3. Cases of the accident investigations (train derailment accident/level crossing accident)

This Chapter presents the train derailment accident caused by "track" and the level crossing accident at the class 3 and class 4 level crossings which provide us with reference to accident prevention measures by the local railway operators as the characteristic accident category of the local railways revealed in Chapter 2.

(1) Train derailment accident (caused by track)

Here, a case where the measures have been taken in line with the opinion issued by the JTSB such as the partial replacement to PC sleepers and the revision of maintenance standard values is presented (Table 2: Case 2).

Case (train derailment accident: gauge widening) Occurred at about 18:52 on April 14, 2019

Train derailed by the rail tilting, etc., due to the continuous defects of the sleepers and rail fastening devices

Outline: While the one-man operated inbound train, composed of two vehicles, was passing through the 160 m radius left curved track between A station and B station at the velocity of about 30 km/h, the driver of the train noticed a shock and applied the emergency brake to stop the train. After the train stopped, the driver checked the situation and found that the 1st axle in the front bogie of the forefront vehicle had been derailed. There were 10 passengers and the driver onboard the train, but no one was injured.

Continuous defects of sleepers	Continuous defects of rail fastening	Maintenance standard values of track
According to the records of the pre-accident sleeper inspection, the number of sleepers with defects is recorded. However, there is no description of the continuous defects.	According to the records of the pre-accident periodic inspection, no defect of rail fastening devices was found. In the post-accident investigation, the continuous defects of rail fastening devices caused by sleepers with defects were found.	The maintenance standard values specified by the railway operator are larger than the proper values of track irregularities and leave a decreased margin against derailment to inside gauge.
In the sleeper inspection conducted by the railway operator, the number of sleepers with defects is recorded by 100 m. Therefore, the existence of continuous defects could not be identified.	The number of spikes hammered in one tie plate in the curve where the accident occurred is fewer than the general standard. Spikes fastening tie plates are not usually hammered completely.	According to the pre-accident track irregularity inspection, almost no standards were exceeded. However, many standards are exceeded if the proper maintenance standard values are applied.
Dynamic gauge widened large due to rail tilting, etc., by the continuous defects of the sleepers and rail fastening devices.		The static irregularity such as the rail tilting occurred, with that the maintenance standard value for the irregularity of gauge was larger than the appropriate value at the point where the derailment started.
Train derailed due to gauge widening		

Figure 8: Analysis of the cause of the accident (only the track-related part)

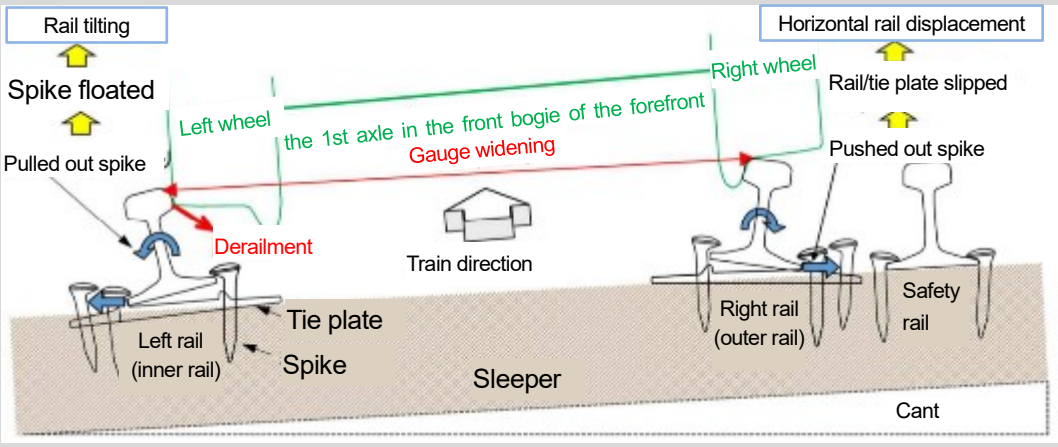
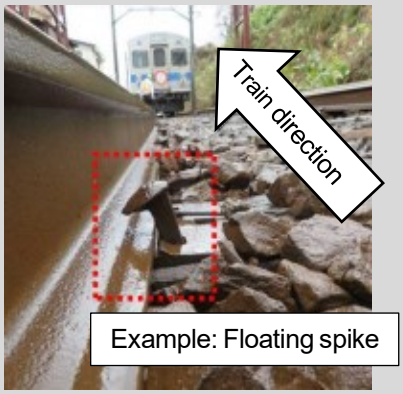


Figure 9: Image of derailment inside gauge of this accident



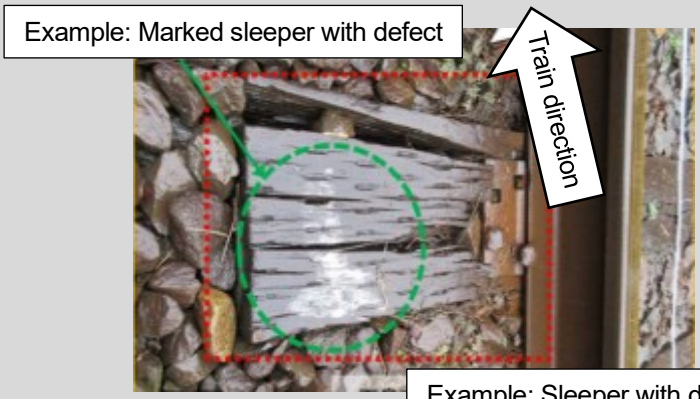


Figure 10: Traces of derailment at the accident

Probable causes:

It is probable that the concerned accident was caused as that the left wheel of the 1st axle in the front bogie of the forefront vehicle fell to inside gauge because the gauge widened significantly while the train was passing through the 160 m radius left curved track. As for the significantly widened gauge, it is probable that the gauge widened dynamically by the rail tilting, etc., due to the lateral force caused by the running train, because of the large static irregularity of gauge and the continuously existed poor sleepers and the poor rail fastening status in the concerned curved track. It is probable that the static irregularity of gauge had been large, related with that the maintenance standard value for the irregularity of gauge was larger than the appropriate value because the slack had not been considered. It is probable that the poor sleepers and the poor rail fastening status had been continuously existed, related with the insufficient repairing works for the sleepers and the rail fastening devices due to the inadequate records and measuring methods in the sleeper inspections. **The insufficient implementation of the measures responding to the opinion for the purpose to prevent the train derailment accident due to the wide gauge, issued by the Japan Transport Safety Board issued on June 28, 2018**.

※The outline of the opinion issued by the Japan Transport Safety Board on June 28, 2018, is presented in Table 1 and is published in the website of the JTSB.
https://www.mlit.go.jp/jtsb/eng-rail_report/English/Railway_opinion20180628_gauge%20widening.pdf

For the prevention of recurrence

Required safety action;

(1) The steady implementation of the track maintenance →**Table 1: 1(i)(ii), 2(i)(ii)**

(2) Change of materials of the sleepers (wooden sleepers → PC sleepers, etc.) → **Table 1: 3(i)**

(3) Study on the reduction of the slack → **Table 1: 2(iv)**

Measures taken by the railway operator after the accident (Excerpt):

(1) Replace to PC sleepers in the steep curves

The aged wooden sleepers were replaced with the PC sleepers in the accident site. Moreover, the **wooden sleepers were replaced with the PC sleepers in a way that the ratio of PC sleepers becomes 1 out of 3 sleepers** in the steep curves whose radius is less than 250 m. In cases where it is difficult to install PC sleepers, a plan to install gauge ties was formulated. It should be noted that, until this work completes, the gauge is measured and the rail fastening devices are inspected once every three months.

(2) Improve the management method of sleepers

As for the management and inspections of sleepers, **the sleeper management ledger was modified to be able to identify the continuity of defective places** by managing sleepers one by one and clarifying the judgment of ranks of the sleeper conditions.

(3) Review the maintenance standard value

The maintenance standard value of gauge irregularities was modified to a proper value corresponding to the slack, and **the deadline of maintenance was specified when exceeded the maintenance standard value**.

(4) Improve the rail fastening method

Although spikes tightening tie plates were not hammered completed in the past, this custom was modified to properly hammer spikes in a way that they are in close contact with tie plate.

The investigation report and materials of this case are published in the website of the JTSB, published on February 27, 2020.
https://www.mlit.go.jp/jtsb/railway/rep-acci/RA2020-1-3.pdf (Report)
https://www.mlit.go.jp/jtsb/railway/p-pdf/RA2020-1-3-p.pdf (Materials)

Chapter 4 presents some examples of the technical support by each corporation and the national subsidy system. This information can be used as reference to the "partial replacement to PC sleepers" or "priority-based installation".

(2) Level crossing accidents at the class 3 and class 4 level crossings

To eliminate accidents at the class 3 and class 4 level crossings, it is desirable to abolish them or convert them into class one level crossings. In the following case, the railway operator, the municipality, and the local ward mayor found an alternative by repeatedly having discussions, and the level crossing was abolished in the end. Please use this information for measures to prevent level crossing accidents.

Case (level crossing accident, abolished after the accident) About 17:51, June 16, 2018

The level crossing was abolished by widening another farm road to reduce the effect of abolition on the living conditions

Outline: While the outbound Local train was running between A station and B station at a velocity of about 84 km/h, the driver of the train noticed an automobile entering C level crossing (class 4 level crossings), then the driver of the train applied an emergency brake and sounded a whistle, but the train collided with the automobile. The driver of the automobile was dead in the accident.

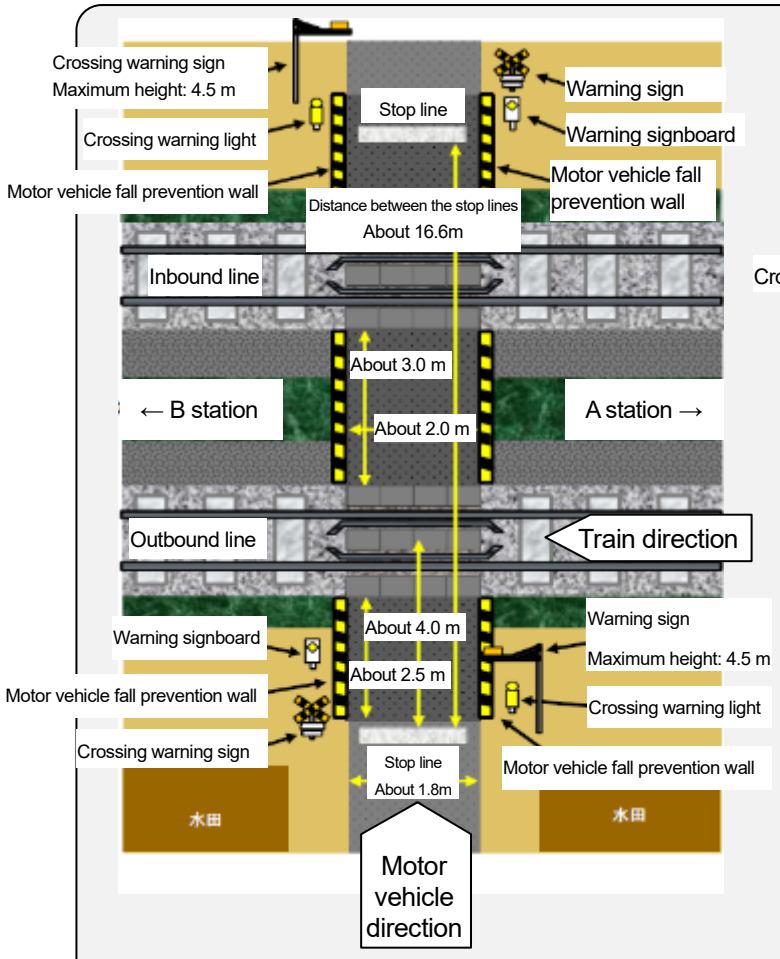


Figure 11: The level crossing where the accident occurred

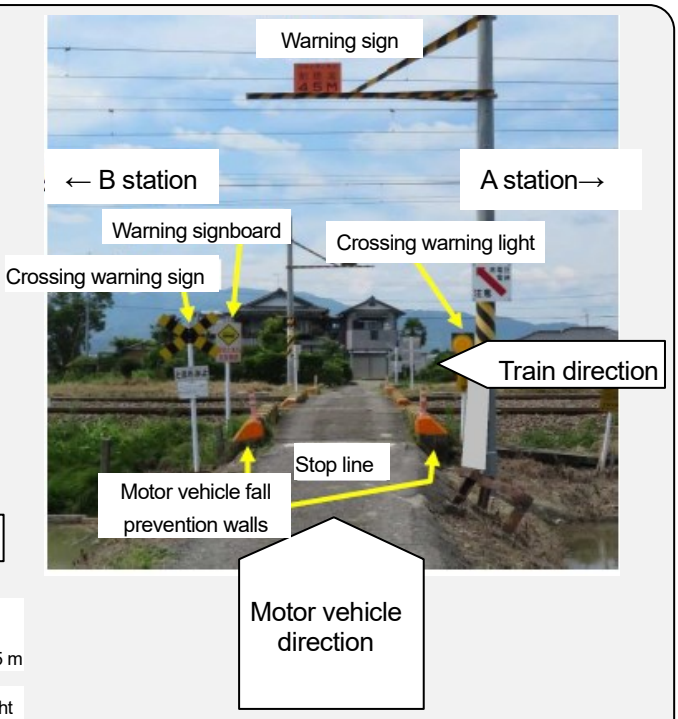


Figure 12: The situation of the level crossing (from the side where the motor vehicle approached)

Probable causes: It is highly probable that the accident occurred as the train collided with the automobile because the automobile entered the C level crossing (class 4 level crossings), class 4 level crossings without automatic barrier machine nor road warning device, in the situation that the train was approaching.

It could not be determined why the automobile entered the level crossing in the situation that the train was approaching, because the driver of the automobile was dead in the accident.

Safety Actions (measures to prevent accidents)

Expected measures to prevent the recurrence:

The class 4 level crossing, that is not equipped with the automatic barrier machine nor the road warning device, should be abolished or should be equipped with the level crossing protection device. Four accidents, including the concerned accident, had occurred since 1997 at this level crossing, where the passing trains have been operated in high speed in heavy railway traffic, and the crossing road was long as located in the double track section. Therefore, the relevant persons such as the railway operators, the road administrators, the regional inhabitants, etc., are required to discuss on the abolishment or the preparation of the level crossing protection devices, decide the policy as fast as possible, and promote the concrete measures, considering that the concerned level crossing is highly dangerous.

It is considered that the abolishment or the preparation of the level crossing protection devices should be implemented for the other class 4 level crossings having the similar dangerous factors as in this level crossing, such as high speed of the passing trains, heavy railway traffic, long level crossing road, etc. Therefore, it is necessary for the relevant persons such as the railway operators, the road administrators, the regional inhabitants, etc., to implement discussions toward the measures, decide the policy as fast as possible, and promote the concrete measures.

The measures taken by the railway operator:

After the accident occurred, **the railway operator, the municipality, and the neighborhood association of local residents discussed an agenda of the "abolition of C level crossing in B station, D line**". They decided to prohibit the passing of motor vehicles as an emergency measure to prevent level crossing accidents, and on September 18, 2018, a signboard of "No Through Road" was placed at the level crossing. Moreover, on September 28, 2018, poles were installed on the road leading to the concerned level crossing.

The relevant parties **decided to continue discussions** on the abolishment of the concerned level crossing (as of the time when the accident investigation report was published).

Background of the subsequent abolishment of the concerned level crossing

When the railway operator requested the municipality to abolish the concerned level crossing in the past, the municipality did not accept it taking into account a significant effect on living conditions of the local residents. However, the railway operator, the municipality, and the local ward mayor had repeated discussions after the concerned accident. As a result, it was found out that some local residents made a request to widen a farm road to the north of the concerned level crossing as an alternative to the travel to the south due to the abolishment of the concerned level crossing because the farm road (blue line in Figure 13) to the north of the concerned level crossing is narrow and residents to the north of the concerned level crossing and visitors to the nursery school had a trouble in passing the road due to vehicles for agricultural work parked on the road in a busy farming season.

After having about 50 discussions (including bilateral discussions between the railway operator, the municipality, and the local ward mayor), the relevant parties agreed to abolish the concerned level crossing, because it was possible to gain an understanding of the local residents under the condition that the concerned farm road will be widened in a way that motor vehicles can pass each other. This is a positive case where **the local ward mayor took the initiative to hear opinions from the local residents, while the railway operator and the municipality understood those opinions and examined a solution to the abolition.**

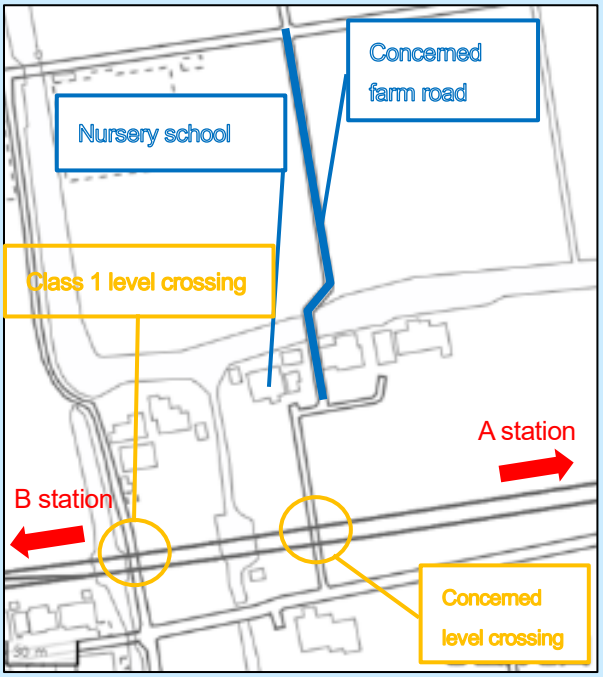


Figure 13: Schematic drawing of the area around the accident site and the concerned level crossing
※Created by the JTSB based on GSI Map Vector (Geospatial Information Authority of Japan)

The investigation report and materials of this case is published in the website of the JTSB, published on April 25, 2019.
https://www.mlit.go.jp/jtsb/eng-rail_report/English/RA2019-3-2e.pdf (Report)
https://www.mlit.go.jp/jtsb/railway/p-pdf/RA2019-3-2-p.pdf (Materials) (Only available in Japanese)