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EXTENDED ABSTRACT

Numerical and Experimental Study of the Interaction between Strip Contact Surfaces with New Geometry and Sandy Soils and Investigation by GEP Method

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Pull out test, Direct shear test, FEM, Plaxis 2D, GEP Method.

1. Introduction

In this study, to study the interaction of soil and strip in the passive and active zoon, pull out experiments, direct shear test and numerical modeling of finite elements were performed. The expected results of this study saved the strip. Also, using genetic expression programming (GEP), new design criteria for soil stabilization in narrow and conflicting building spaces were extracted to estimate the pull out force.

2. Methodology

2.1. Experimental study

In this research, sive analysis gradation, density test, tensile test, pull out test and direct shear tests were performed on soil, strips and galvanized sheets respectively.

2.2. Genetic Expression Programming (GEP)

The proposed GEP model presents the values of pull out force with R2 index equal to 0.93 for the model validation mode (test mode) whose parameters did not play a role in estimating the model. Therefore, according to the presented results, it is suggested to use the relation presented in this study, which is presented using GEP, in order to estimate the pull out force.

2.3. FE modeling

The FEM-based software package, Plaxis 2D, was used for the numerical modeling and analysis. After examining the optimal distance in Plaxis 2D finite element software, numerical studies were performed by finite element software to investigate the interaction and deformation of metal strips.

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3. Results and discussion

3.1. Effect of shearing element on the pull out capacity of strip

When height of elements made variable, the results generally show that taller shear elements have caused increased pull out capacities. As the results indicated the ribs have helped increase pull out capacity. Ribs on both sides of strips appeared to have caused increased friction on both sides of strip. The slip surface appeared to have shifted from strip-soil interface to soil-soil interface. Results showed increment in pull out capacities due to taller elements. The plastic deformation associated with Sample involving one shearing element and 8 cm height is shown in Fig. 1.

Fig. 1. Plastic deformation after pull out test

3.2. Genetic Expression Programming (GEP)

According to the presented results, it is suggested to use the relation (Eq.10) in this study, which is presented using GEP, in order to estimate the extraction force.

F = [h × n 〖× (n + h)2) × (p0.5)] + [(n + 〖((p2-9.585816) × (h0.5))2)〗 0.5]+ [h + n + p-0.15237 × p-(h × (-2.798554)) × (-0.15234 + normal stress)] (10)

3.3. Finite Element Modelling Results

Fig. 2 is an output of a pull out test with a conventional plain strip and a 100 kPa normal stress from Plaxis 2D finite element software. As shown in the figure, the pull out is created symmetrically in the strip. It should be noted that due to the width of the strip and the test box, the flat strain conditions are not perfect. Fig. 3 (a-b) show another model of strip with an 8 cm shear element under 100 kPa normal stress with mesh and contour of the stresses created. The results show that the deformation of the element added to the strip is very similar to the deformation created in the laboratory.

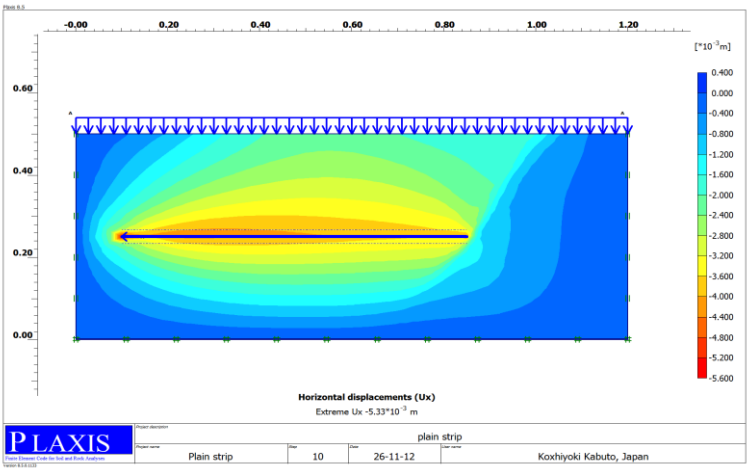

Fig. 2. Plain Strip with 100kPa normal stress

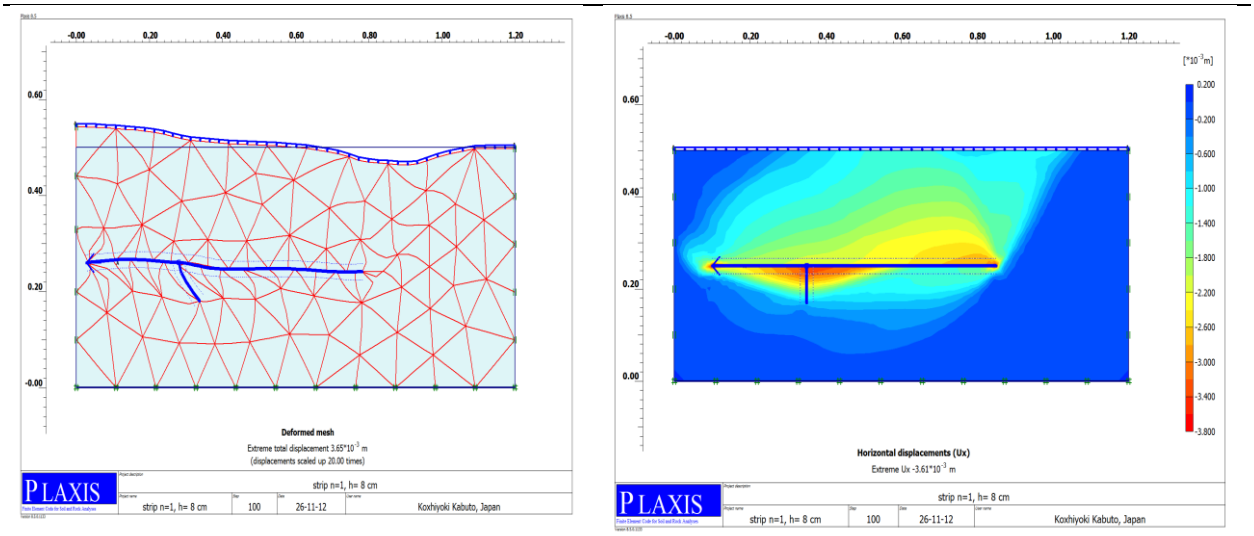

Fig. 3. Strip with one shear element and 8 cm height under 100kPa normal stress

4. Conclusions

The results of this study provide a solution to the problems related to the construction of a reinforced soil project in projects with opposition or limited construction space. The results of direct shear tests on galvanized sheets show that shear element with a height of 8 mm had the highest growth rate in the friction angle and when the number of shear element increased, no significant increase was observed due to the collision and overlap of failure surfaces and their effects on each other. Also, in this study, a finite element model presented of the deformations obtained from the experiment, which had a suitable validity of the created deformations with the laboratory results. The proposed GEP model provides pull out force values with an R2 index of 0.93 for the correct modeling mode (tested mode) whose parameters are not in the ideal drawing model. According to the presented results, Equation 10 can be used for finding pull out capacity of strip.

5. References

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