Thin Concrete Blocks with Adhesive Layer

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Summary
What has been proposed is the practice that conventional asphalt pavements are to be covered with thin concrete. Concrete cover can protect vulnerable asphalt in winter as well as considerably lower the attainable temperatures of pavements in summer preventing thermal rutting. Thin concrete can stay on the surface only in the form of blocks with adhesive layer. The stability of thin blocks are dependent on many factors such as dimensions of blocks let alone the traffick amount. Dimensions are closely related to the construction cost and the mechanical strength. In general the working unit should be as large as possible to reduce the laying cost. Smaller mechanical units are preferable --- smaller blocks are stronger against cracking. This paper centers on the optimal dimensions of related parts in the practice to cover the existing asphalt with thin concrete blocks. Resin concrete blocks can enhance the function further. For such objectives expected properties may differ from these of conventional concrete blocks. Thus the properties of resin are examined from the view points of surface covering, followed by the illustration of the procedure. The case study shows the proof of the precedent works on the thin blocks.

1.Introduction

Pavements in cold regions are subjected to characteristic damages in severe conditions such as abrasion due to the antiskidding means. Asphalt pavements most common today are not strong enough particularly in abrasion by heavy trafficks. In addition to problems related to winter vehicles, vulnerable bases also common in Hokkaido might cause deformation of bearing structures on top of frost heaves. Therefore the pavements have to be flexible to avoid the damages. The more the flexibility of asphalt concrete, the more

the thermal rutting in summer. In order to cut the vicious circle, a practice of different concept may be a solution. The practice proposed in this report is named "the Road Plates of Marvelrec".

2.Resin concrete

a.Basic properties: Marvelrec is resin concrete which consists of a binder of acrylic resin , carbonic calcium and aggregates. It is of low viscosity of 20 cps at 20 degree C. The bending strength with time is shown in Fig.1. The compressive strength with time is shown in Fig.2. The adhesive strength to cement concrete is 23.8 kg/ sq.cm, which enables the abrasion loss maintenance by adding the staff. The skidding resistance is 77 in the British portable skid test which is same as the conventional concrete pavements.

b.Abrasion resistance of resin concrete:The abrasion resistance is over three times as strong as that of conventional cement concrete. The test results of abrasion tests by the metal chains is shown in Fig.3.

3.Procedure of Road Plates practice for rutting

The practice is illustrated in PL.1 to PL.5. The hot asphalt is supplied from the mobil cocker for the adhesive layer which is placed on the processed rutting. The road plate unit is placed when the layer is being heated by burners. The tire roller should firmly press the plate while the asphalt is plastic. Completed examples are shown in PL.6 to PL.8. The cross section is shown in Fig.4.

4.Dimensions of blocks

a.Working unit; The size of a plate which makes a working unit is 1000x600x40 mm. The 40mm depth can allow 30 mm abrasion due to anti-skidding devices which is a limit for smooth driving. The weight is limited under 60 kg for the manual handling at site, although the enlarged working unit is economical in production and construction.

b.Mechanical unit; Each block which makes a mechanical unit on the surface subjected to wheels should be able to bear the tread pressure and transfer it to the base. Blocks are to be connected

with a net to make a working unit. Notches as often found in chocolate bars are also used for connecting blocks. The maximum internal stress is the function of the ratio between the maximum length of a block and the depth under a given tread pressure (1). However cracks in a block are harmless so far as the block stays at the initial location. The location stability can be assured if the grip either by adhesive layer or adjacent blocks is strong enough. The grip depends mainly on the base condition. In the current practice, bituminous layer of asphalt concrete can give an adhesive strength over 1 kg/sq.cm in summer and 3 kg/sq.cm in winter. The dislocation due to ripping has rarely took place in summer, proving that the adhesive strength in summer is enough for the stability of blocks in present traffick conditions. The damage rates of removed blocks on a given adhesive layer for three year period seem to decrease with the maximum lengths of blocks diminished, as shown in Fig.5. The rate is zero when the maximum length is less than 5 cm. However the smaller blocks have setbacks in difficulty of forming works. Besides asphalt of the adhesive layer may ooze out through joints in summer, which is undesirable.

5.Concluding remarks

a.Size of working unit: The size shown above has proved proper for maintenance of rutting in various road conditions, particularly in tunnels where space is limited and the manual handling is inevitable. The carts are useful devices for the practice.

b.size of blocks: Although the blocks of 300 x 400 mm are subjected to cracking , they could keep the maintenance rate for three year period under 0.25 percent without undesirable asphalt ooze.

Reference

(1) M.Inuzuka and I.Sato, CONCRETE BLOCK PAVEMENTS ON ASPHALT HIGHWAYS, Proc. of 2nd Int. Conf. of Concrete Block Pavement, Delft, the Netherlands, 1984, pp322-329

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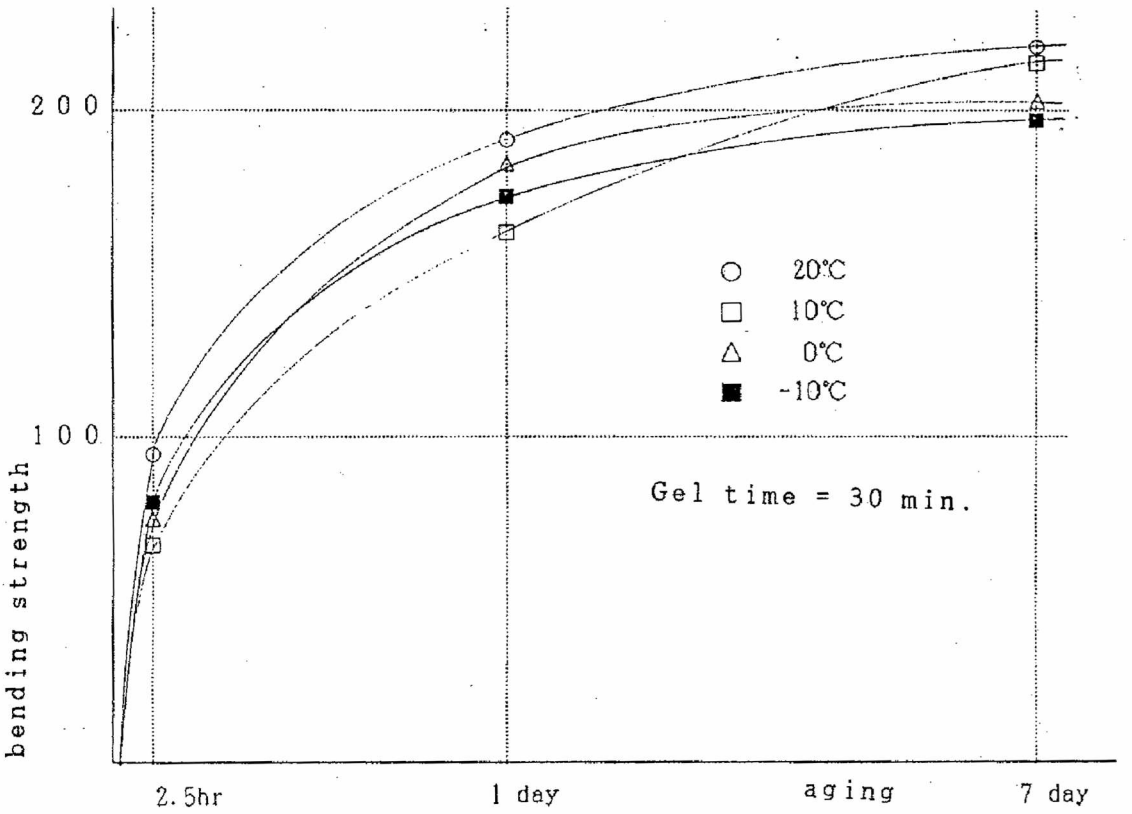


Fig.1 Bending strength with aging

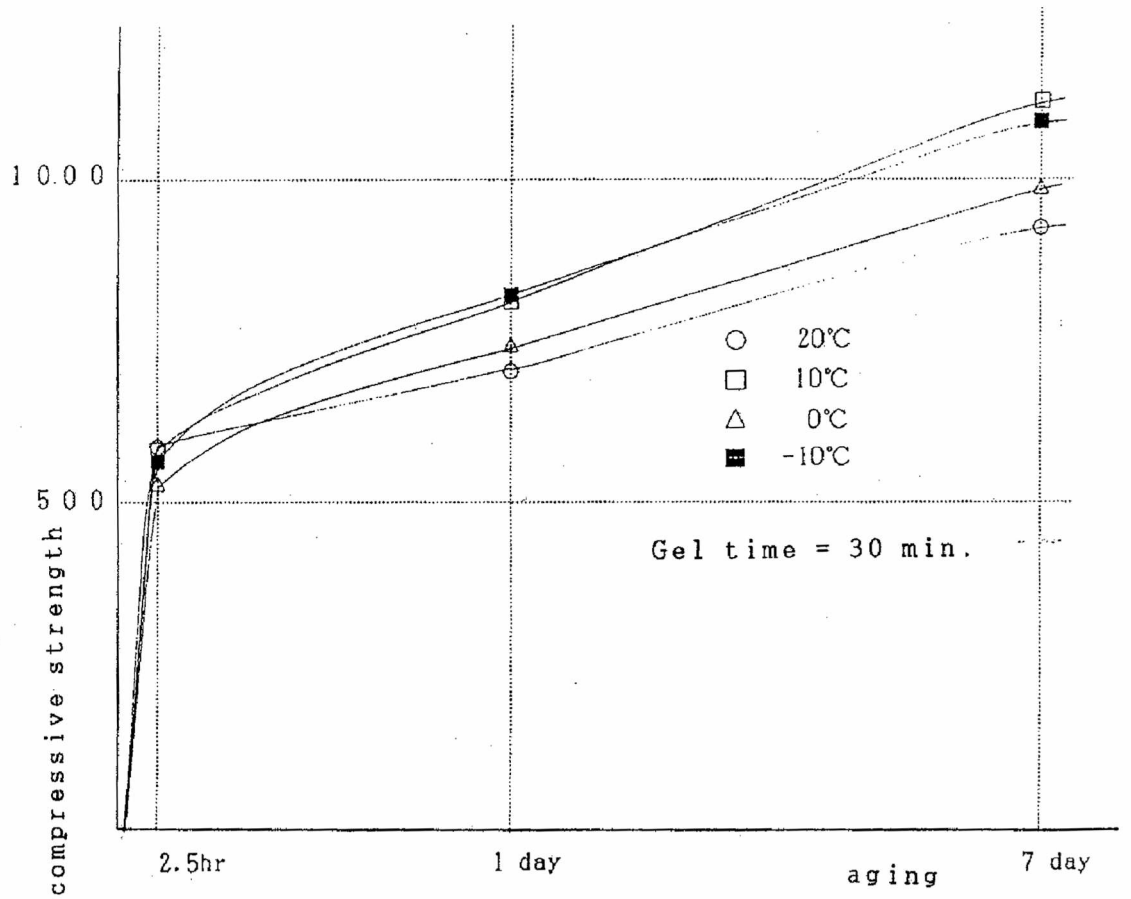


Fig.2 Compressive strength with aging

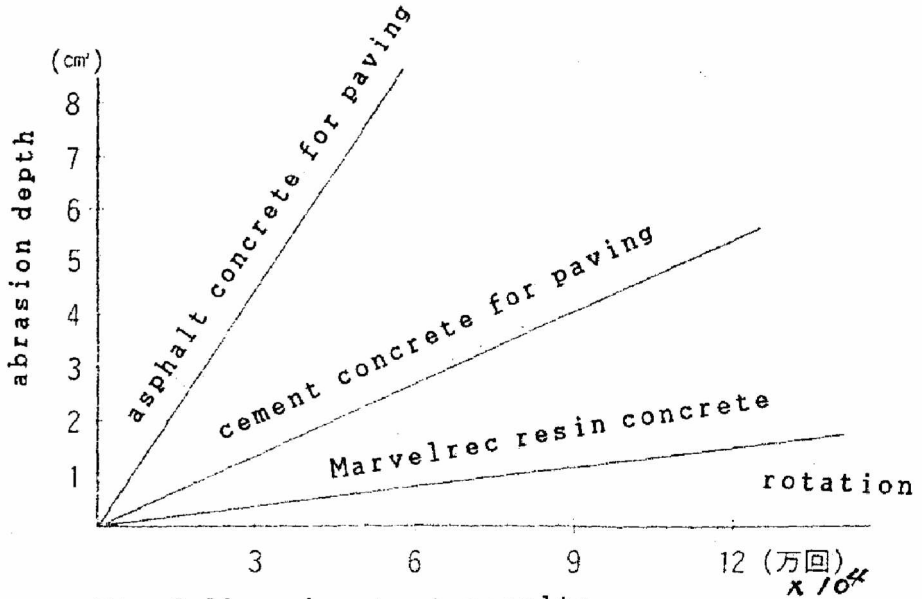


Fig.3 Abrasion test results

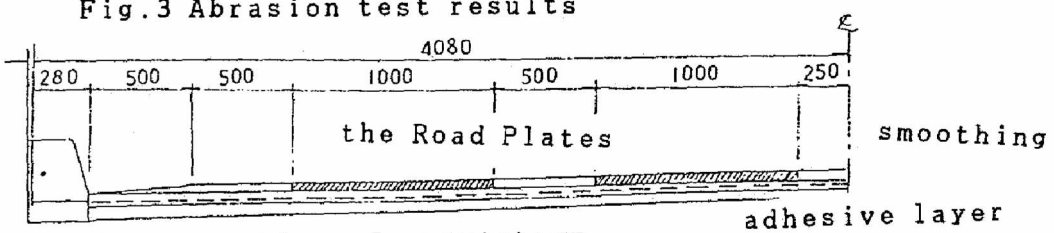


Fig.4 Cross section of completion

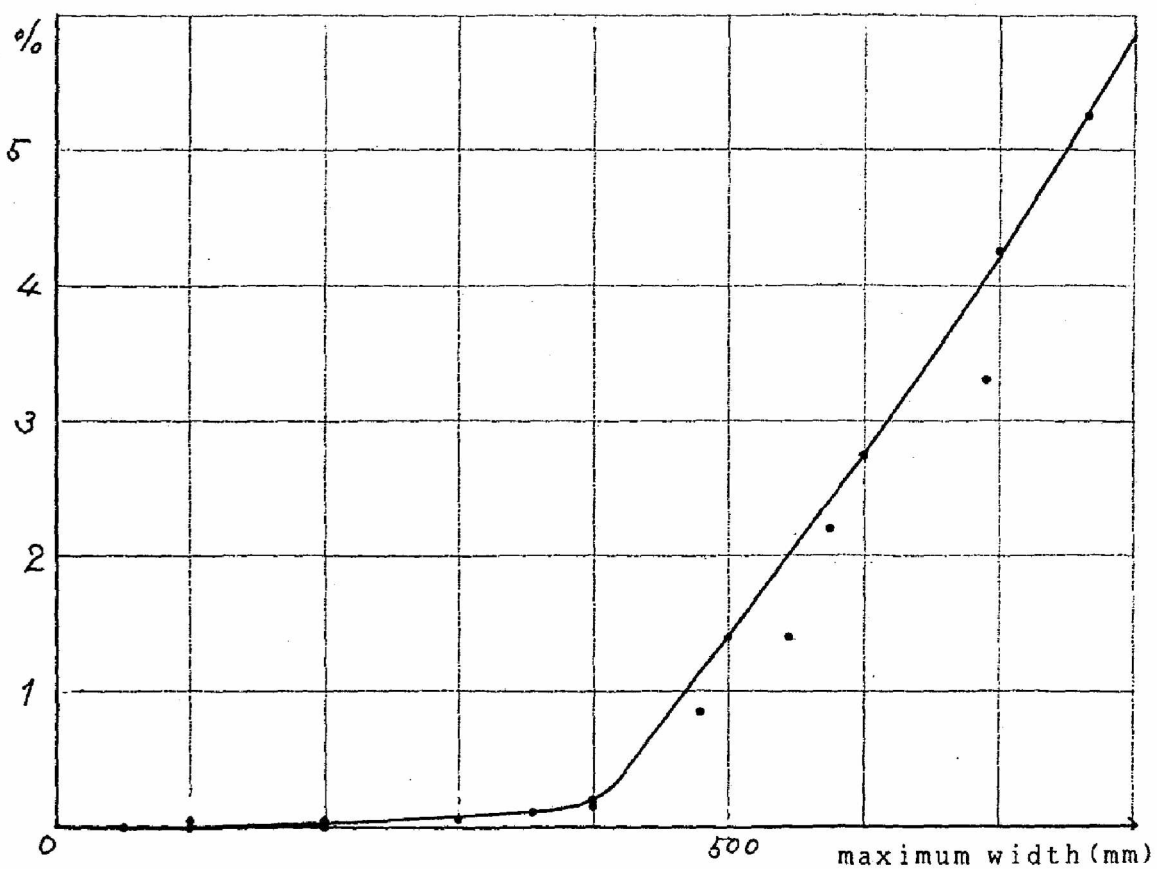
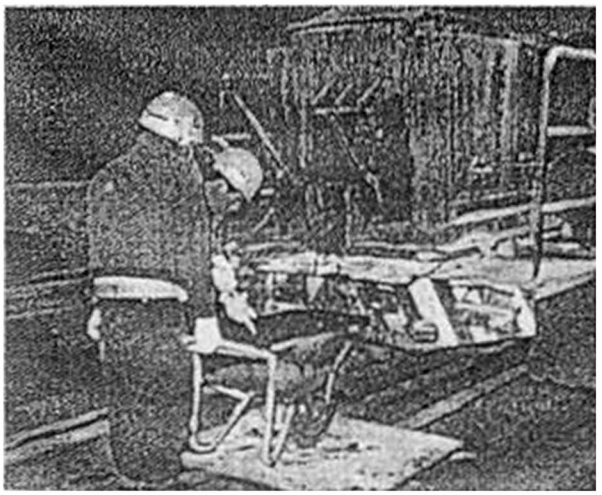
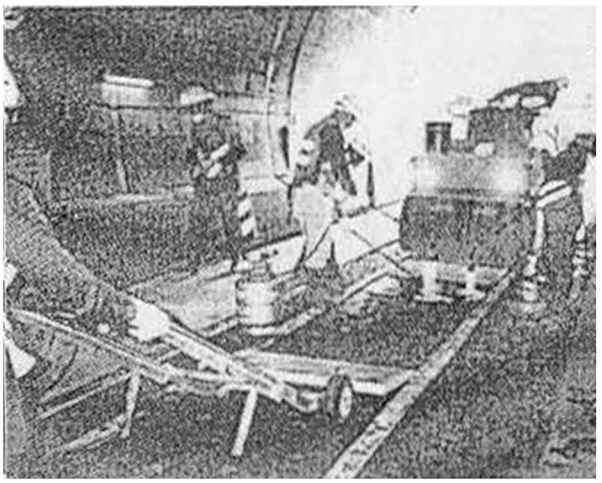


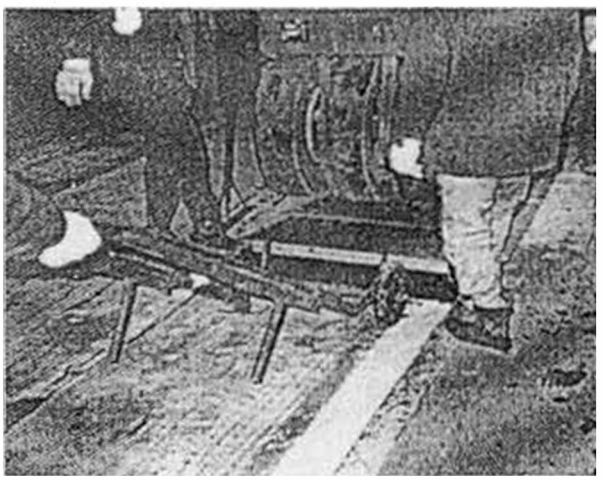
Fig.5 Rate of replaced blocks



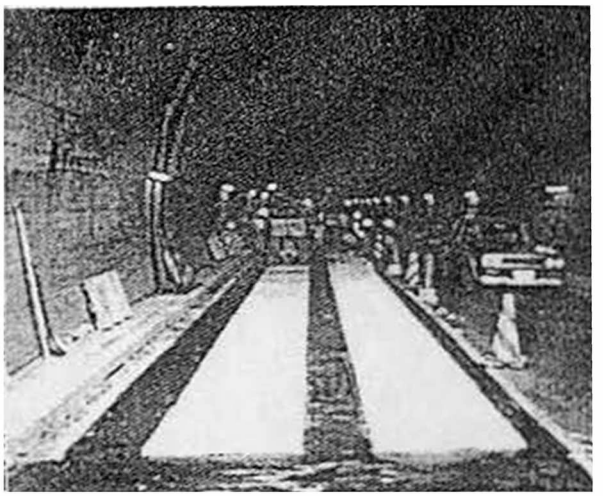
PL.1 Hot asphalt from cocker



PL.2 Carrying



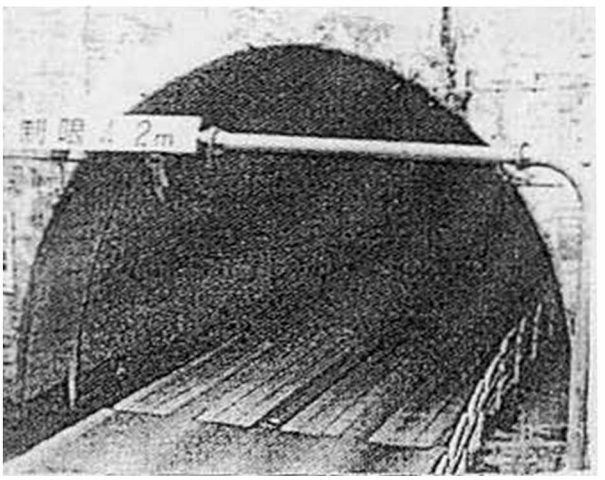
PL.3 Placing & pressing



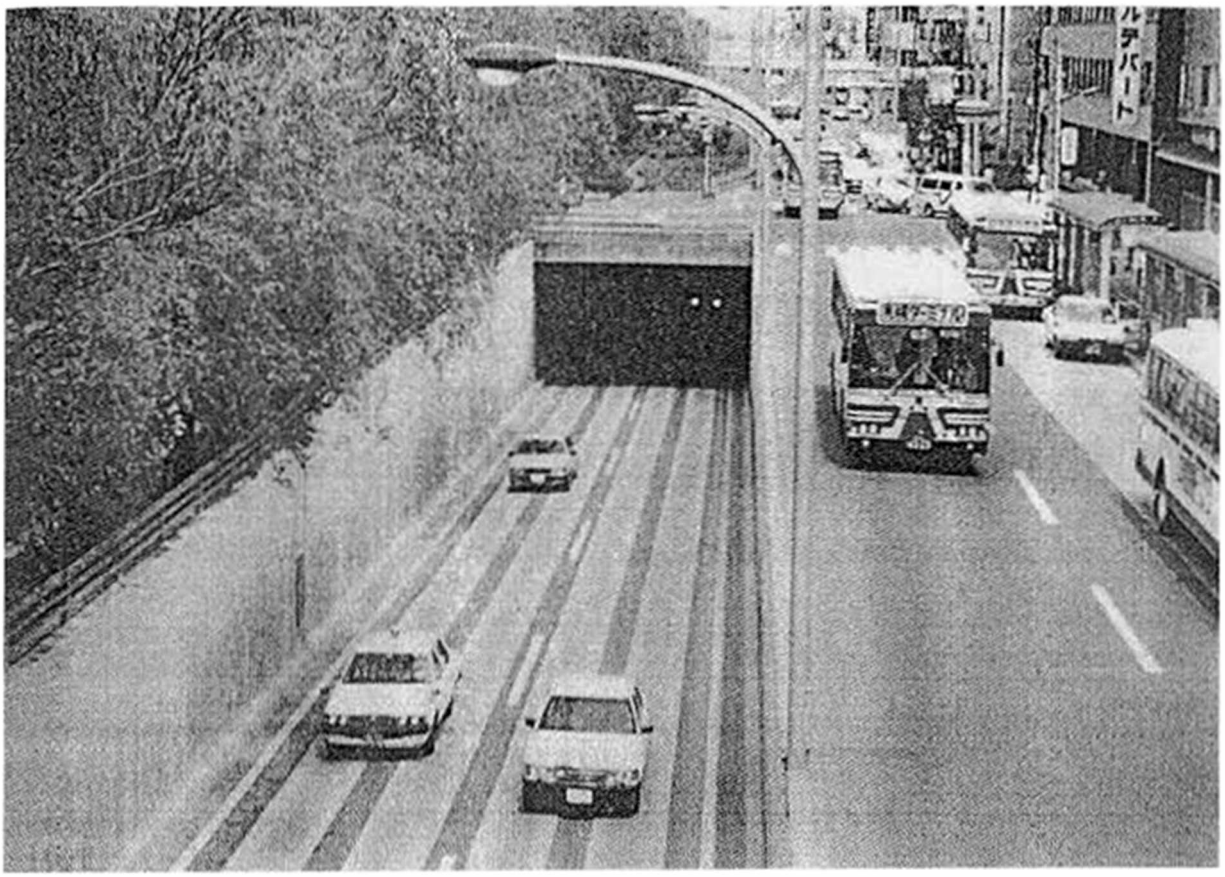
PL.4 Fixed plates



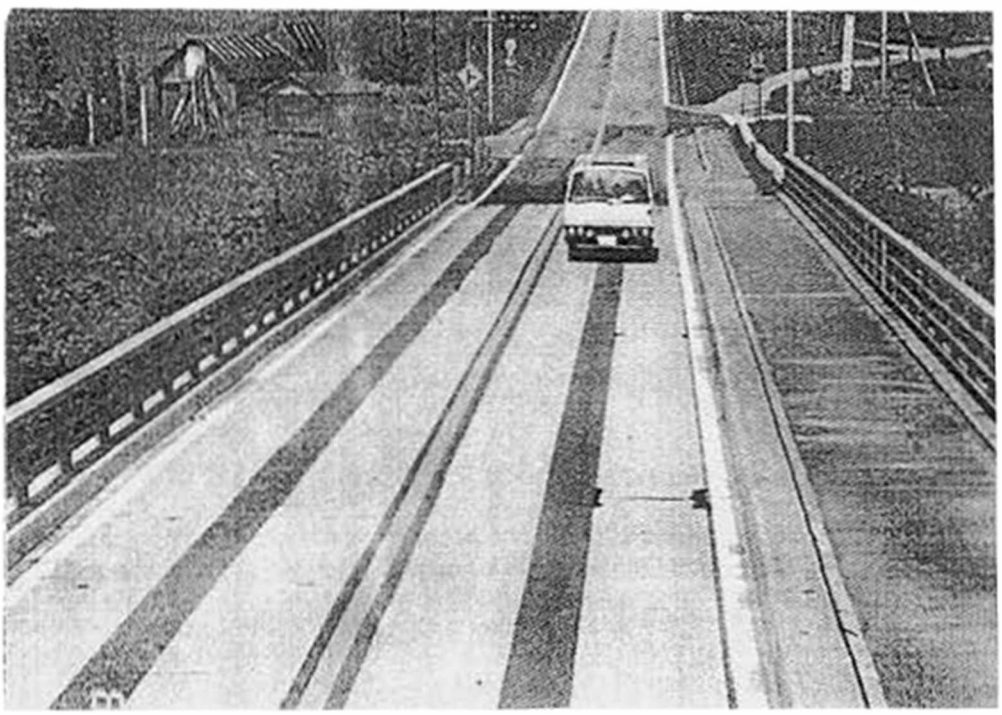
PL.5 Side smoothing



PL.6 Completion in tunnel



PL.7 Completion in underpath



PL.8 Completion on bridge