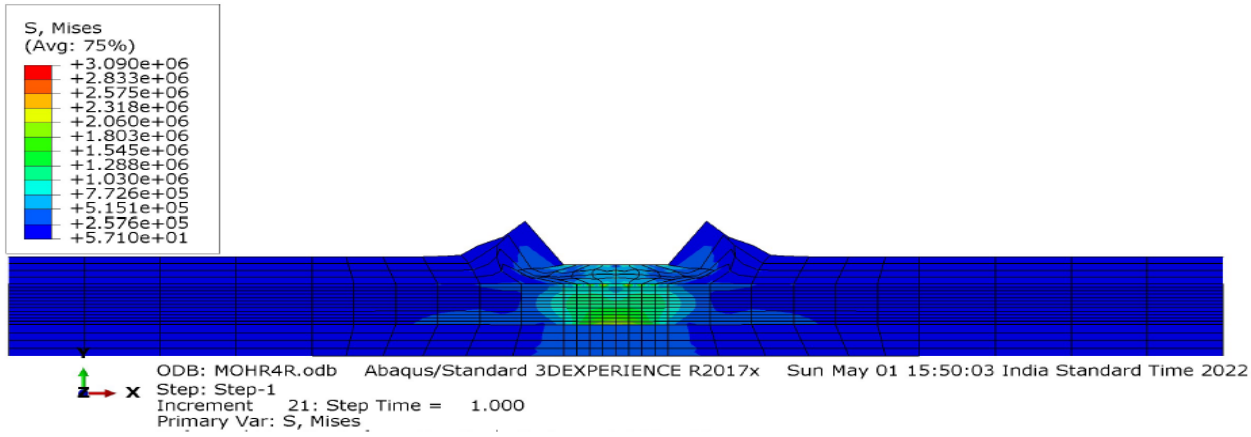


Figure 4.64. Mesh of reinforced soil D’

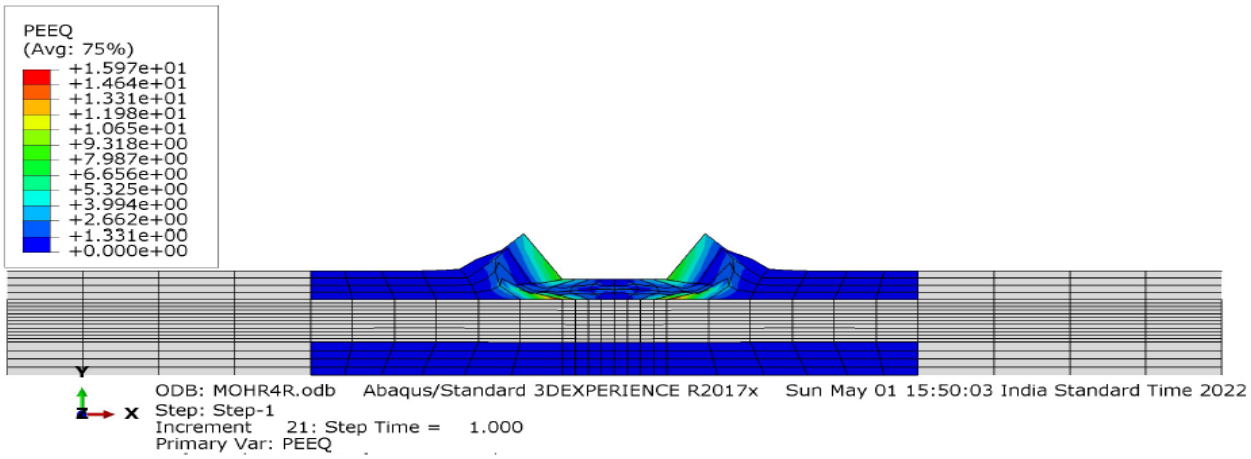
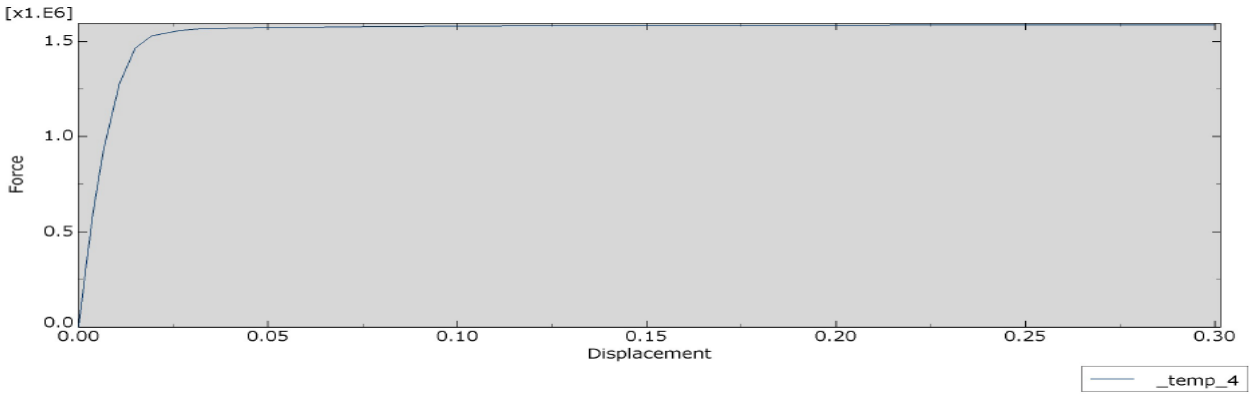


Figure 4.65. Normal stresses of reinforced soil D'



Graph 4.44. Force against Displacement of reinforced soil D' obtained from Abaqus model

- SOIL E'

Table 4.33. Reinforced soil E' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.001875	304667	200438.8158	0.073818898	29.07101233
0.00375	604060	397407.8947	0.147637795	57.63878499
0.0065625	966627	635938.8158	0.258366142	92.23455587
0.009375	1.27E+06	834782.8947	0.369094488	121.0742726
0.0121875	1.51E+06	990335.5263	0.479822835	143.6351346
0.015	1.69E+06	1109888.158	0.590551181	160.9746705
0.0178125	1.81E+06	1190250	0.701279528	172.630098
0.020625	1.86E+06	1226657.895	0.812007874	177.910584
0.0234375	1.89E+06	1241914.474	0.92273622	180.12335
0.02625	1.90E+06	1251394.737	1.033464567	181.4983374
0.0290625	1.91E+06	1257651.316	1.144192913	182.4057719

0.0332813	1.92E+06	1264236.842	1.310287402	183.3609158
0.0364453	1.93E+06	1268046.053	1.434854331	183.9133916
0.0411914	1.93E+06	1272434.211	1.621708661	184.5498362
0.0459375	1.94E+06	1275177.632	1.808562992	184.9477333
0.0506836	1.94E+06	1276473.684	1.995417323	185.1357087
0.0554297	1.94E+06	1277927.632	2.182271654	185.3465846
0.0601758	1.94E+06	1279177.632	2.369125984	185.5278807
0.0672949	1.95E+06	1280901.316	2.649405512	185.7778784
0.0699646	1.95E+06	1281269.737	2.754511811	185.831313
0.0739691	1.95E+06	1282263.158	2.912169291	185.9753956
0.0799759	1.95E+06	1283342.105	3.14865748	186.1318828
0.0889861	1.95E+06	1284355.263	3.503389764	186.278828
0.102501	1.95E+06	1286052.632	4.035472441	186.5250089
0.10588	1.96E+06	1286407.895	4.168503937	186.5765352
0.109259	1.96E+06	1286703.947	4.301535433	186.6194737
0.114327	1.96E+06	1287098.684	4.501062992	186.6767251
0.121929	1.96E+06	1287677.632	4.800354331	186.7606938
0.133333	1.96E+06	1288381.579	5.249330709	186.8627921
0.141886	1.96E+06	1288921.053	5.586062992	186.9410357
0.154714	1.96E+06	1289598.684	6.091102362	187.0393172
0.159525	1.96E+06	1289796.053	6.280511811	187.0679429
0.166742	1.96E+06	1290203.947	6.564645669	187.1271027
0.177566	1.96E+06	1290631.579	6.990787402	187.189125
0.185684	1.96E+06	1290881.579	7.310393701	187.2253842
0.197862	1.96E+06	1291302.632	7.78984252	187.2864523
0.210039	1.96E+06	1291684.211	8.269251969	187.3417953
0.216128	1.96E+06	1291828.947	8.508976378	187.3627875
0.225261	1.96E+06	1292164.474	8.868543307	187.4114512
0.238961	1.96E+06	1292460.526	9.407913386	187.4543897
0.25266	1.97E+06	1292914.474	9.947244094	187.5202288
0.25951	1.97E+06	1292914.474	10.21692913	187.5202288
0.26636	1.97E+06	1293144.737	10.48661417	187.5536255
0.268929	1.97E+06	1293164.474	10.58775591	187.556488
0.272782	1.97E+06	1293256.579	10.73944882	187.5698467
0.278561	1.97E+06	1293394.737	10.9669685	187.5898847
0.28723	1.97E+06	1293539.474	11.30826772	187.6108768
0.290423	1.97E+06	1293644.737	11.43397638	187.6261439
0.295211	1.97E+06	1293684.211	11.62248031	187.631869
0.3	1.97E+06	1293736.842	11.81102362	187.6395025

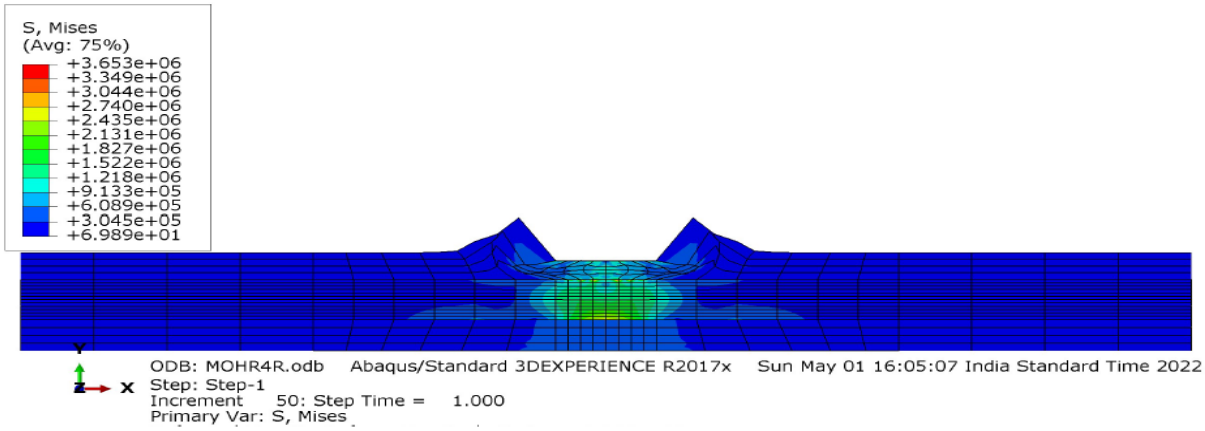


Figure 4.66. Mesh of reinforced soil E’

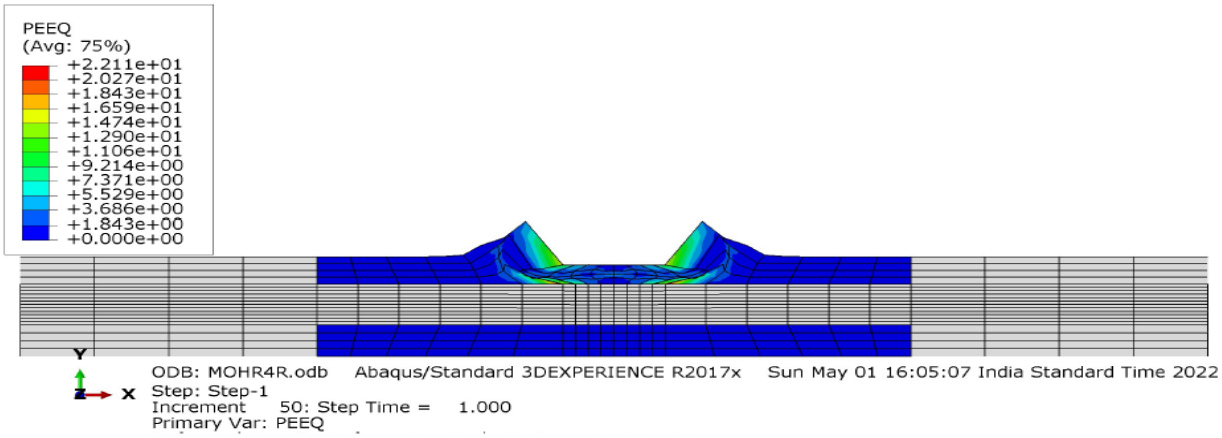
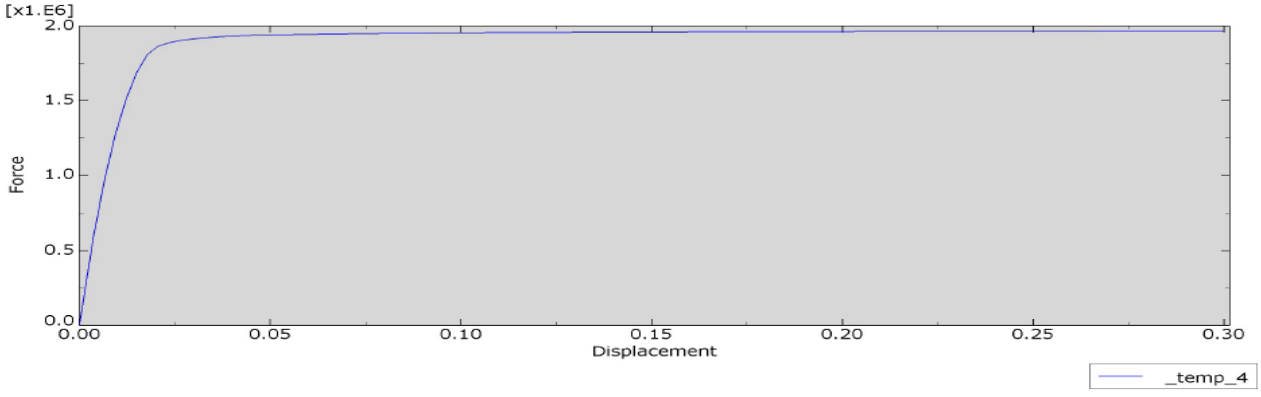


Figure 4.67. Normal stresses of reinforced soil E’



Graph 4.45. Force against Displacement of reinforced soil E’ obtained from Abaqus model

- SOIL F’

Table 4.34. Reinforced soil F' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.001875	304368	200242.1053	0.073818898	29.04248205
0.00375	606695	399141.4474	0.147637795	57.89021398
0.0065625	979600	644473.6842	0.258366142	93.47242621
0.009375	1.29E+06	850552.6316	0.369094488	123.3614654
0.0121875	1.55E+06	1018763.158	0.479822835	147.7581885
0.015	1.75E+06	1153184.211	0.590551181	167.2541931
0.0178125	1.91E+06	1254730.263	0.701279528	181.9821116
0.0192188	1.96E+06	1289098.684	0.756645669	186.9667988
0.020625	1.99E+06	1311690.789	0.812007874	190.2434863
0.0220312	2.02E+06	1325789.474	0.867370079	192.2883149
0.0234375	2.03E+06	1334467.105	0.92273622	193.5468912
0.0248438	2.04E+06	1341526.316	0.978102362	194.5707368
0.02625	2.05E+06	1346565.789	1.033464567	195.3016461
0.0283594	2.06E+06	1352565.789	1.116511811	196.1718671
0.0315234	2.07E+06	1359447.368	1.24107874	197.1699496
0.0338965	2.07E+06	1361585.526	1.334507874	197.4800613
0.0356763	2.07E+06	1364947.368	1.40457874	197.9676522
0.0383459	2.08E+06	1367684.211	1.509681102	198.3645951
0.0423505	2.09E+06	1372598.684	1.66734252	199.0773749
0.0443527	2.09E+06	1374638.158	1.746169291	199.3731737
0.046355	2.09E+06	1375809.211	1.825	199.5430195
0.0493584	2.09E+06	1377710.526	1.943244094	199.8187803
0.0538635	2.10E+06	1379671.053	2.120610236	200.1031288
0.0583685	2.10E+06	1380842.105	2.297972441	200.2729746
0.0628736	2.10E+06	1382276.316	2.475338583	200.480988
0.0673787	2.10E+06	1383414.474	2.652704724	200.6460628
0.0741363	2.11E+06	1384967.105	2.918751969	200.8712516
0.0842727	2.11E+06	1387526.316	3.317822835	201.2424314
0.0880739	2.11E+06	1386980.263	3.467476378	201.1632336
0.0937757	2.11E+06	1388638.158	3.691956693	201.4036894
0.0994774	2.11E+06	1389388.158	3.916433071	201.5124671
0.105179	2.11E+06	1389894.737	4.140905512	201.5859397
0.107317	2.11E+06	1389835.526	4.22507874	201.577352
0.110525	2.11E+06	1390407.895	4.351377953	201.6603665
0.115335	2.11E+06	1390684.211	4.540748031	201.7004424
0.120146	2.11E+06	1391157.895	4.73015748	201.7691441
0.124957	2.12E+06	1391519.737	4.919566929	201.8216245

0.132173	2.12E+06	1392131.579	5.203661417	201.9103642
0.134879	2.12E+06	1392328.947	5.31019685	201.9389899
0.138939	2.12E+06	1392717.105	5.47003937	201.9952871
0.145027	2.12E+06	1392980.263	5.709724409	202.0334547
0.147311	2.12E+06	1393164.474	5.799645669	202.060172
0.150735	2.12E+06	1393322.368	5.934448819	202.0830725
0.155873	2.12E+06	1393697.368	6.136732283	202.1374613
0.163579	2.12E+06	1393993.421	6.44011811	202.1803999
0.166469	2.12E+06	1394256.579	6.553897638	202.2185675
0.170803	2.12E+06	1394467.105	6.724527559	202.2491015
0.177305	2.12E+06	1394750	6.980511811	202.2901317
0.179744	2.12E+06	1394980.263	7.076535433	202.3235283
0.183401	2.12E+06	1394934.211	7.220511811	202.316849
0.188887	2.12E+06	1395473.684	7.436496063	202.3950926
0.190944	2.12E+06	1395282.895	7.517480315	202.3674211
0.19403	2.12E+06	1395690.789	7.638976378	202.4265808
0.198659	2.12E+06	1395815.789	7.821220472	202.4447104
0.205602	2.12E+06	1395967.105	8.094566929	202.4666568
0.208206	2.12E+06	1396092.105	8.197086614	202.4847864
0.212112	2.12E+06	1396302.632	8.350866142	202.5153205
0.21797	2.12E+06	1396394.737	8.581496063	202.5286791
0.226757	2.12E+06	1396875	8.927440945	202.598335
0.230053	2.12E+06	1396796.053	9.057204724	202.5868847
0.234996	2.12E+06	1397210.526	9.251811024	202.6469987
0.24241	2.12E+06	1397000	9.543700787	202.6164646
0.245191	2.12E+06	1397572.368	9.653188976	202.6994791
0.249361	2.12E+06	1397164.474	9.817362205	202.6403193
0.250925	2.12E+06	1397736.842	9.878937008	202.7233338
0.253271	2.12E+06	1397322.368	9.971299213	202.6632199
0.25679	2.12E+06	1397565.789	10.10984252	202.6985249
0.262069	2.12E+06	1397921.053	10.31767717	202.7500511
0.264048	2.12E+06	1397875	10.39559055	202.7433718
0.267018	2.13E+06	1398098.684	10.51251969	202.7758143
0.271471	2.13E+06	1398217.105	10.68783465	202.7929897
0.273141	2.13E+06	1398197.368	10.75358268	202.7901271
0.275647	2.13E+06	1398098.684	10.85224409	202.7758143
0.279405	2.13E+06	1398506.579	11.00019685	202.834974
0.285041	2.13E+06	1398611.842	11.22208661	202.8502411
0.28645	2.13E+06	1398434.211	11.27755906	202.8244779
0.28786	2.13E+06	1398611.842	11.33307087	202.8502411
0.289973	2.13E+06	1398644.737	11.41625984	202.855012
0.293144	2.13E+06	1398677.632	11.54110236	202.859783

0.2979	2.13E+06	1398789.474	11.72834646	202.8760042
0.3	2.13E+06	1398848.684	11.81102362	202.8845919

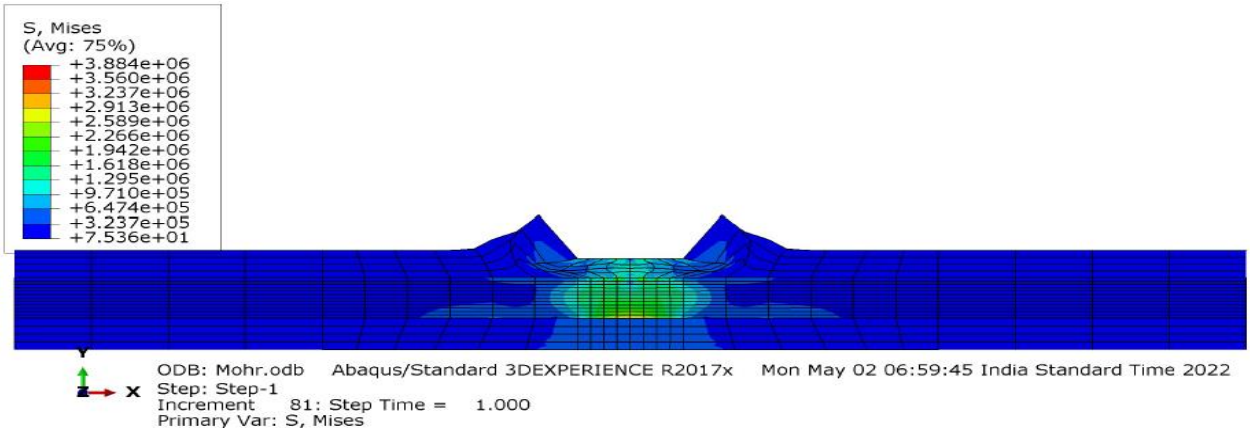


Figure 4.68. Mesh of reinforced soil F'

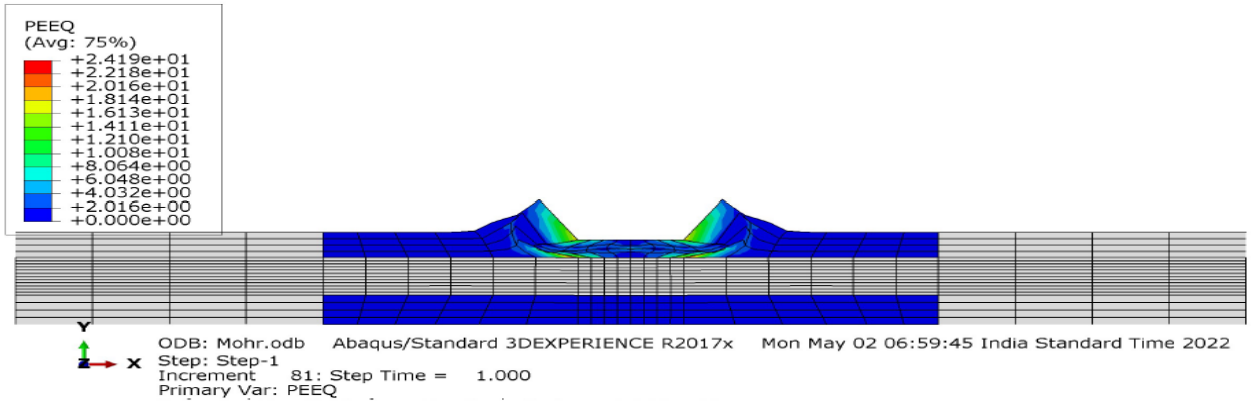
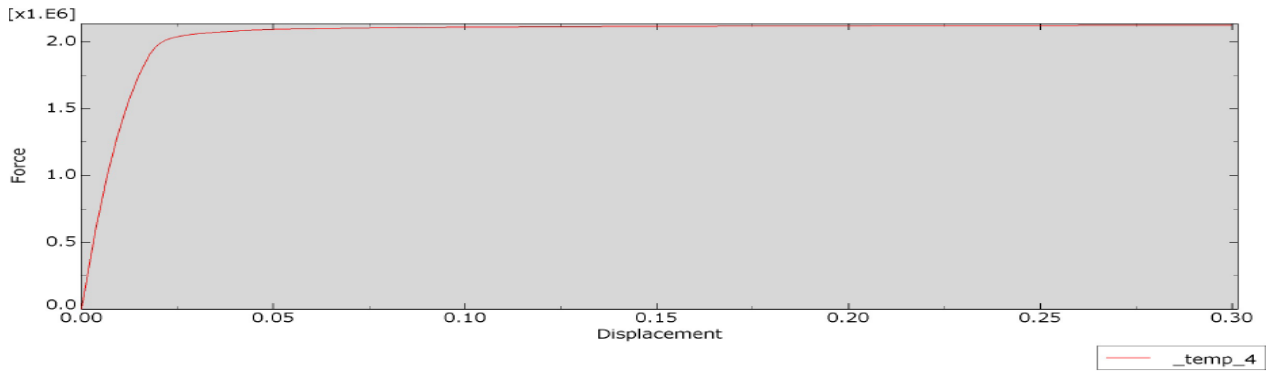
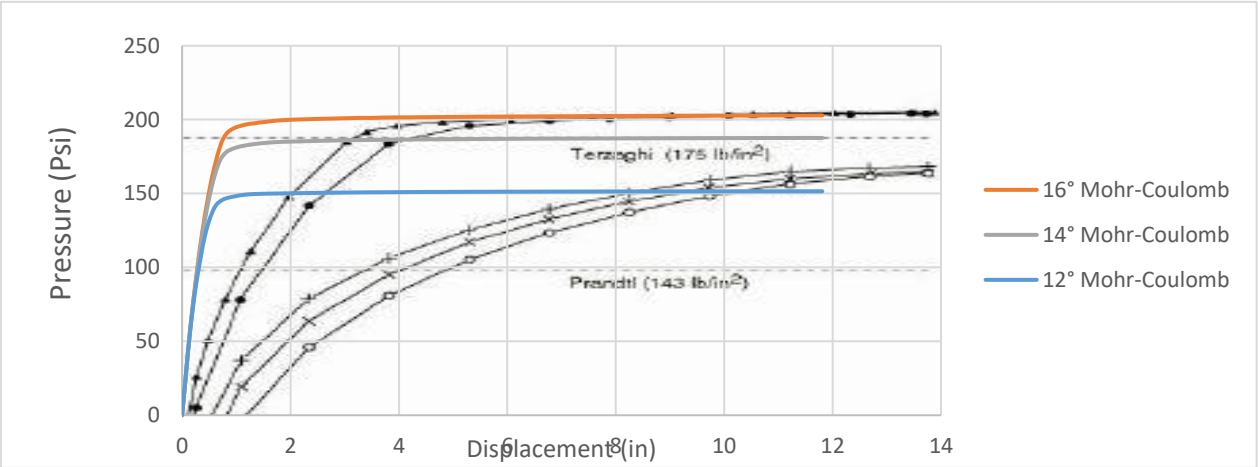


Figure 4.69. Normal stresses of reinforced soil F'



Graph 4.46. Force against Displacement of reinforced soil F' obtained from Abaqus model



4.47. Graph Friction angle variation curves of the reinforced soil D', E'and F' Comparing with the one as given by Chen (1975)

- SOIL G

Table 4.35. Reinforced soil G' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	357447	235162.5	0.086122047	34.10722574
0.004375	674878	443998.6842	0.172244094	64.39616584
0.0065625	928742	611014.4737	0.258366142	88.61960806
0.00875	1.14E+06	749993.4211	0.344488189	108.7766753
0.0120312	1.36E+06	891500	0.473669291	129.3003423
0.0169531	1.51E+06	990644.7368	0.667444882	143.6799816
0.0181836	1.52E+06	1001743.421	0.715889764	145.2896996
0.0194141	1.53E+06	1008861.842	0.764334646	146.3221329
0.0212598	1.54E+06	1015098.684	0.837	147.2267048
0.0240283	1.55E+06	1021236.842	0.945996063	148.1169638
0.0281812	1.56E+06	1027664.474	1.109496063	149.0492072
0.0344104	1.57E+06	1032177.632	1.354740157	149.7037813
0.0437543	1.57E+06	1034381.579	1.722610236	150.0234349
0.0577701	1.58E+06	1036532.895	2.274413386	150.3354549
0.0787938	1.58E+06	1039157.895	3.10211811	150.7161766
0.110329	1.58E+06	1041440.789	4.343661417	151.0472805
0.119079	1.58E+06	1041881.579	4.688149606	151.1112112
0.132204	1.58E+06	1042407.895	5.20488189	151.1875464
0.151892	1.59E+06	1042993.421	5.98	151.2724693
0.159275	1.59E+06	1043164.474	6.270669291	151.2972782

0.170349	1.59E+06	1043453.947	6.706653543	151.3392625
0.18696	1.59E+06	1043769.737	7.360629921	151.3850636
0.211877	1.59E+06	1044125	8.341614173	151.4365899
0.246877	1.59E+06	1044486.842	9.719566929	151.4890703
0.281877	1.59E+06	1044776.316	11.09751969	151.5310547
0.316877	1.59E+06	1045013.158	12.47547244	151.5654055
0.35	1.59E+06	1045184.211	13.77952756	151.5902144

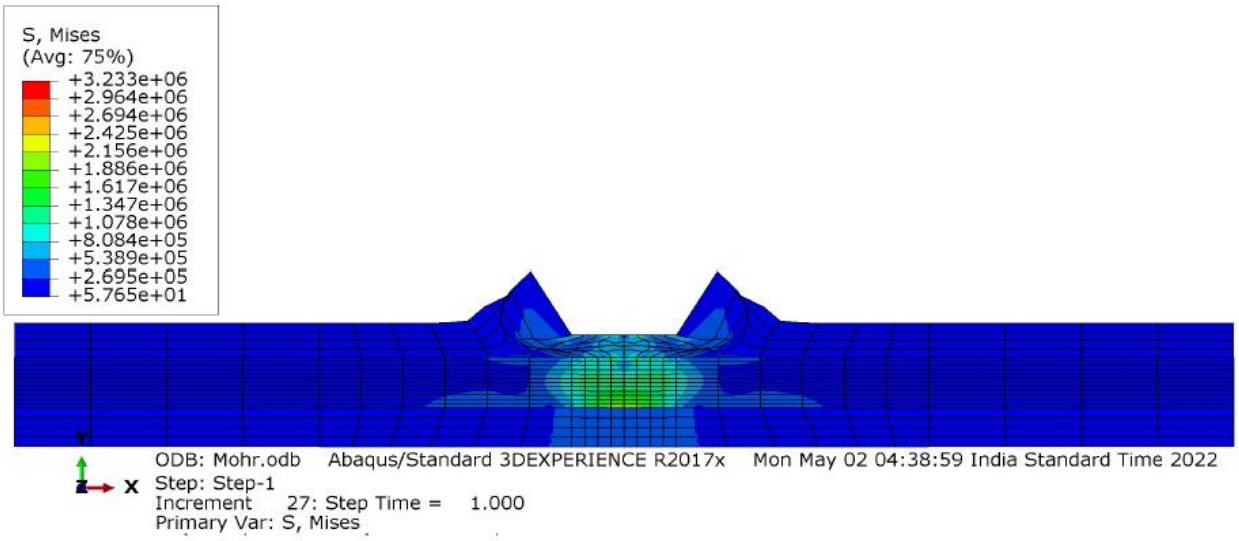


Figure 4.70. Mesh of reinforced soil G'

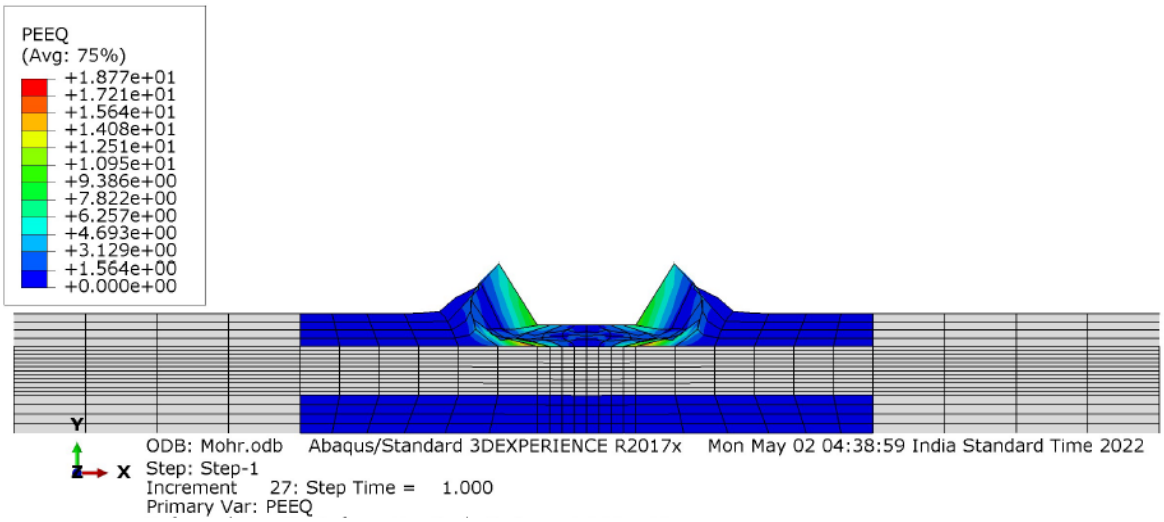
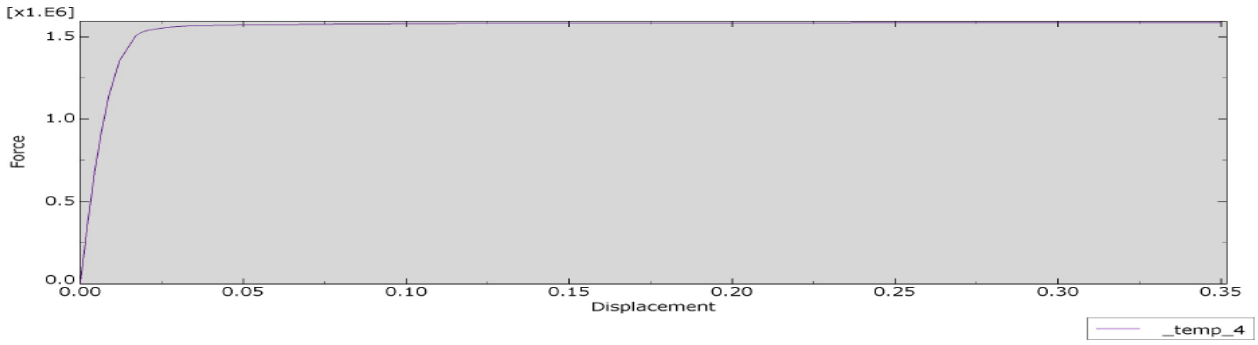


Figure 4.71. Normal stresses of reinforced soil G'



Graph 4.48. Force against Displacement of reinforced soil G' obtained from Abaqus model

- SOIL H'

Table 4.36. Reinforced soil H' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	357211	235007.2368	0.086122047	34.08470686
0.004375	692524	455607.8947	0.172244094	66.07992904
0.0065625	967900	636776.3158	0.258366142	92.35602422
0.00875	1.21E+06	794796.0526	0.344488189	115.2747074
0.0120312	1.49E+06	982565.7895	0.473669291	142.5082366
0.0153125	1.70E+06	1120138.158	0.602854331	162.4612981
0.0185938	1.83E+06	1202671.053	0.73203937	174.4316083
0.021875	1.88E+06	1234394.737	0.861220472	179.0327112
0.0251563	1.90E+06	1247486.842	0.990405512	180.9315487
0.0284375	1.91E+06	1256276.316	1.119586614	182.2063462
0.0317187	1.92E+06	1261960.526	1.248767717	183.0307661
0.0366406	1.93E+06	1267934.211	1.442543307	183.8971704
0.0415625	1.93E+06	1272631.579	1.636318898	184.5784619
0.0464844	1.94E+06	1275065.789	1.830094488	184.9315121
0.0514062	1.94E+06	1276855.263	2.023866142	185.1910517
0.0563281	1.94E+06	1278190.789	2.217641732	185.3847522
0.0637109	1.95E+06	1279940.789	2.50830315	185.6385667
0.0710938	1.95E+06	1281703.947	2.798968504	185.8942895
0.0784766	1.95E+06	1283078.947	3.089629921	186.0937152
0.0895508	1.95E+06	1284730.263	3.525622047	186.3332168
0.0937036	1.95E+06	1285032.895	3.68911811	186.3771095
0.0999329	1.95E+06	1285842.105	3.934366142	186.4944749
0.109277	1.96E+06	1286815.789	4.302244094	186.6356949
0.123293	1.96E+06	1287809.211	4.854055118	186.7797776
0.137308	1.96E+06	1288592.105	5.405826772	186.8933262
0.140812	1.96E+06	1288947.368	5.543779528	186.9448524

0.146068	1.96E+06	1289111.842	5.750708661	186.9687072
0.153952	1.96E+06	1289625	6.061102362	187.043134
0.165778	1.96E+06	1290111.842	6.526692913	187.113744
0.177604	1.96E+06	1290644.737	6.992283465	187.1910334
0.18943	1.96E+06	1291039.474	7.457874016	187.2482847
0.192386	1.96E+06	1291105.263	7.574251969	187.2578266
0.195343	1.96E+06	1291236.842	7.690669291	187.2769104
0.199777	1.96E+06	1291401.316	7.86523622	187.3007652
0.206429	1.96E+06	1291559.211	8.127125984	187.3236657
0.216407	1.96E+06	1291907.895	8.51996063	187.3742378
0.220149	1.96E+06	1291967.105	8.667283465	187.3828255
0.225762	1.96E+06	1292111.842	8.888267717	187.4038177
0.234181	1.96E+06	1292361.842	9.219724409	187.4400769
0.246809	1.96E+06	1292671.053	9.716889764	187.4849238
0.259438	1.97E+06	1292973.684	10.21409449	187.5288165
0.272066	1.97E+06	1293236.842	10.71125984	187.5669841
0.276802	1.97E+06	1293348.684	10.89771654	187.5832053
0.283905	1.97E+06	1293473.684	11.1773622	187.6013349
0.286569	1.97E+06	1293552.632	11.28224409	187.6127852
0.290565	1.97E+06	1293618.421	11.43956693	187.6223271
0.296558	1.97E+06	1293730.263	11.67551181	187.6385483
0.305549	1.97E+06	1293888.158	12.02948819	187.6614489
0.312292	1.97E+06	1293980.263	12.29496063	187.6748076
0.322406	1.97E+06	1294164.474	12.69314961	187.7015249
0.326199	1.97E+06	1294250	12.84248031	187.7139293
0.331888	1.97E+06	1294302.632	13.06645669	187.7215629
0.340422	1.97E+06	1294453.947	13.40244094	187.7435092
0.35	1.97E+06	1294506.579	13.77952756	187.7511427

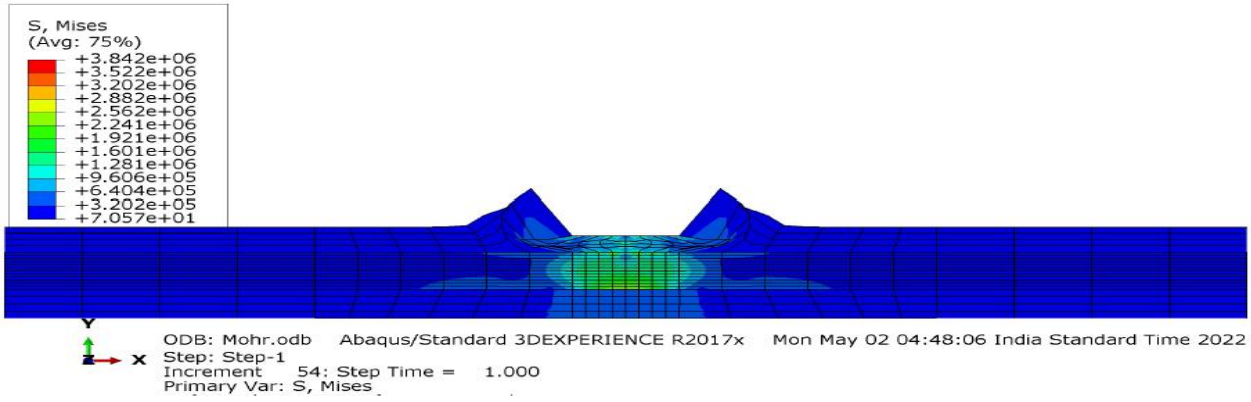


Figure 4.72. Mesh of reinforced soil H'

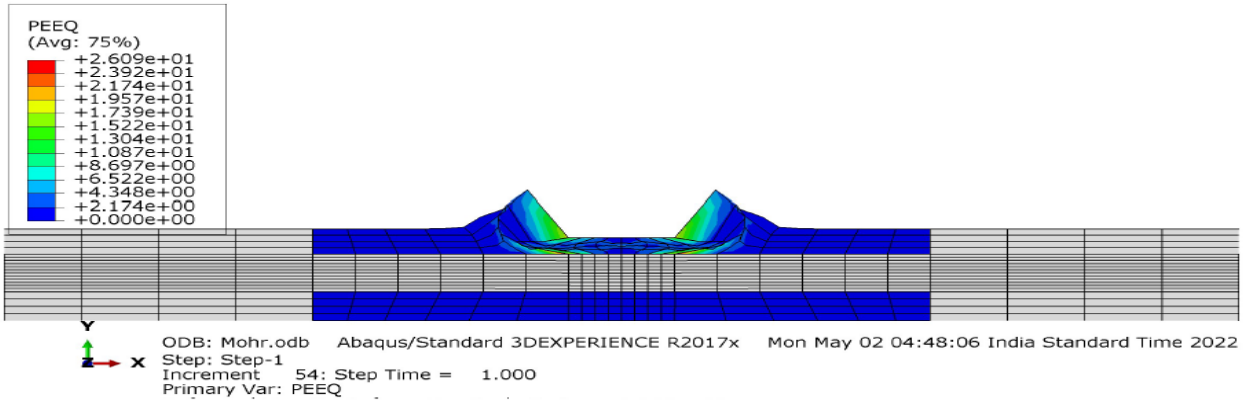
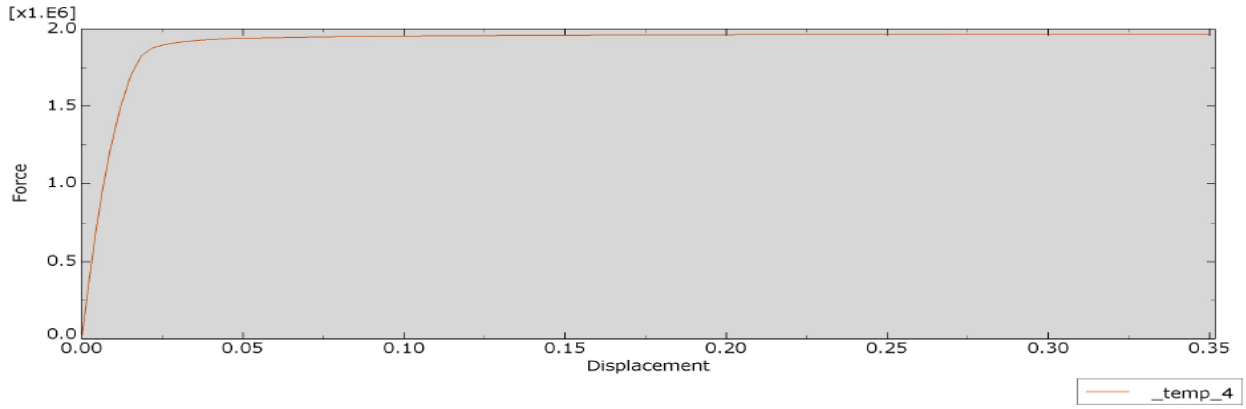


Figure 4.73. Normal stresses of reinforced soil H'



Graph 4.49. Force against Displacement of reinforced soil H' obtained from Abaqus model

- SOIL I'

Table 4.37. Reinforced soil I' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	357036	234892.1053	0.086122047	34.06800854
0.004375	697796	459076.3158	0.172244094	66.58297787
0.00765625	1.11E+06	729171.0526	0.301427165	105.7566648
0.0109375	1.45E+06	950756.5789	0.430610236	137.8947292
0.0142188	1.71E+06	1122138.158	0.559795276	162.7513717
0.0175	1.90E+06	1251440.789	0.688976378	181.5050167
0.0191406	1.97E+06	1295822.368	0.753566929	187.9419807
0.0207813	2.01E+06	1323618.421	0.818161417	191.9734323
0.0224219	2.04E+06	1339960.526	0.882751969	194.3436396
0.0240625	2.05E+06	1349328.947	0.94734252	195.7024058

0.0257031	2.06E+06	1357230.263	1.011933071	196.8483876
0.0273438	2.07E+06	1362710.526	1.076527559	197.6432277
0.0298047	2.08E+06	1369052.632	1.173413386	198.5630666
0.0334961	2.09E+06	1374460.526	1.318744094	199.3474106
0.0353418	2.09E+06	1377842.105	1.391409449	199.8378641
0.0371875	2.10E+06	1379861.842	1.464074803	200.1308003
0.0399561	2.10E+06	1383644.737	1.573074803	200.6794594
0.0441089	2.11E+06	1387322.368	1.736570866	201.2128515
0.0482617	2.11E+06	1390980.263	1.900066929	201.743381
0.0524146	2.12E+06	1393046.053	2.063566929	202.0429966
0.0565674	2.12E+06	1394111.842	2.227062992	202.1975753
0.0607202	2.12E+06	1395578.947	2.390559055	202.4103596
0.064873	2.12E+06	1396625	2.554055118	202.5620758
0.0711023	2.13E+06	1398605.263	2.79930315	202.8492869
0.0734383	2.13E+06	1398868.421	2.891271654	202.8874545
0.0769422	2.13E+06	1399690.789	3.029220472	203.0067282
0.0804462	2.13E+06	1400296.053	3.167173228	203.0945136
0.0839501	2.13E+06	1400927.632	3.305122047	203.1861159
0.089206	2.13E+06	1401559.211	3.512047244	203.2777181
0.091177	2.13E+06	1402098.684	3.589645669	203.3559616
0.0941335	2.13E+06	1402230.263	3.706043307	203.3750454
0.0985682	2.13E+06	1402881.579	3.880637795	203.4695102
0.10522	2.13E+06	1403855.263	4.142519685	203.6107303
0.107715	2.13E+06	1403980.263	4.240748031	203.6288599
0.111456	2.13E+06	1404460.526	4.388031496	203.6985157
0.117069	2.14E+06	1404921.053	4.609015748	203.765309
0.119174	2.14E+06	1405289.474	4.691889764	203.8187436
0.122331	2.14E+06	1405348.684	4.816181102	203.8273314
0.127067	2.14E+06	1406059.211	5.002637795	203.9303838
0.13417	2.14E+06	1406618.421	5.282283465	204.01149
0.136834	2.14E+06	1406552.632	5.387165354	204.0019481
0.14083	2.14E+06	1407052.632	5.544488189	204.0744665
0.146823	2.14E+06	1407315.789	5.780433071	204.1126341
0.152817	2.14E+06	1407657.895	6.016417323	204.1622519
0.158811	2.14E+06	1408072.368	6.252401575	204.2223659
0.164804	2.14E+06	1408375	6.488346457	204.2662586
0.170798	2.14E+06	1408585.526	6.724330709	204.2967927
0.173045	2.14E+06	1408703.947	6.812795276	204.3139681
0.176417	2.14E+06	1408914.474	6.945551181	204.3445022
0.181474	2.14E+06	1409098.684	7.144645669	204.3712195
0.189059	2.14E+06	1409559.211	7.443267717	204.4380128
0.191904	2.14E+06	1409552.632	7.555275591	204.4370586

0.196171	2.14E+06	1409927.632	7.723267717	204.4914474
0.199371	2.14E+06	1409835.526	7.849251969	204.4780888
0.204171	2.14E+06	1410039.474	8.038228346	204.5076686
0.205972	2.14E+06	1410269.737	8.109133858	204.5410653
0.208672	2.14E+06	1410375	8.215433071	204.5563323
0.212722	2.14E+06	1410473.684	8.37488189	204.5706452
0.214241	2.14E+06	1410625	8.434685039	204.5925915
0.216519	2.14E+06	1410618.421	8.524370079	204.5916373
0.219936	2.14E+06	1410539.474	8.658897638	204.5801871
0.225063	2.14E+06	1410861.842	8.860748031	204.6269423
0.227626	2.14E+06	1411065.789	8.961653543	204.6565222
0.230189	2.14E+06	1411065.789	9.062559055	204.6565222
0.234033	2.15E+06	1411296.053	9.213897638	204.6899189
0.237878	2.15E+06	1411421.053	9.365275591	204.7080485
0.241722	2.15E+06	1411440.789	9.516614173	204.710911
0.243164	2.15E+06	1411513.158	9.573385827	204.7214071
0.245327	2.15E+06	1411539.474	9.658543307	204.7252239
0.24857	2.15E+06	1411644.737	9.786220472	204.7404909
0.253436	2.15E+06	1411901.316	9.977795276	204.7777043
0.258302	2.15E+06	1412032.895	10.16937008	204.7967881
0.263168	2.15E+06	1412125	10.36094488	204.8101468
0.265601	2.15E+06	1412243.421	10.45673228	204.8273222
0.26925	2.15E+06	1412263.158	10.6003937	204.8301848
0.272899	2.15E+06	1412414.474	10.74405512	204.8521311
0.276549	2.15E+06	1412414.474	10.88775591	204.8521311
0.282023	2.15E+06	1412552.632	11.10326772	204.8721691
0.284075	2.15E+06	1412776.316	11.18405512	204.9046116
0.287155	2.15E+06	1412657.895	11.30531496	204.8874361
0.289464	2.15E+06	1412967.105	11.39622047	204.9322831
0.292928	2.15E+06	1412888.158	11.53259843	204.9208328
0.296392	2.15E+06	1412980.263	11.66897638	204.9341914
0.299856	2.15E+06	1413164.474	11.80535433	204.9609088
0.305052	2.15E+06	1413105.263	12.00992126	204.952321
0.307	2.15E+06	1413348.684	12.08661417	204.9876261
0.309923	2.15E+06	1413309.211	12.20169291	204.9819009
0.314307	2.15E+06	1413506.579	12.37429134	205.0105266
0.318692	2.15E+06	1413440.789	12.54692913	205.0009847
0.323076	2.15E+06	1413671.053	12.71952756	205.0343814
0.32472	2.15E+06	1413578.947	12.78425197	205.0210227
0.327186	2.15E+06	1413822.368	12.88133858	205.0563277
0.330885	2.15E+06	1413736.842	13.0269685	205.0439233
0.332272	2.15E+06	1413914.474	13.0815748	205.0696864

0.334353	2.15E+06	1413763.158	13.16350394	205.04774
0.337474	2.15E+06	1413815.789	13.28637795	205.0553735
0.339815	2.15E+06	1414046.053	13.37854331	205.0887702
0.343326	2.15E+06	1414019.737	13.51677165	205.0849534
0.346837	2.15E+06	1414098.684	13.655	205.0964037
0.35	2.15E+06	1414243.421	13.77952756	205.1173959

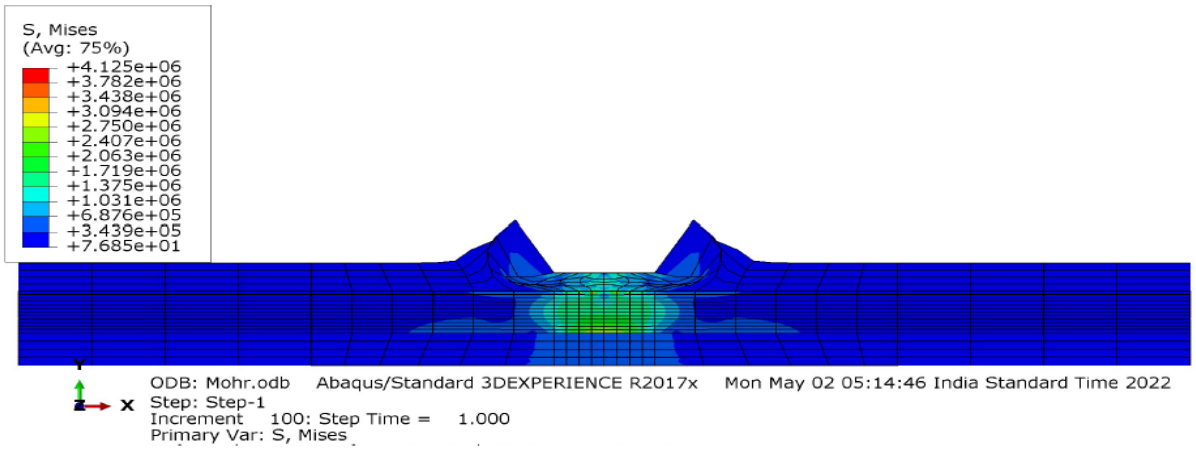


Figure 4.74. Mesh of reinforced soil I'

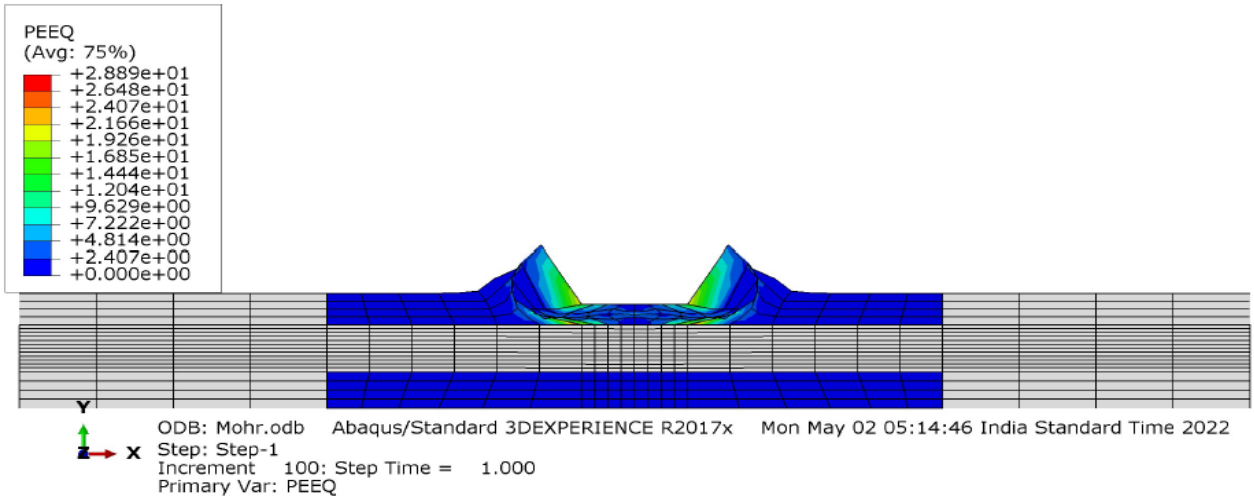
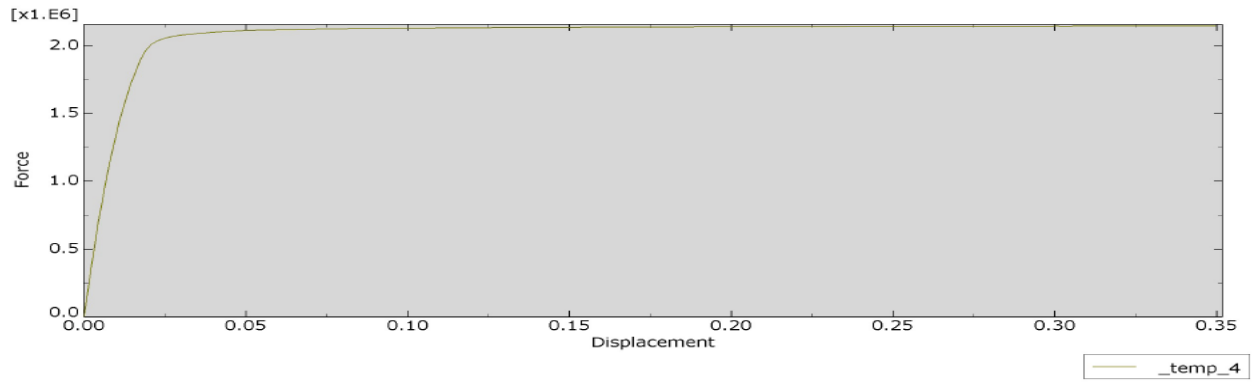
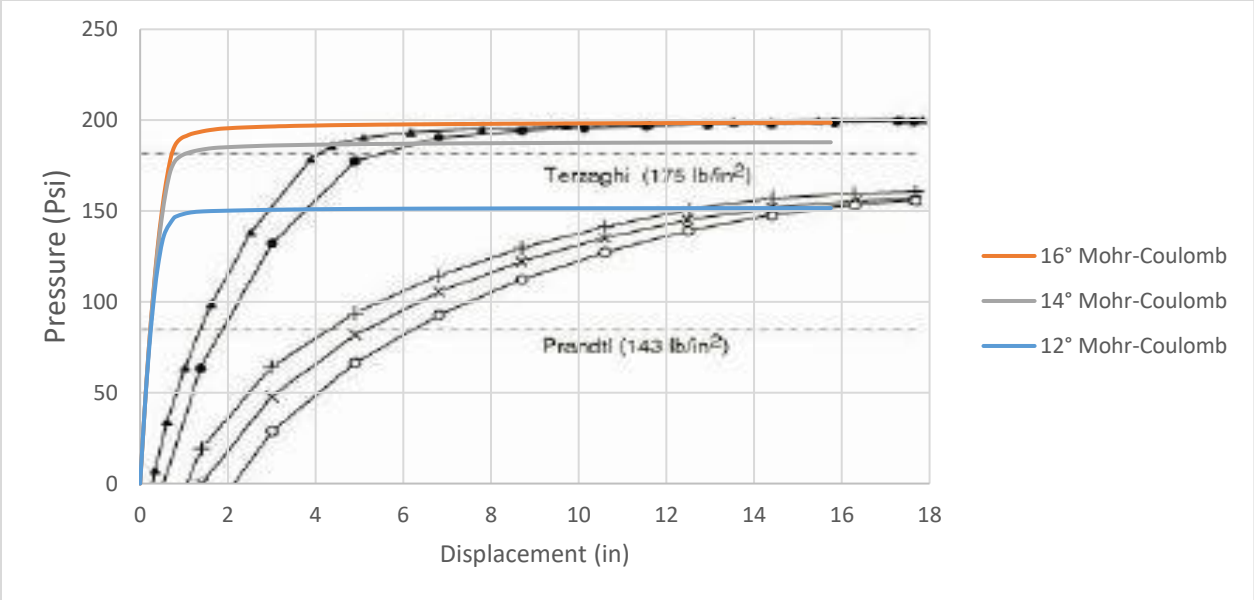


Figure 4.75. Normal stresses of reinforced soil I'



Graph 4.50. Force against Displacement of reinforced soil I' obtained from Abaqus model



4.51. Graph Friction angle variation curves of the reinforced soil G', H'and I' Comparing with the one as given by Chen (1975)

- SOIL J'

Table 4.38. Reinforced soil J' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	407694	268219.7368	0.098425197	38.90174288
0.005	751258	494248.6842	0.196850394	71.68426701
0.0075	1.02E+06	673059.2105	0.295275591	97.61838059
0.01	1.23E+06	811414.4737	0.393700787	117.6849907
0.01375	1.43E+06	940815.7895	0.541338583	136.4529485

0.019375	1.53E+06	1006348.684	0.762795276	145.9576324
0.0214844	1.54E+06	1014960.526	0.84584252	147.2066668
0.0246484	1.55E+06	1021980.263	0.970409449	148.2247873
0.0293945	1.56E+06	1028855.263	1.15726378	149.2219155
0.0365137	1.57E+06	1032815.789	1.437547244	149.7963377
0.0471924	1.57E+06	1034940.789	1.857968504	150.104541
0.0632105	1.58E+06	1037263.158	2.488602362	150.44137
0.0872376	1.58E+06	1039934.211	3.434551181	150.828771
0.111265	1.58E+06	1041532.895	4.380511811	151.0606391
0.135292	1.58E+06	1042500	5.326456693	151.200905
0.171332	1.59E+06	1043381.579	6.745354331	151.3287665
0.181332	1.59E+06	1043578.947	7.139055118	151.3573921
0.196332	1.59E+06	1043881.579	7.729606299	151.4012849
0.218832	1.59E+06	1044190.789	8.615433071	151.4461318
0.252582	1.59E+06	1044526.316	9.944173228	151.4947955
0.292582	1.59E+06	1044835.526	11.51897638	151.5396424
0.332582	1.59E+06	1045078.947	13.09377953	151.5749474
0.372582	1.59E+06	1045276.316	14.66858268	151.6035731
0.4	1.59E+06	1045388.158	15.7480315	151.6197943

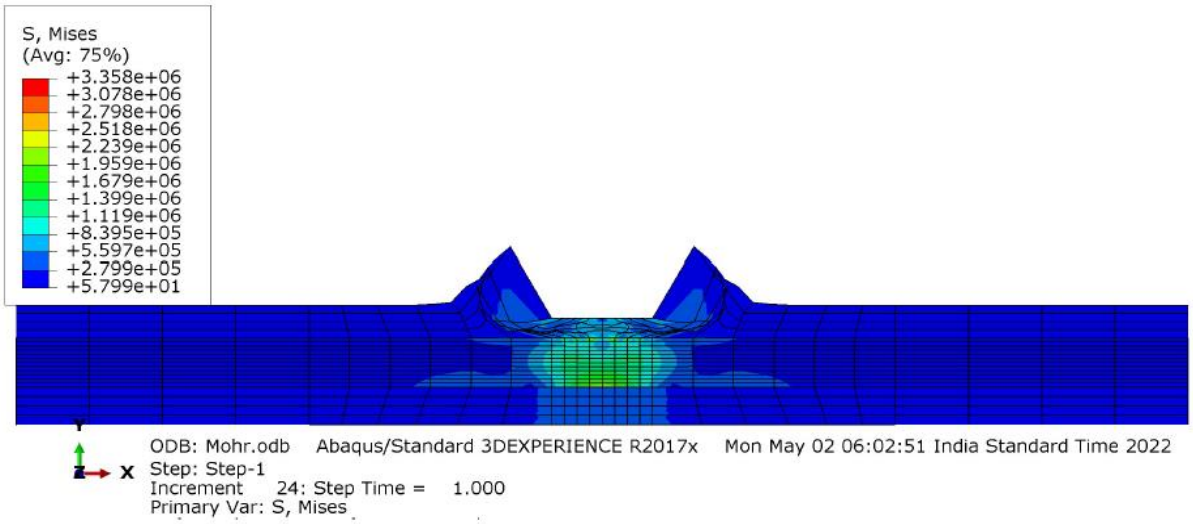


Figure 4.76. Mesh of reinforced soil J’

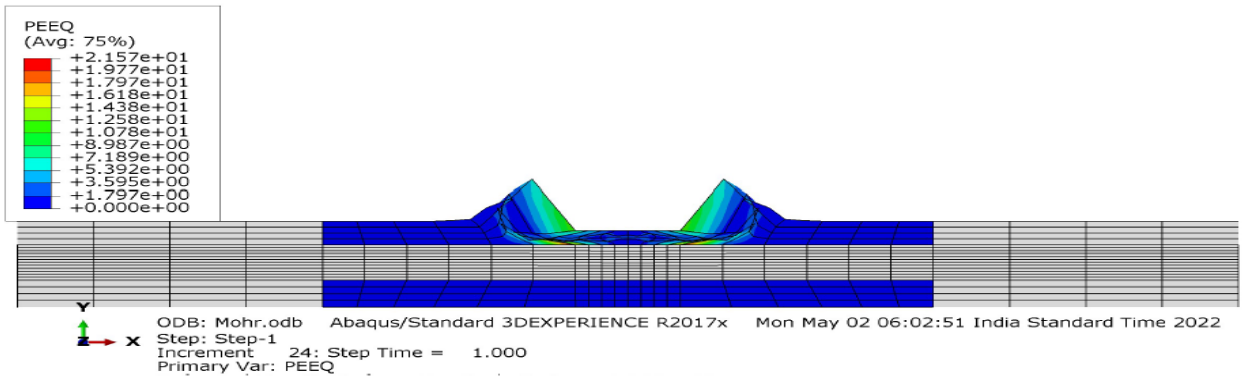
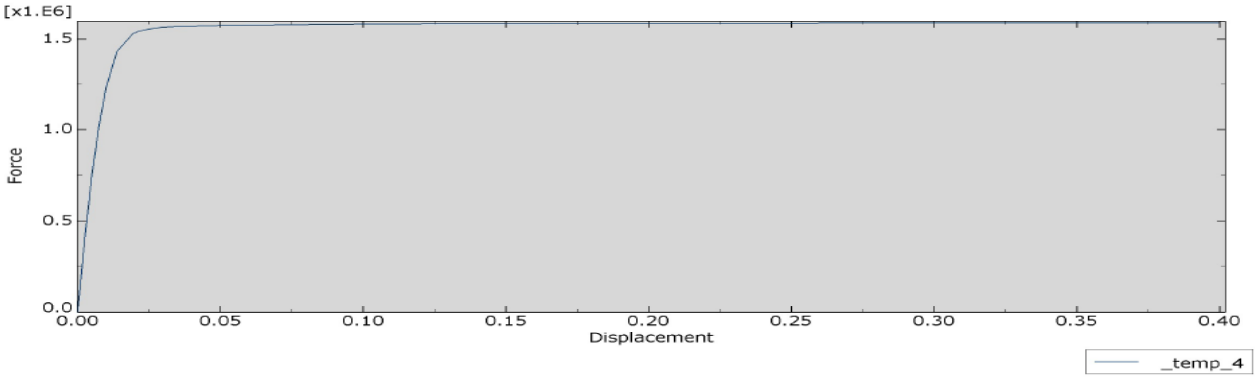


Figure 4.77. Normal stresses of reinforced soil J'



Graph 4.52. Force against Displacement of reinforced soil J' obtained from Abaqus model

- SOIL K'

Table 4.39. Reinforced soil K' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	408279	268604.6053	0.098425197	38.95756298
0.005	775135	509957.2368	0.196850394	73.96258584
0.0075	1.07E+06	706486.8421	0.295275591	102.4666186
0.01	1.33E+06	874026.3158	0.393700787	126.7660144
0.0125	1.53E+06	1006486.842	0.492125984	145.9776704
0.015	1.69E+06	1111098.684	0.590551181	161.1502414
0.0175	1.80E+06	1184967.105	0.688976378	171.8638837
0.02	1.86E+06	1221828.947	0.787401575	177.2102088
0.0225	1.88E+06	1238335.526	0.885826772	179.6042708
0.025	1.90E+06	1248118.421	0.984251969	181.0231509
0.0275	1.91E+06	1254493.421	1.082677165	181.9477608
0.03125	1.92E+06	1261407.895	1.230314961	182.9506142
0.036875	1.93E+06	1268361.842	1.451771654	183.9591927

0.0425	1.94E+06	1273197.368	1.673228346	184.6605222
0.048125	1.94E+06	1275585.526	1.894685039	185.0068931
0.05375	1.94E+06	1277328.947	2.116141732	185.2597533
0.059375	1.94E+06	1278960.526	2.337598425	185.4963924
0.065	1.95E+06	1280348.684	2.559055118	185.6977264
0.0734375	1.95E+06	1282217.105	2.891240157	185.9687163
0.0797656	1.95E+06	1283263.158	3.140377953	186.1204325
0.0892578	1.95E+06	1284355.263	3.514086614	186.278828
0.103496	1.95E+06	1286118.421	4.074645669	186.5345508
0.117734	1.96E+06	1287381.579	4.63519685	186.7177553
0.121294	1.96E+06	1287618.421	4.775354331	186.7521061
0.124854	1.96E+06	1287914.474	4.915511811	186.7950446
0.130193	1.96E+06	1288243.421	5.125708661	186.8427541
0.138202	1.96E+06	1288730.263	5.441023622	186.9133642
0.150215	1.96E+06	1289361.842	5.913976378	187.0049664
0.154721	1.96E+06	1289631.579	6.091377953	187.0440881
0.161478	1.96E+06	1289901.316	6.357401575	187.0832099
0.171615	1.96E+06	1290355.263	6.756496063	187.149049
0.181751	1.96E+06	1290763.158	7.155551181	187.2082088
0.191887	1.96E+06	1291138.158	7.554606299	187.2625976
0.19949	1.96E+06	1291348.684	7.853937008	187.2931317
0.210893	1.96E+06	1291769.737	8.302874016	187.3541998
0.222297	1.96E+06	1292098.684	8.751850394	187.4019093
0.2337	1.96E+06	1292315.789	9.200787402	187.4333976
0.237977	1.96E+06	1292473.684	9.369173228	187.4562981
0.244391	1.96E+06	1292644.737	9.621692913	187.481107
0.254013	1.97E+06	1292894.737	10.00051181	187.5173663
0.268445	1.97E+06	1293111.842	10.56870079	187.5488545
0.273857	1.97E+06	1293315.789	10.78177165	187.5784344
0.281976	1.97E+06	1293401.316	11.10141732	187.5908389
0.28502	1.97E+06	1293532.895	11.22125984	187.6099227
0.289587	1.97E+06	1293618.421	11.40106299	187.6223271
0.296436	1.97E+06	1293703.947	11.67070866	187.6347316
0.306711	1.97E+06	1293927.632	12.07523622	187.667174
0.310564	1.97E+06	1293921.053	12.22692913	187.6662199
0.316344	1.97E+06	1294111.842	12.45448819	187.6938914
0.325013	1.97E+06	1294164.474	12.7957874	187.7015249
0.328264	1.97E+06	1294250	12.92377953	187.7139293
0.333141	1.97E+06	1294421.053	13.1157874	187.7387383
0.340455	1.97E+06	1294375	13.40374016	187.7320589
0.351427	1.97E+06	1294644.737	13.83570866	187.7711807
0.355542	1.97E+06	1294671.053	13.99771654	187.7749975

0.361714	1.97E+06	1294723.684	14.24070866	187.782631
0.370971	1.97E+06	1294776.316	14.60515748	187.7902645
0.374443	1.97E+06	1294855.263	14.74185039	187.8017148
0.37965	1.97E+06	1294953.947	14.94685039	187.8160276
0.387462	1.97E+06	1294907.895	15.25440945	187.8093483
0.399178	1.97E+06	1295085.526	15.71566929	187.8351114
0.4	1.97E+06	1295013.158	15.7480315	187.8246153

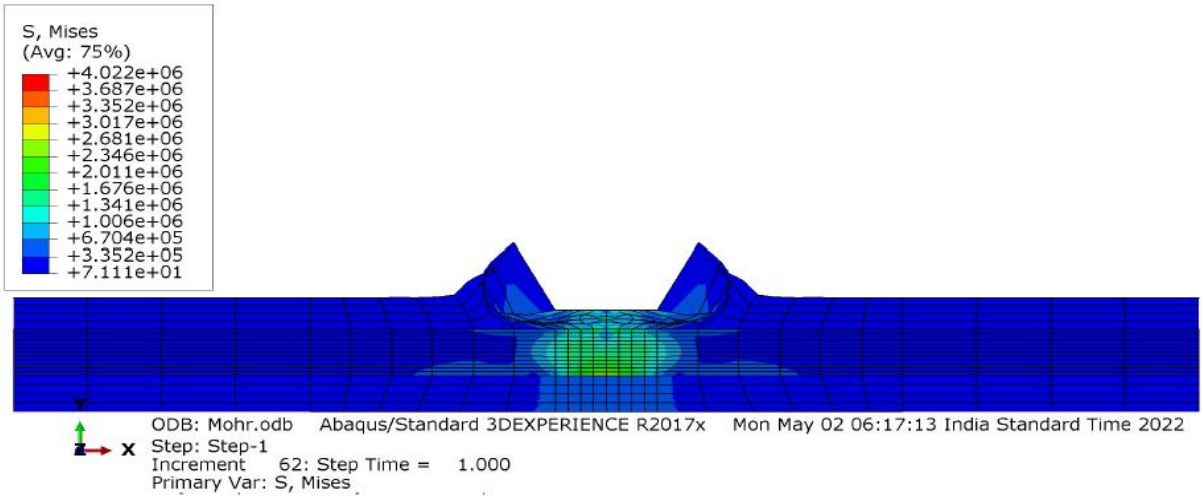


Figure 4.78. Mesh of reinforced soil K'

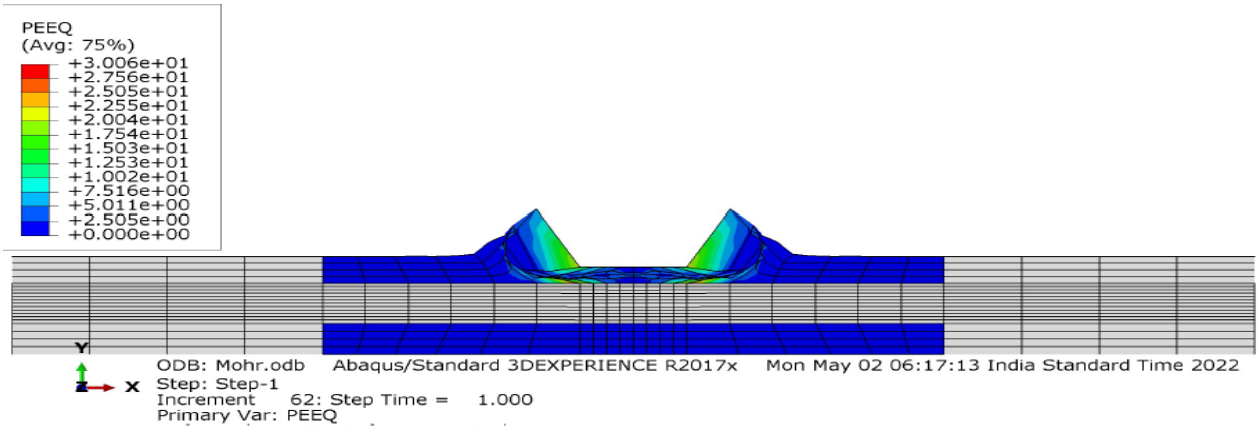
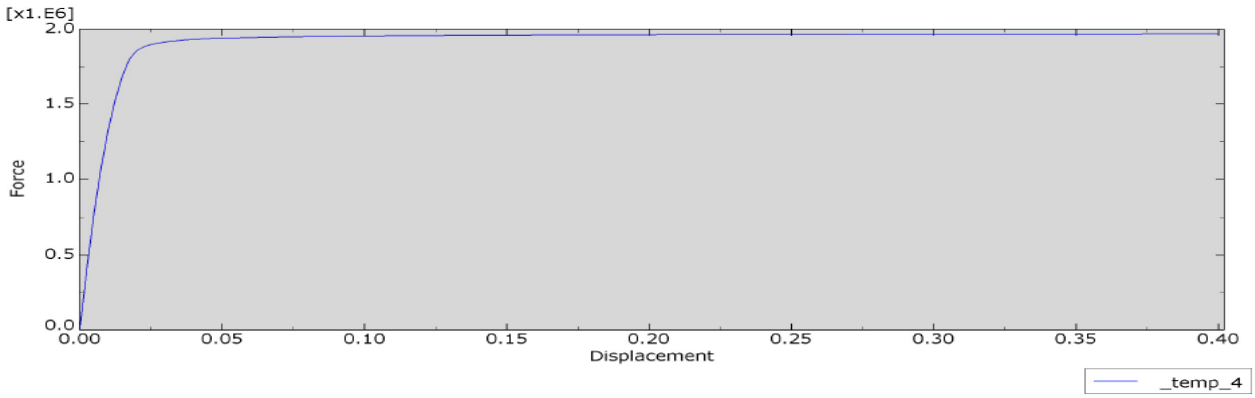


Figure 4.79. Normal stresses of reinforced soil K'



Graph 4.53. Force against Displacement of reinforced soil K' obtained from Abaqus model

- SOIL L'

Table 4.40. Reinforced soil L' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	408342	268646.0526	0.098425197	38.96357438
0.005	780592	513547.3684	0.196850394	74.48328718
0.0075	1.09E+06	714085.5263	0.295275591	103.5687078
0.01	1.35E+06	887677.6316	0.393700787	128.7459581
0.0125	1.56E+06	1028052.632	0.492125984	149.1055044
0.015	1.74E+06	1142302.632	0.590551181	165.6759633
0.0175	1.87E+06	1229875	0.688976378	178.3771828
0.01875	1.92E+06	1259881.579	0.738188976	182.7292422
0.02	1.95E+06	1280710.526	0.787401575	185.7502069
0.02125	1.97E+06	1294322.368	0.836614173	187.7244254
0.0225	1.98E+06	1303144.737	0.885826772	189.0039939
0.02375	1.99E+06	1309835.526	0.93503937	189.9744048
0.025	2.00E+06	1314664.474	0.984251969	190.6747801
0.026875	2.01E+06	1319302.632	1.058070866	191.3474838
0.0296875	2.02E+06	1326868.421	1.168799213	192.444802
0.0339063	2.03E+06	1333348.684	1.334893701	193.3846789
0.038125	2.04E+06	1339111.842	1.500984252	194.2205491
0.0423438	2.04E+06	1343026.316	1.66707874	194.788292
0.0465625	2.05E+06	1346447.368	1.833169291	195.2844707
0.0507813	2.05E+06	1348085.526	1.99926378	195.5220639
0.055	2.05E+06	1349782.895	2.165354331	195.7682449
0.0592187	2.05E+06	1351072.368	2.331444882	195.9552661
0.0655469	2.06E+06	1352559.211	2.580586614	196.1709129
0.071875	2.06E+06	1354111.842	2.829724409	196.3961017
0.0782031	2.06E+06	1355197.368	3.078862205	196.553543

0.0805762	2.06E+06	1355914.474	3.172291339	196.6575497
0.0841357	2.06E+06	1356236.842	3.312429134	196.704305
0.0894751	2.06E+06	1357296.053	3.522641732	196.8579295
0.0974841	2.06E+06	1358085.526	3.837956693	196.9724323
0.105493	2.07E+06	1359177.632	4.153267717	197.1308278
0.113502	2.07E+06	1360032.895	4.468582677	197.2548725
0.121511	2.07E+06	1360638.158	4.783897638	197.3426579
0.123513	2.07E+06	1360842.105	4.862716535	197.3722378
0.125516	2.07E+06	1360921.053	4.941574803	197.3836881
0.128519	2.07E+06	1361177.632	5.05980315	197.4209015
0.133024	2.07E+06	1361440.789	5.237165354	197.4590691
0.139782	2.07E+06	1362046.053	5.503228346	197.5468545
0.142316	2.07E+06	1362046.053	5.602992126	197.5468545
0.146117	2.07E+06	1362375	5.752637795	197.594564
0.151819	2.07E+06	1362578.947	5.977125984	197.6241439
0.156095	2.07E+06	1362940.789	6.145472441	197.6766243
0.16251	2.07E+06	1363184.211	6.398031496	197.7119294
0.164915	2.07E+06	1363355.263	6.492716535	197.7367383
0.168523	2.07E+06	1363473.684	6.63476378	197.7539137
0.173935	2.07E+06	1363842.105	6.847834646	197.8073483
0.182054	2.07E+06	1364171.053	7.167480315	197.8550578
0.190172	2.07E+06	1364486.842	7.487086614	197.9008589
0.19829	2.07E+06	1364802.632	7.806692913	197.94666
0.201335	2.07E+06	1364960.526	7.926574803	197.9695606
0.205901	2.07E+06	1365078.947	8.106338583	197.986736
0.212751	2.08E+06	1365361.842	8.376023622	198.0277662
0.21532	2.08E+06	1365375	8.477165354	198.0296745
0.219173	2.08E+06	1365552.632	8.628858268	198.0554377
0.224952	2.08E+06	1365671.053	8.856377953	198.0726131
0.233622	2.08E+06	1365960.526	9.197716535	198.1145974
0.242291	2.08E+06	1366328.947	9.539015748	198.168032
0.246625	2.08E+06	1366361.842	9.709645669	198.172803
0.253127	2.08E+06	1366631.579	9.965629921	198.2119248
0.259629	2.08E+06	1366750	10.22161417	198.2291002
0.266131	2.08E+06	1366960.526	10.47759843	198.2596343
0.272633	2.08E+06	1367092.105	10.73358268	198.2787181
0.279135	2.08E+06	1367328.947	10.98956693	198.3130689
0.285637	2.08E+06	1367335.526	11.24555118	198.3140231
0.292139	2.08E+06	1367585.526	11.50153543	198.3502823
0.301892	2.08E+06	1367664.474	11.88551181	198.3617326
0.30555	2.08E+06	1367914.474	12.02952756	198.3979918
0.311036	2.08E+06	1367848.684	12.24551181	198.3884499

0.31515	2.08E+06	1368144.737	12.40748031	198.4313884
0.321322	2.08E+06	1368256.579	12.65047244	198.4476096
0.323636	2.08E+06	1368184.211	12.7415748	198.4371136
0.327108	2.08E+06	1368342.105	12.87826772	198.4600141
0.332316	2.08E+06	1368414.474	13.08330709	198.4705102
0.340127	2.08E+06	1368467.105	13.39082677	198.4781437
0.343056	2.08E+06	1368644.737	13.50614173	198.5039068
0.34745	2.08E+06	1368546.053	13.67913386	198.489594
0.35404	2.08E+06	1368815.789	13.93858268	198.5287158
0.363926	2.08E+06	1368611.842	14.32779528	198.4991359
0.367634	2.08E+06	1369052.632	14.47377953	198.5630666
0.373195	2.08E+06	1368769.737	14.69271654	198.5220364
0.37528	2.08E+06	1369111.842	14.77480315	198.5716543
0.378408	2.08E+06	1368888.158	14.89795276	198.5392119
0.3831	2.08E+06	1369250	15.08267717	198.5916923
0.390138	2.08E+06	1369151.316	15.35976378	198.5773794
0.397176	2.08E+06	1369144.737	15.63685039	198.5764253
0.4	2.08E+06	1369250	15.7480315	198.5916923

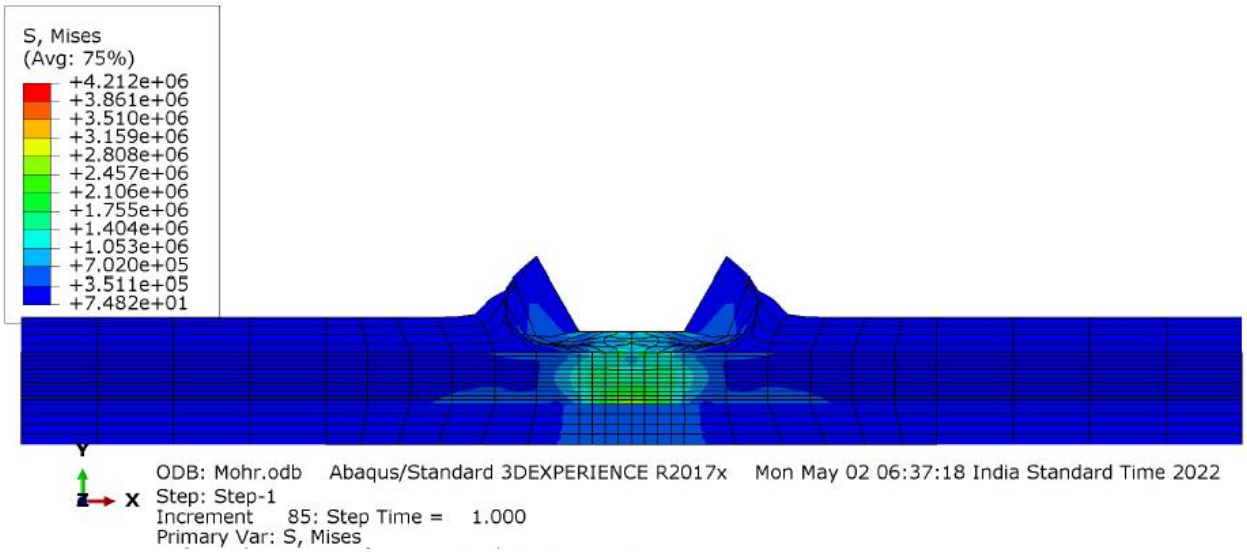


Figure 4.80. Mesh of reinforced soil L’

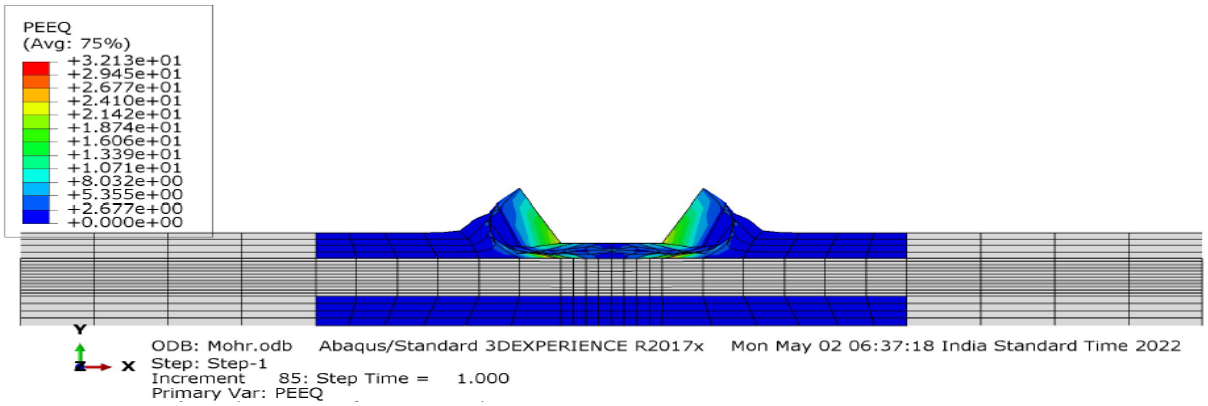
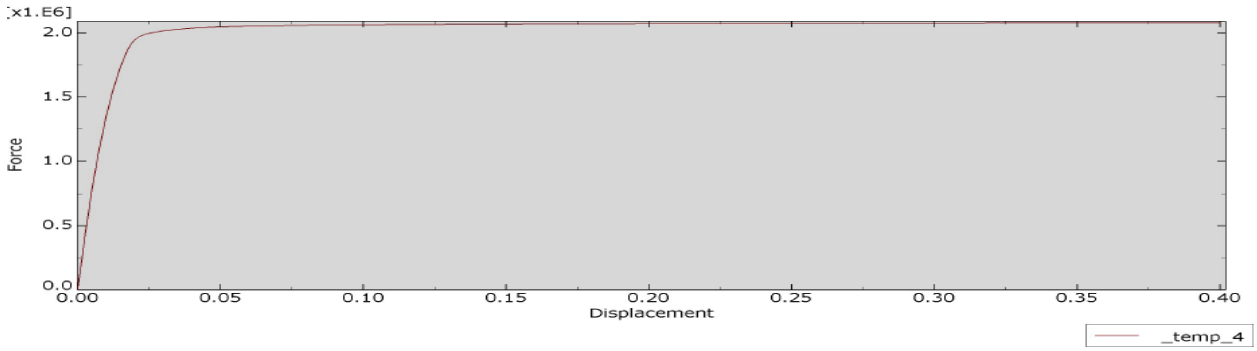
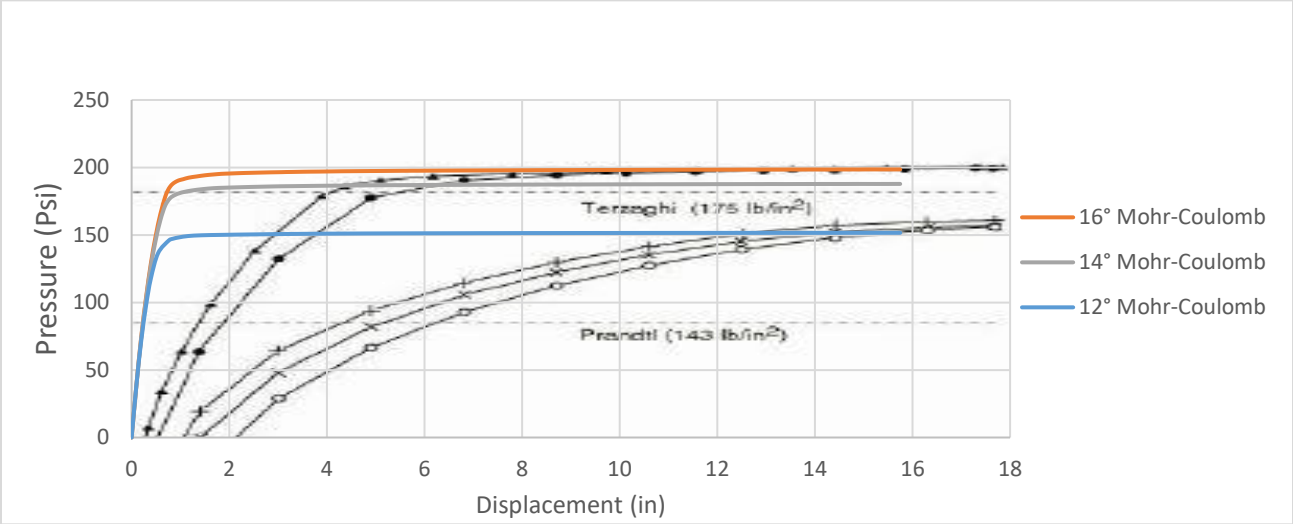


Figure 4.81. Normal stresses of reinforced soil L'



Graph 4.54. Force against Displacement of reinforced soil L' obtained from Abaqus model



4.55. Graph Friction angle variation curves of the reinforced soil J', K'and L' Comparing with the one as given by Chen (1975)

For N= 5

- SOIL A''

Table 4.41. Reinforced soil A'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0015625	296622	195146.0526	0.061515748	28.30336669
0.003125	579506	381253.9474	0.123031496	55.29586752
0.00546875	912083	600054.6053	0.215305118	87.03002339
0.00898437	1.26E+06	827782.8947	0.353715354	120.0590147
0.0103027	1.35E+06	887953.9474	0.40561811	128.786034
0.0122803	1.45E+06	950763.1579	0.483476378	137.8956834
0.0152466	1.51E+06	993480.2632	0.600259843	144.0912373
0.019696	1.54E+06	1014907.895	0.775433071	147.1990333
0.0213646	1.55E+06	1019230.263	0.841125984	147.8259359
0.0238674	1.56E+06	1024019.737	0.939661417	148.5205861
0.0276217	1.56E+06	1029118.421	1.087468504	149.2600831
0.033253	1.57E+06	1032506.579	1.309173228	149.7514908
0.0417	1.57E+06	1034276.316	1.641732283	150.0081679
0.0543706	1.58E+06	1036296.053	2.140574803	150.3011041
0.0733764	1.58E+06	1038756.579	2.888834646	150.6579711
0.0983764	1.58E+06	1040921.053	3.873086614	150.9718995
0.123376	1.58E+06	1042144.737	4.857322835	151.1493788
0.148376	1.59E+06	1042907.895	5.841574803	151.2600648
0.173376	1.59E+06	1043506.579	6.825826772	151.3468961
0.198376	1.59E+06	1043940.789	7.81007874	151.4098726
0.223376	1.59E+06	1044269.737	8.794330709	151.4575821
0.248376	1.59E+06	1044513.158	9.778582677	151.4928871
0.25	1.59E+06	1044539.474	9.842519685	151.4967038

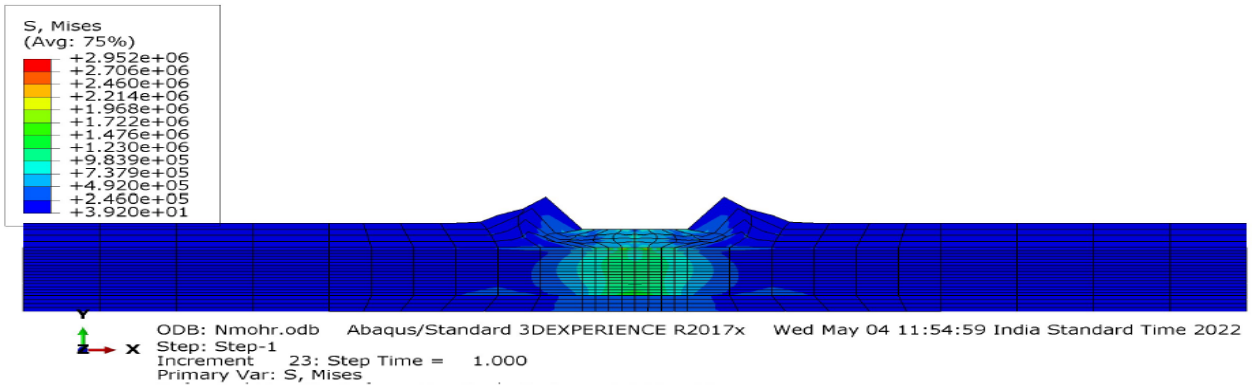


Figure 4.82. Mesh of reinforced soil A''

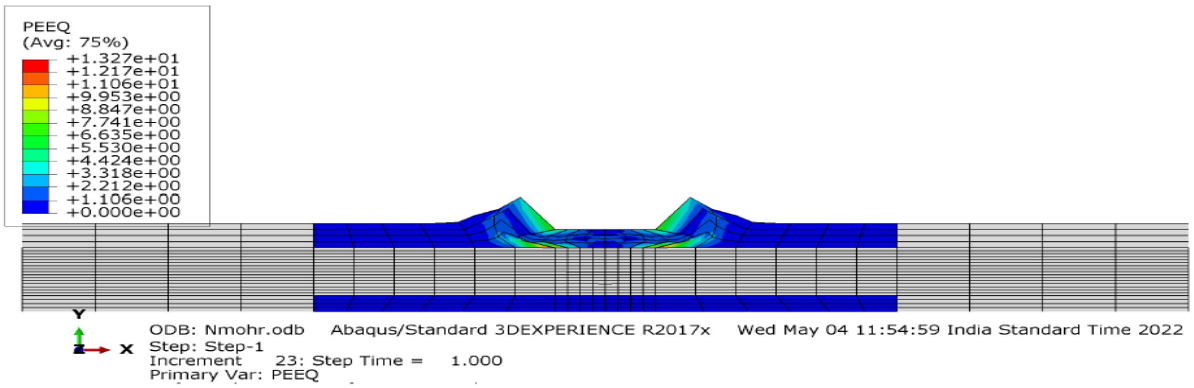
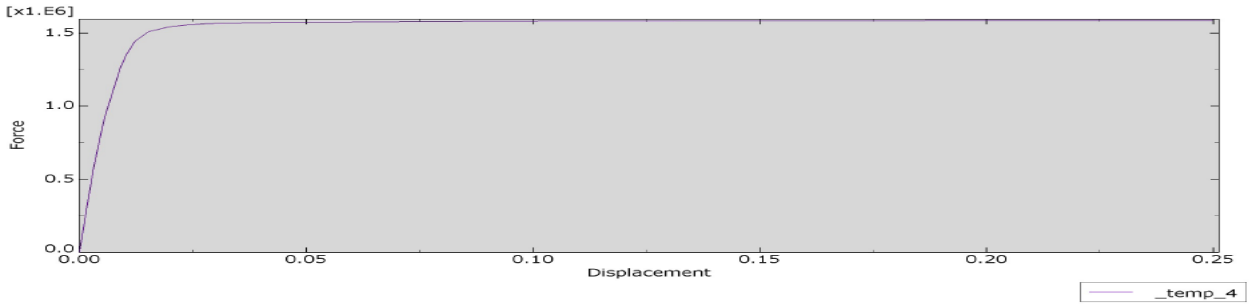


Figure 4.83. Normal stresses of reinforced soil A''



Graph 4.56. Force against Displacement of reinforced soil A'' obtained from Abaqus model

- SOIL B''

Table 4.42. Reinforced soil B'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0.00E+00	0.00E+00	0	0.00E+00
0.0015625	2.96E+05	1.95E+05	0.061515748	2.82E+01
0.003125	5.88E+05	3.87E+05	0.123031496	5.61E+01
0.00546875	9.50E+05	6.25E+05	0.215305118	9.07E+01
0.0078125	1.25E+06	8.22E+05	0.30757874	1.19E+02
0.0101562	1.48E+06	9.75E+05	0.399850394	1.41E+02
0.0125	1.66E+06	1.09E+06	0.492125984	1.58E+02
0.0148437	1.78E+06	1.17E+06	0.584397638	1.70E+02
0.0171875	1.85E+06	1.22E+06	0.676673228	1.76E+02
0.0195313	1.88E+06	1.23E+06	0.768948819	1.79E+02
0.021875	1.89E+06	1.25E+06	0.861220472	1.81E+02
0.0242187	1.90E+06	1.25E+06	0.953492126	1.82E+02
0.0265625	1.91E+06	1.26E+06	1.045767717	1.82E+02
0.0300781	1.92E+06	1.26E+06	1.184177165	1.83E+02
0.0353516	1.93E+06	1.27E+06	1.391795276	1.84E+02
0.040625	1.94E+06	1.27E+06	1.599409449	1.85E+02

0.0458984	1.94E+06	1.28E+06	1.807023622	1.85E+02
0.0511719	1.94E+06	1.28E+06	2.014641732	1.85E+02
0.0564453	1.94E+06	1.28E+06	2.222255906	1.85E+02
0.0617188	1.95E+06	1.28E+06	2.429874016	1.86E+02
0.0696289	1.95E+06	1.28E+06	2.741295276	1.86E+02
0.0814941	1.95E+06	1.28E+06	3.208429134	1.86E+02
0.0933594	1.95E+06	1.29E+06	3.675566929	1.86E+02
0.105225	1.96E+06	1.29E+06	4.142716535	1.87E+02
0.11709	1.96E+06	1.29E+06	4.60984252	1.87E+02
0.128955	1.96E+06	1.29E+06	5.076968504	1.87E+02
0.14082	1.96E+06	1.29E+06	5.544094488	1.87E+02
0.152686	1.96E+06	1.29E+06	6.011259843	1.87E+02
0.164551	1.96E+06	1.29E+06	6.478385827	1.87E+02
0.176416	1.96E+06	1.29E+06	6.945511811	1.87E+02
0.180865	1.96E+06	1.29E+06	7.120669291	1.87E+02
0.18754	1.96E+06	1.29E+06	7.383464567	1.87E+02
0.197551	1.96E+06	1.29E+06	7.777598425	1.87E+02
0.201305	1.96E+06	1.29E+06	7.925393701	1.87E+02
0.206937	1.96E+06	1.29E+06	8.147125984	1.87E+02
0.215384	1.96E+06	1.29E+06	8.479685039	1.87E+02
0.218551	1.96E+06	1.29E+06	8.604370079	1.87E+02
0.223303	1.96E+06	1.29E+06	8.791456693	1.87E+02
0.23043	1.96E+06	1.29E+06	9.072047244	1.87E+02
0.241121	1.96E+06	1.29E+06	9.492952756	1.87E+02
0.25	1.97E+06	1.29E+06	9.842519685	1.88E+02

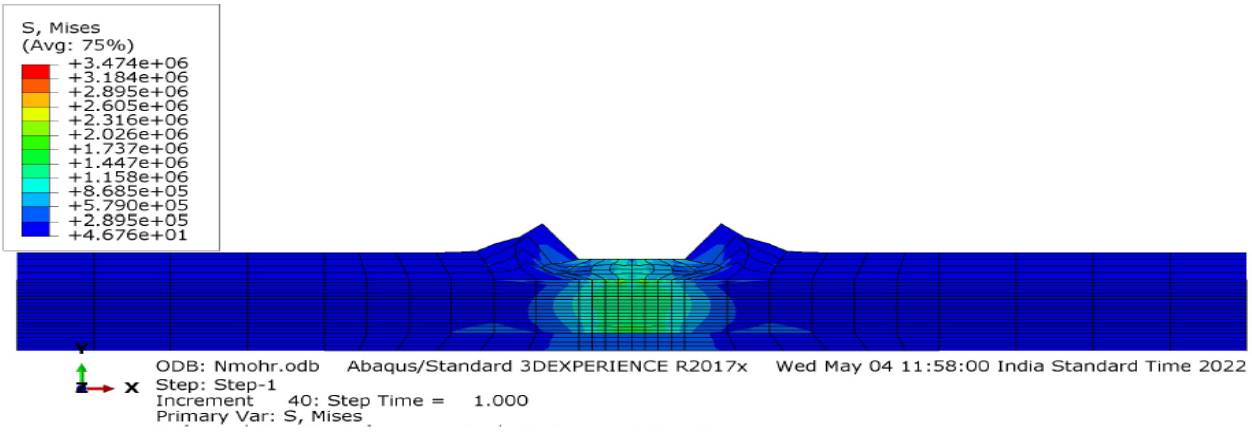


Figure 4.84. Mesh of reinforced soil B’’

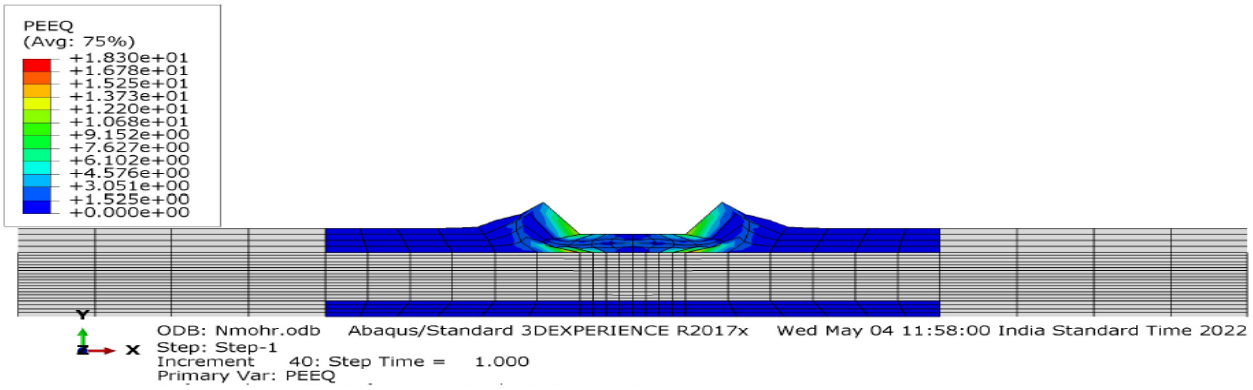
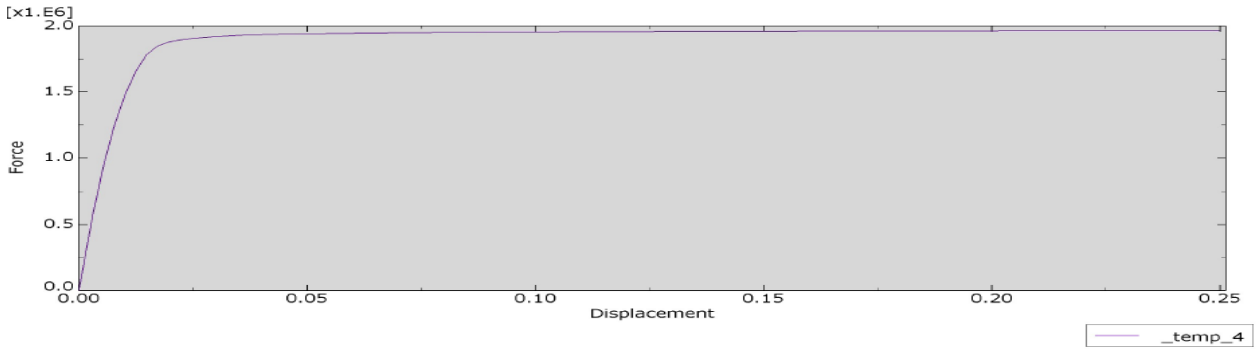


Figure 4.85. Normal stresses of reinforced soil B''



Graph 4.57. Force against Displacement of reinforced soil B'' obtained from Abaqus model

- SOIL C''

Table 4.43. Reinforced soil C'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0.00E+00	0.00E+00	0	0.00E+00
0.0015625	2.95E+05	1.94E+05	0.061515748	2.82E+01
0.003125	5.91E+05	3.89E+05	0.123031496	5.64E+01
0.00546875	9.68E+05	6.37E+05	0.215305118	9.23E+01
0.0078125	1.28E+06	8.44E+05	0.30757874	1.22E+02
0.0101562	1.54E+06	1.01E+06	0.399850394	1.47E+02
0.0125	1.75E+06	1.15E+06	0.492125984	1.67E+02
0.0148437	1.91E+06	1.26E+06	0.584397638	1.82E+02
0.0160156	1.97E+06	1.30E+06	0.630535433	1.88E+02
0.0171875	2.02E+06	1.33E+06	0.676673228	1.93E+02
0.0183594	2.05E+06	1.35E+06	0.722811024	1.96E+02
0.0195313	2.07E+06	1.36E+06	0.768948819	1.98E+02
0.0207031	2.09E+06	1.37E+06	0.815082677	1.99E+02
0.021875	2.10E+06	1.38E+06	0.861220472	2.00E+02
0.0230469	2.11E+06	1.39E+06	0.907358268	2.01E+02

0.0248047	2.12E+06	1.39E+06	0.976562992	2.02E+02
0.0274414	2.13E+06	1.40E+06	1.080370079	2.03E+02
0.0294189	2.14E+06	1.40E+06	1.158224409	2.04E+02
0.0323853	2.14E+06	1.41E+06	1.275011811	2.04E+02
0.0353516	2.15E+06	1.41E+06	1.391795276	2.05E+02
0.0383179	2.15E+06	1.42E+06	1.50857874	2.05E+02
0.0412842	2.16E+06	1.42E+06	1.625362205	2.06E+02
0.0442505	2.16E+06	1.42E+06	1.742145669	2.06E+02
0.0472168	2.16E+06	1.42E+06	1.858929134	2.07E+02
0.0501831	2.17E+06	1.43E+06	1.975712598	2.07E+02
0.0524078	2.17E+06	1.43E+06	2.063299213	2.07E+02
0.0557449	2.17E+06	1.43E+06	2.194681102	2.07E+02
0.0607506	2.17E+06	1.43E+06	2.391755906	2.07E+02
0.0657562	2.18E+06	1.43E+06	2.588826772	2.08E+02
0.0707619	2.18E+06	1.43E+06	2.785901575	2.08E+02
0.0757675	2.18E+06	1.43E+06	2.982972441	2.08E+02
0.0807732	2.18E+06	1.43E+06	3.180047244	2.08E+02
0.0826503	2.18E+06	1.43E+06	3.253948819	2.08E+02
0.085466	2.18E+06	1.43E+06	3.36480315	2.08E+02
0.0896895	2.18E+06	1.44E+06	3.531082677	2.08E+02
0.0960247	2.18E+06	1.44E+06	3.7805	2.08E+02
0.0984005	2.18E+06	1.44E+06	3.874035433	2.08E+02
0.101964	2.18E+06	1.44E+06	4.014330709	2.08E+02
0.107309	2.19E+06	1.44E+06	4.22476378	2.09E+02
0.112655	2.19E+06	1.44E+06	4.43523622	2.09E+02
0.118	2.19E+06	1.44E+06	4.645669291	2.09E+02
0.123346	2.19E+06	1.44E+06	4.856141732	2.09E+02
0.128691	2.19E+06	1.44E+06	5.066574803	2.09E+02
0.134036	2.19E+06	1.44E+06	5.277007874	2.09E+02
0.142054	2.19E+06	1.44E+06	5.592677165	2.09E+02
0.145061	2.19E+06	1.44E+06	5.711062992	2.09E+02
0.149571	2.19E+06	1.44E+06	5.888622047	2.09E+02
0.151263	2.19E+06	1.44E+06	5.95523622	2.09E+02
0.1538	2.19E+06	1.44E+06	6.05511811	2.09E+02
0.157605	2.19E+06	1.44E+06	6.20492126	2.09E+02
0.159032	2.19E+06	1.44E+06	6.261102362	2.09E+02
0.161173	2.19E+06	1.44E+06	6.345393701	2.09E+02
0.164384	2.19E+06	1.44E+06	6.471811024	2.09E+02
0.1692	2.19E+06	1.44E+06	6.661417323	2.09E+02
0.171006	2.19E+06	1.44E+06	6.732519685	2.09E+02
0.173715	2.19E+06	1.44E+06	6.839173228	2.09E+02
0.177779	2.19E+06	1.44E+06	6.999173228	2.09E+02

0.179303	2.19E+06	1.44E+06	7.059173228	2.09E+02
0.181589	2.19E+06	1.44E+06	7.149173228	2.09E+02
0.185017	2.19E+06	1.44E+06	7.284133858	2.09E+02
0.186303	2.19E+06	1.44E+06	7.33476378	2.09E+02
0.188232	2.19E+06	1.44E+06	7.410708661	2.09E+02
0.191125	2.19E+06	1.44E+06	7.524606299	2.09E+02
0.195464	2.19E+06	1.44E+06	7.695433071	2.09E+02
0.197092	2.19E+06	1.44E+06	7.759527559	2.09E+02
0.199533	2.19E+06	1.44E+06	7.855629921	2.09E+02
0.203194	2.20E+06	1.44E+06	7.99976378	2.09E+02
0.206856	2.20E+06	1.44E+06	8.143937008	2.09E+02
0.210517	2.20E+06	1.44E+06	8.288070866	2.09E+02
0.214179	2.20E+06	1.44E+06	8.432244094	2.10E+02
0.21784	2.20E+06	1.44E+06	8.576377953	2.10E+02
0.219213	2.20E+06	1.44E+06	8.630433071	2.10E+02
0.221273	2.20E+06	1.44E+06	8.711535433	2.10E+02
0.224362	2.20E+06	1.44E+06	8.833149606	2.10E+02
0.226679	2.20E+06	1.45E+06	8.924370079	2.10E+02
0.230155	2.20E+06	1.45E+06	9.061220472	2.10E+02
0.23363	2.20E+06	1.45E+06	9.198031496	2.10E+02
0.237106	2.20E+06	1.45E+06	9.33488189	2.10E+02
0.238409	2.20E+06	1.45E+06	9.386181102	2.10E+02
0.240364	2.20E+06	1.45E+06	9.463149606	2.10E+02
0.243297	2.20E+06	1.45E+06	9.578622047	2.10E+02
0.247696	2.20E+06	1.45E+06	9.751811024	2.10E+02
0.25	2.20E+06	1.45E+06	9.842519685	2.10E+02

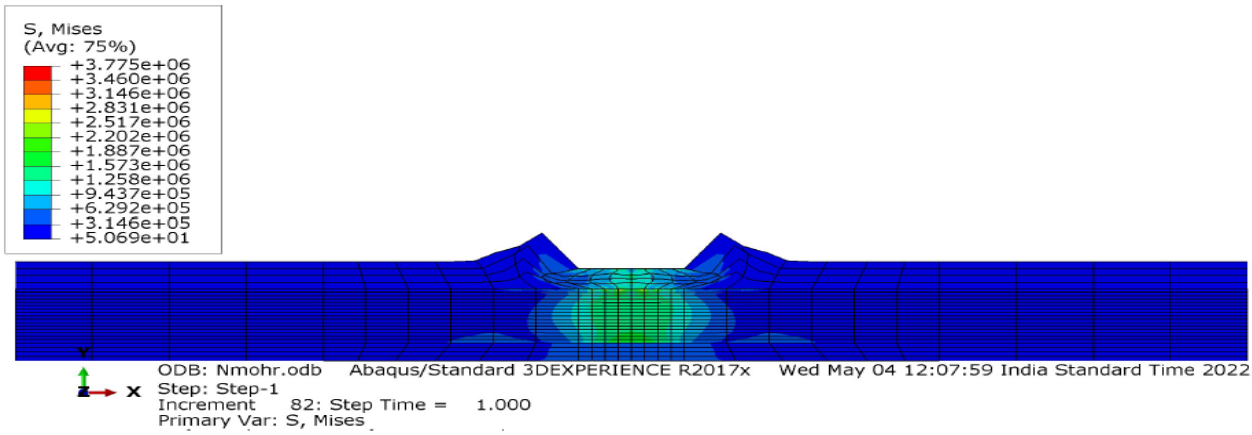


Figure 4.86. Mesh of reinforced soil C’’

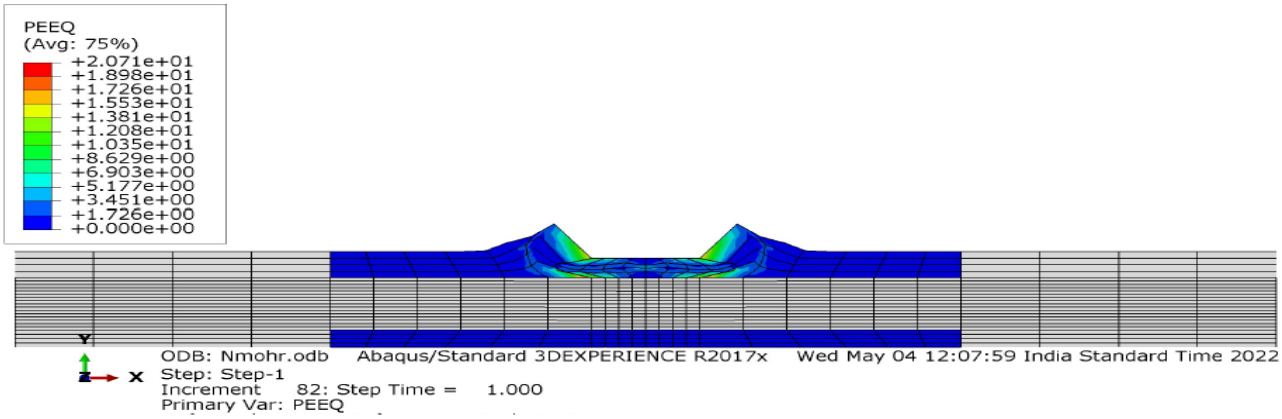
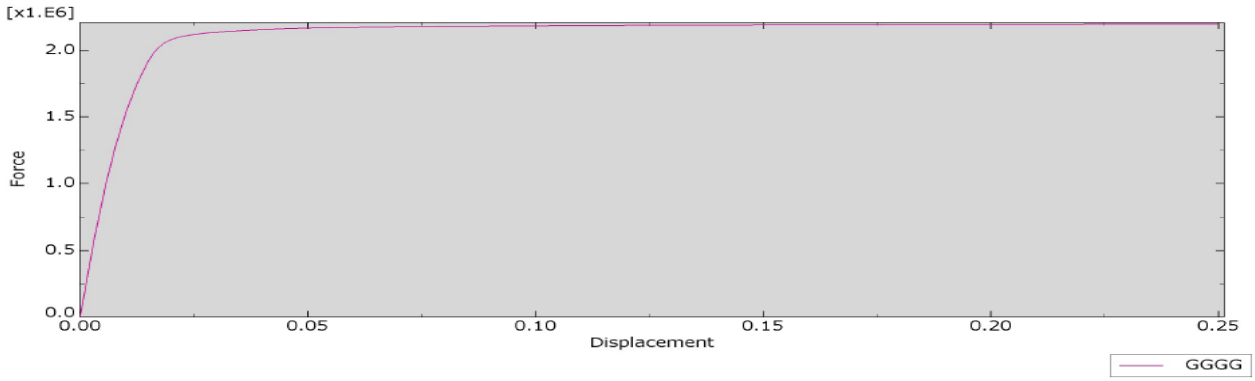
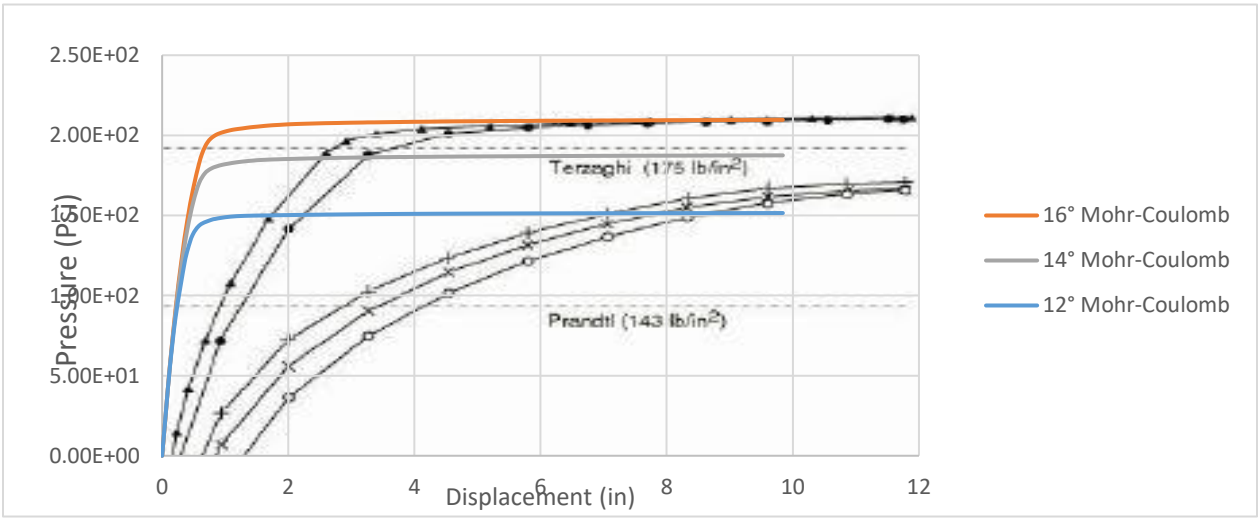


Figure 4.87. Normal stresses of reinforced soil C''



Graph 4.58. Force against Displacement of reinforced soil C'' obtained from Abaqus model



Graph 4.59. Friction angle variation curves of the reinforced soil A'', B''and C'' Comparing with the one as given by Chen (1975)

- SOIL D''

Table 4.44. Reinforced soil D'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0.00E+00	0.00E+00	0	0.00E+00
0.001875	3.57E+05	2.35E+05	0.073818898	3.41E+01
0.00375	6.76E+05	4.45E+05	0.147637795	6.45E+01
0.005625	9.33E+05	6.14E+05	0.221456693	8.91E+01
0.0075	1.14E+06	7.52E+05	0.295275591	1.09E+02
0.0103125	1.35E+06	8.89E+05	0.406003937	1.29E+02
0.0145313	1.50E+06	9.85E+05	0.572098425	1.43E+02
0.01875	1.54E+06	1.01E+06	0.738188976	1.47E+02
0.0229688	1.55E+06	1.02E+06	0.904283465	1.48E+02
0.0292969	1.57E+06	1.03E+06	1.15342126	1.49E+02
0.0387891	1.57E+06	1.03E+06	1.527129921	1.50E+02
0.0530273	1.57E+06	1.04E+06	2.087688976	1.50E+02
0.0743848	1.58E+06	1.04E+06	2.928535433	1.51E+02
0.104385	1.58E+06	1.04E+06	4.109645669	1.51E+02
0.134385	1.58E+06	1.04E+06	5.290748031	1.51E+02
0.164385	1.59E+06	1.04E+06	6.471850394	1.51E+02
0.194385	1.59E+06	1.04E+06	7.652952756	1.51E+02
0.224385	1.59E+06	1.04E+06	8.834055118	1.51E+02
0.254385	1.59E+06	1.04E+06	10.01515748	1.51E+02
0.284385	1.59E+06	1.04E+06	11.19625984	1.52E+02
0.3	1.59E+06	1.04E+06	11.81102362	1.52E+02

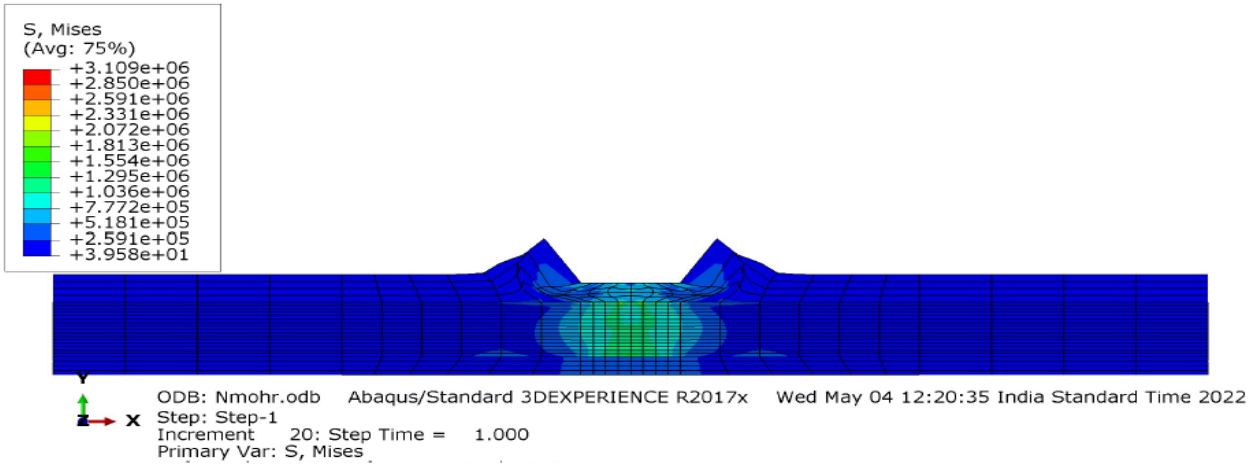


Figure 4.88. Mesh of reinforced soil D''

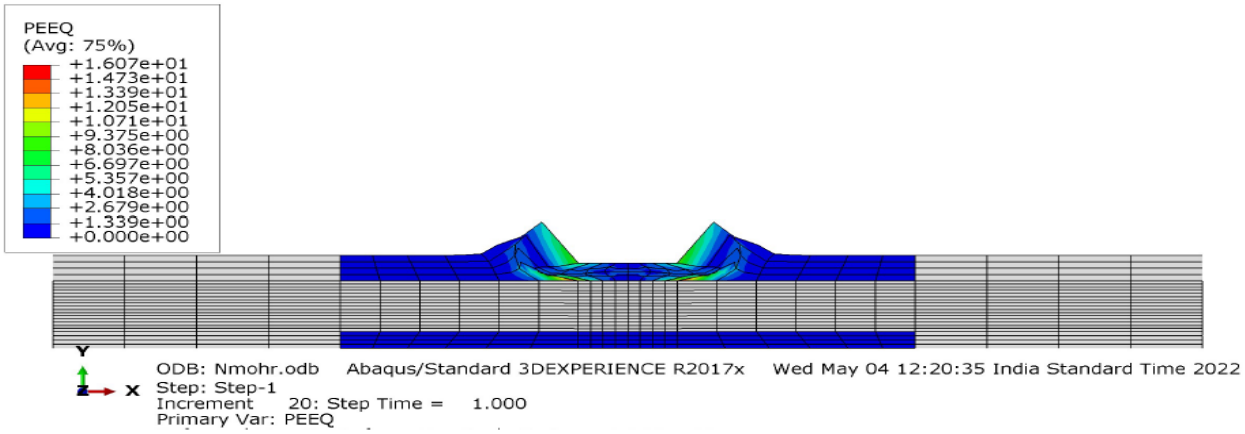
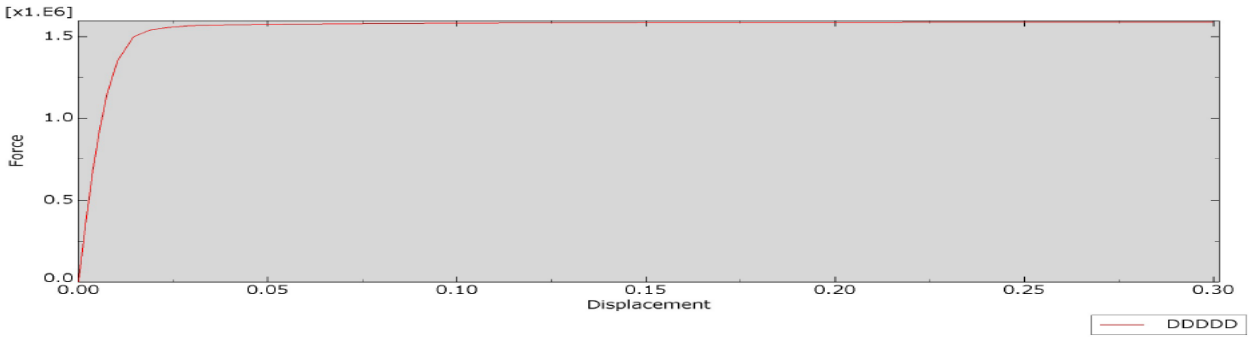


Figure 4.89. Normal stresses of reinforced soil D''



Graph 4.60. Force against Displacement of reinforced soil D'' obtained from Abaqus model

- SOIL E''

Table 4.45. Reinforced soil E'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0.00E+00	0.00E+00	0	0.00E+00
0.001875	3.57E+05	2.35E+05	0.073818898	3.41E+01
0.00375	6.94E+05	4.56E+05	0.147637795	6.62E+01
0.0065625	1.10E+06	7.20E+05	0.258366142	1.04E+02
0.009375	1.41E+06	9.27E+05	0.369094488	1.34E+02
0.0121875	1.63E+06	1.07E+06	0.479822835	1.56E+02
0.015	1.79E+06	1.17E+06	0.590551181	1.70E+02
0.0178125	1.86E+06	1.22E+06	0.701279528	1.77E+02
0.020625	1.88E+06	1.24E+06	0.812007874	1.80E+02
0.0234375	1.90E+06	1.25E+06	0.92273622	1.81E+02
0.02625	1.91E+06	1.26E+06	1.033464567	1.82E+02
0.0304688	1.92E+06	1.26E+06	1.199559055	1.83E+02

0.0336328	1.93E+06	1.27E+06	1.324125984	1.84E+02
0.0383789	1.93E+06	1.27E+06	1.510980315	1.84E+02
0.043125	1.94E+06	1.27E+06	1.697834646	1.85E+02
0.0478711	1.94E+06	1.28E+06	1.884688976	1.85E+02
0.0526172	1.94E+06	1.28E+06	2.071543307	1.85E+02
0.0573633	1.94E+06	1.28E+06	2.258397638	1.85E+02
0.0644824	1.95E+06	1.28E+06	2.538677165	1.86E+02
0.0751611	1.95E+06	1.28E+06	2.959098425	1.86E+02
0.0858398	1.95E+06	1.28E+06	3.379519685	1.86E+02
0.0965186	1.95E+06	1.29E+06	3.799944882	1.86E+02
0.107197	1.96E+06	1.29E+06	4.220354331	1.87E+02
0.111202	1.96E+06	1.29E+06	4.378031496	1.87E+02
0.117209	1.96E+06	1.29E+06	4.614527559	1.87E+02
0.126219	1.96E+06	1.29E+06	4.969251969	1.87E+02
0.139734	1.96E+06	1.29E+06	5.501338583	1.87E+02
0.144802	1.96E+06	1.29E+06	5.700866142	1.87E+02
0.152405	1.96E+06	1.29E+06	6.00019685	1.87E+02
0.163808	1.96E+06	1.29E+06	6.449133858	1.87E+02
0.180913	1.96E+06	1.29E+06	7.122559055	1.87E+02
0.187328	1.96E+06	1.29E+06	7.37511811	1.87E+02
0.196949	1.96E+06	1.29E+06	7.753897638	1.87E+02
0.211382	1.96E+06	1.29E+06	8.322125984	1.87E+02
0.216794	1.96E+06	1.29E+06	8.53519685	1.87E+02
0.224912	1.96E+06	1.29E+06	8.85480315	1.87E+02
0.23709	1.96E+06	1.29E+06	9.334251969	1.87E+02
0.249267	1.97E+06	1.29E+06	9.813661417	1.88E+02
0.261445	1.97E+06	1.29E+06	10.29311024	1.88E+02
0.266011	1.97E+06	1.29E+06	10.47287402	1.88E+02
0.272861	1.97E+06	1.29E+06	10.74255906	1.88E+02
0.283136	1.97E+06	1.29E+06	11.14708661	1.88E+02
0.286989	1.97E+06	1.29E+06	11.29877953	1.88E+02
0.292768	1.97E+06	1.29E+06	11.52629921	1.88E+02
0.3	1.97E+06	1.29E+06	11.81102362	1.88E+02

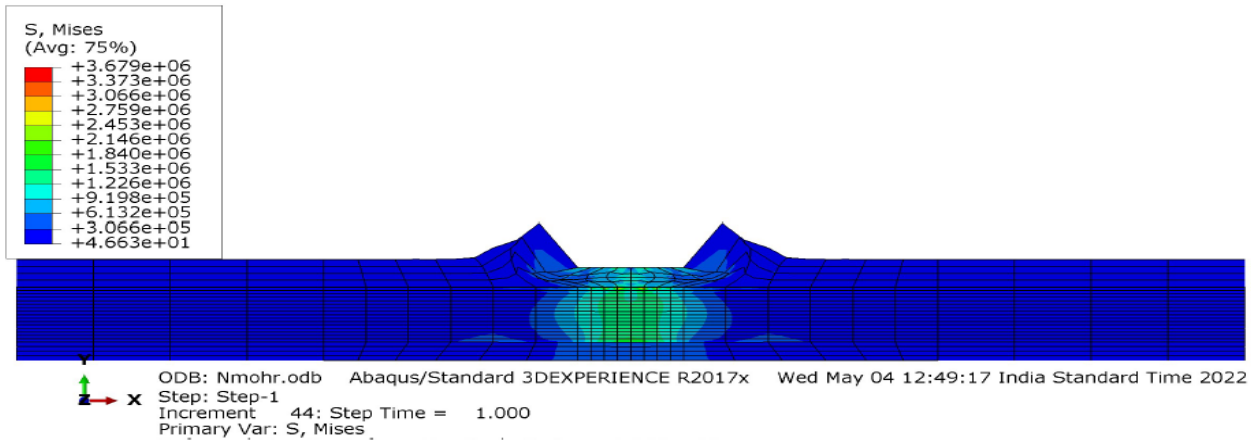


Figure 4.90. Mesh of reinforced soil E''

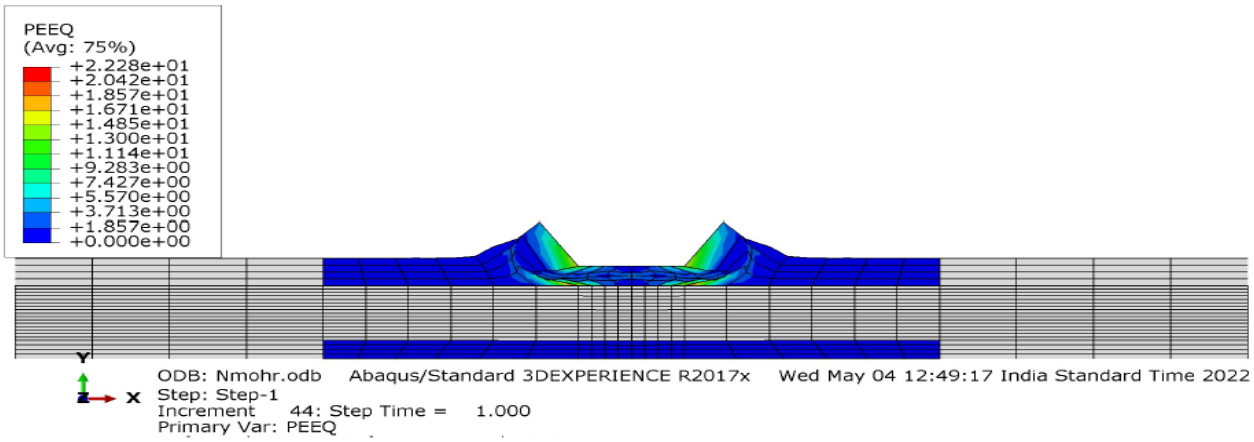
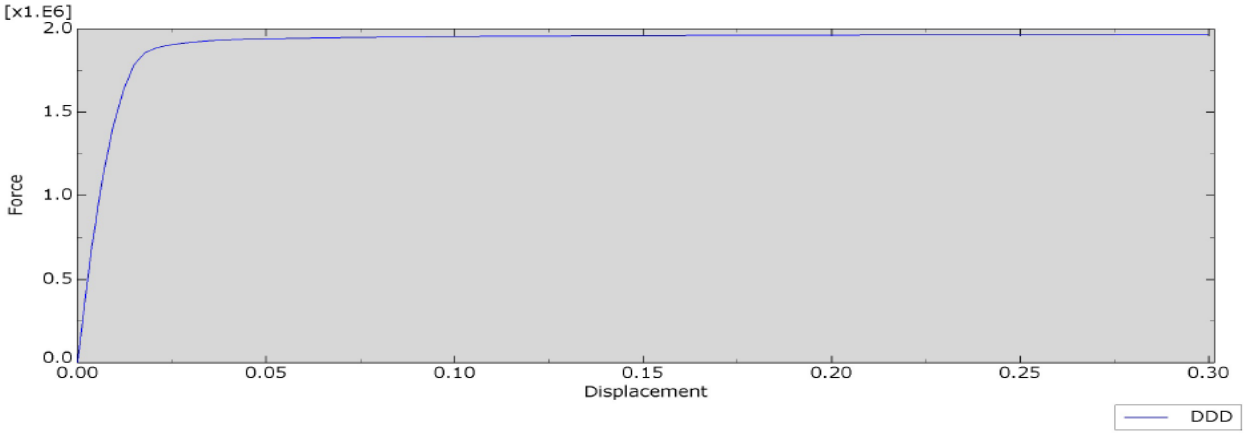


Figure 4.91. Normal stresses of reinforced soil E''



Graph 4.61. Force against Displacement of reinforced soil E'' obtained from Abaqus model

- SOIL F''

Table 4.46. Reinforced soil F'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0.00E+00	0.00E+00	0	0.00E+00
0.001875	3.57E+05	2.35E+05	0.073818898	3.40E+01
0.00375	7.00E+05	4.61E+05	0.147637795	6.68E+01
0.005625	9.91E+05	6.52E+05	0.221456693	9.46E+01
0.0075	1.24E+06	8.19E+05	0.295275591	1.19E+02
0.009375	1.46E+06	9.63E+05	0.369094488	1.40E+02
0.01125	1.64E+06	1.08E+06	0.442913386	1.57E+02
0.013125	1.79E+06	1.18E+06	0.516732283	1.71E+02
0.015	1.92E+06	1.26E+06	0.590551181	1.83E+02
0.016875	2.00E+06	1.32E+06	0.664370079	1.91E+02
0.01875	2.05E+06	1.35E+06	0.738188976	1.96E+02
0.020625	2.08E+06	1.37E+06	0.812007874	1.98E+02
0.0225	2.09E+06	1.38E+06	0.885826772	2.00E+02
0.024375	2.10E+06	1.38E+06	0.959645669	2.01E+02
0.02625	2.11E+06	1.39E+06	1.033464567	2.02E+02
0.0290625	2.12E+06	1.40E+06	1.144192913	2.03E+02
0.0311719	2.13E+06	1.40E+06	1.227240157	2.03E+02
0.0343359	2.13E+06	1.40E+06	1.351807087	2.04E+02
0.035918	2.14E+06	1.41E+06	1.414094488	2.04E+02
0.0375	2.14E+06	1.41E+06	1.476377953	2.04E+02
0.039873	2.14E+06	1.41E+06	1.56980315	2.04E+02
0.0434326	2.15E+06	1.41E+06	1.709944882	2.05E+02
0.0469922	2.15E+06	1.42E+06	1.850086614	2.05E+02
0.0505518	2.16E+06	1.42E+06	1.990228346	2.06E+02
0.0541113	2.16E+06	1.42E+06	2.130366142	2.06E+02
0.0576709	2.16E+06	1.42E+06	2.270507874	2.06E+02
0.0612305	2.16E+06	1.42E+06	2.410649606	2.06E+02
0.0665698	2.16E+06	1.42E+06	2.620858268	2.06E+02
0.0719092	2.17E+06	1.42E+06	2.831070866	2.07E+02
0.0772485	2.17E+06	1.43E+06	3.041279528	2.07E+02
0.0792508	2.17E+06	1.43E+06	3.120110236	2.07E+02
0.0822542	2.17E+06	1.43E+06	3.238354331	2.07E+02
0.0867593	2.17E+06	1.43E+06	3.415720472	2.07E+02
0.0884487	2.17E+06	1.43E+06	3.482232283	2.07E+02
0.0909828	2.17E+06	1.43E+06	3.582	2.07E+02
0.0947839	2.17E+06	1.43E+06	3.731649606	2.07E+02
0.100486	2.17E+06	1.43E+06	3.956141732	2.07E+02
0.106187	2.17E+06	1.43E+06	4.180590551	2.07E+02

0.111889	2.17E+06	1.43E+06	4.40507874	2.07E+02
0.11474	2.17E+06	1.43E+06	4.517322835	2.07E+02
0.117591	2.17E+06	1.43E+06	4.629566929	2.08E+02
0.121867	2.18E+06	1.43E+06	4.797913386	2.08E+02
0.128282	2.18E+06	1.43E+06	5.050472441	2.08E+02
0.130687	2.18E+06	1.43E+06	5.14515748	2.08E+02
0.134295	2.18E+06	1.43E+06	5.287204724	2.08E+02
0.139707	2.18E+06	1.43E+06	5.500275591	2.08E+02
0.141737	2.18E+06	1.43E+06	5.58019685	2.08E+02
0.144781	2.18E+06	1.43E+06	5.70003937	2.08E+02
0.149348	2.18E+06	1.43E+06	5.87984252	2.08E+02
0.15106	2.18E+06	1.43E+06	5.947244094	2.08E+02
0.153629	2.18E+06	1.43E+06	6.048385827	2.08E+02
0.157482	2.18E+06	1.43E+06	6.20007874	2.08E+02
0.163262	2.18E+06	1.43E+06	6.427637795	2.08E+02
0.165429	2.18E+06	1.43E+06	6.512952756	2.08E+02
0.16868	2.18E+06	1.43E+06	6.640944882	2.08E+02
0.173556	2.18E+06	1.43E+06	6.832913386	2.08E+02
0.178433	2.18E+06	1.43E+06	7.02492126	2.08E+02
0.180871	2.18E+06	1.43E+06	7.120905512	2.08E+02
0.184528	2.18E+06	1.44E+06	7.26488189	2.08E+02
0.188186	2.18E+06	1.44E+06	7.408897638	2.08E+02
0.191843	2.18E+06	1.44E+06	7.552874016	2.08E+02
0.193215	2.18E+06	1.44E+06	7.606889764	2.08E+02
0.195272	2.18E+06	1.44E+06	7.687874016	2.08E+02
0.198358	2.18E+06	1.44E+06	7.809370079	2.08E+02
0.202987	2.18E+06	1.44E+06	7.991614173	2.08E+02
0.207616	2.18E+06	1.44E+06	8.173858268	2.08E+02
0.20993	2.18E+06	1.44E+06	8.26496063	2.08E+02
0.213402	2.18E+06	1.44E+06	8.401653543	2.08E+02
0.216873	2.18E+06	1.44E+06	8.538307087	2.08E+02
0.220345	2.18E+06	1.44E+06	8.675	2.08E+02
0.225552	2.18E+06	1.44E+06	8.88	2.08E+02
0.226854	2.18E+06	1.44E+06	8.931259843	2.08E+02
0.228156	2.18E+06	1.44E+06	8.982519685	2.08E+02
0.230109	2.18E+06	1.44E+06	9.059409449	2.08E+02
0.233038	2.18E+06	1.44E+06	9.174724409	2.08E+02
0.237432	2.18E+06	1.44E+06	9.347716535	2.08E+02
0.23908	2.18E+06	1.44E+06	9.412598425	2.08E+02
0.241551	2.18E+06	1.44E+06	9.50988189	2.08E+02
0.245258	2.18E+06	1.44E+06	9.655826772	2.08E+02
0.246649	2.18E+06	1.44E+06	9.710590551	2.08E+02

0.248734	2.19E+06	1.44E+06	9.792677165	2.09E+02
0.251862	2.19E+06	1.44E+06	9.915826772	2.08E+02
0.256554	2.19E+06	1.44E+06	10.10055118	2.09E+02
0.258313	2.19E+06	1.44E+06	10.16980315	2.09E+02
0.260953	2.19E+06	1.44E+06	10.27374016	2.09E+02
0.264912	2.19E+06	1.44E+06	10.4296063	2.09E+02
0.266396	2.19E+06	1.44E+06	10.4880315	2.09E+02
0.268623	2.19E+06	1.44E+06	10.57570866	2.09E+02
0.271963	2.19E+06	1.44E+06	10.70720472	2.09E+02
0.273216	2.19E+06	1.44E+06	10.75653543	2.09E+02
0.275095	2.19E+06	1.44E+06	10.83051181	2.09E+02
0.277913	2.19E+06	1.44E+06	10.94145669	2.09E+02
0.282141	2.19E+06	1.44E+06	11.10791339	2.09E+02
0.283726	2.19E+06	1.44E+06	11.17031496	2.09E+02
0.286104	2.19E+06	1.44E+06	11.26393701	2.09E+02
0.289671	2.19E+06	1.44E+06	11.40437008	2.09E+02
0.291009	2.19E+06	1.44E+06	11.45704724	2.09E+02
0.293015	2.19E+06	1.44E+06	11.53602362	2.09E+02
0.296025	2.19E+06	1.44E+06	11.65452756	2.09E+02
0.3	2.19E+06	1.44E+06	11.81102362	2.09E+02

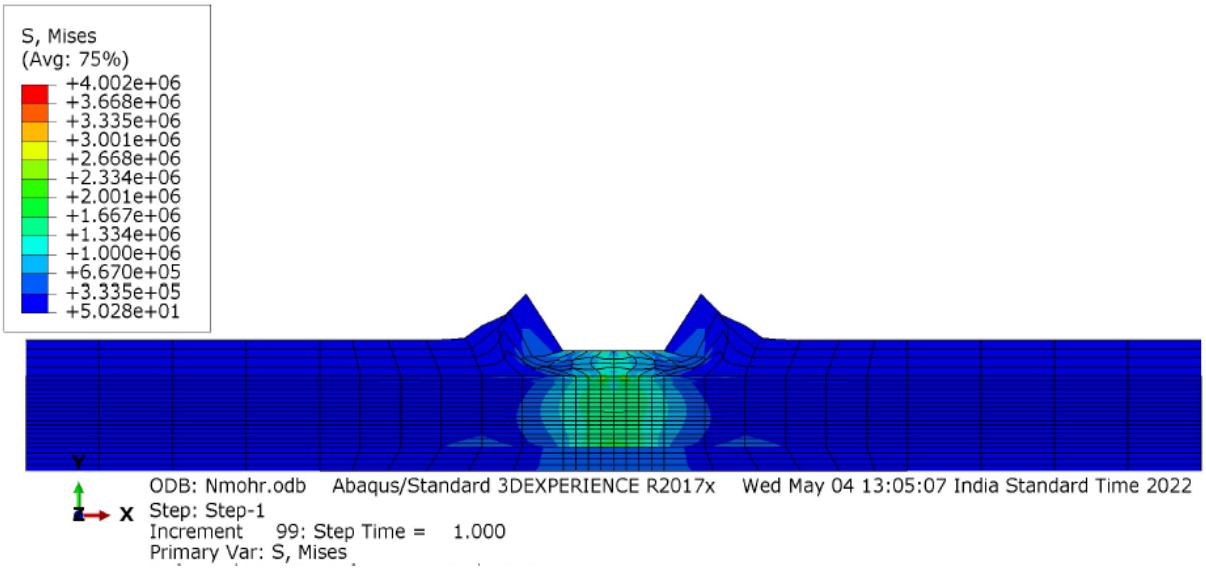


Figure 4.92. Mesh of reinforced soil F’’

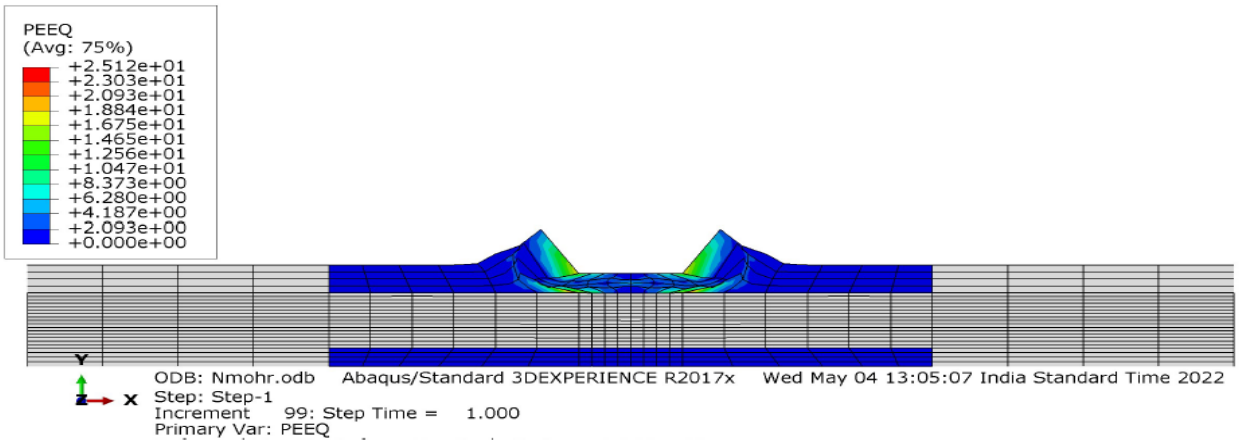
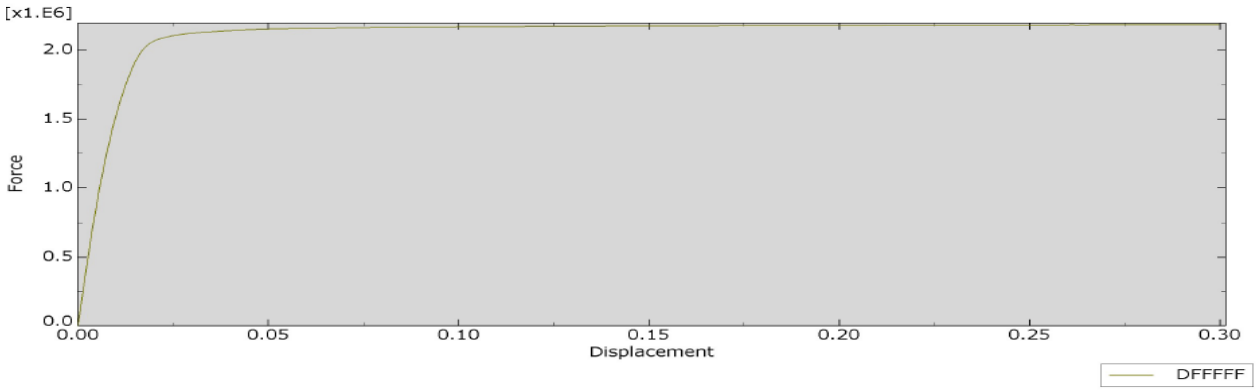
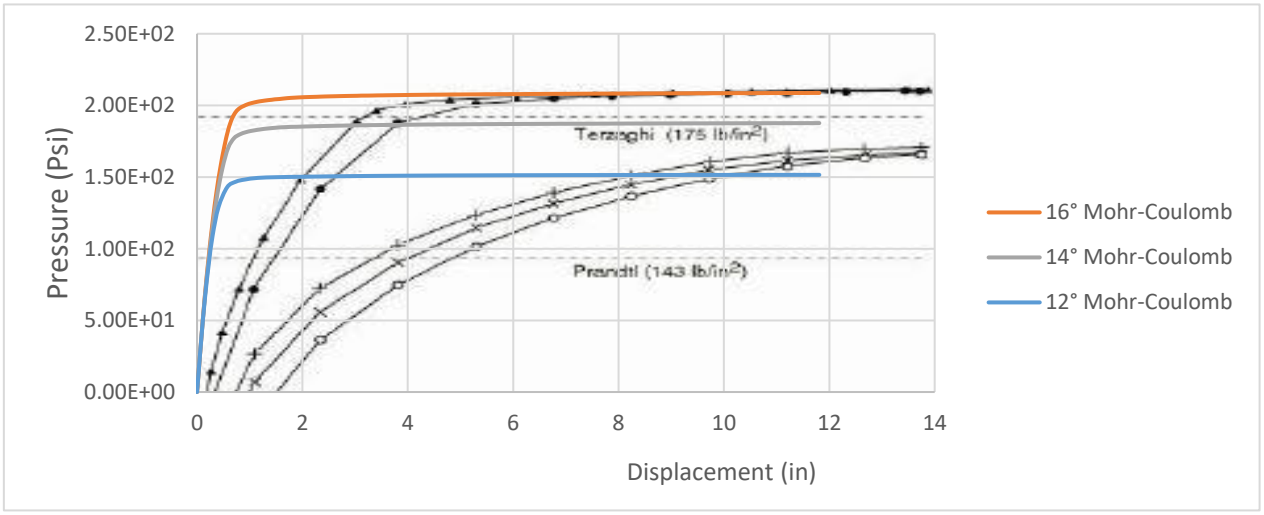


Figure 4.93. Normal stresses of reinforced soil F''



Graph 4.62. Force against Displacement of reinforced soil F'' obtained from Abaqus model



Graph 4.63. Friction angle variation curves of the reinforced soil D'', E''and F'' Comparing with the one as given by Chen (1975)

➢ SOIL G’’

Table 4.47. Reinforced soil G’’ displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	415960	273657.8947	0.086122047	39.69047612
0.004375	766643	504370.3947	0.172244094	73.15228792
0.0065625	1.04E+06	685842.1053	0.258366142	99.47237125
0.00875	1.25E+06	820973.6842	0.344488189	119.0714284
0.0120312	1.43E+06	942276.3158	0.473669291	136.6647786
0.0169531	1.53E+06	1003592.105	0.667444882	145.557827
0.021875	1.55E+06	1019796.053	0.861220472	147.9079963
0.0267969	1.56E+06	1027750	1.054996063	149.0616116
0.0341797	1.57E+06	1032651.316	1.34565748	149.772483
0.0452539	1.57E+06	1034848.684	1.781649606	150.0911824
0.0618652	1.58E+06	1037296.053	2.435637795	150.446141
0.0867822	1.58E+06	1040046.053	3.416622047	150.8449923
0.121782	1.58E+06	1041993.421	4.794566929	151.1274324
0.156782	1.59E+06	1043092.105	6.172519685	151.2867821
0.165532	1.59E+06	1043256.579	6.517007874	151.3106368
0.178657	1.59E+06	1043598.684	7.033740157	151.3602547
0.198345	1.59E+06	1043934.211	7.808858268	151.4089184
0.227876	1.59E+06	1044309.211	8.971496063	151.4633072
0.262876	1.59E+06	1044625	10.34944882	151.5091083
0.297876	1.59E+06	1044888.158	11.72740157	151.5472759
0.332876	1.59E+06	1045098.684	13.10535433	151.57781
0.35	1.59E+06	1045197.368	13.77952756	151.5921228

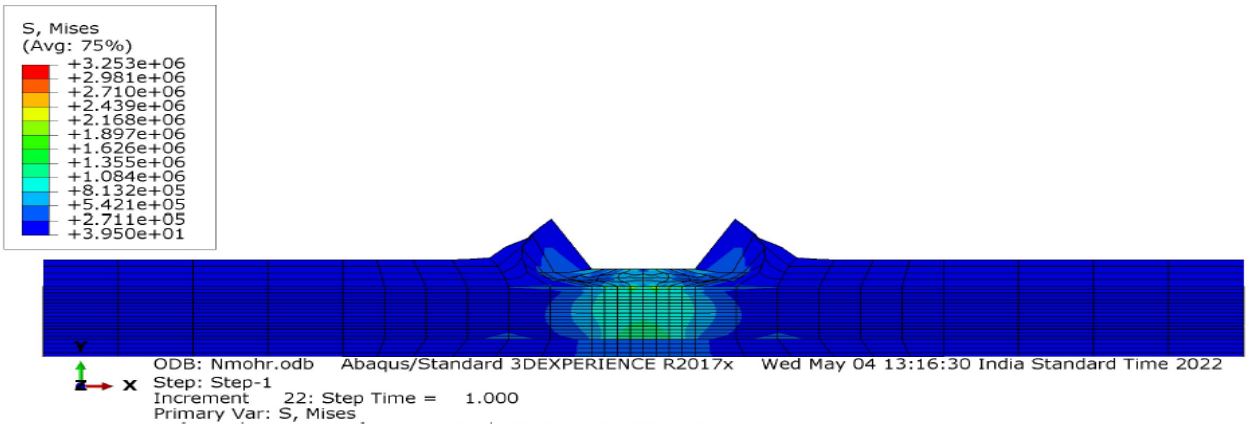


Figure 4.94. Mesh of reinforced soil G’’

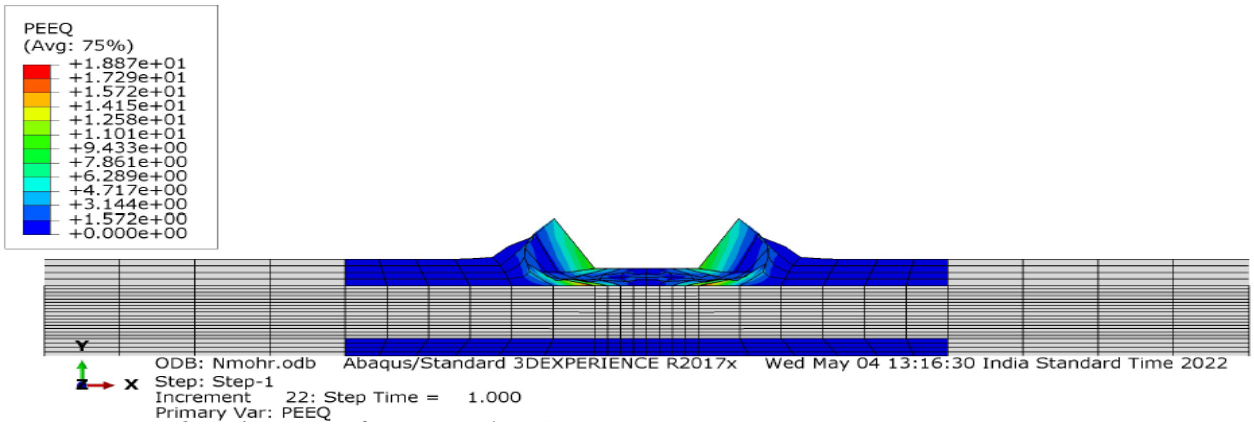
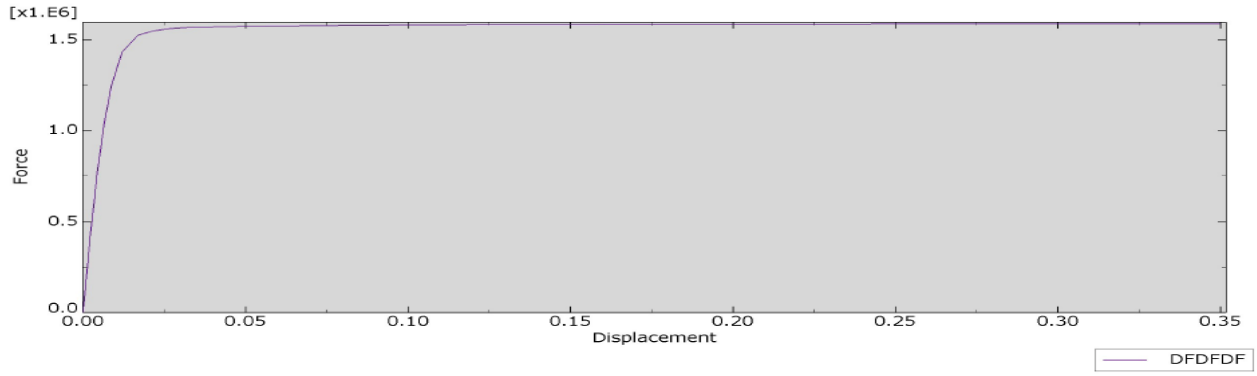


Figure 4.95. Normal stresses of reinforced soil G''



Graph 4.64. Force against Displacement of reinforced soil G'' obtained from Abaqus model

- SOIL H''

Table 4.48. Reinforced soil H'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	416738	274169.7368	0.086122047	39.76471208
0.004375	790835	520286.1842	0.172244094	75.46066372
0.0065625	1.10E+06	721809.2105	0.258366142	104.6889265
0.00875	1.35E+06	889447.3684	0.344488189	129.0026351
0.0109375	1.55E+06	1017565.789	0.430610236	147.5845259
0.013125	1.70E+06	1116421.053	0.516732283	161.9221809
0.0153125	1.80E+06	1184322.368	0.602854331	171.7703731
0.0175	1.85E+06	1219157.895	0.688976378	176.8228077
0.0196875	1.88E+06	1236026.316	0.775098425	179.2693502
0.021875	1.89E+06	1245519.737	0.861220472	180.646246
0.0240625	1.90E+06	1251815.789	0.94734252	181.5594056

0.0273438	1.91E+06	1258822.368	1.076527559	182.5756176
0.0322656	1.92E+06	1265723.684	1.270299213	183.5765627
0.0371875	1.93E+06	1270927.632	1.464074803	184.3313267
0.0421094	1.94E+06	1274190.789	1.657850394	184.8046048
0.0470312	1.94E+06	1275980.263	1.851622047	185.0641445
0.0519531	1.94E+06	1277546.053	2.045397638	185.2912416
0.056875	1.94E+06	1278848.684	2.239173228	185.4801712
0.0642578	1.95E+06	1280592.105	2.529834646	185.7330315
0.0716406	1.95E+06	1282263.158	2.820496063	185.9753956
0.0790234	1.95E+06	1283519.737	3.11115748	186.1576459
0.0900977	1.95E+06	1284651.316	3.547153543	186.3217665
0.0942505	1.95E+06	1285480.263	3.710649606	186.4419944
0.10048	1.95E+06	1286125	3.955905512	186.535505
0.109824	1.96E+06	1286947.368	4.323779528	186.6547787
0.113328	1.96E+06	1287256.579	4.461732283	186.6996257
0.118583	1.96E+06	1287618.421	4.668622047	186.7521061
0.126467	1.96E+06	1288177.632	4.979015748	186.8332122
0.138293	1.96E+06	1288815.789	5.444606299	186.9257686
0.142728	1.96E+06	1289085.526	5.619212598	186.9648904
0.14938	1.96E+06	1289486.842	5.881102362	187.023096
0.159358	1.96E+06	1289907.895	6.273937008	187.0841641
0.1631	1.96E+06	1290078.947	6.421259843	187.108973
0.168712	1.96E+06	1290368.421	6.642204724	187.1509574
0.177131	1.96E+06	1290664.474	6.973661417	187.1938959
0.18976	1.96E+06	1291164.474	7.470866142	187.2664144
0.196074	1.96E+06	1291328.947	7.719448819	187.2902691
0.202388	1.96E+06	1291559.211	7.968031496	187.3236657
0.21186	1.96E+06	1291855.263	8.340944882	187.3666043
0.218963	1.96E+06	1292032.895	8.620590551	187.3923674
0.229618	1.96E+06	1292368.421	9.04007874	187.4410311
0.240274	1.96E+06	1292546.053	9.459606299	187.4667942
0.250929	1.97E+06	1292875	9.879094488	187.5145037
0.254925	1.97E+06	1292927.632	10.03641732	187.5221372
0.260918	1.97E+06	1293078.947	10.2723622	187.5440836
0.269909	1.97E+06	1293236.842	10.62633858	187.5669841
0.276652	1.97E+06	1293414.474	10.89181102	187.5927472
0.286766	1.97E+06	1293565.789	11.29	187.6146936
0.290559	1.97E+06	1293644.737	11.43933071	187.6261439
0.296248	1.97E+06	1293782.895	11.66330709	187.6461819
0.304782	1.97E+06	1293901.316	11.99929134	187.6633573
0.307982	1.97E+06	1294013.158	12.12527559	187.6795785
0.312782	1.97E+06	1294039.474	12.31425197	187.6833953

0.319982	1.97E+06	1294177.632	12.59771654	187.7034333
0.330783	1.97E+06	1294322.368	13.02295276	187.7244254
0.334833	1.97E+06	1294381.579	13.18240157	187.7330131
0.340909	1.97E+06	1294506.579	13.42161417	187.7511427
0.35	1.97E+06	1294539.474	13.77952756	187.7559137

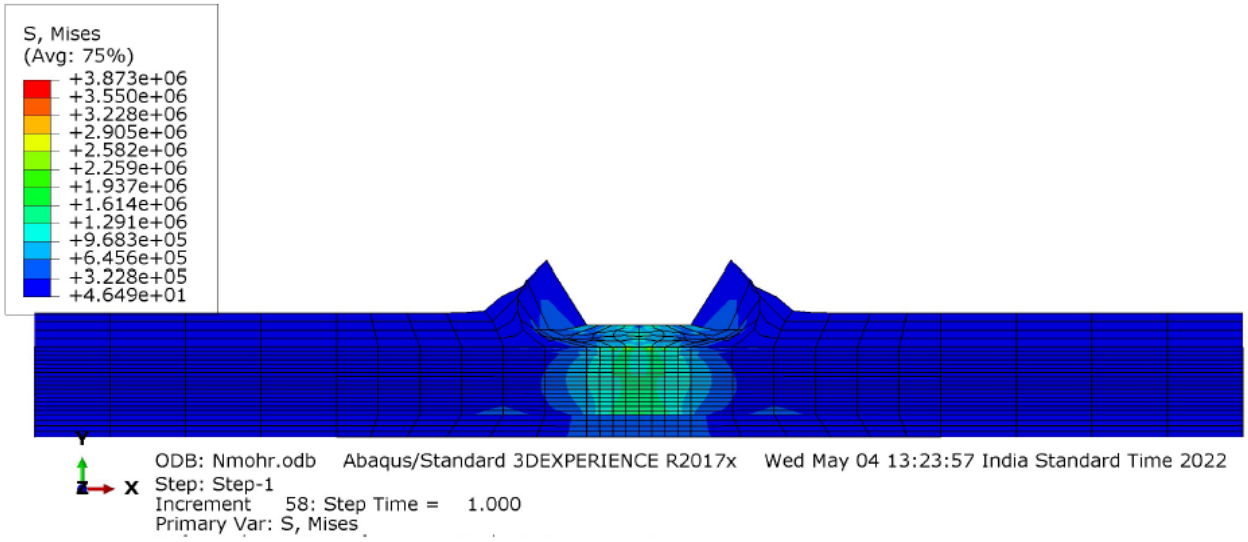


Figure 4.96. Mesh of reinforced soil H''

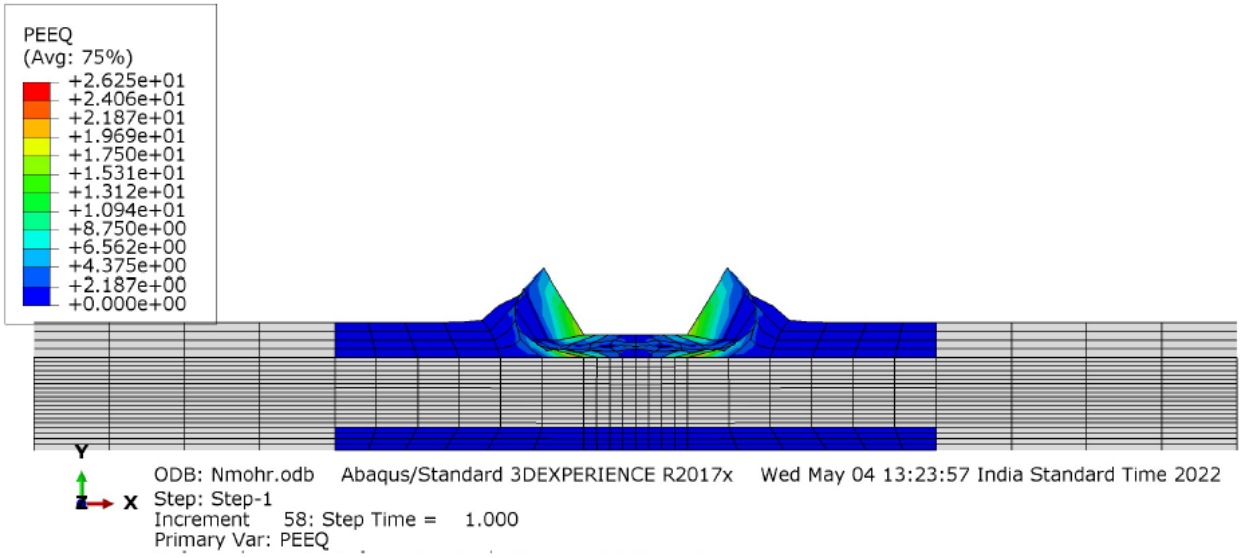
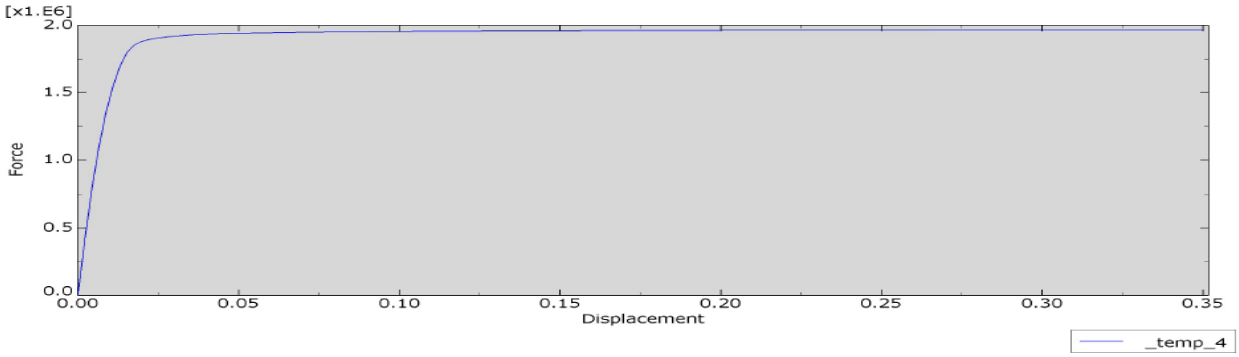


Figure 4.97. Normal stresses of reinforced soil H''



Graph 4.65. Force against Displacement of reinforced soil H'' obtained from Abaqus model

- SOIL I''

Table 4.49. Reinforced soil I'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0021875	416906	274280.2632	0.086122047	39.78074247
0.004375	798698	525459.2105	0.172244094	76.21094311
0.0065625	1.11E+06	733072.3684	0.258366142	106.3224993
0.00875	1.38E+06	910111.8421	0.344488189	131.999745
0.0109375	1.60E+06	1050177.632	0.430610236	152.3144444
0.013125	1.77E+06	1162625	0.516732283	168.6234554
0.0153125	1.90E+06	1248802.632	0.602854331	181.1223867
0.0175	1.97E+06	1299282.895	0.688976378	188.4438845
0.0196875	2.01E+06	1325039.474	0.775098425	192.1795373
0.021875	2.03E+06	1338210.526	0.861220472	194.0898251
0.0240625	2.05E+06	1347125	0.94734252	195.3827522
0.02625	2.06E+06	1353125	1.033464567	196.2529733
0.0295312	2.07E+06	1359921.053	1.162645669	197.2386512
0.0319922	2.07E+06	1363657.895	1.259535433	197.780631
0.0356836	2.08E+06	1368250	1.404866142	198.4466555
0.039375	2.09E+06	1372085.526	1.55019685	199.0029481
0.0430664	2.09E+06	1375328.947	1.695527559	199.4733636
0.0467578	2.09E+06	1377493.421	1.840858268	199.787292
0.0504492	2.10E+06	1379052.632	1.986188976	200.013435
0.0541406	2.10E+06	1380500	2.131519685	200.2233567
0.057832	2.10E+06	1381638.158	2.276850394	200.3884316
0.0633691	2.10E+06	1383026.316	2.494846457	200.5897656
0.0689062	2.10E+06	1384427.632	2.71284252	200.793008
0.0744434	2.11E+06	1385473.684	2.93084252	200.9447242

0.082749	2.11E+06	1386822.368	3.257834646	201.1403331
0.0858636	2.11E+06	1387585.526	3.380456693	201.2510191
0.0905356	2.11E+06	1387973.684	3.564393701	201.3073163
0.0975435	2.11E+06	1388980.263	3.840295276	201.4533073
0.100171	2.11E+06	1389414.474	3.943740157	201.5162838
0.104113	2.11E+06	1389736.842	4.098937008	201.5630391
0.110026	2.11E+06	1390578.947	4.331732283	201.6851754
0.115939	2.11E+06	1390947.368	4.564527559	201.73861
0.121852	2.12E+06	1391500	4.797322835	201.818762
0.127765	2.12E+06	1391980.263	5.03011811	201.8884178
0.129982	2.12E+06	1392177.632	5.117401575	201.9170435
0.133308	2.12E+06	1392361.842	5.248346457	201.9437608
0.138297	2.12E+06	1392802.632	5.44476378	202.0076915
0.145781	2.12E+06	1393105.263	5.739409449	202.0515843
0.157006	2.12E+06	1393934.211	6.181338583	202.1718122
0.161216	2.12E+06	1393927.632	6.347086614	202.170858
0.16753	2.12E+06	1394519.737	6.595669291	202.2567351
0.173844	2.12E+06	1394625	6.844251969	202.2720021
0.180158	2.12E+06	1394940.789	7.092834646	202.3178032
0.186473	2.12E+06	1395328.947	7.341456693	202.3741004
0.192787	2.12E+06	1395513.158	7.59003937	202.4008177
0.199101	2.12E+06	1395875	7.838622047	202.4532981
0.205415	2.12E+06	1396105.263	8.087204724	202.4866948
0.21173	2.12E+06	1396309.211	8.335826772	202.5162747
0.218044	2.12E+06	1396598.684	8.584409449	202.558259
0.224358	2.12E+06	1396710.526	8.832992126	202.5744802
0.230672	2.12E+06	1397013.158	9.081574803	202.618373
0.23304	2.12E+06	1397006.579	9.17480315	202.6174188
0.236592	2.12E+06	1397236.842	9.314645669	202.6508154
0.24192	2.12E+06	1397302.632	9.524409449	202.6603573
0.243917	2.12E+06	1397447.368	9.603031496	202.6813495
0.246914	2.12E+06	1397480.263	9.721023622	202.6861204
0.251409	2.12E+06	1397651.316	9.897992126	202.7109294
0.253095	2.12E+06	1397657.895	9.964370079	202.7118836
0.255624	2.12E+06	1397743.421	10.06393701	202.724288
0.259417	2.12E+06	1397802.632	10.21326772	202.7328757
0.265106	2.12E+06	1397986.842	10.43724409	202.759593
0.26795	2.13E+06	1398118.421	10.5492126	202.7786768
0.270795	2.13E+06	1398210.526	10.66122047	202.7920355
0.275062	2.13E+06	1398361.842	10.8292126	202.8139819
0.281462	2.13E+06	1398322.368	11.0811811	202.8082567
0.283862	2.13E+06	1398585.526	11.17566929	202.8464243

0.287463	2.13E+06	1398664.474	11.31744094	202.8578746
0.292863	2.13E+06	1398644.737	11.53003937	202.855012
0.294888	2.13E+06	1398815.789	11.60976378	202.8798209
0.297926	2.13E+06	1398750	11.72937008	202.8702791
0.302482	2.13E+06	1398986.842	11.90874016	202.9046299
0.307039	2.13E+06	1399072.368	12.08814961	202.9170343
0.311595	2.13E+06	1399177.632	12.26751969	202.9323014
0.316152	2.13E+06	1399296.053	12.44692913	202.9494768
0.320708	2.13E+06	1399282.895	12.62629921	202.9475684
0.322417	2.13E+06	1399414.474	12.69358268	202.9666522
0.32498	2.13E+06	1399368.421	12.79448819	202.9599729
0.328825	2.13E+06	1399585.526	12.94586614	202.9914611
0.334592	2.13E+06	1399736.842	13.17291339	203.0134075
0.336754	2.13E+06	1399598.684	13.2580315	202.9933695
0.339998	2.13E+06	1399835.526	13.38574803	203.0277204
0.344864	2.13E+06	1399934.211	13.57732283	203.0420332
0.35	2.13E+06	1399756.579	13.77952756	203.0162701

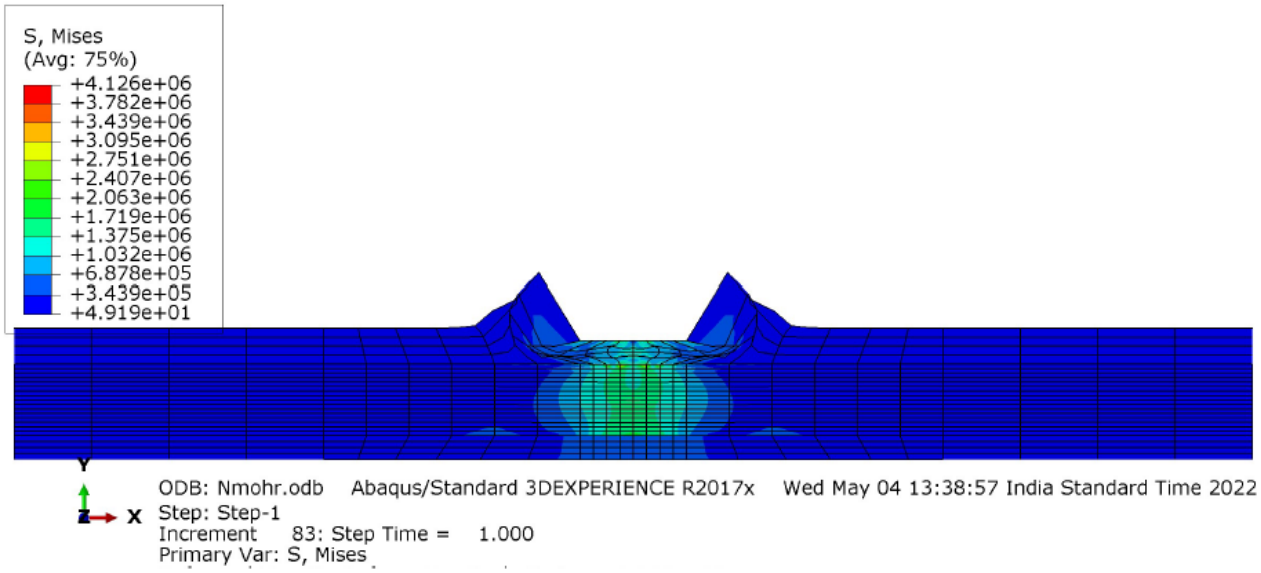


Figure 4.98 Mesh of reinforced soil I''

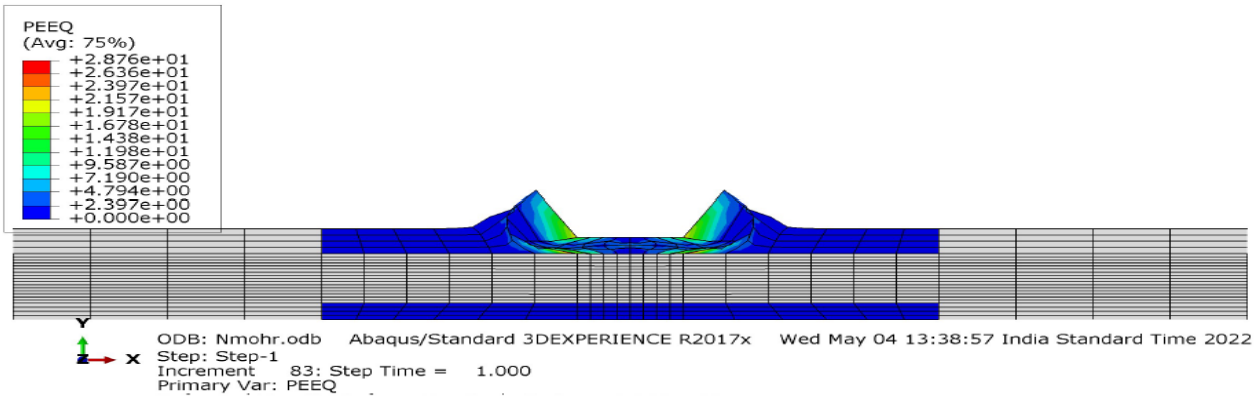
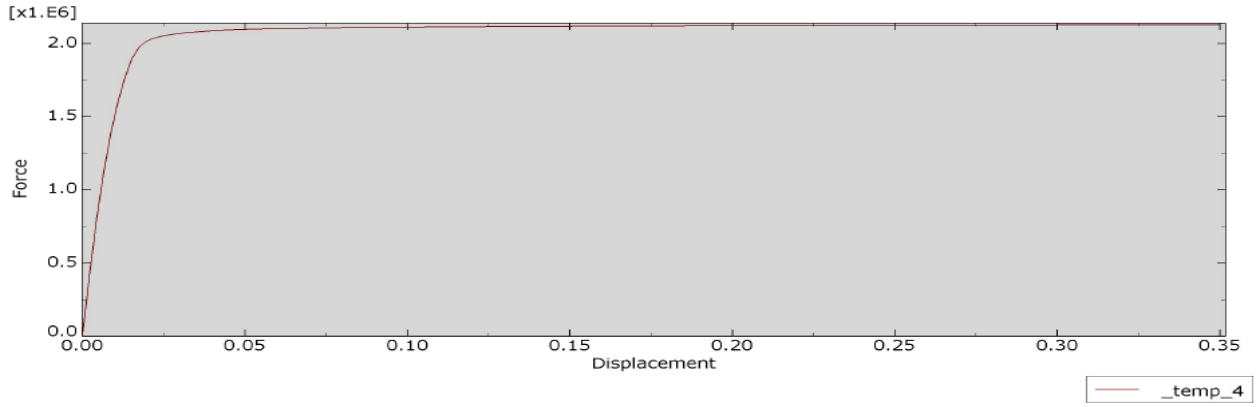
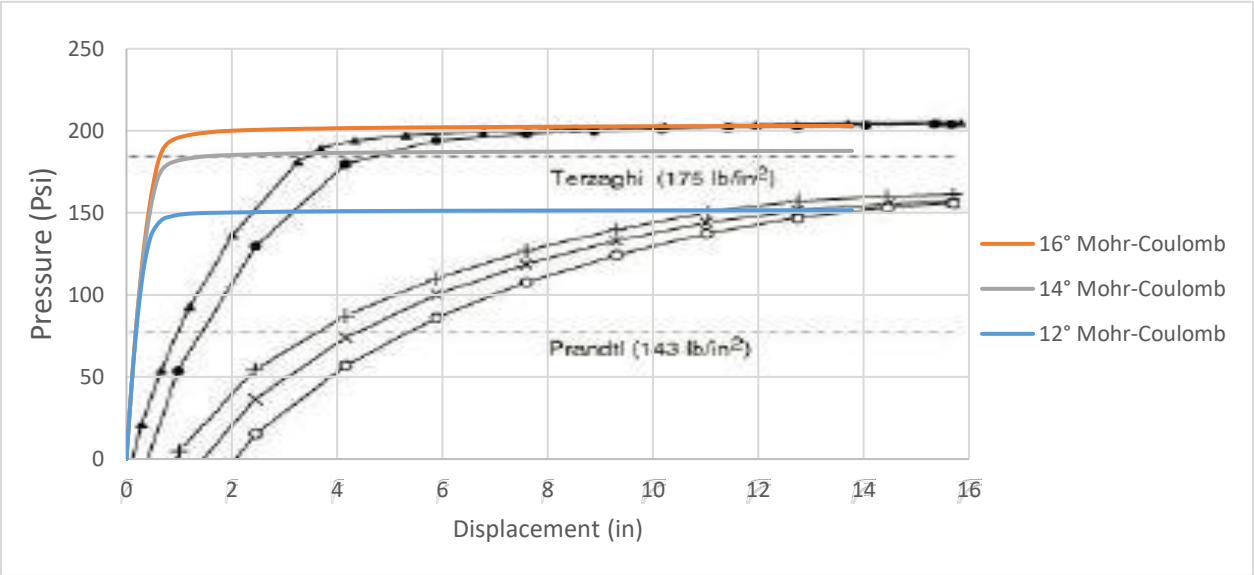


Figure 4.99. Normal stresses of reinforced soil I''



Graph 4.66. Force against Displacement of reinforced soil I'' obtained from Abaqus model



Graph 4.67. Friction angle variation curves of the reinforced soil G'', H''and I'' Comparing with the one as given by Chen (1975)

- SOIL J''

Table 4.50. Reinforced soil J'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	473007	311188.8158	0.098425197	45.13384229
0.003125	580267	381754.6053	0.123031496	55.36848136
0.00375	678617	446458.5526	0.147637795	64.75293738
0.0046875	814780	536039.4737	0.184547244	77.74547103
0.00609375	994425	654226.9737	0.239911417	94.88701249
0.00820312	1.21E+06	794651.3158	0.32295748	115.2537152
0.0113672	1.41E+06	924414.4737	0.447527559	134.0741535
0.0161133	1.52E+06	998506.5789	0.63438189	144.8202383
0.0178931	1.53E+06	1009447.368	0.704452756	146.4070558
0.0205627	1.55E+06	1017638.158	0.809555118	147.595022
0.0245673	1.56E+06	1025078.947	0.967216535	148.6742106
0.030574	1.57E+06	1031302.632	1.203700787	149.5768741
0.0395842	1.57E+06	1033881.579	1.558433071	149.9509165
0.0530994	1.57E+06	1036098.684	2.090527559	150.2724784
0.0733723	1.58E+06	1038697.368	2.888673228	150.6493834
0.103782	1.58E+06	1041190.789	4.085905512	151.0110213
0.143782	1.58E+06	1042717.105	5.660708661	151.2323933
0.153782	1.59E+06	1043019.737	6.054409449	151.276286
0.163782	1.59E+06	1043282.895	6.448110236	151.3144536

0.178782	1.59E+06	1043611.842	7.038661417	151.3621631
0.201282	1.59E+06	1043980.263	7.924488189	151.4155977
0.235032	1.59E+06	1044381.579	9.253228346	151.4738033
0.275032	1.59E+06	1044717.105	10.8280315	151.522467
0.315032	1.59E+06	1044986.842	12.40283465	151.5615887
0.355032	1.59E+06	1045203.947	13.9776378	151.593077
0.395032	1.59E+06	1045368.421	15.55244094	151.6169318
0.4	1.59E+06	1045394.737	15.7480315	151.6207485

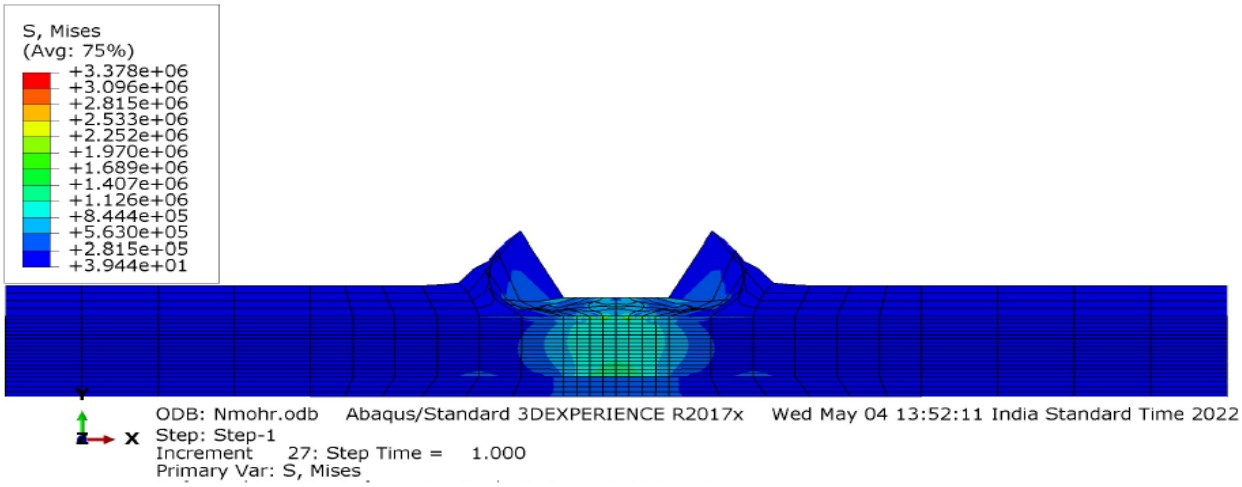


Figure 4.100. Mesh of reinforced soil J''

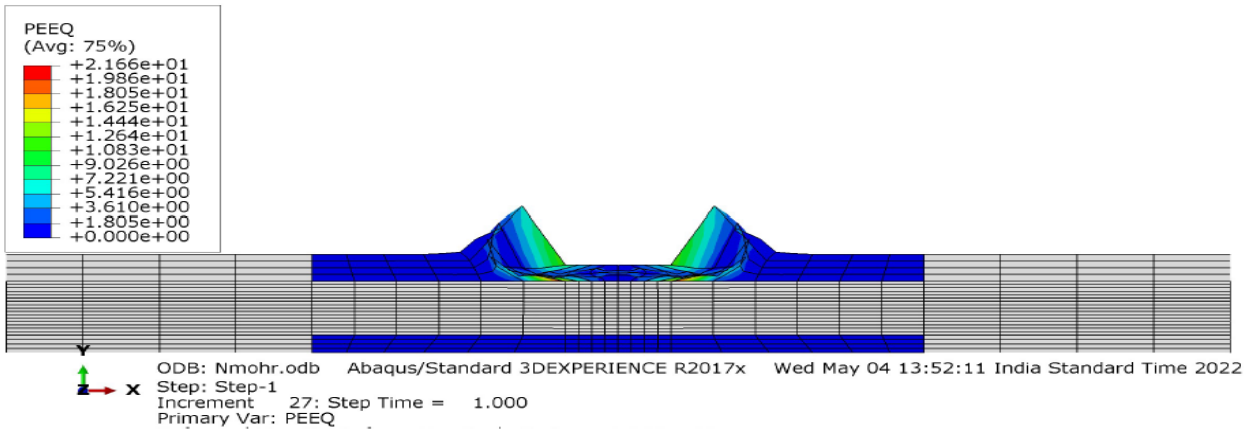
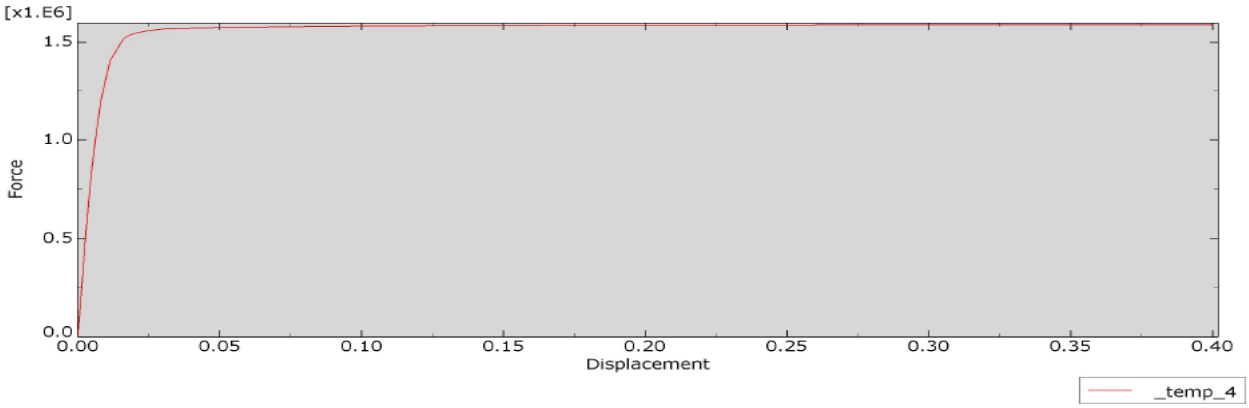


Figure 4.101. Normal stresses reinforced soil J''



Graph 4.68. Force against Displacement of reinforced soil J'' obtained from Abaqus model

- SOIL K''

Table 4.51. Reinforced soil K'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	475010	312506.5789	0.098425197	45.32496649
0.003125	588659	387275.6579	0.123031496	56.16923738
0.00375	695651	457665.1316	0.147637795	66.37830417
0.0046875	841795	553812.5	0.184547244	80.3232146
0.00609375	1.04E+06	684513.1579	0.239911417	99.27962492
0.00820312	1.30E+06	853625	0.32295748	123.807072
0.0103125	1.50E+06	985447.3684	0.406003937	142.9261717
0.0124219	1.66E+06	1088842.105	0.489051181	157.9222175
0.0145313	1.77E+06	1165671.053	0.572098425	169.0652452
0.0166406	1.84E+06	1208815.789	0.655141732	175.3228215
0.01875	1.87E+06	1230585.526	0.738188976	178.4802353
0.0208594	1.89E+06	1241644.737	0.82123622	180.0842282
0.0229688	1.90E+06	1248993.421	0.904283465	181.1500582
0.0250781	1.91E+06	1253756.579	0.987326772	181.8408915
0.0282422	1.92E+06	1260401.316	1.111897638	182.8046232
0.0329883	1.93E+06	1266723.684	1.298751969	183.7215995
0.0377344	1.93E+06	1271506.579	1.485606299	184.4152954
0.0424805	1.94E+06	1274401.316	1.67246063	184.8351389
0.0472266	1.94E+06	1276078.947	1.859314961	185.0784573
0.0519727	1.94E+06	1277565.789	2.046169291	185.2941042
0.0567188	1.94E+06	1278822.368	2.233023622	185.4763544
0.0638379	1.95E+06	1280592.105	2.51330315	185.7330315
0.0745166	1.95E+06	1282651.316	2.933724409	186.0316928
0.0851953	1.95E+06	1284263.158	3.354145669	186.2654693
0.095874	1.95E+06	1285690.789	3.774566929	186.4725285

0.106553	1.96E+06	1286638.158	4.195	186.6099318
0.117231	1.96E+06	1287618.421	4.615393701	186.7521061
0.12791	1.96E+06	1288289.474	5.035826772	186.8494334
0.131915	1.96E+06	1288532.895	5.193503937	186.8847385
0.137921	1.96E+06	1288855.263	5.42996063	186.9314938
0.146932	1.96E+06	1289335.526	5.784724409	187.0011496
0.153689	1.96E+06	1289657.895	6.050748031	187.0479049
0.163826	1.96E+06	1290131.579	6.44984252	187.1166066
0.173962	1.96E+06	1290565.789	6.848897638	187.1795831
0.184099	1.96E+06	1290953.947	7.247992126	187.2358803
0.191701	1.96E+06	1291177.632	7.547283465	187.2683227
0.203104	1.96E+06	1291578.947	7.996220472	187.3265283
0.214508	1.96E+06	1291901.316	8.44519685	187.3732836
0.217359	1.96E+06	1292013.158	8.557440945	187.3895048
0.22021	1.96E+06	1292059.211	8.669685039	187.3961842
0.224486	1.96E+06	1292144.737	8.838031496	187.4085886
0.2309	1.96E+06	1292381.579	9.090551181	187.4429395
0.240522	1.96E+06	1292552.632	9.469370079	187.4677484
0.254955	1.97E+06	1292953.947	10.03759843	187.525954
0.260367	1.97E+06	1293032.895	10.25066929	187.5374042
0.268485	1.97E+06	1293203.947	10.57027559	187.5622132
0.280663	1.97E+06	1293500	11.04972441	187.6051517
0.29284	1.97E+06	1293723.684	11.52913386	187.6375942
0.305017	1.97E+06	1293907.895	12.00854331	187.6643115
0.317195	1.97E+06	1294177.632	12.48799213	187.7034333
0.320239	1.97E+06	1294157.895	12.60783465	187.7005707
0.324806	1.97E+06	1294210.526	12.7876378	187.7082042
0.331656	1.97E+06	1294381.579	13.05732283	187.7330131
0.34193	1.97E+06	1294427.632	13.46181102	187.7396925
0.345783	1.97E+06	1294578.947	13.61350394	187.7616388
0.351563	1.97E+06	1294585.526	13.84106299	187.762593
0.360232	1.97E+06	1294703.947	14.1823622	187.7797684
0.363483	1.97E+06	1294743.421	14.31035433	187.7854936
0.36836	1.97E+06	1294842.105	14.5023622	187.7998064
0.375674	1.97E+06	1294855.263	14.79031496	187.8017148
0.386646	1.97E+06	1294993.421	15.22228346	187.8217528
0.389985	1.97E+06	1295019.737	15.35374016	187.8255695
0.394992	1.97E+06	1294980.263	15.55086614	187.8198444
0.4	1.97E+06	1295052.632	15.7480315	187.8303405

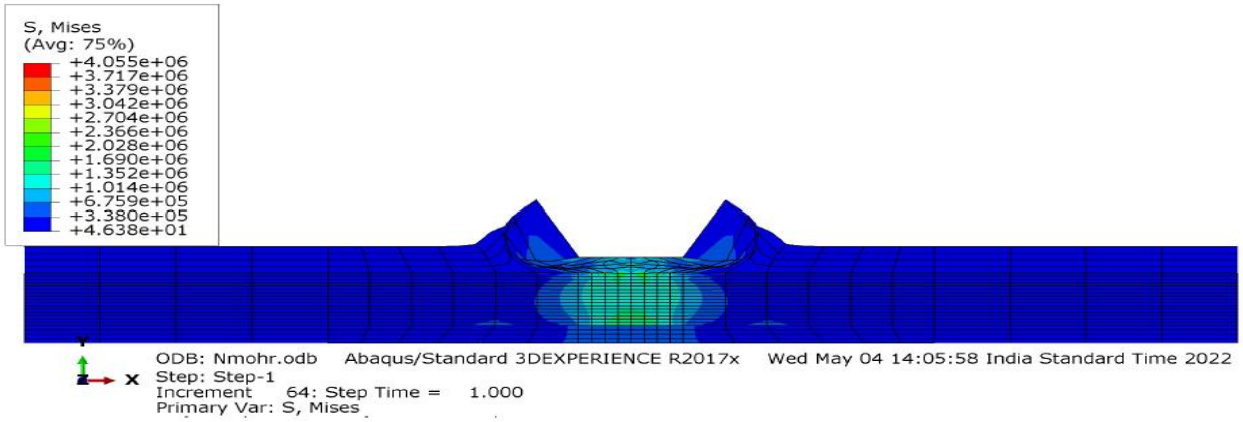


Figure 4.102. Mesh of reinforced soil K''

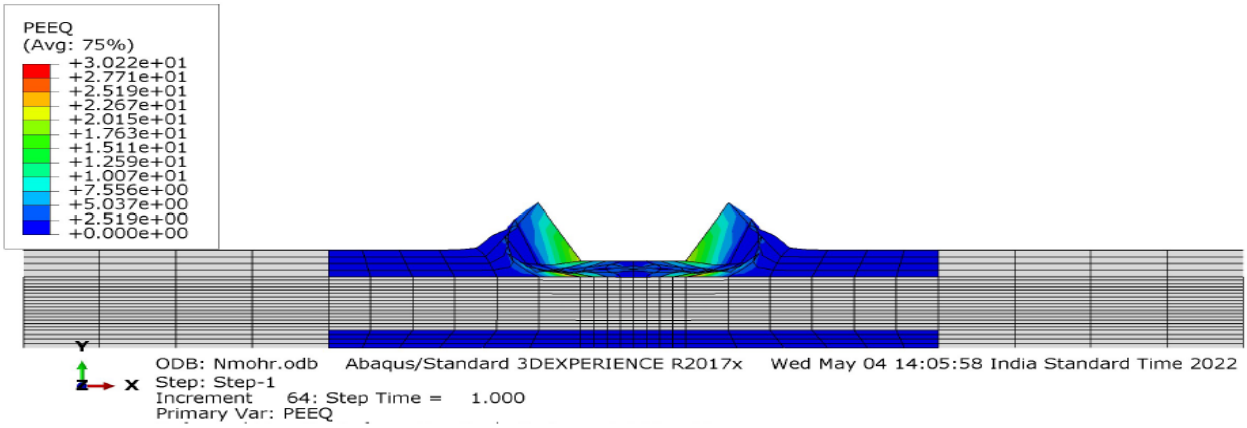
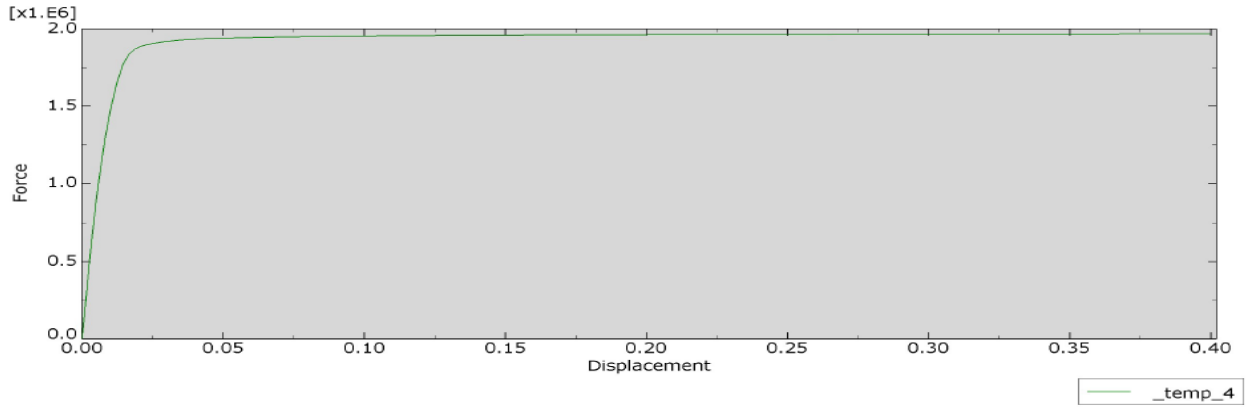


Figure 4.103. Normal stresses of reinforced soil K''



Graph 4.69. Force against Displacement of reinforced soil K'' obtained from Abaqus model

- SOIL L

Table 4.52. Reinforced soil L'' displacement, load and pressure values via Abaqus model.

Displacement (m)	Force (N)	Pressure (Pa)	Displacement (in)	Pressure (Psi)
0	0	0	0	0
0.0025	475381	312750.6579	0.098425197	45.36036693
0.003125	590388	388413.1579	0.123031496	56.33421679
0.0040625	751045	494108.5526	0.159940945	71.66394277
0.00546875	964689	634663.8158	0.215305118	92.0496339
0.00757813	1.24E+06	818407.8947	0.298351575	118.6992944
0.0096875	1.48E+06	971375	0.381397638	140.8851598
0.0117969	1.66E+06	1093203.947	0.464444882	158.5548453
0.0139062	1.81E+06	1190342.105	0.547488189	172.6434567
0.0160156	1.91E+06	1259203.947	0.630535433	182.6309606
0.018125	1.97E+06	1297026.316	0.713582677	188.1165974
0.0202344	2.00E+06	1316078.947	0.796629921	190.8799309
0.0223437	2.02E+06	1326315.789	0.879673228	192.3646501
0.0244531	2.03E+06	1334085.526	0.962720472	193.4915482
0.0265625	2.04E+06	1339565.789	1.045767717	194.2863882
0.0297266	2.05E+06	1345730.263	1.170338583	195.180464
0.0320996	2.05E+06	1349230.263	1.26376378	195.6880929
0.0356592	2.06E+06	1353559.211	1.403905512	196.3159498
0.0392187	2.06E+06	1357407.895	1.544043307	196.8741508
0.0427783	2.07E+06	1360098.684	1.684185039	197.2644144
0.0463379	2.07E+06	1362493.421	1.824326772	197.6117394
0.0498975	2.07E+06	1363657.895	1.964468504	197.780631
0.053457	2.07E+06	1364986.842	2.104606299	197.9733773
0.0570166	2.08E+06	1366085.526	2.244748031	198.132727
0.062356	2.08E+06	1367480.263	2.45496063	198.3350153
0.0676953	2.08E+06	1368815.789	2.665169291	198.5287158
0.0730347	2.08E+06	1369921.053	2.87538189	198.6890196
0.0810437	2.08E+06	1371164.474	3.19069685	198.8693615
0.0840471	2.09E+06	1371973.684	3.308940945	198.9867268
0.0885522	2.09E+06	1372651.316	3.486307087	199.0850084
0.0953098	2.09E+06	1373203.947	3.752354331	199.1651603
0.100378	2.09E+06	1373888.158	3.951889764	199.2643961
0.10798	2.09E+06	1374894.737	4.251181102	199.4103871
0.110831	2.09E+06	1375026.316	4.363425197	199.4294709
0.115108	2.09E+06	1375500	4.531811024	199.4981725
0.121522	2.09E+06	1376144.737	4.784330709	199.5916831
0.131144	2.09E+06	1376565.789	5.163149606	199.6527513
0.134752	2.09E+06	1377026.316	5.30519685	199.7195446
0.140164	2.09E+06	1377296.053	5.518267717	199.7586663
0.148282	2.09E+06	1377861.842	5.837874016	199.8407266
0.156401	2.09E+06	1378263.158	6.157519685	199.8989322

0.164519	2.10E+06	1378782.895	6.477125984	199.9743132
0.167563	2.10E+06	1378796.053	6.596968504	199.9762216
0.17213	2.10E+06	1379032.895	6.776771654	200.0105724
0.17898	2.10E+06	1379440.789	7.046456693	200.0697322
0.181548	2.10E+06	1379486.842	7.147559055	200.0764115
0.185401	2.10E+06	1379736.842	7.299251969	200.1126707
0.191181	2.10E+06	1379973.684	7.526811024	200.1470216
0.19985	2.10E+06	1380263.158	7.868110236	200.1890059
0.208519	2.10E+06	1380677.632	8.209409449	200.2491199
0.210687	2.10E+06	1380710.526	8.29476378	200.2538908
0.213938	2.10E+06	1380710.526	8.422755906	200.2538908
0.218814	2.10E+06	1381111.842	8.614724409	200.3120964
0.222472	2.10E+06	1381006.579	8.758740157	200.2968293
0.227958	2.10E+06	1381223.684	8.974724409	200.3283176
0.236187	2.10E+06	1381546.053	9.298700787	200.3750729
0.238244	2.10E+06	1381671.053	9.379685039	200.3932025
0.240301	2.10E+06	1381657.895	9.460669291	200.3912941
0.243387	2.10E+06	1381677.632	9.582165354	200.3941567
0.248016	2.10E+06	1381993.421	9.764409449	200.4399578
0.254959	2.10E+06	1381967.105	10.03775591	200.436141
0.257563	2.10E+06	1382263.158	10.14027559	200.4790796
0.261469	2.10E+06	1382171.053	10.29405512	200.4657209
0.267327	2.10E+06	1382585.526	10.52468504	200.5258349
0.269524	2.10E+06	1382434.211	10.6111811	200.5038885
0.272819	2.10E+06	1382690.789	10.74090551	200.5411019
0.277762	2.10E+06	1382763.158	10.93551181	200.551598
0.285177	2.10E+06	1382868.421	11.22744094	200.566865
0.287957	2.10E+06	1382973.684	11.33688976	200.5821321
0.292128	2.10E+06	1383026.316	11.50110236	200.5897656
0.298384	2.10E+06	1383217.105	11.74740157	200.6174371
0.30464	2.10E+06	1383315.789	11.99370079	200.6317499
0.310896	2.10E+06	1383421.053	12.24	200.647017
0.317152	2.10E+06	1383644.737	12.48629921	200.6794594
0.323408	2.10E+06	1383769.737	12.73259843	200.697589
0.325754	2.10E+06	1383782.895	12.82496063	200.6994974
0.329273	2.10E+06	1383835.526	12.96350394	200.7071309
0.334551	2.10E+06	1383986.842	13.17129921	200.7290773
0.33983	2.10E+06	1383967.105	13.37913386	200.7262147
0.345108	2.10E+06	1384171.053	13.58692913	200.7557946
0.347088	2.10E+06	1384197.368	13.66488189	200.7596114
0.350057	2.10E+06	1384164.474	13.78177165	200.7548404
0.354511	2.10E+06	1384315.789	13.95712598	200.7767868

0.361191	2.10E+06	1384263.158	14.22011811	200.7691533
0.363697	2.10E+06	1384401.316	14.31877953	200.7891912
0.367454	2.10E+06	1384578.947	14.46669291	200.8149544
0.373091	2.10E+06	1384368.421	14.68862205	200.7844203
0.375205	2.10E+06	1384611.842	14.77185039	200.8197253
0.378376	2.10E+06	1384460.526	14.89669291	200.797779
0.383132	2.10E+06	1384638.158	15.08393701	200.8235421
0.390266	2.10E+06	1384592.105	15.36480315	200.8168627
0.4	2.11E+06	1384888.158	15.7480315	200.8598013

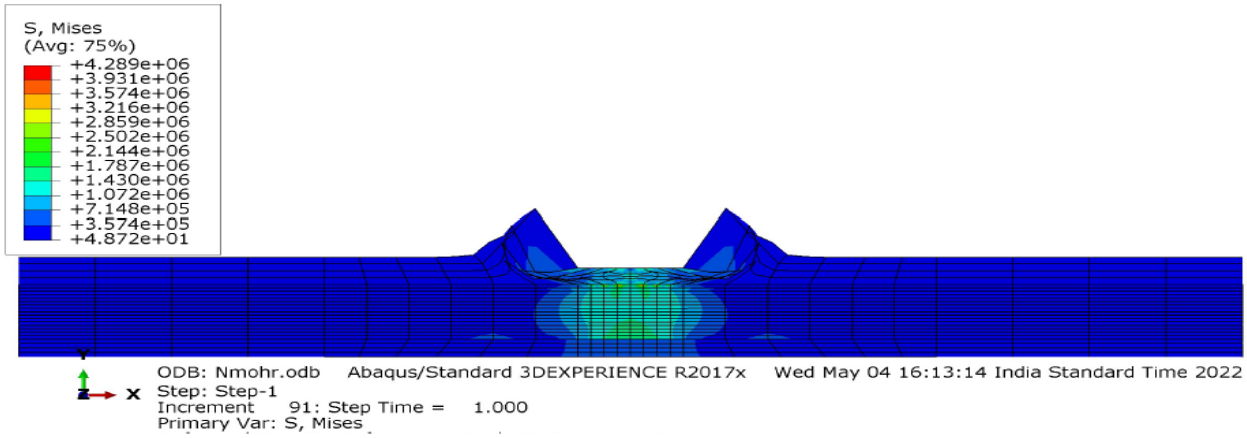


Figure 4.104. Mesh of reinforced soil L''

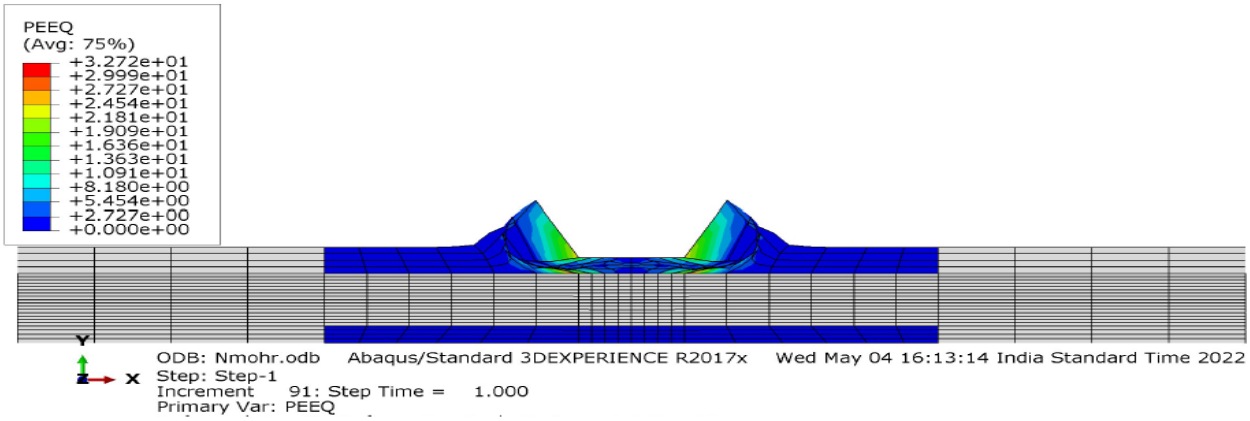
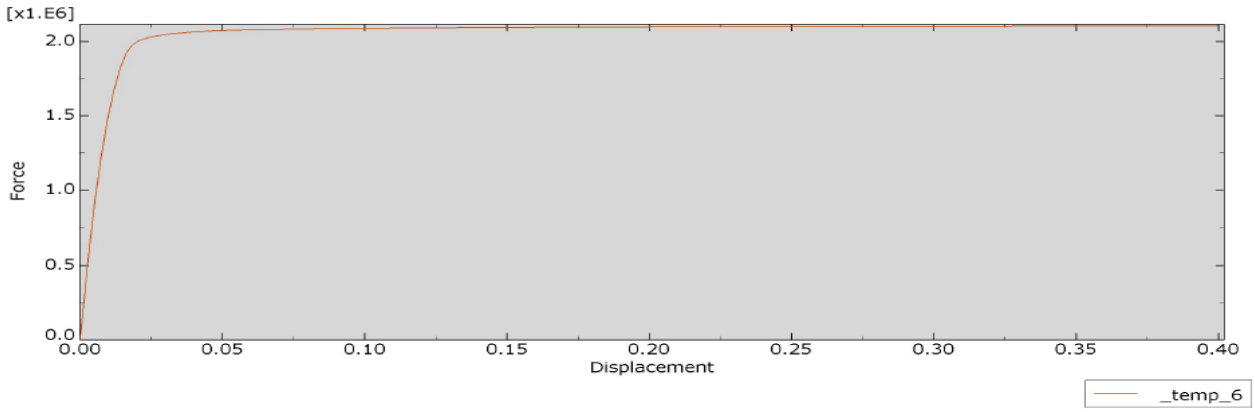
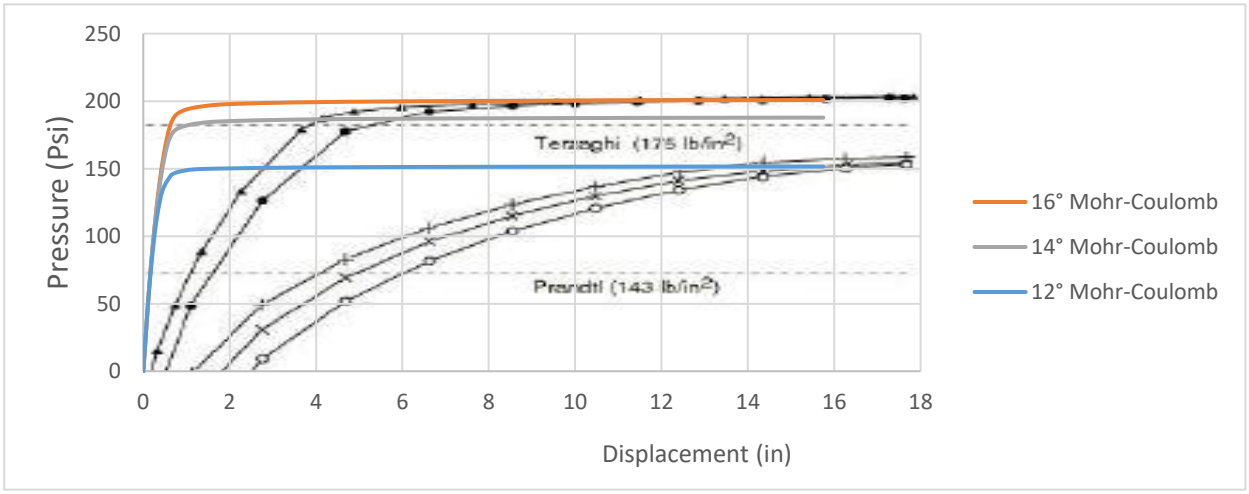


Figure 4.105. Normal stresses of reinforced soil L''



Graph 4.70. Force against Displacement of reinforced soil L'' obtained from Abaqus model



Graph 4.71. Friction angle variation curves of the reinforced soil J'', K''and L'' Comparing with the one as given by Chen (1975)

Table 4.53 Results of the improvement of the Bearing Capacity

Types of soil	Displacement (mm)	Maximum Loads without Geotextile (kN)	Maximum Loads with Geotextile (kN)			Percentage of Improvement (%)
			N=3	N=4	N=5	
A	0.250	1490	1590	1590	1590	6.71
B	0.250	1330	1960	1970	1970	48.12
C	0.250	1200	2150	2200	2200	83.33

D	**0.300**	**1490**	**1590**	**1590**	**1590**	**6.71**
E	**0.300**	**1330**	**1970**	**1970**	**1970**	**48.12**
F	**0.300**	**1200**	**2130**	**2130**	**2190**	**82.5**
G	**0.350**	**1490**	**1590**	**1590**	**1590**	**6.71**
H	**0.350**	**1330**	**1970**	**1970**	**1970**	**48.12**
I	**0.350**	**1200**	**2130**	**2150**	**2130**	**79.17**
J	**0.400**	**1490**	**1590**	**1590**	**1590**	**6.71**
K	**0.400**	**1330**	**1970**	**1970**	**1970**	**48.12**
L	**0.400**	**1200**	**2100**	**2080**	**2110**	**75.83**

Firstly, results were showing that the insertion of geotextile reinforcement origins the settlements reduction from the initial foundation soil level and increase the bearing capacity value at the consolidation final stages.

Note also that at the depth of 0.82B, N = 4 we have three layers of geotextile ep=0.005m each with a distance of 0.5m from each other and the soil C' bearing capacity pressure gives us an extreme value of 209 Psi. Moreover, at the depth of 1.01B, N= 5 we have 4 layers of geotextiles with the same characteristics and the soil C'' and the bearing capacity pressure gives a maximum value of 210 Psi.

By referring to the technical, resistant and economic regulations of structures in Civil Engineering, we can take as an optimal value 209 Psi for soil C' bearing capacity pressure which would be approximately that of the soil C''. Also, the load values at N equal to respectively 4 and 5 give 2200 kN with 83.33 **% of improvement.**

The Optimal value retained is 209 Psi with three layers at the depth of 0.82B, N=4.

CHAPTER FIVE

5.0 CONCLUSIONS

5.1 Conclusions

In accordance with the aim and objectives of the study and according to foregoing obtained, the resulting deductions were drawn,

- Due to a progressive limit load obtained on the foundation the results were showing at the level of the mesh the failure envelope for unreinforced soil.
- The friction angle and the dilation angle have an important effect on the foundation soil when both parameters are changed, especially the friction angle, which causes more settlements from the beginning of the unreinforced foundation soil then lowers the bearing capacity value at the consolidation final stages.
- The bearing capacity of the reinforced foundation soil rises as the number of geotextile layers increases.
- The insertion of geotextile reinforcement origins the settlements reduction from the initial foundation soil level and increase the bearing capacity value at the consolidation final stages, according to numerical results varying the friction angle.
- The Optimal value of the Bearing Capacity pressure retained is 209 Psi with three layers at the depth of 0.82B, N=4 in accordance with the technical, resistant and economic regulations of structures in Civil Engineering.

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