Republic of the Union of Myanmar
Ministry of Construction, PW

The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar

Technical Note on National Highway & Expressway

(Geometric Structure & Traffic Safety Facility)

June 2015

Japan International Cooperation Agency
（JICA）

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TECHNICAL NOTE
ON
NATIONAL HIGHWAY
& EXPRESSWAY

(Geometric Structure & Traffic Safety Facility)

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The Project for Improvement of Road Technology in Disaster Affected Area in Myanmar

Department of Highway, Ministry of Construction	**JICA Expert Team**

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0. Summary

0.1 Purpose and Outline of the Work

JICA Expert Team (the Team) conducted to develop the proposal for mitigation of traffic accident in aspect of road geometric structure and traffic safety facility through the following works.

- ✓ Site investigation to identify issues on the national highways and the expressway.
- ✓ Analysis of the issues.
- ✓ Developing proposal for the solution.

0.2 Classification of the Identified Issues

The Team classified the issues according to major causes as listed below. After then the Team analyzed the each cause to consider its solution.

(1) Inappropriate arrangement and/or absence of road furniture
(2) Unnecessary object is continued to exist
(3) Inappropriate road geometric structure
(4) Inappropriate work manner
(5) Inappropriate traffic manner
(6) Defect due to inappropriate construction quality

0.3 Proposal for the Solution

The Team developed the proposal for the solution against the above stated issues by examining practicability level of the solution from A to C in accordance with the following criteria.

- **Level-A: High practicability**
  Implementation will be enabled by internal approval in MOC. Cost is low and period is short.
- **Level-B: Moderate practicability**
  Implementation will be enabled by the government's approval and/or co-working with other Ministries. Cost is low – medium and/or period is medium – long.
- **Level-C: Low practicability**
  Implementation will be enabled by the government's approval and/or co-working with other Ministries. Cost is high and/or period is long.

Summary of the proposal is as shown in the following table.

Summary of the Proposal for the Solution

No.	Issue	Approach (desirable)	Practicability	Approach (secondary)	Practicability
(1)	Inappropriate arrangement and/or absence of road furniture	- Rearrangement, relocation and/or newly installation	A		
(2)	Unnecessary object is continued to exist	- Removal	A		
(3)	Inappropriate road geometric structure	- Large scale realignment & reconstruction - Slope cutting & road widening	C	- Install traffic safety facility	A – B
(4)	Inappropriate work manner	- Prepare work manual & training program	B	- Establish work cycle	A
(5)	Inappropriate traffic manner	- Reinforce penal regulation - Access control to expressway	C	- Public awareness campaign of traffic safety	B
(6)	Defect due to inappropriate construction quality	- Repair work based on investigation & design in appropriate manner	C	- Install traffic safety facility - Temporary repair work	A – B

0.4 Action Taken by the Government of Myanmar

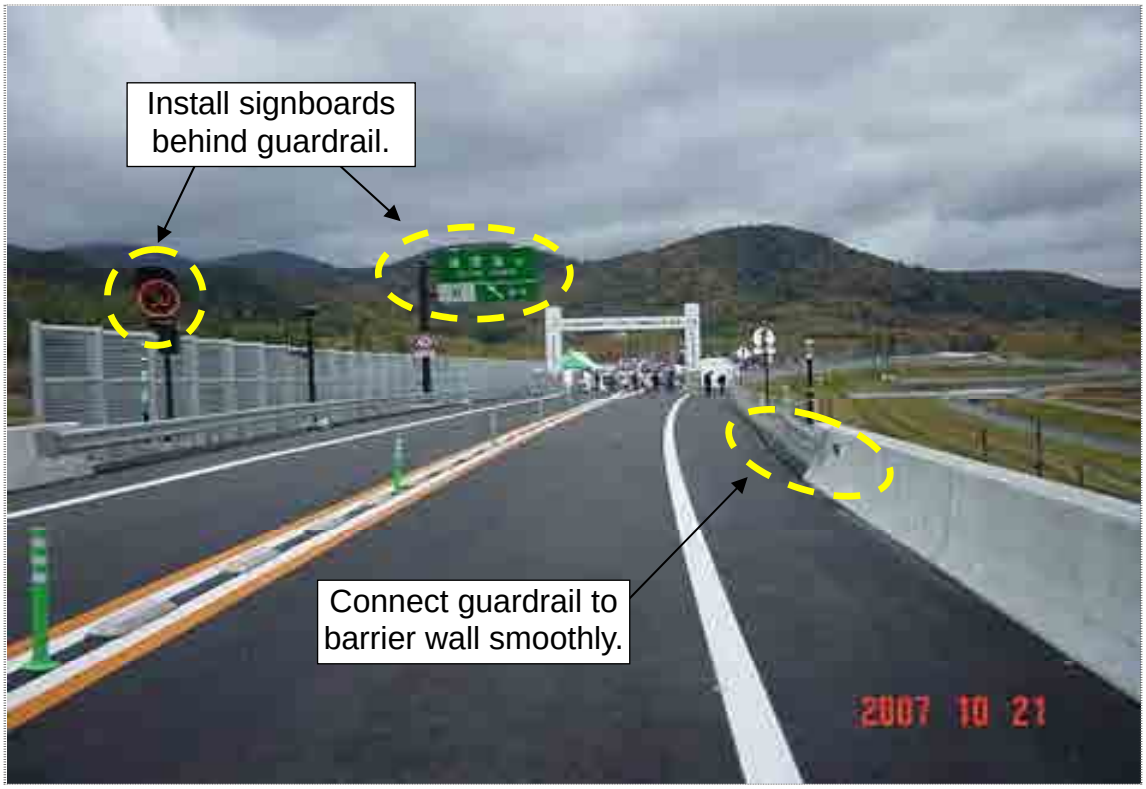
The counterpart (CP) of the Government of Myanmar took swift action to solve the issues in response to the discussion with the Team as shown in the following figure.

Location : 2mile-5furlong in Yangon – Mandalay Expressway
Action : Removal of unnesessary concrete posts

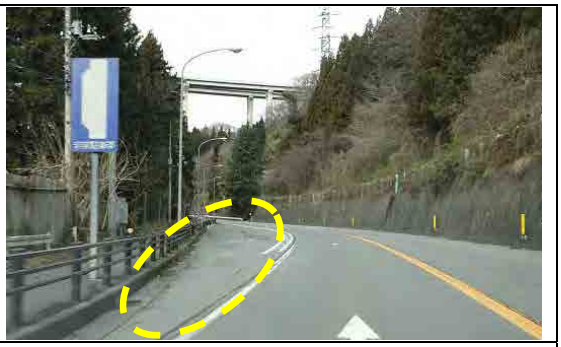
Action Outcome of the CP

0.5 Effort by the Road Agencies in Japan

The Team introduces the effort by the Japanese road agencies in both road classifications namely expressway and national highway. Sample photos are as shown below.



Arrangement View of Traffic safety Facilities in the Expressway

	
Daily patrol by the office (collecting obstacles on the road).	Turnout bay in mountainous section.

Work View and Road Facility in the National Highway

1. Introduction

1.1 Work Purpose

JICA Expert Team (the Team) conducted the work to mitigate risk of traffic accident on the road infrastructure in aspect of road geometric structure and traffic safety facility. The Team implemented site investigation works on both of road categories namely national highway and expressway to identify the issues those threatening traffic safety. Subsequently, the Team analyzed the issues and considered to develop the mitigation approaches.

The work output is compiled in this "TECHNICAL NOTE ON NTIONAL HIGHWAY & EXPRESSWAY (Geometric Structure & Traffic Safety Facility)".

1.2 Work Outline

The Team implemented a total of 8 times site investigation works on the following routes. The work schedule is as shown in Table 1.2.1. Furthermore, the route map is as illustrated in Figure 1.2.1.

(i) Yangon-Mandalay Expressway
(ii) National Highway No.1 (Nay Pyi Taw, Bago Region & Yangon Region)
(iii) National Highway No.4 (Shan State)

Table 1.2.1 Investigation Schedule

No.	Period	Route	Investigation Section
1	3 – 4, Oct, 2013	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw – Mandalay
2	28 – 31, Jan, 2014	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw – Mandalay
3	7 – 8, Jul, 2014	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw
4	20, Aug, 2014	National Highway No.1	Nay Pyi Taw – Yangon
5	21 & 23, Aug, 2014	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw
6	27, Oct, 2014	Yangon-Mandalay Expressway	185/0 – 185/1 (Pilot work section for installation of various delineators)
7	28 – 29, Oct, 2014	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw
8	17 – 20, Dec, 2014	National Highway No.4 (Shan State)	Heho – Taunggyi – Loilem – Takaw

Figure 1.2.1 Route Map of Site Investigation Work

1.3 Work Approach

The work is composed of;-

- ✓ site investigation to identify issues,
- ✓ analysis of the issues, and
- ✓ developing proposal for the solution.

Each work component is summarized as follows. Furthermore, Details of the works are described in Chapter 2.

(1) Site Investigation Work

The Team executed visual investigation on vehicle basis to identify extraordinary situation occurred on road geometric structure and traffic safety facility on the investigated route. After then, the Team got off from the vehicle for taking photo and note in case of the identifying. Working photos during the investigation are as shown in Figure 1.3.1.

	
Visual investigation in the vehicle	Investigation on foot

Figure 1.3.1 Working Photos in the Site Investigation

(2) Analysis of the Identified Issues

The Team discussed and analyzed the identified issues to clarify its cause and find clue for the solution. Note example in Japan was often referred for comparative analysis work as shown in Figure 1.3.2.

	
Mountainous road without safety facility (Shan State)	Mountainous road with guardrail & mirror (Japan)

Figure 1.3.2 Comparison of Roads between Myanmar and Japan

(3) Developing Proposal for solution

The Team finalized and compiled proposal for solution on the basis of the above works. Examples of the proposal are as shown in Figure 1.3.3.

	
Proposal Guardrail should be connected with bridge handrail gradually and smoothly to prevent severe accident.	**Proposal** Unnecessary posts should be removed to prevent potential accident.

Figure 1.3.3 Examples of Proposals for the Solution

2. Work Contents

2.1 Classification of the Issues

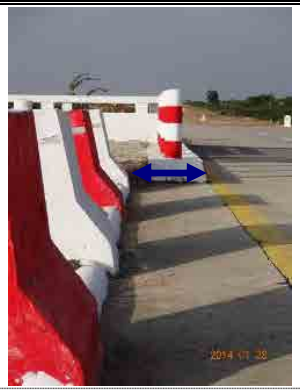
At first, the Team classified the issues according to major causes as listed below. After then the Team worked for analysis of the each cause to consider its solution. The work detail is described in the following clauses.

(1) Inappropriate arrangement and/or absence of road furniture
(2) Unnecessary object is continued to exist
(3) Inappropriate road geometric structure
(4) Inappropriate work manner
(5) Inappropriate traffic manner
(6) Defect due to inappropriate construction quality

2.2 Analysis of the Issues

The Team listed up frequent observations of the each issue in Table 2.2.1 – 2.2.6 respectively. Furthermore, negative effect if the situation remains neglected is also stated in the tables.

Table 2.2.1 Observation of the Issues: (1) Inappropriate Arrangement and/or Absence of Road Furniture

No.	Observation & Effect (If Neglect)	Photo	
1	**(Observation)** - The furniture is not located in a straight line each other. **(Effect)** - Damage will be severer if vehicle hits gap between the objects.		
		Parapet wall is located ahead of the curb stone.	Foundation of post is located ahead of the parapet walls.
2	**(Observation)** - The furniture is located ahead of protective facility (e.g. guardrail). **(Effect)** - Damage will be severer if vehicle hits the object.		
		Traffic sign is located ahead of guardrail.	Milestone post is located ahead of guardrail.

No.	Observation & Effect (If Neglect)	Photo	
3	**(Observation)** - Inappropriate alignment/location of guardrail. **(Effect)** - Damage will be severer due to inappropriate alignment/location as stated in right columns.		
		Gap between guardrail and handrail on bridge. Overrun vehicle may hit concrete block.	Guardrail is installed inside of the curve instead of outside. Over speeded vehicle may overrun from carriageway.
4	**(Observation)** - Absence of the furniture. **(Effect)** - Risk of accident will increase due to the absence as stated in right columns.		
		No lane mark on road surface. Risk of a head-on collision will increase.	No guardrail and mirror on mountainous road. Risk of fall accident and/or head-on collision will increase.

No.	Observation & Effect (If Neglect)	Photo	
5	**(Observation)** - Object is installed within road clearance limit. **(Effect)** - Risk of hit by large vehicle will increase.		
		Sign board is too close to carriageway and too low.	Electric wire seems too low.

Table 2.2.2 Observation of the Issues: (2) Unnecessary Object is Continued to Exist

No.	Observation & Effect (If Neglect)	Photo	
1	**(Observation)** - Concrete objects remain existed. **(Effect)** - Risk of accident (collision) will increase due to the existence.		
		Concrete posts at beginning of ramp section.	Concrete blocks at end of widening section.
		Concrete walls in front of widened bridge.	Former parking area (?)

Table 2.2.3 Observation of the Issues: (3) Inappropriate Road Geometric Structure

No.	Observation & Effect (If Neglect)	Photo	
1	**(Observation)** - Insufficient sight distance. **(Effect)** - Risk of accident will increase as stated in right columns.	 Insufficient sight distance due to small vertical curve in expressway. Risk of rear-end collision.	 Insufficient sight distance due to inappropriate vertical alignment in National Highway No.4. Risk of a head-on collision.
2	**(Observation)** - Small horizontal curve in mountainous section. **(Effect)** - Risk of accident will increase as stated in right columns.	 Small horizontal curve in mountainous section. Passing with long body size vehicle is very difficult.	 Small horizontal curve and insufficient visibility. Risk of a head-on collision and/or a fall accident.

No.	Observation & Effect (If Neglect)	Photo	
2	**(Observation)** - Small horizontal curve in mountainous section. **(Effect)** Risk of accident due to overrun of high speed vehicle will increase.		
		Horizontal curve seems smaller as expressway's one.	

Table 2.2.4 Observation of the Issues: (4) Inappropriate Work Manner

No.	Observation & Effect (If Neglect)	Photo	
1	**(Observation)** - Insufficient maintenance work. **(Effect)** - Risk of accident will increase as stated in right columns.	 Debris composed of soil and grass covers on shoulder due to lack of cleaning work. Vehicle will loose control once it runs on the shoulder.	 Driver's visibility is hindered due to insufficient vegetation control.
2	**(Observation)** - Work group does not comply with authorized method. **(Effect)** - Risk of accident will increase as stated in right columns.	 Inappropriate arrangement of traffic control items (Barrier). Abrupt steering may be required in front of the barrier.	 Workers took a rest within carriageway. Firstly, risk of accident against human. Vehicle also will be suffered secondary accident due to action to avoid human.

Table 2.2.5 Observation of the Issues: (5) Inappropriate Traffic Manner

<table>
<tr><th>No.</th><th>Observation & Effect (If Neglect)</th><th colspan="3">Photo</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">(Observation)
- Road users in various categories do not comply with authorized traffic rule.

(Effect)
- Risk of secondary accident will increase as stated in right columns.</td><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Riding bicycle on carriageway in expressway. Firstly, risk of accident against human. Vehicle also will be suffered secondary accident due to action to avoid bicycle.</td><td>Excessive numbers of passengers on open roof vehicle in expressway. Risk of accident for fallen passengers. Vehicle also will be suffered secondary accident due to action to avoid passenger.</td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Height of cargo is too high. Firstly, risk of overturning accident and/or collapse of cargo. Following vehicle also will be suffered secondary accident due to initial accident.</td><td></td></tr>
</table>

Table 2.2.6 Observation of the Issues: (6) Defect due to Inappropriate Construction Quality

No.	Observation & Effect (If Neglect)	Photo	
1	**(Observation)** - Defects on pavement. **(Effect)** - Driving comfortableness will be impaired. - Traffic safety will be threatened if it becomes severer. - Cost of repair/rehabilitation will significantly increase if defect achieves deeper layers (i.e. base/subbase course).		
		De-lamination. Possible cause is inadequate cleaning and/or failure of tack coating work before placement of upper layers.	Defect area gradually has been spread.
2	**(Observation)** - Gap occurred between each structure (e.g. bridge and approach road). **(Effect)** - Traffic safety will be threatened if it becomes severer.		
		Overlaying for filling gap between bridge and approach road. Possible cause is settlement occurred on foundation ground on approach section.	Depth of gap reached 20cm.

No.	Observation & Effect (If Neglect)	Photo	
2	(Continued)		
		Gap between carriageway and shoulder. Possible cause is failure of dimension control during construction period (?)	Water remains in the gap area.
3	**(Observation)** - Destruction of the structure. **(Effect)** - Traffic safety will be threatened if it becomes severer. - Risk of road closure if destructed completely. - Cost of repair/rehabilitation will significantly increase.		
		Large cavity under concrete slab. Possible cause is erosion due to inadequate treatment of groundwater.	Collapse of slope protection (concrete block). Possible cause is circular slip on the slope or settlement on foundation ground.

2.3 Proposal for the Solution

The Team discussed development of the proposal for the solution against the above stated issues. Table 2.3.1 indicates 1 or 2 approaches namely desirable case and secondary case by the issue. Note the Team examined practicability level of the approaches from A to C in accordance with the following criteria.

- **Level-A: High practicability**

Implementation will be enabled by internal approval in MOC. Cost is low and period is short.

- **Level-B: Moderate practicability**

Implementation will be enabled by the government's approval and/or co-working with other Ministries. Cost is low – medium and/or period is medium – long.

- **Level-C: Low practicability**

Implementation will be enabled by the government's approval and/or co-working with other Ministries. Cost is high and/or period is long.

Summary of the proposal is as shown in Table 2.3.1.

Table 2.3.1 Summary of the Proposal for the Solution

No.	Issue	Approach (desirable)	Practicability	Approach (secondary)	Practicability
(1)	Inappropriate arrangement and/or absence of road furniture	- Rearrangement, relocation and/or newly installation	A		
(2)	Unnecessary object is continued to exist	- Removal	A		
(3)	Inappropriate road geometric structure	- Large scale realignment & reconstruction - Slope cutting & road widening	C	- Install traffic safety facility	A – B
(4)	Inappropriate work manner	- Prepare work manual & training program	B	- Establish work cycle	A
(5)	Inappropriate traffic manner	- Reinforce penal regulation - Access control to expressway	C	- Public awareness campaign of traffic safety	B
(6)	Defect due to inappropriate construction quality	- Repair work based on investigation & design in appropriate manner	C	- Install traffic safety facility - Temporary repair work	A – B

Table 2.3.2 Proposal for the Solution: (1) Inappropriate Arrangement and/or Absence of Road Furniture

No.	Proposal	Photo	
1	**(Observation)** - The furniture is not located in a straight line each other. **(Proposal)** - Relocate furniture to uniform front face in a straight line. **Practicability: A**	 Parapet wall and curb stone	 Foundation of post and parapet wall
2	**(Observation)** - The furniture is located ahead of protective facility (e.g. guardrail). **(Proposal)** - Relocate furniture behind guardrail. **Practicability: A**	 Traffic sign	 Milestone post

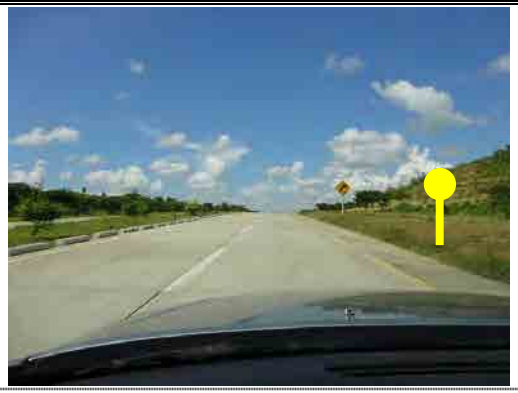
No.	Proposal	Photo	
3	**(Observation)** - Inappropriate alignment/location of guardrail. **(proposal)** - Realignment and/or relocation of guardrail. **Practicability: A**	 Realignment.	 Relocation.
4	**(Observation)** - Absence of the furniture. **(Proposal)** - Newly installation of the furniture. **Practicability: A**	 Paint lane mark.	 Install guardrail and mirror.

No.	Proposal	Photo	
5	**(Observation)** - Object is installed within road clearance limit. **(Proposal)** - Relocate object to out of limit. **Practicability: see right columns**	 Sign board. **Practicability: A**	 Electric wire & pole **Practicability: B** (Co-work with Ministry of Electric Power is necessary.)

Table 2.3.2 Proposal for the Solution: (2) Unnecessary Object is Continued to Exist

No.	Proposal	Photo	
1	**(Observation)** - Concrete objects remain existed. **(Proposal)** - Remove the object. - Temporary barrier (non-hard material) with reflector will be installed to mitigate collision impact if indication is necessary. **Practicability: A**	 Concrete posts will be removed.	 Concrete blocks will be removed.
		 Concrete walls will be replaced with temporary barrier.	 Concrete posts for former parking area (?) will be removed.

Table 2.3.3 Proposal for the Solution: (3) Inappropriate Road Geometric Structure

No.	Proposal	Photo	
1	**(Observation)** - Insufficient sight distance. **(Proposal)** - Reconstruction to improve vertical alignment. (Desirable case) - Install traffic sign for warning. (Secondary case) **Practicability: C for desirable and A for secondary**	 Unforeseen situation (e.g. parking car) after top of crest will be warned by the sign.	 Unforeseen situation (e.g. parking car and/or oncoming car) after bending point will be warned by the sign.
2	**(Observation)** - Small horizontal curve in mountainous section. **(Proposal)** - Slope cutting for road widening. (Desirable case) - Install turnout bay (Secondary case) - Install traffic sign for warning. (Secondary case) **Practicability: see right columns**	 Install turnout bay for waiting vehicle. **Practicability: B**	 Install continuous guardrail, mirror and traffic sign. **Practicability: A**

No.	Proposal	Photo	
2	**(Observation)** - Small horizontal curve in expressway. **(Proposal)** - Reconstruction to improve vertical alignment. (Desirable case) - Install traffic sign for warning. (Secondary case) - Replace concrete wall with guardrail for overrun vehicle. (Secondary case) - **Practicability: C for desirable and A for secondary**		Install guardrail and traffic sign.

Table 2.3.4 Proposal for the Solution: (4) Inappropriate Work Manner

No.	Proposal	Photo	
1	**(Observation)** - Insufficient maintenance work. **(Proposal)** - Frequent work implementation. **Practicability: A**	 Debris clearing work.	 Bush cutting on the slope.
2	**(Observation)** - Work group does not comply with authorized method. **(Proposal)** - Prepare manual for appropriate work manner. (desirable) - Work implementation by complying with the manual. Training program also will be prepared. (desirable) **Practicability: B** (Take time and cost for the manual preparation and dissemination of the work method.)	 Appropriate layout of the work area will be set up based on the manual.	 Appropriate work manner will be instructed by the supervisor based on the manual.

Table 2.3.5 Proposal for the Solution: (5) Inappropriate Traffic Manner

No.	Proposal	Photo	
1	**(Observation)** - Road users in various categories do not comply with authorized traffic rule. **(Proposal: desirable)** - Reinforce penal regulation. (Difficult to obtain consensus in the parliament.) - Access control to expressway. (Construction cost for the control facility will be very large.) **(Proposal: secondary)** - Public awareness campaign for dissemination of traffic manner to be complied by all road users through several media and/or town meeting. (Take time and cost for the campaign in moderate level.) **Practicability: C for desirable and B for secondary**	 Riding bicycle on carriageway in expressway.	 Excessive numbers of passengers on open roof vehicle in expressway.
		 Height of cargo is too high.	

Table 2.3.6 Proposal for the Solution: (6) Defect due to Inappropriate Construction Quality

No.	Proposal	Photo	
1	**(Observation)** - Defects on pavement. **(Proposal)** - Implementation of appropriate road maintenance work cycle. (desirable) **Practicability: A**	 De-lamination. Patching work is required.	 Defect area gradually has been spread. Surface dressing work is required.
2	**(Observation)** - Gap occurred between each structure (e.g. bridge and approach road). **(Proposal)** - Countermeasure work based on investigation, analysis and design. (desirable) - Filling gap occurred between each structure. (secondary) **Practicability: C for desirable and A for secondary**	 Overlaying for filling gap between bridge and approach road.	 Depth of gap reached 20cm.

No.	Proposal	Photo	
2	(Continued) **Practicability: C for desirable and A for secondary**	 Gap between carriageway and shoulder.	 Water remains in the gap area.
3	**(Observation)** - Destruction of the structure. **(Proposal)** - Countermeasure work based on investigation, analysis and design. (desirable) - Destructed part will be replaced with gabion box. (secondary) **Practicability: C for desirable and B for secondary**	 Large cavity under concrete slab.	 Collapse of slope protection (concrete block).

2.4 Action Taken by the Government of Myanmar

The Team had fruitful discussion with the counterpart (CP) appointed by the Government of Myanmar to deal with the issues identified through the site investigation. Subsequently, CP took swift action to solve the issues such as mainly for issue (1) and (2). Photos of the action outcome are illustrated in Figure 2.4.1. Furthermore, checklist of the action taken by CP (latest version: Jun/2015) is as shown in Table 2.4.1. The Team expects sustainable implementation of the action a lot in a future.

Location : 2mile-5furlong in Yangon – Mandalay Expressway
Action : Removal of unnesessary concrete posts

Location : 9mile-5furlong in Yangon – Mandalay Expressway
Action : Relocation of traffic sign post

Figure 2.4.1 Action Outcome of the CP

Table 2.4.1 Checklist of the Action taken by the CP (1 of 4)

Direction: YGN => MDL				M: Mile, F: Furlong
No.	M	F	Observation	Action
1	1	1	Unnecessary post should be removed.	
2	2	5	Unnecessary post should be removed.	Removed
3	3	5	Concrete wall should be replaced with temporary barrier.	Removed
4	3	6	Unnecessary post should be removed.	Removed
5	4	7	Concrete wall should be replaced with temporary barrier.	Removed
6	6	1	Concrete wall should be replaced with temporary barrier.	Removed
7	9	5	Signboard is too close to carriageway.	Relocated
8	12	0	Unnecessary post should be removed.	Removed
9	13	3	Signboard is too close to carriageway.	Relocated
10	16	7	Signboard is too close to carriageway.	Relocated
11	17	0	Signboard is too close to carriageway.	Relocated
12	25	3	Signboard is too close to carriageway.	Relocated
13	29	3	Signboard is too close to carriageway.	
14	42	3	Mileage post is too close to carriageway.	
15	42	6	Mileage post is too close to carriageway.	
16	43	1	Erosion on embankment.	
17	49	4	Mileage post & signboard are too close to carriageway.	Relocated
18	49	5	Signboard is too close to carriageway.	Relocated
19	50	3	Mileage post is too close to carriageway.	
20	50	4	Road lighting pole is too close to carriageway.	
21	51	2	Unnecessary concrete wall should be removed.	
22	52	0	Mileage post is too close to carriageway.	Relocated
23	54	1	Mileage post is too close to carriageway.	
24	54	6	Mileage post is too close to carriageway.	
25	56	4	Mileage post is too close to carriageway.	Relocated
26	57	1	Signboard is too close to carriageway.	Relocated
27	63	2	Guardrail should connect bridge wall smoothly.	
28	63	5	Signboard is too close to carriageway.	Relocated
29	65	2	Signboard is too close to carriageway.	Relocated
30	65	3	Mileage post is too close to carriageway.	Relocated
31	66	0	Unnecessary concrete wall should be removed.	
32	70	2	Unnecessary concrete wall should be removed.	
33	72	5	Arrow board and cushion should be removed	
34	73	3	Unnecessary concrete wall should be removed.	
35	75	7	Unnecessary post should be removed.	
36	79	5	Unnecessary concrete wall should be removed.	
37	80	5	Unnecessary concrete wall should be removed.	
38	81	0	Unnecessary concrete wall should be removed.	
39	81	6	Mileage post is too close to carriageway.	
40	81	7	Unnecessary concrete wall should be removed.	
41	84	1	Unnecessary concrete wall should be removed.	
42	84	5	Signboard is located in front of guardrail.	
43	84	7	Arrow signboard should be removed	
44	85	7	Mileage post is too close to carriageway.	Relocated
45	87	0	Mileage post is too close to carriageway.	Relocated
46	92	6	Mileage post is too close to carriageway.	Relocated
47	92	7	Mileage post is too close to carriageway.	Relocated
48	94	7	Unnecessary concrete wall should be removed.	
49	95	2	Mileage post is too close to carriageway.	Relocated
50	98	5	Mileage post is too close to carriageway.	

Table 2.4.1 Checklist of the Action taken by the CP (2 of 4)

Direction: YGN => MDL				M: Mile, F: Furlong
No.	M	F	Observation	Action
51	100	0	Mileage post is too close to carriageway.	
52	101	7	Partially broken guardrail.	Repaired
53	107	6	Mileage post is too close to carriageway.	
54	108	1	Mileage post is too close to carriageway.	
55	108	2	Mileage post and signboard are too close to carriageway.	
56	108	3	Mileage post is too close to carriageway.	
57	108	4	Mileage post is too close to carriageway.	
58	108	5	Mileage post and signboard are too close to carriageway.	
59	108	6	Mileage post is too close to carriageway.	
60	109	0	Mileage post is too close to carriageway.	
61	109	1	Mileage post is too close to carriageway.	
62	109	2	Mileage post and signboard are too close to carriageway.	
63	114	4	Unnecessary concrete wall should be removed.	
64	117	4	Mileage post is too close to carriageway.	
65	120	6	Mileage post is too close to carriageway.	
66	120	6	Partially broken guardrail.	
67	125	4	Unnecessary concrete wall should be removed.	
68	126	6	Mileage post is too close to carriageway.	
69	129	4	Unnecessary concrete wall should be removed.	
70	132	5	Unnecessary concrete wall should be removed.	
71	137	6	Unnecessary post should be removed.	
72	138	0	Unnecessary post should be removed.	
73	138	4	Reflection board should be removed.	
74	140	2	Signboard is too close to carriageway.	Relocated
75	140	3	Signboard is too close to carriageway.	Relocated
76	144	5	Mileage post is too close to carriageway.	Relocated
77	146	4	Unnecessary post should be removed.	
78	147	4	Unnecessary concrete wall should be removed.	
79	148	6	Unnecessary concrete wall should be removed.	
80	154	3	Unnecessary concrete wall & post should be removed.	
81	163	0	Unnecessary concrete wall should be removed.	
82	171	1	Unnecessary concrete wall should be removed.	
83	173	3	Unnecessary concrete wall should be removed.	
84	176	6	Unnecessary concrete wall should be removed.	
85	178	7	Signboard is too close to carriageway.	Relocated
86	302	2	Gap between curb stone and foundation concrete of handrail on box culvert.	
87	305	1	Gap between curb stone and foundation concrete of handrail on box culvert.	
88	338	6	Erosion around abutment.	
89	339	0	Inappropriate material (concrete) filled in cushion barrel.	
90	339	0	Erosion around abutment.	

Table 2.4.1 Checklist of the Action taken by the CP (3 of 4)

Direction: MDL => YGN				M: Mile, F: Furlong
No.	M	F	Observation	Action
91	199	0	Unnecessary concrete wall should be removed.	
92	197	5	Unnecessary concrete wall should be removed.	
93	196	5	Cushion barrel should be installed.	
94	196	4	Mileage post is too close to carriageway.	Relocated
95	190	4	Mileage post is too close to carriageway.	Relocated
96	190	3	Mileage post is too close to carriageway.	Relocated
97	186	3	Mileage post is too close to carriageway.	Relocated
98	181	4	Mileage post is too close to carriageway.	Relocated
99	178	7	Mileage post is too close to carriageway.	Relocated
100	178	4	Mileage post is too close to carriageway.	Relocated
101	176	6	Concrete wall and post should be replaced with temporary barrier.	Replaced
102	176	2	Partially broken guardrail.	
103	175	5	Mileage post is too close to carriageway.	
104	174	1	Mileage post is too close to carriageway.	
105	174	0	Mileage post is too close to carriageway.	
106	173	4	Concrete wall and post should be removed.	
107	173	3	Signboard is too close to carriageway.	
108	173	1	Unnecessary concrete wall & post should be removed.	
109	171	0	Unnecessary concrete wall should be removed.	
110	170	4	Signboard is too close to carriageway.	
111	170	2	Arrow board & concrete wall should be removed.	Removed
112	167	2	Signboard is too close to carriageway.	
113	167	1	Signboard is too close to carriageway.	
114	166	0	Arrow board should be removed	
115	165	2	Guardrail should connect bridge wall smoothly.	
116	164	0	Signboard is too close to carriageway.	
117	163	6	Unnecessary concrete wall should be removed.	
118	162	6	Mileage post is too close to carriageway.	
119	153	7	Unnecessary concrete wall should be removed.	
120	148	6	Good example for wall arrangement in front of bridge.	
121	148	3	Signboard is too close to carriageway.	
122	147	6	Signboard is too close to carriageway & too low.	
123	147	4	Signboard is too close to carriageway & unnecessary post should be removed.	
124	144	2	Mileage post is too close to carriageway.	Relocated
125	143	0	Arrow board is in front of guardrail.	
126	142	6	Signboard is too close to carriageway.	
127	140	3	Signboard & mileage post are too close to carriageway.	Relocated
128	137	7	Cushion & concrete post should be removed. Tapered lane should be installed.	
129	132	3	Unnecessary concrete wall should be removed.	
130	132	2	Mileage post is too close to carriageway.	Relocated
131	129	3	Unnecessary concrete wall should be removed.	
132	128	3	Mileage post is too close to carriageway.	Relocated
133	125	4	Unnecessary concrete wall should be removed.	
134	125	3	Unnecessary concrete wall should be removed.	
135	120	6	Signboard is too close to carriageway.	
136	120	6	Barrier should be removed	
137	114	2	Unnecessary concrete wall should be removed.	
138	113	4	Unnecessary concrete wall should be removed.	
139	112	7	Unnecessary concrete wall should be removed.	
140	107	2	Unnecessary concrete wall should be removed.	

Table 2.4.1 Checklist of the Action taken by the CP (4 of 4)

Direction: MDL => YGN				M: Mile, F: Furlong
No.	M	F	Observation	Action
141	100	6	Mileage post is too close to carriageway.	
142	94	7	Unnecessary concrete wall should be removed.	
143	94		Arrow board should be removed	
144	91	7	Mileage post is too close to carriageway.	Relocated
145	90	2	Partially broken guardrail.	
146	89	2	Mileage post is too close to carriageway.	Relocated
147	89	1	Mileage post is too close to carriageway.	Relocated
148	86	2	Signboard is in front of guardrail.	
149	86	1	Mileage post is too close to carriageway.	
150	86	0	Mileage post is too close to carriageway.	
151	84	4	Arrow board is in front of guardrail.	
152	83	1	Concrete wall & cushion barrel should be removed.	
153	81	7	Unnecessary concrete wall should be removed.	Removed
154	81	0	Unnecessary concrete wall should be removed.	
155	80	5	Unnecessary concrete wall should be removed.	
156	79	3	Unnecessary concrete wall should be removed.	
157	79	2	Mileage post is too close to carriageway.	
158	79	1	Mileage post is too close to carriageway.	
159	73	6	Unnecessary concrete wall should be removed.	
160	72	2	Cushion should be removed.	
161	70	1	Unnecessary concrete wall should be removed.	
162	68	4	Cushion should be placed in front of wing wall of abutment.	
163	68	3	Mileage post is too close to carriageway.	
164	66	2	Signboard is too close to carriageway.	Relocated
165	66	1	Signboard is too close to carriageway.	Relocated
166	65	7	Unnecessary concrete wall should be removed.	
167	63	2	Cushion should be placed in front of wing wall of abutment.	
168	56	0	Signboard is too close to carriageway.	
169	53	2	Mileage post is too close to carriageway.	
170	52	7	Mileage post is too close to carriageway.	
171	52	6	Signboard is in front of guardrail.	
172	52	3	Signboard is too close to carriageway.	
173	51	0	Unnecessary concrete wall should be removed.	
174	49	5	Unnecessary concrete wall should be removed.	
175	49	2	Mileage post is too close to carriageway.	
176	48	0	Mileage post is too close to carriageway.	Relocated
177	46	3	Arrow board is too close to carriageway.	
178	42	4	Unnecessary concrete wall should be removed.	
179	42	4	Mileage post is too close to carriageway.	
180	22	5	Mileage post is too close to carriageway.	
181	21	6	Signboard is too close to carriageway.	
182	21	5	Signboard is too close to carriageway.	
183	21	3	Arrow board is too close to carriageway.	
184	12	1	Unnecessary post should be removed.	
185	8	1	Unnecessary post should be removed.	
186	6	2	Unnecessary concrete wall should be removed.	Removed
187	4	7	Unnecessary concrete wall should be removed.	Removed
188	3	5	Unnecessary concrete wall should be removed.	Removed
189	2	5	Unnecessary post should be removed.	

3. Effort to Secure Traffic Safety in Japan

3.1 General

The Team introduces the effort taken by the road agencies in Japan to secure traffic safety in both road classifications namely expressway and national highway in this chapter.

3.2 Expressway

Network of expressway in Japan has been operated by 3 companies namely East Nippon Expressway Co., Ltd. (E-NEXCO), Central Nippon Expressway Co., Ltd. (C-NEXCO) and West Nippon Expressway Co., Ltd. (W-NEXCO). These companies apply the integrated regulations including geometric structure and traffic safety for their operation.

Regulation of the traffic safety facility in the expressway is severely determined in order to ensure high speed vehicle in safe condition. Image of various dimensions of the traffic signboards are illustrated in Figure 3.2.1 – 3.2.4. Furthermore, photos of actual arrangement of the facilities on the sites are as shown in Figure 3.2.5 and 3.2.6.

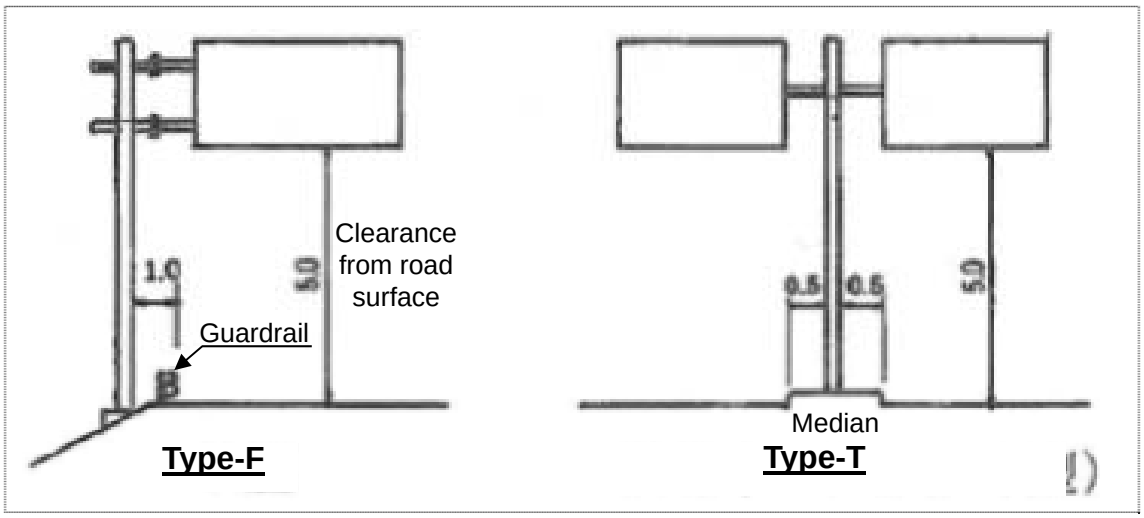


Figure 3.2.1 Dimension of Signboard Installation (1)

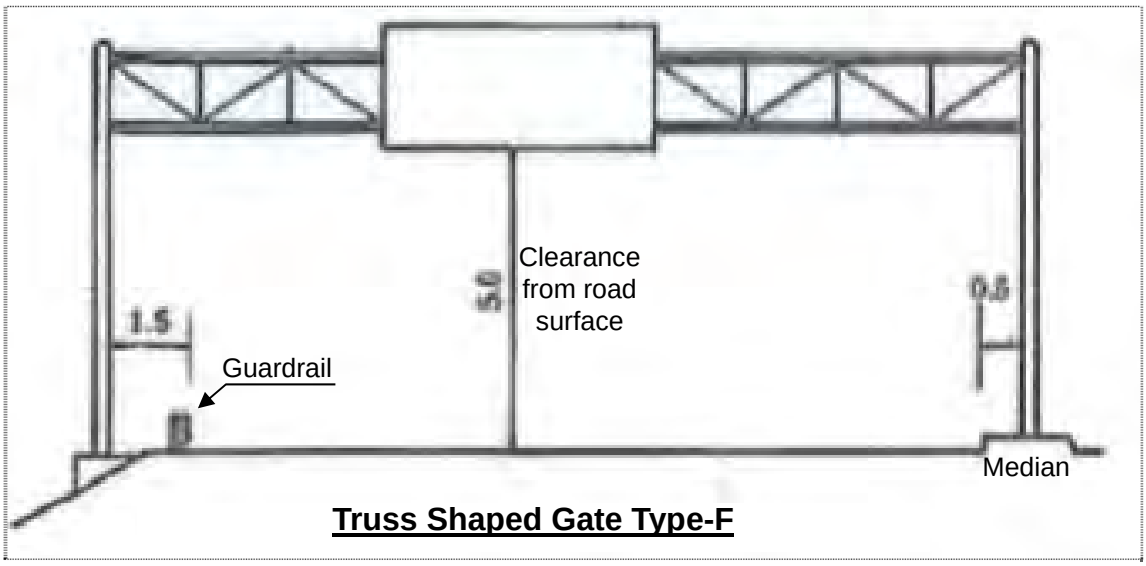


Figure 3.2.2 Dimension of Signboard Installation (2)

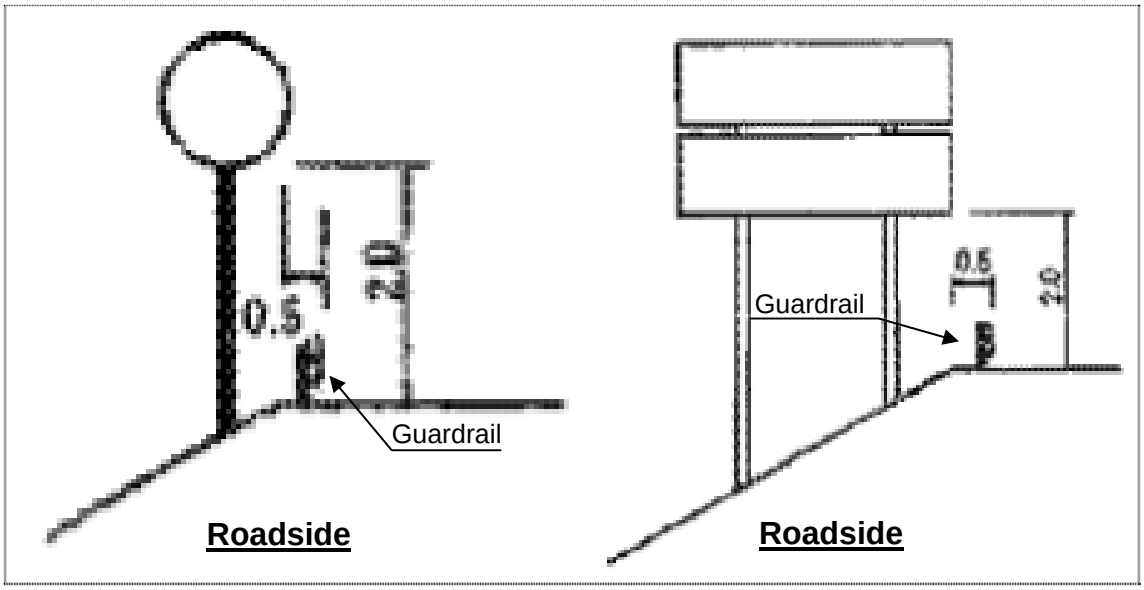


Figure 3.2.3 Dimension of Signboard Installation (3)

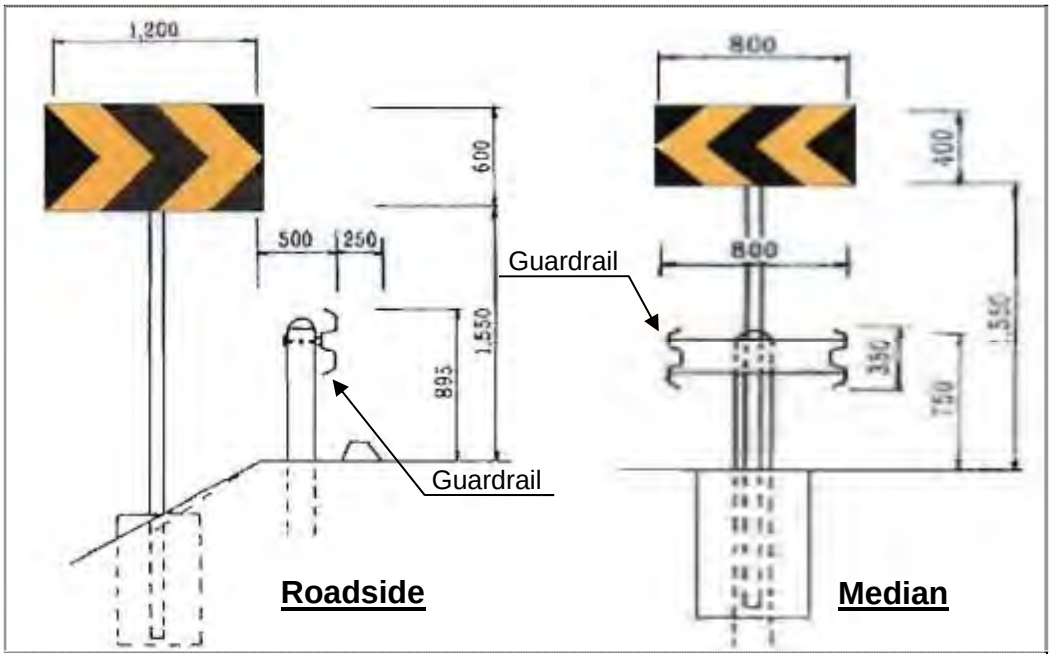


Figure 3.2.4 Dimension of Signboard Installation (4)

Figure 3.2.5 Arrangement View of Traffic safety Facilities (1)

	
Connect guardrail to barrier wall smoothly	Install guardrail continuously in embankment section.

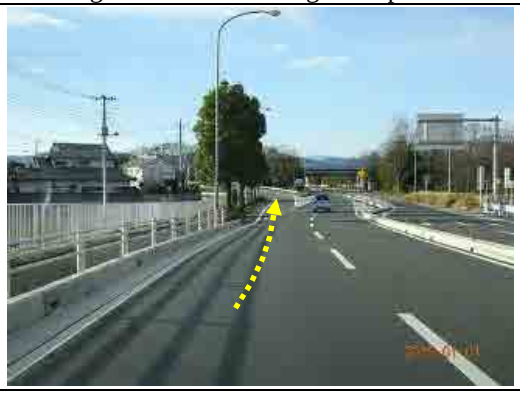
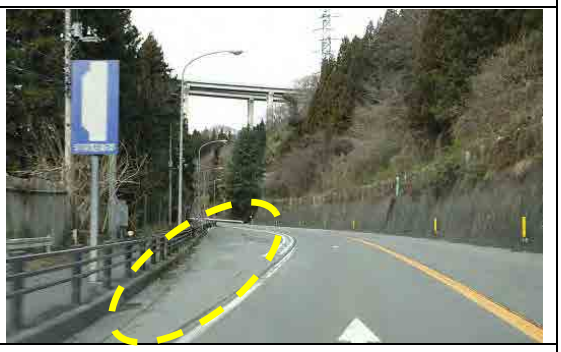
Figure 3.2.6 Arrangement View of Traffic safety Facilities (2)

3.3 National Highway

National highway network in Japan has been managed by the Road management offices under the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The each office is required to secure traffic safety and enhance service level for road users. On the other hand, characteristics of the network are varied by comparing with the expressway as follows.

- ✓ Very long and complicated network
- ✓ Various road geometric dimensions by their classification
- ✓ Various surroundings along the roads (e.g. topography, climate, land use, etc)
- ✓ Various types of road users (e.g. pedestrian, bicycle, motorcycle, vehicle, etc)
- ✓ Free access from the roadside in almost of the network sections

Therefore, the offices have been dealing with the given missions in the above stated circumstances. Photos of the road facilities are illustrated in Figure 3.3.1.

	
Distances to principal cities are clearly indicated. Traffic signs are installed behind the rail.	Warning sign to notify school nearby. Traffic sign for “no overtaking” & “speed limit”.
	
Variable bulletin board (warning “icy road section ahead”).	Smooth alignment to ramp section.
	
Signboard to notify “radio frequency for road information service”.	Climbing lane for slow speed vehicle.
	
Warning sign “steep vertical gradient & sharp curve”.	Turnout bay in mountainous section.

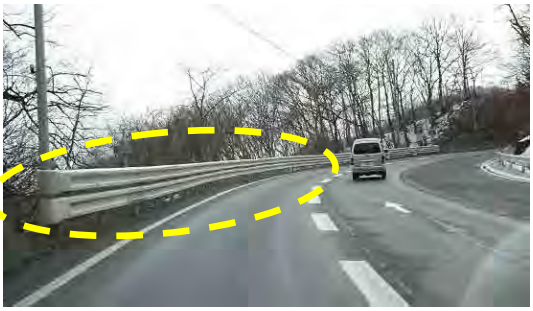
	
Evacuation zone for vehicle in brake failure in steep downhill section.	Evacuation zone for vehicle in brake failure.
	
Delineator arrow sign boards to guide driver's view.	Double guardrail in steep mountainous section.
	
Daily patrol by the office (collecting obstacles on the road).	Mirror and guardrail in sharp road curve section.
	
Warning sign for "unforeseen event".	Rock fall prevention shed.

Figure 3.3.1 Photos of the Road Facilities in National Highway

4. Photos Taken during the Site Investigation Work

Photos taken during the site investigation work (8times in total) and observation comments are attached in this chapter.

No.	Period	Route	Investigation Section
1	3 – 4, Oct, 2013	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw – Mandalay

Ph.1 Parapet wall was located ahead of the curbs. Damage will be severer in case of the accident.

Ph.2 No cushion on the concrete wall.

Ph.3 Prohibited traffic manner (bicycle riding in the expressway area).

Ph.4 Sediment composed of soil and grass covers on the shoulder. High speed vehicle will loose its control once it runs on the shoulder.

	
Ph.5 Water remains on the shoulder due to malfunction of drainage. It also raises a risk of slipping of the vehicle.	**Ph.6** Destructed shoulder.
	
Ph.7 Defect on the pavement in the bridge approach section. Possible cause is insufficient compaction of base and/or subbase course.	**Ph.8** Severe defect on the pavement in the bridge section. Possible cause is inadequate treatment of binding material between asphalt mixture and deck slab.
	
Ph.9 Punching shear damage on the concrete pavement.	**Ph. 10** Insufficient sight distance due to small radius of vertical curve.

Ph. 11 Insufficient sight distance.

Ph.12 Milestone is protected by guardrail (good example).

Ph.13 Milestone is protected by guardrail (good example).

Ph.14 Milestone is out of guardrail range. Vehicle colliding with guardrail may slide to the stone (secondary collision).

Ph.15 Radius of horizontal curve seems smaller as expressway's one.

Ph.16 Radius of horizontal curve seems smaller as expressway's one.

Ph.17 Risk of serious injury on passengers in case of colliding with concrete posts.

Ph.18 Unnecessary posts should be removed to prevent potential accident.

Ph.19 Unnecessary posts should be removed.

Ph.20 Posts were replaced with guardrail (good example).

Ph.21 Lane mark should be painted to divide traffic flow clearly.

Ph.22 Parapet wall is located behind the curbs.

Ph.23 Gap occurred between carriageway and shoulder.

Ph.24 Gap occurred between shoulder and the outer area (photo from behind direction.

Ph.25 Large cavity under concrete slab. Potential risk of the collapse.

Ph.26 Repair works (asphalt overlaying) on settled parts occurred behind and/or beyond the box culverts.

Ph.27 Repair works (asphalt overlaying) on settled parts occurred behind and/or beyond the box culverts.

Ph.28 Asphalt overlaying work. Insufficient treatment on the edge. Vibration occurred during even non-heavy vehicle was passing.

	
Ph.29 Pavement repair work by penetration macadam instead of asphalt mixture.	**Ph.30** Pavement material composed of aggregate and soil.
	
Ph.31 Plastic barrels to be used for cushioning purpose (good example).	**Ph.32** Repair work (asphalt overlay) on large gap due to settlement behind the abutment.
	
Ph.33 Asphalt overlaying work (thickness over 20cm) after only 3yrears since the opening. Possible cause is insufficient compaction work.	**Ph.34** Gap occurred between carriageway and shoulder. Water remains on the surface.

Ph.35 Car could not return to the carriageway by itself due to big gap with the shoulder.

Ph.36 Injection of cement mortal into joint parts between each concrete slabs to prevent water penetration (good example).

Ph.37 Workers took a rest within carriageway (prohibited work manner).

Ph.38 Continuous concrete wall on median strip side instead of concrete block (good example). Overrun will be prevented.

Ph.39 Speed meter

Ph.40 Workers took a rest within carriageway (prohibited work manner).

No.	Period	Route	Investigation Section
2	28 – 31, Jan, 2014	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw – Mandalay

Ph.41 Raised up milestone foundation to improve its visibility (Good example).

Ph.42 Repair work of differential settlement occurred beside box-culvert. Possible cause is scouring of ground soil (fine grain size) due to sub surface water.

Ph.43 Repair work of differential settlement (median strip area).

Ph.44 Same type of repair work on the other location.

Ph.45 Spraying asphalt emulsion prior to thin asphalt overlaying.

Ph.46 Foundation of post on box-culvert is located ahead of the parapet walls. It threatens traffic safety.

Ph.47 Foundation of post on box-culvert (enlarged view).

Ph.48 Headwall of box-culvert.

Ph.49 Side view of box-culvert & guideposts.

Ph.50 Small-medium size bridge.

Ph.51 Guidepost & handrail of the bridge.

Ph.52 Cushion barrels against runaway vehicle.

Ph.53 Inner cover was made of concrete. It may cause severer damage in case of the collision.

Ph.54 Deformation occurred due to scouring on the embankment.

Ph.55 Cavity between the bridge and the embankment due to the scouring.

Ph.56 Scouring behind the abutment.

Ph.57 Deformed slope protection due to the settlement of foundation ground.

Ph.58 Large cavity under concrete slab. Potential risk of the collapse.

Ph.59 Slope drainage is in danger of collapse due to the scouring.

Ph.60 Scoured embankment.

Ph.61 Traffic sign was located ahead of the guardrail.

Ph.62 Traffic sign was located behind the guardrail (good example).

Ph.63 Sign board was too close to carriageway and too low. Danger to hit large vehicle.

Ph.64 Milestone was located ahead of the guardrail.

No.	Period	Route	Investigation Section
3	7 – 8, Jul, 2014	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw

Ph.65 Traffic signs guide the driver's vision in the curve section (good example).

Ph.66 Prohibited traffic manner (driving motorcycle on reverse direction).

Ph.67 Widening work of the bridge (2-lanes to 3-lanes).

Ph.68 Widening work of the bridge on the opposite side (2-lanes to 3-lanes).

Ph.69 Place of the bus fall accident on May/2015 (198mile). Bridge construction site.

Ph.70 Place of the bus fall accident on May/2015 (198mile). Bridge widening work (2-lanes to 4-lanes) is in progress.

Ph.71 Guardrail should be connected with bridge handrail gradually and smoothly to prevent severe accident.

Ph.72 IC (grade separation type) requires guardrail installation to prevent the fall accident.

Ph.73 Taper lane smoothly guides driver's vision (good example).

Ph.74 traffic sign and concrete posts threatened traffic safety. These should be removed.

Ph.75 Traffic warning light was located ahead of the guardrail.

Ph.76 Prohibited traffic manner (excessive numbers of passengers).

Ph.77 Solar-powered road lighting device (good example).

Ph.78 End of widening section should not be blocked. Taper lane should be installed instead of setting blockage device at end of widening section.

Ph.79 Unnecessary blockage (concrete wall) in front of widened bridge. It may cause severe damage in case of the collision.

Ph.80 Unnecessary blockage (concrete wall) in front of widened bridge.

No.	Period	Route	Investigation Section
4	20, Aug, 2014	National Highway No.1	Nay Pyi Taw – Yangon

Ph.81 Start point of the investigation. This road constitutes a part of Asian Highway (AH-1).

Ph.82 Road condition was good in general. But lane mark should be painted to divide traffic flow clearly.

Ph.83 Large vehicles and wagons are coexisting.

Ph.84 Large numbers of heavy vehicles.

Ph.85 Agricultural products (corn) on roadside.

Ph.86 Toll gate (Contractor: ASIA World).

	
Ph.87 Motorcycles and people are many.	**Ph.88** Toll gate (Contractor: KBZ).
	
Ph.89 Repair work.	**Ph.90** Damaged pavement.
	
Ph.91 Widening work.	**Ph.92** Shed for heating asphalt mixture.

Ph.93 Bridge (one-direction to YGN).

Ph.94 Bailey bridge (one-direction to NPT).

Ph.95 Damaged pavement.

Ph.96 Rehabilitated section.

Ph.97 Toll gate (Contractor: Hi Star).

Ph.98 Weigh gauge (toll amount is based on the weight).

Ph.99 City area in Bago (congested on various traffic modes). By-path route should be constructed.

Ph.100 Toll gate (Contractor: Shwe Than Lwin).

No.	Period	Route	Investigation Section
5	21 & 23, Aug, 2014	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw

Ph.101 Concrete wall was removed (good action). Post also should be removed.

Ph.102 Guardrail was installed after removal of concrete wall (good action).

Ph.103 Concrete wall was removed (good action).

Ph.104 Defect on expansion joint on the bridge.

Ph.105 Repair work. Work area was clearly surrounded by the cones (good example).

Ph.106 Repair work. Work area was clearly surrounded by the cones (good example).

Ph.107 Traffic controlled area should be gradually guided by taper shape.

Ph.108 Repair work on median strip. Traffic controlled area should be gradually guided by taper shape.

Ph.109 Work site of guardrail installation.

Ph.110 Work site of guardrail installation.

Ph.111 Soil bags installed for diversion of rain water.

Ph.112 Foundation soil of U-ditch was eroded due to insufficient arrangement of drainage facilities.

Ph.113 Unnecessary posts should be removed.

Ph.114 Unnecessary barriers and reflector should be removed.

Ph.115 Guardrail should be installed on outside based on the driving direction.

Ph.116 Guardrail should be installed on outside based on the driving direction.

Ph.117 Repaired part.

Ph.118 Widening work of the bridge.

Ph.119 Protection devices should be removed after completion of the widening work.

Ph.120 Drainage on the bridge deck (good example).

Ph.121 Pavement on the deck. 2-layers (lower: penetration macadam, upper: hot asphalt mixture)

Ph.122 Asphalt plant on the roadside. The material will be used for the overlaying work.

Ph.123 Missing part of guardrail should be repaired immediately.

Ph.124 Guardrail should be connected with bridge handrail gradually and smoothly to prevent severe accident.

Ph.125 Solar panel was missing (stolen?)

Ph.126 Earth drainage on the slope (too small dimension).

Ph.127 Concrete wall smoothly indicates the narrow road section (good example).

Ph.128 Defect on the pavement (stripping of surface material).

Ph.129 Bridge widening work (Steel I-beam).

Ph.130 Information boards of emergency call.

Ph.131 Concrete wall was removed (good action).

Ph.132 Concrete wall was removed (good action).

No.	Period	Route	Investigation Section
6	27, Oct, 2014	Yangon-Mandalay Expressway	185/0 – 185/1 (Pilot work section for installation of various delineators)

Ph.133 Delineator on wall.

Ph.134 Delineator on wall.

Ph.135 Tender pole with reflector & large size delineator.

Ph.136 Tender pole with reflector & large size delineator.

Ph.137 Delineator on curb stone.

Ph.138 Dust proofing type delineator on curb stone.

No.	Period	Route	Investigation Section
7	28 – 29, Oct, 2014	Yangon-Mandalay Expressway	Yangon – Nay Pyi Taw

Ph.139 Concrete curve was set back to median strip side to secure shoulder width (good action).

Ph.140 But concrete wall also should be set back.

Ph.141 Traffic sign was relocated to behind the guardrail (good action).

Ph.142 Electric wire seems too low.

No.	Period	Route	Investigation Section
8	17 – 20, Dec, 2014	National Highway No.4 (Shan State)	Heho – Taunggyi – Loilem – Takaw

Day-1: 17/Dec
Ph.143 Road condition is moderate – fair in general (Heho – Taunggyi section)

Ph.144 Smooth passing with large vehicle in mountainous section.

Ph.145 Separating point of inbound direction and outbound direction.

Ph.146 Pavement rehabilitation work.

Ph.147 Height of cargo is too high.

Ph.148 Toll gate at entrance of Taunggyi city area.

Ph.149 Taunggyi city center.

Ph.150 Quarry site at outskirt of city area. Easy access to stone material unlike Ayeyarwady Region.

Ph.151 Mountainous section requires guardrail instead of guide posts (Taunggyi – Loilem section).

Ph.152 No post/guardrail section may increase a risk of fall accident.

Ph.153 Very difficult for passing with long body size vehicle.

Ph.154 This road constitutes a part of Asian Highway (AH-2). Many cargo vehicles are traveling on this road.

	
Day-2: 18/Dec **Ph.155** Loilem town area.	**Ph.156** Road (Loilem – Namsang section).
	
Ph.157 Road (Loilem – Namsang section).	**Ph.158** Namsang town area.
	
Ph.159 Road width seemed 1.5lanes (Namsang – Kunhing section).	**Ph.160** Road improvement work.

Ph.161 Existing steel truss bridge. Construction work of new bridge (RC) is in progress.

Ph.162 Guards were dispatched from army due to security reason.

Ph.163 Road widening work is in progress.

Ph.164 Slope cutting work for the road widening.

Ph.165 Bridge over Nan Pun River in Kunhing.

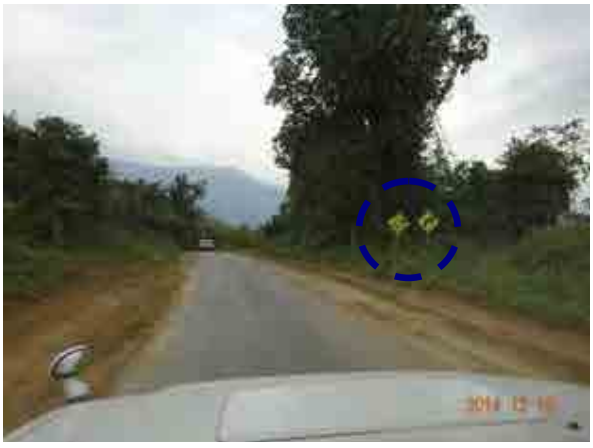
Ph.166 Kunhing town area. White station wagon is the guard dispatched from police.

Ph.167 Road (Kunhing – Takaw section).

Ph.168 Sight distance is not enough. Mirror should be installed on curve.

Ph.169 Only traffic sign for “honk!” in mountainous section. Guardrail also should be installed.

Ph.170 Sight distance is not enough due to inappropriate vertical alignment.



Ph.171 Traffic signs for “honk!” and “indicating right curve”.

Ph.172 Road widening work is in progress.

Ph.173 Check gate at 49 Than Lwin River in Takaw.

Ph.174 Than Lwin River

Ph.175 Bridge over Than Lwin River

Ph.176 Takaw town area.

Ph.177 Vegetation control and slope cutting is required to secure sight distance.

Ph.178 Slope cutting work is in progress.

	
Day-3: 19/Dec **Ph.179** Foggy day (Loilem – Taunggyi)	**Ph.180** Steep mountainous section. Mirror and guardrail should be installed.
	
Ph.181 Retaining wall.	**Ph.182** Slope cutting work was completed.