Zeitschrift: IABSE structures = Constructions AIPC = IVBH Bauwerke
Band: 3 (1979)
Heft: C-8: The structures of new railway line in Japan

Artikel: Track structures
Autor: Structure Design Office, Japanese National Railways
DOI: https://doi.org/10.5169/seals-15801

9. Track Structures

The slab type tracks are used extensively in the Tohoku Shinkansen and the Joetsu Shinkansen. Formerly there were some difficulties in application of the slab type track to turnouts and expansion rail joints, but now they have been improved successfully. The outline of these track structures will be explained here.

Slab Type Track

The slab type track has been developed to mitigate track deterioration caused by frequent and high-speed train operation and consequently to reduce the works for track maintenance (see Photo 1 and Fig. 1).

In the construction of the Sanyo Shinkansen, this kind of track was adopted over 544 km in total length and has proved to be successful. As a major part of the Tohoku and the Joetsu Shinkansens passes through cold and frozen regions, the effect of freezing and melting of water on the track materials has been taken into consideration in particular, and the following measures have been taken.

The concrete slabs on which rails are laid are so designed that the crack width may be limited to less than 0.1 mm under a 25.5 ton design load in order to minimize their damage due to freezing of water in the cracks.

For reasons of economy, this kind of slab is to be constructed by the so-called "unbound prestressing bar method".

Resistance of cement-asphalt mortar to freezing and melting action is increased by improvement of asphalt emulsion and by adjustment of entrained air content.

Turnouts for Slab Type Track

Ballast type tracks in the existing Shinkansen line are mostly provided with No. 18 simple turnouts, 71.3 m long, with sleepers of maximum length of 4.8 m. Because replacement of this type of turnout is time-consuming, it has been decided to adopt instead for the new Shinkansen lines a turnout for slab type tracks so as to reduce the time required for maintenance. This kind of turnout has the following characteristics (see Photo 2).

Slabs are made of prestressed reinforced concrete, and for ease of transportation on roads, are neither longer than 6 m nor wider than 2.3 m. Resin 25 mm thick is grouted between the slab and the surface of viaduct or bridge for reduction of the vibration transmitted to the superstructure. In order to transmit the shearing force without fail from the track slab to the superstructure, indentations are formed on the underside of the track slabs and the surface of the superstructures.

The packing material which is inserted under the rails for adjustment of rail level is a kind of polyester resin, which presents plasticity when heated by electricity and possesses sufficient resistance to the shock caused by the train passing the turnout.

The main part of the turnout is almost the same as that for the existing ballast type track.

Expansion Rail Joints for Slab Type Track

Expansion rail joints composed of tapered rails are used for the slab type track (see Photo 3), too, in the section of continuous welded rail track. This type of joint has given excellent reliability since its application to the tracks of the Tokaido Shinkansen, opened 15 years ago. Those used for the Tohoku and Joetsu Shinkansens have the following characteristics;

The total length of the joint is designed to be 18.75 m, because of the length of the regular track slabs. The stroke of movement is as much as $\pm$ 200 mm, which is comparable to that for the ballast type track and, consequently, the expansion joints can be used for the ballast type tracks in common.

The concrete block for the track slab, on which the expansion joint is installed, is 5 m long and 2.34 m wide. The width is the same as that of the slab for ordinary continuous welded rail track.

25 mm-thick rubber mats are laid under the slab in order to reduce the transmission of the vibration to the viaduct or the bridge. Also, cement-asphalt mortar is grouted between the slab and the superstructure for adjustment of track level.

Ballast Type Track

In regions of weak ground, where differential subsidence of structures is anticipated, ballast type tracks are adopted. The track structure thereof is almost the same as that of the Sanyo Shinkansen (see Photo 4); i.e. 60 kg/m rails and 3-H type prestressed concrete sleepers are used and 25 mm-thick rubber mats are laid under 200 mm-thick ballast on viaducts or bridges.

Others

Fig. 2 and Photo 5 show other types of track which have been recently developed and tested.

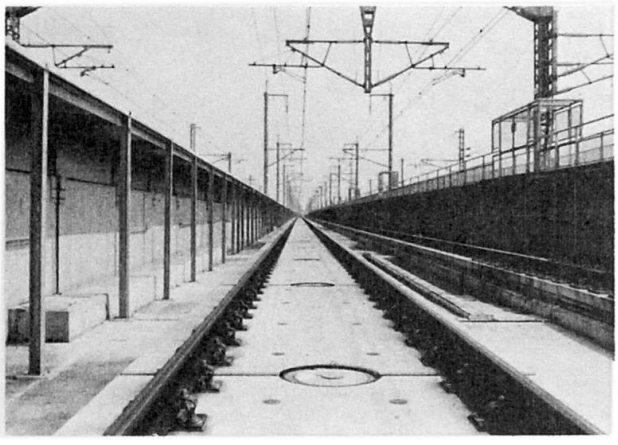


Photo 1 Slab type track

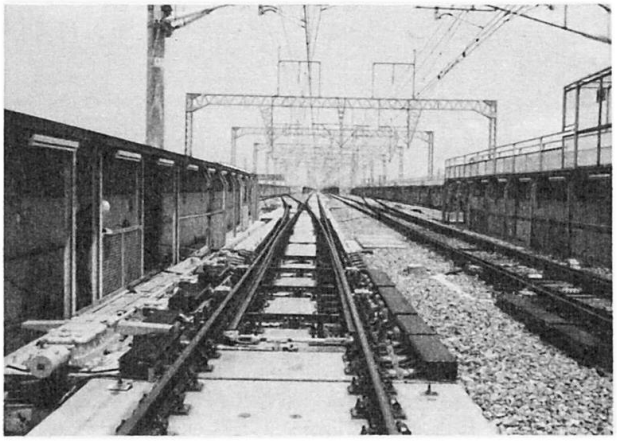


Photo 2 Turnout for slab type track

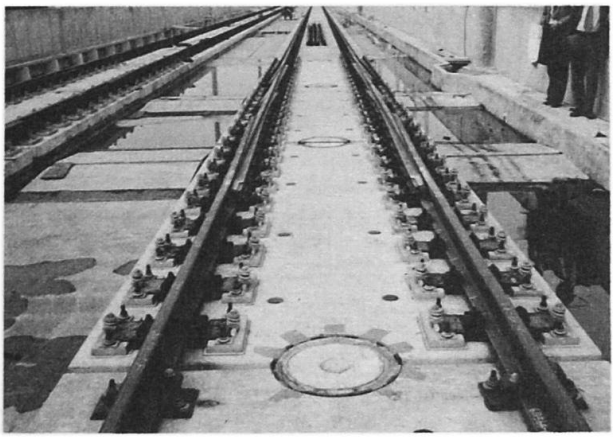


Photo 3 Expansion rail joint for slab type track

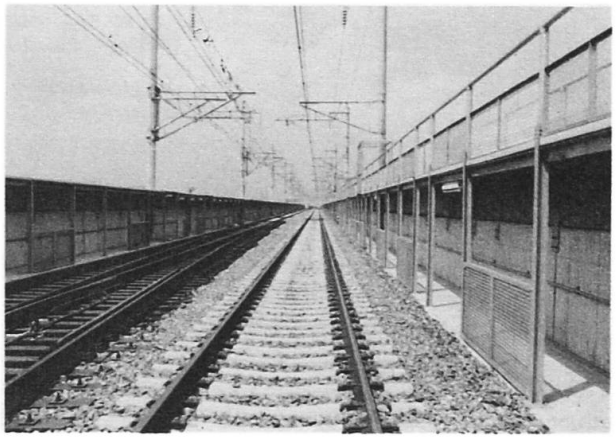
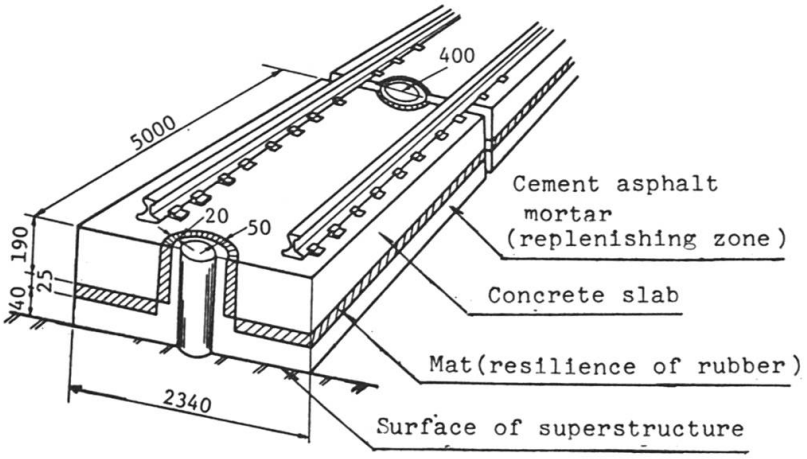
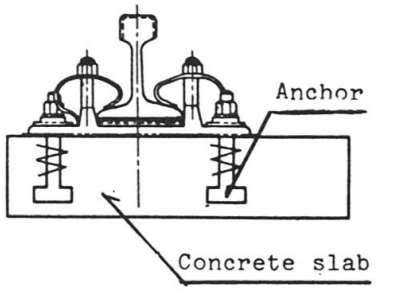


Photo 4 Ballast type track





Details of rail fastening

Fig. 1 Slab track structure

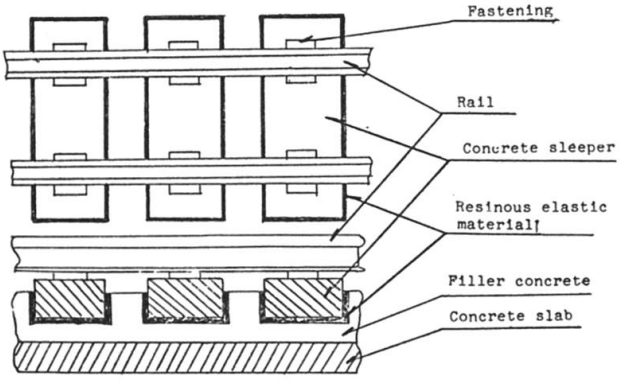


Fig. 2 Track on concrete ties coated with elastic material and embedded in concrete

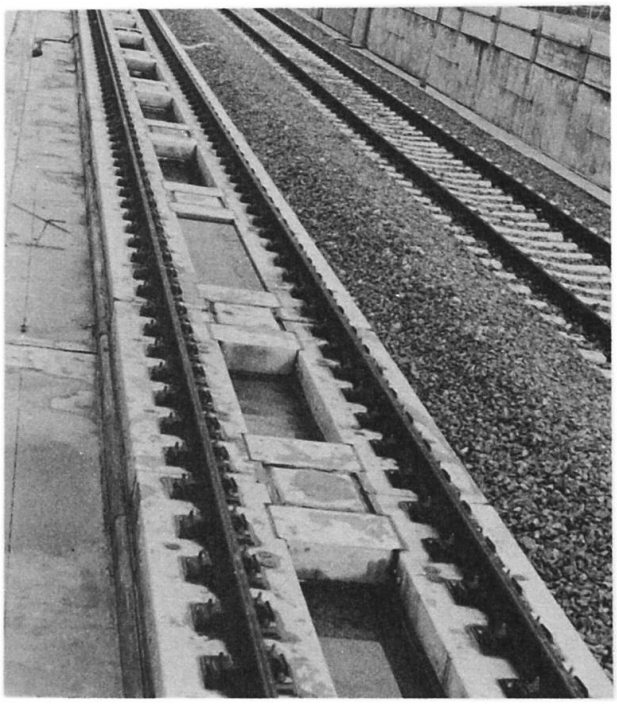


Photo 5 Anti-vibration slab track with precast concrete frames