VARIATION OF SWELLING PRESSURE WITH AREA RATIO

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Abstract: As we increase the Area Ratio, the lateral surface area exposed to water increases. This although, helps in getting the soil sample saturated to a greater extent and thus increasing the swelling tendency to a greater degree, but at the same time the lateral confinement of the sample is decreased. Due to the decrease in the lateral confinement some lateral swelling of sample takes place, which reduces the axial swelling of the sample and thus causing a decrease in swelling pressure (which is measured in the axial direction only).

Keyword: Area Ratio, Surface Area, Swelling Pressure

1. INTRODUCTION

In order to study the effect of uniformity in the degree of saturation over the entire length of the specimen, on swelling pressure, five types of cylindrical moulds of varying Area Ratio (Ar) (from 0.0 to 0.6) were used. In the present work the Area Ratio has defined as:

$$Ar = \frac{\text{Surface area of perforated holes}}{Surface \text{ area of lateral surface of cylindrical mould}}$$

The details of these cylindrical moulds are given in Table 1.

Table No. 1

Cylinder	Size of holes	Centre to Centre spacing	Dimension of Mould		Area Ratio (Ar)
			Length	Diameter	
1.	Nil	Nil	7"	3"	0
2.	2.5 mm	18 mm	7"	3"	0.15
3.	2.5 mm	9 mm	7"	3"	0.3
4.	3.0 mm	9. mm	7"	3"	0.45

5.	2.5 mm	4.5 mm	7"	3"	0.6

2. METHOD AND MATERIALS

METHOD OF TESTING

(a) Preparation of Remoulded Sample: - After pulverisation and oven drying the soil passing through a 40 mm seive were taken for investigation. The samples were prepared by static compaction at water content 2% & 4% either side of O.M.C. & at O.M.C. Special attention was paid on uniform mixing of water in soils before compaction.

(b) Fixing of Sample

After compacting the sample in the mould, porous stone is placed at the top and bottom of the sample. Along with these porous stones the sample is placed on the base plate. The clearance between the cylindrical wall of the mould and porous stone or plunger piece must be sufficient to prevent friction, yet small enough to keep the soil from being squeezed out. The sample is then ready for test.The mould with the soil sample, porous stones and plunger is put inside a water bath and the whole assembly is placed on the base of the frame under the ram of the testing apparatus in such a way that the centre of the plunger comes directly under the ram. The ram is then lowered to touch the plunger.

(c) Saturation

The bath is then filled with water so that the whole sample is under water. As the sample begins to absorb water it tends to swell and develop swelling pressure. The deflection occurring in the proving ring indicates the development of pressure. The reading is taken at regular intervals until maximum constant reading is obtained.

3. RESULTS AND DISCUSSIONS

The variations of maximum swelling pressures, for various Area Ratio of the mould, are shown in Fig. 1 to 3. It is observed that the maximum swelling pressure first increases with the increase of Area Ratio upto a certain limit and then with further increase in Area Ratio, it decreases. Almost in all the samples the Area Ratio of 0.3 gives the maximum swelling pressure. Initially all the samples were tested at three Area Ratio i.e. 0, 0.3 and 0.6. The results indicated that maximum swelling occurs at Area Ratio of 0.3. To ascertain the exact trend of variation, all three soil samples, compacted at O.M.C. were tested at Area Ratio of 0.15 and 0.45 also, i.e. two more points on either side of 0.3 were taken. These points clearly indicates that the maximum swelling occurs at Area Ratio of 0.3. The soils compacted at water contents other than O.M.C. have been tested only for Area Ratio of 0.0, 0.3 and 0.6, Assuming that the trend will remain the same as shown by soil samples at O.M.C., the variation has been plotted for soils compacted at water content other than O.M.C.

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Fig: 1 Variation of Swelling Pressure with Area Ratio 0

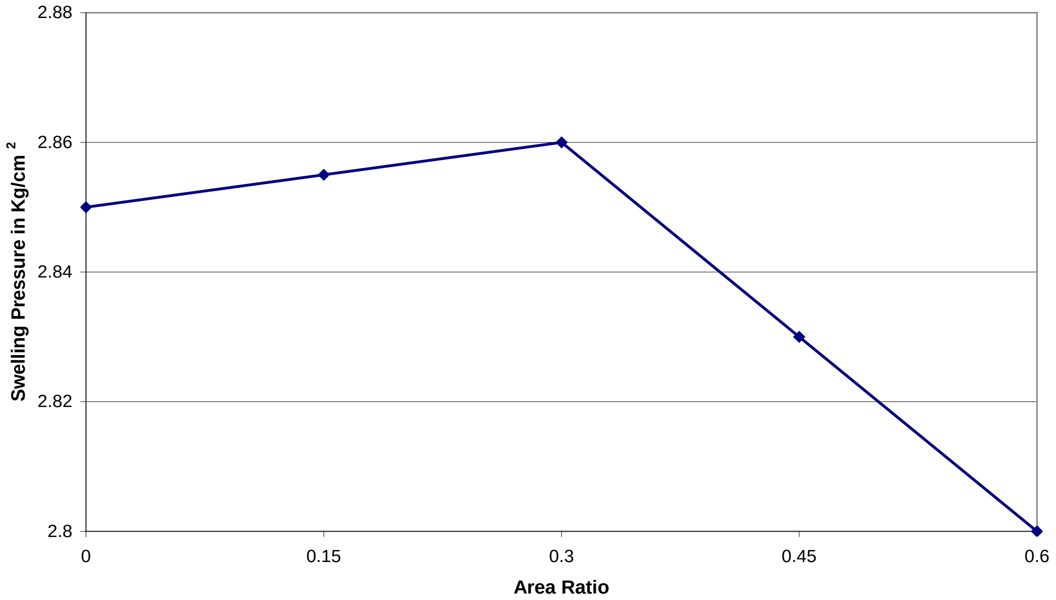

Fig: 2 Variation of Swelling Pressure with Area Ratio 0.3

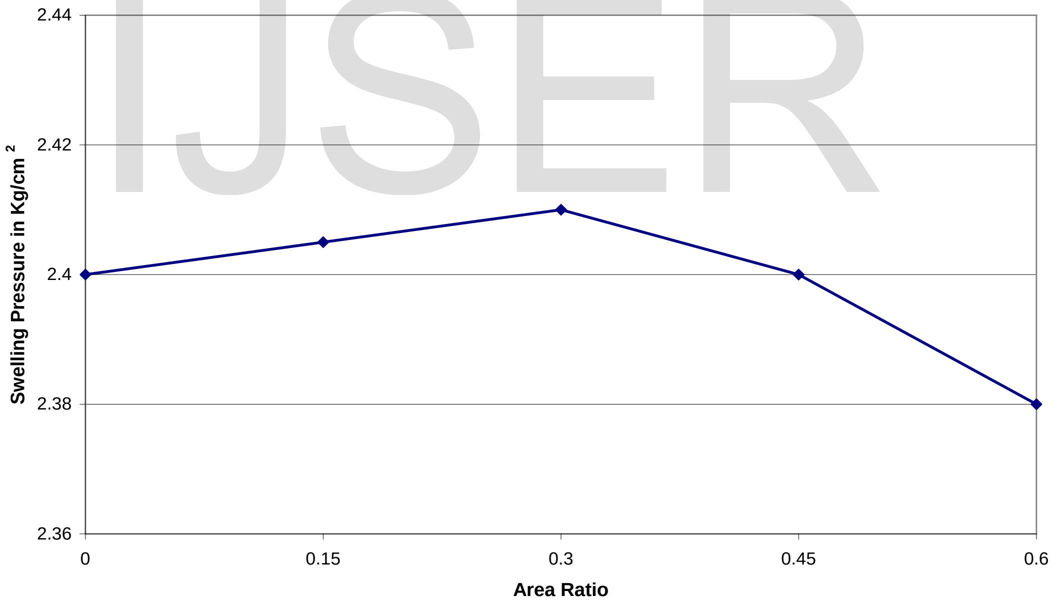

Fig: 3 Variation of Swelling Pressure with Area Ratio 0.6

Initially due to the perforations (giving Area Ratio less than 0.3) the saturation of the soil sample at intermediate heights, is increased due to lateral flow of water, through increased surface area of the sample directly in contact with water. This causes an increase in the swelling pressure.

4. CONCLUSION

1. With the increase on Area Ratio, the swelling pressure first increase and then decreases. The maximum swelling pressure is obtained at the Area Ratio of 0.3.
2. With the increase in Area Ratio the degree of saturation is increased. Also the uniformity of saturation of soil in increased.
3. The time to attain maximum swelling pressure is reduced.

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