(7) Myaungmya Br.

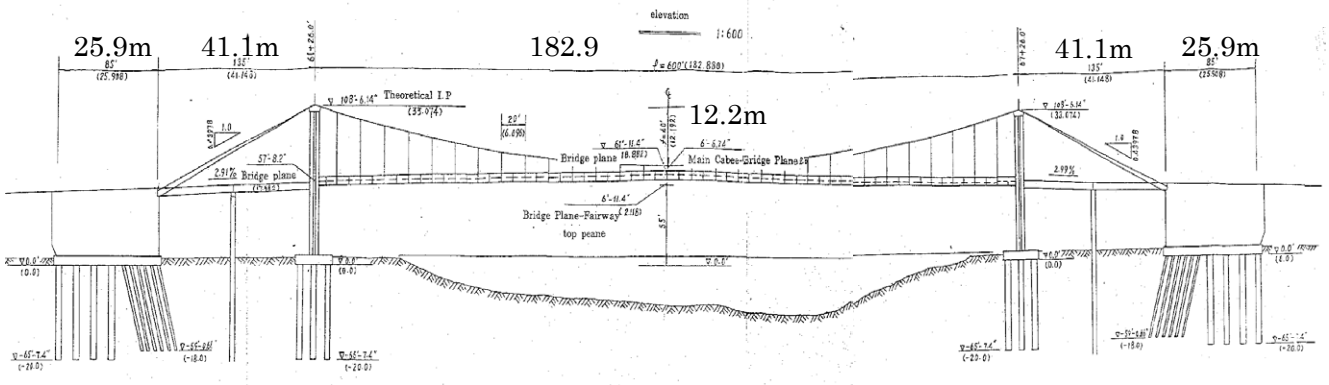
Bridge Type:SUSPENSION

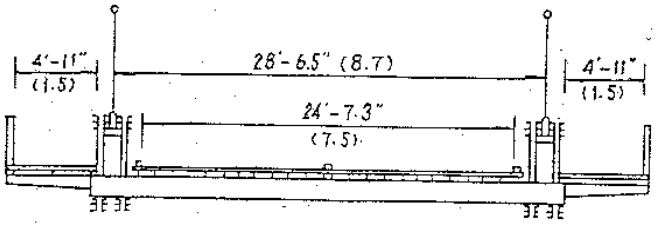
Design and Making: China

Work : PW

Constructed Year :1996

- The hanging position is maintained changing the height, because of falling down of chamber.
- Number of anchorage piles was increased in construction stage.





Cover shot

Stiffening girder
：Bailey bridge

Suspender cable at hanging up position

- The camber felled down by 1m at the center, and camber was maintained by changing of hanging up position.

Situation of main cable
・A re-wrapping has been constructed.

Pavement part: Board fence

- The board comes off easily.
- A part of balustrade levee crown raggedly：due to corrosion.

(8) Lapuda Br.

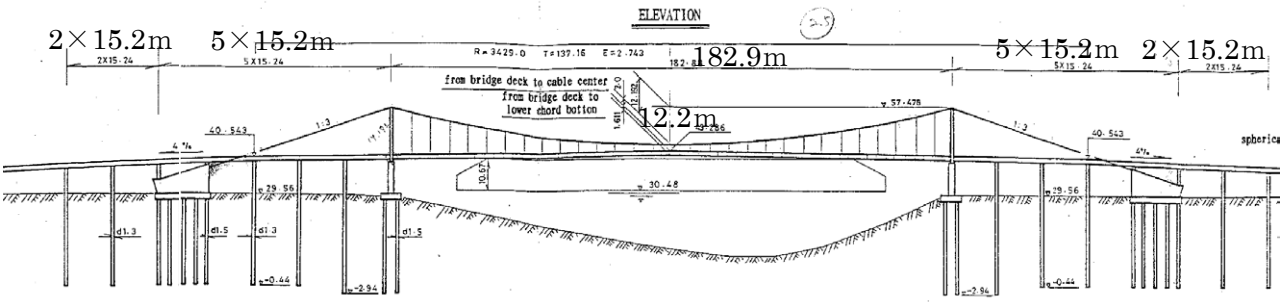
Bridge Type:SUSPENSION

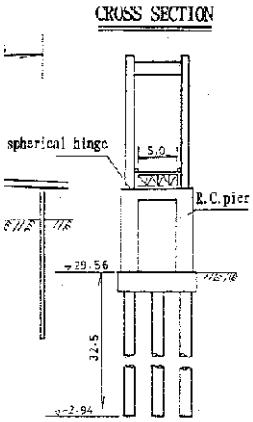
Design and Making: China

Work : PW

Constructed Year :1998

- The salt damage environmental region
- Painting executes the re-painting at the frequency once every one or two years.





Cover shot

Stiffening girder

: Bailey bridge

The re-wrapping construction of a main cable

- The worker has neither sandals nor the helmet.

Approach girder

- The mold form partially of a horizontal girder remains.

- There is no drainage pipe from roadway drainage along the pier.

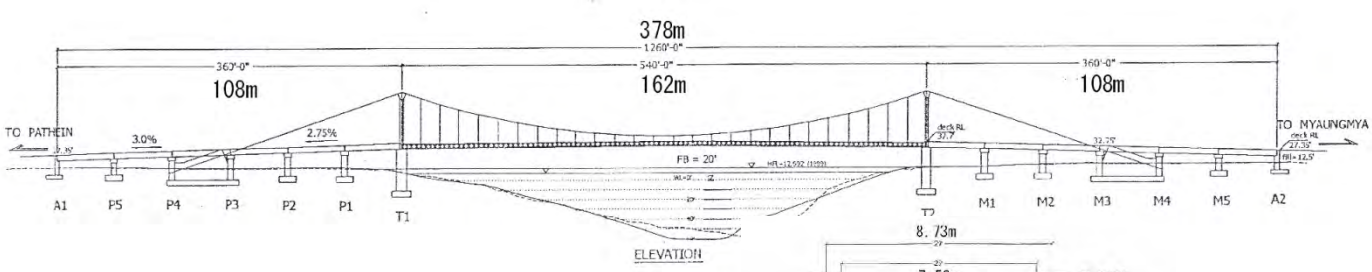
(9) Panmawaday Br.

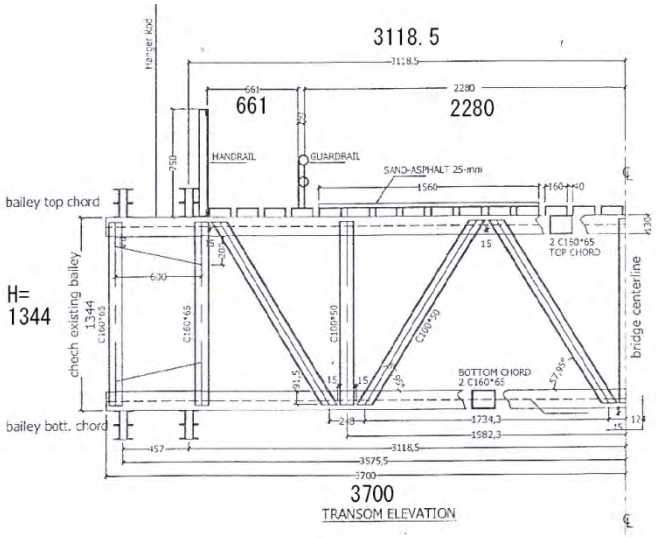
Bridge Type:SUSPENSION

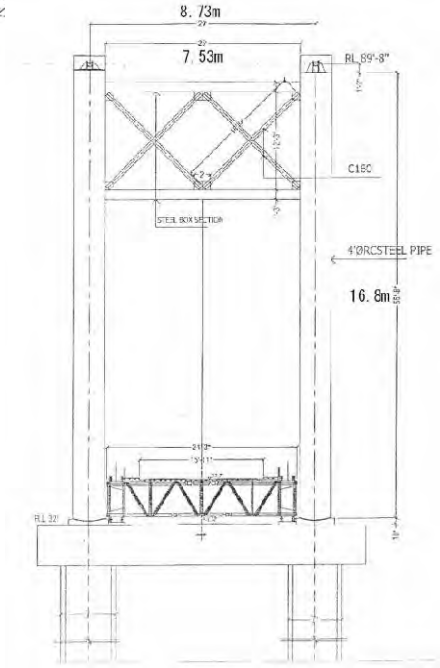
Design and Making: China

Work : PW

Constructed Year :2004



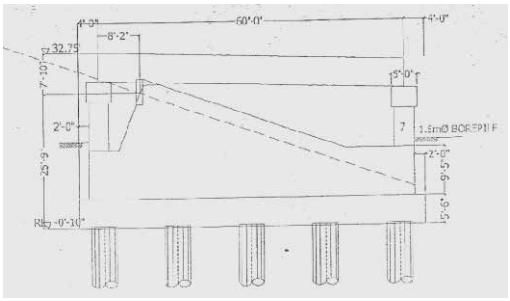




Cover shot

Situation of anchorage

- Neither damage nor the crack



Expansion apparatus on anchorage (on M3 pier)

- An abnormal neither opening nor blocking

Approach girder (PC girder)

- Remarkable damage is not seen by the main girder and the deck slab.
- Horizontal girder (RC) : no prestressed concrete

Pier of approach girder

・ Concrete painting right under the main girder (beam) of the M3 pier starts peeling off.
(There is a possibility about the crack can be made by anchorage moving).

Bridge abutment

・ Neither special steps nor damage are seen.

(10) Yadanabon Br.

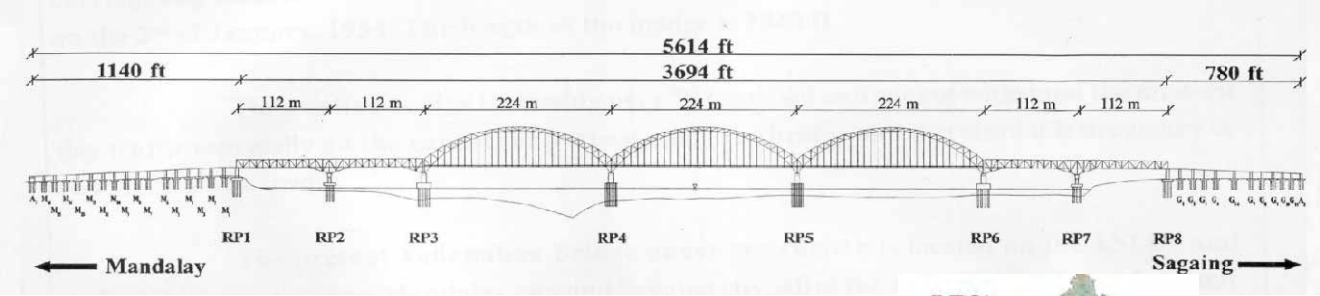
Bridge Type:Steel Arch & Truss

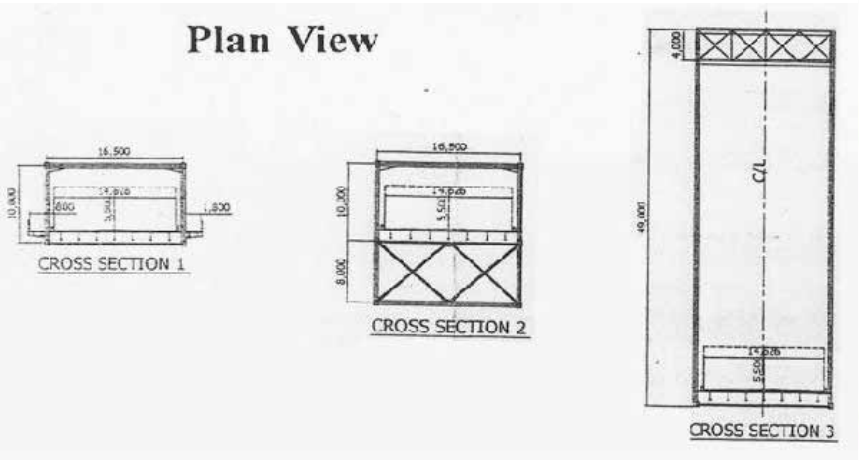
Design and Making: China

Work : PW

Construction Period : October 2001 - April 2008　(for six months and seven years)

- Constructed at 600m upstream of old bridge (passing 78 years) as new bridge.
  [Old bridge : suffered from heavy traffic / now also, in operation as railway and road bridge with the vehicle restriction (15t or less).].
- There were four ideas when the bridge installation position
- When constructing it, the vibration by the wind was generated.
- It shook well when the vehicle was passed.





Cover shot

The cable is set up.

I type section of suspension device is covered with the steel board.

- To enlarge the rigidity because the vibration by the wind was generated in the construction stage, it is adopted the box section (from PW interview).
- The Stiffening girder is set up.

The Stiffening girder is set up on the other side.
A red sign of the photograph is a bolt to fix the stiffening girder.

Construction accuracy of bolt alignment

- There are enough space form a bolt to the edge of plate.

Situation of joining part

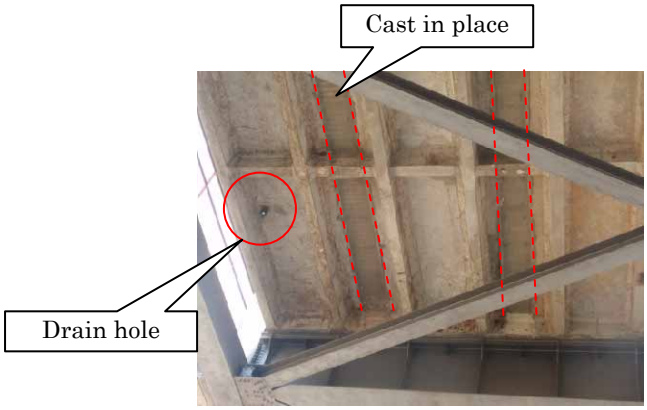
- The bolt is missed.

Situation of inspection work

- The life rope was no prepared.

Situation of Deck slab (main bridge)

- Precasting RC deck slab
- The truss horizontal girder interval is about 4m. (from PW interview)
- In the external check, remarkable damage is not observed.



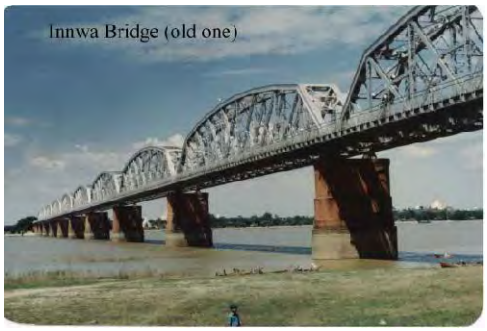
Approach girder

- Drainage from deck slab falls down to web parts.

Construction situation

Old bridge (Innwa Bridge)

- Construction in 1934, a combined road-railway bridge , 1188m in length
- 78 years have passed since a bridge was constructed.
- The passing car is limited to 15t or less in 1992.



(11) No.1Shwe Chaung Br.

Bridge Type:PC I girder

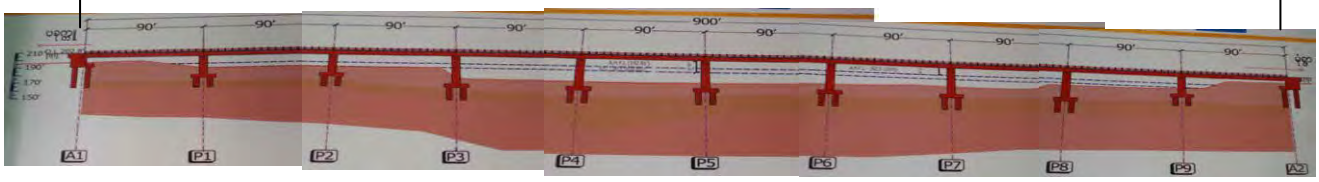
Design and Making: PW

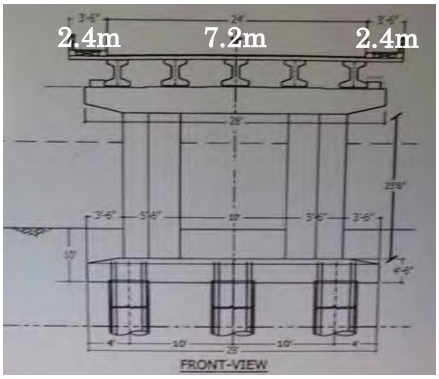
Work : PW

Constructed Year : under construction (implementing of the girder painting and the pavement).

- The old bridge (construction in RC girder and 1967) became impossible to use in 2011 because of flood, and New one planed and started to construct.
- Construction period the foundation to the slub was for five months. (June is rainy season)
- The horizontal girder is RC structure. (no prestressed).

27.1m(simple span)×10=271m /Pc Girder





Cover shot

Roadway drainage pipe

・The length have the position under the slab.

Painting work of main girder

・Scaffolding is not stable

Pavement work

Paving work (bridge)

・Asphalt paving

Expansion device

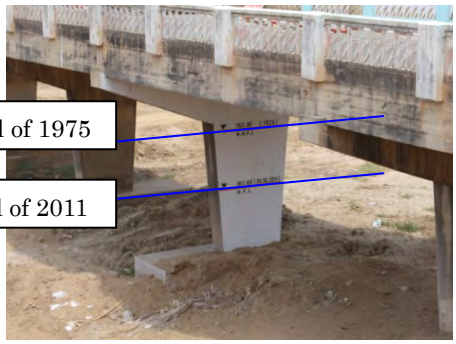
・Structure that have no waterproof.
Roadway drainage drips off from seam onto pier.

The production yard of pre-tension girder

Preparation for opening ceremony

Parameter of old bridge

- RCI girder structure
- The thickness of the pier wall of an old bridge is about 60cm.



Situation of pile head of old bridge

- The stake is RC stake (rectangle).
- The reinforcing bar of the pile head rust and is bent.

Temporary bridge for construction on old bridge

(12) Pakokku Br.

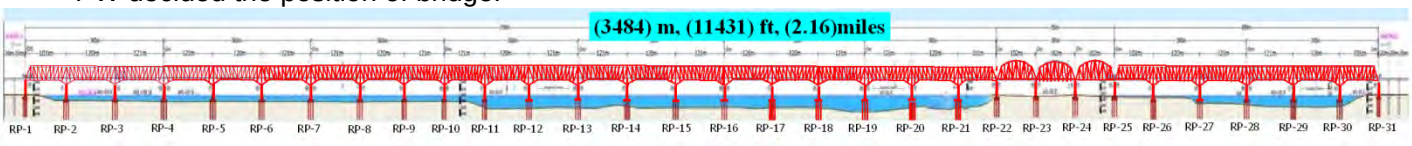
Bridge Type:Truss (3,483m in length, 100m and 120m in span length)

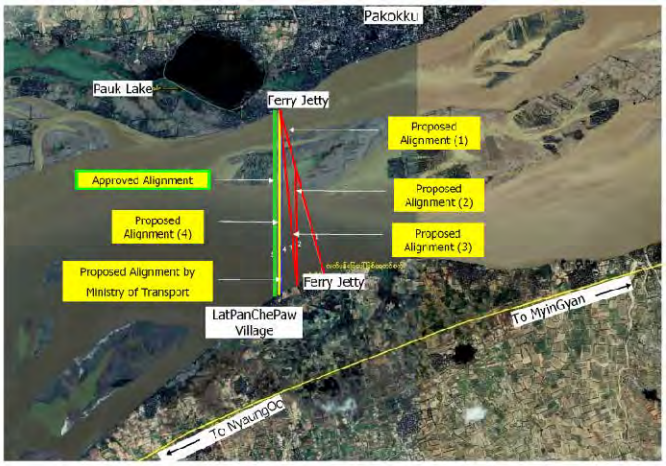
Design and Making: China (design, material offer, and construction leader dispatch)

Work : PW

Construction Period :25th December 2009 to , 23rd December 2011 (for two years)

- A combined road-railway bridge
- PW decided the position of bridge.



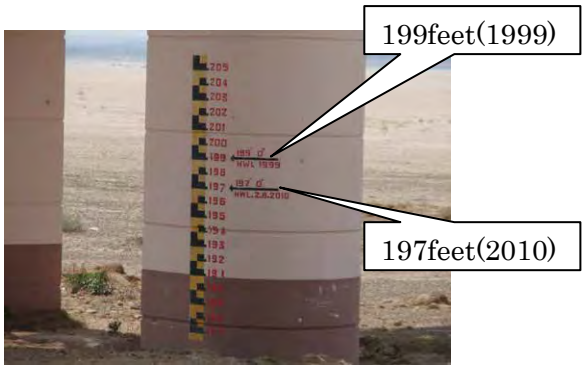


The Working Programme of the Main Bridge

Sr No	Particular	Unit	Quantity	2009		2010												2011											
				Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1	Pre Engineering Work	1 item	1 item																										
2	Substructure Work																												
	(a) Bored Pile Foundation Work	No	520																										
	(b) Pile Cap Construction Work	No	31																										
	(c) Pier Shaft Construction Work	No	31																										
	(d) Pier Top Beam Construction Work	No	31																										
3	Superstructure Work																												
	(a) Transportation of steel truss	span	30																										
	(b) Preassembling work	span	30																										
	(c) Erection Work	span	30																										
	(d) Painting Work	span	30																										
	(e) Decking and Hand Rail Work	span	30																										

Cover shot

Past highest level of water



Situation of joint part

・There is a part where the bolt is missing.

Deck slab of pavement

・ There are some part where the edge concrete was droped off

Situation of deck slab

・Remarkable damage is not observed.

Approach girder

- PC I girder
- The railway ection is composed of four PCI girder.

(13) Malun Br.

Bridge Type : Truss (main bridge, 980m in length of bridge and 112m in span length)

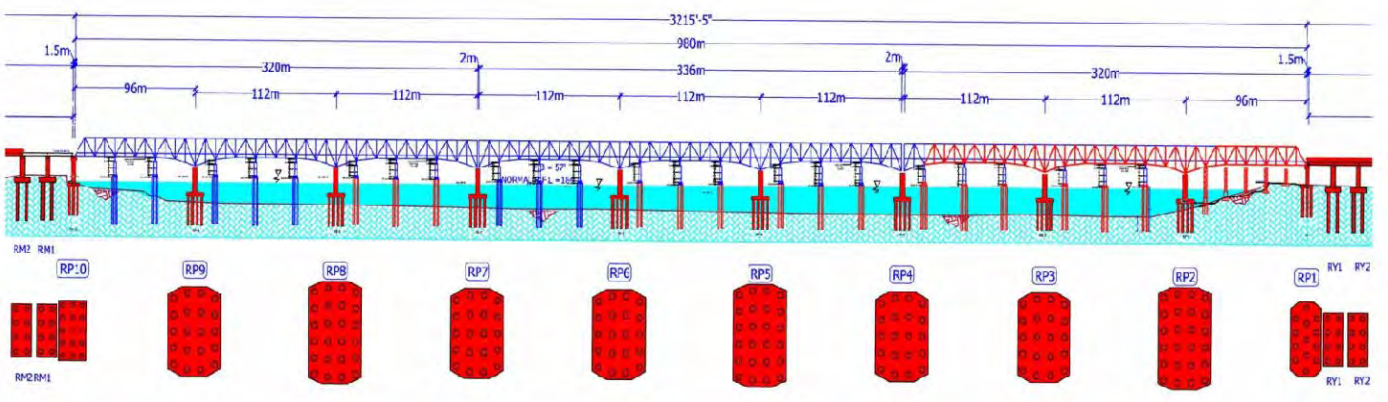
Design : PW and MEC (technical co-operation of JFE).

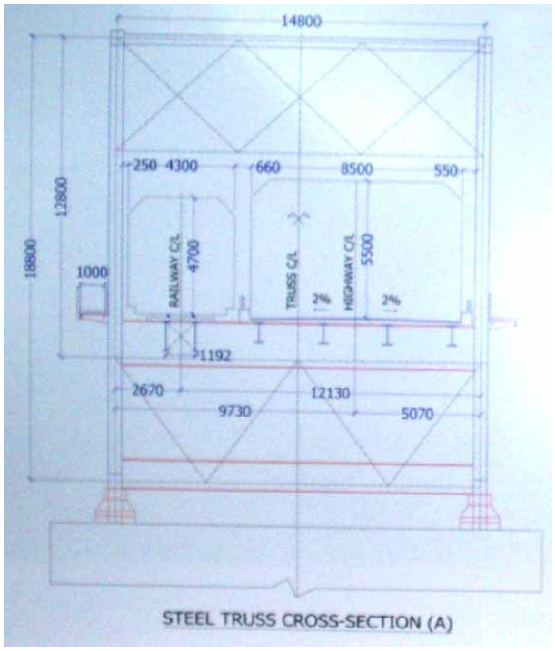
Making : MEC (SM570, High tension bolt, and Bearing are procured from Japan).

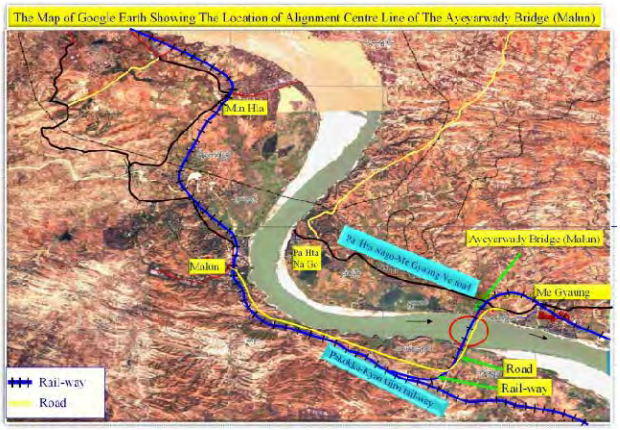
Work : PW (The construction leader is sent from JFE).

Construction Year : 22nd November 2009 to December 2012

- A combined road-railway bridge
- A main bridge is being constructed. (The approach bridge has been completed)
- The factory of MEC is carried to the materials production to another bridges, and the delivery date of the construction material is delayed one year.



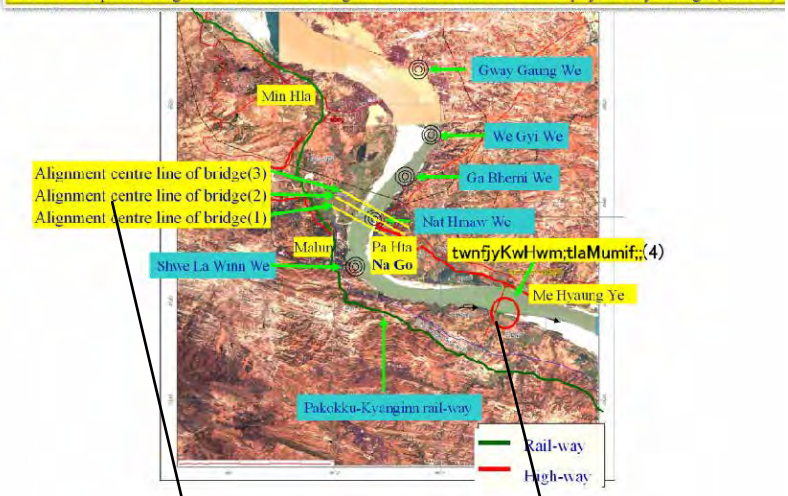




Selection of construction position of the bridge

・Executed by PW

3. The Map Showing The Location Of Alignment Centre Line Of The Ayeyarwady Bridge (Malun)



Comparison of construction position of the bridge

・Considered the economy (from PW staff interview).

The Comparison Of The Alignment Centre Line Of The Bridge (2) And (4)

Sr No:	Pa Hta Na Go Aligment Centre Line of Bridge	Me Gyaung Ye Alignment Centre Line of Bridge
1.	The extent of both river banks (2500)ft	The extent of both river banks (3150) Feet
2.	The depth of water (116) feet	The depth of water (39) feet.
3.	The average rate of water current flow (2.2 metre /second)	The average rate of water current flow (1.5 metre/second)
4.	Strong force of water current at the eastern bank	Regular force of water current
5.	Existing among five whirl pools, the water current flow is bexding.	No whirl pools, the water current flow is straight.
6.	The river bank is stable.	The river bank is stable.
7.	No superficial mass of each on the riverbed, only the surface of sand stone (rock)	Having about average (70) feet of superficial mass of earth on the river bed.

Construction situation of truss bridge

・Cantilever (with bent)

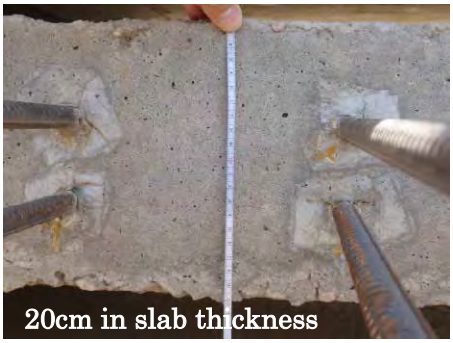
Apparutus of stairs

Dismantlement situation of RC bengt

・dismantled by humans.

Barge ship

Precasting RC slub



4. Field survey: Expressway structures (river bridges, interchange bridge, etc.)

We conducted a survey of the expressway that have gone into operation since 2009, in order to assess recent bridge construction technology in Myanmar. The survey focused primarily on bridges, but covered intersection structures, etc. as well so as to give a picture of the overall condition of Myanmar's expressways.

4-1 Overall condition of expressways

Myanmar's first expressway was the Yangon-Mandalay Expressway, with the section between Yangon and Nay Pyi Taw opened to traffic in 2009. Currently, this expressway extends a total of 590 km (366 miles 4 furlongs) from Yangon to Mandalay by way of the capital Nay Pyi Taw, and remains the country's only expressway. According to Public works that there are currently no concrete plans for further expressway construction.

Myanmar put forth plans for an expressway many times, but these did not fully take shape until April 2005. At this time the plan was for a 530km (325 mile, 6 furlong) expressway connecting Highway No. 3 in Yangon with Sagaing Rotary in Mandalay.

The first stretch of expressway open to public use was the section between Yangon and Nay Pyi Taw (approx. 325 km.), opened on March 25, 2009. This was followed by the Nay Pyi Taw-Mandalay section (approx. 265 km), opened on December 29, 2010. The final stretch, in suburban Mandalay (approx. 20 km) opened on December 23, 2011. A newspaper article from the time reveals that the initial opening ceremonies were grand ones, featuring top politicians such as the Prime Minister and President at the time.

Opening ceremony photographs (from the New Light of Myanmar newspaper)

Yangon-Nay Pyi Taw opening ceremony
From March 26, 2009 article

Nay Pyi Taw-Mandalay opening
From December 30, 2010 article

Suburban Mandalay opening
From December 24,2011 article

Construction was handled by the Public Works / Ministry of Construction and Directorate of Military Engineers / Ministry of Defense of Myanmar. The allocation of construction work was as shown in the figure.

The expressway is currently administered by the Public Works /Ministry of Construction. The section of expressway currently operational has four lanes (two lanes going each direction). Future plans are for an eight-lane road (four lanes going each direction).

In its current form, the expressway is not fully closed to the outside, and vehicles and people can enter or cross the expressway from other points besides interchanges. For this reason pedestrians can be seen crossing the expressway, as well as reverse drive using it for short-distance trips.

In the suburban Mandalay area, there is a location where the expressway intersects with railroad tracks. When a train goes through, a gate closes, bringing traffic on the expressway to a halt. There are also rotaries on the expressway, which also necessitate traffic stoppage or slowdown at times.

In the Yangon-Mandalay interval, there are 72 bridges of 180 feet or more, 202 bridges between 50 and 180 feet, and 164 bridges of under 50 feet, making a total of 438 bridges. (When the section between Yangon and Nay Pyi Taw opened, the plan at the time was for a total of 434 bridges: 72 bridges of 180 feet or more, 200 bridges between 50 and 180 feet, and 162 bridges of under 50 feet.)

Also, in the suburban Mandalay interval there are two bridges of 180 feet or more, 12 bridges between 50 and 180 feet, and 34 bridges of under 50 feet, for a total of 48 bridges.

In addition, 891 culvert boxes and 75 underpasses have been constructed.

The concrete paving consists of a lower layer six inches thick and an upper layer 12 inches thick, with a design load of 80 tons. (Source: New Light of Myanmar newspaper article)

Expressway service status

Expressway, 2 lanes each direction (100km/h speed limit)
(concrete paving)

Zones with sharp curves have a speed limit of 80km/h
"SLOW" warning sign painted on road surface

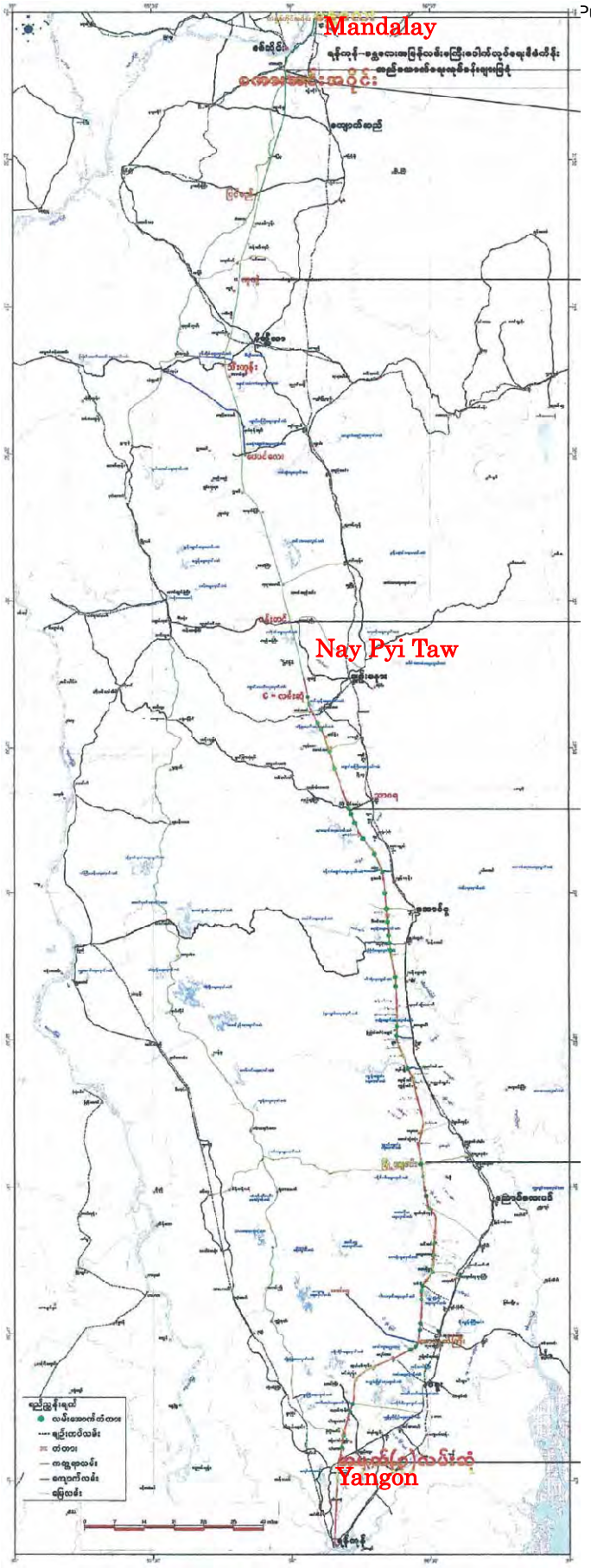
Expressway is not completely closed off, meaning that vehicles and people may enter or cross at locations other than inter changes.

There are some buildings which can only be entered from the expressway (this is for a pagoda)

In suburban Mandalay, traffic slows due to rotary-style on/off ramps
(speed limit 60kmh on main expressway road)

Railway crosses expressway.
Road traffic blocked with manually operated gate

Expressway construction work allocation



Public Works / Ministry of Construction

(13 miles 5 furlongs)

Public Works / Ministry of Construction

(49 miles 4 furlongs)

Military Engineers / Ministry of Defense

(82 miles 1 furlongs)

Public Works / Ministry of Construction

(48 miles 0 furlong)

Military Engineers / Ministry of Defense

(89 miles, 3 furlongs)

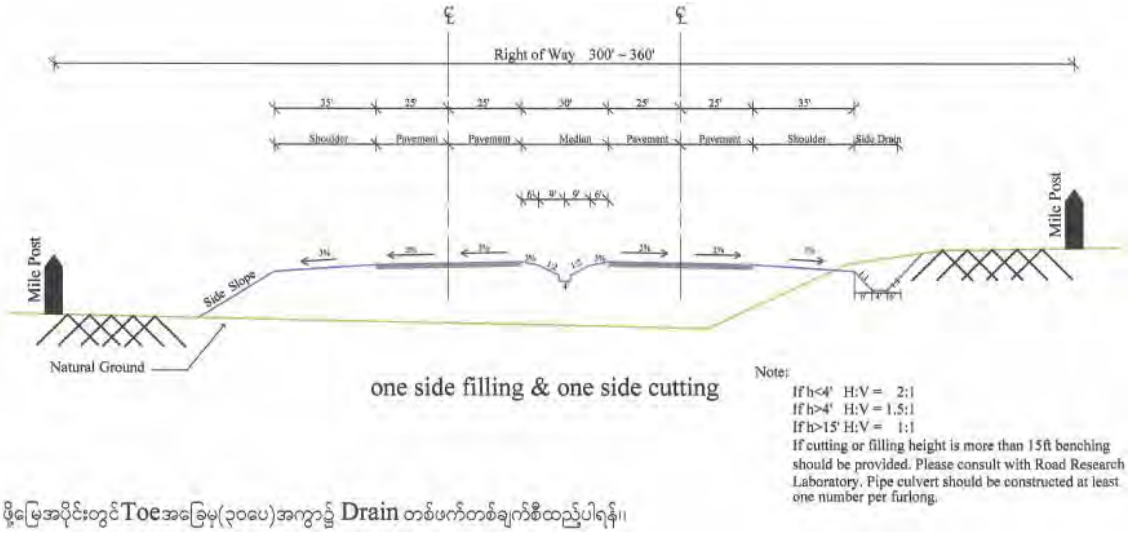
Public Works / Ministry of Construction

(83 miles 6 furlongs)

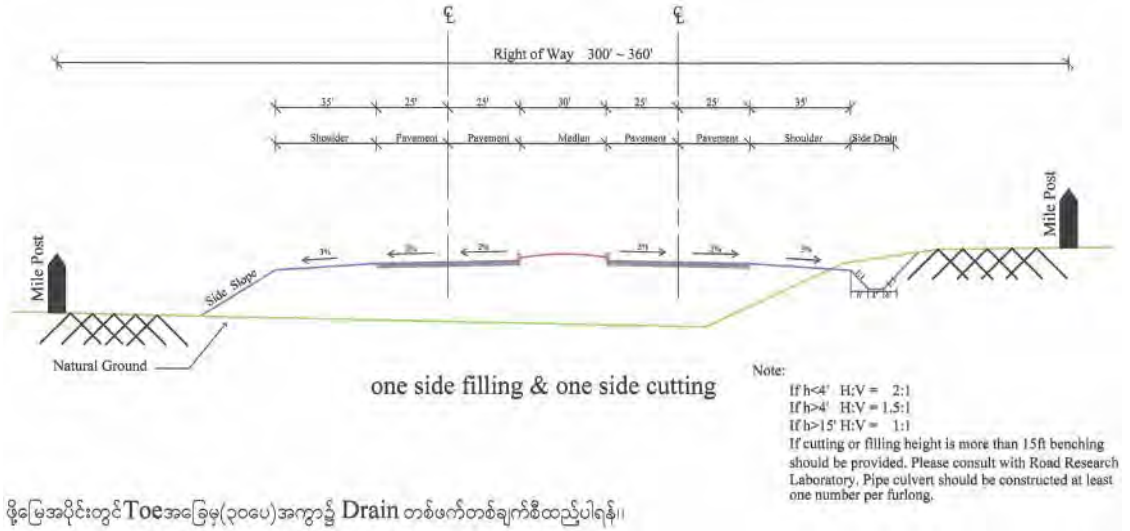
Total 366 mile 3furlongs

Source: Public Works / Ministry of Construction

Plan for Cross section (to be implemented when expressway widened to eight lanes)



ဖို့မြေအပိုင်းတွင် Toe အခြေမှ(၃၀ပေ)အကွာ၌ Drain တစ်ဖက်တစ်ချက်စီထည့်ပါရန်။



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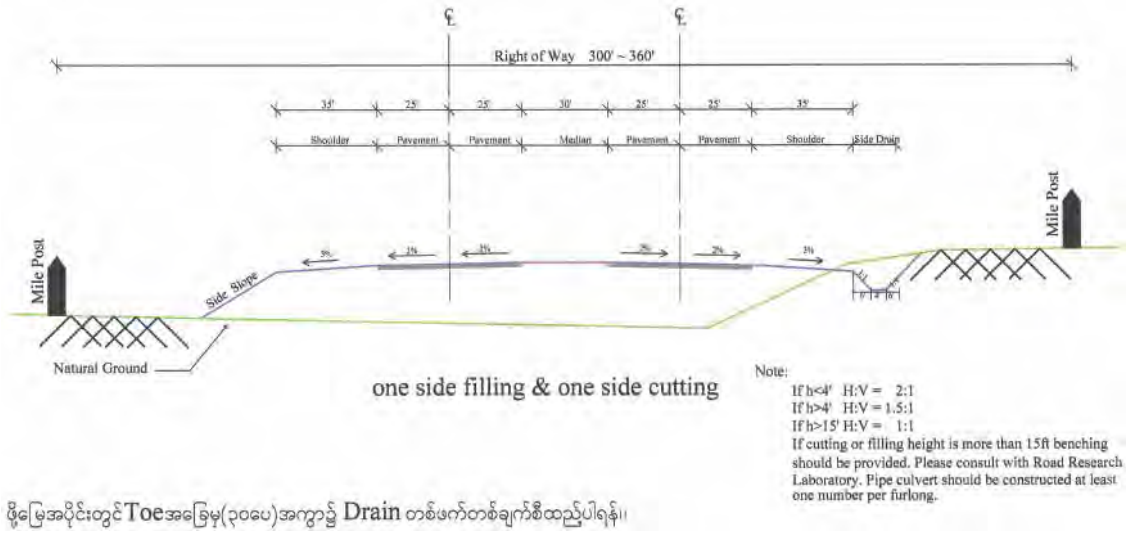

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Source: Public Works / Ministry of Construction

4-2　Status of operation

4-2-1　Road surface

The road surface is uneven, particularly at either end of bridges (there may be no approach cushion) and in areas where structures are added on to crossings (thought to be caused by insufficient surface compaction at narrow points). However, the road surface is uneven overall, not only in these particular areas, indicating that the construction underneath the pavement lacks consistency. In places that have sunk considerably, vehicles are severely jolted when they drive past, and driving conditions appear to be hazardous.

As clotheds were not incorporated into curve entrances and exits when the road path was designed, curves seem to be very sharp. On the other hand, in most those zones the visual appearance of the road is good.

As road shoulders were constructed separately from the main carriageway, the parts outside the exterior lane of the expressway are twisted or sunken in many areas. Water seeps into the damaged parts of the shoulder, and it is feared this could lead to damage to the lane portions of the road.

The sections slated for future lane addition and the central median are almost composed of earth, making them vulnerable to rainwater. The future lane sections are in good shape in places where conduits are installed to drain water away, but in other areas the future lane without conduits are noticeably eroded in many places.

Road surface has sunk in backfill sections on the ends of bridges

Sagging sections of road show severe damage
Concrete paving slabs exhibit nonuniform sinking

Shoulders constructed separately from carriageway
Damage is more severe than on carriageway

Numerous cracks run lengthways

Abrupt a alignment of carriageway

Entrances to curves give the impression of being too sharp

Conduit situation (In areas slated for future lane construction) Some areas with conduits are in relatively good condition
However, in many sections without conduit on shoulders leads to severe erosion.

4-2-2 Toll collection

The expressway has toll barriers in Yangon, Nay Pyi Taw and Mandalay. Elsewhere, tolls are collected at interchanges, entrances and exits.

For example, on the way from Yangon to Mandalay, drivers pay the toll as far as Mandalay at the Yangon toll booth, and receive a receipt. They may then pass through the toll booths at Nay Pyi Taw on the way to Mandalay and in Mandalay itself by showing this receipt.

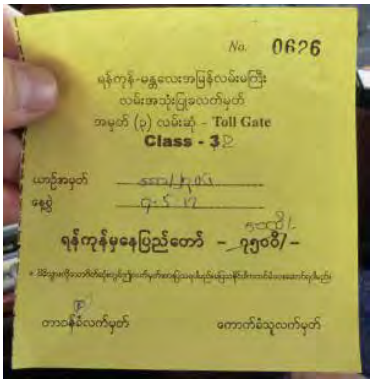
As the expressway is not closed system expressway, drivers may enter the road at points where there is no toll booth, in which case they must pay a toll at the next toll booth they pass. For example, if vehicles enter at a point past Nay Pyi Taw where there is no toll booth, they must pay a toll at the next toll booth they pass, in Mandalay.

There are four different toll rates depending on the class of vehicle. The tolls for the key zones of the road are shown on the table below.

ETC has already been installed on the expressway. According to PW engineers, vehicles equipped with ETC can pass through toll booths without stopping. However, during this survey, no vehicles were observed using the ETC lane, indicating so it seems that it has not been installed in many vehicles.

Toll barrier of carriageway
Toll booths also found at ICs, entrances, exits

Pre-paid “ETC”-type lane
No vehicles observed using the lane during this survey



Expressway coupon (Yangon→Nay Pyi Taw)

List of tolls at toll booth (Yangon exit)

Table Expressway tolls for key zones

Vehicle class	Yangon - Pyu	Pyu - Nay Pyi Taw	Yangon - Nay Pyi Taw	Yangon - Mandalay
Class 1	1000 kyat (approx. 100 yen)	1500 kyat (approx. 150 yen)	2500 kyat (approx. 250 yen)	4500 kyat (approx. 450 yen)
Class 2	2000 kyat (approx. 200 yen)	3000 kyat (approx. 300 yen)	5000 kyat (approx. 500 yen)	9000 kyat (approx. 900 yen)
Class 3	3000 kyat (approx. 300 yen)	4500 kyat (approx. 450 yen)	7500 kyat (approx. 750 yen)	13500 kyat (approx. 1350 yen)
Class 4	5000 kyat (approx. 500 yen)	7500 kyat (approx. 750 yen)	12500 kyat (approx. 1250 yen)	22500 kyat (approx. 2250 yen)

Based on reading of toll list at toll booth

4-2-3 Rest facilities

There are rest facilities with restaurants on the expressway. One of these has a single facility spanning both sides of the expressway, while in the other two locations there are separate facilities going each direction. There are also rest facilities featuring only gas stations, and some other rest facilities under construction were observed.

All of these are extremely large, with an enormous number of parking spaces.

Sign indicating a rest facility

Rest facility with a restaurant (Rest Camp)

4-2-4 Structures built on to road

In terms of structures built on the expressway, there are lights, mostly in the vicinity of toll booths. There are also lights powered by solar cells in bridge areas.

There are no guardrails along the main road, making it easy for vehicles to go off the road.

There are road signs indicating names of places, but no variable message signs providing information, etc.

There are no emergency telephones installed. However, in the vicinity of Yangon there are some signs indicating the locations of telephones.

There are no emergency callbox.
Telephones are found in some locations.

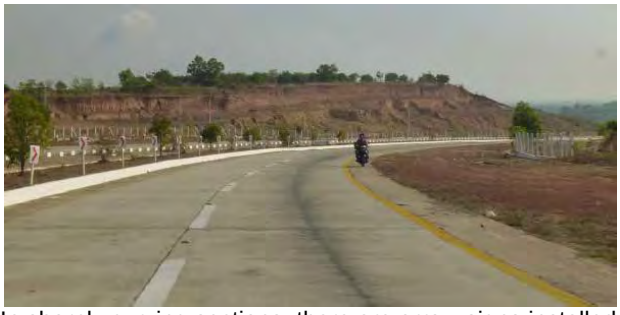
Lights are found only around bridges or major interchanges.
Lights are powered by solar cells.

4-2-5 Safety measures

On January 22, 2011, there was a traffic accident involving a Japanese driver. On the expressway on the way from Yangon to Nay Pyi Taw, a Japanese dentist andarese railway official crashed on a bridge and were killed.

Accident photos along the route, intended to boost safety

Currently there are billboards showing photos of traffic accidents positioned along the route so as to boost safety awareness. Although the expressway has relatively good visibility, facilities and measures to ensure safety are insufficient, and it appears that when accidents do occur they are often catastrophic.


In sharply curving sections, there are arrow signs installed
(Motorcycle is going the wrong direction)


Some interchange ramps have no safety facilities whatsoever
Nay Pyi Taw interchange ramp (extremely poor visibility)


Painting curbstone along the median.
Traffic regulations are extremely rudimentary


Workers repainting lane marker
No regulations, no guard for the rear


Both two lanes closed.
Vehicles directed to detour on unpaved part


One lane closed due to re-painting work on central lane marker
Worker is difficult to see, dangerous conditions.

One example of geometric design-related safety issues are the on/off-ramps to carriageway. See the photos below of an IC ramp (traffic direction is left to right).

In the areas around interchange entrances and exits, there are four lanes going each direction, reflecting the future plan for the entire road. This means that on- and off-ramps connect to these four-lane sections.

(Left) Approaching the IC exit. The deceleration lane is very short, meaning vehicles must slow down abruptly when approaching the off-ramp. In addition, they must cross two additional lanes to reach the off-ramp from the driving lane, necessitating drastic maneuvering with the steering wheel.

(Center) After passing the off-ramp, there are four lanes between this point and the off-ramp. The two additional lanes on the right have zebra lane markings in places. However, this section allows for four-lane traffic, and vehicles easily slip into the lane to the right.

(Right) Approaching the IC on-ramp. The acceleration lane is very short, meaning that vehicles must merge with traffic quickly after entering the expressway from the on-ramp. In addition, they must cross two additional lanes to reach the driving lanes.

Currently, there are no major problems because of being few vehicles. However, if the volume of traffic increases, there is a risk of traffic congestion and collisions in deceleration zones approaching IC exits. Also, if vehicles coming on to the expressway from IC entrances do not accelerate sufficiently, it may be disturbance from the car driving on the carriageway, and result in safety problems as well.

Ramps at interchanges

On right, deceleration lane ⇒ ＋off ramp can be seen

Road widens to four lanes ⇒ between off- and on-ramp

On right, on-ramp +acceleration lane can be seen

Explanatory diagram of off-ramp

At the ends of bridges, there are walls or concrete poles to prevent vehicles from falling in rivers. Since the expressway has no guardrails, there is a risk that cars could go out of the lane and collide with these walls, resulting in major, fatal accidents. Particularly at small bridges without light facilities such as the one shown in the photo below, this risk becomes greater after nightfall. There is an urgent need to take measures such as installation of reflectors and cushion drums, etc.

Bridge area with high risk of collision

4-3 Bridge survey

4-3-1 Survey and challenges

(1) Specifications of bridges surveyed

Expressway bridges have mainly the following specifications in common:

Road width: About 10m (Two lanes going each direction)

Bridge length: Depends on combination of forms shown below. Generally between 15m - 200m

Form : All are simple girder bridges fitting formats [1] through [3] below.

Between each abutment are generally either formats [1] or [2] alone, or else a combination of them in sequence. A few bridges employ PC girders.

[1] Steel I-girder span L = approx. 25m

* No sway bracing or lateral bracing, only crossbeams.

[2] RC girder span L = approx. 15m

Girders are in the form of I-girders with no top flange. Although they are different from T girders, these will be referred to as “T girders” from now on for convenience’s sake.

[3] PC I-girders span L = approx. 25m

Deck slabs: RC deck slabs are not linked above support points.

Some floor slabs consist either of concrete poured atop pre-cast frame plates positioned on the main girders, or of pre-cast floor slabs.

Bearing and support point condition :

[1] Steel I-girder Line bearing (Movement restricted to approx. 5cm)

[2] RC T-girder Steel plate (no movement restriction)

[3] PC I-girder Steel plate (”)

Bridge Piers: RC columnar piers (T-form, multi-columnar) approx. 10m or less

Bridge Abutments: Reverse T-form abutment approx. 5m

Foundations: Cast-in-place concrete pilings (H-form steel pilings also possible)

Expansion devices:

[1] Steel I-girder No intermediate supports, only end supports (steel fingers)

[2] RC T* girder None

[3] PC I-girder None

Handrail (Bridge railing): Concrete

(2) Typical damage

The following are some typical examples of damage incurred by expressway bridges

Main girders, crossbeams:

[1] Steel I-girders None

[2] RC T*-girders Coated

Main girders show numerous rock pockets, and some are insufficiently

compacted.

[3]PC I-girders Coated

Main girders show numerous rock pockets, and some are insufficiently compacted.

On crossbeams, transverse pre-stressed steel compression plates and anchor nuts are rusted. Steel may be corroded.

In general, the anchor sections of Japanese bridges feature blocked-out concrete, which is filled in with mortar after tension anchoring.

Deck slabs : Reinforced concrete deck slabs

No major damage.

Steel reinforcing bars of some deck slabs needed for future widening are exposed and rusting (between Nay Pyi Taw and Yangon). However, some steel reinforcing bars are wrapped in concrete or cured with anti-rust treatment (between Nay Pyi Taw and Mandalay).

Bearing: [1] Steel I-girders Line support bearing Some are damaged due to the lack of steel reinforcing bars in height-adjusting base concrete approx. 10cm in thickness.

[2] RC T*-girders Steel plates Steel plates are rusted, supports and abutments show traces of rust fluid.

[3] PC I-girders Steel plates See (2) above.

Bridge Piers: Reinforced Concrete column type piers (T-type, multi-column type)

Coated. No damage caused by leakage has been confirmed on intermediate bridge piers. Exterior shows no signs of damage.

Abutments : Reverse T-form abutments

Some abutments are structurally tilted. It is possible that the abutment foundations have been scoured by the river current, and are pushed by soil pressure in the rear of the abutment. Measures to address this must be considered.

Some stacks of riverbank reinforcing blocks surrounding the abutments have caved in due to the tilting of the abutments.

Foundations: Cast-in-place concrete pilings

The pier and abutment pilings in the river have been scoured and many pilings are jutting out. It has not been confirmed whether the design called for jutting pilings. Measures must be taken to address this as well as abutment structure.

Expansion device:

[1] Steel I-girders No expansion-contraction mechanisms can be seen in the intermediate supports, and road surfaces are usually cracked with water leaking. Where abutments have steel finger joints, these have a water drainage structure and are subject to water leakage from road surface. No damage to steel finger joints themselves.

[2] Reinforced concrete T*-girders : Intermediate supports same as [1] above. Abutments have angle bars which is rusting

[3] Prestressed concrete I-girder Intermediate supports same as [1] above. Abutments have angle bars which is rusting

Road surface: Cracks and gaps in sections without steel finger joints.

Drainage: Water drainage pipes are laid atop bridge wall rails and water drains into rivers. There is no plumbing draining water from earthworks surrounding abutments, and water is eroding soil in front of abutments.

Wall rails (railing):

Honeycombing of bridge wall rail concrete can be seen, resulting from overabundance of water when concrete was set.

(3) Challenges

The following are common challenges facing expressway bridges.

Scouring

・Tilting of abutments due to scouring

→Necessary to fix soil in place to prevent scouring, reinforce scoured portions, and halt tilting

Possibilities include wall foundations, consecutive underground walls, or steel pipe wells in vicinity of existing footing (may be difficult to arrange for equipment)

・Scouring of pier foundations

→Design must be confirmed, as pilings are protruding.

・Abutment / pier positioning plans

→Scouring occurs because bottom surface of footing has higher elevation than riverbed, and abutments are positioned in rivers

→Necessity of appropriate determination of river areas, design riverbed levels, etc.

→River plans drawn up by river plan administrators needed.

・Appropriate water-plumbing equipment

→Road surface water flows out of earthworks in abutment sections, carving paths in the front of abutments and causing erosion.

→ Appropriate water plumbing is required.

Quality of concrete - main girders, deck slabs, wall rails -

・Concrete may be made with excessive amounts of water

→More thorough quality control of fresh concrete during manufacturing and pouring

・Main girders show numerous rock pockets

→More effective compaction. Possibility that vibrators are not applied

Corrosion of steel bearing pressure plates and anchor of prestressd cocrete

→If nuts come loose, steel bars may fall out. Anti-rust measures must be taken.

In general, the anchor sections of Japanese bridges feature blocked-out concrete, which is filled in with mortar after tension anchoring.

→Already rusted sections must be re-examined.

Lleakage from girder ends

→Water is leaking whether or not expansion-contraction mechanisms are in place, and road surface water is reaching abutments and piers. As there is no salt damage resulting from spreading of anti-freeze materials, like that found on Japanese expressways, this problem is not thought to be

serious. However, it is thought advisable to prevent rusting on girder ends of steel bridges and to make steel-plate support bearings on RC and PC bridges rust-proof by giving them a non-water drainage structure.

Cracks and gaps in road surface in parts without expansion devices

→ Causes problems for cars on the road, but not thought to pose structural problems for the time being (countermeasures depend on Myanmar government opinion)

4-3-2 Condition at the site

Near 38 miles 6 furlongs post

2 @ RC simple T*-girder + 4 @ steel simple I-girder + RC simple T*-girder

- In wide sections, steel bars of pier beams and pier bases are cured with concrete.

- Abutments are moving toward the river, meaning that the earthwork behind the abutments is loosening. The shift behind the abutments generates cracks in the pavement.

Near 51 miles 1 furlongs post

RC simple T*-girder

- Steel beams of floor slabs for widening are protruding and not protected, therefore they are rusting.

- The riverbed has sunk drastically, exposing the abutment pilings and making the retaining wall foundation appear to float.

- The joints are butt joints where floor slab ends are fitted with angle bars, and rainwater easily seeps below the road surface.

Near 67 miles 0 furlongs post

RC simple T*-girder ＋ 3 @ steel simple I-girder ＋ RC simple T*-girder

- In wide sections, steel bars of pier beams and pier bases are cured with concrete.

- Abutment has fallen and is interfering with the girder. This causes damage to the concrete paving.

- Stiffener for connecting parts, used during widening, is applied to the steel girder web.

- Support bearing is in the form of a horizontal steel plate.
  Earth and sand has accumulated in the gaps between joints, and the steel plates themselves are rusting.

Near 77 miles 3 furlongs post

RC simple T*-girder ＋ 3 @ steel simple I-girder ＋RC simple T*-girder

- There is a vertical ditch to drain water away from the median, but it is broken.
  As it is broken yet stays in place, the bottom of the block pitching is greatly scooped out. The hollowed-out part extends to beneath the abutments, and further damage is feared.

(It is not clear which the damage to the vertical ditch or the scouring of bottom of block pitching came first. However, it is evident that insufficient periodic inspections have made the damage worse.)

Near 93 miles 3 furlongs post

4 @ steel simple I-girder

- There is no drainage ditch to conduct water from the vertical ditch in the block pitching to the river. This results in severe erosion of the soil, digging a natural channel for the water.

  As the position of the abutments' footing is high, it is feared that damage to the block embankment and abutments such as that seen at the 33 miles 3 furlongs location could develop.

Near 145 miles 1 furlongs post

11 @ steel simple I-girder

- Various steps are taken to protect the steel bars fo widening.

  On the piers, the main steel bars are protected, bu the structure causes water to build up.

- In the widened area, only the single edges of finge joints are mounted. These have already begun deteriorating, and it is advisable to start widening work right away.

- There is a stiffener for connecting parts, with a hole in it, installed in the steel girder web for widening.

Near 164 miles 3 furlongs post

RC simple T*-girder

- As water is conducted to the flowing portion of the river and the girder is protected with concrete blocks or sealed with concrete, this bridge has not suffered damage like the other bridges.

Near 165 miles 3 furlongs post

9 @ steel simple I-girder

- The concrete retaining wall has completely fallen down, and the block pitching has been demolished. Outside the collapsed block embankment, a new block embankment is being erected.

  The paving surface is cracked in a longitudinal direction.

  Cracks can be seen in the curb in a location roughly corresponding to the vertical wall of the abutment.

- The destroyed slope indicates that the entirety of the earthwork, including the backfill, is in loosened condition.

  This means it is necessary to investigate the effects on the lower part of the road surface.

- Currently, repair work is underway. However, for this to be effective, it is necessary to remove the entire loosened section and re-compact the earthwork densely. The current emergency construction work, which consists only of pushing down the earth, should be re-considered.

Near 208 miles 7 furlongs post

Steel simple I-girder

- The concrete pedestal of the support bearing is broken. Although the pedestal is high, there are no steel reinforcing bars.

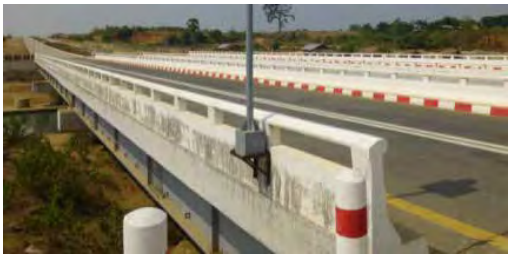
  While fixed in place, it is capable of moving several centimeters, and this breakage is assumed to result from stretching of the girders beyond this capacity.

- The main girder flange width is compressed at the girder end, possibly with the intention of making the support bearing smaller. This is not a desirable structure.

- A curb blocks the upper end of a block pitching, meaning water does not drain through the ditch. For this reason, the edge of the curb is eroded by water

Near 214 miles 5 furlongs post

3 @ steel simple I-girder



There is no drainage device to conduct water from the vertical ditch in the block pitching to the river. This results in severe erosion of the soil, digging a natural channel for the water.

Near 214 miles 5 furlongs post

4 @ steel simple I-girder

・ Anchor bolts are boxed out so as to install support bearing for widening.

・The drainpipe for the road surface is laid atop the bridge railling. This appears to be a temporary measure, as the bridge railing will removal when the road is widened.

Near 2694 miles 2 furlongs post

RC simple T*-girder ＋ 2 @ steel simple I-girde

・ This bridge is completed, with the steel bars for widening protected, and relatively sturdy construction.

・ (Photo at right) The steel girder work consists only of crossbeams, with no sway bracing or lateral bracing.

The flanges are of consistent width, and plate thicknesses are modified accordingly.

・The RC girders and steel girders both have RC slabs.

Near 285 miles 4 furlongs post

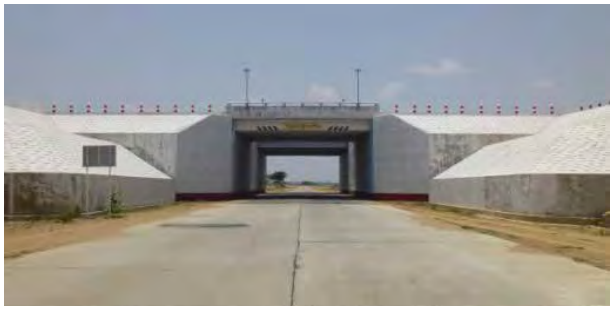
RC simple T*-girder + 3 @ steel simple I-girder ＋RC simple T*-girder

- A cable is clamped to the girder, but it is appeared to be only temporary.

- Some of the bolts on the splice sections are star to rust.

Near 294 miles 5 furlongs post

RC simple T*-girder (IC bridge)



- The paving of the IC bridges has particularly severe height differentials compared to the rest of this expressway. For this reason, the pavement is being repaired as a sinking measure both on the main road and on the road it intersects with.

  This situation is appeared to result from insufficient surface compaction despite the fact that the earthwork is piled higher than in other earthwork locations.

- The ends of the bridge are protected with concrete blocks and concrete seal. Repaired cracks were observed in the concrete seal sections. As these sections are entirely covered, it is impossible to observe the condition of the earthwork. If sinking or height differentials continue to progress in the future, it will be necessary not only to perform simple repairs but also to inspect the earthwork beneath.

- As the joints are structured to drain water, asphalt emulsion from the pavement repair of the main road has dripped down, dirtying the concrete wall.

Near 325 miles 7 furlongs post

RC simple T*-girder (IC bridge)

- This IC bridge does not exhibit as much overall sinking as the previously mentioned IC bridges. However, irregular sinking has caused the abutments to fall over as if bowing. Both the abutment parapets and girders are cracked.

- Steel bars used for holding in place during attachment of joint are still welded on and have not been removed. Even though this is a driving surface, this situation has been left as is for over a year, and no inspections appear to have been performed whatsoever.

Near 341 miles 4 furlongs post

3 @ steel simple I-girder

- This bridge is located at a major bend in the river. For this reason, in areas of fast current near the edge of the river, slopes (block embankments, etc.) have been destroyed, and restoration work has already been performed.
- This restoration work entails the deployment of structures which appear intended to slow the river current (it is questionable whether these are effective.)

- The abutment is falling forward, and have collided with the upper sections of the girders.

- The boxed-out protective coverings of the support bearing anchor bolts for widening have broken.

- Mechanisms to halt shifting are attached to the support bearing at right angles to the bridge axis. However, the construction measure of the bridge seat section is not good.

Near 358 miles 2 furlongs post

RC simple T*-girder + 5 @ PC I-girder ＋ RC simple T*-girder

・ This was the only PC-structure bridge covered in this part of the expressway survey.

・ On the upstream side of the piers in the river, buffers are deployed to protect the piers from collisions with ships.

・ Water leakage from the joint sections has caused blackening of the support bearings of the steel plates. Water drainpipes are protruding, and their positioning should be reconsidered.

Near 360 miles 1 furlongs post

5 @ steel simple I-girder

・ The piers for widening of the road have already bee completed on this bridge.

・ Butt joint : Height differential is not severe, as it has been only five months since this bridge opened to traffic

4-4 Survey of crossing structures

4-3-1 Survey and challenges

Among crossing structures, culvert boxes were designed to cross the scheduled future eight-lane expressway. As they are long, they are equipped with an aperture in the median above to let in sunlight. There are no lights inside and the culvert boxes are long, but they are not pitch-black inside as they are completely straight.

There is a problem with water drainage. When culvert box cross sections are large, there are water channels positioned on the crown of the earthwork. However, the water is not conducted as far as downstream, resulting in water erosion particularly at the foot of the slope.

Also, the apertures in the medians to let in light also let in water from the medians. This means that rainwater and earth washes down into the culvert boxes from these locations.

1-3-2 Condition at the site

Near 224 miles 5 furlongs post

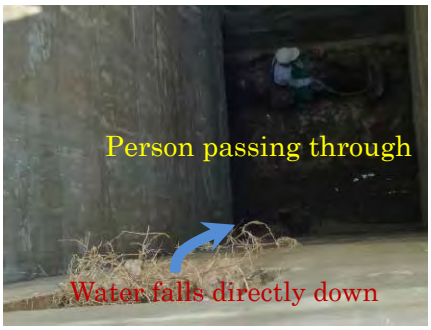
Walkway underpass

- The earth covering is made quite high.

- Vertical shafts in the median let in light as well as draining water.

- A man leading livestock passed through the tunnel while the survey was being conducted this time.

- As there is no pipe or channel, etc., water draining from the median falls directly into the culvert box.



- Water channels in the vicinity of the culvert box are not connected to plumbing, and at the ends of the ditches, erosion has occurred, and the drainage devices are broken. (Removed from carriageway , no immediate influence on expressway)

Near 280 miles 5 furlongs post

Water channel underpass

- This water channel underpass has a 1.5m-square cross section.
- As it is a small-scale culvert box, there are no water conduit facilities. For this reason, eroded soil accumulates around the entrances to the underpass.

- Due to the sinking of structures (culvert boxes), the road surface has sunk, and repairs are underway. It is likely that weight has caused the bottom plates to sink. This indicates that work on the bottom plates was not properly constructed.

- As there are no water drainage or collection facilities, erosion is progressing on the top of the slope.

Near 280 miles 6 furlongs post

Walkway underpass

- Walkway underpass with 2m-square cross section
- As described above, the slope surface shows marks of erosion.

- The end of the wraparound section shows damage

Near 325 miles 6 furlongs post

Water channel underpass

- Eroded areas of slope surface are filled in with stone fragments.
- Essential repairs have not been implemented, so soil continues to build up inside the underpass.