Geofoam as a Subbase Material

Issue: Premature pavement distress/failure has occurred atop geofoam. What is the cause of this poor performance?

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TH 47 in Isanti County, Minnesota

- geofoam fill placed in Nov. 2005
- roadway completed in Dec. 2005
- small cracks in Spring 2006
- severe rutting Spring 2007

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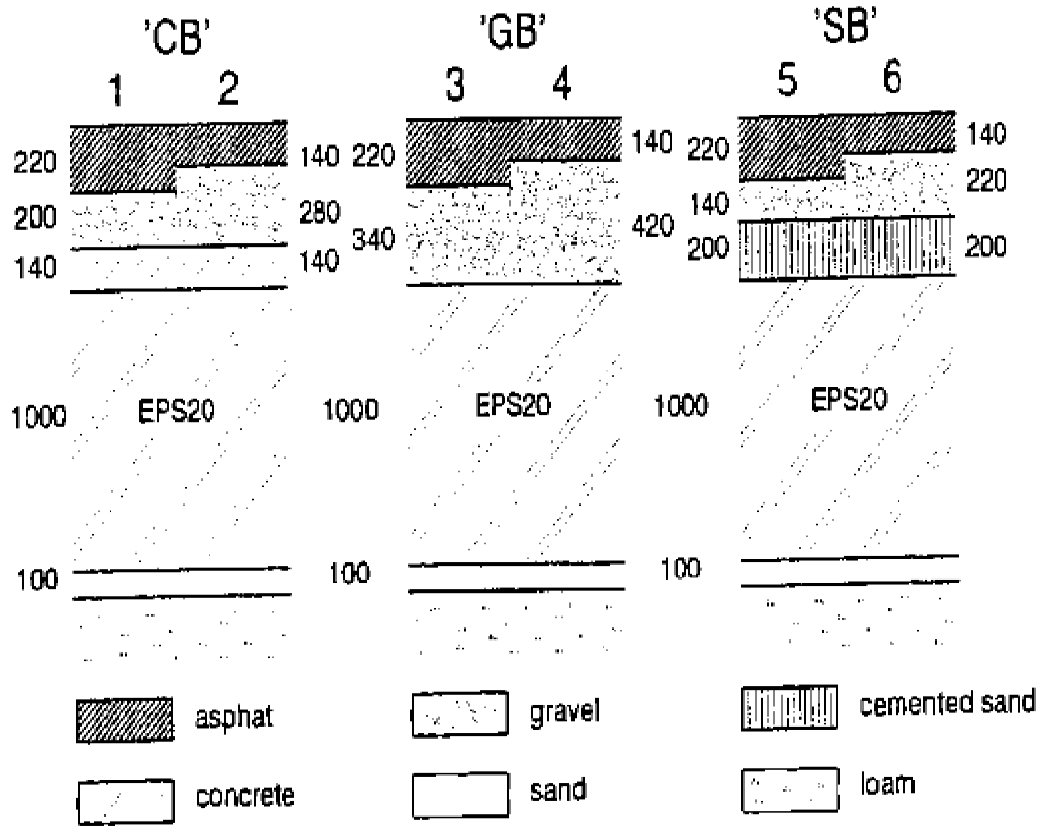
Possible Causes of Distress

- Geofoam out of specification
- Geofoam damage during construction (placement of overlying materials and compaction)
- Pavement section under-designed
    - no load distribution slab
    - flexible pavement with insufficient structural support

Findings from Dutch Research (BASt – Test facility)

concrete



cemented sand

Findings from Dutch Research (BASt – Test facility)

Findings – Pavement Design

Unbound roadbase materials have a lower 'effective' stiffness in pavement structures without a cement-bound load-spreading layer above the EPS sub-base compared to a structure with such a layer. Therefore, in linear-elastic calculations the assumed E-value for the unbound material should be lower when this material is laid directly over an EPS sub-base than in the case of an intermediate cement bound layer.

This means that the compacted base material placed atop the EPS has lower stiffness and this should be considered in the pavement design.

Findings from Dutch Research (BASt – Test facility)

Findings - Construction

Truck serviceability in the construction phase is unconditionally possible only on section 'CB'2 with a reinforced concrete capping layer above EPS and a 280 mm unbound roadbase on top of it. Loadings lower than 50 kN per wheel are allowed on roadbases of the sections 'CB'1 (with a concrete capping and a 200 mm thick unbound base layer), 'SB'5 and 'SB'6 (with a cement-stabilized sand layer above the EPS sub-base) while the sections 'GB'3 and 'GB'4 (with a roadbase of only unbound gravel material) should under no circumstances be subjected to heavy vehicles in the construction phase. It would result into high plastic deformations in the base, and therefore only vehicles with wheel configurations that results in low stresses might be allowed.

LDS protects the EPS during construction/compaction, granular base does not.

Findings from Dutch Research (BASt – Test facility)

Findings – Pavement Performance

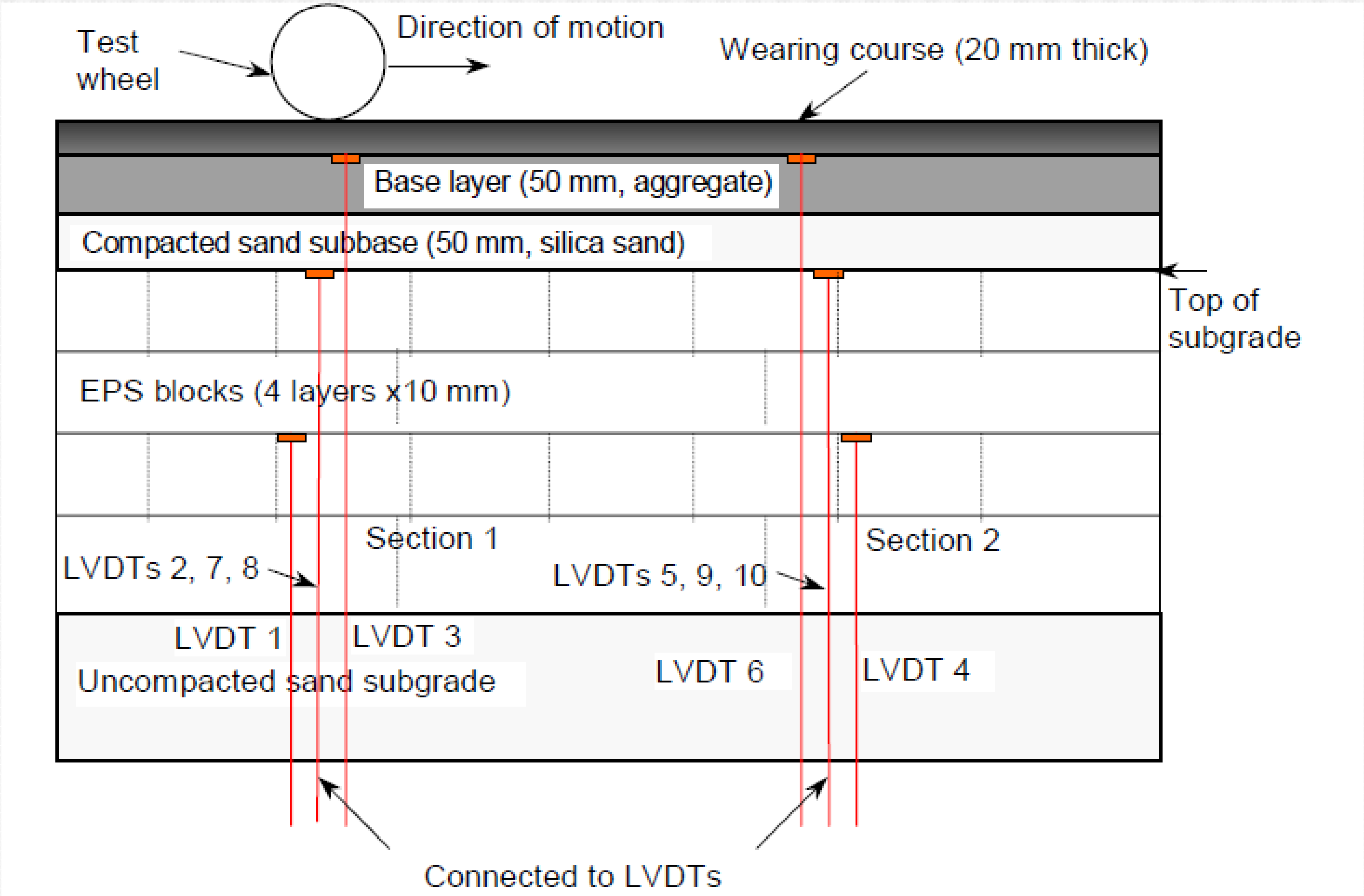
The horizontal strain at the bottom of the (200 mm thick) asphalt layer, an important criterion for the determination of the design life of an asphalt pavement structure, is approximately 15% higher when an EPS sub-base is built-in below an unbound roadbase instead of sand. Such a strain difference results in an approximately two times lower allowable number of standard axle load repetitions, i.e. a two times shorter pavement design life if an EPS sub-base is applied.

Pavement life may be 2 times shorter.

'GB' pavement structures, as applied at BASt, can sustain only a low number of standard load repetitions before cracking of the asphalt occurs.

Early cracking may occur

Findings from Australian Research



Findings from Australian Research

Findings – Pavement Performance

Resilient deformation of EPS geofoam at the subgrade level is much higher than that for compacted sand. The resilient deformation manifests as a deeper rut on the pavement surface of the EPS geofoam subgrade test section than on the compacted sand subgrade test section, even when both have the same pavement structure. The rut depth could be reduced, however, by using an appropriately designed pavement structure (e.g. increase the pavement thickness or use stiffer pavement).

Test results showed that block size and lateral restraint did not significantly affect the performance of the EPS geofoam blocks. These findings will give design engineers added flexibility in design.