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Problems Identification And Observation Of Repairing Damaged Floor Laid Expansive Soil

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Abstract- Engineering structures constructed on expansive soils detrimental behavior of such soils, leading to their damage and cracking. The structure which can not resist the heave pressure of soil and undergo temporary or permanent deformation is known as light structure. Less lightly loaded structures like, house, canal banks and linings, cross drainage works, have been damaged and cracked due to these soil. The damage occurs, due to the swelling and shrinking behavior of such soils. Since the structures built on such soils get lifted up during rainy season due to the heave of the foundation soil and settle down during summer season due to the shrinkage of the foundation soil, there is a need to adopt remedial measures so as to prevent lifting and sinking of the structures.

Keywords- light structure, remedial etc.

I. INTRODUCTION

Many methods are available to stabilize foundations from the effects of expansive soils, some which work better than others. The process of foundation repair usually includes foundation stabilization and the implementation of one of these methods. This may involve modification of the foundation support system itself, under pinning with deeper support, the construction of peripheral barriers that function to isolate the soils under the structure, or the installation of some type of system that attempts to control the moisture content of the soils or the molecular action of the clay when the moisture content is changed.

In addition to stabilizing a foundation from future movements, foundation repair may also include the process of restoring a foundation to its original constructed position by using some type of leveling procedure. This usually involves jacking the concrete grade beams at the lower portions of the foundation upward until they are level with the other areas, and then re-supporting the grade beams at the areas that have been raised. In limited circumstances, lowering high areas may be possible by supporting the foundation in the high area, excavating a void, and then lowering the foundation with the installed support. In some cases, it may be desirable to level and then raise the whole ground floor even higher than the original constructed position. The leveling procedure may also include the injection of grout or foam under the low areas of the slab-on-grade. Generally, in the southeast Texas area, damage to residential and low-rise buildings as a result of foundation movements, is most often due to changes in moisture content of expansive soils [1-5].

II. AREA

Madhya Pradesh is one of the states in India having large area covered with expansive black cotton soil. Generally the topsoil is black in color followed by either yellow soil or the weathered (fully or partially) basalt or both. The black soil is good for growing cotton and hence is popularly known as black cotton soil. Both the black cotton soil and yellow soil are residual soil derived mainly from in-situ weathering of the basalt under semi arid climate. The depth of black cotton soil is generally 3-4m in most of the places but it may be as low as 0.5m to as much as 10m. The Civil Engineering construction on black cotton soil faces severe problems due to swelling

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and shrinkage nature of the soil which is attributed due to seasonal moisture variation. A huge loss of capital both in public and private sector is taking place due to failure of structures founded on such soils. The failure cases include roads, boundary walls, railway embankments, houses etc. Lack of knowledge about the nature of soil and poor engineering practice are the main reasons for such failures and loss. Bhopal, the capital city of Madhya Pradesh, is also having topsoil as black cotton soil at most of the places. The Bhopal has black cotton soil layer; the depth of which in the campus varies from 1 to 4 meters and is followed by yellow soil and/or highly weathered basalt [6-8].

A number of houses constructed around the year 1975, in the Bhopal are facing the problem of sunken floor. The soil under the floor is black cotton soil. Not only the floors but the partition walls as well, in ground floor houses have diagonal cracks at different levels. The light weight non load bearing walls at many places have left floors and gap between wall and floor can easily be seen. Earlier attempts to repair the cracked walls or patch repair of the floors did not prove effective as within after few months of repair the similar problem reoccur either at the same or the other location. Hence, in order to have the permanent solution to the above problem, in the year 2008, repair work of a few residential single story houses has been under taken.

III. PROBLEMS FINDING

A structure resting on expansive soil may suffer from damage that may be apparent usually several years after the construction. During the wet season, the soil below exerts swelling pressure both upward and laterally. As a result, the floor slab is lifted up, typically in an irregular dome shaped or corners-down pattern, leading to the cracking of floor. The footing walls are pushed outward and leading to cracking of the end walls of the structure. Since there is restriction of movement at the junction between the walls and the floor as well as between the walls and the roof slab, structural distress is apparent at these locations which are exaggerated by shrinkage of soil in following summer months leading to loss of support. Cracking is also normally evident at the corners of the window and door openings. These usually assume the form of diagonal cracks – a consequence of differential settlement in the walls (Ranjan and Rao, 2002). These problems are very common to all structures which are constructed on black cotton soil. In initial stage, the cracks are minor, but as time passes the cracks increase, finally the floor get sink or settled. In many situations the problem is only with the floors and partition walls. The main walls and columns are laid deep and the superimposed load is enough to counteract the upward pressure exerted by the swelling soil [9-11].

IV. THE PROBLEMS EXPANSIVE SOILS CAN CAUSE

There are many problems you may experience with expansive soils. These issues will typically result from the substantial amount of pressure expansive soils can exert on your home. Here are a few of the top problems that expansive soils can cause.

1.Leaning and Bowing Foundation Walls

Do you have foundation walls that have an inward slant or seem to push in further in the center than at the top and bottom? These problems indicate a significant amount of hydrostatic pressure, which is the pressure water exerts when it's at rest. Hydrostatic pressure can come from a variety of places, but expansive soil can exacerbate it.

Leaning and bowing foundation walls are no joke. If you leave them for too long, you can end up with serious foundation problems, including foundation wall failure. Foundation wall failure is not something that anyone wants to deal with. That's why it's so important to target these problems early on and ensure you're not having recurring foundation problems.

2.Cracked and Sinking Foundation

When considering how your foundation could have concerns because of expansive soil, you may not think about the impacts expansive soil can have on the initial construction of the home. A building crew isn't usually going to build on top of an area that's actively drenched in water. However, some companies may not do their due diligence to ensure the area is as dry as possible [12-15].

If you build a home on top of expansive soil that's already started to expand, you're going to have many problems. First off, you're probably going to have a sinking foundation as the weight of the concrete pushes the water out and moves the soil

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around. You could also have cracks in your foundation because of potentially uneven sinking. Lastly, if the soil dries in the future, you could lose support for the foundation.

3.Wall Failure Due to Shrinking

One thing you may not have recognized is that expansive soil can also turn into consolidating soil. When soil expands dramatically due to moisture entering it, you can only assume that the soil will also shrink dramatically when moisture exits it. That means that your soil, which may have initially created enough support for your foundation, could end up withdrawing away from the foundation when it dries.

This lack of support is exactly what leads to wall failure issues. Shrinking in your foundation is a frustrating problem to deal with; it's common for this shrinking concern to cause serious and dramatic foundation problems. You can even end up with complete wall failure because of a lack of support around your foundation walls.

4.Building Movement Analysis Divides Into These 3 Main Categories

4.1 Amount & rate of building movement: What is the present extent (how much so far) and rate (how fast) of movement and does either of those make the building unsafe for example, if movement has moved framing such that framing connections are insecure a floor could collapse leading to serious injury, or if there are sinkholes or a sinkhole from melting permafrost or other cause, a sudden foundation collapse could be dangerous as well. If you are really seeing movement every day that sounds like a significant safety concern.

4.2 What is the cause of building movement – is it poor framing connections, improper design, improper site preparation below the foundation, or an innate site problem like a sinkhole?

4.3 Structural repair need & urgency: Based on the above, what repairs are needed, and at what urgency and with what alternatives. In cases of unstable buildings where there is a threat of sudden collapse, it may be necessary to immediately evacuate the structure and protect its surrounding area, notifying the appropriate local authorities.

V. PROBLEM FORMULATION- REPAIR OF SUNKEN FLOOR: GENERAL PRACTICE

The deformed floors are traditionally been repaired using methods seeking to overcome the expansive soils forces through

- **Soil removal and replacement by good soil,**
- **Soil stabilization,**
- **R.C.C. flooring.**

Expansive soils have relatively shallow occurrences to within 2.0 to 4.0 meters from the natural ground surface. However, in some cases it may be more than 4m deep. At such places it is problematic and costly to remove the existing soil to greater depth and to replace it with other good soil. Stabilization or modification of expansive soils by chemical admixtures is a common method for reducing the swell-shrink tendency of expansive soils. Among various chemical stabilization methods, lime stabilization is most widely adopted method (Wagh, 1999, Venkataswamy 2000). Generally, the quantity of lime required varies from 4 -10% by weight of the soil (Eades et al. 1963).

The deep stabilization of soils by lime columns, lime piles and lime slurry injection techniques have been successful for stabilizing soft soils deposits (Rao, 1992). Soil stabilization by lime is more effective in controlling volume changes, increases the overall strength of the stabilized soils and this method is suitable for shallow depth. Reinforced cement concrete floors are costly and at times the swelling pressure of soil may disrupt them also. Hence it is desirable to attempt stabilization (reduction in swell-shrink behavior) and strengthening of soil with minimum removal and replacement of the existing expansive soil.

Integrated Approach

The integrated approach aims at

- Minimizing moisture variation in the soil and
- Providing unyielding and uniformly strong support beneath the floor.

Minimizing the Moisture Variation: This may be achieved by provision of plinth protection slab at the outer periphery of the building of sufficient width (1.5 m or more) if possible and keeping away the deep rooted plants from the periphery of the building. Providing Unyielding Support beneath the Slab: This could be achieved by removal of 0.3m to

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0.5m of expansive soil immediately below the damaged floor and placing non expansive soil in place, lime treatment of existing expansive soil and construction of cast in situ short concrete piles of 150mm to 200mm uniform diameter and length of 1.5 m – 2.0 m @ 1.0 m to 1.50 m c/c below the removed expansive soil level.

VI. CONCLUSION AND FUTURE SCOPE

To meet the above objectives model test in the laboratory on prepared floor of concrete laid over expansive soil are proposed. The soil movement is thought to be minimized using piles and stabilizers.

For this purpose a well-designed test set up was built to study the behaviour of bamboo and concrete piles placed in prepared expansive soil deposit.The test set up is prepared by scaling down for the (assumed) dimension of a prototype room construction in black cotton soil area. The assumed parameters and corresponding values for prototype and model test set.

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