Use of Continuous Welded Rail (CWR) Track with Turnouts

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CWR tracks are effective in reducing noise, vibrations and related problems. They also reduce the amount of track maintenance and greatly improve ride quality. To promote their more widespread use, technical advances are needed to permit the installation of CWR track even in bridges, turnouts, and other infrastructure where CWR track cannot generally be laid yet.

Research has clearly identified conditions for laying CWR track for a single turnout on ballasted track. The JR group and other railway companies already have many experiences in laying CWR track for turnouts on ballasted track, however only for the case where one turnout exists in the track section. On ballasted track sections with two or more successive turnouts, CWR tracks have been very seldom to be laid for the turnouts, because no reliable analytical method has been established yet.

We therefore have established a finite element model for evaluating the CWR force at track sections with successive turnouts, and proposed a new method of analysis based on the model. This method can calculate the temperature-dependent axial force and the amount of expansion and contraction of each CWR, corresponding to turnout type, turnout location, and track conditions, including rail type and ballast resistance. The method can be also applied to even the case of multiple turnouts laid in a large yard or depot. From the estimated results of CWR force, it is possible to calculate the required lateral resistance of ballast, and to examine other requirements for laying CWR track on the sections with successive turnouts. We confirmed the validity of our analysis method by carrying out field measurement tests at CWR on ballasted track with two successive turnouts (see Figs. 1 and 2).

Fig. 3 shows a turnout whose sleepers are fixed directly to the roadbed concrete. The sleepers are bolted to the roadbed concrete, and the rails are rigidly fixed to the sleepers using washers. Since the rail creepage resistance at a rail fastening is larger than that on a slab track, longitudinal resistance characteristics in the turnout section must be examined if CWR track are to be laid for turnouts fixed directly to the roadbed concrete on a viaduct. In order to identify the CWR force characteristics at turnouts on direct fixation track laid on a viaduct, we developed a program to analyze the CWR force in relation to the expansion and contraction of viaduct girders due to temperature changes. An analysis made with this program showed that when a turnout was laid near the girder end, the maximum CWR force often exceeded the critical value (980kN) for the longitudinal load on the CWR specified in the design standards for the railway structures (see Fig. 4). Further analyses clarified the relationship between girder length, bearing layout and CWR force, making it possible to identify the conditions for installing turnouts on direct fixation CWR track sections.

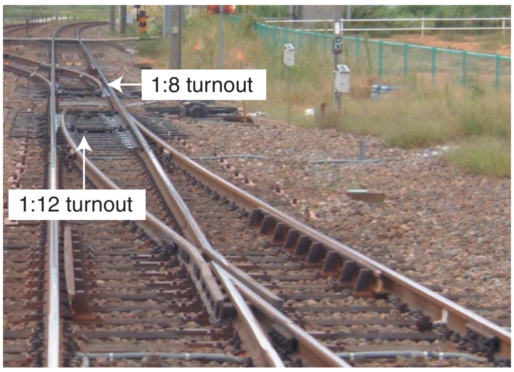

Figure 1. CWR laid with two turnouts in succession

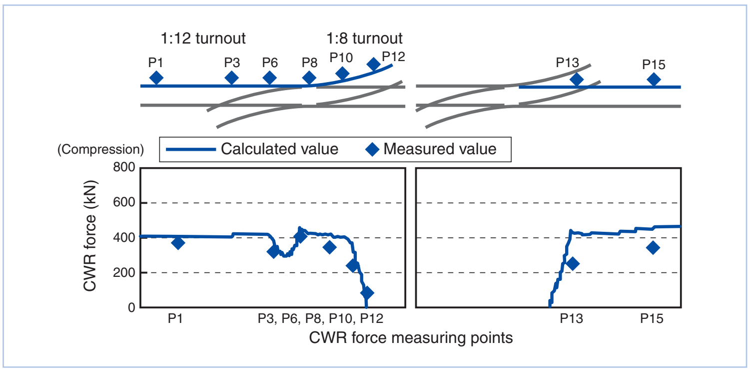

Figure 2. CWR force distribution

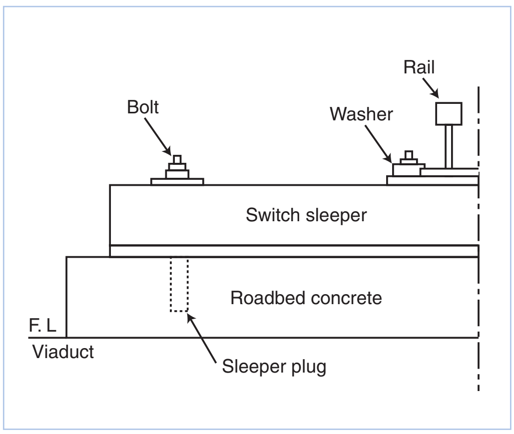

Figure 3. Direct fixation structure of turnouts

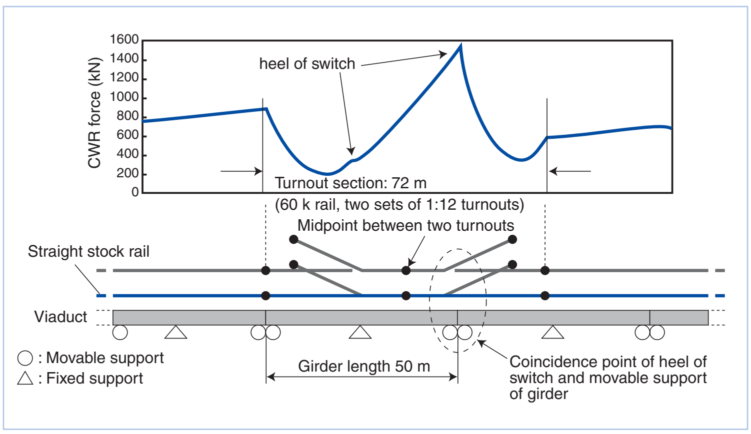

Figure 4. Sample analysis of CWR forces in CWR track with successive turnouts on viaduct