

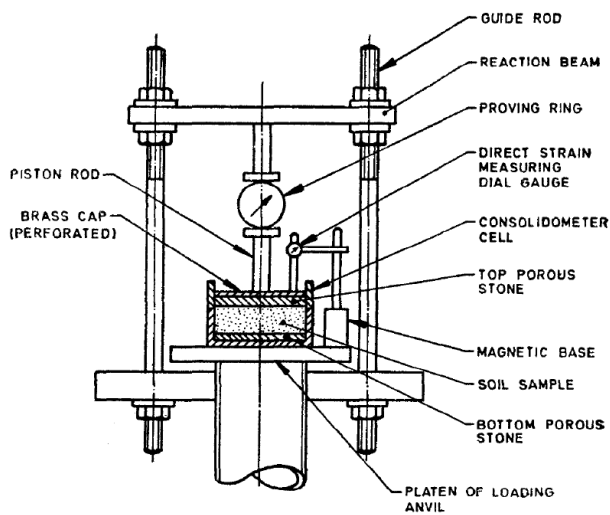
SWELL PRESSURE TEST

1. Objective: The pressure which the expansive soil exerts, if the soil is not allowed to swell or the volume change of the soil is arrested is known as Swelling Pressure of Soil.

The main purpose of swelling pressure test is to determine the intrinsic swelling pressure of the expansive soil tested. The expansive clays increase in their volume when they come in contact with water owing to surface properties of these clay types. Light structures founded on these type of clays - popularly known in India as black cotton soil, experience severe structural damage due to the swelling of the subsoil. Since the intrinsic swelling pressure is to be associated with the design of structures against such damages, measurement of swelling pressure assumes importance. The swelling pressure is dependent upon several factors namely (a) the type and amount of clay in the soil and the nature of the clay mineral, (b) the initial water content and dry density, (c) the nature of pore fluid, (d) the stress history of the soil including the confining pressure and (e) drying and wetting cycles to which the soils have been subjected to. Besides, the dependence of swelling pressure on volume change makes a precise measurement of swelling pressure difficult.

This test procedure covers the laboratory method of conducting one dimensional swelling pressure test using either fixed or the floating rings on both undisturbed and remoulded soils in the partially saturated condition to determine the swelling pressure of the soil. Two methods, namely, consolidometer method in which the volume change of the soil is permitted and the corresponding pressure required to bring back the soil to its original volume is measured and the constant volume method in which the volume change is prevented and the consequent pressure is measured are covered.

2. Apparatus Required:



The arrangement for Swell Pressure Test by Consolidometer consists of Consolidometer, Dial gauge, Water reservoir, Soil trimming tools, Oven, Desiccator, Balance and Containers

Fig. 1: Swell Pressure Test by Consolidometer



The arrangement for Swell Pressure Test by Constant Volume Method consists of Loading unit (5 tonnes), Proving ring (with high sensitivity, 200 kg capacity) along with all Apparatus as used in Consolidometer method.
2.

Fig. 2: Swell Pressure Test by Constant Volume Method

3. Reference: IS 2720(Part 41):1977 Methods of test for soils: Measurement of swelling pressure of soils. Reaffirmed- December 2016.

4. Procedure:

A. Sample Preparation:

1. Reject at least 30mm (more if desired) sample from one end of the sample.

2. Clean the consolidation ring and gradually insert the consolidation ring in the sample by pressing with hands and carefully removing the soil around it.
3. The soil specimen cut shall project around 10mm on either side of the ring.
4. Trim, smooth and flush the specimen with both ends of the ring and fill all the voids if any.
5. The test may be conducted for both soaked as well as unsoaked conditions. If the sample is to be soaked, in both cases of compaction, put a filter paper on the top of the soil and place the adjustable stem and perforated plate on the top of filter paper.
6. Clean the ring from outside.
7. From disturbed sample compact the soil with desired field density and moisture content and then repeat the above procedure.

B. Test procedure:

1. Assembly of the Consolidometer Test is to be done as per Fig. 1.
2. The free swell reading under the seating shall be recorded at different time intervals till the equilibrium is reached. It takes around 6-7 days to reach equilibrium. (Refer Table 1)
3. Consolidate the swollen sample under different pressures record the compression dial readings till the sample reaches steady state for each load. (Refer Table 2)
4. Increase the consolidation loads until the specimen attains its original volume.

5. Observation and Recording:

S. No.	Elapsed time (Hours)	Swelling dial readings (mm)	S. No.	Elapsed time (Hours)	Swelling dial readings (mm)
1	0		9	20	
2	0.5		10	24	

3	1		11	36	
4	2		12	60	
5	4		13	72	
6	8		14	96	
7	12		15	120	
8	16		16	144	

Table 1: Observation Table for Swelling

S. No.	Applied Pressure (kg/cm ²)	Change in Thickness of Specimen	S. No.	Applied Pressure (kg/cm ²)	Change in Thickness of Specimen
1	0.05		6	2.0	
2	0.1		7	4.0	
3	0.25		8	8.0	
4	0.5		9	16.0	
5	1.0				

Table 2: Observation Table for Change in Thickness

6. Graph:

1. Plot swelling dial reading (refer Table 1) with elapsed time as abscissa and swelling dial reading as ordinates on natural scale. If the curve so drawn becomes asymptotic with the abscissa, the swelling has reached its maximum and hence the swelling phase shall be stopped, and the consolidation phase shall be started.
2. The compression readings (refer Table 2) shall be plotted with change in thickness of expanded specimen as ordinates and consolidation pressure applied as abscissa in semi- logarithmic scale. The swelling pressure exerted by the soil specimen under zero swelling condition shall be obtained by interpolation.