The spiral foot vertical ground movement gauge

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TECHNICAL NOTE

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SUBJECT The Spiral Foot Vertical Ground Movement Gauge

In studying vertical ground movements in grass plots near trees and houses and beneath concrete slabs, the Soil Mechanics Section of the Division of Building Research, NRC, has employed two types of ground movement gauges. The multi-rod gauges (Ward 1953) were used in most cases, but in limited spaces the concentric telescoping gauges (Baracos and Marantz 1953) were used. Both of these gauges performed fairly well for about two years but after that time considerable difficulty in obtaining reliable results was experienced (Bozozuk and Burn 1958). Some of the difficulties were:

a) In soft soils the foot of the multi-rod gauge (foot area 3/4 sq. in.) punched into the soil under the weight of a survey rod.

b) In spite of the precautions taken to keep the voids between concentric tubes and between the rods and casings filled with grease, water seeped in and froze during the winter causing the gauges to heave.

c) The concentric telescoping gauges jammed, apparently due to rusting.

To overcome these difficulties, a spiral foot gauge was developed which was an improvement on the multi-rod gauge. This gauge, with the larger spiral foot cast of bronze (Fig. 1(a)), will not rust in the soil and can be re-used. It was designed so that it could be filled with grease or oil from the bottom up, and could be serviced at any time after installation. Materials and equipment required for one installation are listed in the following paragraphs.

Materials Required for a Gauge at Depth "Z"

1. Cast bronze spiral foot of diameter 1.7/8 in.
2. Rigid carlon pipe, type T.L inside diameter 1 1/2 in., length Z to form the gauge casing.
3. Galvanized iron pipe, 3/8 in. diameter, of length (Z + 12 in.). The upper end has a standard pipe thread, while the lower end is threaded on the inside with a 1/4-in. pipe thread. Two 3/16-in. holes are drilled six in. from this end to provide ports through which grease or oil can be pumped (a 1/4-in. pipe could be used instead).
4. Plastic collar to plug the top of the casing and prevent lateral movement of the rod. It must fit very loosely around the rod.
5. Very light grease or heavy transmission oil to fill casing; the amount required is approximately 3/4 lb. per lineal ft of casing.
6. Auger of 2 in. diameter for boring the hole. The best type is a long spiral auger as it produces a straight and smooth hole.
7. Wrenches or vice grips and shovel.

8. Handle to fit rod for turning the spiral foot into the undisturbed soil.

9. Grease fitting to fit the 3/8 in. rod.

10. Manually operated grease or oil pump for filling the gauges.

Installation Procedure

Using the ground movement gauge assembly drawing shown in Fig. 1(b) as a guide, the installation is as follows:

1. At the selected location, the 2-in. diameter hole is bored with the auger to within six in. of the desired gauge depth Z.

2. The 3/8 in. rod, with foot attached, is placed foot first down to the bottom of the hole.

3. The 1 1/2 in. rigid plastic casing is then pushed down the hole to within 6 in. of the bottom, leaving 12 in. protruding above the ground surface. This makes it easier to find the gauges in the winter.

4. The handle is fastened to the top of the rod and the spiral foot turned six in. into undisturbed soil to the required depth Z, leaving about three in. of rod protuding above the casing.

5. The handle is removed from the rod and replaced with the grease fitting. Grease or heavy oil is pumped down the rod and up into the casing forcing loose soil or dirt ahead of it and out the top. (In some instances, when the casing has filled with ground water, it is preferable to flush with water before grease or oil is used).

6. The grease fitting is removed after the casing has been filled, and the plastic collar inserted in the top of the casing to complete the installation.

Measurements and Maintenance

Absolute vertical ground movements are measured to the nearest .001 ft with a precise engineer's level using a bench mark set down to bedrock. The site should be fenced where possible and kept clear of weeds. To protect against disturbances due to freezing, the grease or oil should be changed at least every fall.

Advantages of Spiral Foot Ground Movement Gauge

1. With the larger area of the spiral foot (2.3/4 sq. in.) there is greater resistance to "punching" into the soil.
2. Because the foot is turned six in. into undisturbed soil, it eliminates the need for very careful augering to provide a perfectly clean hole to an exact depth. This produces a saving of time, and a better installation.
3. Turning the foot six in. into undisturbed soil anchors the gauge, thus offering considerable resistance to any heaving forces due to freezing.
4. By filling the casing from the bottom by pumping down the inner rod, it is possible to periodically flush the casing without disturbing the gauges. It is also a fairly simple job to keep them full of clean grease or oil, thus further diminishing the effects of frost heaving.

Note

In areas where frost penetration into the soil is considerable, care must be taken to ensure that sufficient oil is put into the casing to displace all the water that may freeze and affect the installation. This may be accomplished either by pumping the water from the casing through the middle rod and pouring the oil directly into the casings from the top, or by pumping the oil down the inner rod at a rate sufficient to displace the required amount of water from the casings. Since oil is lighter than water, a low oil pumping rate may not displace sufficient water.

When oil (specific gravity = 0.9) is put into the casing, it will attain a depth such that it will be in equilibrium with the pore water pressure in the soil. For an oil level one foot above the ground in a casing installed in soil where the ground water table is at the surface, the depth of oil in the casing will be nine feet below the surface of the ground at equilibrium conditions. This value may be changed as required to suit the conditions at the site by correspondingly changing the level of the oil in the casing above the ground.

References

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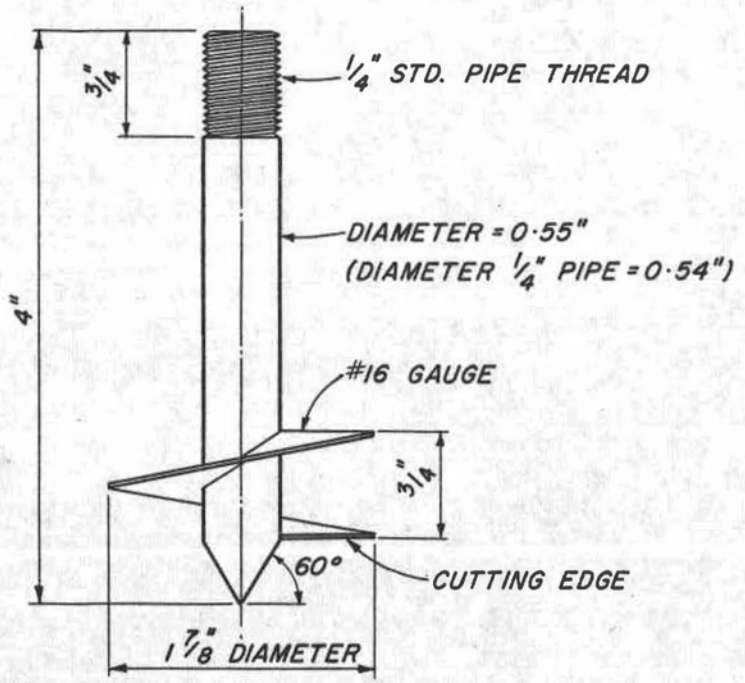
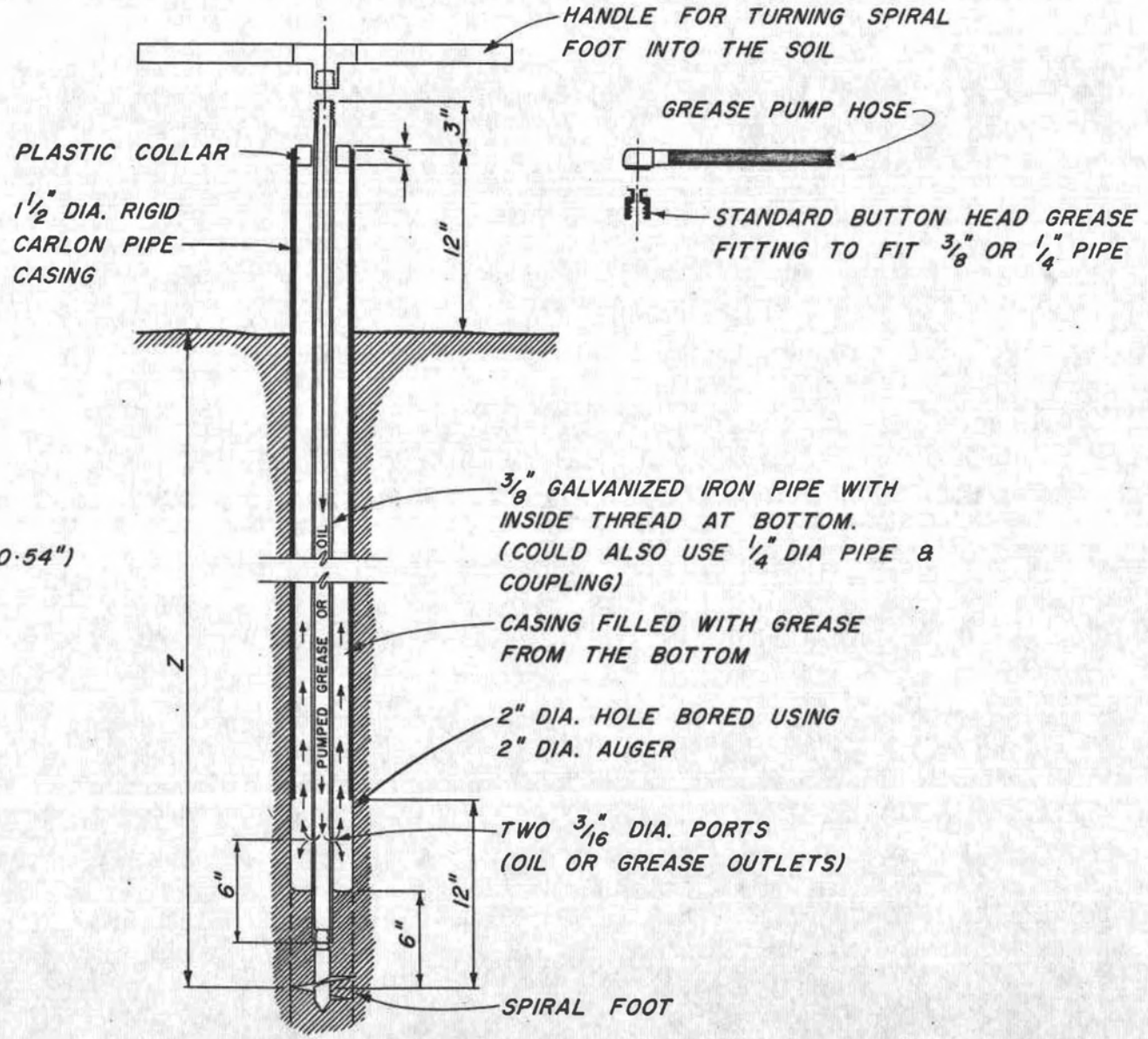


BRONZE SPIRAL FOOT OF GROUND MOVEMENT GAUGE

FIGURE 1(a)



GROUND MOVEMENT GAUGE ASSEMBLY

FIGURE 1(b)