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Approach to the design of stabilised platforms in the context of temporary works applications

Background

Construction platforms are an essential component of most project and are typically classified as temporary works. Design guidance has been produced by the BRE, CIRIA amongst others and the Temporary Works Forum produced an excellent summary of research of the topic. However, use of stabilised site-won material as improved subgrade has not been discussed. While the Federation of Piling Specialists have produced some guidance on the use of hydraulically bound working platforms, little design guidance is available and it should be noted that design using stabilised material is a specialist activity nominally outwith general design practices.

In situations where stabilisation is practical (e.g. already being used on site or where construction platforms are extensive on plan area), improvement to subgrades through stabilisation processes can result in substantial reduction in granular platform depth and ultimately cost savings through saving of material import & geosynthetics and better use of site-won materials. It should be noted that "stabilisation" is often used interchangeably between lime and cement. While some pozzolanic by-products occur, lime addition to soil and mixing to effect moisture content reduction closer to the optimum moisture content for better compaction should be referred to as "moisture conditioning". In contrast, addition of cement or lime/cement mixtures to soil to effect substantial strength gain can be referred to as "stabilisation".

Approach to loading

The good practice guidance outlined in BRE R470 should generally be followed and, in addition, the FPS guidance for calculation of piling rig loads should be observed in determining load cases. The general scenario of having Case 1 and Case 2 loadings based on the Meyerhoff equivalent uniform loading, with appropriate load factors, should be followed.

Strengthening of the subgrade

Bearing capacity in two-layer systems is governed by four distinct mechanisms, all of which should be checked in detail. These are as follows:

1. Failure of the uppermost material
2. Punching failure through the uppermost layer
3. Distributed failure through the uppermost material
4. Punching failure of uppermost material in relation to edge distance

It is often the case, particularly for tracked plant where there are localised and heavily concentrated loads, that the punching failure mechanisms (as shown below in Figure 1) will govern. BRE R470 outlines a conservative approach to punching shear failure which forms the basis of the approach advocated in the guidance. It is noted that this failure mechanism would be negated normally where the depth of platform is greater than 1.5 x track width (of the plant applying the design loading). For most heavy plant, this would likely result in platform thickness well in excess of 1m. On this basis, strengthening of the subgrade to account for punching shear failure modes is the most economical means to reduce platform thickness. It should be noted that punching shear close to platform edges should be extensively examined through the assessment of slip plane formation and overall stability in order to define edge distance exclusions. This is outwith the scope of this note.

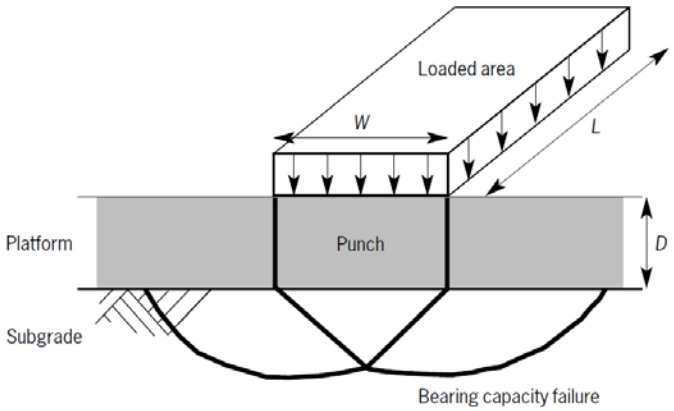

Figure 1 - Punching shear mechanism (extracted from BRE R470)

Granular running platform

Provision of a granular running surface should nominally be provided in all cases. BRE R470 recommends a minimum platform thickness of half the track width for light plant or 300mm thick granular platform regardless of the results of the assessment. It is considered that sufficient thickness of good quality granular fill as a running surface should be provided for the following:

1. To realise the assumptions on internal angle of shear resistance corresponding to the assumed load distribution through the platform
2. Sufficient depth to realise assumptions of uniform loading where trapezoidal distributions occur
3. To provide a flat and free-draining surface which can be readily maintained

In sum, the depth of platform should be adequately assessed by the Designer to suit salient assumptions and provide a platform in line with good practice guidance.

Design charts for use in operations

In the context of temporary works, a critical factor is the assessment of strength increase with time given that the stabilisation process relies on cement addition. A typical design chart is presented below in Figure 2 which outlines what the Designer should be targeting in informing the follow-on works. The chart is based on an initially firm cohesive subgrade with 300mm granular running surface and Case 1/2 piling rig loading applied.

In this particular example, if the Contractor wants to commence operations on the platform inside of one-week (7-days) from completion, the cement content would need to be 2% with a 300mm depth of subgrade treatment or 3% with a 200mm depth of treatment. By contrast, if the Contractor wants an operational platform inside 4 days, the cement content would need to be 2% with a 500mm treatment depth, 3% with a 300mm treatment or 4% with a 200mm treatment.

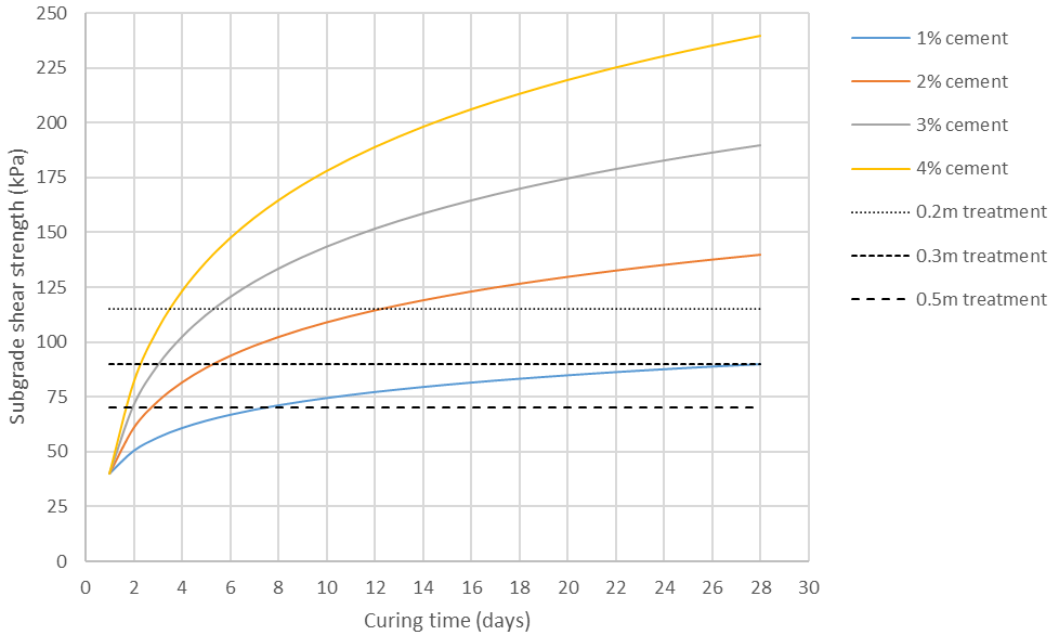

Figure 2 - Design chart for stabilised subgrade

The assessment of strength improvement for a given soil type and binder content should be undertaken by a stabilisation specialist or an engineer familiar with the treatment system and associated material science as it can be affected by proprietary treatment systems and compaction plant. Separately, verification of the subgrade improvement and running surface stiffness should be undertaken with plate bearing tests in line with normal good practice (detailed discussion of verification procedures is outwith the scope of this note). Geosynthetic separators should be provided if deemed necessary by the Designer in consideration of the interface of cohesive and granular soil bodies (again detailed discussion of this is outwith the scope of this note).