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TITLE-INFLUENCE OF POLYPROPYLENE IN STRENGTH OF SOIL..USING FLY ASH AS ADMIXTURE

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I. INTRODUCTION

In last few years, environmental and economical issues have stimulated interest in the development of alternative materials and reuse of industrial waste/by-products that can fulfil specification. A material such as fly ash is a residue collected from thermal power plants and also have problem disposal of fly ash, it requires a lot of land use and also have hazardous effect to environment. To minimise these problems fly ash has been used in several fields like filling of low lying area, used in concrete as small replacement of cement, used in bituminous pavement etc. Fly ash is a non-plastic and lightweight material having the specific gravity relatively lower than that of the similar graded conventional earth material. Fly ash is a fine-coarse, powder recovered from the gases of burning coal during the production of electricity. These micron-sized earth elements consist primarily of silica, alumina and iron. Massive generation of Fly ash by thermal power plants has become a major cause of concern for people living in and around thermal power plants. The current rate of generation of coal ash in India has reached 150 million tons per annum with about 85,000 acres of precious land under the cover of abandoned ash ponds. It is estimated that the generation of Fly ash from coal fired generation units in India will reach 210 million tons per annum by the year 2020 whereas, the current rate of utilization of ash is about 35%. This leads to an ever increasing area for storing ash and related environmental issues. On the other hand, the construction of highways and roads in India, which has taken a boom in the recent years, requires a huge amount of natural soil and aggregates. To meet this demand ruthless exploitation of fertile soil and natural aggregate is being adopted. This has brought the situation to an alarming state. To address these problems Fly ash has been tried in the low lying areas as structural fills and embankment construction for highways. However, due to lack of sufficient knowledge and confidence its use has not taken momentum. The basic and essential parameters of Fly ash, to be used either as structural fill or embankment material.

Fly ash, the by-product of thermal power plants is considered as solid waste and its disposal is a major problem from environment point of view and also it requires lot of disposal areas. Utilization of Fly ash to the maximum possible extent is a worldwide problem. To solve the problem, Fly ash can be used as a structural fill for developing low-lying areas to construct structures on it. There are two types of ash produced by thermal power plants, viz., Top ash and bottom ash. These two ash mixed together are transported to the ash Fly and this deposit is called Fly ash. Improvement of load bearing capacity of shallow foundation on Fly ash may be possible by introducing jute-geo textile sheet into the fly ash as reinforcement, mixing of polypropylene fibre or some other material which increase its cohesion value.

II. MATERIAL USED AND EXPERIMENTAL WORK

2.1 Source of Fly Ash

Fly ash used in this study will be collected from the thermal power plant of National Thermal Power Plant of Panki, Kanpur. The samples will be dried at the temperature of 105-110 degrees. The ash sample will screened through 2 mm sieve to separate out the foreign and vegetative matters. Then the fly ash samples will stored in airtight container for subsequent use.

2.2 Source of Geo-fibres (Recron-3S)

Geo-fibre used for the test will buy from the market seal packed having size 12mm. The fibre used for reinforced Fly Ash specimens was a polyester fibre (Recron-3s). These fibres are made from polymerization of pure teraphthalic acid and Mono Ethylene Glycol using a catalyst. These fibres were found to be widely used in concrete technology.

Silt and clay size (%)	16.8
Specific gravity	2.42

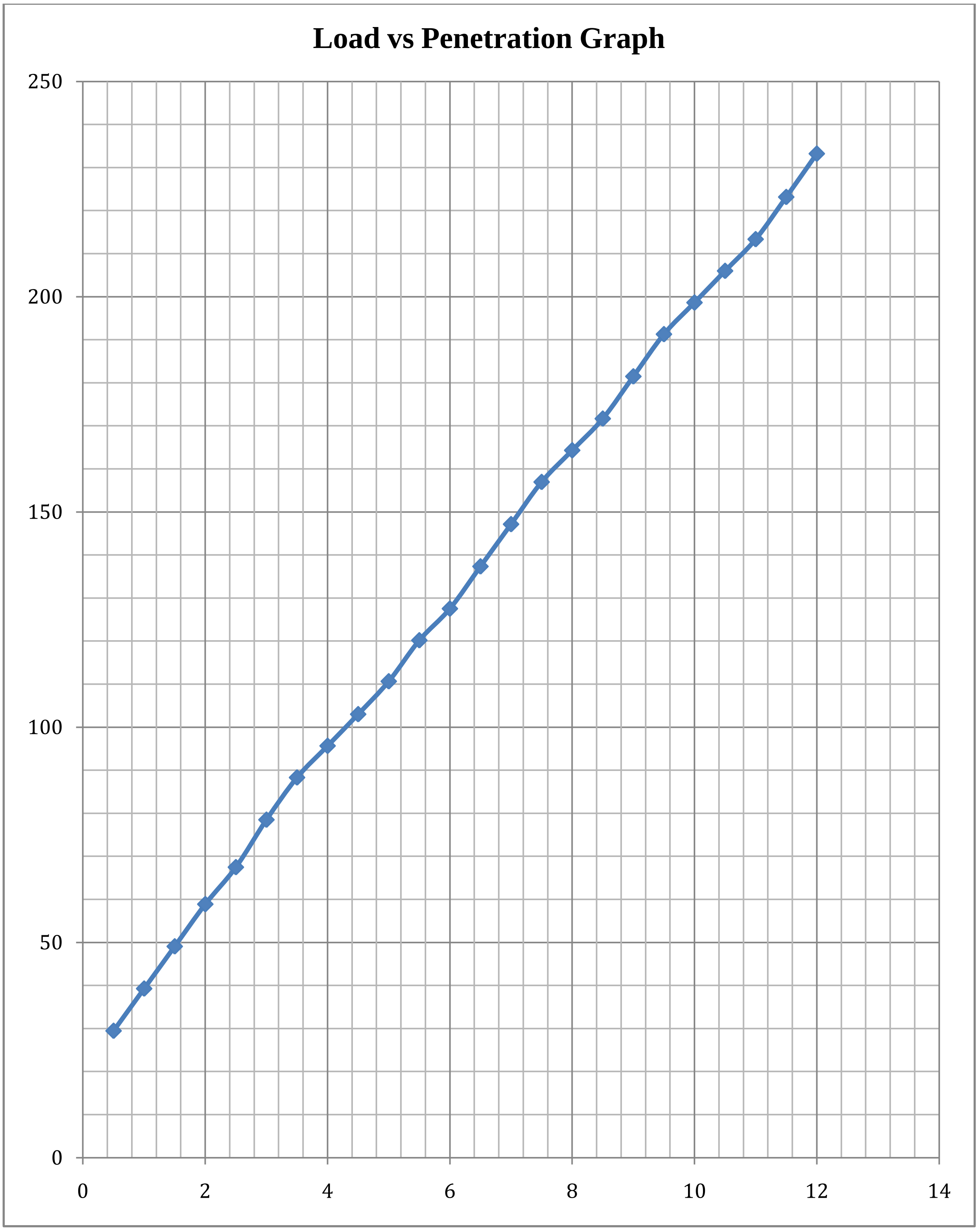
Co-efficient of Uniformity(Cu)	3.50
Co-efficient of Curvature (Cc)	0.64
Liquid limit (%)	Non-Plastic
Plastic limit (%)	Non-plastic
Maximum dry density (MDD) (gm/cc)	1.287
Optimum moisture content (OMC) (%)	36.34

2.3 CBR determination using 1% of polypropylene fibre as reinforcement in fly ash

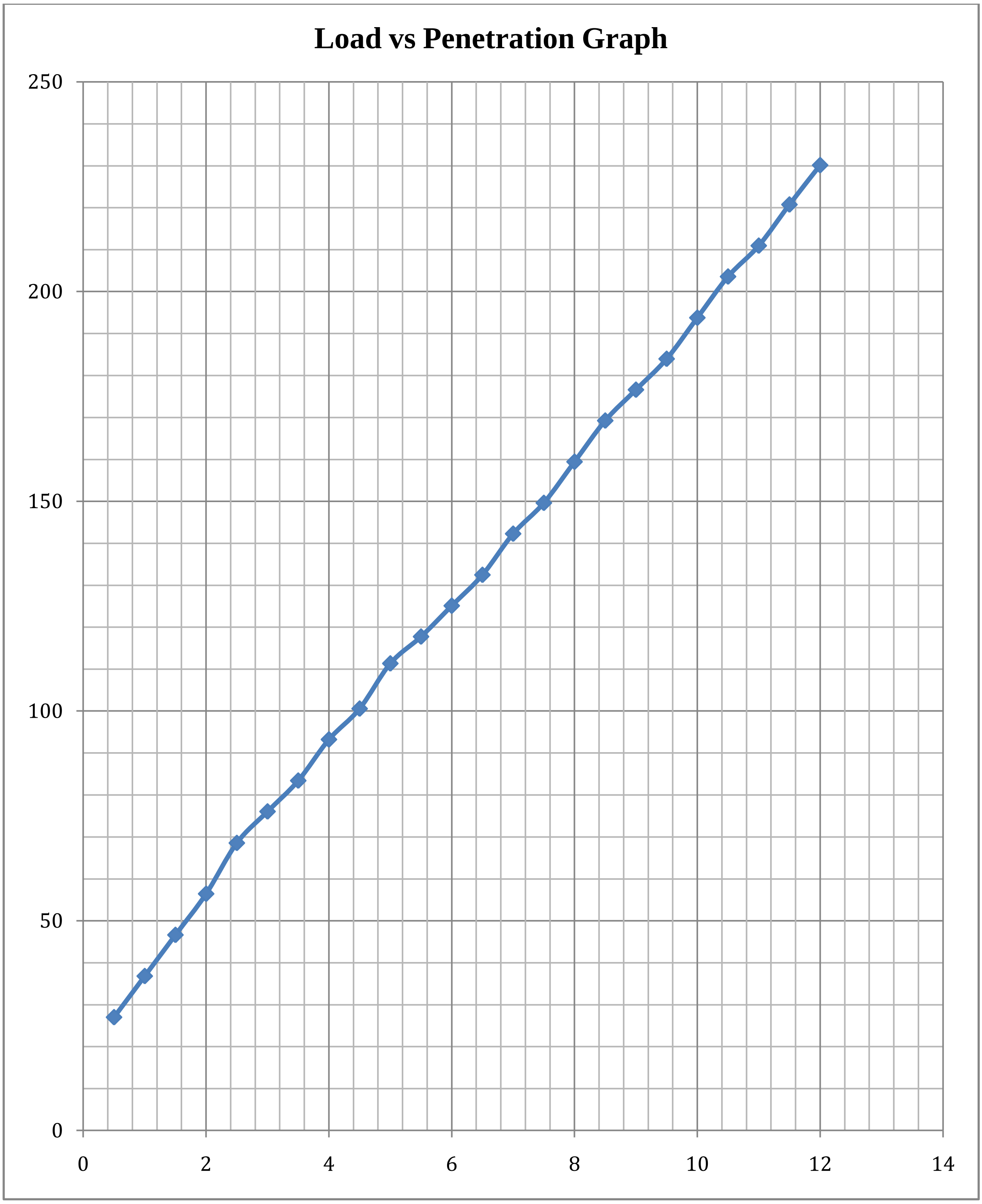
OMC = 36.34%
Soil sample = 5.50 kg
Mixing water = 5.50 x 36.34% = 1.99 litre = 1990 ml
3 layers and number of blows = 56
Hammer weight =2.6 kg (light compaction)

Table 2.1: Observations of fly ash reinforced with 1% of fibre

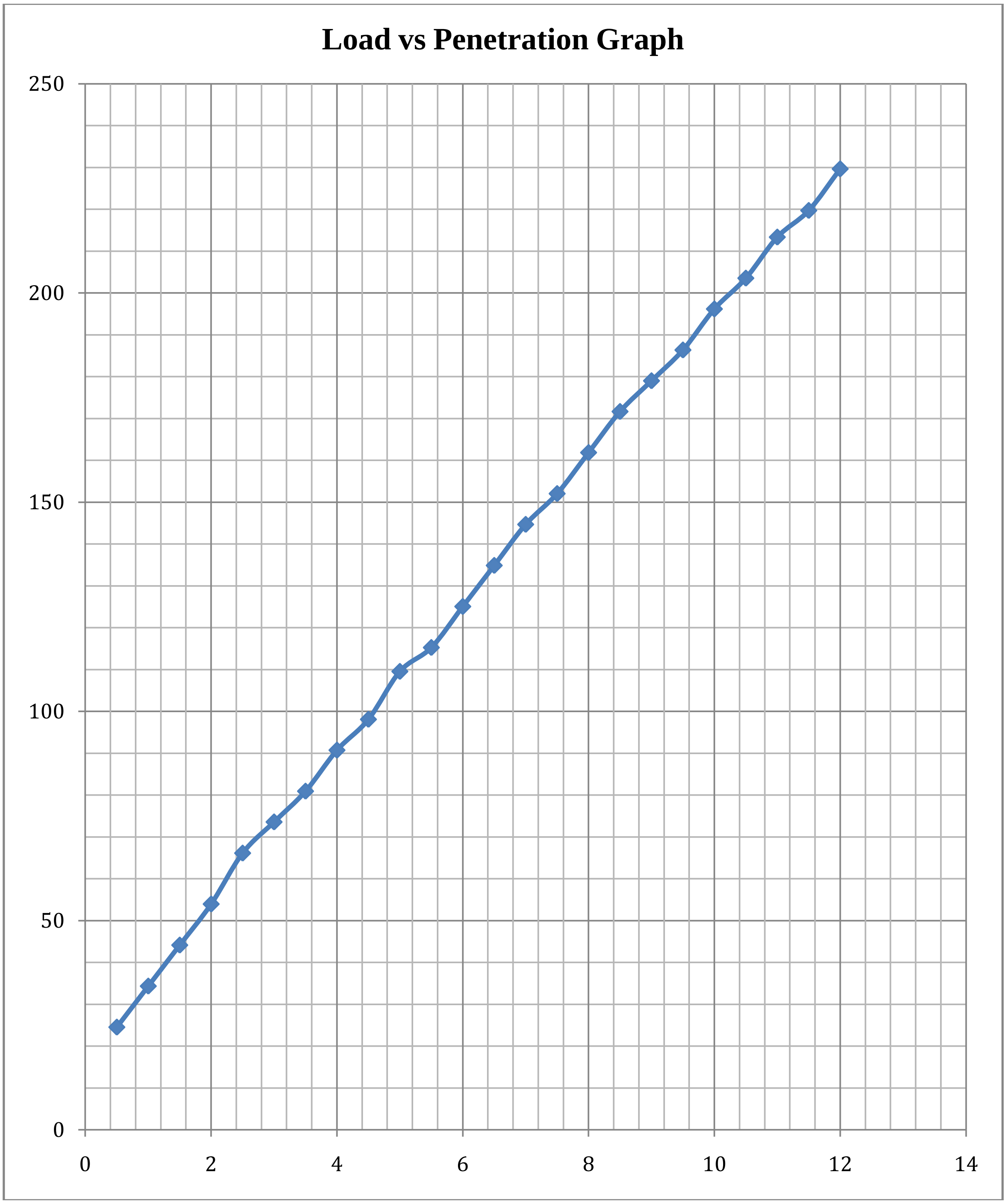
Penetration (mm)	Proving Ring (Using 1% of Polypropylene fibre) (Load) (kg-f)		
	Sample (1)	Sample (2)	Sample (3)
0.5	29	26	24
1.0	39	36	34
1.5	49	46	44
2.0	58	56	53
2.5	67	69	66
3.0	78	76	73
3.5	88	83	80
4.0	95	93	90
4.5	103	100	98
5.0	110	112	109
5.5	120	117	115
6.0	127	125	125
6.5	137	132	134
7.0	147	142	144
7.5	156	149	152
8.0	164	159	161
8.5	171	169	171
9.0	181	176	179
9.5	191	183	186
10.0	198	193	196
10.5	206	203	203
11.0	213	210	213
11.5	223	220	219
12.0	233	230	229



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.8 (a): Sample (1) (Reinforcement with 1.0 % of Polypropylene Fibre)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.8 (b): Sample (2) (Reinforcement with 1.0 % of Polypropylene Fibre)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.8 (c): Sample (3) (Reinforcement with 1.0 % of Polypropylene Fibre)

2.4 CALCULATION OF CBR RESULT
Standard Values of load for different penetration

S. No.	Penetration of plunger (mm)	Standard load (Kg-f)
1	2.5	1370
2	5	2055
3	7.5	2630
4	10	3180

5	12.5	3600

2.4.1 CBR (Unreinforced Fly Ash)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	10	1370	0.73	0.92
2	5.0	19	2055	0.92	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	10	1370	0.73	0.88
2	5.0	18	2055	0.88	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	12	1370	0.88	1.02
2	5.0	21	2055	1.02	

Final CBR = 1.02%

2.4.2 CBR (Fly Ash reinforced with 0.25% of Polypropylene fibre)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	27	1370	1.97	2.53
2	5.0	52	2055	2.53	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	24	1370	1.75	2.43
2	5.0	50	2055	2.43	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	28	1370	2.04	2.63

2	5.0	54	2055	2.63	

Final CBR = 2.63%

2.4.3 CBR (Fly Ash reinforced with 0.50% of Polypropylene fibre)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	56	1370	4.08	4.77
2	5.0	98	2055	4.77	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	53	1370	3.87	4.67
2	5.0	96	2055	4.67	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	52	1370	3.79	4.57
2	5.0	94	2055	4.57	

Final CBR = 4.77 %

2.4.4 CBR (Fly Ash reinforced with 0.75% of Polypropylene fibre)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	67	1370	4.89	5.01
2	5.0	103	2055	5.01	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	65	1370	4.74	4.86
2	5.0	100	2055	4.86	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	64	1370	4.67	4.81
2	5.0	99	2055	4.81	

Final CBR = 5.01%

2.4.5 CBR (Fly Ash reinforced with 1.0% of Polypropylene fibre)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	67	1370	4.89	5.35
2	5.0	110	2055	5.35	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	69	1370	5.03	5.45
2	5.0	112	2055	5.45	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	66	1370	4.82	5.30
2	5.0	109	2055	5.30	

Final CBR = 5.45 %

Table 2.2: CBR Values of Reinforced Fly Ash

Fibre Content (%)	CBR Value	% Increase in CBR Value
0	1.02	-
0.25	2.63	258
0.50	4.77	468
0.75	5.01	491
1	5.45	536

2.5 GEOTECHNICAL PROPERTIES OF SOIL

2.5.1 OPTIMUM MOISTURE CONTENT

Weight of soil = 2.5 kg.
Mould wt. = 4.660
3 layers and number of blows = 25
Hammer wt. = 2.6 kg
Water mixing = 10 % of the soil sample [{(2.5x10)/100} = 0.25 litre = 250 ml of water
Mould: D=10cm, H= 12.73cm
Volume of mould = 1000 cc

Table 2.3(a): Observation of unreinforced soil

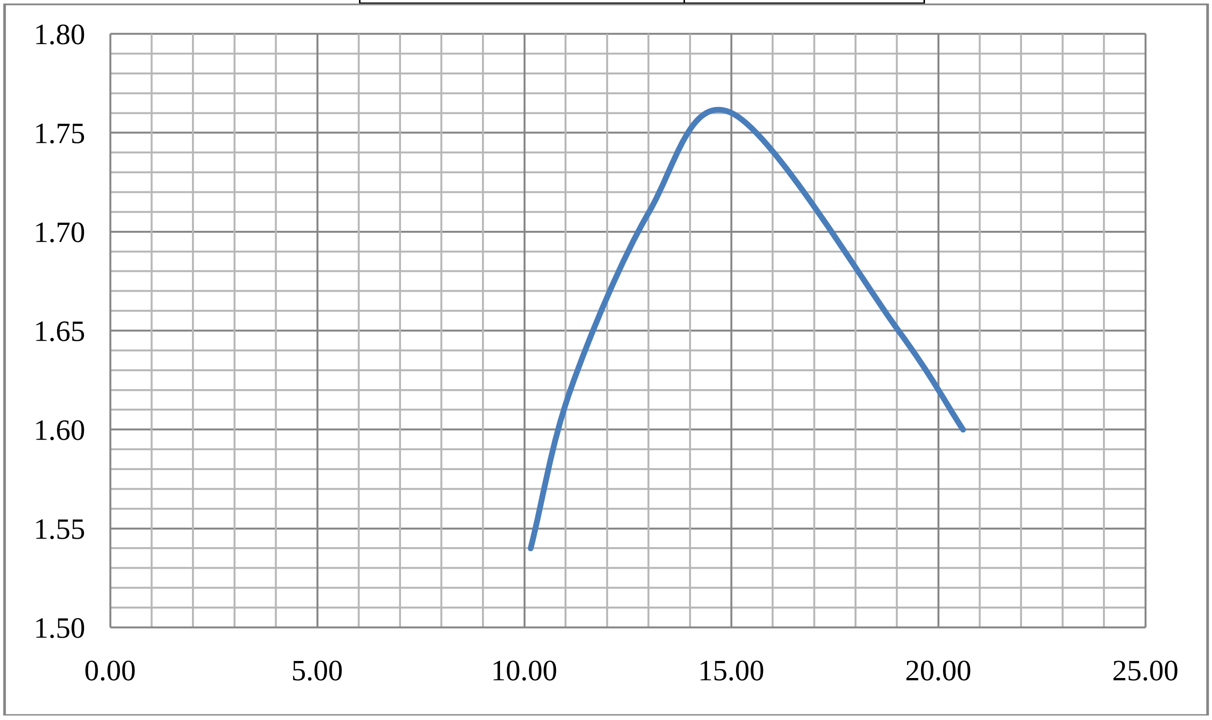
Determination Number	1	2	3	4	5	6

Weight of mould, W_m (gm)	4660	4660	4660	4660	4660	4660
Weight of Mould + Compacted Soil, W (gm)	6360	6460	6590	6680	6620	6620
Moisture Container Number	135	196	152	200	129	118
Weight of moisture container W_1 (gm)	16.11	11.24	11.16	14.02	15.51	16.26
Weight of container + wet soil W_2 (gm)	32.60	29.13	34.88	37.54	39.89	41.02
Weight of container + dry soil W_3 (gm)	31.08	27..34	32.15	34.47	35.99	36.79
Wet Density, $\Upsilon_m= (W-W_m)/V_m$	1.70	1.80	1.93	2.02	1.96	1.93
Moisture Content, w%= $(W_2-W_3)100/(W_3-W_1)$	10.15	11.11	13.01	15.01	19.04	20.60
DryDensity, $\Upsilon_d=\Upsilon_m/(1+w/100)$	1.54	1.62	1.71	1.76	1.65	1.60

Result: The water content of the sample = 15% (approx) and Draw a curve between water content and dry density

Draw the curve between Water content and dry density:

Water content (w) In %	**Dry density in g/cc**
10.15	1.54
11.11	1.62
13.01	1.71
15.01	1.76
19.04	1.65
20.60	1.60



On X-axis: Water content (%)
On Y-axis: Dry density (g/cc)
Fig 3.11: Curve between water content and Dry density

2.5.2 OPTIMUM MOISTURE CONTENT OF REINFORCED SOIL WITH 0.5% RECRON AND 5% OF FLY ASH

Weight of soil = 2.362 kg
Weight of Fly ash = 125 gm
Weight of Recron = 12.5 gm
Mould wt. = 4.660
3 layers and number of blows = 25

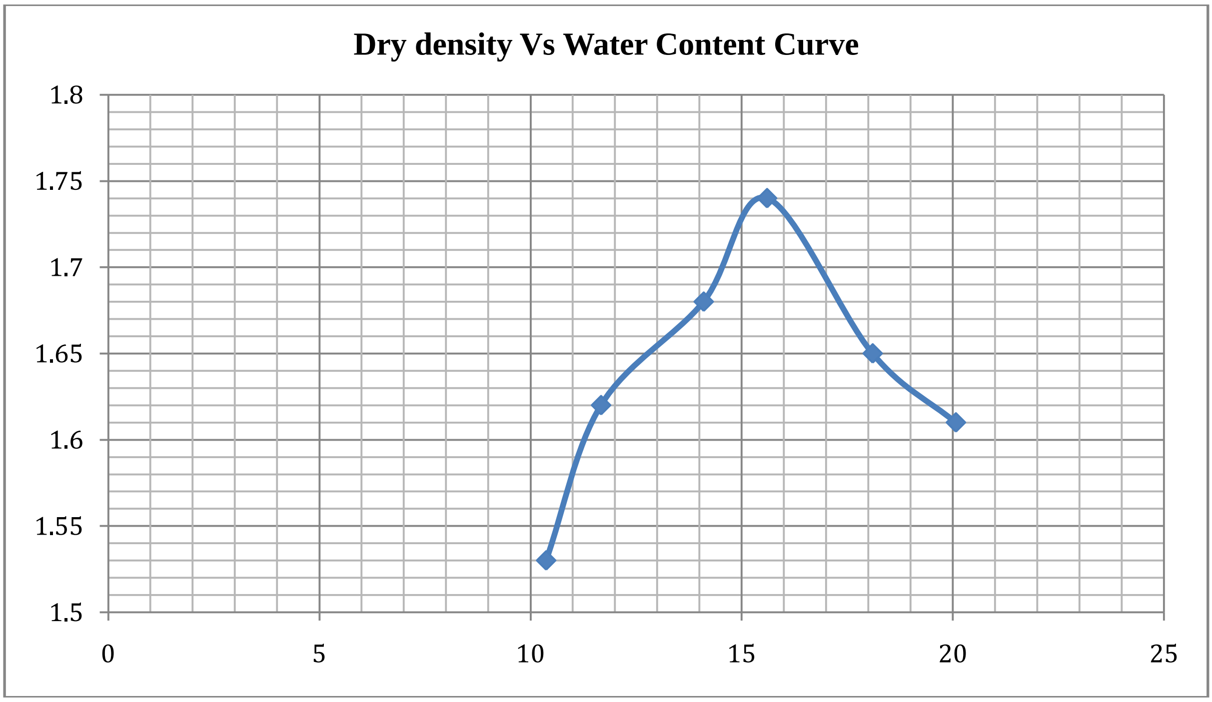
Hammer wt. = 2.6kg
Water mixing = 12% of the soil sample [{(2.5x10)/100} = 0.25 liter = 250 ml of water
Mould: D=10cm, H= 12.73cm
Volume of mould = 1000 cc

Table 2.3(b): Observations of reinforced soil with 0.5% Recron and 5% of fly ash

Determination Number	1	2	3	4	5	6
Weight of mould, W_m (gm)	4660	4660	4660	4660	4660	4660
Weight of Mould + Compacted Soil, W (gm)	6350	6470	6580	6670	6620	6610
Moisture Container Number	112	157	200	140	196	142
Weight of moisture container W_1 (gm)	16.25	12.61	14.02	16.47	19.22	16.47
Weight of container + wet soil W_2 (gm)	32.74	33.56	31.25	36.47	42.57	35.47
Weight of container + dry soil W_3 (gm)	31.19	31.37	29.12	33.77	38.99	32.21
Wet Density, $\Upsilon_m= (W-W_m)/V_m$	1.69	1.81	1.92	2.01	1.96	1.95
Moisture Content, w%= $(W_2-W_3)100/(W_3-W_1)$	10.37	11.67	14.10	15.60	18.10	20.07
DryDensity, $\Upsilon_d=\Upsilon_m/(1+w/100)$	1.53	1.62	1.68	1.74	1.65	1.61

Result: The water content of the sample = 15.76% and Draw a curve between water content and dry density
Draw the curve between Water content and dry density:

Water content (w) In %	Dry density in g/cc
10.37	1.53
11.67	1.62
14.10	1.68
15.60	1.74
18.10	1.65
20.07	1.61



On X-axis: Water content (%)
On Y-axis: Dry density (g/cc)
Fig 3.12: Curve between water content and Dry density

2.5.3 OPTIMUM MOISTURE CONTENT OF REINFORCED SOIL WITH 0.5% RECRON AND 10% OF FLY ASH

Weight of soil = 2.237 kg
Weight of Fly ash = 250 gm
Weight of Recron = 12.5 gm
Mould wt. = 4.660
3 layers and number of blows = 25
Hammer wt. = 2.6 kg
Water mixing = 12% of the soil sample [{(2.5x10)/100} = 0.25 liter = 250 ml of water
Mould: D=10cm, H= 12.73cm
Volume of mould = 1000 cc

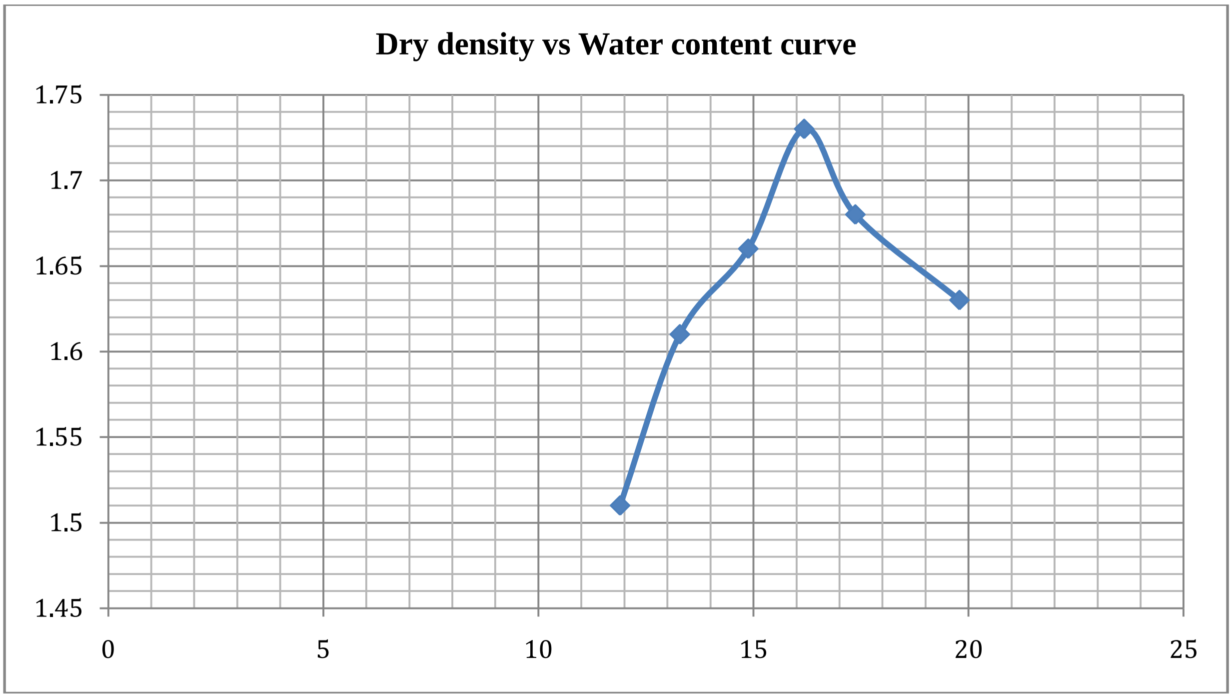
Table 2.3(c): Observations for reinforced soil with 0.5% of recron and 10% of flyash

Determination Number	1	2	3	4	5	6
Weight of mould, W_m (gm)	4660	4660	4660	4660	4660	4660
Weight of Mould + Compacted Soil, W (gm)	6360	6490	6580	6680	6640	6620
Moisture Container Number	142	157	152	139	132	200
Weight of moisture container W_1 (gm)	16.47	12.61	14.31	15.46	16.49	14.03
Weight of container + wet soil W_2 (gm)	25.68	40.56	34.35	32.11	33.58	25.47
Weight of container + dry soil W_3 (gm)	24.70	37.28	31.68	29.79	31.05	23.58
Wet Density, $\Upsilon_m = (W-W_m)/V_m$	1.70	1.83	1.92	2.02	1.98	1.96
Moisture Content, w%= $(W_2-W_3)100/(W_3-W_1)$	11.90	13.29	15.37	16.18	17.37	19.79
DryDensity, $\Upsilon_d=\Upsilon_m/(1+w/100)$	1.51	1.61	1.66	1.73	1.68	1.63

Result: The water content of the sample = 16.18% (approx) and Draw a curve between water content and dry density

Draw the curve between Water content and dry density:

Water content (w) In %	Dry density in g/cc
11.90	1.51
13.29	1.61
15.37	1.66
16.18	1.73
17.37	1.68
19.79	1.63



On X-axis: Water content (%)
On Y-axis: Dry density (g/cc)
Fig 3.13: Curve between water content and Dry density

2.5.4 OPTIMUM MOISTURE CONTENT OF REINFORCED SOIL WITH 0.5% RECRON AND 15% OF FLY ASH

Weight of soil = 2.112 kg
Weight of Fly ash = 375 gm
Weight of Recron = 12.5 gm
Mould wt. = 4.660
3 layers and number of blows = 25
Hammer wt. = 2.6 kg
Water mixing = 12% of the soil sample [{(2.5x10)/100} = 0.25 litre = 250 ml of water
Mould: D=10cm, H= 12.73cm
Volume of mould = 1000 cc

Table 2.3(d): Observations of reinforced soil with 0.5% of Recron and 15% of fly ash

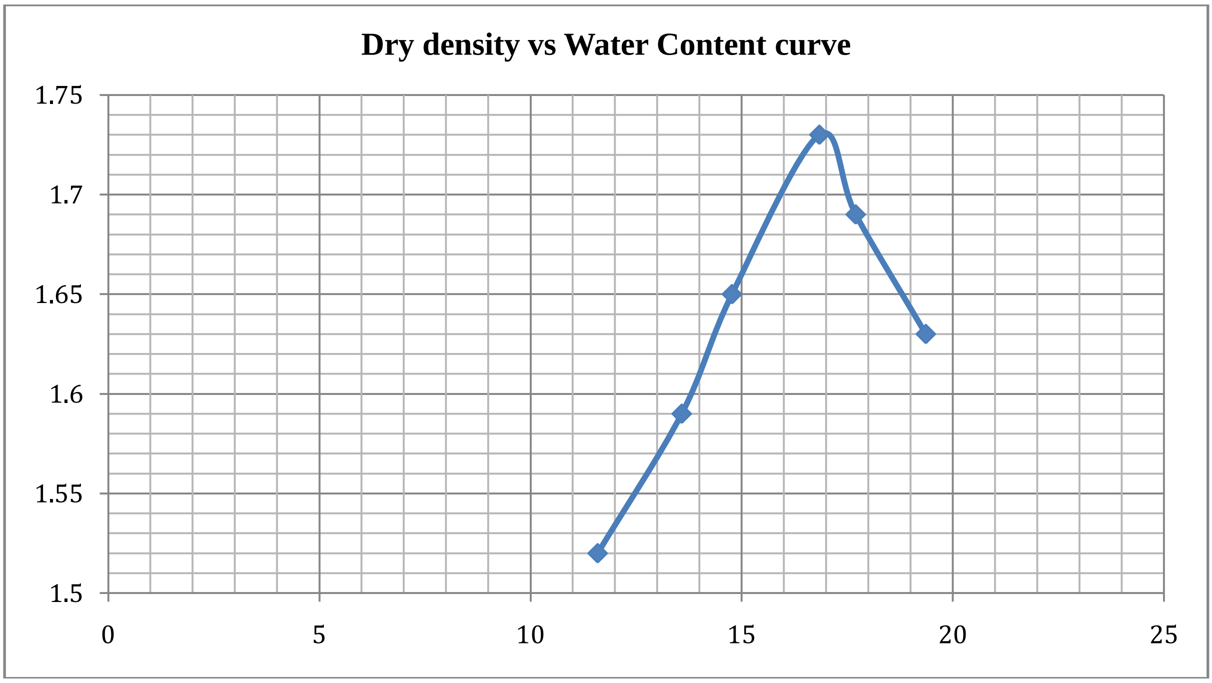
Determination Number	1	2	3	4	5	6
Weight of mould, W_m (gm)	4660	4660	4660	4660	4660	4660
Weight of Mould + Compacted Soil, W (gm)	6360	6470	6580	6690	6650	6630
Moisture Container Number	112	160	139	140	157	140
Weight of moisture container W_1 (gm)	16.25	16.06	15.47	16.47	12.61	16.47
Weight of container + wet soil W_2 (gm)	25.68	32.28	31.69	35.55	28.70	38.10
Weight of container + dry soil W_3 (gm)	24.70	30.58	29.48	32.80	26.28	34.44
Wet Density, $\Upsilon_m = (W-W_m)/V_m$	1.70	1.81	1.92	2.03	1.99	1.97
Moisture Content, w%= $(W_2-W_3)100/(W_3-W_1)$	11.59	13.58	15.77	16.84	17.70	20.36
Dry Density, $\Upsilon_d=\Upsilon_m/(1+w/100)$	1.52	1.59	1.65	1.73	1.69	1.63

Result: The water content of the sample = 16.18% (approx) and Draw a curve between water content and dry density

Draw the curve between Water content and dry density:

Water content (w) In %	Dry density in g/cc
11.59	1.52

13.58	1.59
15.77	1.65
16.84	1.73
17.70	1.69
19.36	1.63



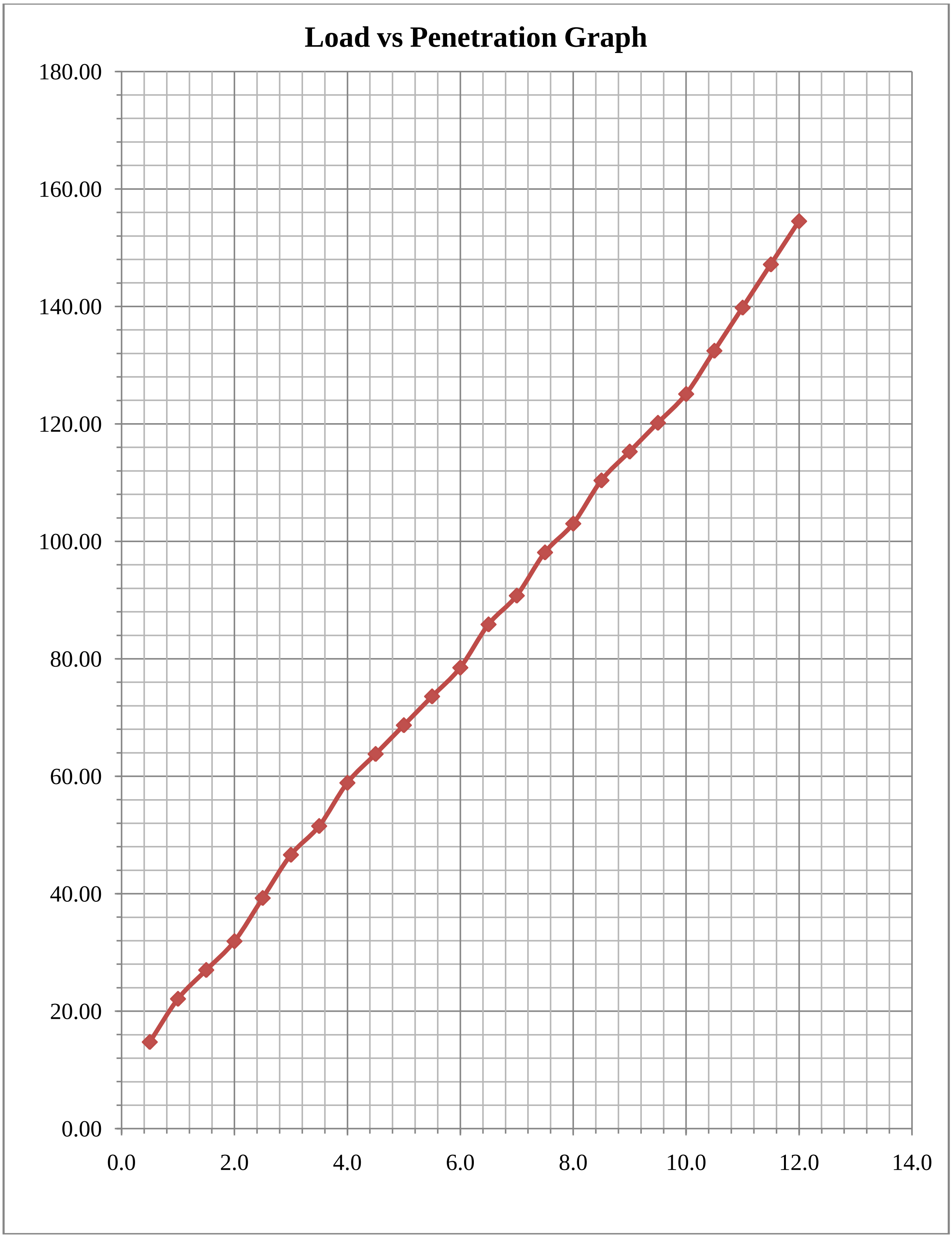
On X-axis: Water content (%)
On Y-axis: Dry density (g/cc)
Fig 3.14: Curve between water content and Dry density

2.5.5 CBR DETERMINATION
Without using polypropylene fibre and fly ash in CBR moulds.
OMC = 15.01%
Soil sample = 5.50 kg
Mixing water = 5.50 x 15.01% = 0.825 liter = 825 ml
3 layers and number of blows = 56
Hammer weight =2.6 kg (light compaction)

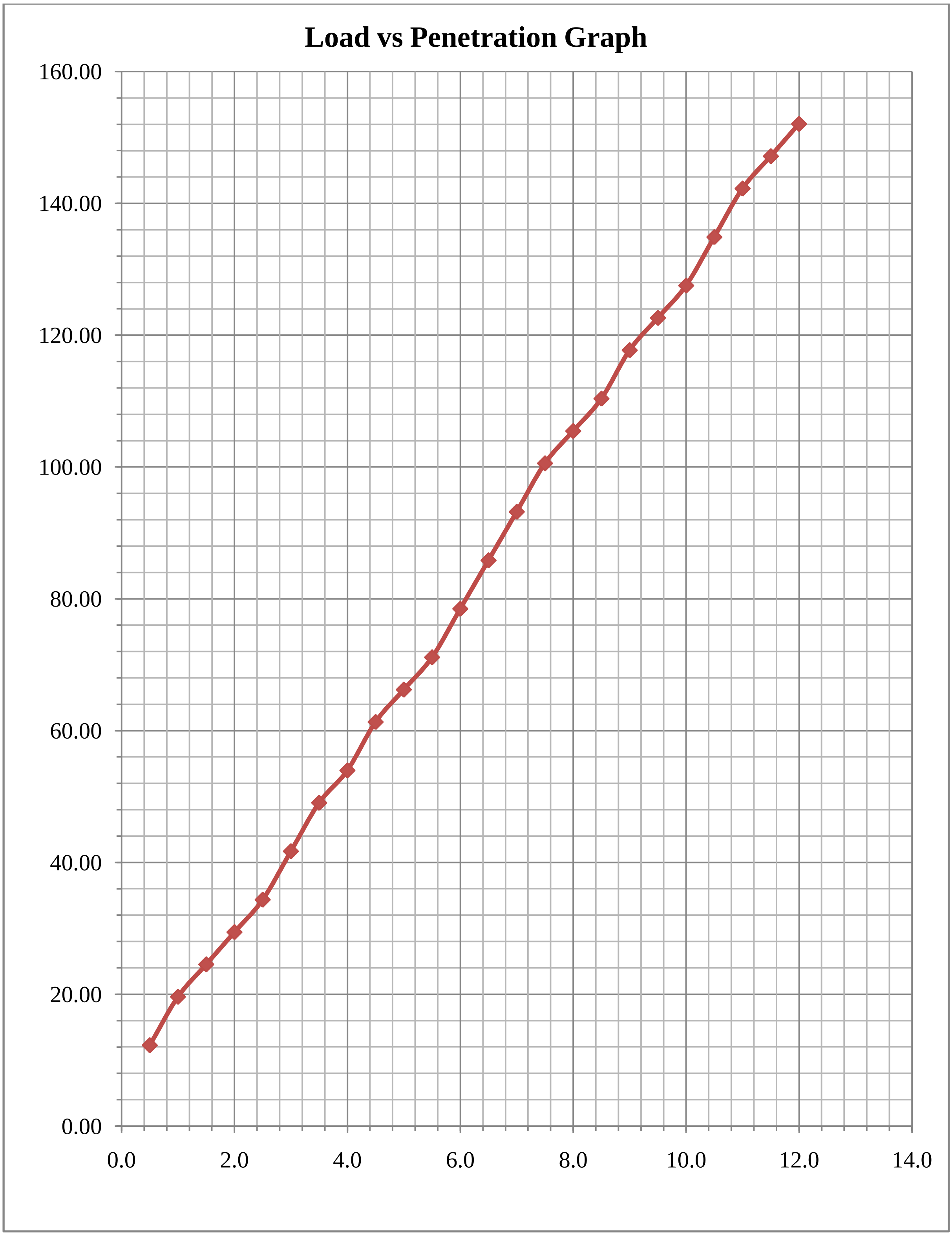
Table 2.4(a): Observations of unreinforced soil

Penetration (mm)	Proving Ring (Without using fly ash and polypropylene fibre) (Load) (kg-f)		
	Sample (1)	Sample (2)	Sample (3)
0.5	14	12	17
1.0	22	19	22
1.5	26	24	26
2.0	31	29	31
2.5	40	35	37
3.0	46	41	41

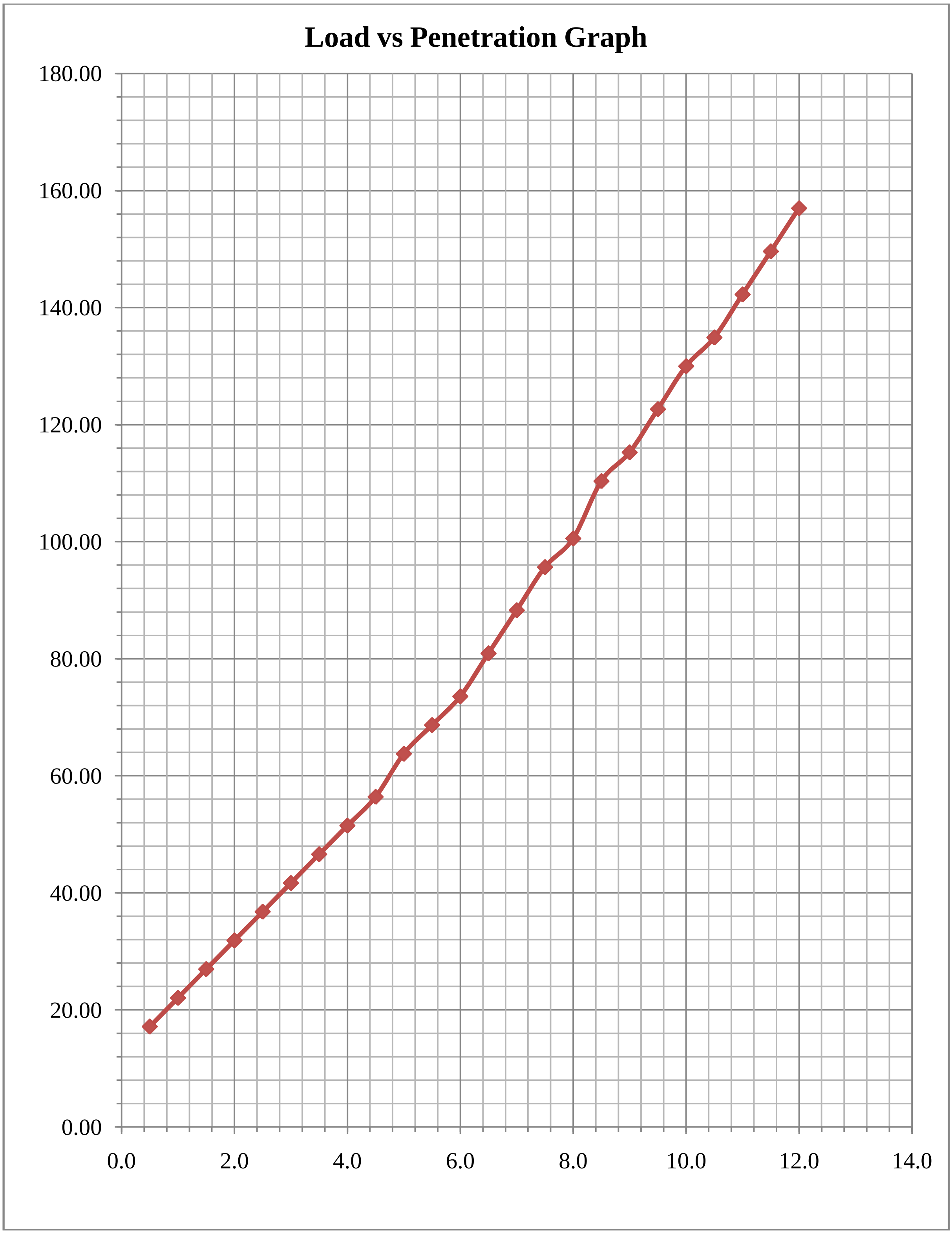
3.5	51	49	46
4.0	58	53	51
4.5	63	61	56
5.0	69	66	64
5.5	73	71	68
6.0	78	78	73
6.5	85	85	80
7.0	90	93	88
7.5	98	100	95
8.0	103	105	100
8.5	110	110	110
9.0	115	117	115
9.5	120	122	122
10.0	125	127	129
10.5	132	134	134
11.0	139	142	142
11.5	147	147	149
12.0	154	152	156



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.15 (a): Sample (1)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.15 (b): Sample (2)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.15 (c): Sample (3)

CALCULATION

Standard Values of load for different penetration

Sr. No.	Penetration of plunger (mm)	Standard load (Kg-f)
1	2.5	1370
2	5	2055
3	7.5	2630
4	10	3180
5	12.5	3600

CBR (Without Reinforcement of soil)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	40	1370	2.91	3.35
2	5.0	69	2055	3.35	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	35	1370	2.55	3.21
2	5.0	66	2055	3.21	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	37	1370	2.70	3.11
2	5.0	64	2055	3.11	

Final CBR is = 3.35%

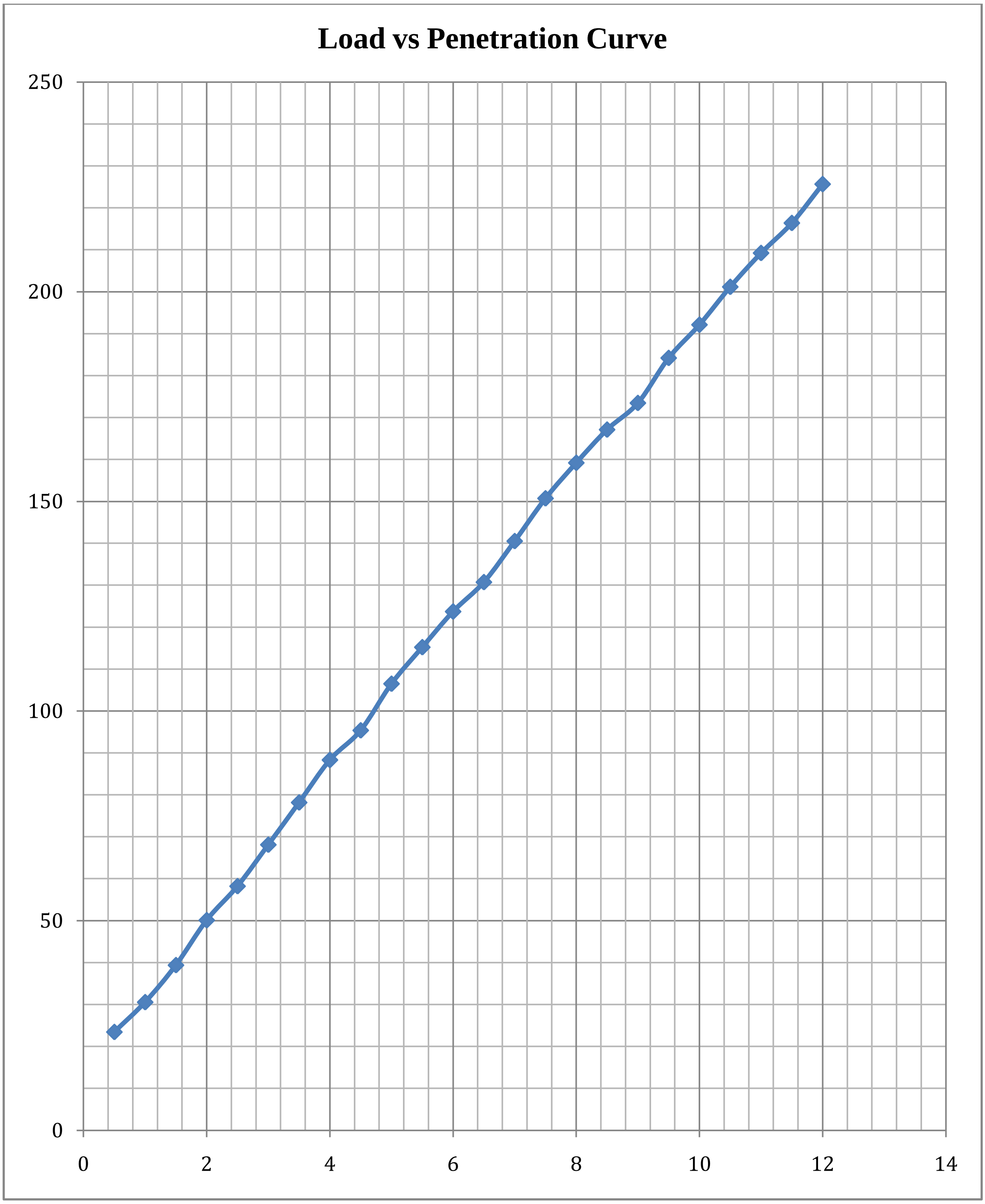
2.5.6 CBR DETERMINATION

Using 5% of fly ash with 0.5% of polypropylene fibre in CBR moulds.
OMC = 15.60%
Soil sample = 5.50 kg
Mixing water = 5.50 x 15.60% = 0.858 litre = 858 ml
3 layers and number of blows = 56
Hammer weight =2.6 kg (light compaction)

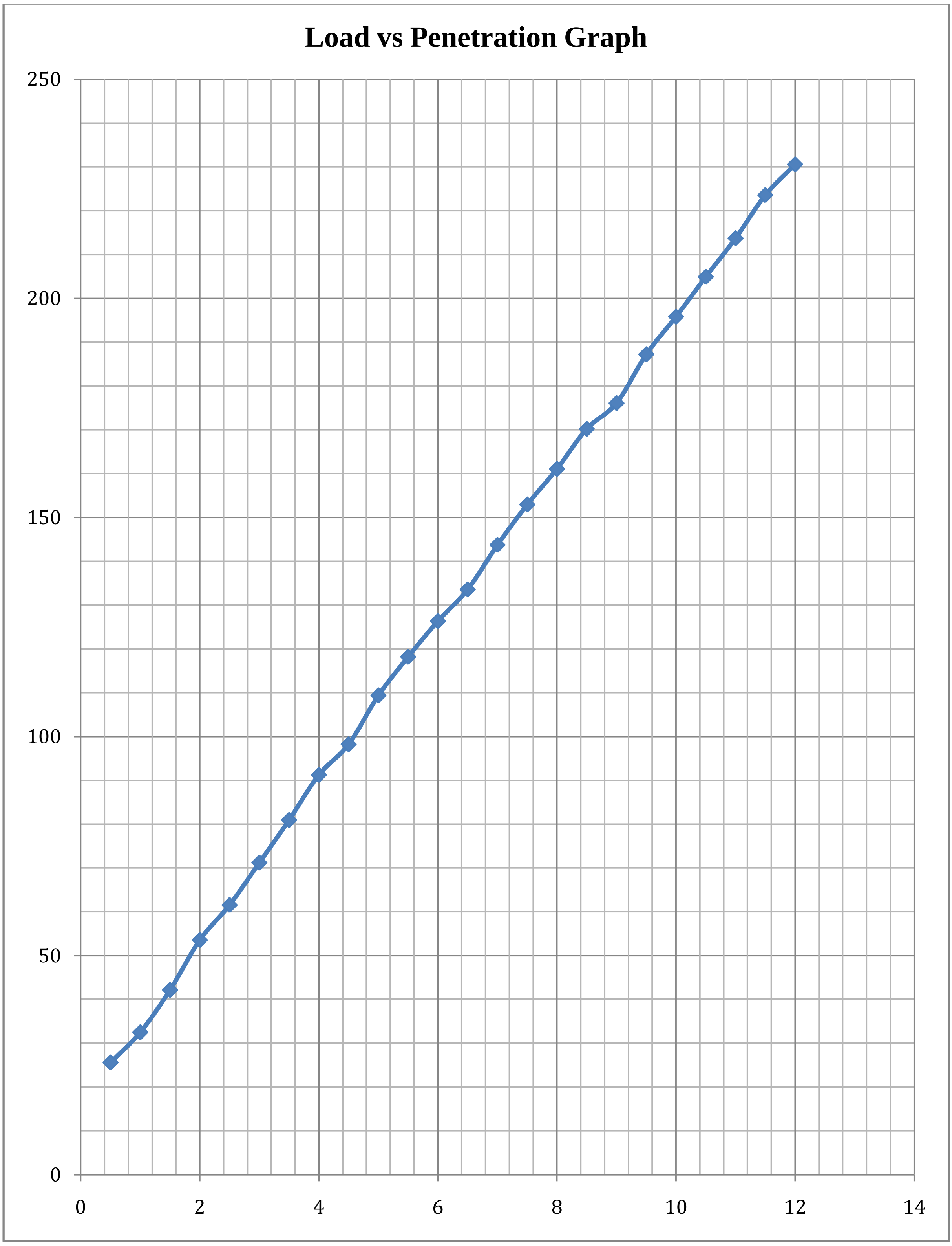
Table 2.4(b): Observation of reinforced soil with 5% of fly ash with 0.5% of Recron

Penetration (mm)	Proving Ring (Using 5% fly ash with 0.5% polypropylene fibre) (Load) (kg-f)		
	Sample (1)	Sample (2)	Sample (3)
0.5	23	25	23
1.0	30	32	30

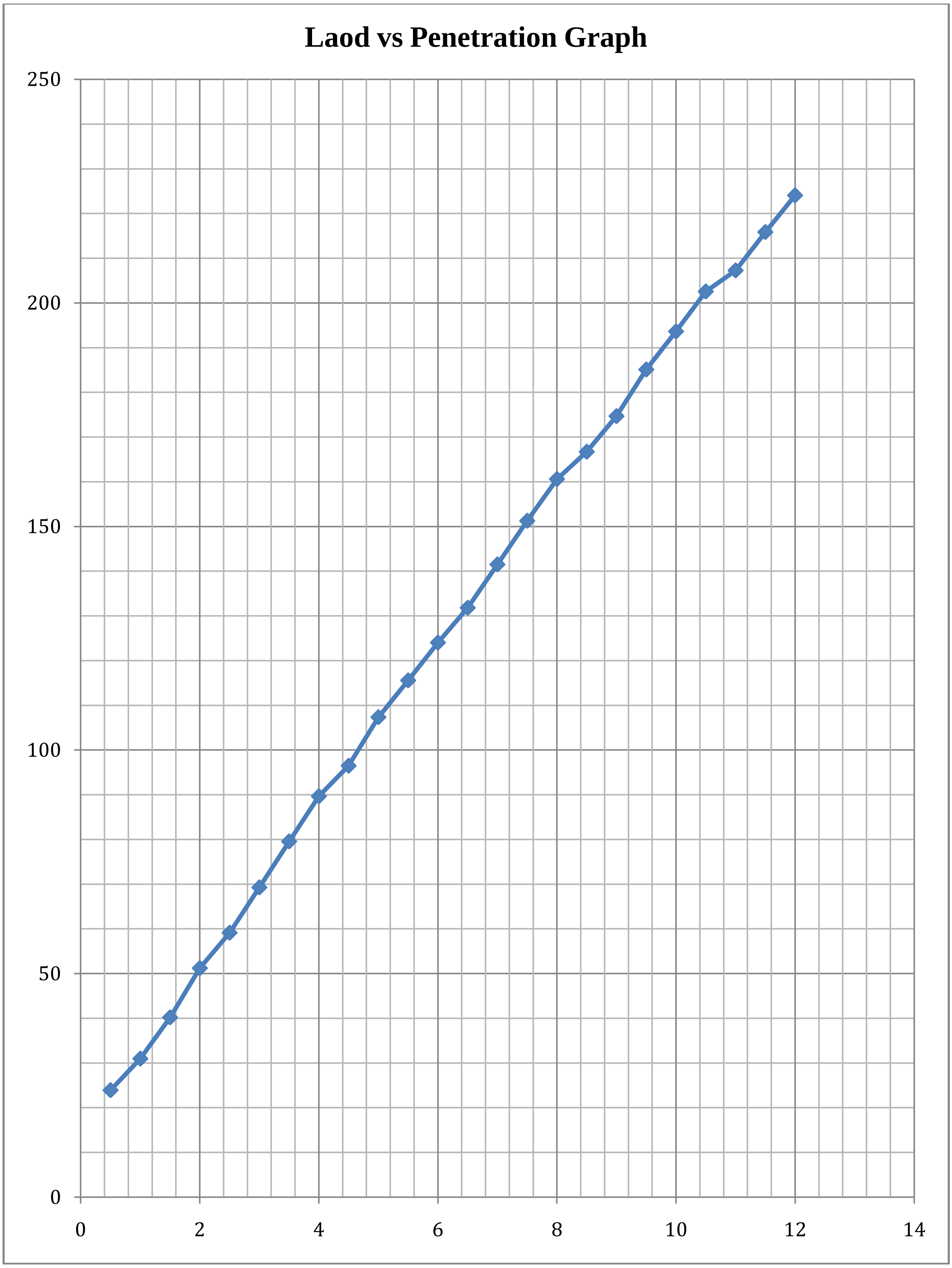
1.5	39	42	40
2.0	50	53	51
2.5	58	62	59
3.0	68	71	69
3.5	78	80	79
4.0	88	91	89
4.5	95	98	96
5.0	107	110	108
5.5	115	118	119
6.0	123	126	124
6.5	130	133	131
7.0	140	143	141
7.5	150	152	151
8.0	159	161	160
8.5	167	170	167
9.0	173	176	174
9.5	184	187	185
10.0	192	195	193
10.5	201	204	202
11.0	209	207	207
11.5	216	216	215
12.0	225	228	224



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.16 (a): Sample (1)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.16 (b): Sample (2)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.16 (c): Sample (3)

CALCULATION

CBR (Using 5% of fly ash with 0.5% of Polypropylene fibre)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	58	1370	4.23	5.21
2	5.0	107	2055	5.21	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	62	1370	4.53	5.35
2	5.0	110	2055	5.35	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	CBR (%)
1	2.5	59	1370	4.30	5.25
2	5.0	108	2055	5.25	

Final CBR is = 5.35%

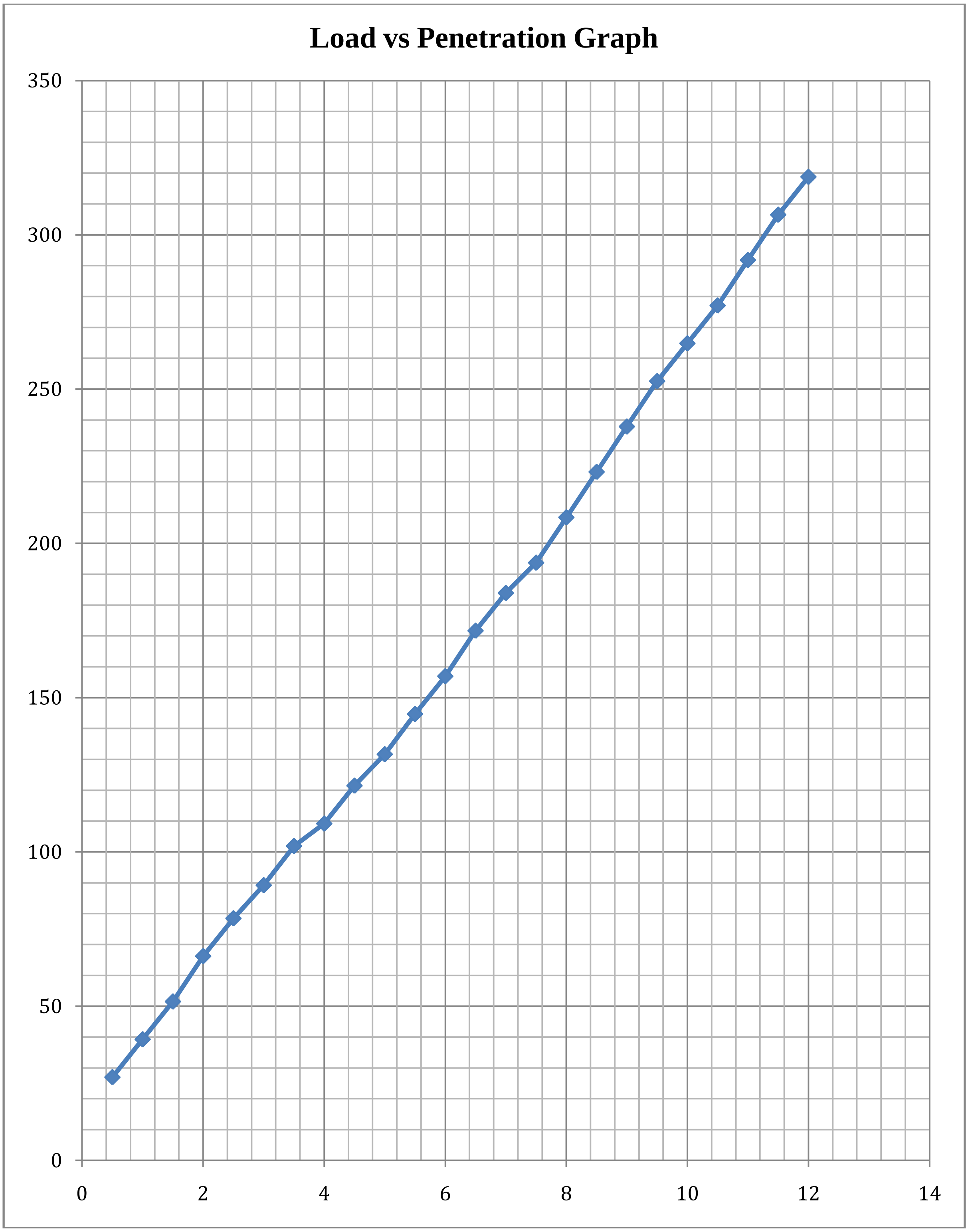
2.5.7 CBR DETERMINATION

Using 10% of fly ash with 0.5% of polypropylene fibre in CBR moulds.
OMC = 16.18%
Soil sample = 5.50 kg
Mixing water = 5.50 x 16.18% = 0.89 litre = 890 ml
3 layers and number of blows = 56
Hammer weight =2.6 kg (light compaction)

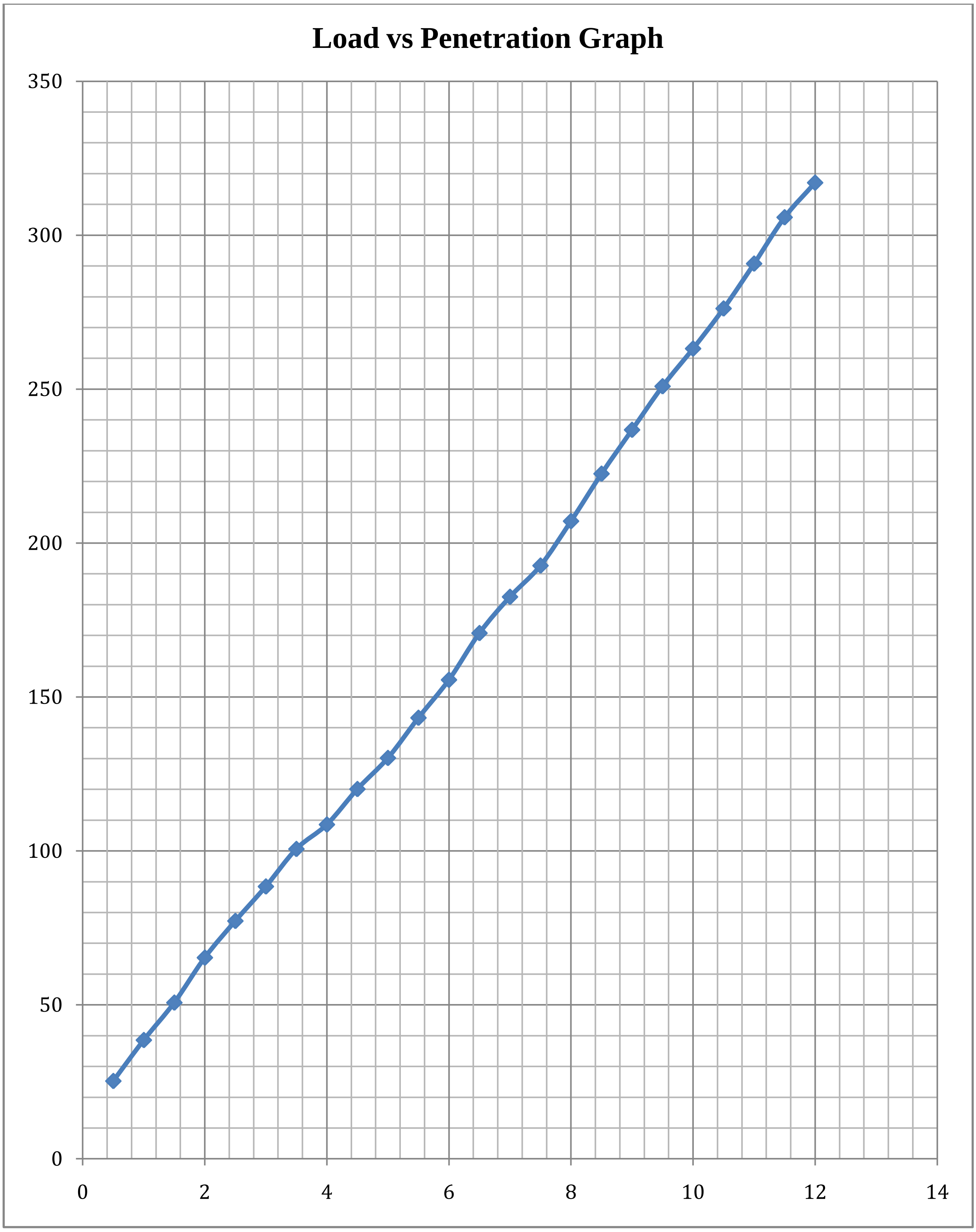
Table 2.4(c): Observations of reinforced soil with 10% of fly ash with 0.5% of recron

Penetration (mm)	Proving Ring (Using 10% fly ash with 0.5% polypropylene fibre) (Load) (kg-f)		
	Sample (1)	Sample (2)	Sample (3)
0.5	26	25	24
1.0	39	38	36
1.5	51	50	49
2.0	66	65	63
2.5	79	77	77
3.0	89	88	87
3.5	101	100	98
4.0	109	108	106
4.5	121	120	118
5.0	132	130	129

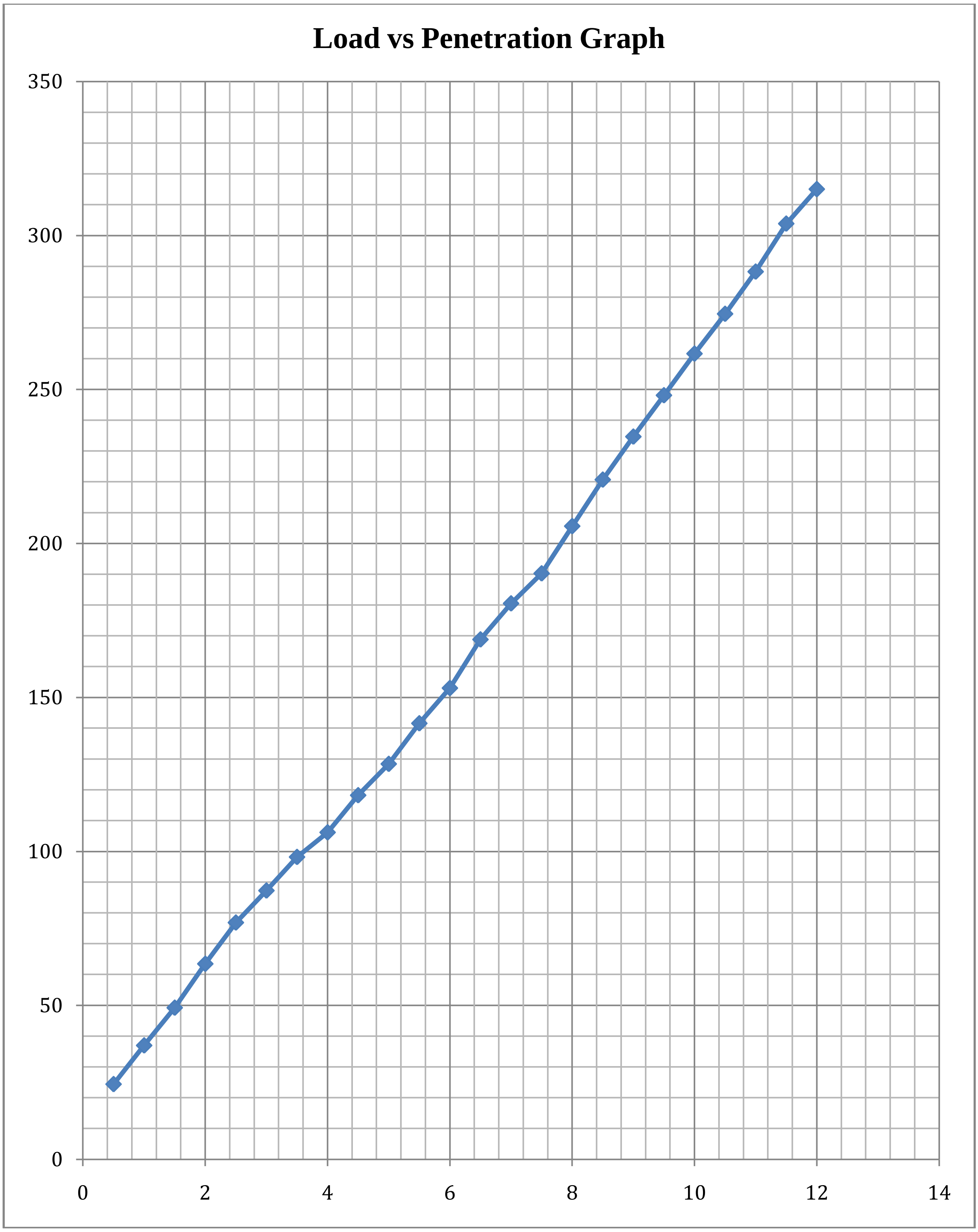
5.5	144	143	141
6.0	156	155	153
6.5	171	170	168
7.0	183	182	180
7.5	193	192	190
8.0	208	207	205
8.5	223	222	220
9.0	237	236	234
9.5	252	250	248
10.0	264	263	261
10.5	277	276	274
11.0	291	290	288
11.5	306	305	303
12.0	318	317	315



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.17 (a): Sample (1)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.17 (b): Sample (2)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.17 (c): Sample (3)

CALCULATION

CBR (Using 10% of fly ash with 0.5% of Polypropylene fibre)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	Required CBR (%)
1	2.5	79	1370	5.77	6.42
2	5.0	132	2055	6.42	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	Required CBR (%)
1	2.5	77	1370	5.62	6.33
2	5.0	130	2055	6.33	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	Required CBR (%)
1	2.5	77	1370	5.62	6.28
2	5.0	129	2055	6.28	

Final CBR is = 6.42%

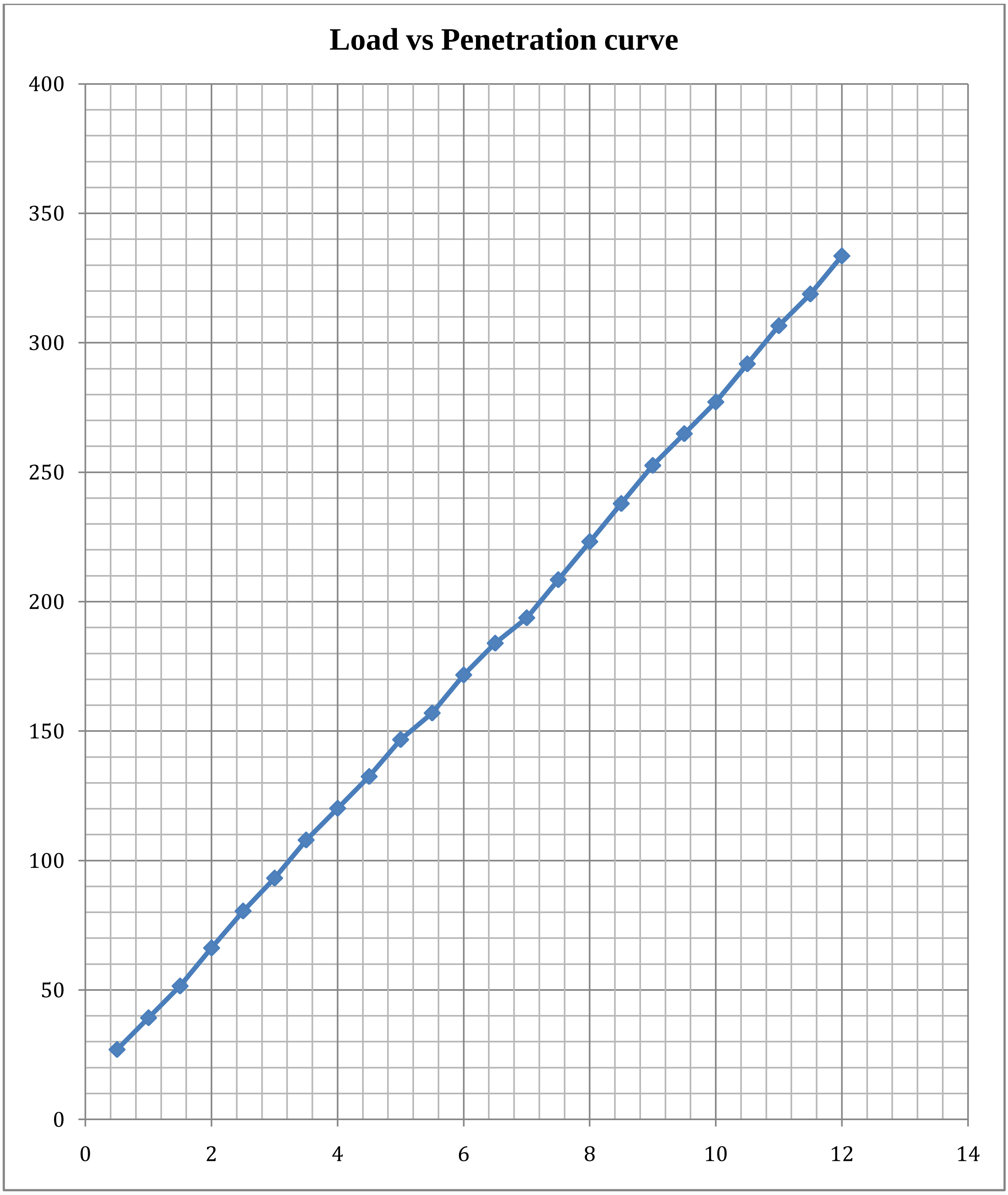
2.5.8 CBR DETERMINATION

Using 15% of fly ash with 0.5% of polypropylene fibre in CBR moulds.
OMC = 16.84%
Soil sample = 5.50 kg
Mixing water = 5.50 x 16.84% = 0.926 liter = 926 ml
3 layers and number of blows = 56
Hammer weight =2.6 kg (light compaction)

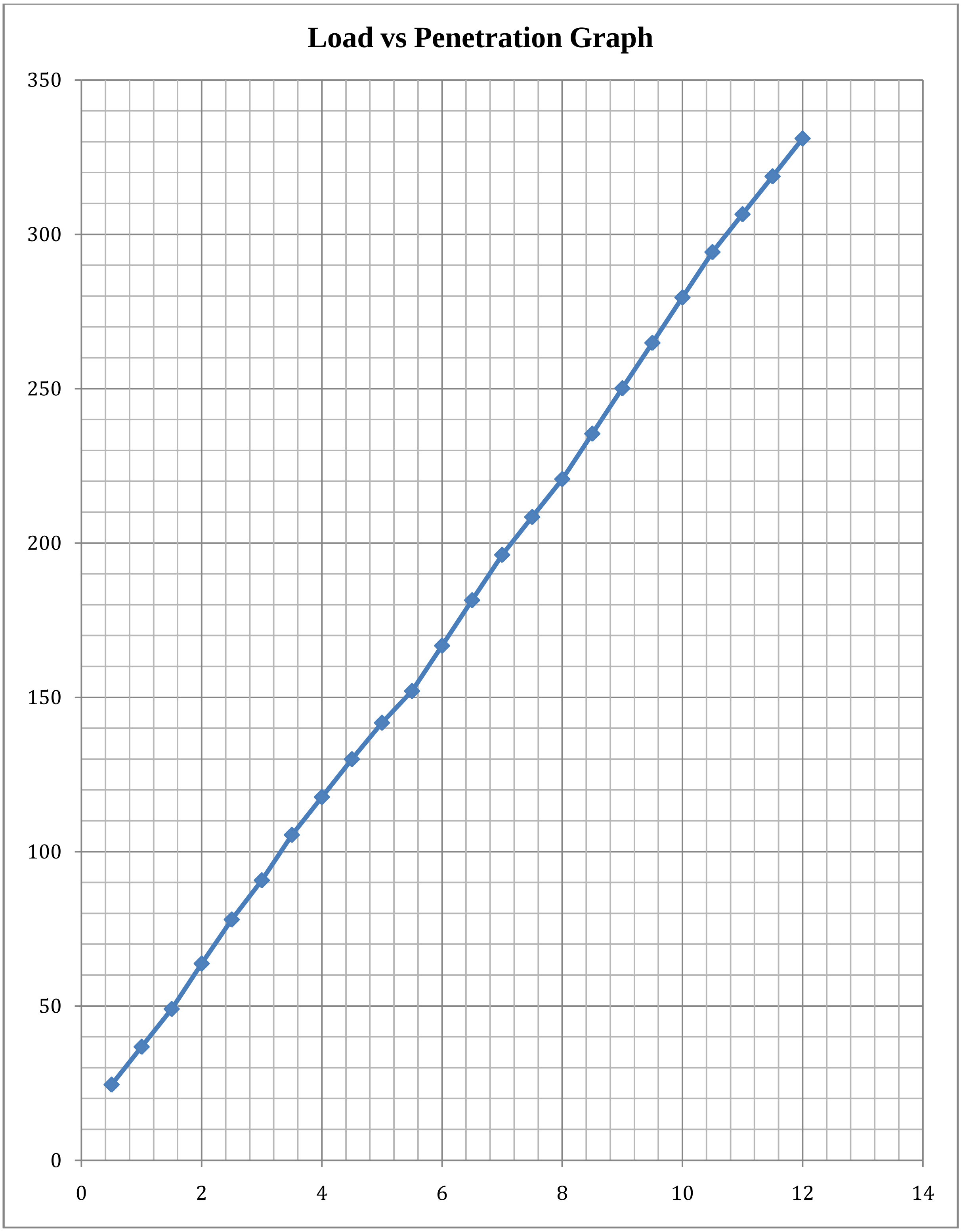
Table 2.4(d): Observations reinforced soil with 15% of fly ash with 0.5% of Recron

Penetration (mm)	Proving Ring (Using 15% fly ash with 0.5% polypropylene fibre) (Load) (kg-f)		
	Sample (1)	Sample (2)	Sample (3)
0.5	26	24	26
1.0	39	36	41
1.5	51	49	53
2.0	66	63	66
2.5	80	78	83
3.0	93	90	93
3.5	107	105	105
4.0	120	117	117
4.5	132	129	129
5.0	146	141	144
5.5	156	152	155
6.0	171	166	171
6.5	183	181	183
7.0	193	196	196
7.5	208	208	210
8.0	223	220	225
8.5	237	235	240

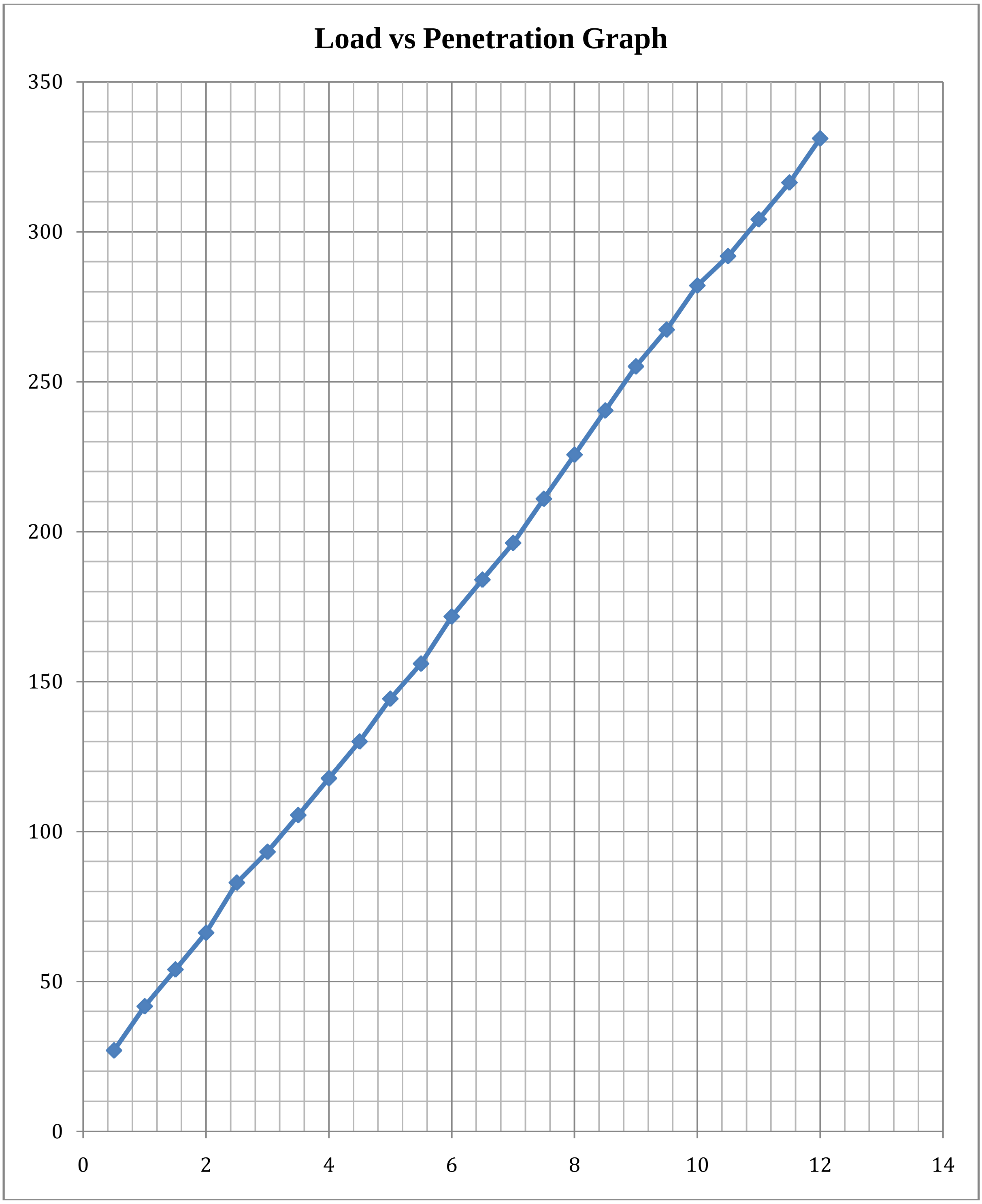
9.0	252	250	255
9.5	264	264	267
10.0	277	279	282
10.5	291	294	291
11.0	306	306	304
11.5	318	318	316
12.0	333	331	331



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.18 (a): Sample (1)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.18 (b): Sample (2)



On X-Axis Penetration in mm
On Y-Axis Load in Kg-f
Fig 3.18 (c): Sample (3)

CALCULATION

CBR (Using 15% of fly ash with 0.5% of Polypropylene fibre)

Sample (1)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	Required CBR (%)
1	2.5	80	1370	5.84	7.10
2	5.0	146	2055	7.10	

Sample (2)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	Required CBR (%)
1	2.5	78	1370	5.69	6.86
2	5.0	141	2055	6.86	

Sample (3)

Sr. No	Penetration (mm)	Test load (kg-f)	Standard load (kg-f)	CBR (%)	Required CBR (%)
1	2.5	83	1370	6.06	7.00
2	5.0	144	2055	7.00	

Final CBR is = 7.10%

Table 2.5: CBR Values of Reinforced Soil

Fibre Content (%)	Fly Ash Content (%)	CBR Value	% Increase in CBR Value
0	0	3.35	-
0.50	5%	5.35	160
0.50	10%	6.42	192
0.50	15%	7.10	212

III. CONCLUSION

- Fly Ash is a non plastic light weight material having specific gravity relatively lower than similar graded material.
- CBR value of unreinforced ash is observed exceptionally low but on increasing value of fibre content (0.25% to 1.0%) CBR value increased up to 536%.
- The Fly Ash consists of grains mostly of fine sand with uniform gradation of particles. The specific gravity of particles is lower than that of the conventional earth materials.
- The bearing resistance of specimens is found to increase with the fibre content. However, the rate of increase of strength with fibre content is not uniform, bearing resistance is found to remain almost constant with higher value of fibre content.
- However bearing resistance is found to increases substantially with increase in fibre content.
- Inclusion of fibre increase frictional force between particles of specimens. It can further be notice that increasing fibre content increases the bonding between particles so CBR value increases up to some extent.
- This indicates that inclusion of fibre gives ductility to the specimens but increase in ductile nature is not uniform.
- It can be safely concluded that reinforced Fly Ash can replace natural earth material in geotechnical construction with some limitation.

Using polypropylene fibre in construction, it will be easier than other techniques. Polypropylene fibre will be costly initially but in long term it will be economical as it will provide soil reinforcement and improve the design life of embankment. If we compare with soil stabilization expenditure with fibre application the cost difference will be less. In comparison soil stabilization method, spreading of layer of geosynthetics sheet at subbase level is easier and require less machinery and handling equipment and less skilled personnel.

So using polypropylene fibre as reinforcement, the project cost might increase slightly but considering long term planning (the cost of maintenance etc.) the fly ash or soil-fly ash mixture will serve as a better replacement then conventional method of filling by soil. Hence, the strength parameters achieved in the present study is comparable to the good quality, similar graded conventional earth materials. Hence, it can be safely concluded that reinforced fly ash can be used effectively in geotechnical construction, it will be more effectively work with soil.