REPORT ON PLATE LOAD TESTS AT GOVIND DAIRY FACTORY, PHALTAN AND INTERPRETATION

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CONTENTS :

1. SCOPE

Performing the plate load tests on a NPA (novel polymeric alloy), Neoweb® reinforced and unreinforced pavement sections at Govind Dairy Factory, Phaltan and interpreting for the modulus of different layers. It is proposed to utilise the pressure-settlement data from these plate load tests to estimate the Modulus Improvement Factor for the Neoweb reinforced section.

2. OBSERVATIONS AT THE SITE

M/s Govind Dairy Factory, Phaltan had constructed some part of their internal roads using the Neoweb NPA cellular confinement reinforcement, manufactured by PRS in place of the conventional sections. The construction took place during March-April 2010. Some other parts of the road were constructed in the conventional manner without any reinforcement. As the subgrade soil is of highly expansive type, lime treatment was given at subgrade level for 400 mm thickness. On top of this lime treated subgrade, the pavement section consisted of: 400 mm thick GSB, 150 mm thick Neoweb layer filled with GSB and 75 mm GSB cover. No wearing course was provided at the road sections. Schematic of the road section is shown below in Figure 1.

The road sections have been in service for nearly 8 to 9 months and have undergone one severe monsoon season. The general observation was that the unreinforced road sections showed extensive undulations in the road sections while the Neoweb NPA geocell treated road sections had maintained perfect level surface. Some pictures of the road section with and without reinforcement are shown in the following.

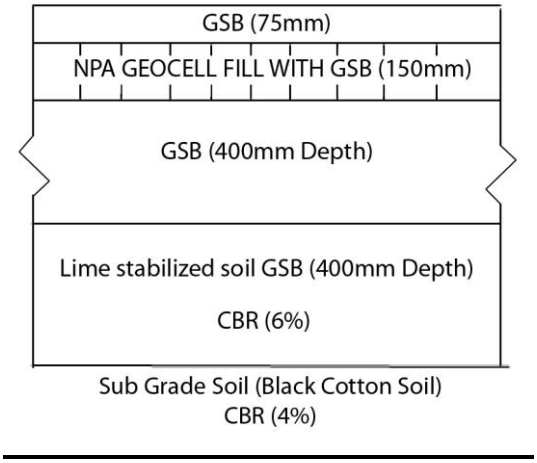


Figure 1. Pavement section at Govind Dairy Factory

Figure 2. Unreinforced road section with severe surface depressions

Figure 3. Neoweb reinforced road section showing level surface

It is clear from the site observations and the feedback given by the owners of the site that the Neoweb reinforced pavement section showed good riding quality for the milk tankers while the unreinforced sections posed difficulties due to severe rutting. The unreinforced sections required frequent maintenance to make a level surface.

3. APPARATUS USED FOR THIS TEST

a) Circular steel plate of 300 mm diameter
b) Supporting steel beam of length 3 m
c) Hydraulic jack of capacity 250 kN
d) Dial gauges, plumb bob & spirit level
e) Short steel supporting members
f) Loaded truck

4. TEST PROCEDURE:

The following steps were used for conducting test in field as per the relevant Indian Standards. All the field plate load tests were performed during December 25-30, 2010. Many of the initial load tests did not result in meaningful data because of the milk vans used for taking the reaction loads and the malfunctioning of loading jack.

a) Selection of location:

The general surface area to be tested should be exposed, cleaned of all loose and dried material and levelled. Two locations were selected for conducting tests on unreinforced pavement and three locations for Neoweb reinforced pavement.

b) Test arrangement:

- There is no disturbance of surface within a distance of 3.5 times size of test plate from its centre. We used loaded truck for reaction so we maintained no contact of vehicle wheels with in this range.
- Arrange the vertical steel supporting members on both side of marking at equal distance and place steel beam above these supports. Mark centre point on steel beam and check this centre with the location centre by using plumb bob and check the level of beam by using spirit level.
- The test plate shall be placed over a fine sand layer of maximum thickness of 5mm. check the plate centre by using plumb bob from beam centre and check the level by using sprit level.
- Place the hydraulic jack on the plate and place the surcharge above the jack piston up to steel beam level. Lift the jack till the steel beam touch the loaded vehicle bottom.
- Two supports of the reference beam arranged for fixing of dial gauges resting at diametrically opposite ends of plate.

c) Loading increment:

As per code (IS1888:1982) apply the load to the soil in cumulative equal increments up to 1 kg/cm^2 or one-fifth of the estimated ultimate bearing capacity, whichever is less. We used the loading increment as 12.5 kN.

d) Settlement and observation:

Settlements observed for each increment of load after an interval of 1,2.25,4,6.25,9,16 and 25 minutes and thereafter at hourly intervals to the nearest 0.02 mm. during testing on sub grade, each load increment done for not less than one hour and sometimes done when the rate of settlement gets appreciably reduced to a value of 0.02 mm/min.

5. FIELD TEST DATA & RESULTS:

a) Reinforced NPA geocell layered pavement

Test-1:

Load (KN)	Pressure (kPa)	Time (min)	Dial gauge 1 reading	Dial gauge 2 reading	Dial gauge 3 reading	Settlement from DG1 (mm)	Settlement from DG2 (mm)	Settlement from DG3 (mm)	Average settlement (mm)
0	0								0.00
seating load (0.5)	7.070707	0	27.28	23.73	25.04	0	0	0	0.00
12.5	176.7677	1	26.6	22.74	24.78	0.68	0.99	0.26	0.64
		4	26.56	22.72	24.72	0.72	1.01	0.32	0.68
25	353.5354	1	25.98	22.24	24.18	1.3	1.49	0.86	1.22
		4	25.97	22.24	24.16	1.31	1.49	0.88	1.23
37.5	530.303	1	25.5	21.85	23.65	1.78	1.88	1.39	1.68
		4	25.5	21.84	23.64	1.78	1.89	1.4	1.69
50	707.0707	1	25.15	21.54	23.17	2.13	2.19	1.87	2.06
		4	25.14	21.53	23.15	2.14	2.2	1.89	2.08
62.5	883.8384	1	24.8	21.28	22.75	2.48	2.45	2.29	2.41
		4	24.78	21.26	22.69	2.5	2.47	2.35	2.44
75	1060.606	1	24.5	21.02	22.37	2.78	2.71	2.67	2.72
		4	24.46	20.97	22.3	2.82	2.76	2.74	2.77
87.5	1237.374	1	24.18	20.72	21.95	3.1	3.01	3.09	3.07
		4	24.16	20.68	21.94	3.12	3.05	3.1	3.09
100	1414.141	1	23.94	20.46	21.66	3.34	3.27	3.38	3.33
		4	23.92	20.41	21.61	3.36	3.32	3.43	3.37

Test-2:

Load (KN)	Pressure (kpa)	Time (min)	Dial gauge 1 reading	Dial gauge 2 reading	Dial gauge 3 reading	Settlement from DG1 (mm)	Settlement from DG2 (mm)	Settlement from DG3 (mm)	Average settlement (mm)
0	0								0.00
seating load (o.5)	7.070707	0	24.72	18.9	23.98	0	0	0	0.00
12.5		1	24.02	18.12	23.32	0.7	0.78	0.66	0.71
		4	24.02	18.11	23.32	0.7	0.79	0.66	0.72
25		1	23.48	17.48	22.78	1.24	1.42	1.2	1.29
		4	23.4	17.35	22.7	1.32	1.55	1.28	1.38
		10	23.39	17.32	22.67	1.33	1.58	1.31	1.41
37.5		1	23.32	17.04	22.61	1.4	1.86	1.37	1.54
		4	23.3	17.01	22.6	1.42	1.89	1.38	1.56
50		1	23.05	16.65	22.32	1.67	2.25	1.66	1.86
		4	23.01	16.62	22.29	1.71	2.28	1.69	1.89
62.5		1	22.75	16.18	22.06	1.97	2.72	1.92	2.20
		4	22.72	16.13	22.04	2	2.77	1.94	2.24
75		1	22.44	15.87	21.85	2.28	3.03	2.13	2.48
		4	22.4	15.82	21.81	2.32	3.08	2.17	2.52
87.5		1	22.05	15.51	21.51	2.67	3.39	2.47	2.84
		4	22	15.45	21.47	2.72	3.45	2.51	2.89
100		1	21.7	15.11	21.06	3.02	3.79	2.92	3.24
		4	21.65	15.05	21.01	3.07	3.85	2.97	3.30

Test-3:

Load (KN)	Pressure (kPa)	Time (min)	Dial gauge 1 reading	Dial gauge 2 reading	Dial gauge 3 reading	Settlement from DG1 (mm)	Settlement from DG2 (mm)	Settlement from DG3 (mm)	Average settlement (mm)
0	0								0
seating load (0.50)	7.070707	0	25.58	18.89	24.15	0	0	0	0
12.5	176.7677	1	24.65	18	23.69	0.93	0.89	0.46	0.76
		4	24.63	17.98	23.68	0.95	0.91	0.47	0.776667
25	353.5354	1	24.1	17.5	23.35	1.48	1.39	0.8	1.223333
		4	24.07	17.45	23.33	1.51	1.44	0.82	1.256667
37.5	530.303	1	23.52	16.93	22.93	2.06	1.96	1.22	1.746667
		4	23.45	16.87	22.92	2.13	2.02	1.23	1.793333
		10	23.42	16.82	22.9	2.16	2.07	1.25	1.826667
50	707.0707	1	23.08	16.46	22.67	2.5	2.43	1.48	2.136667
		4	23.03	16.41	22.65	2.55	2.48	1.5	2.176667

62.5	883.8384	1	22.35	16.11	22.3	3.23	2.78	1.85	2.62
		4	22.26	16.04	22.26	3.32	2.85	1.89	2.686667
		10	22.2	15.96	22.22	3.38	2.93	1.93	2.746667
75	1060.606	1	21.66	15.76	21.95	3.92	3.13	2.2	3.083333
		4	21.57	15.69	21.9	4.01	3.2	2.25	3.153333
		10	21.46	15.6	21.83	4.12	3.29	2.32	3.243333
87.5	1237.374	1	20.93	15.37	21.53	4.65	3.52	2.62	3.596667
		4	20.79	15.26	21.45	4.79	3.63	2.7	3.706667
		10	20.65	15.17	21.38	4.93	3.72	2.77	3.806667
100	1414.141	1	20.19	14.87	20.93	5.39	4.02	3.22	4.21
		4	20.01	14.65	20.82	5.57	4.24	3.33	4.38
		10	19.89	14.65	20.71	5.69	4.24	3.44	4.456667

Unreinforced section:

Test-1:

Load (KN)	Pressure (KPa)	Time (min)	Dial gauge 1 reading	Dial gauge 2 reading	Dial gauge 3 reading	Settle-ment from DG1 (mm)	Settle-ment from DG2 (mm)	Settle-ment from DG3 (mm)	AVG Settle-ment (mm)	Settle-ment (mm)
0	0									0
seating load (0.5)	7.070707	0	4	20	5.1	0	0	0	0	0
12.5	176.7677	1	3.98	19.62	5.01	0.02	0.38	0.09	0.163333	0.22
		4	3.96	19.55	5	0.04	0.45	0.1	0.196667	
		10	3.95	19.53	5	0.05	0.47	0.1	0.206667	
		20	3.92	19.51	5	0.08	0.49	0.1	0.223333	
25	353.5354	1	3.45	19.06	4.65	0.55	0.94	0.45	0.646667	0.65
		4	3.45	19.06	4.64	0.55	0.94	0.46	0.65	
37.5	530.303	1	3.19	18.75	4.45	0.81	1.25	0.65	0.903333	0.91
		4	3.18	18.73	4.44	0.82	1.27	0.66	0.916667	

Test-2:

Load (KN)	Pressure (Kpa)	Time (min)	Dial gauge 1 reading	Dial gauge 2 reading	Dial gauge 3 reading	Settlement from DG1 (mm)	Settlement from DG2 (mm)	Settlement from DG3 (mm)	AVG Settlement (mm)
seating load (0.5)	7.070707	0	27.92	22.75	25.77	0	0	0	0
12.5	176.7677	1	27.91	22.69	25.69	0.01	0.06	0.08	0.05
		4	27.9	22.68	25.69	0.02	0.07	0.08	0.056667
		10	27.89	22.68	25.69	0.03	0.07	0.08	0.06

25	353.5354	1	27.28	22	25.31	0.64	0.75	0.46	0.616667
		4	27.22	22	25.24	0.7	0.75	0.53	0.66
37.5	530.303	1	26.7	21.6	24.99	1.22	1.15	0.78	1.05
		4	26.68	21.6	24.98	1.24	1.15	0.79	1.06
50	707.0707	1	26.26	21.35	24.6	1.66	1.4	1.17	1.41
		4	26.22	21.27	24.52	1.7	1.48	1.25	1.476667
62.5	883.8384	1	25.76	21.08	24.12	2.16	1.67	1.65	1.826667
		4	25.7	21.03	24.07	2.22	1.72	1.7	1.88
75	1060.606	1	25.21	20.76	23.66	2.71	1.99	2.11	2.27
		4	25.16	20.7	23.62	2.76	2.05	2.15	2.32
87.5	1237.374	1	24.71	20.45	23.24	3.21	2.3	2.53	2.68
		4	24.59	20.35	23.12	3.33	2.4	2.65	2.793333
		10	24.49	20.26	23.02	3.43	2.49	2.75	2.89
100	1414.141	1	24.03	19.96	22.61	3.89	2.79	3.16	3.28
		4	23.93	19.88	22.52	3.99	2.87	3.25	3.37
		10	23.81	19.79	22.42	4.11	2.96	3.35	3.473333

c) Plate load test at the subgrade level.

Test-1:

Load (KN)	Pressure (Kpa)	Time (min)	Dial gauge 1 reading	Dial gauge 2 reading	Dial gauge 3 reading	Settlement from DG1 (mm)	Settlement from DG2 (mm)	Settlement from DG3 (mm)	AVG Settlement (mm)
0	0								0.00
seating load (0.5)	7.070707	0	24.75	22.71	24.08	0	0	0	0.00
12.5		1	23.74	21.45	23.08	1.01	1.26	1	1.09
		4	23.68	21.38	22.99	1.07	1.33	1.09	1.16
		10	23.68	21.36	22.98	1.07	1.35	1.1	1.17
25		1	22.55	19.82	21.25	2.2	2.89	2.83	2.64
		4	22.27	19.59	21.04	2.48	3.12	3.04	2.88
		10	22.14	19.45	20.9	2.61	3.26	3.18	3.02
		20	22.02	19.36	20.81	2.73	3.35	3.27	3.12
37.5		1	20.61	17.85	19.22	4.14	4.86	4.86	4.62
		4	20.37	17.64	19.05	4.38	5.07	5.03	4.83
		10	20.06	17.34	18.74	4.69	5.37	5.34	5.13
		20	19.82	17.08	18.48	4.93	5.63	5.6	5.39
		30	19.64	16.89	18.3	5.11	5.82	5.78	5.57
50		1	18.29	15.45	17.7	6.46	7.26	6.38	6.70
		4	17.92	15.2	17.46	6.83	7.51	6.62	6.99
		10	17.55	14.85	17.05	7.2	7.86	7.03	7.36
		20	17.23	14.53	16.72	7.52	8.18	7.36	7.69
		30	17.02	14.32	16.51	7.73	8.39	7.57	7.90
62.5		1	15.82	12.73	14.84	8.93	9.98	9.24	9.38

		4	15.45	12.33	14.4	9.3	10.38	9.68	9.79
		10	14.8	11.7	13.76	9.95	11.01	10.32	10.43
		20	14.24	11.05	13.18	10.51	11.66	10.9	11.02
		30	13.98	10.78	12.89	10.77	11.93	11.19	11.30
		40	13.73	10.52	12.68	11.02	12.19	11.4	11.54
75		1	12.73	9.6	11.55	12.02	13.11	12.53	12.55
		4	12.13	8.9	10.95	12.62	13.81	13.13	13.19
		10	11.35	8.08	10.2	13.4	14.63	13.88	13.97
		20	10.62	7.39	9.4	14.13	15.32	14.68	14.71
		30	10.16	6.9	8.93	14.59	15.81	15.15	15.18
		40	9.82	6.56	8.6	14.93	16.15	15.48	15.52
		90	9.63	6.35	8.35	15.12	16.36	15.73	15.74
87.5		1	8.64	5.45	6.55	16.11	17.26	17.53	16.97
		4	8.29	4.75	6.54	16.46	17.96	17.54	17.32
		10	7.76	4.35	6.45	16.99	18.36	17.63	17.66
		20	7.24	3.82	6.15	17.51	18.89	17.93	18.11
		30	6.72	3.39	5.49	18.03	19.32	18.59	18.65
		40	6.32	3	4.89	18.43	19.71	19.19	19.11
		50	5.89	2.65	4.37	18.86	20.06	19.71	19.54
		60	5.57	2.33	3.95	19.18	20.38	20.13	19.90
		70	5.39	2.19	3.78	19.36	20.52	20.3	20.06
100		1	4.39	1.06	3.33	20.36	21.65	20.75	20.92

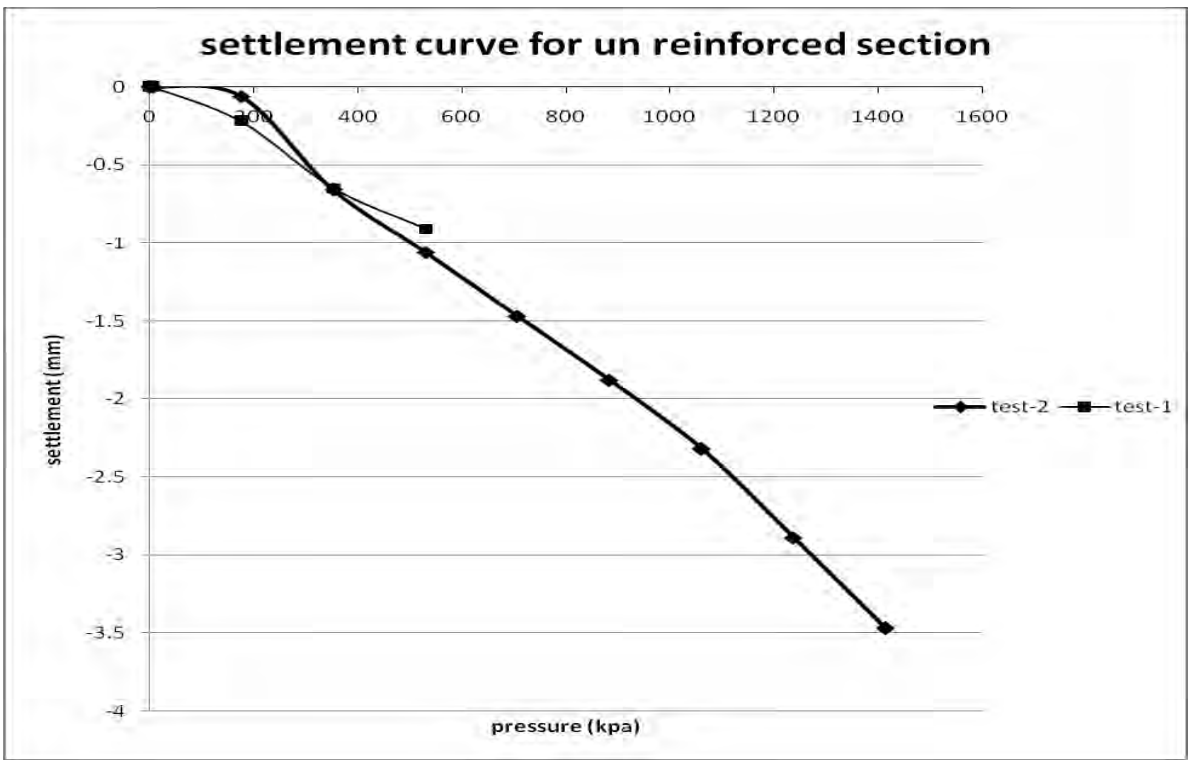
Combining all the test data:

Test conducted on		SUB-GRADE	NPA REINFORCED PAVE-1	NPA REINFORCED PAVE-2	NPA REINFORCED PAVE-3	UN-REINFORCED SECTION-1	UN-REINFORCED SECTION-2
Load (KN)	Pressure (Kpa)	Settlement (mm)	Settlement (mm)	Settlement (mm)	Settlement (mm)	Settlement (mm)	Settlement (mm)
0	0	0	0	0	0	0	0
0.5	7.070707	0	0	0	0	0	0
12.5	176.7677	-1.17	-0.68	-0.72	-0.77	-0.22	-0.06
25	353.5354	-3.12	-1.23	-1.41	-1.25	-0.65	-0.66
37.5	530.303	-5.57	-1.69	-1.56	-1.82	-0.91	-1.06
50	707.0707	-7.9	-2.08	-1.89	-2.17		-1.47
62.5	883.8384	-11.54	-2.44	-2.24	-2.74		-1.88
75	1060.606	-15.74	-2.77	-2.52	-3.24		-2.32
87.5	1237.374	-20.06	-3.09	-2.89	-3.8		-2.89
100	1414.141	-25	-3.37	-3.3	-4.45		-3.47

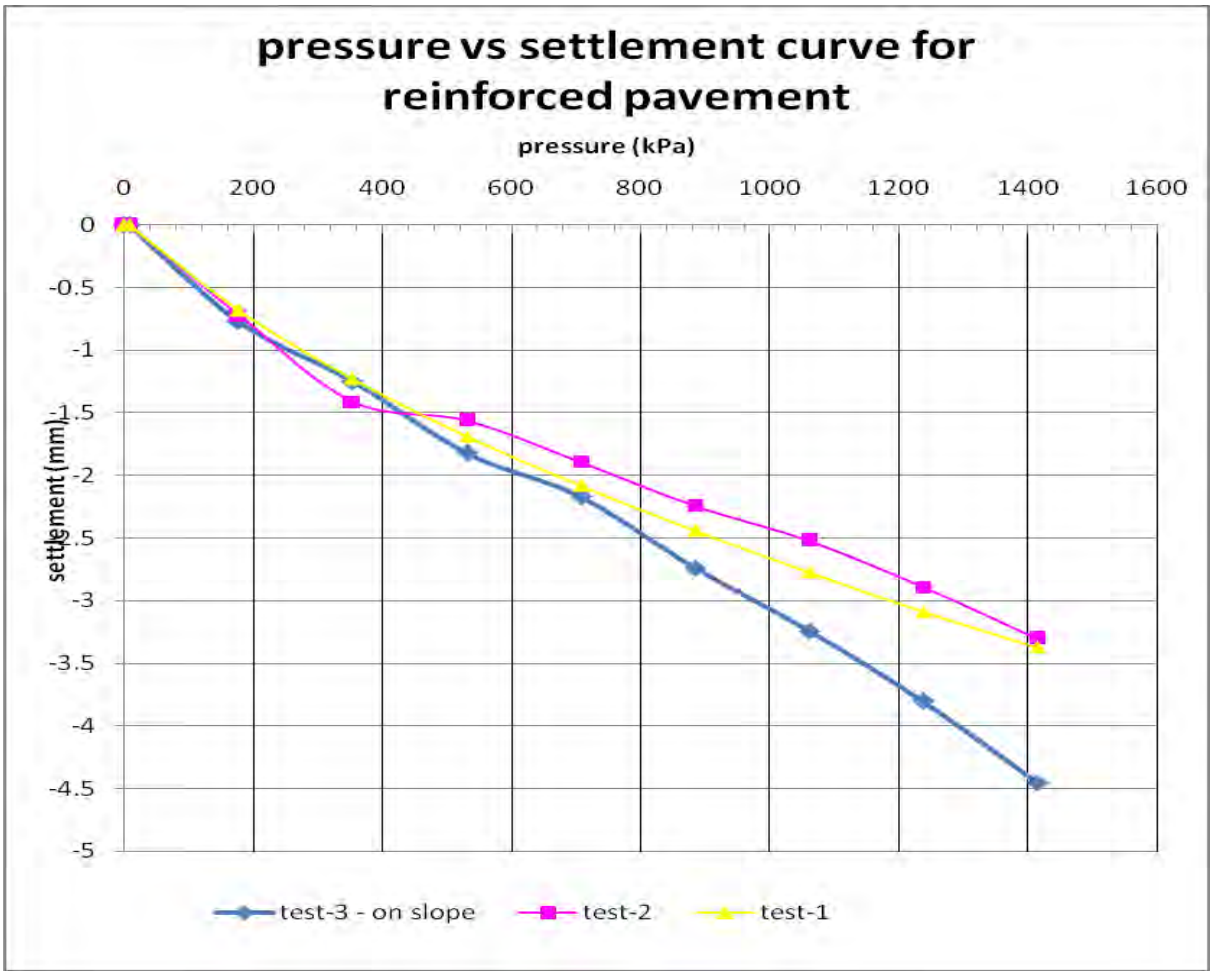
Load settlement curves:

a) Unreinforced section: The hydraulic jack failed the first time the test was performed. Hence, the test was repeated at some other location. The unreinforced section had bouldery subgrade layer. Very large size stones are observed at this section in the subgrade layer as shown in the following figure. Because of the large size boulders, the measured pressure-settlement data also showed skewed results. Only one test could be performed at the unreinforced road section because of time constraints.

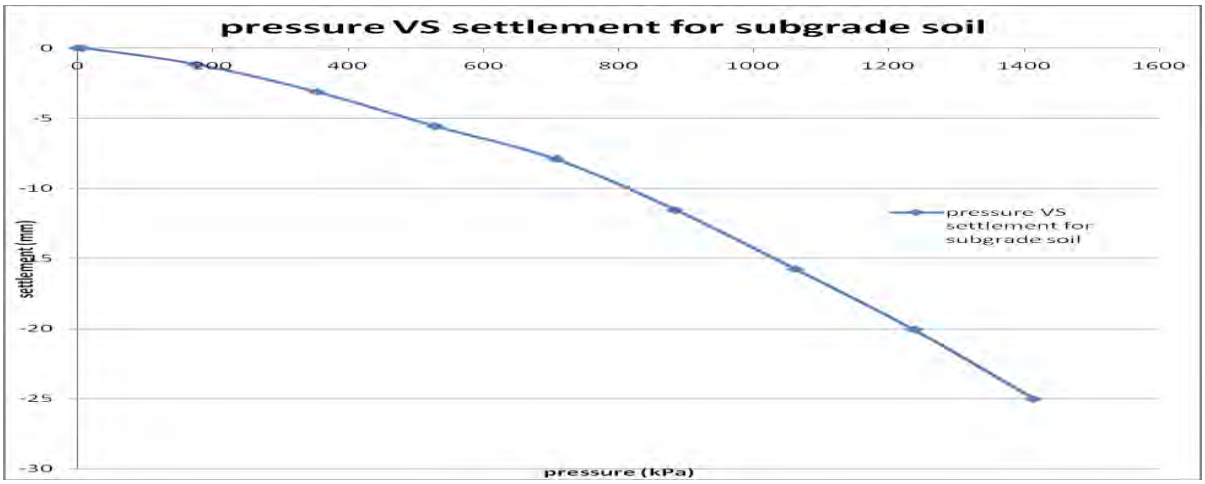
Figure 4. Bouldery size stones present at the subgrade level of unreinforced section



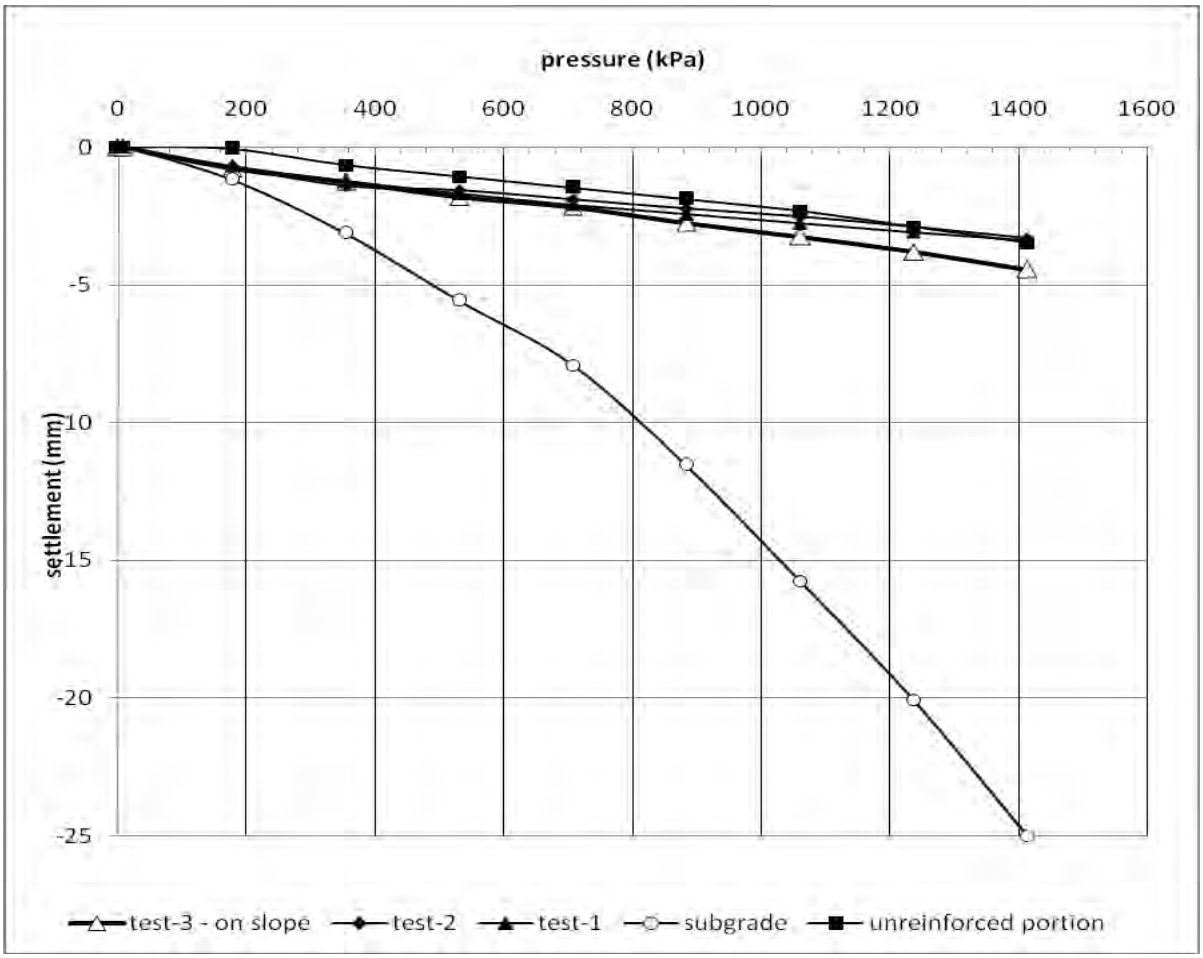
b) NPA Reinforced section:



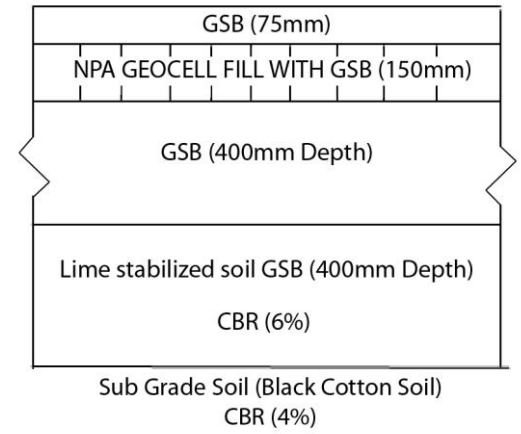
c) On subgrade soil:



Combined graph:



<u>Analysis done by KENPAVE Program</u> :



IRC-37 FORMULAS for Modulus of soil layers in terms of CBR values:

Subgrade[8]

$E(MPa) = 10*CBR$ for $CBR \leq 5$ and
$= 176*(CBR)^{0.64}$ for $CBR > 5$

Granular Sub-base and Base[7]

$E_2 = E_3*0.2 * h^{0.45}$

E_2 = Composite Ealstic Modulus of granular Sub-base nad Base (MPa)
E_3 = Elastic Modulus of Subgrade (MPa)
H = Thickness of granular layers (mm)
Poisson's ratio for both the granular layer as well as subgrade layer may be taken as 0.4

E- Value for subgrade (CBR 4%) = 10*4 =40 mPa = 40000 kPa

E-Value for stabilized subgrade (CBR 6%) = 17.6*6^0.64 = 55.40 Mpa = 55400 kPa

E-value for GSB (225mm thick) =55400*0.2*225^0.45= 126771.577 kPa

E-value for GSB (75mm thick) = 55400*0.2*75^0.45 = 77324.53 kPa

E-value for GSB (150mm thick) = 55400*0.2*150^0.45 = 105628.43 kPa

E- value for GSB (400mm thick) = 55400*0.2*400^0.45 = 164235.39 kPa

IMPROVEMENT FACTOR = (E-Value of reinforced layer / E-Value for unreinforced layer)

The analysis of pavement by using Kenpave software for the load of 100 kN and contact radius of 150 mm. The modulus of the Neoweb layer was selected by trial and error process to match the measured settlement at a load of 100 kN.

IMPROVEMENT FACTOR	E-Value (NPA Geocell with GSB of 150 mm thick)	SETTLEMENT (mm) on surface under 10T LOAD
1	105628.43 kPa	4.32
2	211256.86 kPa	3.57
2.5	264071.075 kPa	3.41
2.75	290478.18 kPa	3.35
3	316885.29 kPa	3.29
4	422513.72 kPa	3.14
5	528142.15 kPa	3.03

As per field settlement on surface for 10T LOAD = (3.33+3.37)/2 =3.35 mm

Considered contact radius = 150 mm
Contact pressure = load/area =100/area of plate =1414 kPa

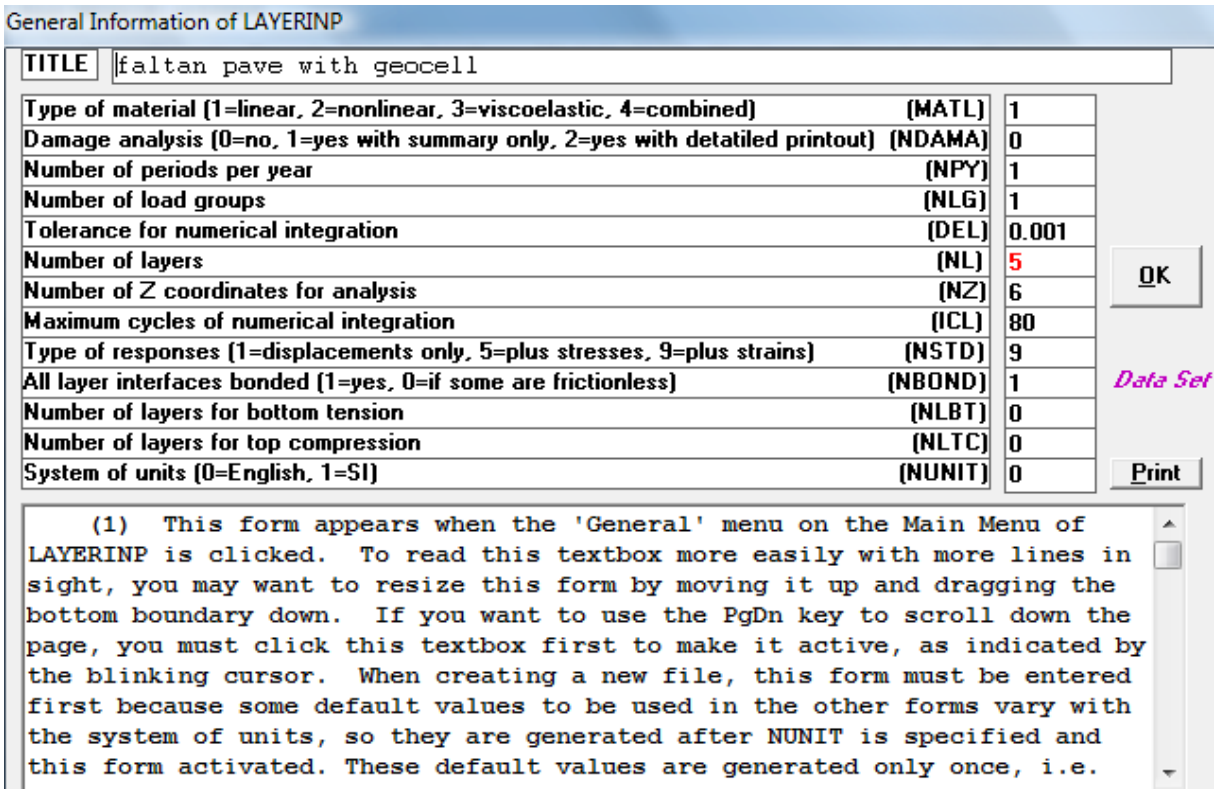
Based on Kenpave analysis we concluded IMPROVEMENT FACTOR = 2.75

Depth (Vertical coordinates)	IF-2.75 IRC-37			
	Vertical stress (psi)	Vertical stress (kpa)	settlement (in)	settlement (mm)
0	200.25	1419.206	0.13194	3.351276
-2.95	186.212	1319.717	0.09039	2.295906
-8.85	77.681	550.5386	0.07466	1.896364
-24.606	9.984	70.75833	0.05089	1.292606
-40.35	3.994	28.30617	0.03691	0.937514
-50	2.786	19.74486	0.03109	0.789686

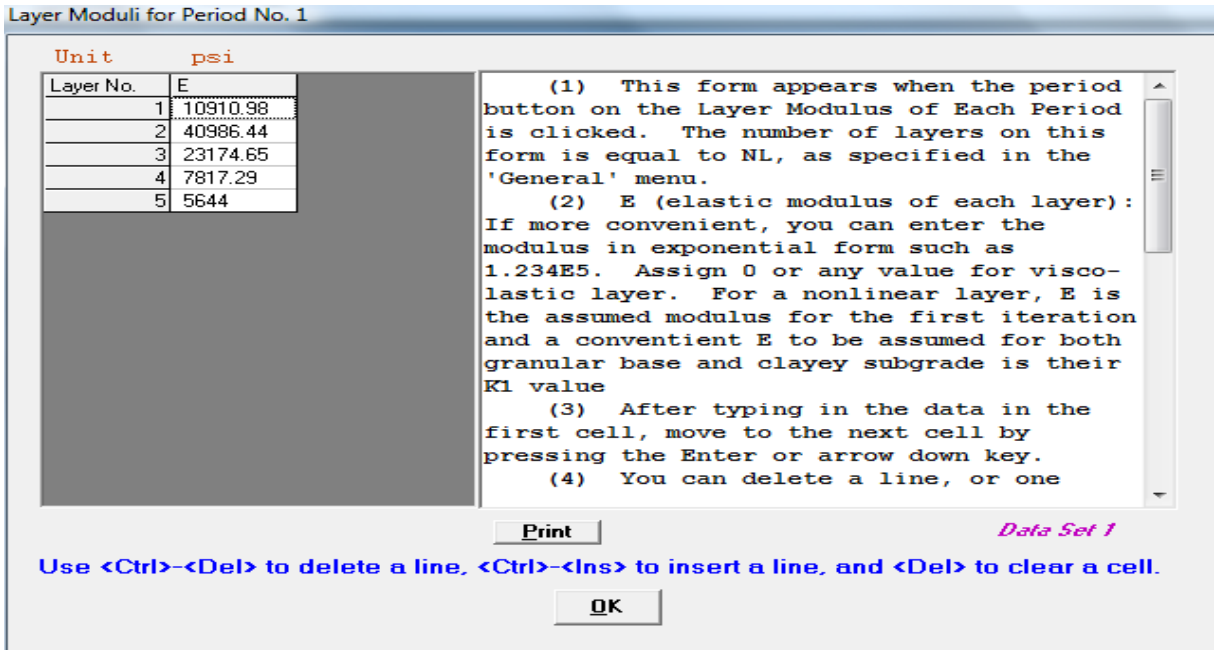
SCREEN SHOTS FROM <u>KENPAVE SOFTWARE ANALYSES:</u>

STEP 1:

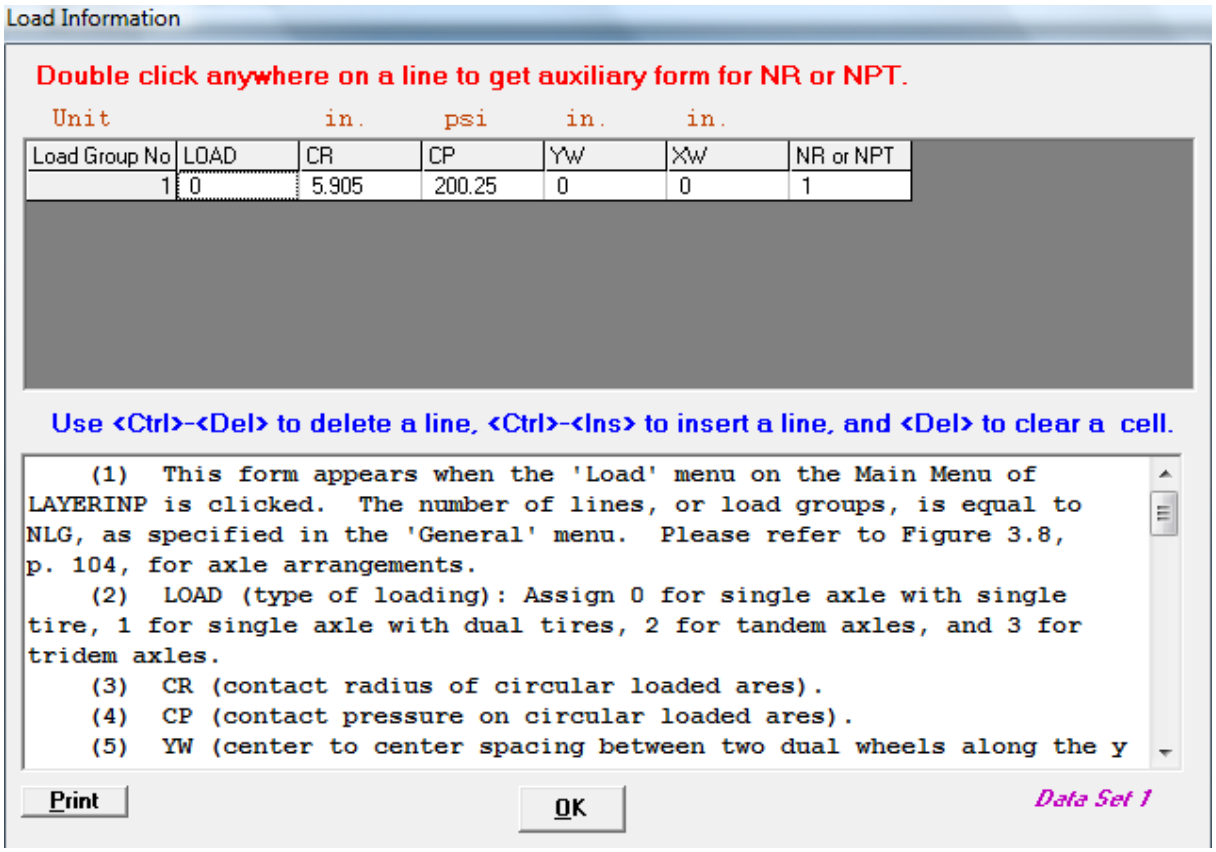
STEP-2: ENTER THE VALUES CORRESPONDING REQUIREMENT FOR ANALYSIS



STEP 3: ENTER THE MODULUS VALUES

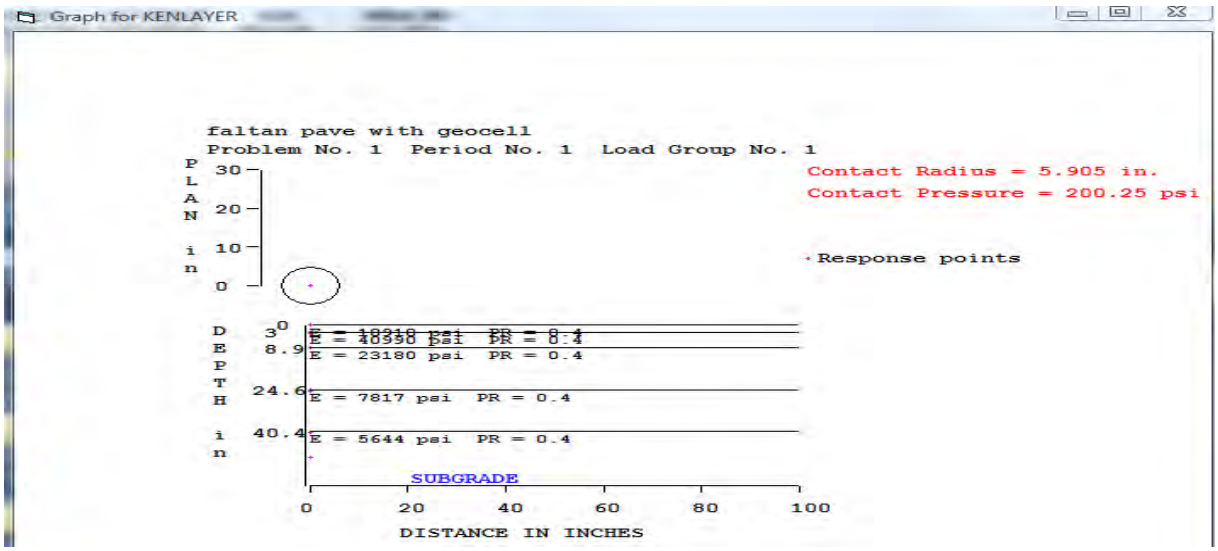


STEP-4: ENTER THE LOAD VALUE



STEP-5: CLICK **SAVE** BUTTON AND SAVE THE FILE, AFTER THAT CLICK "**KENLAYER**" BUTTON

STEP-6: CLICK ON "**LGRAPH**" BUTTON



STEP-7: CLICK ON EDITOR BUTTON AND SEE THE RESULTS

INPUT FILE NAME -C:\Users\dell\Desktop\faltan site geocell pav 2.75.DAT

NUMBER OF PROBLEMS TO BE SOLVED = 1

TITLE -faltan pave with NPA geocell

MATL = 1 FOR LINEAR ELASTIC LAYERED SYSTEM
NDAMA = 0, SO DAMAGE ANALYSIS WILL NOT BE PERFORMED
NUMBER OF PERIODS PER YEAR (NPY) = 1
NUMBER OF LOAD GROUPS (NLG) = 1
TOLERANCE FOR INTEGRATION (DEL) -- = 0.001
NUMBER OF LAYERS (NL)---------- = 5
NUMBER OF Z COORDINATES (NZ)------ = 6
LIMIT OF INTEGRATION CYCLES (ICL)- = 80
COMPUTING CODE (NSTD)---------- = 9
SYSTEM OF UNITS (NUNIT)----------= 0

Length and displacement in in., stress and modulus in psi unit weight in pcf, and temperature in F

THICKNESSES OF LAYERS (TH) ARE : 2.95 5.91 15.75 15.75
POISSON'S RATIOS OF LAYERS (PR) ARE : 0.4 0.4 0.4 0.4 0.4
VERTICAL COORDINATES OF POINTS (ZC) ARE: 0 2.953 8.86 24.6 40.35 50
ALL INTERFACES ARE FULLY BONDED

FOR PERIOD NO. 1 LAYER NO. AND MODULUS ARE :
1 1.091E+04 2 4.099E+04 3 2.317E+04 4 7.817E+03 5 5.644E+03

LOAD GROUP NO. 1 HAS 1 CONTACT AREA
CONTACT RADIUS (CR)---------- = 5.905
CONTACT PRESSURE (CP)---------- = 200.25
RADIAL COORDINATES OF 1 POINT(S) (RC) ARE : 0

PERIOD NO. 1 LOAD GROUP NO. 1

RADIAL COORDINATE	VERTICAL COORDINATE	VERTICAL DISPLACEMENT (STRAIN)	VERTICAL STRESS (STRAIN)	RADIAL STRESS (STRAIN)	TANGENTIAL STRESS (STRAIN)	SHEAR STRESS
0.00000	0.00000	0.13194	200.250	194.583	194.583	0.000
(STRAIN)			1.148E-02	4.023E-04	4.023E-04	.000E+00
0.00000	2.95300	0.09039	186.212	103.664	103.664	0.000
(STRAIN)			2.520E-03	-2.998E-04	-2.998E-04	.000E+00
0.00000	8.86000	0.07466	77.681	-29.462	-29.462	0.000
(STRAIN)			2.470E-03	-1.189E-03	-1.189E-03	.000E+00
0.00000	24.60000	0.05089	9.984	-15.089	-15.089	0.000
(STRAIN)			9.517E-04	-5.630E-04	-5.630E-04	.000E+00
0.00000	40.35000	0.03691	3.994	-1.201	-1.201	0.000
(STRAIN)			6.339E-04	-2.966E-04	-2.966E-04	.000E+00
0.00000	50.00000	0.03109	2.786	-0.072	-0.072	0.000
(STRAIN)			5.037E-04	-2.050E-04	-2.050E-04	.000E+00

7) APPENDIX

NOVEL POLYMERIC ALLOY CELLULAR CONFINEMENT SYSTEM (GEOCELL)

SYSTEM PHYSICAL DESCRIPTION

PROPERTIES	DESCRIPTION
Material	Polymeric Alloy
Friction Efficiency Angle	Angle of internal friction efficiency factor 0.80
Traceability	Each section marked for full detailed traceability
Cell Distance between Weld Seams	330 mm
Cell Wall Heights	<50, 65, 75, 100, 125, 150, 175 mm>

MECHANICAL PROPERTIES – STIFFNESS AND STRENGTH

	DESCRIPTION	UNITS	TEST METHOD
SHORT TERM			
Strength at Yield	**> 19**	kN/m	PRS method *(1)*
LONG TERM RESISTANCE TO PLASTIC (Permanent) DEFORMATIONS (Creep Included)			
Allowed Strength for Design (50 years)	**> 7.0**	kN/m	ASTM D-6992 (SIM) *(2)*
Creep (Deformation) Reduction Factor (50 years)	**< 2.7**	kN/m	ASTM D-6992 (SIM) *(3)*

(1) Test sample cut from cell seam to seam measured at strain rate 20%/min, 23°C;
(2) Allowed strength to reach 10% creep strain max for 50 years at 23°C;
(3) Creep (deformation) reduction factor for 50 years at 23°C

DIMENSIONAL STABILITY

PROPERTIES	DESCRIPTION	UNITS	TEST METHOD
Coefficient of Thermal Expansion (CTE)	**≤ 80**	ppm/^{o}C	ISO 11359-2 (TMA) ASTM E831 *(4)*

(4) CTE measurement range from -30°C to +30°C

PERFORMANCE AT ELEVATED TEMPERATURES

PROPERTIES	DESCRIPTION	UNITS	TEST METHOD
Flexural Storage Modulus at sample temp:			
30°C	**> 750**	MPa	ISO 6721-1
45°C	**> 650**		ASTM E2254
60°C	**> 550**		(DMA)
75°C	**> 300**		

OXIDATION RESISTANCE

PROPERTIES	DESCRIPTION	UNITS	TEST METHOD
Oxidative Induction Time (OIT) (virgin material prior to any aging)	**≥ 100**	minutes	ISO 11357-6, ASTM D3895 (OIT @ 200°C)

PHOTOCHEMICAL RESISTANCE

PROPERTIES	DESCRIPTION	UNITS	TEST METHOD
Durability to UV Degradation (UV Resistance)	**> 250**	minutes	ASTM D5885 (HPOIT @ 200°C)