～Introduction and analysis of accident investigation ～

JTSB Digests

JTSB (Japan Transport Safety Board) DIGESTS

No. 43 (Issued in September 2023)

Digests of the Analyses of Railway Accidents

Accident Prevention Measures in Local Railways

1. Introduction

Local railways refer generally to railway and tramway other than the Shinkansen lines, conventional arterial lines, and urban railways.

Local railways are essential means of transportation for the local residents for commuting, hospital visits, etc. and play an important role as a local infrastructure for tourism promotion and economic activities. On the other hand, since the number of passengers has decreased excessively due to the aging population and declining birthrate and depopulation in rural areas as well as the spread of automobiles, most of railway operators face severe business conditions. Severe business conditions may lead into the deterioration of vehicles and facilities. Therefore, how safety measures are taken to prevent accidents efficiently and effectively is important.

The former Aircraft and Railway Accidents Investigation Commission and the Japan Transport Safety Board (JTSB) investigated 371 railway accidents. (Excluding the tramways such as street cars) occurred between October 2001 ~ March 2023 and published accident investigation reports. Out of 371 accidents, a total of 99 accidents and serious incidents occurred in local railways. Various types of accidents are included therein such as the derailment accidents caused by insufficient safety measures, the level crossing accidents at the class 3 and class 4 level crossings, and the derailment accidents caused by natural disaster, etc. This digest analyzes the status of the accidents in the local railways and presents necessary safety measures for the purpose of contributing to the prevention of accidents in the local railways. We hope that this digest will be utilized by all relevant in the local railway business.



Photos: South Hokkaido Railway Company (left)/Wakasa Railway Company (Center and Right)

2. Status of occurrence of accidents and necessary safety measures

This Chapter presents the accidents in the local railways and the points to be referred to for safety measures to prevent the similar accidents.

As described above, a total of 99 local railway accidents and serious incidents occurred. They were investigated by the former Aircraft and Railway Accidents Investigation Commission and the Japan Transport Safety Board (JTSB) between October 2001 ~ March 2023 and accident investigation reports were published. This means that 1 ~ 8 accidents have occurred annually (average: 4.5) (See Figure 1).

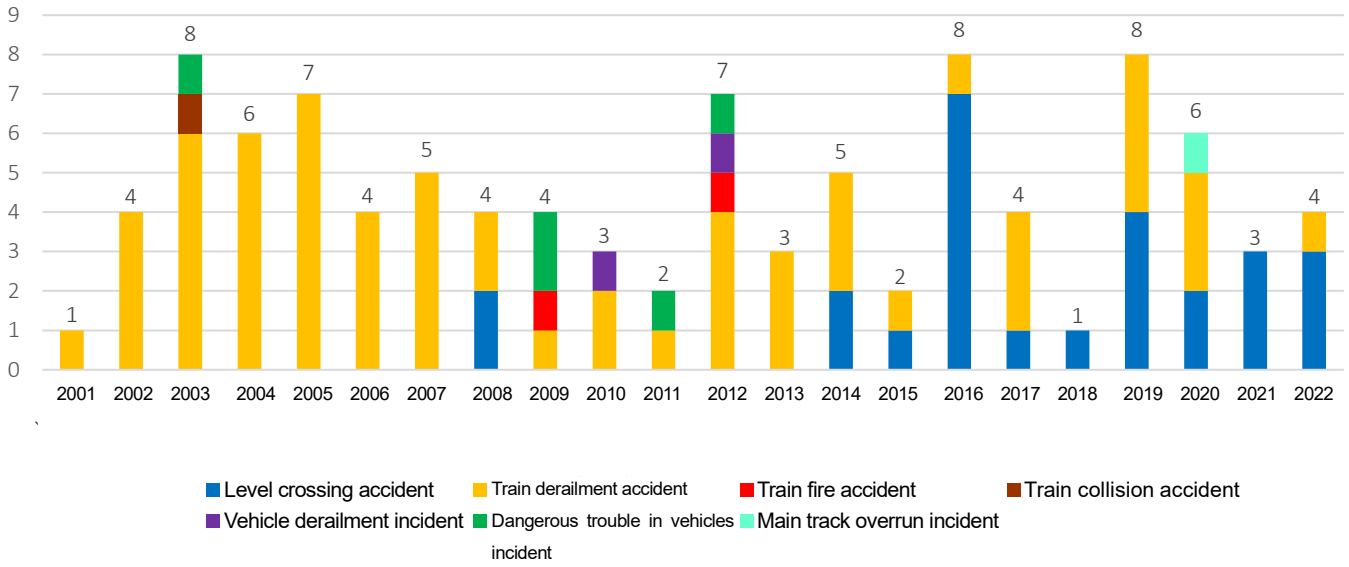


Figure 1: Number of occurred accidents, etc. in the local railways

It seems that the number of level crossing accidents has increased since 2014. This is because fatal accidents occurred at the level crossings where crossing gates are not installed (class 3 level crossings) and the level crossing where crossing gates and road warning devices are not installed (class 4 level crossings) were newly added to the target of investigation in April 2014.

Status of accidents occurred

When we categorize 99 accidents by category (Figure 2), the most common cause is train derailment, accounting for about 63% of all accidents, followed by level crossing accident (approximately 26%). Since these two accident categories account for about 90% of all accidents, we can say that they are the principal accident categories in local railways. Therefore, we analyze more detail thereon.

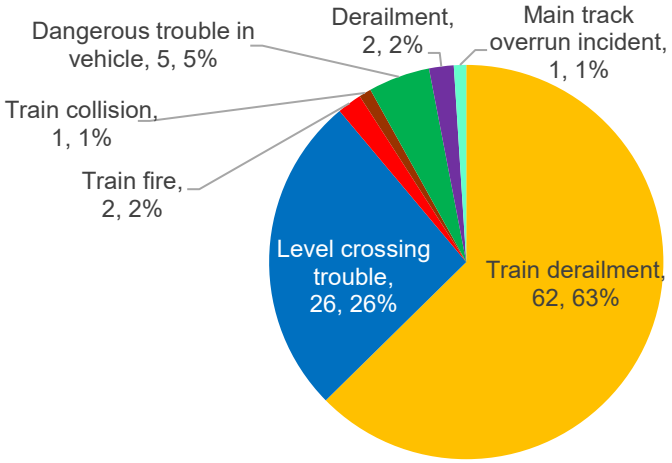


Figure 2: Classification of accidents, etc. in the local railways by category

Train derailment accident

If we look at the breakdown of factors of 62 train derailment accidents (Figure 3), **the most common factor in the local railways is "Track: Maintained status of ground facilities such as the track" and accounts for about 43%. For a reference**, if we look at the breakdown of 147 "train derailment accidents" of the JR lines and major private railway companies other than the local railway companies (Figure 4), "Track: Maintained status of ground facilities such as the track" only accounts for about 7%. We can notice a different tendency.

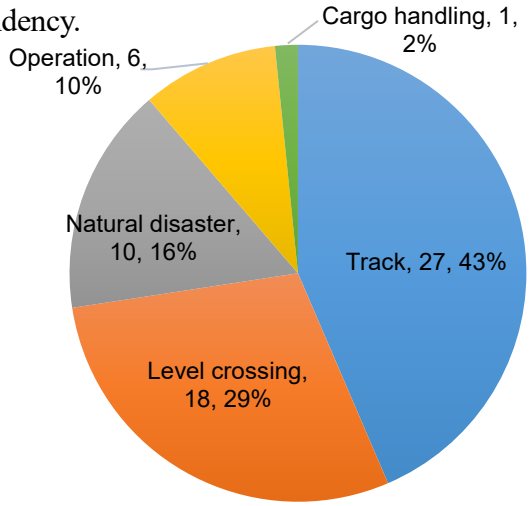


Figure 3: Classification of the factors of train derailment accidents in the local railways

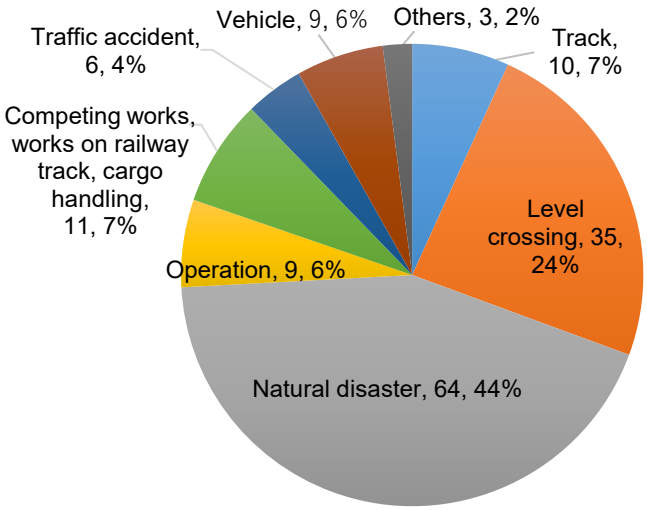


Figure 4: Classification of the factors of train derailment accidents other than the local railways

Then, if we pay attention to the yearly number of accidents caused by "Track", "Level crossing such as the collision with automobile which had entered the level crossing", "Natural disaster such as the vehicle ran over the earth and sand", and "Operations: handling operation" (Figure 5), the 5-year moving average graph shows that it has decreased other than "track". Although the number of accidents caused by "track" has been decreasing, **the tendency remains almost the same. In the past 10 years, nearly 80% of the train derailment accidents in the local railways is caused by "track".**

※The number of accidents of 2021 and 2022 does not include the accidents under investigation as of April 1, 2023. Moreover, the year 2001 is excluded, because the period for obtaining statistics did not reach 1 year.

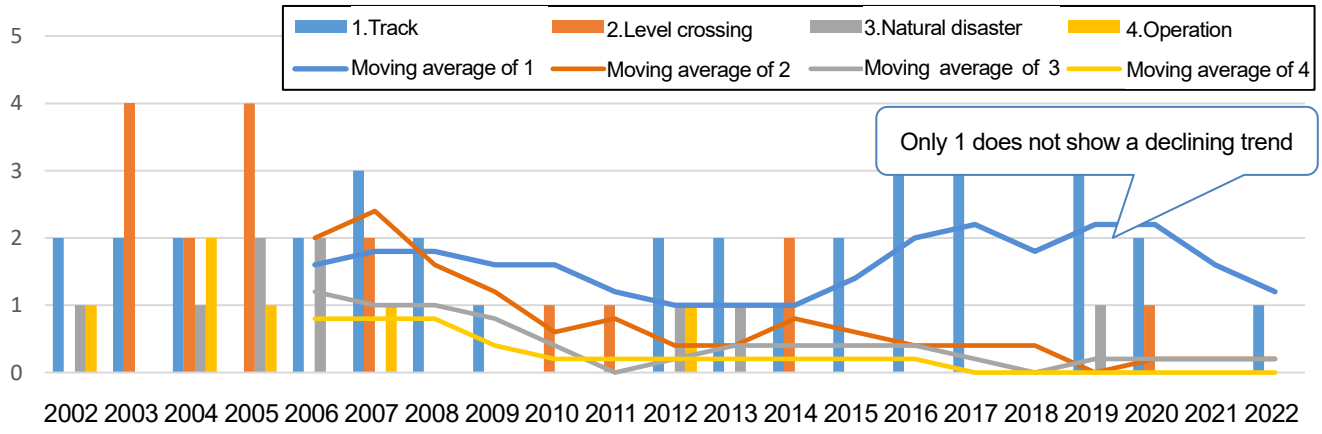


Figure 5: Number of train derailment accidents in the local railways by cause (the line graph is 5-year moving average)

Based on the above data, we have found out that the train derailment accidents in the local railways have the following characteristics.

- **The number of accidents caused by "track" is larger compared to other railway operators.**
- **The number of accidents caused by "track" does not show a declining tendency and remains the principal cause of recent train derailment accidents.**

As for the train derailments caused by "track", on June 28, 2018, the JTSB stated its "opinion to prevent the train derailment accident caused by the gauge widening" (hereinafter referred to as "the opinion"). Moreover, the JTSB Digests No. 28[1] (hereinafter the "Digests No. 28") points out the characteristic that "the number of train derailment accidents caused by track is large in the local railways" and presents some examples of initiatives from which we can draw lessons and of initiatives to prevent accidents. Table 1 describes the outline of content which the JTSB requested to inform the railway operators in the opinion.

Table 1: Outline of the "opinion to prevent the train derailment accident caused by the gauge widening"

1.	On the managing method of the track maintenance
(i)	It is necessary to manage rail fastening devices, etc., properly by the periodic inspections of tracks and the track patrols, and also it is necessary to implement measures to prevent gauge windings. It is necessary to pay attention to the continuity of looseness of rail fastening devices, etc. and to give priority to steep curve with large slack.
(ii)	The measurement of track irregularity measured under loaded condition using track inspection car is the effective method on the measurement of track irregularities. Rail fastening devices, etc. should be managed adequately, when implement the management of track irregularities based on the measurement of track irregularity measured under unloaded condition only.
2.	On the managing standard of track maintenance
(i)	Decide the maintenance standard values of the track irregularity considering the limit of safety
(ii)	Make clear the period of maintenance when the maintenance standard values are exceeded
(iii)	Decide the handling of the operation control and the track maintenance, etc., when the remarkable track irregularity was detected
(iv)	Confirm that the slack in the curved track is arranged to the proper value corresponded to the running vehicles
3.	On the track structure
(i)	It is desirable to implement systematically the replacement to concrete sleepers, etc., considering the places in high priority based on the generated status of defects of sleepers and the track shape, etc.
(ii)	It is desirable to install guard angles or guard rails as possible, when installed the guard rail, etc., in the curved section, and it is also necessary to inspect and check the status of materials and maintenance by the periodic inspections and implement repairing works

Although no accident caused by track occurred in 2018 when the opinion and the digest No. 28[1] were published, **several accidents caused by "track" factor have occurred every year since then**. When we look at the relationship between the content of the opinion and 6 accidents occurred after 2018 (Table 2), we can see that all of them occurred due to insufficient measures in response to the opinion.

[1] The Japan Transport Safety Board Digests Vol.28, For the prevention of derailment accidents, "Points of management of the track maintenance", https://www.mlit.go.jp/jtsb/bunseki-kankoubutu/jtsbdigests_e/jtsbdigests_No28/No28_pdf/jtsbdi-28_all.pdf

Table 2: Comparison table of the causes of accidents occurred after the opinion was issued and the content of the opinion

"×" means that the accident occurred because no measure has been taken in response to the opinion

	1(i)	1 (ii)	2(i)	2(ii)	2(iii)	2(iv)	3(i)	3(ii)	Others
Case 1	×	×	×	×		※2	×	×	Insufficient technical capacity
Case 2	×	×	×	×		※2	×		Insufficient technical capacity
Case 3	×	×					×		Insufficient technical capacity
Case 4	×	×					※3		Insufficient technical capacity + Lack of communication
Case 5	×	×	※1	×					Insufficient technical capacity
Case 6	×	×	×	×		※2		×	Insufficient technical capacity

※1 There is a description in the accident investigation report that "it is desirable to decide the standard values considering the limit of safety by the deadline, because too many reference values are exceeded.

※2 There was no clear flaw, since there is a description in the accident investigation report that "the margin against derailment to inside gauge had been decreased".

※3 An idea of partially replacing to PC sleepers was correct, but priority was not determined based on safety.

In all examples, the accidents were caused by the improper maintenance management method of track. Moreover, in more than half of the examples, the maintenance standard values were not established properly. Since the lack of technical abilities is pointed out in most of the examples, **it is desirable to take the initiative to use the technical support provided by various corporations**.

Furthermore, the replacement to the concrete sleepers, etc. (hereinafter referred to as "PC sleepers, etc.") is recommended. In cases where it is difficult to secure a sufficient budget, the "**partial replacement to PC sleepers**" (one out of several sleepers is replaced to a PC sleeper, etc.) or the "**priority-based installation**" (the construction starts from the places in high priority based on safety such as steep curves) is recommended. The technical support, etc. provided by various corporations can be used to examine the ratio of PC sleepers, etc. in consideration of the conditions such as running vehicles, track shape, etc. and to examine the places in priority in consideration of the danger of derailment to inside gauge due to gauge widening. We expect that this will be translated into the measures to maximize the effect from limited expenses together with the national subsidy system. In Case 5 shown in Table 2, a gauge widening risk was underestimated, because the replacement to PC sleepers completed. As a result, rail fastening devices were not managed and maintained properly. **It is necessary to keep in mind that the proper maintenance management of tracks is required continuously even after PC sleepers are installed**.

Chapter 3 of this digest presents Case 2 shown in Table 2 in which the partial replacement to PC sleepers and the revision of the maintenance standard values were carried out as the post-accident measures. Chapter 4 presents the technical support provided by each corporation, etc. and the national subsidy system available for the "partial replacement to PC sleepers" and "priority-based installation".

Points of train derailment accidents caused by "track"

○ The number of this type of accidents has not decreased in recent years. Many of the derailment accidents in local railway operators were caused by the maintained status of the ground facilities such as the track, etc.

○ It is important to take proper measures based on "the opinion" issued by JTSB in the past.

○ In cases where it is difficult for a local railway operator to take measures by itself for economic or technical reasons, **it is desirable to carry out the "partial replacement to PC sleepers" or "priority-based installation", etc. by making use of the technical support provided by various corporations or the national subsidy system** (the proper maintenance management is required continuously even after the replacement to PC sleepers completes).

It was explained that the number of train derailment accidents caused by "level crossing", "natural disaster", and "operation" has been decreasing other than "track". However, as accidents caused by those factors occur once every few years, it is necessary to continue to take safety measures. Particularly, natural disasters may cause railway accidents, because heavy rains caused by typhoons, etc. have become severer and more frequent and caused the inclination and washout of train bridges across a river in recent years.

The JTSB issued its opinion to the Minister of MLIT in the past in response to a train derailment accident caused by the bridge pier scouring due to river level rises. The opinion is considered to be useful for taking measures for scouring by the local railways. Moreover, the MLIT invited the JR companies to hold the "Review Committee on Measures for JR's River Bridges" in September 2021 to discuss measures to prevent the damages caused by heavy rains. The details are available on the following websites as a reference of disaster prevention measures such as preventive conservation of structures. Chapter 3 includes a column of a railway operator that took the measures using the subsidy.

○ Opinion on Train Derailment Accident of the Nankai Electric Railway Co., Ltd. (Opinion of January 31, 2019)
The opinions, full text, is published in the website of the JTSB,
https://www.mlit.go.jp/jtsb/eng-rail_report/English/Railway_opinion20190131.pdf

○ Review Committee on Measures for JR's River Bridges (Held on September 28, 2021)
The materials distributed at the Review Committee on Measures for JR's River Bridges are published in the website of the MLIT.
https://www.mlit.go.jp/tetudo/content/001425578.pdf (only available in Japanese)

Level crossing accidents at class 3 and class 4 level crossings

The most of "level crossing accidents" investigated by the JTSB are fatal accidents occurred at class 3 and class 4 level crossings. When we look at the number of accidents occurred at the class 3 and class 4 level crossings (Figure 6), the accidents have occurred every year, although the number varies significantly every year. Hence, it is necessary to continue to abolish those level crossings or transform them to class one level crossings (hereinafter "class-one conversion") by installing level-crossing security equipment.

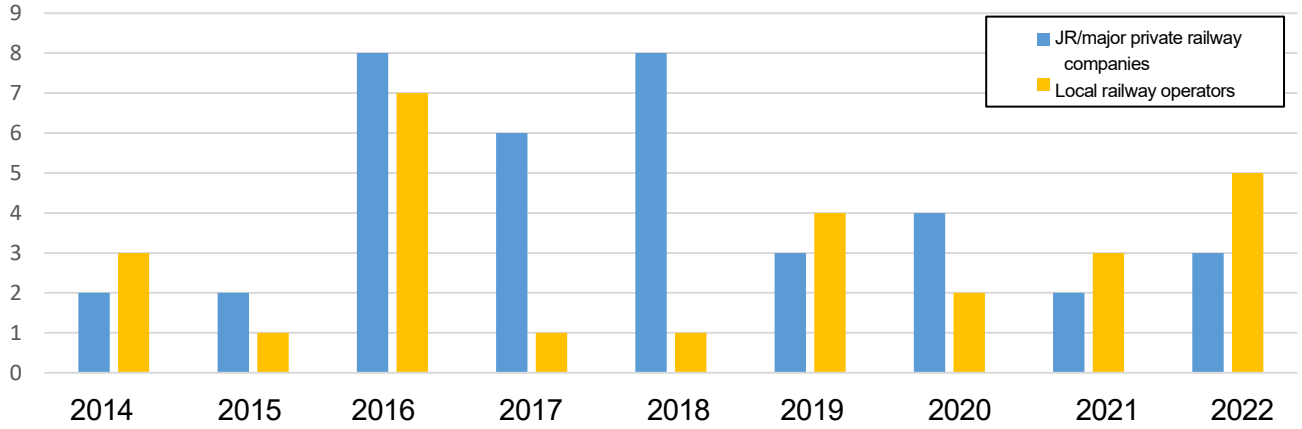


Figure 6: Number of accidents at class 3 and class 4 level

In the local railway operators, the ratio of the class 3 and class 4 level crossings to the total number of level crossings is three times as high as the JR/major private railway companies. (Table 3).

Table 3: Number of level crossings of the JR/major private railway companies and the local railway operators

	Total number of level crossings	Number of the class 3 and class 4 level crossings	Ratio of the class 3 and class 4 level crossings
JR/major private railway companies	25,053	1,685	6.7%
Local railway operators	7,040	1,353	19.2%

※The number of level crossings was obtained from the Railway Bureau of the MLIT: Information on Safety of Railway and Tramway Transport (FY2021)

Moreover, **when we look at the status of the post-accident measures for the class 3 and class 4 level crossings where accidents occurred in the past, about 60% were abolished or converted into class 1 level crossings in the JR and major private railway companies, while only about 36% in the local railway operators** (Table 4).

Table 4: Status of the measures taken for those level crossings where accidents occurred by the JR/major private railway companies and the local railway operators

	Type of measure taken	Number of level crossings where measures have been taken	Ratio (%) of level crossings where measures have been taken	Total number of measures taken	Total (%) of level crossings where measures have been taken
JR/major private railway companies (35 accidents)	Abolishment	10	29%	21	60%
	Class-one conversion	11	31%		
Local railway operators (22 accidents)	Abolishment	3	14%	8	36%
	Class-one conversion	5	23%		

※The statistics were obtained from the reports issued between April 2014 when the JTSB started to investigate the fatal accidents occurred at level crossings where crossing gates are not installed and September 2022 when the follow-up survey on the status of measures taken was conducted.

The number of level crossings converted into class 1 is larger than those abolished both in the JR/major private railway companies and the local railway operators. In many of those cases, they intended to abolish the class 3 and class 4 level crossings, but negotiations with the local governments and the local residents were complicated and changed the policy to the class-one conversion. However, many local railway operators comment that the class-one conversion is difficult for economic reasons. In the cases where the level crossings were converted into class 1, the local governments covered all or part of the construction expenses or the subsidy was used. In some cases, it is difficult to pay their own expenses, because the subsidy does not cover 100%. The class-one conversion has an advantage that it is easier to gain an understanding of the local residents, because the level crossing remains. However, **it is desirable for the local railway operators to aim to "abolish" the class 3 and class 4 level crossings, in principle, from the economic and safety points of view**.

The follow-up survey on the status of post-accident measures reveals that one of the factors of a low rate of post-accident measures in the local railway operators is **the lack of discussions**. The average number of discussions of the local railway operators is fewer than that of the JR and major private railway companies (Table 5). Especially, there is a wide gap in the number of discussions for the cases where post-accident measures have not been taken. **In more than half of the cases where the local residents are against the abolishment, the local railway operators have not set any place for discussion, because they do not find any solution.** Since there are cases where an agreement on the abolition or class-one conversion is reached in the first discussion, the lack of discussions is not necessarily the factor of the low rate of taking measures. However, it is difficult to think that an agreement is reached without discussions in cases where the local residents are against the abolition plan. Therefore, **it is important to repeat discussions** for the purpose of finding an alternative to convince them. Moreover, keeping a record of discussions is also effective.

Table 5: Average number of discussions after the accidents by the JR/major private railway companies, and local railway operators

	Average number of discussions ※1	Average number of discussions per year ※2
JR/Major private railway companies	4.5	4.7
Cases where measures have been taken	4.0	6.9
Cases where measures have not been taken	5.6	1.7
Local railway operators	1.9	1.2
Cases where measures have been taken	3.7	2.8
Cases where measures have not been taken	0.4	0.1

※1 The calculations were made from 39 cases where we received answers on the number of discussions in the follow-up survey on the status of measures taken among 57 cases of accidents.

※2 The average number of discussions was converted to the annual number based on the period between the time when the accidents occurred and the completion of measures (the cases where measures have been taken) or between the time when the accidents occurred and the follow-up survey (the cases where measures have not been taken). The average is calculated by case (the number of discussions/period (year)).

When we look at the period required from an accident to the abolition or class-one conversion (Figure 7), the level crossing was abolished within 1 year in 9 out of 12 cases. In the case of the local railway operators, the level crossing was abolished within 1 year in all cases. The class-one conversion takes time due to the time required for securing necessary budget or for construction works.

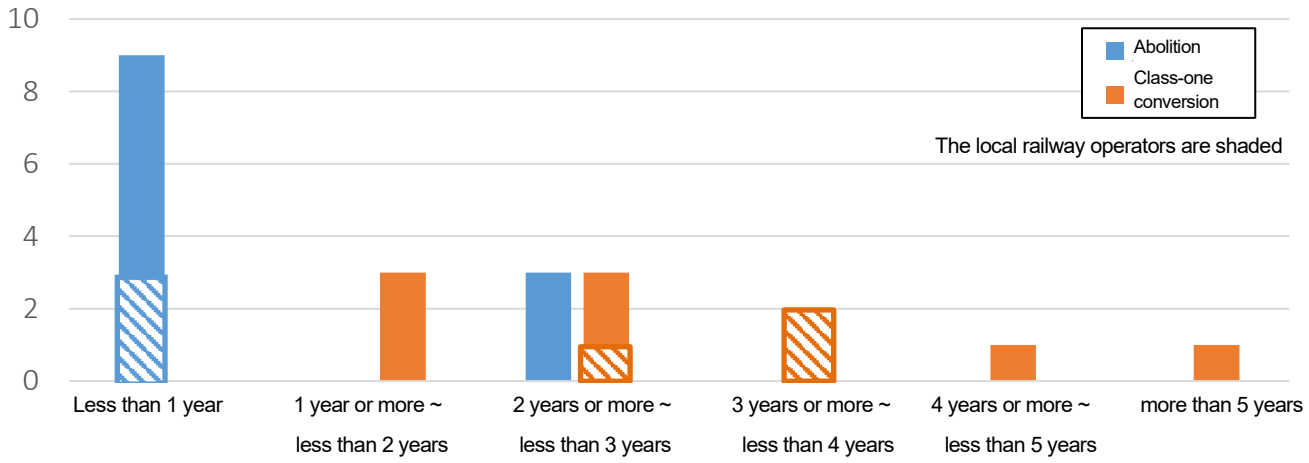


Figure 7: Period required from the accident to the abolition or class-one conversion

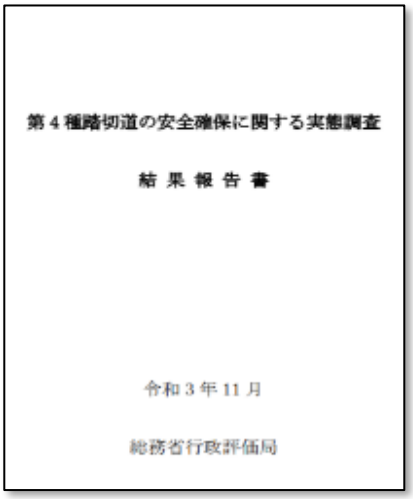
※ This figure shows 22 cases where answers on the period until measures are taken were obtained in the follow-up survey on the status of measures taken among 29 cases where measures have been taken.

When we look at those cases where the level crossing was abolished within 1 year from the accident, **a way of thinking of the local government and the local residents changed after the fatal accident and discussions for abolishment moved ahead in the most of cases**. Even in the cases where the local residents are against the abolition after the accident, the local government, the police, and neighborhood associations make an effort for moving ahead discussions.

In some cases where discussions for abolition stay stalled, the accident has been forgotten over time and a momentum of the relevant parties for abolition has cooled down. It is ideal to abolish the class 3 and class 4 level crossings before any accident occurs, but **it is desirable to move ahead discussions for the early abolition or class-one conversion, while the relevant parties are strongly aware of the danger of the level crossing**.

There was a case where **the level crossing was abolished after more than 2 years have passed since the accident by taking sufficient time to have a lot of discussions for the purpose of gaining an understanding of the local residents**. This case is presented in Chapter 3 of this digest. Moreover, there was a case where the abolishment was decided to give priority to safety after repeating several explanation sessions and meetings to exchange opinions, though all local residents were not in favor of the decision.

As regards the class 4 level crossings, the Minister of Internal Affairs and Communications issued a recommendation[2] requiring improvements as to fostering discussions and consensus building in the communities through the Local Level Crossing Improvement Council and other channels for the abolition or class-one conversion of level crossings to the Minister of Land, Infrastructure and Transportation on November 30, 2021. Moreover, the JTSB Digests Vol. 31[3] present the classification and points of the background of cases where the class 3 and class 4 level crossings were abolished. Please refer to the report of the Ministry of Internal Affairs and Communications and the JTSB Digests for discussing and building consensus on the abolition of the class 3 and class 4 level crossings or their class-one conversion in the communities.


第４種踏切道の安全確保に関する実態調査

結 果 報 告 書

令和３年11月

総務省行政評価局

Furthermore, Chapter 3 presents the column of awareness-raising activities to prevent level crossing accidents in the local railway operator for your reference.

Points of the level crossing accidents at the class 3 and class 4 level crossings

- **The ratio of the class 3 and class 4 level crossings is high in the local railway operators and the rate of level crossings where post-accident measures have been taken is low**.
- It is required to take concrete measures for the class 3 and class 4 level crossings urgently including their abolition. However, **in many cases where measures have not been taken, local railway operators have not discussed with the relevant parties such as local governments**.
- **It is effective to refer to the initiatives to abolish level crossings in the past** in order to move forward discussions. Moreover, in cases where an accident occurs, it is effective to move forward discussions at an early stage. However, **it is also required to make continuous efforts to find an alternative by repeating discussions and gain an understanding of local residents**.

[2] Administrative Evaluation Bureau, Ministry of Internal Affairs and Communications, "Survey on Safety of the Class 4 Level Crossings (recommendation based on the results)", https://www.soumu.go.jp/menu_news/s-news/hyouka_211130000153246.html (only available in Japanese)

[3] JTSB Digests Vol. 31, "The level crossing without crossing gate is dangerous ~ Urgent measures required to abolish or to prepare crossing gate, road warning device, https://www.mlit.go.jp/jtsb/bunseki-kankoubutu/jtsbdigests_e/jtsbdigests_No31/No31_pdf/jtsbdi-31_all.pdf

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)

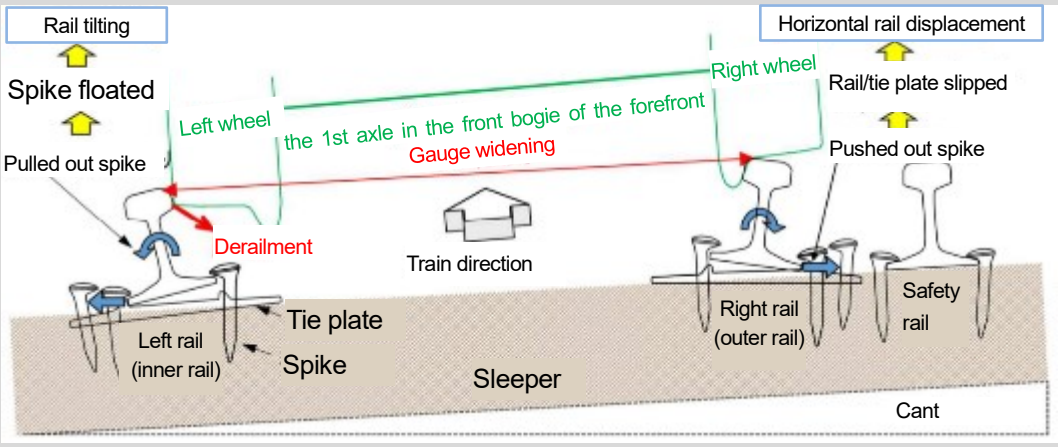
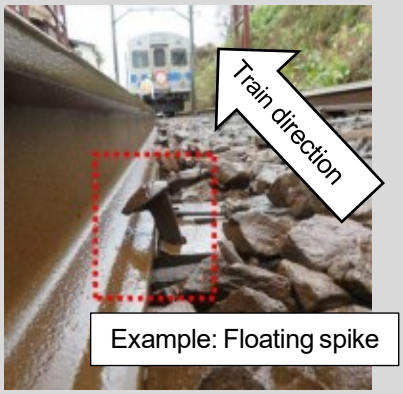


Figure 9: Image of derailment inside gauge of this accident



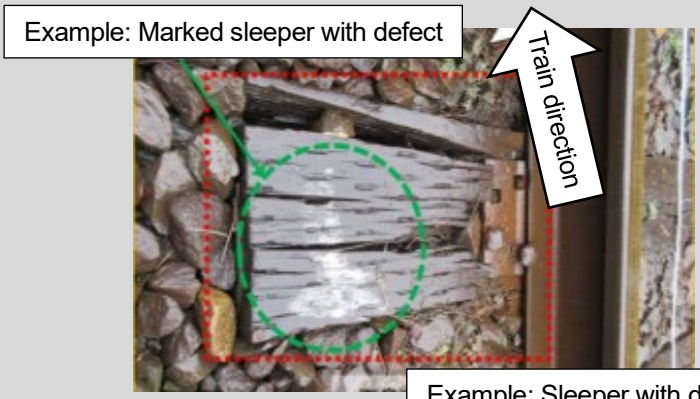


Figure 10: Traces of derailment at the accident

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.

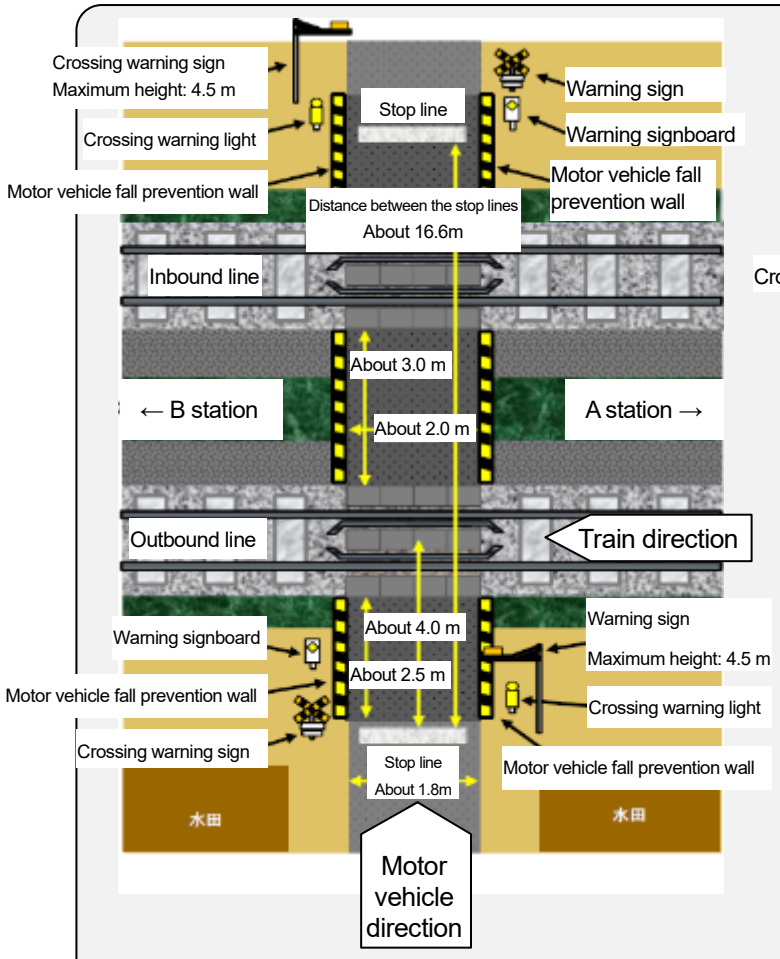


Figure 11: The level crossing where the accident occurred

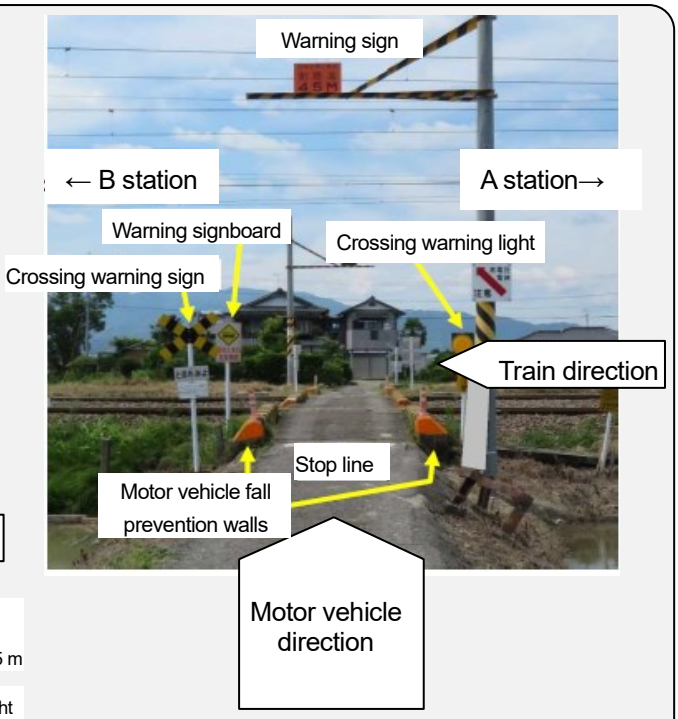


Figure 12: The situation of the level crossing (from the side where the motor vehicle approached)

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.**

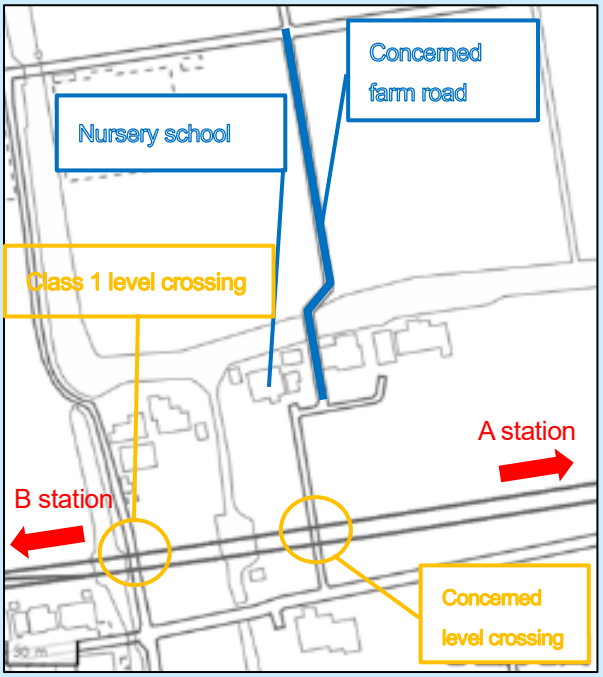


Figure 13: Schematic drawing of the area around the accident site and the concerned level crossing
※Created by the JTSB based on GSI Map Vector (Geospatial Information Authority of Japan)

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)

Column

Awareness raising activities to prevent level crossing accidents

It is important to take initiatives to improve awareness of compliance with traffic rules and of safety for drivers and pedestrians who pass through level crossings to prevent level crossing accidents. South Hokkaido Railway Company has taken awareness raising activities to prevent level crossing accidents in tandem with the national traffic safety campaign period. We interviewed them about the details of those activities.

【Interview with South Hokkaido Railway Company】

It is important to take initiatives to improve safety awareness of new elementary school children, since "they do not have much knowledge about road traffic" and "they start to act independent of their parents" once they live in a society with traffic.

(i) Call for the prevention of accidents at the neighborhood elementary schools

South Hokkaido Railway Company has called for the prevention of accidents since its inauguration (March 2016) in tandem with the spring national traffic safety campaign period every year for new students of seven elementary schools along the railway lines by distributing sheet protectors for raising awareness of traffic accident prevention. New elementary school students seem to look forward to receiving these sheet protectors. On the other hand, our employees have an opportunity to establish cooperative relationships with the schools to prevent level crossing accidents through direct communications with teachers.

Figure 14: Sheet protector for distribution

(ii) Promotion of safety awareness through local cable TV and radio stations

We have called for safe crossing at the level crossings every year since 2018 through the local radio station by requesting to "stop before entering the level crossing". Moreover, we have been interviewed by a TV station about level crossing accident preventive measures since 2019. Our employees appear on a program of the local TV station and carry out awareness raising activities near the level crossings. We ask for "stop before entering the level crossing" and "safety check". Also, we distribute tissues and leaflets for awareness raising to motor vehicles that stop before entering the level crossing.

(iii) Call for the prevention of level crossing accidents using the electric signboards of the drink vending machines

We call for the prevention of level crossing accidents using the electric signboards of the drink vending machines installed in all 5 stations of the South Hokkaido Isaribi lines.

Figure 15: Street awareness raising activity broadcasted by the local cable TV station

Figure 16: Use of electric signboard of the drink vending machine (Kunebetsu station)

It is expected that safety awareness of those who pass through the level crossings by establishing cooperative relationships with the local elementary schools and engaging in awareness raising activities through the local Cable TV and radio stations with the aim of preventing level crossing accidents. Considering the fact that level crossing accidents occur even in class 1 level crossings, these awareness raising activities continue to play an important role in accident preventive measures in addition to the abolition of class 3 and class 4 level crossings and their conversion into class 1 level crossings.

Column

Measures to prevent scour using the subsidy

This column presents a case where Iwate Galaxy Railway Co., Ltd. took the measures using the "Support for project cost for general safety measures for railway facilities" to respond to heavy rains that have become more frequent and severer in recent years. The company has installed new riverbed protection blocks and new scouring detectors as the measures against scouring of bridges with the aim of improving the safety of railway passengers and preventing bridges from being washout out or inclined by heavy rains. We interviewed with Iwate Galaxy Railway Co., Ltd. about the details of this project and the procedures for the subsidy.

【Interview with Iwate Galaxy Railway Co., Ltd.】

In the upstream and downstream sides of No.4 Kitakami River bridge, the river width was widened by the river improvement works carried out in the past. However, the river width was reduced near the concerned bridge compared to the upstream and downstream sides, because the position of the bridge abutment has not been changed. Therefore, the flow velocity near the bridge accelerates when the water level rises, and the riverbed has lowered. As a result of conducting the overall and individual inspections of the concerned bridge, the riverbed lowering near the bridge pier as well as partial scouring of the bridge abutment were observed. It was found out that reinforcement works are necessary.

Figure 17: No.4 Kitakami River Bridge (Full view from the upstream side)

Figure 18: No.4 Kitakami River Bridge (Full view from the downstream side)

Moreover, the riverbed has lowered at No.8 and No.10 Mabechi River bridges from the time when they were constructed. Therefore, riverbed protection blocks were newly installed at No.8 Mabechi River bridge (FY2013) and at No.10 Mabechi River bridge (FY2016) to control the riverbed lowering. Since then, as a result of conducting the overall and individual inspections of both bridges, it was confirmed that there is no problem in their soundness. However, there was a risk that the bridge piers are washed out or inclined due to insufficient embedment caused by the riverbed lowering when the river level rises. Therefore, it was necessary to examine a possibility of introducing inclination detection devices (See Figure 25).

Figure 19: No.8 Mabechi River Bridge (Full view from the downstream side)

Figure 20: No.10 Mabechi River Bridge (Full view from the downstream side)

It was found out, based on the above information, that it is necessary to take measures to prevent wash-out and inclination of the bridge due to heavy rains (3 parts of the bridge). The project was carried out using the "Support for project cost for general safety measures for railway facilities". The details of the project are as follows;

Construction work to install new riverbed protection blocks at No.4 Kitakami River bridge

When selecting a construction technique, riverbed protection blocks were selected taking into account the nearby environment, because the work can be done in a narrow space, these blocks can prevent bridge piers and abutments from being washed out and the riverbed from being lowered, and the company has an experience in this construction technique. Since the bridge piers and newly-installed concrete riverbed protection blocks have been connected, a possibility of wash-out decreases significantly. In addition, the scouring and riverbed lowering are prevented by covering the entire river width with these new blocks.

Figure 21: Installation of new riverbed protection blocks (completion of concrete placement)

Figure 22: Completion of work (Full view)

Figure 23: Completion of work (riverbed bottom)

Installation of new scouring detection devices at No.8 and No.10 Mabechi River bridges

Since the devices capable of automatically transmitting observational data from inclinometers on-line have been installed, it is now possible to check data on a real-time basis and efficiently control operations. Moreover, it is now possible to check the stability of bridge piers with the inclinometers when resuming the train operation after it has been restricted (stopped) due to the rise in water levels. In addition, it is possible to view data on restrictions and disasters in the past.

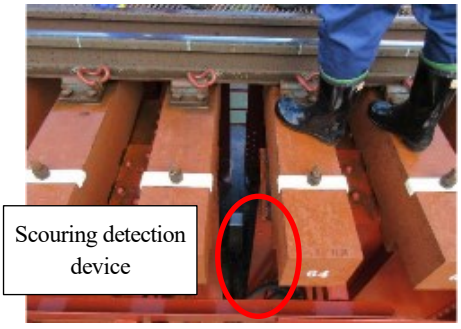


Figure 24: No.10 Mabechi River bridge (work completed)

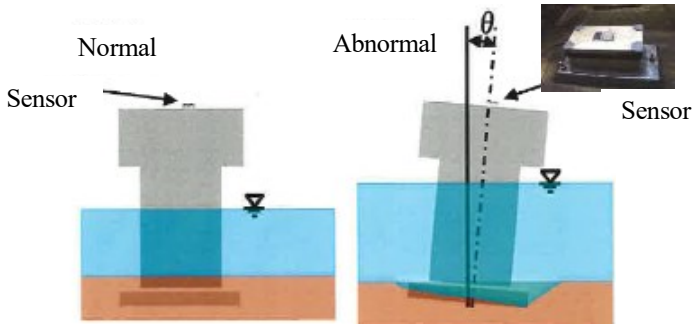


Figure 25: System to detect a bridge pier inclination with a scouring detection device

The above measures have resulted in preventive preservation to prevent accidents due to heavy rains.

It was difficult to prepare documents related to the construction works and contracts for the subsidy examination process, since the works started at the end of the fiscal year. However, the procedure for applying for the subsidy completed without problems.

We expect that accidents caused by heavy rains are prevented by considering a possibility of using the subsidy for reinforcement of bridges (wash-out preventive measures) and the installation of scouring detection devices.

【Subsidy used by Iwate Galaxy Railway Co., Ltd.】
Support for project cost for general safety measures for railway facilities, project to take measures against heavy rains

- To support the reinforcement of bases of bridge piers/abutments, the rehabilitation of bridges, and the introduction of abnormality detection systems to prevent railway river bridges from being washed out or inclined due to heavy rains.
  ※The subsidy is applicable to bridges on routes where the one-way passenger volume is more than 10,000 and less than 150,000 per day or routes where higher category trains or cargo trains operate.

4. Introduction of the support systems to prevent accidents

This chapter presents some examples of the technical supports provided by each corporation and the national subsidy system to contribute to preventing accidents and improving transport safety.

As described in Chapter 2, the lack of technical abilities of railway operators may be a factor of train derailment accidents caused by "track" in the local railway operators. We expect the technical supports provided by each corporation to be used for the proper maintenance management of tracks and the proper planning of the "partial replacement to PC sleepers" and "priority-based installation". Moreover, the national subsidy system is expected to be used to maximize the effect of measures with a limited budget, thereby contributing to the reduction in accidents and the improvement of safety.

Furthermore, you may consider a possibility of taking advantage of the available national subsidy systems for converting class 3 or class 4 level crossings into class 1 level crossings.

(1) Examples of the technical supports

(i) Railway Technical Research Institute, RTRI

Railway Technology Promotion Center, RTRI, implements "Site investigation", "Lectures and training courses", and "Advice via email, etc." responding to the technical consultation from the members of railway operators without fee. Moreover, the RTRI prepares educational materials for the fostering of railway engineers.

Status of "site investigation"

(Outline)

- "Site investigation"

  The researchers of the RTRI and the rail advisors (the expert retired from railway operators) are dispatched to implement the technical diagnosis and advice directly at site. As a recent case of the tracks, an on-site investigation on the soundness of tracks and the alignment irregularity management in the curves was carried out.

- "Lectures and training courses"

  The researchers and the rail advisors who have the deep knowledges and plentiful actual experiences give lectures and training courses.

- "Advice via email, etc."

  The researchers of the RTRI respond to inquiries about the railway technologies via email and provide consultation services via on-line meetings.

(Website of the RTRI) https://www.rtri.or.jp/tecce/

(Phone) Railway Technology Promotion Center, RTRI, 042-573-7236

(ii) Japan Railway Construction, Transport and Technology Agency, JRTT

The JRTT implements the support "Railway family doctor" by effectively using the experiences and the knowhow cultivated in the duties of the railway construction and the railway support, for the railway operators and local public organizations supporting the local railways.

Concretely, the JRTT implements the technical advice and the provision of information such as the introduction of the precedents and provision of references, etc., responding to the consultation on the repairing, the maintenance management, the replacement plan including the replacement to PC sleepers, etc., of railway facilities such as the tracks, and introduces proper construction methods responding the situation based on the investigation of the facilities implemented at site according to the necessity, in free of charge.

Status of "site investigation"

(Concrete examples)

- Advise on the inspection method of the aged facilities and the points required attention on the maintenance management
- Introduction of the construction methods and materials for the repair works.
- Advise on the decision of the construction plans, ordering of the construction works, the supervising of the construction works.
- Introduction of the supporting systems.

(Website of the JRTT) https://www.jrtt.go.jp/construction/outline/family-doctor.html

(Phone) Railway General Support Section, International, General Affairs Dept., JRTT, 045-222-9016

(iii) Japan Railway Rolling Stock & Machinery Association, JRMA

The JRMA holds the "Training course for succession of technologies for the vehicle maintenance in the local railways" in each district transport bureau, together with the Ministry of Land, Infrastructure, Transport and Tourism, and the JR, the major railway operators, in order to secure safety and maintain and continue the technical abilities in the local railways.

(Phone) Vehicle Dept., JRMA, 03-3593-5611

Experience of "door adjustment work"

(2) National subsidy system

(i) Support for project cost for general safety measures for railway facilities, project to improve safe transport facilities of railway and tramway.
Subsidy for project cost to improve, maintain, secure the local public traffics, project to improve safe transport facilities of railway and tramway.

(Outlines)

The partial support of necessary expenses to renew facilities, etc., to contribute improvement of safety conducted by the local railway operators to secure safe railway transportation.

【Operators to be supported】	Railway and tramway operators
【Ratio of support】	One third of the expense subjected to be supported, etc.
【Facilities to be supported】	Rails, sleepers, facility to prevent falling stones, ATS, train radio facility, windbreak facilities, bridges, tunnels, level crossing protection facilities[*1], vehicles[*2], etc.

(*1) "Level crossing security facilities are only subject to the Support for project cost for general safety measures for railway facilities, project to improve safe transport facilities of railway and tramway. The local public bodies, the JR, and the major private railway companies are not subject to this subsidy. Moreover, **in cases where level crossing security facilities are newly installed, "a level crossing on roads other than the national roads, prefectural roads, and municipal roads specified in the Road Act" is subject to the subsidy**.

(*2) "Vehicle" is the targeted support facility of the subsidy for project cost to improve, maintain, secure the local public traffics, project to improve safe transport facilities of railway and tramway.

(Website of the MLIT) https://www.mlit.go.jp/tetudo/tetudo_tk5_000001.html
(only available in Japanese)

(ii) Support for project cost for general safety measures for railway facilities, project to improve level crossing security facilities

(Outlines)

To subsidize a part of the expenses of developing level crossing security facilities for the purpose of preventing traffic accidents and contributing to smooth traffic under the Act on Promotion of Railway Crossings.

【Operators to be supported】 (i) Railway and tramway operators other than local public bodies

A railway and tramway operator that meets any of the following. It has

- a deficit;
- an operating loss; or
- fixed assets for business which are 7% or less of operating margins

and, in all its businesses, has

- a deficit;
- an operating loss; or
- fixed assets for business which are 10% or less of operating margins.

(ii) Railway operators that are local public bodies

A railway and tramway operator that has a deficit.

【Ratio of support】 Within one half of the expense subjected to be supported (one third in cases where current profits are marked in the railway and tramway business)

【Facilities to be supported※ 】 Crossing gates, road warning devices (including omni-directional alarms), road warning device time control devices, two-phase crossing gates, large crossing gates, over-hung alarming devices, crossing trouble detectors (limited to high-spec detectors or control devices among obstacle detection devices and crossing obstacle detection devices), and crossing security cameras

（※）Only level crossings designated under the Act on Promotion of Railway Crossings (level crossings on roads specified in the Road Act) are applicable to the subsidy.

5. Summary (Conclusion)

The accidents and serious incidents in local railway operators have the following characteristics based on the status of accidents occurred in the past.

- About 90% of the accidents and serious incidents in local railway operators are “train derailment accidents” and “level crossing accidents”.
- The common cause of train derailment accidents is **“Track: related to maintained status of ground facilities such as track”. The number of this type of accidents does not show a declining trend after the Japan Transport Safety Board issued an opinion on June 28, 2018**.
- The number of train derailment accidents caused by “level crossing accident”, “natural disaster”, and “operation” has been decreasing in recent years, but these types of accidents occur once every few years.
- **The ratio of class 3 and class 4 level crossings is high** in the local railway operators that require specific measures such as the urgent abolition. **The ratio of level crossings for which measures have been taken after accidents occurred is also low compared to the JR and the major private railway companies**.

Based on the above data, we verified the characteristics and issues of the train derailment accidents caused by "track" and the level crossing accidents at class 3 and class 4 level crossings which characterize the accidents in local railway operators and the following points were found out.

○ Train derailment accidents (caused by track)

【Characteristics of the factors of accidents】

- The proper maintenance management of tracks is not carried out, the proper maintenance management standard values have not been set, and the replacement to PC sleepers, etc. has not been made, based on the opinion issued by the JTSB on June 28, 2018.
- The lack of technical abilities of the local railway operators is pointed out to be an underlying factor of the improper maintenance management of tracks.

【Important points to prevent accidents】

- The proper maintenance management of tracks should be implemented based on the opinion of the JTSB.
- In cases where it is difficult for a local railway operator to take measures on its own for economic or technical reasons, **it is desirable to work on the "partial replacement to PC sleepers" or "priority-based installation" using the technical supports provided by various corporations and the national subsidy systems**. (the proper maintenance management of tracks is required on a continuous basis even after the replacement to PC sleepers completes).

○ Level crossing accidents at class 3 and class 4 level crossings

【Issues concerning the prevention of accidents】

- In many cases, discussions and consensus building in local communities toward the abolition of level crossings or their conversion into class 1 level crossings do not progress.
- It is required that the relevant parties make an effort for building consensus through discussions. However, **the local railway operator does not have discussions with the local government and relevant parties** in many cases where no measures have been taken.

【Important points to prevent accidents】

- **It is required to continuously work on to gain an understanding of the local residents by repeating discussions between the relevant parties including the consideration of alternatives** with reference to the actual cases where the level crossings were abolished.

We expect that accident prevention measures will be taken by the local railway operators using the technical supports and the national subsidy system presented in this digest.

Comment from the Director of the Analysis, Recommendation and Opinion Office

Local railways play an important role as a mode of transportation for the local residents and is the base of economic activities in each region. On the other hand, the local railway operators face various issues such as how to ensure safe transportation and the lack of young engineers under severe business conditions. It is our desire that the local railway operators can refer to the measures to prevent the recurrence presented in this digest to ensure safe railway transportation. Moreover, we expect accident prevention measures to be taken smoothly by effectively using the national subsidy system and the technical supports.

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