ANALYSIS OF THE SHEAR BEHAVIOR OF STABILISED SOIL-CONCRETE INTERFACE IN GEOTECHNICAL STRUCTURES

W.A.W. Wijesingha [1], K.H.S.M. Sampath [1, *]

[1] Department of Civil Engineering, University of Moratuwa, Moratuwa

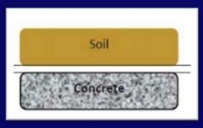
Understanding the behaviour between the interface of soil and concrete structures has a significant role when considering stability and the capacity of geotechnical structures such as shallow foundations, deep foundations, and earth-retaining structures. Quarry dust (QD) is an alternative waste material used for soil stabilisation to improve the engineering properties of existing weak soil, such as bearing capacity, stability, strength, and compressibility. Assessing the respective behaviour of the interface under various mix proportions of QD and the existing soil is important since the geotechnical properties of stabilised soil mainly vary with the mix proportion. This research investigates the influence of different QD and clayey sand (SC) mix proportions on the interface shear behaviour by laboratory experiments with modified direct shear tests. The effectiveness of the clayey sand stabilisation process using QD is demonstrated based on the plasticity characteristics, compaction characteristics, and shear strength of the soil-soil interface and the soil-concrete interface. The results demonstrate that QD provides effective clayey sand stabilisation since the Plasticity Index is decreased by 46.8%, MDD is increased by 11.26%, and Shear Strength is increased by 74.57% under 200 kN/m^2 of normal stress when the QD percentage in the stabilised soil is increased from 0% to 20%. Also, 40% of QD was obtained as the optimum mix proportion to stabilise clayey sand based on compaction characteristics since MDD is increased up to 40% and again decreased with the addition of QD. This investigation demonstrates that QD provides highly effective shear strength increment to clayey sand, and the shear strength is completely governed by the effect of friction angle beyond 10% QD addition since the cohesion is negligible.

Further, in the second phase, the accuracy of recommended co-relations between interface shear strength properties and soil shear strength properties provided in existing design codes has been assessed, particularly focusing on the QD-based stabilised clayey sand and using two concrete surfaces that have different roughness values (R1 and R2). The results demonstrate that when 20% of QD is added, the Interface Friction is increased by 23.2% in the soil-concrete interface (R1) and 22.5% in the soil-concrete interface (R2), and the obtained Interface Friction Angle Reduction Factors (IFARF) are in the range of 0.72 – 0.95. Therefore, the experimental results concluded that the IFARF, used in current design practices and values recommended in design guidelines, overestimates the interface shear reduction of the SC soil when it is stabilised with QD. In contrast, the Cohesion Reduction Factor (CRF), used in the current design guidelines, underestimates the interface shear reduction of clayey sand and stabilised clayey sand with QD when the contacted concrete surface is smoother than the relative roughness of 0.510 since the obtained CRFs are in the range of 0.52-0.67. Hence, the outcomes of the research conclude that the interface shear behaviour highly varies with the interface soil properties and the surface roughness of the structure; as such, adopting a common interface reduction factor for both friction angle and cohesion is not always accurate for designing geotechnical structures. It is recommended that a design optimisation should be performed by carrying out appropriate interface shear strength tests, considering the soil types and concrete surface properties, especially when the existing soil is stabilised with an additive like QD.

Keywords: Shear Strength, Quarry Dust, Interface, Reduction Factor

[*] Correspondence: sampathkh@uom.lk

THE SHEAR BEHAVIOR OF STABILIZED SOIL-CONCRETE INTERFACE



Soil-Concrete Interface

Shear Strength

Quarry Dust Stabilization

Geotechnical Structures

METHOD

Quarry Dust + Clayey Sand

Plasticity Characteristics
Compaction Characteristics

Soil-Soil Interface Shear Strength
Soil-Concrete Interface Shear Strength

Soil-Concrete Interface (R1)
Soil-Concrete Interface (R2)

The accuracy of recommended co-relations between interface shear strength properties and soil shear strength properties is assessed

RESULTS

Optimum QD Percentage → **40% (Based on MDD)**

Property	Increment with 20% QD
PI	46.8%
MDD	11.26%
Shear Strength	74.57%
IFARF	23.2% (R1), 22.5% (R2)

Obtained Interface Friction Angle Reduction Factors → **> 0.67**

Obtained Cohesion Reduction Factors → **< 0.67**

Conclusion

It is recommended that a design optimization should be performed by carrying out appropriate interface shear strength tests, considering the soil types and concrete surface properties, especially when the existing soil is stabilized with an additive like QD.

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