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Selected laboratory research on geogrid impact on stabilization of unbound aggregate layer

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Abstract

The influence of geogrid on aggregate layer has been tested by number of research organizations across the globe since early 80-ties of XX century. Test were carried out in laboratories and in field. The paper discuss selected laboratory tests important for stabilization function as well as describes recent laboratory research influence of geogrid for stabilization of aggregate layer in pavement. Laboratory part of the research was focused on interaction between grid and aggregate. Part of model tests carried out in box include calibration of measurement unit for future test in real trafficked pavement.

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Keywords: stabilisation by geogrid; unbound aggregate; confinement; stiffness; interlock

1. Introduction

The development of technologies utilising geosynthetics results in a dynamic increase both in applications and the geosynthetic products used in them. The last decade witnessed a peculiar revolution in the field of understanding and describing the geogrid interaction with the unbound aggregate [6, 7, 8, 9, 12, 16]. First, the reinforcement mechanism was clearly distinguished from the stabilisation mechanism [5]; second - numerous studies were initiated on practical confirmation of a favourable impact of geogrid on improvement to the conditions of aggregate layer

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interaction. The literature describes various mechanism related to the geosynthetics influence on the layers of unimproved pavements [10, 11,14, 15]. And so it is possible to distinguish here:

- In the field of geosynthetic's impact on the improvement to the pavement interaction in the case of base course strengthening:
  - improvement in the distribution of load transferred from vehicle's wheels
  - lateral confinement of the unbound aggregate in the base course

  Both mechanisms are closely interrelated
- In the field of geosynthetic's impact on the improvement to the pavement interaction in the case of subsoil strengthening:
  - improvement to parameters of strengthened subsoil due to the improved distribution of load and the increase in the deformation moduli
  - reduction of soils deformation in the subsoil
  - transfer of the load via the effect of stretched membrane.

The last mechanism occurs only in the case of subsoil deformations, resulting from the traffic load that large (min. 10 cm), that in practice the soil structure in the subsoil is damaged. Further loading with traffic requires a high-strength geosynthetic, working as a membrane supporting the entire structure and delaying the deformation increase under load.

It should be emphasised, that terms 'mechanical stabilisation of aggregate' and 'aggregate stabilisation with a geogrid', albeit close are not synonyms. In both cases the stabilisation is achieved as a result of the compaction of aggregate featuring a proper particle size distribution and appropriate humidity, which results in the decline of aggregate layer void ratio. In the first case, as a result of load, including also cyclic, action on the layer as a result of e.g. vehicles traffic the grains, in particular at this layer bottom, have a possibility to move, depending directly on the number of load cycles. Instead, in the second case the compaction process of aggregate properly poured down results in grains blocking in the geogrid aperture, featuring the aperture undeformability and the stiffness in a plane, which definitely reduces the capability of grains movement under the load. As a result, the layers of aggregate stabilised with a geogrid show much smaller deformations than the layers without geogrid at the same number of load cycles. It is also known that triaxial and biaxial geogrids behave differently [4].

Applications, in which the stabilisation is the basic mechanism, have been specified below:

- mechanical stabilisation of subgrade and structural layers of roads, railway lines, runways, etc.
- stabilisation of working platform layers
- stabilisation of floor bases
- stabilisation of the toe of embankment max. 2.5 m high, formed on a soft soil
- geosynthetic protections in the mining and seismic areas
- stabilisation of aggregate pad layers - geomattrasses

2. Selected completed laboratory tests

2.1. Description of a few cases

In the years 2007-2016 a series of research studies on the behaviour of geogrids stabilising a layer of aggregate were carried out in the laboratory of the Department of Geotechnics and Roads of the Silesian University of Technology [13]. For example, the tensile tests on large samples of geosynthetic carried out by means of a frame (Fig. 1) have shown big differences in the geogrid deformations depending on its interaction with aggregate or without it (Fig. 3), maintaining the identical speed of forced frame deformation.

The tests (Fig. 2) were carried out for many geogrids and geonets, analysing among other things the influence of the load action direction, the effect of geosynthetic interaction with aggregate or comparing the behaviour of individual geosynthetic types eg. comparison between biaxial and triaxial geogrids.

Laboratory tests were also partly verified in field tests on a natural scale, where the layers of aggregate stabilised with geogrid were subject to a forced deformation during trial loading.