Abutments in Reinforced Soil for a Road Bridge

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ABSTRACT: Two 8 m high abutments of geogrid reinforced soil were constructed on weak ground carrying a road bridge superstructure of 4000 kN dead weight. Up to 40 mm settlements occurred in the subsoil within 16 months without negative influence on the total structure.

1 INTRODUCTION

The use of polymer geogrids for reinforcing retaining walls has been well known for many years. This construction method has proved to be economic and technically sound. Nevertheless, conservative engineers hesitate to design soil structures including polymer reinforcement, if the application seems to be risky. Therefore, it is of great interest to report on a special bridge abutment project reinforced with flexible geogrids.

2 GROUND AND STRUCTURE

Over the main railway line Nyborg - Fredericia on the Danish island Funen a road bridge had to be built. The ground for this bridge at the city of Ullerslev consists of late glacial clay. Due to the weak ground settlement of the bridge abutments had to be expected. For that reason Danish State Railways opted for reinforced soil abutments, which are not susceptible to settlement.

The road bridge with a 15.5 m span consists of a 11 m wide encased steelgirder superstructure resting on two 8 m high abutments (Fig. 1). Each abutment has to carry 2000 kN dead weight and 1700 kN traffic loading.

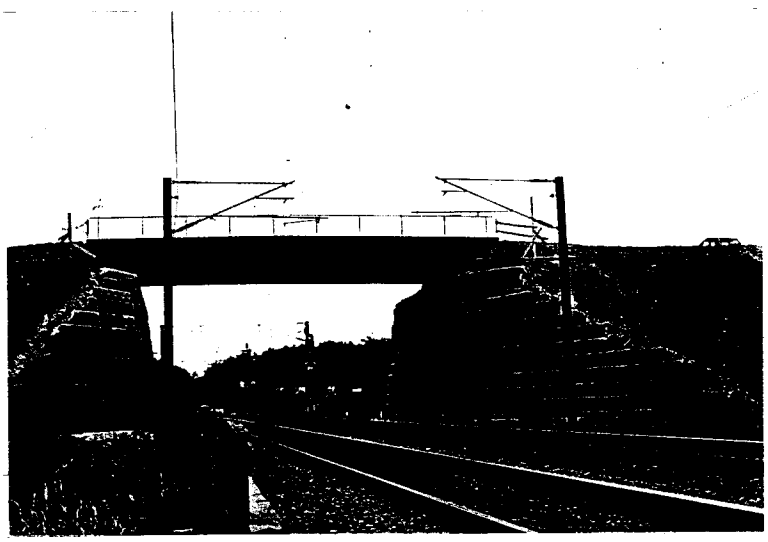

Fig. 1 Road bridge at Ullerslev

A gravel - sand was employed as fill material for the abutments with following soil mechanical parameters:

particle diameter d_{50} = 0.5 mm
uniformity coefficient C_u = 3
required degree of compaction
$D_{Pr} \geq 100\%$
unit weight γ = 19 kN/m^3
friction angle cal ϕ = 35°.

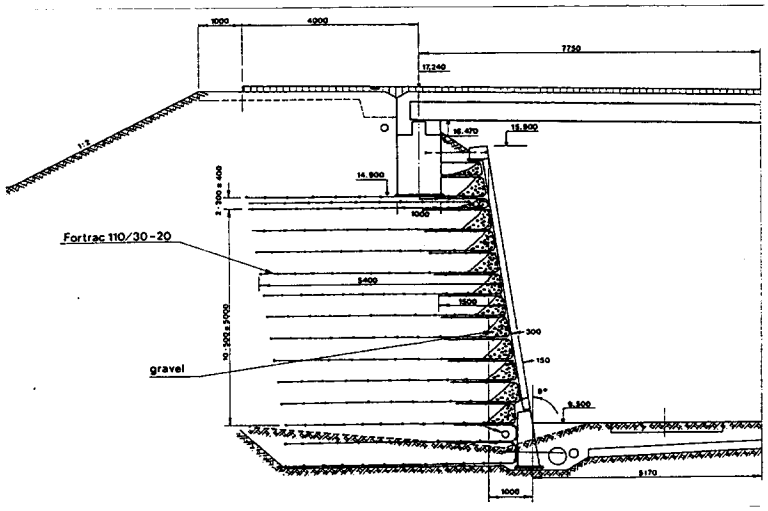

Fig. 2 Cross section of Southern abutment

The stability of the abutments with 81° frontal inclination was analyzed and required a reinforcement with an ultimate strength of 110 kN/m at a spacing of 500 mm (Fig. 2). The minimum anchor length was calculated as 5.4 m.

9250 m^2 flexible polyester geogrid Fortrac 110/30-20 was used for the reinforcement. A description of the geogrid properties and design principles are detailed in (N.N., 1992).

3 DEFORMATION MEASUREMENTS

The abutments were constructed from December 1991 to June 1992 and the steel superstructure was erected in August 1992. Since December 1991 until April 1993 the vertical and horizontal deformation of both abutments was measured at 40 points at the front and on the slopes (Fig. 3). After bridge superstructure erection only about 2 mm settlement has been observed in the abutments themselves in both vertical and horizontal direction (Fig. 4). The ground settlement is about 40 mm, of which 10 mm occurred after the bridge superstructure erection.

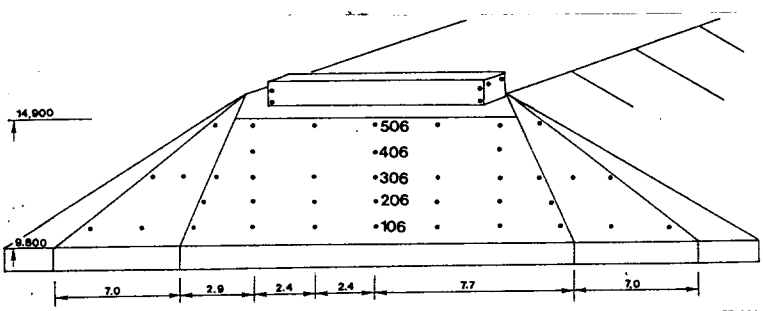

Fig. 3 Grid of measuring points of Northern abutment

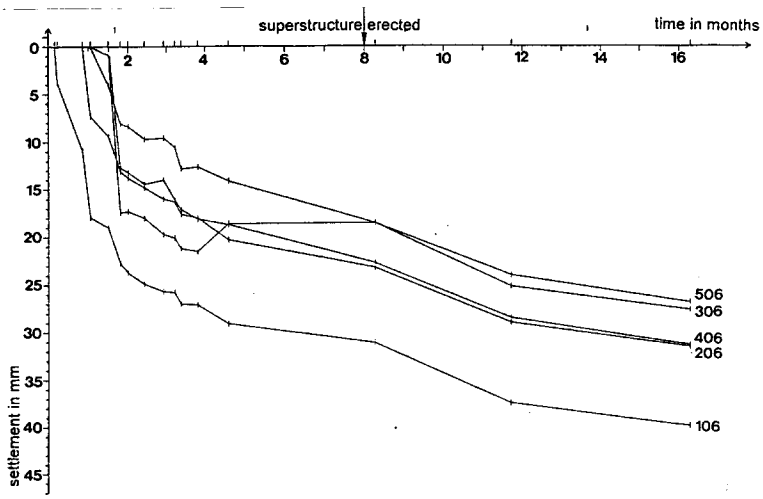

Fig. 4 Settlements in vertical cross section of Northern abutment from 12 Dec 91 to 27 Apr 93

4 CONCLUSIONS

Due to the weak ground settlement of around 40 mm occurred within 16 months without negative influence on the reinforced soil abutments or the bridge superstructure itself. The construction method using flexible geogrids to reinforce abutments has proved to be technically sound.

REFERENCES

N.N. (1992) Fortrac Geogrids, Roads and Bridges Agrement Certificate No. 92/69, British Board of Agrement, Watford