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4. Concrete Viaducts

General

In order to avoid level crossings with highways for the purpose of securing a higher safety of the super-high-speed train operation, concrete viaducts have been extensively used. Although there has been a great variety in the types of viaducts, an outline of the two typical types which are applied to the recent Shinkansens will be introduced here.

Viaducts of rigid frame type

Viaducts of rigid frame type are typical concrete structures for elevating tracks in the Shinkansen. The design of the structures applied to the ballast-type tracks needs modification for the slab-type tracks (see Fig. 1), because a permissible relative displacement between adjacent structures for stability of trains running at a high speed is smaller in the latter than the former.

In the case of the ballast-type tracks, the influence of the relative displacement of adjoining structures on the alignment of rails is abated mainly in the ballast layer (see Fig. 2).

The following two types of viaducts were developed for the slab-type tracks. One is a structure in which simply supported T-shaped girders are provided between the adjacent viaducts as shown in Fig. 3 in order to reduce the influence of the relative displacement due to rotation and subsidence of the viaducts' foundations. The other is a structure in which the end columns of the two adjoining viaducts stand on one footing in common as shown in Fig. 4. In this structure the relative displacement is quite small because it is caused only by the transverse flexibility of the structure above the footing.

Viaducts composed of simply supported girders

Viaducts composed of simply supported girders were adopted in many locations, especially in urban areas, because they are of a structural type of low noise and low ground vibration and in addition can be easily constructed by utilizing the so-called "Travelling Form Method" (see Fig. 5).

The equipments for the travelling form method were so designed as to satisfy the following conditions; light-weight, easy handling, optimum economy, easy adjustment of camber and also a high degree of safety considering the construction over and near the railways and highways in service.

Although there are many kinds of travelling form methods, the one which the J.N.R. has developed is illustrated in Fig. 6. The bridge is of a 2-cell-box-type structure supporting a double track and it has a constant web depth for the purpose of higher constructional efficiency. The bridge lengths are 20, 21, 22, 23, 24, 25 and 26 meters for reinforced concrete structures and 28, 30, 31, 33, 34 and 35 meters for prestressed concrete structures. The intermediate cross-beams are eliminated and the holes in the end diaphragms are opened as large as possible to make it easy to pull out the inside forms. The average constructional period of each span is 14 days.

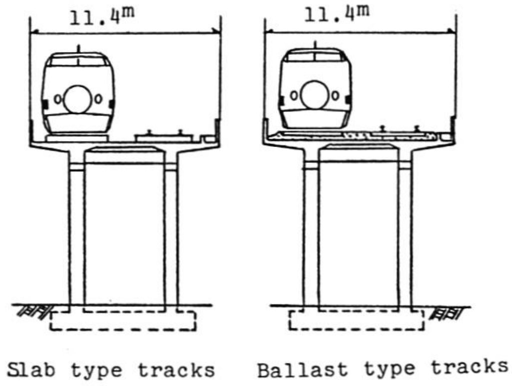

Fig. 1 Cross section of viaducts

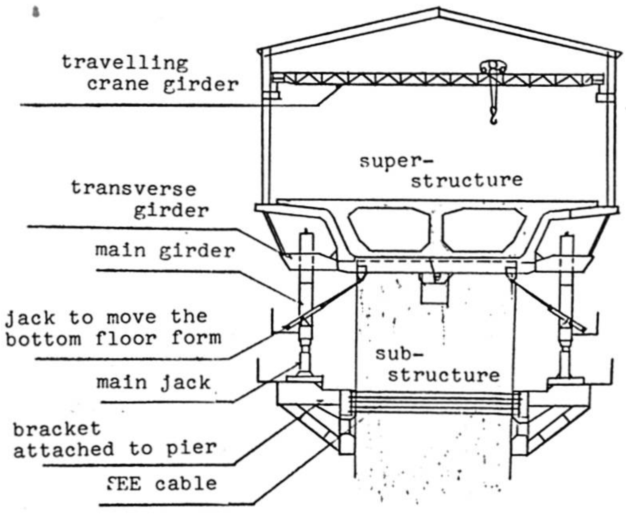

Fig. 6 J.N.R. - type travelling form

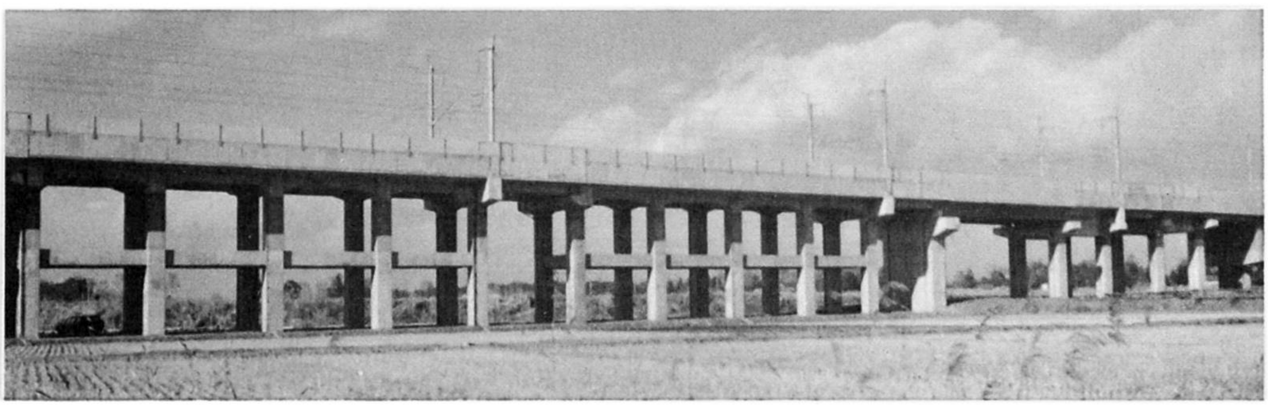

Photo 1 Concrete viaducts

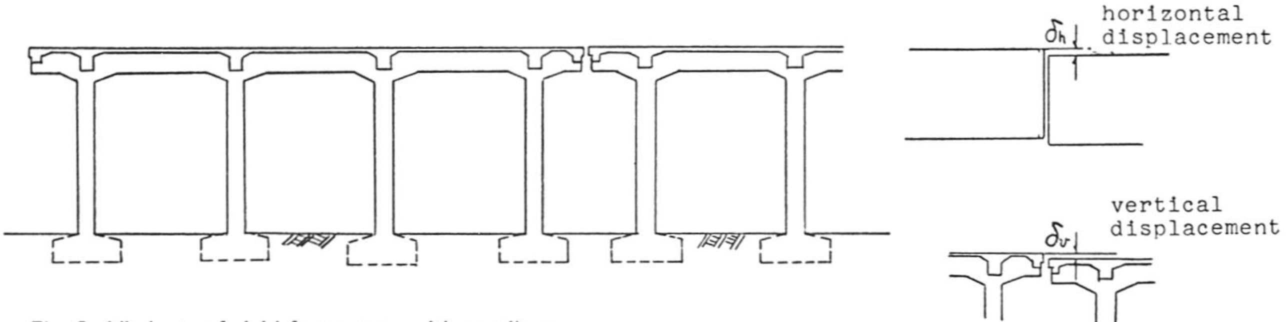

Fig. 2 Viaducts of rigid frame type with cantilevers

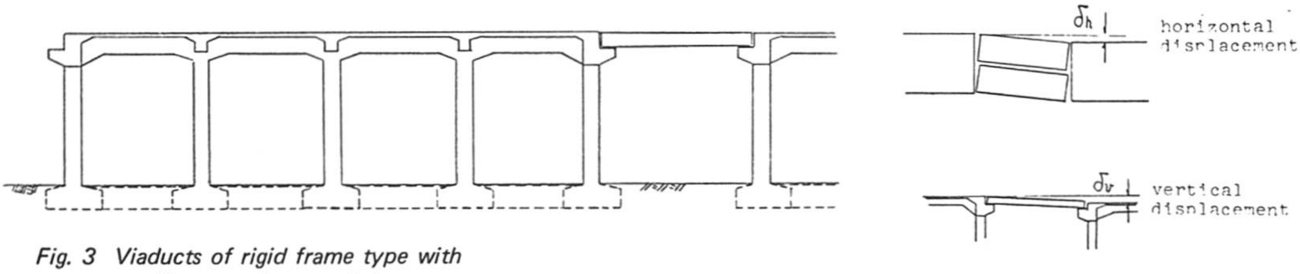

Fig. 3 Viaducts of rigid frame type with cantilevers and suspended spans

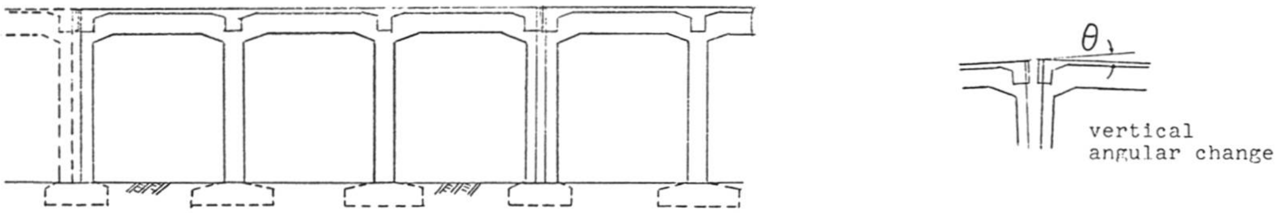

Fig. 4 Viaducts of rigid frame type with adjacent end columns on a common footing

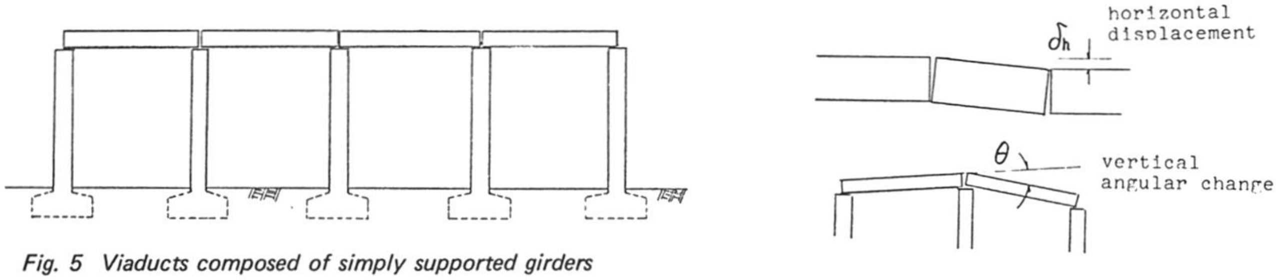

Fig. 5 Viaducts composed of simply supported girders

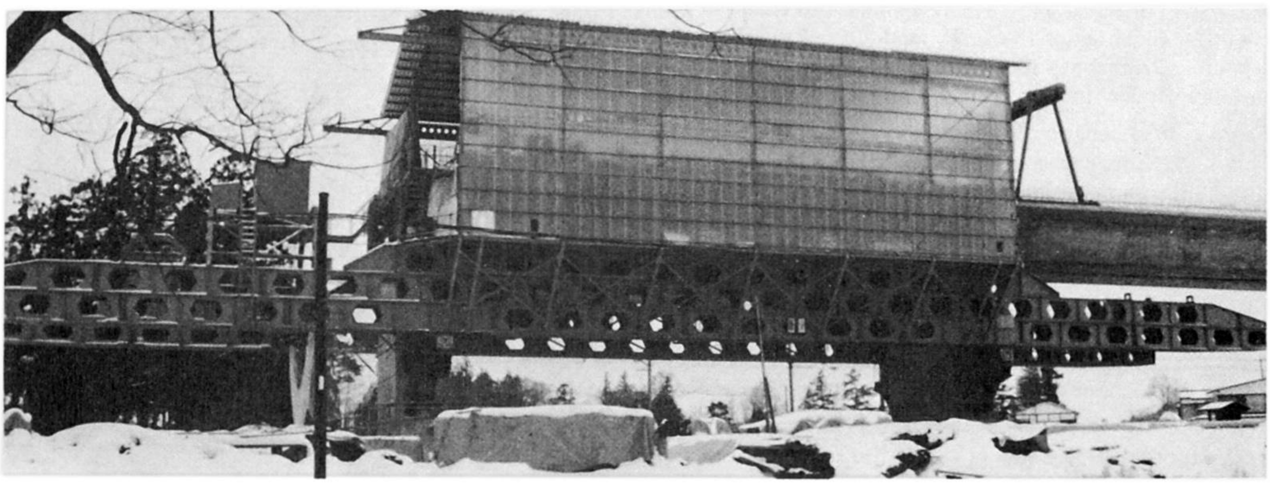

Photo 2 J.N.R. - type travelling form