

Digest of the Analysis of Railway Accidents

The level crossing without crossing gate is dangerous

Urgent measures required to abolish or to prepare crossing gate, road warning device

[Synopsis]

Implement urgent measures such as to abolish level crossing without crossing gate, or to prepare crossing gate and road warning device.

- Decide the policy to abolish level crossing or to provide crossing gate, etc., urgently in order to eliminate accidents in the level crossing without crossing gate. It is necessary to take concrete measures urgently promoting the discussions to obtain agreement in the cooperation with the relevant parties such as the railway operators, the road administrators, the local residents, etc.
- Example of the level crossing considered as required the urgent measures.
 - Level crossing where passerby of level crossing is hard to notice the approaching train.
 - ex. - The case that visibility from level crossing is blocked by neighboring building and fence, etc.
 - The case that visibility distance of train is restricted by the effect of curve, tunnel, etc., existed in the track in the neighborhood of level crossing, etc.
 - Level crossing where trains are passing in high speed.
[Ref.] The train running at 80 km/h advances about 22 m in one second, the train running at 120 km/h advances about 33 m in one second.
 - Level crossing where many trains are passing.
 - Level crossing in double track section, etc., with long crossing road and required long time to be crossed.
[Ref.] Average aged pedestrian advances 1.2 m in one second for the age of 65, and 1.0 m in one second average for the age of 75 and above.
 - Level crossing steadily used by the children going school, aged persons, handicapped persons, etc.
 - Level crossing where passersby increased or anticipated to increase in the future by the change of surrounding circumstances due to the development of residential areas, etc.
 - Level crossing where accident had occurred in the past.
- It is important for the railway operators to extract these high risk level crossings and realize the abolishment of level crossing or the preparation of crossing gate, etc., in early stage, promoting the discussions with the relevant parties pressured actively.

Over half accidents resulted fatal of the aged person of over 65 years.

- Among 34 accident investigation reports already published,
 - many accidents involving with fatality of aged person, 53 % was the age of 65 years or above.
 - Certain number of accidents occurred for pedestrian, 38 %, and automobiles, 35 %.

There is limit to let passerby notice the approaching train, in the status without crossing gate, etc.

- There is the case that the safety measures only depended on the attentiveness of passersby of level crossing have a limit against the following major relevant factors.
 - Bad visibility of trains from the once stop position of level crossing, *i.e.*, hard to confirm approaching train.
 - Bad visibility due to building, fence, miscellaneous trees, etc., in around the level crossing.
 - The approaching train is hard to be sighted from driver's seat in automobile, compared to pedestrian.
 - Passersby, automobile, etc., of level crossing did not stop before level crossing, unsafe action could not be excluded completely.
 - Affected by the restriction of physical function of passersby of level crossing, difficult to respond to the information on danger.
 - The warning sound of level crossing or the sound of whistle cannot be heard.
 - Difficult to judge visually the time till train arrive at level crossing when it runs fast.

Points of examples realized the abolishment of level crossing without crossing gate.

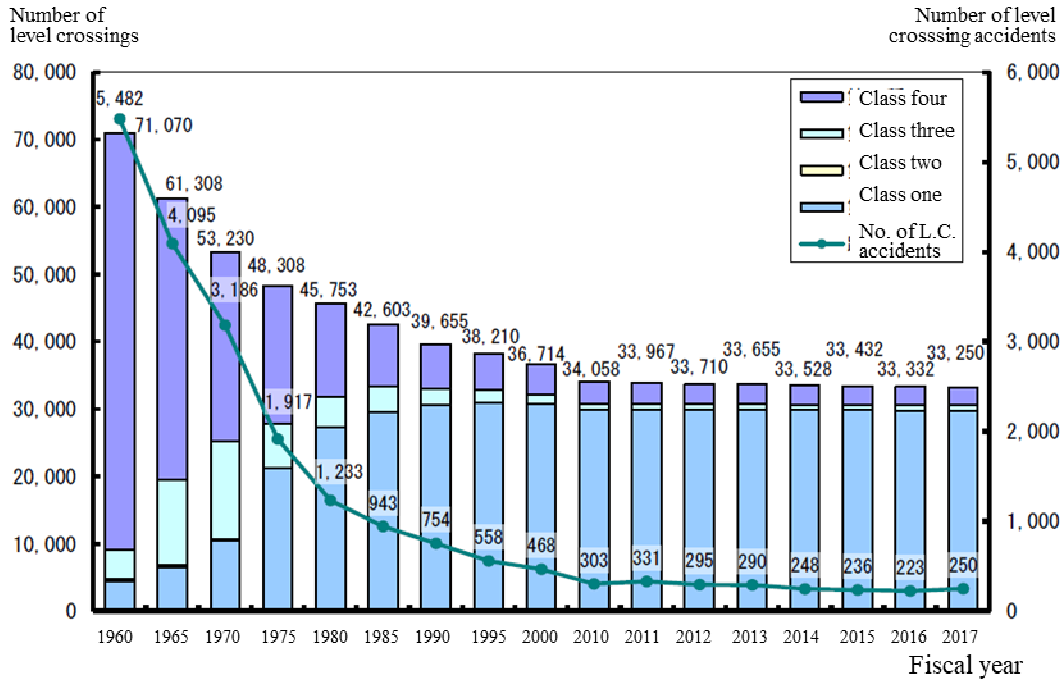
- The ultimate measure to eliminate the level crossing accident is to abolish level crossing itself, and there is the case that the relevant parties promoted the discussions and abolished level crossing. The patterns and the points (⇒) of the process to the abolishment are as follows. It is expected to implement concrete measures to prevent accident referring each case shown in Section 5, in pages 9 to 13.
 - (a) Abolish only the level crossing without crossing gate
 - ⇒ The railway operator and the road administrator explained the necessity of abolishment of level crossing, and promoted the understandings and cooperation of the local residents, etc.
 - (b) Integration and abolishment together with the neighboring level crossing
 - (i) Abolish accompanied to widening of the neighboring level crossing.
 - ⇒ Improve safety of neighboring level crossing, *i.e.*, prepare walkway or widen level crossing road, and guided the passerby of level crossing.
 - (ii) Prepare bypass to the neighboring level crossing, and abolished.
 - ⇒ To make easy to use neighboring level crossing, by establishment of bypass route, and guide the passerby of level crossing.
 - ⇒ Local government and railway operator cooperate each other to prepare bypass route.
 - (c) Abolishment had been scheduled after completion of the work for overhead crossing of the level crossing and surroundings, but abolished earlier responded the occurrence of accident.

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1. Change of number of level crossings, quoted from materials of the Railway Bureau, MLIT

- Total number of level crossings had been reduced by the change to overhead crossing or the integration and abolishment, and the preparation of level crossing protection device such as the improvement to class one level crossing equipped with crossing gate and road warning device, but did not so change in the recent years. Refer to Figure 1.



* Horizontal axis expressed every 5 years between 1960 and 2010 and every one year after that.
 Quoted from "Information on the safety of railway and tramway transportation" Railway Bureau, MLIT.

Figure 1. Changes of number of level crossings and level crossing accidents

[Reference] Category of level crossing

<Class one level crossing>



Equipped with road warning device and crossing gate, or the level crossing security guard is posted.

<Class two level crossing>



Level crossing security guard operated crossing gate in only partial time band, not existed at present.

<Class three level crossing>



Equipped with road warning device and crossing warning sign.

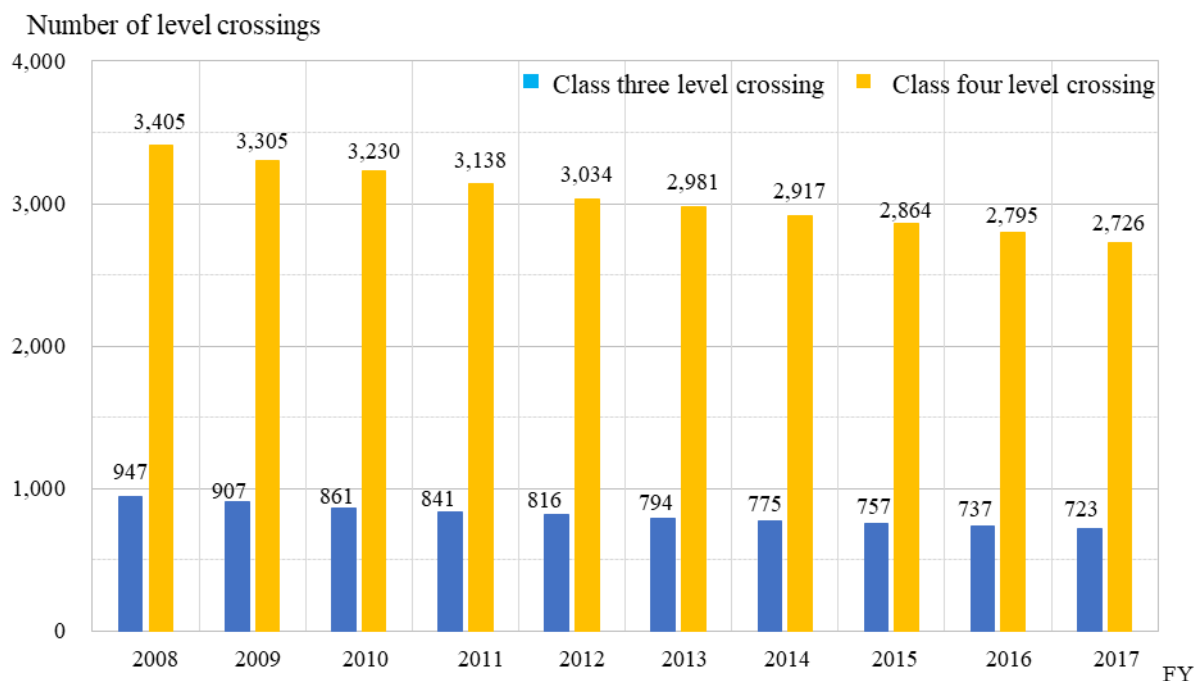
<Class four level crossing>



Level crossing with crossing warning sign only, no device to notice the approaching train.

Quoted from "True face of major private railways", Japan Private Railway Association, October 2018.

□ The change of numbers of class three level crossing, without crossing gate and with road warning device, and class four level crossing, without crossing gate nor road warning device, from 2008 FY to 2017 FY, was that the reducing ratio of level crossing was slowing down, and 723 class three level crossings and 2,726 class four level crossings still existed at the end of 2017 FY. Refer to Figure 2.



Quoted from "information on the safety of railway and tramway transportation" Railway Bureau, MLIT.

Figure 2. Changes of numbers of class three and class four level crossings

□ The numbers of class three and class four level crossings reduced by the abolishment or the change to class one level crossing from the end of FY2016 to the end of FY2017 were shown in Table 1. The reductions by abolishment and the change to class one level crossing were almost the same in the class three level crossing, and the reduction by abolishment was the major in the class four level crossing. Refer to Table 1.

Table 1. Reduced number of class three and class four level crossings in 2017 FY

Class of level crossing	Class three	Class four
Number of level crossings, end of FY2016 (a)	737	2,795
Number of level crossings end of FY2017 (b)	723	2,726
Reduced Number of level crossing (a-b)	14	69
Among above, abolished level crossing	6	41
Changed to class one level crossing	7	16
Abolished railway line	1	12

On April 2014, the JTBSB added the level crossing accident with fatality in the level crossing without crossing gate, i.e., class three and class four level crossing, where in high risk of accident, to the subject of the investigation, for the reduction of number of fatalities by the accident in the railway and tramway operation.

In the opportunity that five years had passed from the start of the investigation, the investigation reports published so far were analyzed and put together the "example of measures" to prevent the similar accidents.

2. Status of occurrence of the accident with fatality in the level crossing without crossing gate

The 39 accidents with fatality had occurred in the level crossing without crossing gate in the period from April 2014 to January 2019, as shown in Table 2. Among these, the JTBSB had published 34 railway accident investigation reports by January 2019, and investigating remained 5 accidents. Refer to Table 3 in page 20 to 21, for the summary of the published 34 railway accident investigation reports.

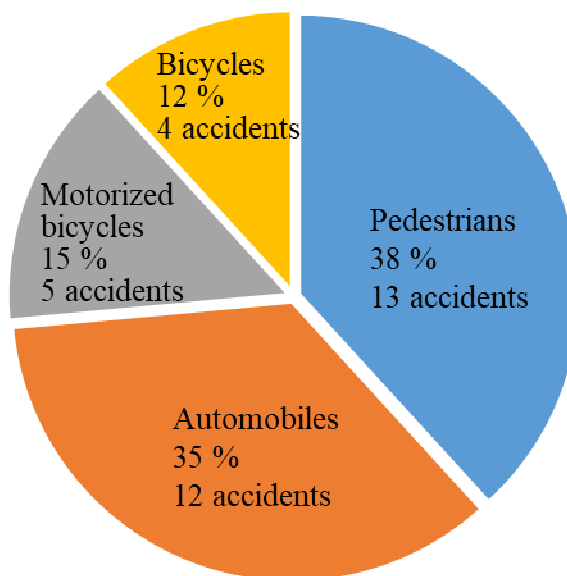
Table 2. Number of occurred accidents with fatality in the level crossing without crossing gate

	2014 FY	2015 FY	2016 FY	2017 FY	2018 FY, till to Jan.	Total
Class three level crossing	1	0	3	1	1	6
Class four level crossing	4	5	13	5	6* *5 are investigating	33
Total	5	5	16	6	7	39

Classification of occurred accidents Classified 34 published railway accident investigation reports

(1) Details of passersby of level crossing

The most was pedestrian, 13 accidents, 38 %, the second most was automobiles, 12 accidents, 35 %.



* "Automobile" include the light motor vehicle and small sized special vehicle, i.e., tractor for agriculture.

Figure 3. Details of passersby of level crossing

(2) Age of the passersby, or driver of crossing automobile, of level crossing

The ratio of aged person, 65 years old or above, was 18 accidents, 53 %, *i.e.*, occupied over half.

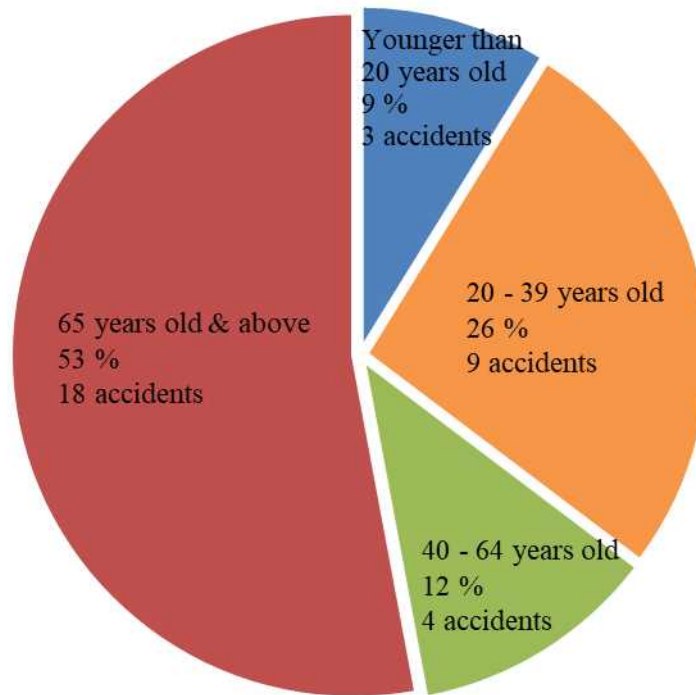


Figure 4. Classification by the age of passersby of level crossing

(3) Velocity of the train when the passerby was found

The ratio of 60 km/h or above was 79 %, 27 accidents, *i.e.*, velocity of train is high.

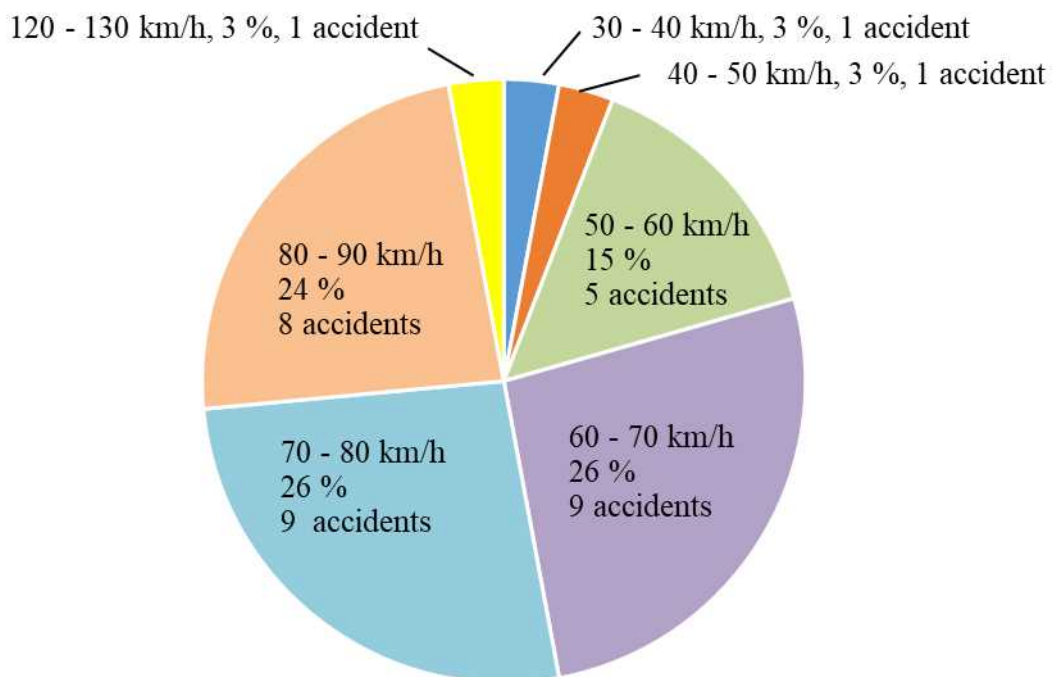


Figure 5. Velocity of the train when the passerby was found

(4) Classification by the relevant causes

The major factors, considered the possibility as related to the passersby entering the level crossing in the situation that the train was approaching to the level crossing, were classified as follows.

- (i) Bad visibility of trains from the once stop position of the level crossing.
- (ii) Passersby, automobile, etc., did not stop before the level crossing.
- (iii) The restriction of physical function of the passersby had been affected.

Refer to "7. Examples of the accident investigation, pages 16 - 19, and Table 4, page 22 - 23.

3. Implement measures urgently such as to abolish or install of crossing gate and road warning device, in the level crossing without crossing gate

(1) Level crossing without crossing gate is dangerous

The rules, to stop once before the level crossing and check safety of left and right, after that, across the level crossing, have been recognized by many people, inspired by the safety education in the schools, etc., and guided in the lectures in the training to acquire driver's license of automobiles, etc., and individual passerby have been implemented definitely.

It is necessary for the passersby to implement certainly the confirmation of safety whether train is approaching or not, particularly in the level crossing without crossing gate.

However, as described in the above (4) relevant causes, the accident occurred as the passerby could not confirmed safety due to some factors and entered the level crossing when train was approaching. Like this, the level crossing without crossing gate has high risk of accident.

(2) Some safety measures depended only to the awareness of passerby of level crossing have a limit

Among 34 accidents with fatality in the level crossing without crossing gate, that the JTSC had published the investigation report by January 2019, 10 accidents, including the accidents without casualties, had been occurred in the same level crossing.

Among these 10 accidents, there were the level crossing where implemented the traffic control, the installation of sign board to call attention, etc., responding to the past accidents, but accident occurred again.

Moreover, among 34 accidents which the accident investigation reports were published, over half 18 accidents were the case that passerby of level crossing was the aged person over 65 years old, and six accidents were the case that passerby of level crossing was the handicapped person in the hearing function, etc.

Furthermore, it is probable that there is the characteristics that the driver of automobile is hard to confirm the train compared to the pedestrian, because the driver of automobile confirms the approaching train from the position of the driver's seat, located further backward of the once stop line of the level crossing.

In addition, it is considered as difficult for the passerby of level crossing to judge visually the time till the train approach at the level crossing when the velocity of the train is fast, for example, the train running in 120 km/h advances about 33 m in one second.

Therefore, there is the case that the safety measures only depending on the awareness of passerby in the safety confirmation whether train is approaching or not, in the level crossing without crossing gate, have a limit.

(3) Decide the policy of measures urgently and implement concrete measures

The ultimate measure to eliminate level crossing accident is to eliminate level crossings, and it is necessary for the railway operator and the road administrator, etc., to promote more positively to obtain agreement with the local residents for the abolishment and integration of level crossing.

There was the case that realized the abolishment of level crossing, by promoted discussions between railway operator, the road administrator, the local residents, etc. On the other hand, there are the level crossings still existed as class three or class four with the high risk against accidents, although discussion had been implemented between relevant parties but the future policy to abolish level crossing or to install level crossing protection devices are not decided yet.

Therefore, it is considered as necessary to implement the concrete measures by fixed conclusion in early stage on the abolishment of level crossing or the preparation of level crossing protection devices by promoting the discussion between relevant parties, to make zero or to reduce the risks against accident as soon as possible.

From the point of view of the danger against occurrence of accidents, it is necessary to decide the policy on the abolishment or the preparation of level crossing protection device and to take concrete measures, especially in class three and class four level crossings described in the followings.

- Level crossing where passerby of level crossing is hard to notice the approaching train.

[Example]

- The case that the visibility of level crossing was obstructed by the neighboring building or fence, etc.
- The case that the sight distance of train was restricted by the effects of curve and tunnel, etc., existed in the track in the neighborhood of level crossing, etc.

- Level crossing where trains pass in high speed

[Ref.] The train running at 80 km/h advances about 22 m in one second, the train running at 120 km/h advances about 33 m in one second.

- Level crossing where many trains are passing.

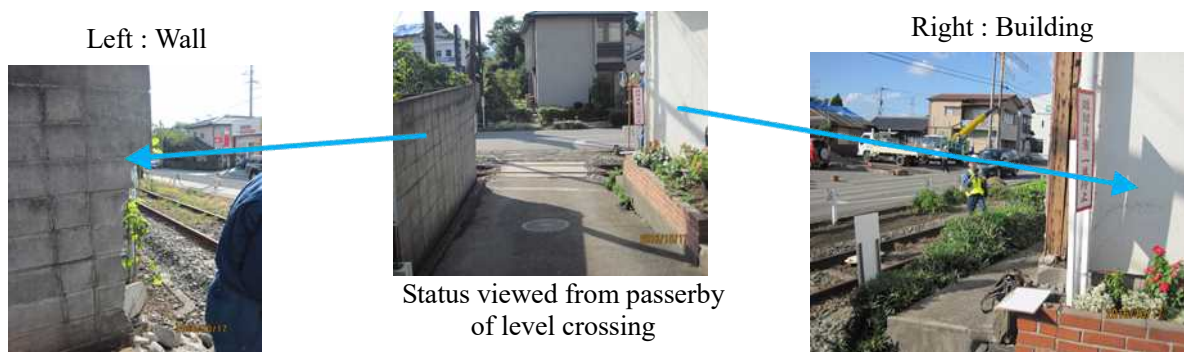
- Level crossing with long crossing road due to double tracks, etc., and required long time to be crossed.

[Ref.] It is said that the average aged pedestrian of 65 years old advances 1.2 m in one second, and the pedestrian of above 75 years old advances 1.0 m in one second, in average.

[Quoted from the home page of the Railway Bureau, MLIT "On the measures to prevent level crossing accident by aged people, etc.", October 2015.]

- Level crossing constantly used by the children going school, aged persons, handicapped persons, etc.
- Level crossing where passersby increased or anticipated to increase in the future by the change of surrounding circumstances due to the development of residential areas, etc.
- Level crossing where accident had occurred in the past.

The railway operator can comprehend the status of the individual level crossing such as the sighting status of level crossing, the velocity and the number of operating trains passing the level crossing, the length of level crossing, etc. Therefore, it is important for the railway operator to extract level crossing with high risk as described in the above, to promote discussions by appealing to the relevant parties positively, to realize the abolishment of level crossing or the installation of level crossing protection device in early stage.



Example that the visibility of level crossing is obstructed by the neighboring buildings or fences

4. Point to promote measures for abolishment of level crossing

It is described in the above that the ultimate measure to eliminate the level crossing accident is to abolish level crossing itself. However, although the relevant parties such as railway operator, road administrator, local residents, etc., are discussing for the abolishment of level crossing based on the above idea, it is considered that there are many level crossings where discussion is not in advance.

Therefore, the patterns and the points () of the process of the cases which resulted to abolish level crossing are summarized as follows.

It is expected to implement concrete measures to prevent accidents referring each case shown in Section 5, in pages 9 to 13, etc.

(a) Individual abolition of the level crossing without crossing gate

➡ The railway operator and the road administrator explained the necessity of abolishment of level crossing, and promoted the understandings and cooperation of the local residents, etc.

(b) Integration and abolishment together with neighboring level crossing

(i) Abolish at the same time as widening the neighboring level crossing.

➡ Improve safety of neighboring level crossing, i.e., prepare walkway or widen level crossing road, and guide the passersby of level crossing.

(ii) Establish bypass route to the neighboring level crossing, and abolish.

➡ To make easy to use neighboring level crossing, by preparing bypass route, and guide the passersby of level crossing.

➡ Local government and railway operator cooperated with each other to prepare bypass route.

(c) Abolishment had been scheduled after completed work for overhead crossing of level crossing and surroundings, but abolished earlier upon the occasion of the occurrence of accident.

5. Examples to realize abolishment of level crossing without crossing gate

Four examples are introduced in the followings, based on the hearing from railway operators and the local governments.

Among these, the case (b) (i) and (b) (ii) part.2 had occurred in Chikusei City, Ibaraki Prefecture. The Chikusei City, responded to the occurrence of the accident with fatality in class four level crossing, in the strong thought that "the City will abolish dangerous class four level crossings in order not to cause the similar accident anymore", promote discussions with local residents as the City took the lead, and realized to abolish not only level crossing where caused the accident with fatality, but also abolished the other class four level crossings where accident had not occurred yet. The discussions on the abolishment are now continued for the class four level crossings still existed in the city.

We consider that the other relevant parties such as railway operators and the local governments, etc., promote the discussions in the relevant parties before accident will occur and implement the concrete measures such as the abolishment, etc., in early stage, referring these activities to abolishment of level crossing.

Example of "(a) abolished only the level crossing without crossing gate"

- Responded to the occurrence of accident with fatality, explained necessity to abolish level crossing, and understandings and cooperation of local residents, etc., were accelerated -

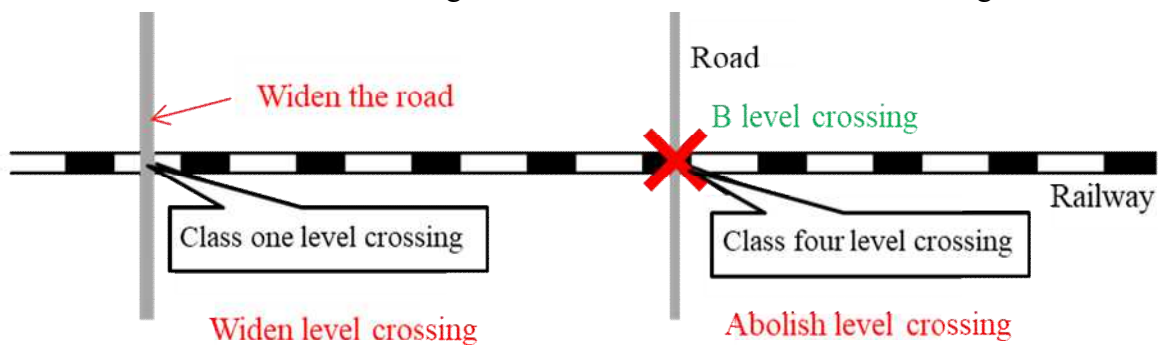
When the accident occurred in class four level crossing in the past, the railway operator requested the local government who is the road administrator, to discuss based on the abolishment of level crossing, and has been promoted to abolish class four level crossings in that area or to change to class one level crossings, but could not decide to abolish because there were not a few opinions which opposed to abolish the A level crossing.

This time, in view of the seriousness that the accident with fatality had occurred, the local government implemented the investigation on traffic volume of the level crossing, summarized the investigated results and held the explanatory meeting for the local area, by announcing to the members of the city council, the chairmen of the district, the local residents, etc. As the results, the understandings to the abolishment of level crossing could be obtained, then the railway operator abolished the A level crossing after implemented the required procedures.

Example of "(b) (i) Abolish in cooperate to widen the neighboring level crossing"

- Improved safety of the neighboring level crossing, i.e., prepared walkway and widen the level crossing road, then guided the users of level crossing -

Responded to the occurrence of the accident with fatality, the relevant parties such as the local government, the police, the school, etc., studied on the abolishment of the B level crossing, but expressed disapproval for the abolishment because the present status of the neighboring class one level crossing and the connected road was narrow and dangerous, therefore, the relevant parties decided to abolish the B level crossing after widened, i.e., prepared walkway, the neighboring level crossing. The local government prepared the revised budget to widen the neighboring level crossing, implemented to widen the level crossing, after that, abolished the B level crossing.

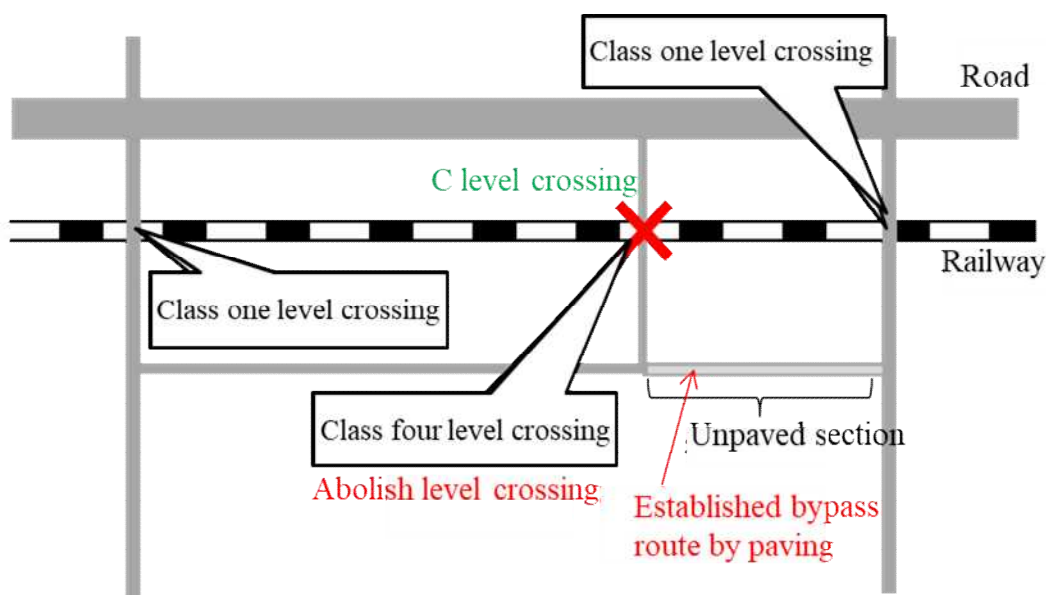


- Widen the level crossing
 - Widen the road
 - Preparation of walkway, green part
 - Relocation of the road warning device and change to the overhang type
- Improved the utility of pedestrian, and visibility of level crossing !

Example of "(b) (ii) Prepare bypass route to the neighboring level crossing, and abolish", part 1
 - To make easy to use the neighboring level crossing, *i.e.*, provision of bypass route, and guide the users of level crossing -

The accident that train collided with bicycle occurred in the C level crossing in the past, then the railway operator, the local government, the police, and the local neighborhood association held the discussions, and the local government installed the car stop fence and the guard pipes in order to call attention to pass the level crossing. After that, the railway operator and the local government discussed on the abolishment of level crossing, etc., but still continued the discussions considering that there were the passersby of the level crossing.

Responded to the accident with fatality at this time, the railway operator, the local government, the local neighborhood association discussed on the safety measures of the C level crossing, and agreed to abolish the C level crossing after prepared the bypass route to the neighboring level crossing. After that, the local government completed the installation of bypass route, and abolished the C level crossing.



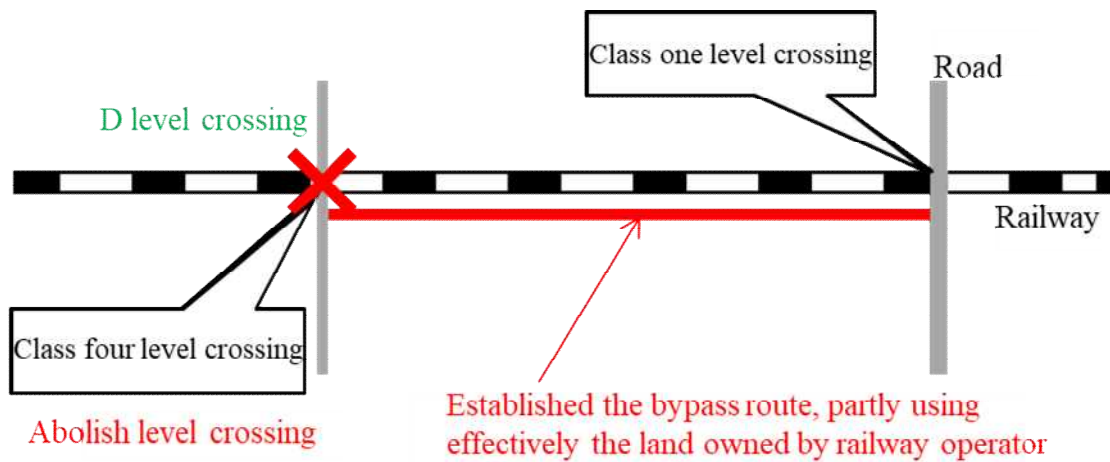
Example of "(b) (ii) Prepare bypass route to the neighboring level crossing, and abolish", part 2
 - The local government and railway operator cooperated with each other to prepare bypass route -

Although this example is not the case of class four level crossing generated the accident with fatality, but the example that the local government tackled to abolish class four level crossing existed in the jurisdiction, *i.e.*, the D level crossing, responded to the occurrence of the accident with fatality occurred in the other class four level crossing.

The local government implemented the investigation by questionnaire, which investigated the status and purpose to use level crossing and the OD, *i.e.*, origin and destination of the movement, for the users of the level crossing, together with railway operator, for the abolishment of the level crossing, based on the recognition that class four level crossing is highly dangerous, and held the study meeting on the safety measures together with the resident's association to study on the abolishment of the level crossing.

The major opinions in the study meeting was to abolish the level crossing while securing the bypass route to the neighboring level crossing, and the local government studied on the bypass route and discussed with the relevant parties and reached the results to prepare the bypass route by renting the land owned by the railway operator.

In parallel to the above measures, the document to ask cooperation for the abolishment of the level crossing were distributed to the local residents via the resident's association. After the local government completed the preparation of the bypass route, the D level crossing was abolished.



Abolished class four level crossing
Crossed three routes of three railway operators



Bypass viewed from the site of class four level crossing
Rent the leased land of railway operator

"Integration and abolishment together with neighboring level crossing" is to study the measures as a set with the neighboring level crossing, and plan the reduction of number of level crossings while securing the convenience of local traffic. In addition, there was the case of the integration and abolishment that the level crossing of small traffic was abolished and another level crossing was changed to the class one level crossing in the case that there were plural neighboring class four level crossings.

Furthermore, in the example to realize the abolishment of level crossing, the local government took the leading roles to study the policy of the measurements by hearing the voices of the resident's association, and the local residents, etc., and the local government took measures such as to widen the neighboring level crossing and to prepare the bypass route, therefore, it is considered that the local government took the major roles in this example.

It is necessary to study the measures against the class four level crossing individually responding the circumference of the level crossing and its used status, etc., however, it is expected to promote the studies on the concrete measures by referring these examples.

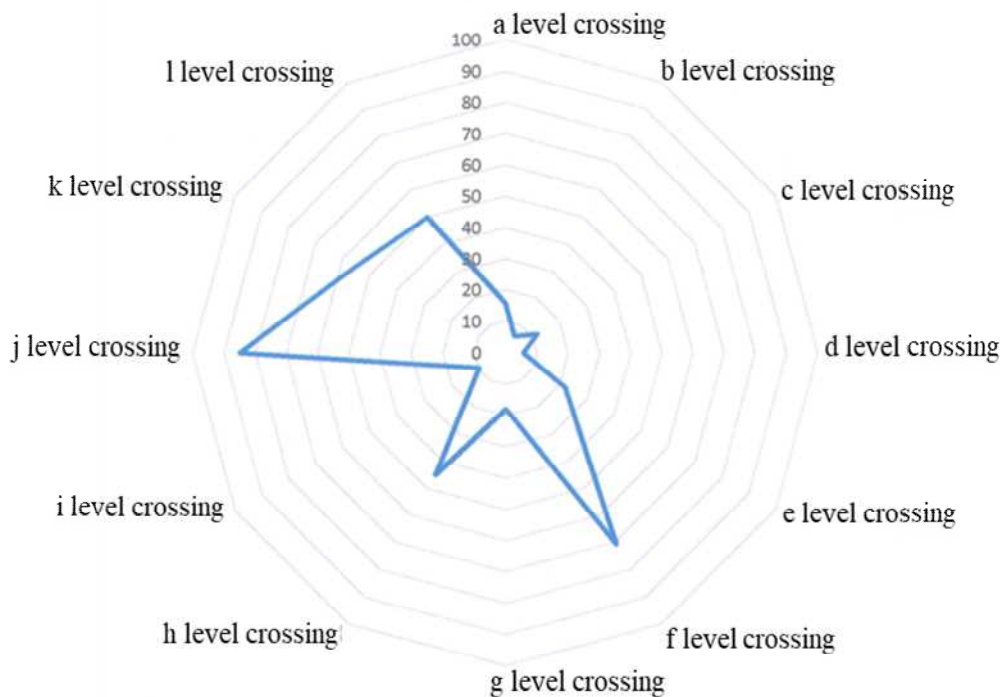
[Reference] Example of material used by the railway operator in the discussion with the local government on the abolishment of level crossing, etc.

Kanto Railway Co., Ltd. has been possessed together with the track side local governments, etc., on the information which visualized the risks to cause accidents, and using effectively for the discussions on the abolishment of individual level crossing and for the promotion of the comprehension on the discussions for urgent implementation of the required safety measures.

The following figure shows the risks to cause accident, based on the status of the occurred accidents, the traffic volume and installed status of level crossing protection devices in individual level crossing, which are converted to the numerical values, indicated in the radar chart and put in order by the level of risks.

It is important to shorten the period till to implement the concrete measures such as the abolishment, etc., as soon as possible, by the positive actions to promote such understandings.

Radar chart on the degree of danger of level crossings, image



Degree of safety	
Obstruction warning signal	-5
Obstruction detecting device	-10
Overhang type warning device	-10
Omnidirectional warning light	-5
Class four warning sign	-5
Hanging belts	-5
Color pavement	-10
Others	-3

Degree of danger	
Contacted accidents in the past 5 years	20
Just before crossing, in the past 5 years	5
Fallen barrier trap, in the past 5 years	5
Class four level crossing	50
Complex shaped level crossing	10
Traffic volume/100, maximum 30	30

High risk level crossing in the city				
Order	Name	Point	Class	Remarks
First	j level crossing	85 pt	Class one	Scheduled to renew the overhang type warning device in 2018
Second	f level crossing	71 pt	Class one	Scheduled to renew the overhang type warning device in 2019
Third	k level crossing	55 pt	Class four	Under discussion for abolishment
Fourth	l level crossing	50 pt	Class one	Prepared overhang type warning device, color pavement, walk way, in 2017 FY
Fifth	h level crossing	45 pt	Class one	

The risks to cause accident were converted to the points based on the degree of safety, *i.e.*, prepared status of safety facilities, etc., and the degree of danger, *i.e.*, the occurred status of accident, visibility, traffic volume, etc., and reviewed by the total point.

6. Temporary measures till to abolish or prepare level crossing protection device for the level crossing without crossing gate

It is necessary to prevent accidents for the moment till to implement abolishment of level crossing without crossing gate or to prepare the level crossing protection devices, by improving the safety even a little by implemented the following temporary measures in addition to the activities of enlightenment described in the column in the next page.

[Facilities related to level crossing]

The following measures can be listed as the measures to improve safety of the class four level crossing. It is expected to attempt to secure the safety by studying the effective measures responded to the circumference of the level crossing including these measures, in order to reduce the risks to cause accident even a little, till to take the concrete measures such as abolishment of level crossing or preparation of level crossing protection devices.

- Measures to control passersby of level crossing
 - Installation of piles to stop passage by automobiles
 - Installation of fences to stop passersby riding bicycles
- Measures to notice the approaching train easily
 - Weeding, constructing weed-killer earth, weed-killer seat in around the level crossing
 - Installation of the whistle sounding sign
- Measures to call attention of passersby by making the existence of level crossing more clearer
 - Installation of level crossing caution fence, caution sign board
 - Indication on the road
 - Indication of the once stop position on the road surface
 - Stop sign, which is the indication to promote the once stop to passersby, and secure the visibility by the flashing LED at night
 - Installation of lighting facility of level crossing



Example of installation of the fence to stop passersby riding bicycles



Installed example of the stop sign

[Traffic control]

It is considered as effective to reduce the risks to cause accident, by asking cooperation for the automobiles, the motorcycles, the motorized bicycles equipped with driving power, which are considered as having high tolerance against a little detouring, to bypass to the overhead crossing road or the class one level crossing of higher safety, in addition to the above measures. Particularly, automobiles are considered as highly dangerous because there are the level crossing where the approaching train cannot be noticed unless to enter the front head of automobile to some extent in the level crossing.

Therefore, it is expected to take positively the traffic control of the class three and the class four level crossing, obtaining cooperation of the relevant administrative organization, from the view point to manage actively the road traffic flow.

To prevent the level crossing accidents, the relevant parties such as the railway operators and the local government, etc., habitually implement the enlightening activities, because it is important for the pedestrians and the drivers who operate automobile, etc., who pass level crossing, to obey the traffic rules and to improve the consciousness for the safety.

Furthermore, the campaign activities to prevent level crossing accident has been implemented in the period of nationwide traffic safety campaign in spring and autumn, etc., and the railway and tramway operators, the police, the parties relevant to the local government including the road administrators, the traffic safety association in each district, every associations relevant to the transportation, the relevant stuffs in the district transport bureau, etc., from the nation, joined to implement concretely the enlightening activities such as the followings.

(1) Enlightening on the streets

The enlightening activities, on the safe passage to the users of level crossing, etc., by distributing the leaflet and goods, etc., on the streets in around the level crossing and in the premises of stations.

(2) Enlightening publicity

The enlightening publicity on the prevention of accidents by the public announce system in the station and the trains, broadcasting appearing the prevention of accidents periodically by the radio as the media, the posters and the large electric display, etc., in the stations.

(3) Enlightening activities for aged people and children

Particularly, many accidents related with the aged persons, and the safety education in childhood is important, therefore, drawing up leaflet to prevent level crossing accidents for the aged persons and asking cooperation to distribute them in the old-age homes, the medical facilities such as hospitals, etc., the old people's club association, etc., and guiding on the passage in level crossing targeted to little children and elementary school children, etc.



Enlightening leaflet for aged people drawn by the Chugoku District Transport Bureau



Enlightening activity in "railway course" cosponsored by the Kanto District Transport Bureau and Fiji Kyuko Co., Ltd.

We sincerely hope that these enlightening activities promote to improve consciousness for the prevention of accidents, and result to the reduction of occurrence of the level crossing accidents.

7. Examples of accident investigations, focused on the factors related to that the approaching train could not be noticed, shown in Table 4, in page 22 to 23.

(i) Bad visibility of train from once stop position at the level crossing

Case 1. Occurred at about 12:46, Tuesday, September 27, 2016 [No.22 in Table 3]

Level crossing accident where visibility of train from level crossing is limited and train passed in high speed.

Summary : When the driver of the local train composed of four vehicles was going to sound a whistle at the place about 50 m before the level crossing, noticed a motorized bicycle entering the level crossing from left, so that, immediately sounded the whistle and applied the emergency brake, but the train collided with the motorized bicycle. The driver of the motorized bicycle was dead in this accident.

Probable causes : It is highly probable that the accident occurred as the train collided with a motorized bicycle, because the motorized bicycle entered class four level crossing without crossing gate nor road warning device, in the situation that the train was approaching . As it is somewhat likely that the motorized bicycle entered the level crossing where the train was approaching, related with the restricted visibility of the track by houses, hedges and overgrown weeds, but it could not be determined the precise situations because the driver of the motorized bicycle was dead.

Analysis on the improvement of safety in the accident level crossing :

The sight distance of the train was about 103 m from the central position of the level crossing caution fences, *i.e.*, center of the level crossing fence apart about 2.0 m from left rail, restricted by houses, hedges and overgrown weeds, and it takes about 4 seconds when train runs this distance at the velocity of about 95 km/h. It is somewhat likely that the passerby started to cross level crossing after confirmed that there was no train in the visible distance, cannot finish crossing the level crossing in this time.

It is expected for the railway operator to secure always the maximum sighting distance as possible, by implementing properly the weeding in the periphery so as to increase sighting distance even a little for the passersby of the accident level crossing, because the safety of class four level crossing is secured by the precondition that the passersby can confirm the safety in left and right directions sufficiently.

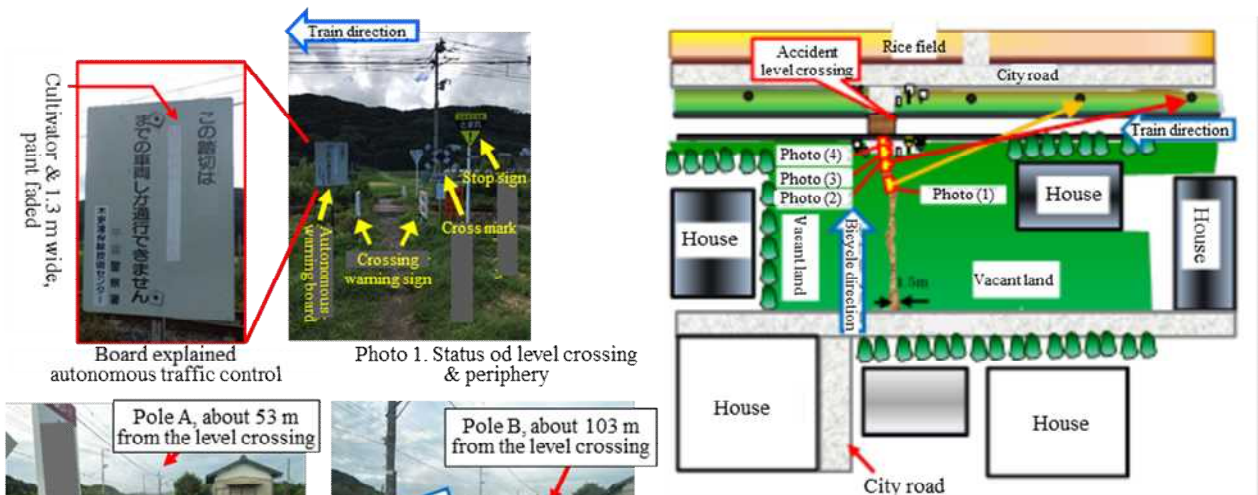


Figure. Status of level crossing & periphery

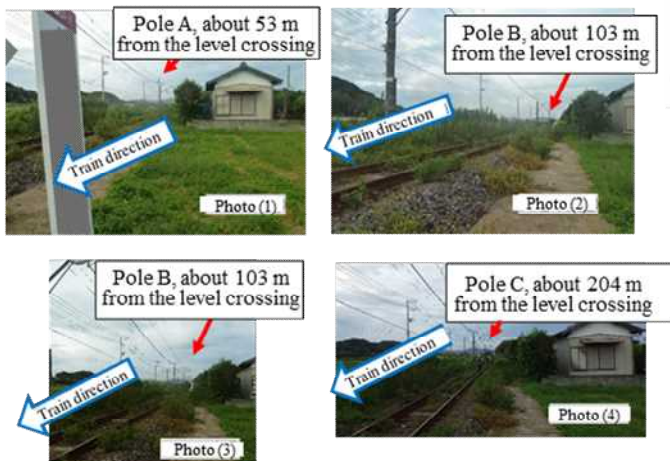


Photo 2. Sighting toward Minami-Mihara sta. from level crossing, taken at the positions of Photos (1) to (4)

For the prevention of the recurrence

Matters expected to prevent recurrence :

It is necessary for the railway operator and the municipality to cooperate to implement continuously the discussions for the integration and abolishment of class four level crossing, considering the high speed, about 95 km/h, of the trains passing the accident level crossing, even though class four level crossing is secured its safety by the precondition that the passersby can confirm the safety in left and right directions sufficiently.

It is expected to take the following measures for the accident level crossing till to complete integration and abolishment of the level crossing or the preparation of the level crossing protection devices.

- (1) To secure the maximum sighting distance as possible for the passersby, by implementing properly the weeding in the periphery, etc., for the accident level crossing.
- (2) Railway operator shall study on the measures to sound a whistle at the proper position, in order to let the passersby using the accident level crossing notice the approaching train.

The accident in the level crossing where driver seated in the automobile is hard to see approaching train

Summary : The driver of the local train, composed of one vehicle, noticed an automobile entering level crossing from right at about 30 m before the level crossing and applied the emergency brake and sounded a whistle immediately, but the train collided with the automobile. The driver of the automobile was dead in this accident.

Probable causes : It is highly probable that the accident occurred as the train collided with an automobile because the automobile entered class four level crossing without crossing gate nor road warning device, in the situation that the train was approaching.

It is somewhat likely that the automobile entered to the level crossing in the situation that the train was approaching related to that the driver seated in the automobile was hard to see the approaching train. However it could not be determined precise situations because the driver of the automobile was dead.

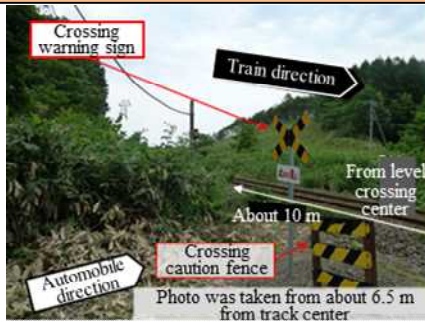
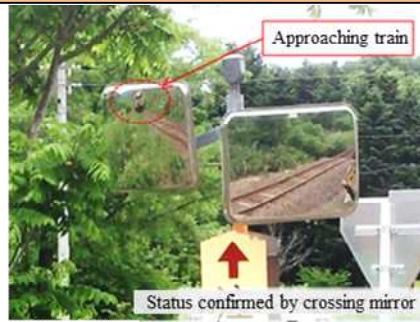


Photo 1. Sight of train viewed from the driver of bicycle



Confirmed by the train operated at the same time as the accident train in the next day of this accident.

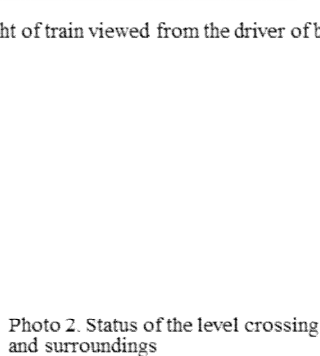
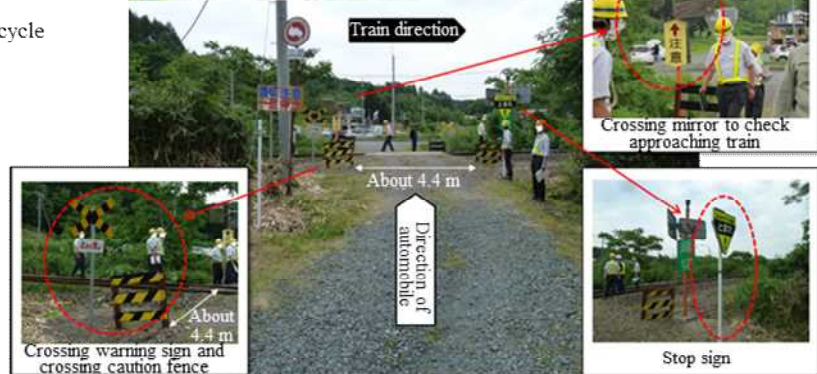


Photo 2. Status of the level crossing and surroundings



For the prevention of the recurrence

Matters expected to prevent recurrence :

Railway operator has studied various measures to prevent accident in class four level crossing such as to install the level crossing mirror and the stop sign, etc., since the occurrence of this accident, and promoted by established the full-time system from April 2017. It is desirable to attempt to improve safety by promoting these measures continuously.

Furthermore, considering that the level crossing accident in which the driver of automobile crossing the accident level crossing was dead had occurred in the past, it is expected for the relevant parties such as the local relevant persons and the railway operator, etc., to restart the discussion in early stage and study on the abolishment, etc., and implement measures. It is considered as a measure to improve safety by prohibiting the passage of automobiles through a year, till to complete the above measures.

Matters expected to prevent accident of automobile in class four level crossing, extracted

It is probable that there is the characteristic that the driver of automobile is hard to confirm the train compared to the pedestrian because the driver confirmed the approaching train from the position of the driver's seat, although the circumferences of level crossings, where the accident with automobile had occurred, are not uniform.

Therefore, from the view point to improve safety of the traffic circumference still more by guiding the passersby driving automobiles to the neighboring two-layer crossing or class one level crossing where they can detour safely, it is considered as effective to prevent accident by taking the traffic control positively such as to close for automobiles till to "abolish class four level crossing or to prepare the level crossing protection devices when remained as the level crossing". It is desirable for the railway operators, the road administrators and individual relevant administrative organization to attempt to promote these measures.

It was found that there were the cases that the contents of regulation in the plural traffic control signs installed in level crossings are inconsistent, and that the understandings in the relevant parties on the traffic control were inconsistent, in the past accident investigations. Therefore, it is expected to pay attention as to comprehend the actual status of the facilities and revise if necessary, in order to let the contents of the traffic control known properly to the passersby of level crossing.

(ii) Passerby of level crossing, cars, etc., did not stop before the level crossing.

Case 3.

Occurred at about 14:35, Monday, March 6, 2017 [No.28 in Table 3]

Accident considered as passerby of level crossing, bicycle, did not stop once at just before the level crossing

Summary : The driver of the local train, composed of one vehicle, noticed a passerby riding bicycle about 20 to 30 m before the level crossing, and applied the emergency brake, but the train collided with the passerby. The passerby was dead in this accident.

Probable causes : It is highly probable that the accident occurred as the train collided with a passerby riding bicycle, because the passerby riding bicycle entered the level crossing in the situation that the train was approaching to class four level crossing without crossing gate nor road warning device.

It is probable that the passerby did not stop just before the level crossing in the situation that the train was approaching, and entered the level crossing without confirming the approaching train well. However, it could not be determined the reason why the passerby entered the level crossing, because the passerby was dead.



Photo 1. Status of level crossing viewed from the entered bicycle



Photo 2. Sight in around the place of fence in the entered side of the bicycle



Photo 3. Image in the image recording device of the accident train, before about 100 m

For the prevention of the recurrence

Matters expected to prevent recurrence :

Class four level crossing without crossing gate nor road warning device should be abolished or prepared the level crossing protection devices. It is desirable to implement continuously the study on the abolishment or the change to class one level crossing, for this accident level crossing.

The investigation report of this case is published in the home page of the JTSB, published on January 25, 2018, <http://www.mlit.go.jp/jtsb/railway/rep-acci/RA2018-1-3.pdf>

(iii) Affected by the restriction of physical functions of the passerby of level crossing.

Case 4. Occurred at about 11:04, Thursday, March 23, 2017 [No.4 in Table 3]

Accident considered as affected by the status of physical function of the passerby in class three level crossing

Summary : The driver of the local train, composed of one vehicle, noticed a pedestrian went up the side walk at the place about 70 m before level crossing, and sounded a whistle once to call attention, but the pedestrian did not stop. The driver noticed the pedestrian entering the level crossing from right although the red flashing lamp was operating, at the place about 50 m before the level crossing, so that, continued to sound a whistle and applied the emergency brake, but the train contacted with the pedestrian. The pedestrian was dead in this accident.

Probable causes : It is probable that the accident occurred as the train contacted with a pedestrian because the pedestrian entered class three level crossing equipped with road warning device, in the situation that the road warning device was operating according to the approaching train.

It is somewhat likely that the pedestrian entered the level crossing in the situation that the road warning device was operating responded to approaching train, related with the situation that the pedestrian had been lost hearing sense. Also, it is somewhat likely that the pedestrian could not recognize red flashing lights when the pedestrian entered the level crossing, but the precise situation could not be determined because the pedestrian was dead.

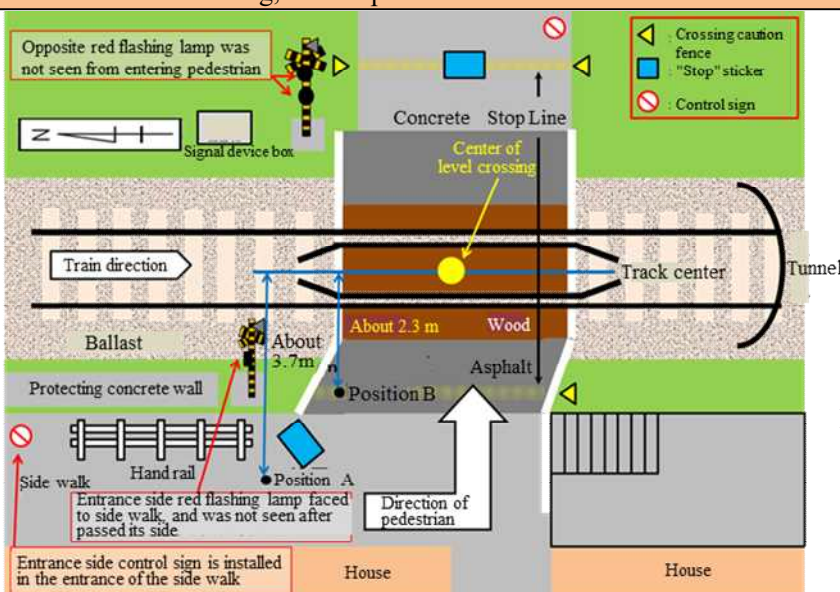


Figure. Status of level crossing and periphery and layout of level crossing protection devices, etc.

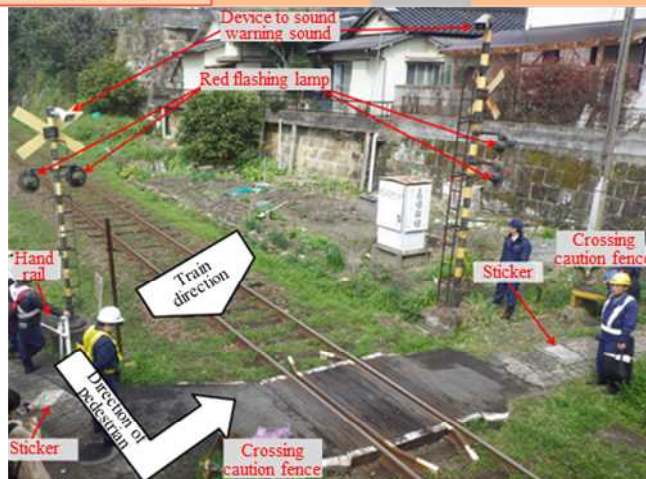


Photo. Status of level crossing and periphery

For the prevention of the recurrence

Matters expected to prevent recurrence :

The accident level crossing was class three level crossing equipped with road warning device, however, it is desirable to install omnidirectional red flashing lamp, to enable the passersby certainly recognize the operation of road warning device accompanied to the approaching train. Furthermore, it is expected for the relevant parties to cooperate with each other to improve the safety from the present status, as to install crossing gate in addition to road warning device, to deter the passersby from mistaking to enter the level crossing, In addition, it is desirable to maintain the measures applied to the accident level crossing in the proper status.

The investigation report of this case is published in the home page of the JTSB, published on September 28, 2017, <http://www.mlit.go.jp/jtsb/railway/rep-acci/RA2017-7-1.pdf>

[Reference] Table 3. List of accidents with fatality occurred in class three and class four level crossings after April 2014, accidents that investigation reports had been published.

[Class three level crossing]

No.	Date	Passerby	Age of passerby or driver	Train speed when noticed passerby	Traffic control	Major measures implemented after accident	Remarks
1	Oct. 3, 2014	Pedestrian	71	64	Closed for automobile except for two wheeled vehicle		Passerby is hearing impairment
2	June 10, 2016	Subcompact car	73	63	No traffic control	Logged bushes, repaint crossing caution fence, indicated once stop line, install reflecting mirror, enlightened by information bulletin	
3	Nov. 10, 2016	Pedestrian	81	61	Closed for automobile except for two wheeled vehicle	Trimmed garden trees, installed omnidirectional red flashing lamp	Passerby is hearing impairment
4	Mar. 23, 2017	Pedestrian	67	55	Closed for automobile except for two wheeled vehicle	Repainted stop line, planted board, installed omnidirectional red flashing lamp	Passerby is hearing impairment
5	Sept. 18, 2017	Bicycle	18	50	Closed for automobile except for two wheeled vehicle, excluded subcompact car & small sized special vehicle	Added car stop, installed omnidirectional red flashing lamp, paint "stop" on road surface, indicated stop line, enlightening activity, asked principal of elementary and junior high school in the city to guide to prevent accident, distributed leaflet in stations	
6	Apr. 11, 2018	Pedestrian	29	81	Closed for automobile except for two wheeled vehicle, excluded small sized special vehicle		Passerby was laid in level crossing

[Class four level crossing]

No.	Date	Passerby	Age of passerby or driver	Train speed when noticed passerby	Traffic control	Major measures implemented after accident	Remarks
7	Apr. 12, 2014	Small sized special vehicle	77	64	Closed for automobile except for two wheeled vehicle	Installed metal piles as automobiles except for two wheeled vehicle cannot pass	
8	June 9, 2014	Compact sedan	25	80	No traffic control		
9	July 11, 2014	Standard sized automobile	70	50	No traffic control		Train derailment accident accompanied to level crossing accident
10	Oct. 27, 2014	Motorized bicycle	18	75	No traffic control		
11	June 19, 2015	Pedestrian	83	60	Closed for automobile except for two wheeled vehicle, excluded small sized special vehicle	Installed whistle sounding sign in 32 places in 21 level crossing, replaced other whistle sounding signs in 32 places in 22 level crossings	Passerby : disabled one leg, hard to hear in one ear
12	Aug. 26, 2015	Subcompact car	79	73	Closed for automobile except for two wheeled vehicle, excluded subcompact car, & small sized special vehicle	Logged treed and plants, removed caution board, rebuild crossing caution fence	
13	Nov. 14, 2015	Subcompact car	82	68	Closed for large sized vehicle	Installed whistle sounding sign	
14	Mar. 3, 2016	Pedestrian	46	65 - 70	No traffic control		
15	Mar. 20, 2016	Pedestrian	91	52 - 53	Closed for entire automobiles		passerby was hard of hearing
16	June 17, 2016	Pedestrian	32	75	Closed for entire automobiles	Abolished level crossing	Passerby wore earphone
17	July 7, 2016	Pedestrian	73	120	Closed for entire automobiles		Passerby, brain lost function, left eye could see faintly

No.	Date	Passerby	Age of passerby or driver	Train speed when noticed passerby	Traffic control	Major measures implemented after accident	Remarks
18	July 29, 2016	Bicycle	64	85	Closed for automobile except for two wheeled vehicle	Study to advance period to abolish level crossing scheduled in 2018 to 2019 FY.	
19	Aug. 22, 2016	Subcompact car	71	44	No traffic control	Remove trees and plants	
20	Sept. 6, 2016	Subcompact car	70	60	No traffic control	Logged bushes, remove weeds, road construction to relax gradient, installed cross mark & crossing caution board.	
21	Sept. 12, 2016	Bicycle	9	65	Closed for all automobiles	Logged bushes, installed control piles, <i>i.e.</i> , car stop, abolished level crossing	
22	Sept. 27, 2016	Motorized bicycle	26	84	Closed for vehicles excluded cultivator and the vehicle of less than 1.3 m wide	Remove weeds, installed whistle sounding sign	
23	Oct. 8, 2016	Subcompact car	36	80	Closed for automobile except for two wheeled vehicle, excluded subcompact car & small sized special vehicle	Weeded, installed weed resist seats, enlightened by local information bulletin	
24	Oct. 16, 2016	Standard sized automobile	30	35	No traffic control	Yellow painted level crossing road surface, reconstruct stop lines, enlarged reflecting mirror, installed no entry board	
25	Nov. 2, 2016	Motorized bicycle	73	61	Closed for automobile except for two wheeled vehicle, excluded small sized special vehicle, & closed for all traffic in the period of snowfall in winter	Logged weeds, installed reflecting mirror, installed whistle sounding sign	
26	Nov. 6, 2016	Subcompact car	82	85	Closed for automobile except for two wheeled vehicle, excluded subcompact car, small sized special vehicle	Abolished level crossing	
27	Jan. 8, 2017	Pedestrian	73	57	Closed for automobile except for two wheeled vehicle, excluded subcompact car, small sized special vehicle		
28	Mar. 6, 2017	Bicycle	83	77	Closed for automobile except for two wheeled vehicle, excluded small sized special vehicle	Changed paint on road edge to reflecting orange color, enlightened by the disaster administrative radio	
29	June 20, 2017	Standard sized automobile	33	73	Closed for large sized automobile	Mowed, installed whistle sounding sign	Proposed against traffic control for automobiles
30	June 27, 2017	Pedestrian	30	78	Closed for automobile except for two wheeled vehicle	Scheduled to abolish level crossing	
31	Sept. 7, 2017	Motorized bicycle	26	70	Closed for automobile except for two wheeled vehicle	Repaired control piles, changed crossing warning sign, repair crossing caution fences, repaved city road, indicated "caution to cross"	
32	Jan. 16, 2018	Motorized bicycle	50	82	No traffic control	Logged bamboos, scatter weed killers to base surface of construction	
33	Feb. 27, 2018	Pedestrian	44	77	Closed for automobile except for two wheeled vehicle		
34	July 10, 2018	Pedestrian	74	83	Closed for vehicles, excluded bicycle		

* "Train speed when noticed passerby" was indicated in the unit "km/h".

* "Traffic control" is at the time of occurrence of the accident.

* "Major measures implemented after accident" is the major measures described in individual reports.

[Reference] Table 4. Related factors in the column of probable causes, extracted from individual report

(i) Bad visibility of the train from the once stop position of level crossing

- It is probable that the driver of the subcompact truck drove the subcompact truck into level crossing where train was approaching, because the driver of the subcompact truck did not recognize the approaching train correctly, although it is considered that the driver of the subcompact truck had stopped once the subcompact truck before the level crossing and confirmed the train.

It is somewhat likely that the driver of subcompact truck did not recognize the approaching train correctly affected by that it was hard to confirm the approaching train from the once stop position of level crossing due to the bushes and the signboard, etc. [12]

- It is somewhat likely that a pedestrian entered a level crossing in the status as the train was approaching because the pedestrian did not notice the approaching train.

It is somewhat likely that the pedestrian did not notice the approaching train affected by the disturbed visibility due to the existence of hedges, etc., although pedestrians can confirm direction of the train directly unless to enter the level crossing. [15]

- It is somewhat likely that the bad visibility to the direction of approaching train due to the thickly wooded area, etc., in the track side had related to disturb the driver of the subcompact car to confirm safety in left and right directions sufficiently at before the level crossing, and the rainy weather at the time of the accident and the farm road was winding to right and steep upgrade gradient at just before the level crossing were related to cause the factor to reduce attentiveness of the driver against approaching train. [20]

- It is somewhat likely that the passerby riding bicycle entered level crossing in the situation that the train was approaching, related by the situation that the approaching train could not be sighted by the miscellaneous trees unless the passerby got closer to around the prop of the cross mark. [21]

- It is somewhat likely that the motorized bicycle entered the level crossing in the situation that the train was approaching related by that the visibility of the railway track was restricted by houses, hedges, and dense weeds. [22]

- It is somewhat likely that the driver of automobile drove the automobile into level crossing in the situation that the train was approaching, related to that the visibility of the train was bad. [24]

- It is somewhat likely that the motorized bicycle entered the level crossing in the situation that the train was approaching to the level crossing, related by the situation that the driver of the motorized bicycle was hard to see the train by the dense weeds unless to get closer to the level crossing from the location of the crossing caution fence. [25]

- It is somewhat likely that automobile entered level crossing in the situation that the train was approaching, related by that the driver of the automobile was hard to see the approaching train in the status as boarding on the automobile. [29]

(ii) Passerby of level crossing, vehicle, etc., did not stop before the level crossing

- It is probable that the accident occurred because the motorized bicycle entered the level crossing without stopped, although train was approaching to the level crossing, and collided with the train. [10]

- It is probable that the passerby riding bicycle entered the level crossing as did not confirm the approaching train sufficiently without stopped once before the level crossing, in the status that the train was approaching. [28]

- It is probable that the driver of the motorized bicycle entered the level crossing because the driver did not confirm the status the the train was approaching sufficiently, unless stopped once just before the level crossing, in the situation that the train was approaching. [31]

(iii) The restriction by physical function of the passerby of level crossing was affected

- It is highly probable that the pedestrian entered the level crossing while warning sound of the road warning device was sounding and did not notice the whistle of train because the pedestrian could not hear the warning sound and the whistle because the pedestrian was a deaf person.
It is somewhat likely that the pedestrian entered the level crossing while the red flashing lamp was flashing, affected by the following situations.
 - (1) The pedestrian was in the situation as hard to see the flashing of the red flashing lamps because the field of vision became narrow due to the parasol and the wide brim hat.
 - (2) The flashing of the red flashing light was in the status as hard to be seen by reflection of the sun light. [1]
- It is somewhat likely that the pedestrian entered the level crossing in the situation that the road warning device was operating, related by that the hearing ability of both ears of the pedestrian were deteriorated. Furthermore, it is somewhat likely that the pedestrian could not confirm the red flashing lamp when entered the level crossing. [3]
- It is somewhat likely that the pedestrian entered the level crossing in the status that the road warning device was operating responded to the approaching train, related by that the pedestrian had lost hearing sense. Furthermore, it is somewhat likely that the pedestrian could not recognize the red flashing lamp when entered the level crossing. [4]

* Numbers in [] in the above table were the numbers in the "No." column in Table 3, page 20 - 21.

[Reference] Support systems on the preparation of level crossing protection devices

The national support system can be utilized to prepare the level crossing protection devices.

Support for working expense for general safety measures of railway facilities

Assist a part of expense of the preparation for the purpose to contribute to the prevention of accidents and the smooth traffic by preparation of the level crossing protection devices, based on the "Act on the promotion of improvement of level crossing".

1. Contents of the project

Installation of the level crossing protecting device, such as the crossing gate, the road warning device, etc.

2. The target of the support

(1) Railway and tramway operators other than the regional public bodies

The operators who meet one of the followings,

- the deficit
- the operating loss
- the fixed assets for business is less than 7 % of the operating profit rate in the railway and tramway business, and at the same time,

the operators who meet one of the followings,

- the deficit
- the operating loss
- the fixed assets for business is less than 10 % of the operating profit rate in the whole business.

(2) Railway operators who are the regional public body

The operator generated the deficit in the railway and tramway business.

3. Rate of support

Within a half of the expense to be supported, or within one third of the expense to be supported if generated the ordinary profit in the railway and tramway business.

8. For the future

The Japan Transport Safety Board, the JTSB, implemented objectively the investigation on the accidents with fatality occurred in class three and class four level crossings without crossing gate, showed the probable causes in the railway accident investigation reports, and made clear the dangerous factors such as the sighting status of the level crossing and the train velocity, etc., and stated the measures to prevent the recurrence.

On the other hand, in order to eliminate accidents in the level crossing without crossing gate having the high danger potentially, it is necessary to implement steadily the concrete measures to abolish or to prepare crossing gate and road warning device even in the other level crossings, and to plan the reduction of the number of class three and class four level crossings in early stage.

For this reason, the JTSB plans to promote investigation and researches required to offer the proposals on the prevention of accidents such as to comprehend the actual status of the high risk class three and class four level crossings as described in 3. (3), such as high train velocity and large number of operating trains, etc., as the theme of the analysis to prevent accidents in the JTSB.

9. Conclusion

The JTSB expects, by dispatching information via the investigation reports, etc., for the railway operators, the local government, etc., who take the responsibility on traffic policy and the management and control of the roads in the regions, the people living in the region, to recognize commonly the actual status of level crossings including the dangerous factors, and the measures for the safety, and lead to the promotion of discussions in the relevant parties and concrete actions.

The JTSB will conduct the investigation on the accidents with fatality in class three and class four level crossings continuously, and concentrate our efforts as to contribute to the improvement of safety in the level crossing, by effort to provide the required information including proposals on the measures to prevent the recurrence.

To edit this bulletin, the JTSB expressed its sincere thanks to many relevant parties, including Chikusei City Office, Kanto Tetsudo Co., Ltd., Fuji Kyuko Co., Ltd.

Comment from the Chairperson

The 16 persons were dead in the level crossing without crossing gate in FY2016. It was sad that seven persons were dead, including the student of elementary school riding bicycle and young person boarding automobile, by the end of January in this fiscal year.

The railways have been prepared all over the country and composed the convenient traffic network in Japan. Recent years, the convenience has been improved still more, as there are the routes between major cities where trains are operated in high speed nearly to 120 km/h. However, the level crossings without crossing gates have been existed actually in these high speed routes. It is said that class four level crossing without crossing gate nor road warning device is same as the pedestrian cross the crosswalk in the superhighway, however, it can be said that class four level crossing is more dangerous considered that the train require the several times longer braking distance compared to automobiles.

The Article 40 "level crossing" in the "Ministerial Ordinance Providing for the Technological Standard for Railways", Ministerial Ordinance No.151 prescribed by the Ministry of Land, Infrastructure, Transport and Tourism, 2001, prescribed that the level crossing shall equip the level crossing protection device, such as the crossing gate and the road warning device. However, the provisions for the interim measures prescribe as "it can conform to the conventional cases", as the results, about 2,700 class four level crossings are still remained. I felt from the bottom of my heart through the analyses to prevent accidents that I would like to ask the operators sides to promote to change to class one level crossing positively, for the safe and stable operation of the trains in the main line where many trains are operated in high speed, even though it seems difficult to abolish level crossing due to the convenience, etc., of the neighboring residents.

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Opinions for the JTSB Digest and request for the course on demand are welcomed.