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ROAD SUBGRADE DEFORMATIONS ANALYZING

Monitoring of 23 Ukraine regions revealed that major part of abnormal subgrade deformations have highway embankments higher 21 m. According to the monitoring results, a comparison histogram of malformed embankment amount to their total value was drawn. The main causes of road subgrade deformations are analyzed.

Keywords: *highway embankment, subgrade deformation, long-term strength.*

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АНАЛІЗ ПРИЧИН ДЕФОРМАЦІЙ ЗЕМЛЯНОГО ПОЛОТНА

Моніторингом 23 областей України було встановлено, що переважну частину наднормативних деформацій на автомобільних дорогах складають насипи висотою понад 21 м. За результатами моніторингу побудовано гістограму порівняння кількості деформованих насипів до їх загального числа. Проаналізовано основні причини деформацій, які виникають в земляному полотні автомобільних доріг.

Ключові слова: *дорожній насип, деформація земляного полотна, тривала міцність.*

Monitoring of 23 Ukraine regions established majority of abnormal deformations (52,2%) recorded in highway embankments higher 21 m. The average percentage of these embankments deformations – 31,1%. The main type of abnormal deformations (70%) − washouts slopes of embankments, earth-bank and road shoulder breaks [1]. Figure 1a shows a typical case of soil liquefaction. Based on current knowledge, the suspected causes are rain or wind and grain redistribution within soil due to high local hydraulic gradients. 70% of incidents occurred during the months of January to March, that is at low temperatures and with soil frost [2]. Figure 1b describes longitudinal cracks near the edge of pavement. Reason – tensile stresses induced by flexion of the pavement during settlements caused by the dry season leads to the development of longitudinal cracks. During the dry season there is a drop off in moisture content of the soil in the shoulders of the pavement structure. The consequence of this reduction in moisture is a settlement in the shoulders that does not take place in the centre of the pavement where the moisture of the soil remains stable thorough the year [3 – 5].

Embankment subsidence caused by soils consolidation from which it was erected is wide-spread (Fig. 2, c). Subsidence appears when soils was compacted insufficiently. The reason may be the difference in the filtration rates of soils and through the blocks of ice and snow in an array of frozen soil [3, 4]. Soil settlement (Fig. 2, d) takes place due to the insufficient strength and high deformability of base on which the embankment is arranged [5].

These deformations do not cover all destruction cases. Thus typical slopes damages, ablations that occur due to atmospheric precipitation, periodic soil freezing and defrostation, insufficient slopes strengthening, reloading of soils, violations of drainage. When upper soil layer was defrosting, the embankment contains a significant water amount. Its moisture may exceeds the liquid limit, and soil slows down by slope [3 – 5].

Figure 1 – Road subgrade deformations [6]:
a – flow liquefaction;
b – longitudinal cracks near the edge of pavement
c – soil settlement
d – embankment subsidence

The chart in Figure 2 shows the number of malformed embankment amount to their total value. The vertical Y-axis illustrates number of embankments; the horizontal X-axis presents embankment height in five ranges (6 – 10 m, 10 – 12 m, 12 – 15 m, 15 – 20 m, and more than 21 m).

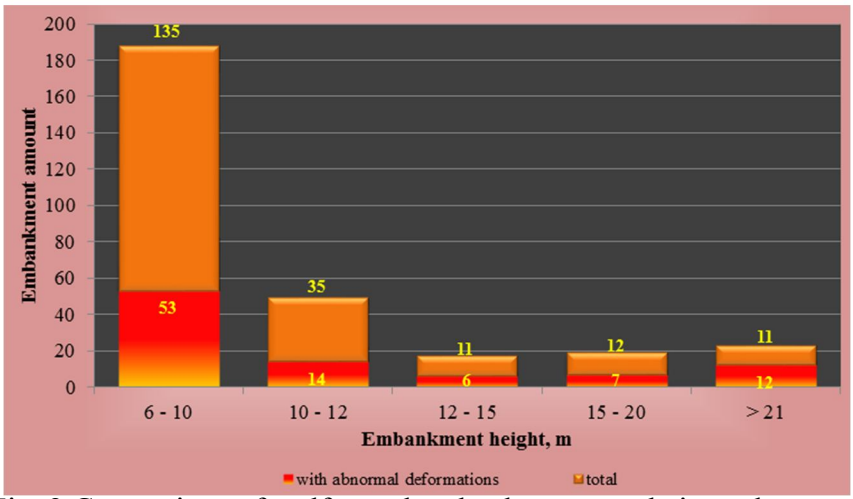

Fig. 2 Comparison of malformed embankments to their total amount

That's why one of significant problems of highway embankment erection is their long-term strength ensuring, when during normative operational time the values of soil mechanical characteristics, obtained after compaction, have been saved [5].

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