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Examining the Effect of Different Loadings on Truss Foundation Subsidence

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ABSTRACT

Examining the magnitude and the predictions of the rate of subsidence and damage caused by land subsidence is among the major and new studies done for truss structures and / or the fortifications needed before irreversible catastrophes occur that can be very useful for managing the urban crisis. The present study examined the modeling behavior of the foundation under the truss structure, where three types of soil, three types of loading, three types of widths, and three depth states are performed, and the following results were obtained. The effect of forces exiting the center (like wind) for foundations is almost negligible. In the samples, with 25 cm increase in foundation depth, vertical subsidence decreased roughly 4 times. The effect of soil type on the subsidence of software models was significant and with decrease in the soil elasticity modulus, 25% subsidence of the foundation increased.

Keywords: *Loading effect, Truss Foundation, Subsidence.*

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1. INTRODUCTION

Subsidence in the building is one of the phenomena occurring in some structures and, if not stopped, could have devastating effects on the structure. Theoretically (structure analysis), one can assume the structure subsidence as a simple frame with a rigid ceiling. Generally, sandy soils are exposed to subsidence, given an immediate subsidence resulting from loads exceeding the load capacity (constructing structure) and / or cyclic drying (crust subsidence) or earthquake-induced liquefaction.

With the construction of structures, the incidence of subsidence will usually be in form of differential or general subsidence. The implementation of raft or sometimes strip foundation is one of the ways to cope with differential subsidence. Moreover, to prevent overall subsidence and increase the bearing capacity, one can use the load transmitted to the lower layers with higher resistance.

Some studies have been conducted in this regard. In a numerical modeling study by ABAQUS finite element software, Taherian et al. (2015) examined the effect of different soil parameters such as angle and (ρ) density, (φ), and elastic modulus friction (E) on the dynamic subsidence of surface foundations on sandy soil affected by of the horizontal component of earth acceleration, from the magnitude of the Manjil earthquake mapping (Abr station). The results obtained from the analysis showed that the increase in friction angle and density reduces the dynamic subsidence, and the change in elastic modulus does not have much effect on the dynamic subsidence of surface layers. In a paper entitled "Validation of finite elements numerical methods in the estimation of instantaneous subsidence of strip foundations" using the concepts of finite element and Fortran Programming 95 and using different sub-routines, Saberi et al. (2014) calculated the flexible foundations subsidence in non-sticky soils. The results were compared using instantaneous subsidence relationships, simulation with Plexis 1 software, and the results of field loading test on the University of Texas-American site. Zarfam et al. (2012) measured the subsidence of the subsoil and loaded loads, and showed how much subsidence was applied to the structures and re-designed the structures.

One of the main engineering structures is truss. This structure provides a practical and economical solution to many engineering problems, especially in the design of bridges, power transmission towers, and buildings. According to the definition, truss is composed of the total number of members, all of which are on one page and their composition creates a triangular network. If in some cases, the consequences of soil volume, such as subsidence, inflation, or collapse or bedding of the soil bed tumble create serious problems, and cannot be addressed by optimization, foundation and structural, improvements, using preventive measures may lead to the non-economic results not to be justifiable.

Examining the magnitude and the predictions of the rate of subsidence and damage caused by land subsidence is among the major and new studies done for truss structures and / or the fortifications needed before irreversible catastrophes occur that can be very useful for managing the urban crisis. Hence, the purpose of the study was to examine the effect of different loading on subsidence of truss foundation.

2. METHODOLOGY

One of the most widely used software for performing finite element analysis (FEM) is ABAQUS software. As this software is based on the nonlinear problems, it has a great ability in simulating the real world. A wide range of elements is available in ABAQUS, which allows the user to be able to model and analyze various types of problems. Each element has the following five characteristics: the family, degrees of freedom that depend directly on the family of the members, the number of nodes, and the formulation and integration method. Each element in ABAQUS has a unique name, like S4R or T2D2 or C3D81. The name of an element shows all of its five characteristics.

ABAQUS uses numerical methods to integrate different quantities into a unit element. ABAQUS calculates the behavior of the material in each point-integration of an element using the Gaussian square method. If the continuum element is used, then one must use two options: Full Integration and Reduced Integration. This choice has a great effect on the accuracy of problem solving.

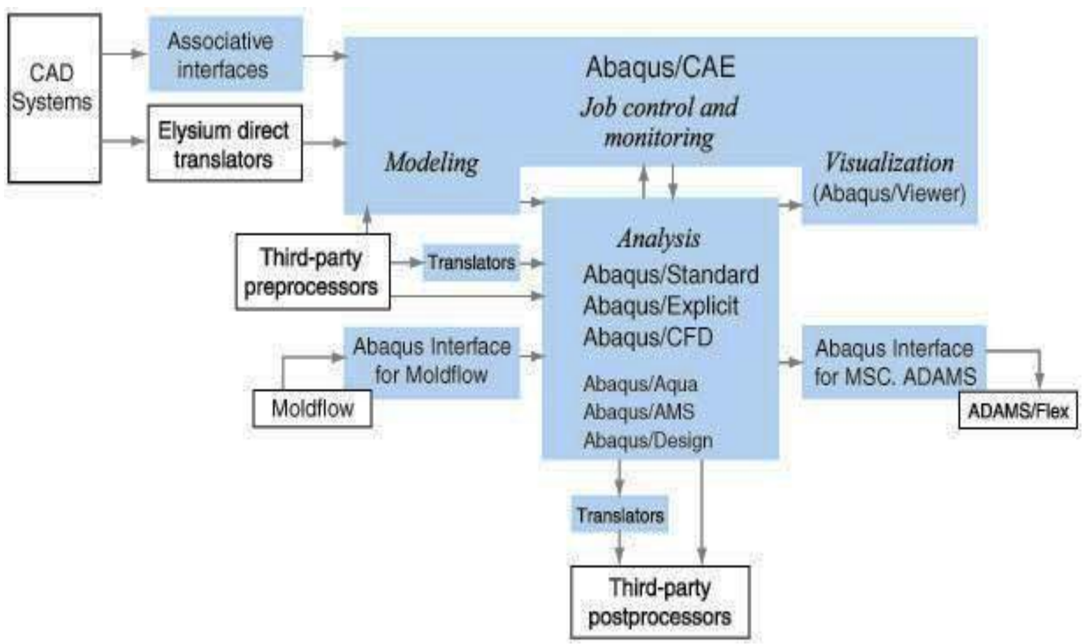

Figure 1: The relationship between different parts of ABAQUS

The following table describes the characteristics of the modeled samples

Table 1: Sample specification

Sample	Foundation Width centimeter	Modulus of soil elasticity Kg per square centimeter	Foundation depth centimeter	Base displacement centimeter
A1	75	50	75	3
A2	75	75	75	3
A3	75	100	75	3
B1	75	50	75	4
B2	75	50	75	5
B3	75	50	75	6
C1	100	50	75	6
C2	125	50	75	6
D1	75	50	100	6
D2	75	50	125	6

3. RESULTS

3.1. Examining the results of Samples

According to Table 4.1, samples A1, A2 and A3, only vary the modulus of elasticity of the samples, so that it can vary the soil type on the truss foundation, which varies from 50, 75 and 100 kg / cm2, respectively. In Figure 2, vertical subsidence graphs of samples are shown by loading along the foundation.

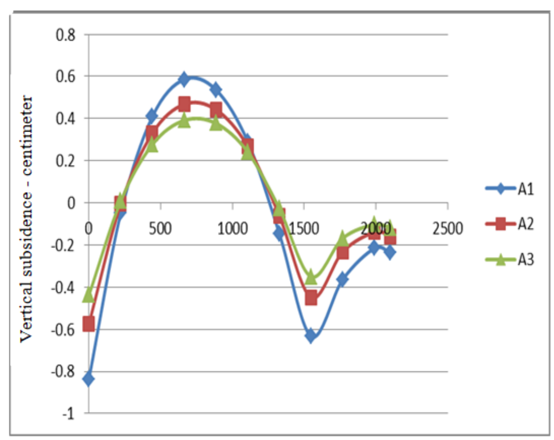

Figure 2: Vertical subsidence of the samples due to loading

3.2. Examining the results of B Samples

According to Table 4.1, in samples B1, B2 and B3, only the displacement of the structure on the columns varies, so that one can see the difference of soil type on the truss foundation, which varies from 4, 5 and 6 cm, respectively. In Figure (3), the vertical subsidence graph of the samples due to the loading carried along the foundation is shown.

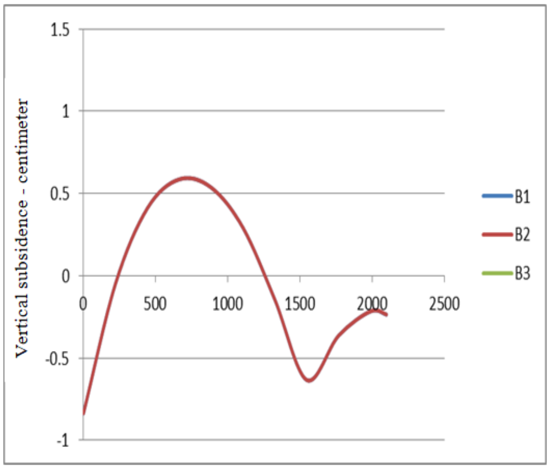

Figure 3: Vertical subsidence graph of the samples due to loading

3.3. Examining the results of C samples

According to Table 4-1, C1 and C2 samples differ only in the width of the foundations, so that one can see the width of the foundations on the subsidence, which varies from 1 to 1.25 meters, respectively. In Fig. 4, vertical subsidence graph of the samples is shown due to loading carried out along the foundations.

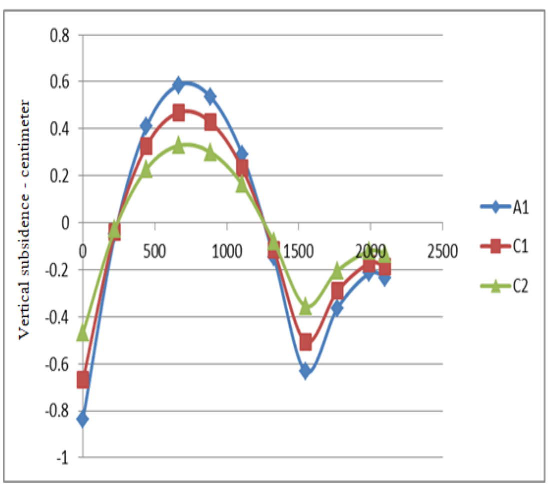

Figure 4: Vertical loading chart of samples due to loading

3.4. Examining the results of D samples

Samples D1 and D2 differ only in depth of foundations, so that one can see the effect of the width of the foundations on the subsidence, which varies from 1 to 1.25 m, respectively. In Figure 5, the loading carried out along the foundation shows the vertical subsidence graph of the samples.

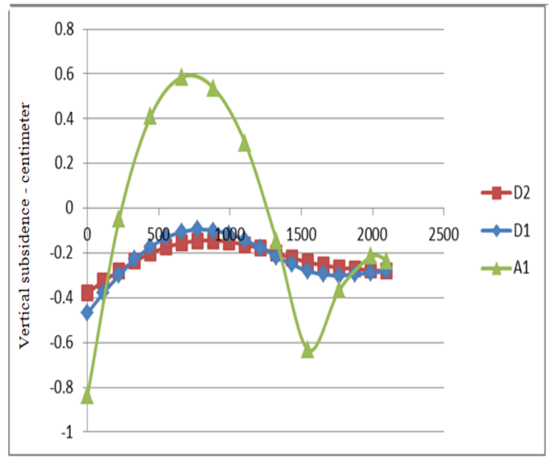

Figure 5: Vertical subsidence graph of samples due to loading

4. CONCLUSION

According to the results, the best way to reduce subsidence in decreasing vertical subsidence is to make a deeper foundation of the samples, with an increase of 25 cm in the depth of foundation; the vertical subsidence is reduced by approximately 4 times. The effect of soil type on the subsidence of the software models is significant and with decrease in the soil elastic modulus, a 25% subsidence of the base increases. In the foundations, the important component examined seems to be the displacement of the foundation, and a large horizontal displacement seems important. Accordingly, examining the instantaneous subsidence of the foundations and strip foundations and examining the common gravity load increase on tape foundations must be taken into account.

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