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# Factors affecting kinked steel grid reinforcement in MSE structures

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ABSTRACT

In order to investigate the factors affecting kinked steel grid reinforcement in Mechanically Stabilized Earth (MSE) structures, pullout tests were conducted to find out the new structure of steel grid reinforcement by making one or two triangular kinks on it to effect yielding in the steel grid. The pullout resistance is higher at larger pullout displacement when more kinks are made in the steel grid. Adding more kinks in the steel grid allowed sufficient lateral yielding with sufficient displacements to achieve the active condition as opposed to at-rest condition and thereby reduce the loading in the reinforcements.



## 1. Introduction

Investigating the influences of three components of MSE structures, that is backfill material, type of facing and reinforcement, on reinforcement loads and strains are necessary to achieve a good MSE structure design. Materials used in reinforcement elements include steel, polymeric materials (e.g. polypropylene, polyethylene, polyester) and even bamboo. Considering its modulus, the reinforcement material can be classified into two types: inextensible materials and extensible materials. Inextensible materials are wire mesh, steel strip, bar mat, and welded wire or steel grid. Extensible reinforcement include non-metallic material such as geosynthetics.

Applying finite element analysis, Bergado et al. (2000) concluded that the tensile force in reinforcement layers increased as the stiffness of the reinforcement increased as shown in Fig. 1. A similar conclusion has also been reported for short-term behavior of reinforced wall in Ling et al. (2005), Hatami and Bathurst (2006), Helwany et al. (2007). In the long-term finite element analysis, Liu and Won (2009) showed an increase in the reinforcement stiffness, the maximum reinforcement load increased correspondingly. Moreover, the maximum tensile load in the reinforcement element (BS 8006) is calculated using the following equation:

$$T_{max} = K\sigma_v S_v \quad [1]$$

where K is the coefficient of lateral earth pressure, $\sigma_v$ is the vertical stress acting at the reinforcement level, $S_v$ is vertical reinforcement spacing. The value of K depends on the stiffness of the reinforcement and obtained from Fig. 2. The steel reinforced soil walls get the larger K value resulted from the less extensible metallic reinforcing elements, which prevent the development of the minimum active earth pressure condition following the classical earth pressure theory (Bathurst et al., 2008).

As shown in Fig. 2, the earth pressure coefficient used for calculation of reinforced wall with extensible material is considered as active limit state. Meanwhile, for the steel grid without kinks the coefficient of lateral earth pressure K varies linearly with depth below the wall crest from $K_0$ to the active earth pressure value $K_a$ at a depth of 6 m then remains constant thereafter. However, changing the structure of steel grid by adding some kinks on the longitudinal bars allows some deformation along the steel bars. As a result, the at-rest condition ($K_0$) moves toward an active limit state condition ($K_a$); so the lateral earth pressure demand will also be reduced.

In-soil pullout tests were conducted to determine the displacement and structure of kinked steel reinforcement layer

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