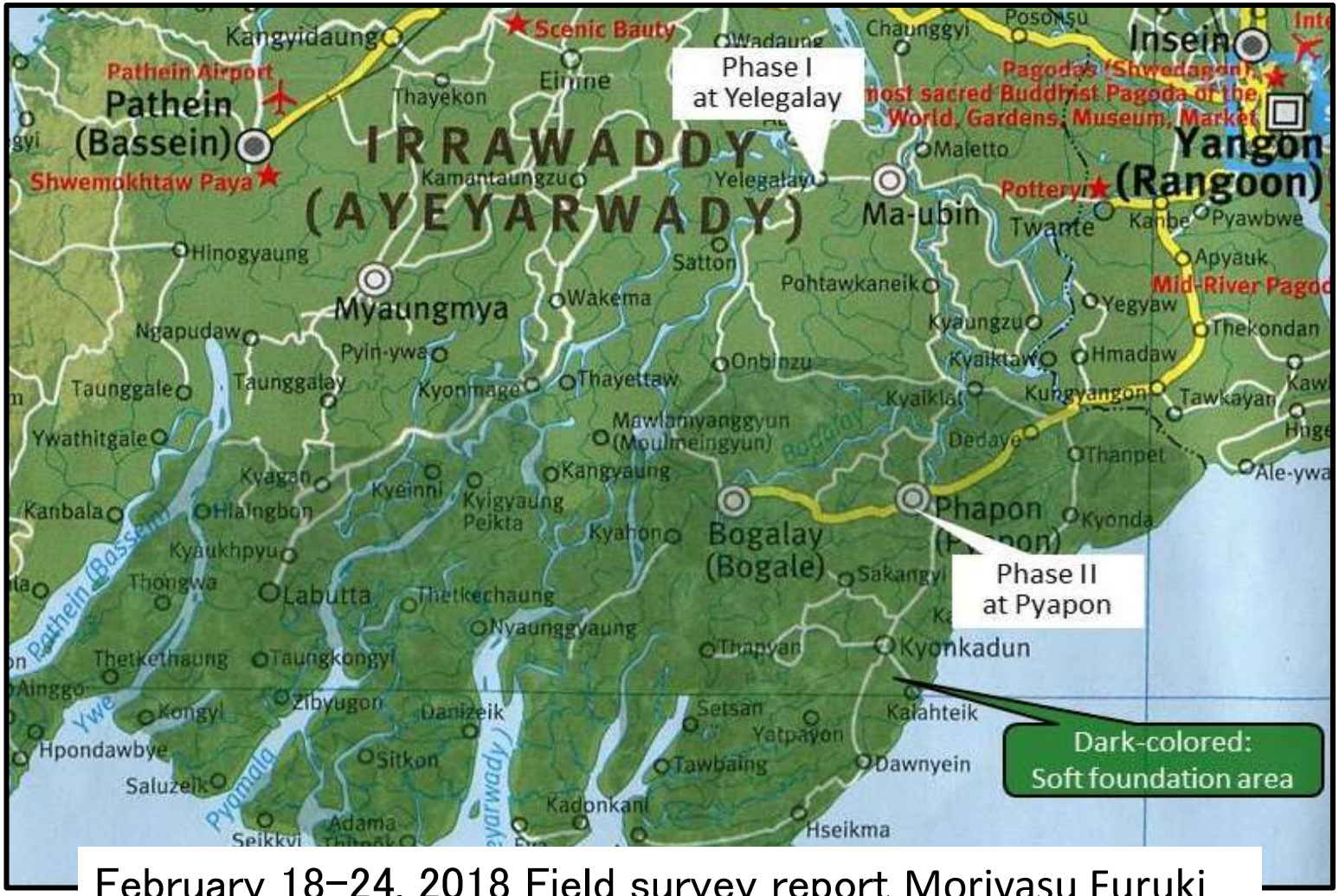
Introduction of Grassroots Projects

JIP (Japan Infrastructure Partners)

- Development of Light Transportation Infrastructure



February 18–24, 2018 Field survey report Moriyasu Furuki

(*All the photos in the slides were taken by Furuki, except for the ones with the names of the providers.)

1. Roads and bridges for grassroots projects and other light traffic

■Outline and background of the project

(**Light Transportation Paving: JICA, Grassroots Technical Cooperation Project, Implementer: JIP**)
The paving rate in Myanmar is extremely low and the main technology is the pervious macadam. Especially for roads in rural areas, rational design methods and quality control have not been introduced.
Therefore, a manual on design and construction methods was jointly prepared by Japan and Myanmar on the premise of light traffic, and test construction was carried out at two locations in Ayeyarwady district, namely Yelegaray (Phase 1) and Pyapon (Phase 2).

■Outline of the project implementation entity: JIP (Japan Infrastructure Partners)

A non-profit organization established by former Ministry of Land, Infrastructure, Transport and Tourism (MLIT) engineers with overseas experience to contribute to infrastructure development in developing countries as a private NGO, utilizing their experience and contacts in ODA.

2. Light traffic pavement phase I: Asphalt-based pavement

■Background

(1) Precedents in Mongolia (2007-2012 Grassroots Technical Cooperation Project)
In Mongolia, unemployment due to modernization has become a social problem, and road maintenance as infrastructure is urgently needed. As a countermeasure, it was decided to transfer simple paving technology with the participation of local residents and engineers, and manuals were developed, training was conducted, and test construction was carried out.

(2) Myanmar's **"Human Resource Development Project on Labor-Intensive Simple Roads Inprovement for Employment Promotion in the Ayeyarwady Delta Region"** (2012-2014 Grassroots Technical Cooperation Project, commonly known as **Phase I**)
In collaboration with the Ministry of Construction (MOC) of Myanmar and local residents, a manual for simple pavement was prepared and test construction was carried out in the Ayeyarwady Delta region, which was severely damaged by Cyclone Nargis, as a pilot district.

(3) **"Project to Support Sustainable and Self-Sustaining Implementation of Labor-Intensive Simple Pavement Construction in Poverty Areas"** (2016-2021 Grassroots Technical Cooperation Project, commonly known as **Phase II**)
Based on the technical cooperation method supported by the results of Phase 1, technology transfer of simple pavement using cement, a domestic resource of Myanmar, is being conducted for the Ayeyarwady area.
The following is an introduction to the implementation of the project in the field.

■Standard cross-section of road pavement (asphalt type) in Myanmar

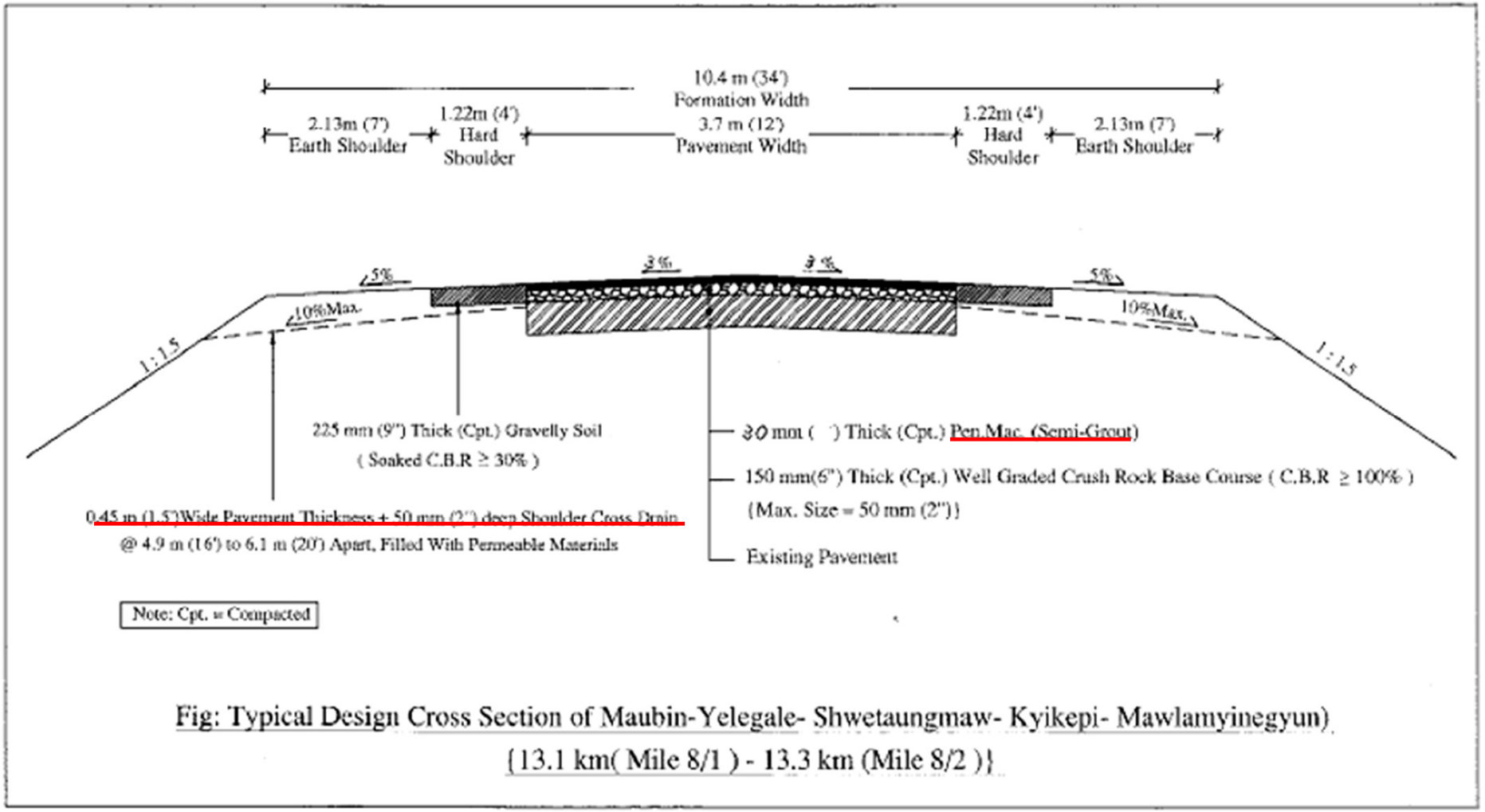
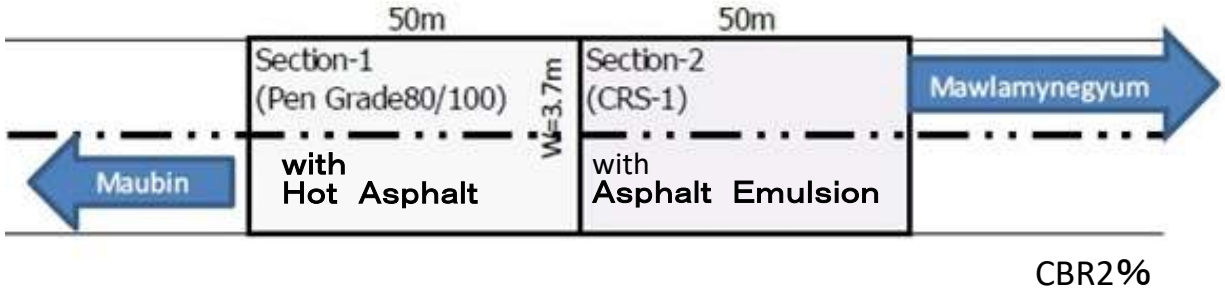


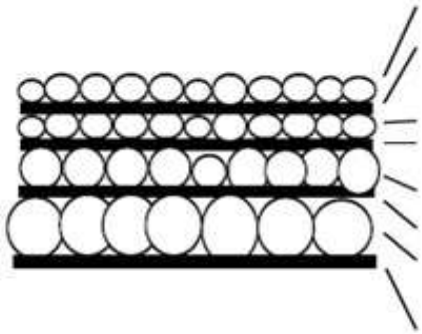
Fig: Typical Design Cross Section of Maubin-Yelegale- Shwetaungmaw- Kyikepi- Mawlamyinegyun)
{13.1 km(Mile 8/1) - 13.3 km (Mile 8/2)}

Figure A-2 Standard cross section

■Phase I: Pilot construction section and macadam pavement section



Yelegalay pilot construction area plan



Quantity (kg/m³)/100m²

Crushed stone(5～2.5):0.5m³	Crushed stone(5～2.5):0.4m³
Straight asphalt:70～90L	Emulsified asphalt:100～120L
Crushed stone(5～2.5):0.5m³	Crushed stone(5～2.5):0.5m³
Straight asphalt:100～110L	Emulsified asphalt:180～200L
Crushed stone(13～5):1.0m³	Crushed stone(13～5):1.0m³
Straight asphalt:220～230L	Emulsified asphalt:200～220L
Crushed stone(30～20):3.0m³	Crushed stone(30～20):3.0m³
Straight asphalt:120L	Emulsified asphalt:120L

Cross-section of 4-layer micro-macadam pavement (tentative name) and amount of asphalt spread

■Phase I: Pilot section construction status (2014) Multilayer surface treated pavement

Before installation Preparation for patching

Morning assembly at the start of work

Layer 1 under construction Multilayer surface treated pavement

Pilot section completed, then widened at MOC

(Photos on this page are from the JIP report)

■Manual for labor-intensive light traffic paving

- Based on the simplified pavement manual in Mongolia, the 84-page manual has been revised by the Myanmar MOC to be consistent with Myanmar standards.
- In contrast to conventional pervious macadam pavement

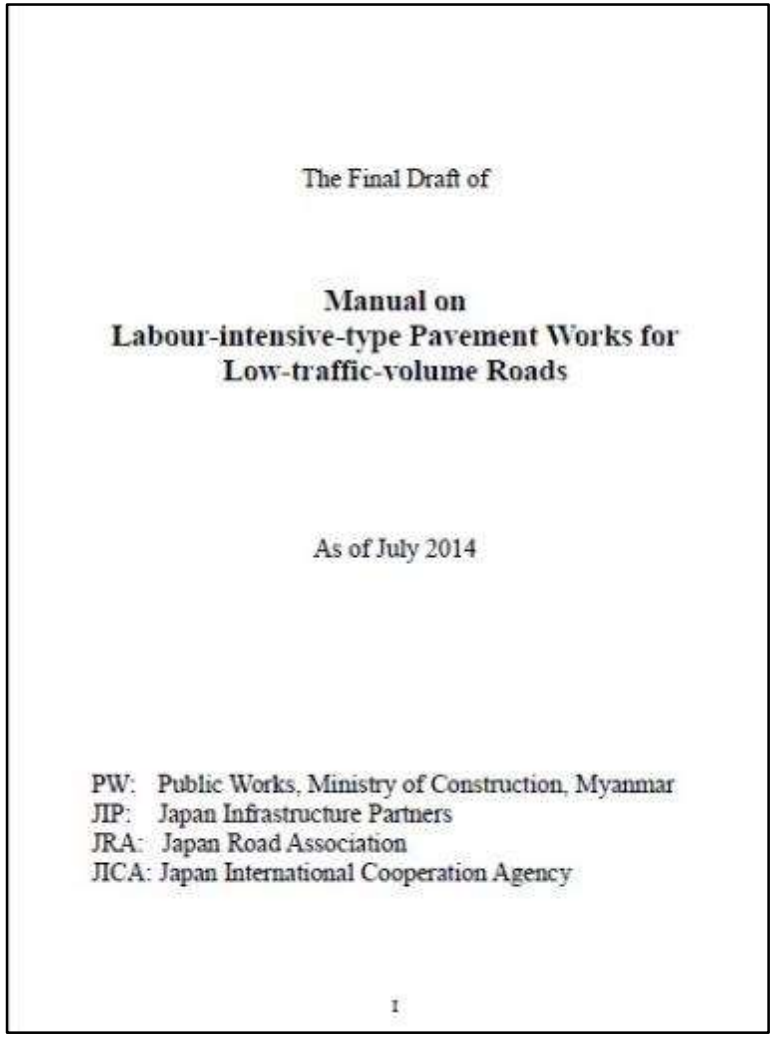
①Introduction of pavement design method (TA method) considering traffic and roadbed CBR

②Introduction of quality control for pavement materials, such as particle size and material

③Introduction of multilayer surface treatment (DBST, etc.)

④It features modifications by the Burma MOC to reflect field conditions and make it easier to use.In addition, it has been translated and distributed in Myanmar language by MOC.

- It was immediately applied to the 40km section near Ma-ubin in Ayeyarwady.



The Final Draft of

Manual on
Labour-intensive-type Pavement Works for
Low-traffic-volume Roads

As of July 2014

PW: Public Works, Ministry of Construction, Myanmar
JIP: Japan Infrastructure Partners
JRA: Japan Road Association
JICA: Japan International Cooperation Agency

I

Current status of Yelegalay pilot section

Taken in February 2018

View of the pilot section MOC maintains the road in front and behind As a result, transportation became dramatically more convenient, and the region's population grew.

To ship rice by land, instead of the traditional direct shipping by boat, a collection point has been set up.

The village has a population of 2,000 households, but the market is huge. (The photo shows a cell phone store.)

We were invited to a grand tea ceremony at the village chief's house. We still made our way. My friends trust me immensely, and the second and third people from the right are the village chief and his wife.

MOC Yangon Road Research Laboratory (RRL)

Taken in February 2018

The facilities have been enhanced compared to three years ago, and a triaxial testing machine has been introduced.

Kanbe-Pyapon-Bogalay Road

Permeation macadam's paving of gravel layer repairing the road surface during the dry season

Lay out fine gravel on top of gravel and spread heated asphalt with a watering pod

Taken in February 2018

Deterioration of Kanbe-Pyapon-Bogalay road (2015⇒2018) Well maintained!

Asphalt spreading and employment measures?

Repairs all over the place (paid for and maintained)

Fundraising for the temple with cars on the toll road

Same route in June 2015 (3 years ago)

Taken in February 2018

ADB Pyapon-Mobin road improvement (likely to be 'Rural Roads and Access Project')

Section where the base layer is paved

Cement or lime stabilization of the roadbed in progress

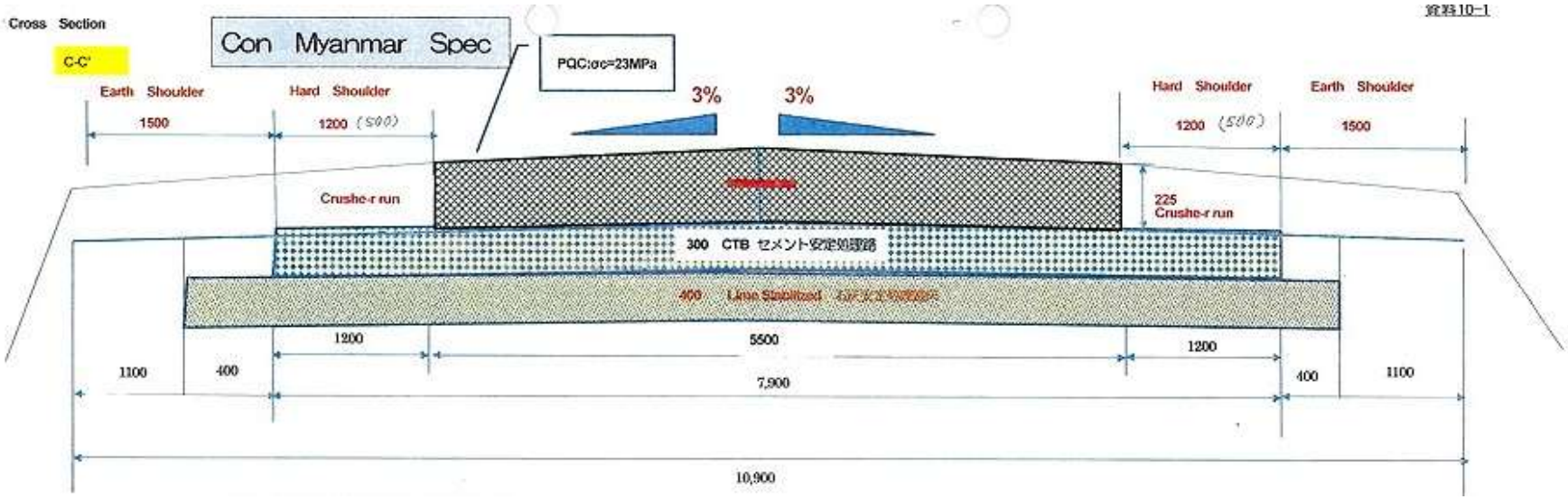
Rural areas of Myanmar

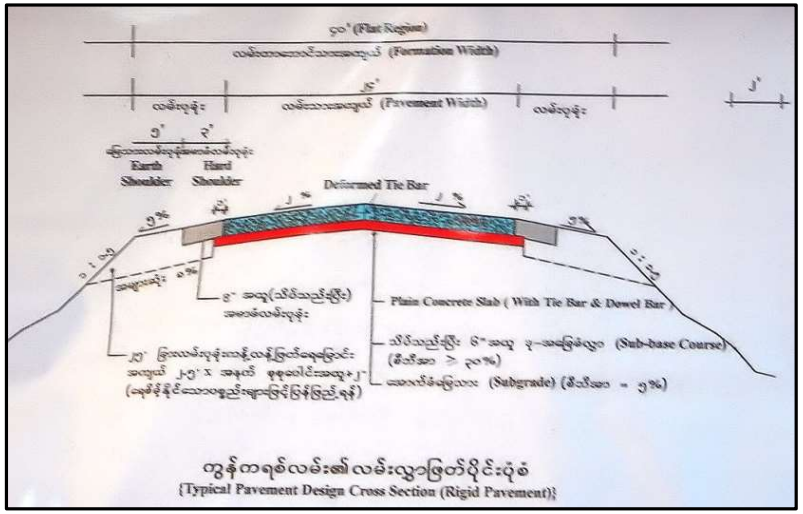
Ayeyarwady's specialty? Bamboo bridge, the entrance to his house.

The level road on the map is also in this condition (to Yoma Bridge)

3. Light Traffic Pavement Phase II Cementitious Pavement

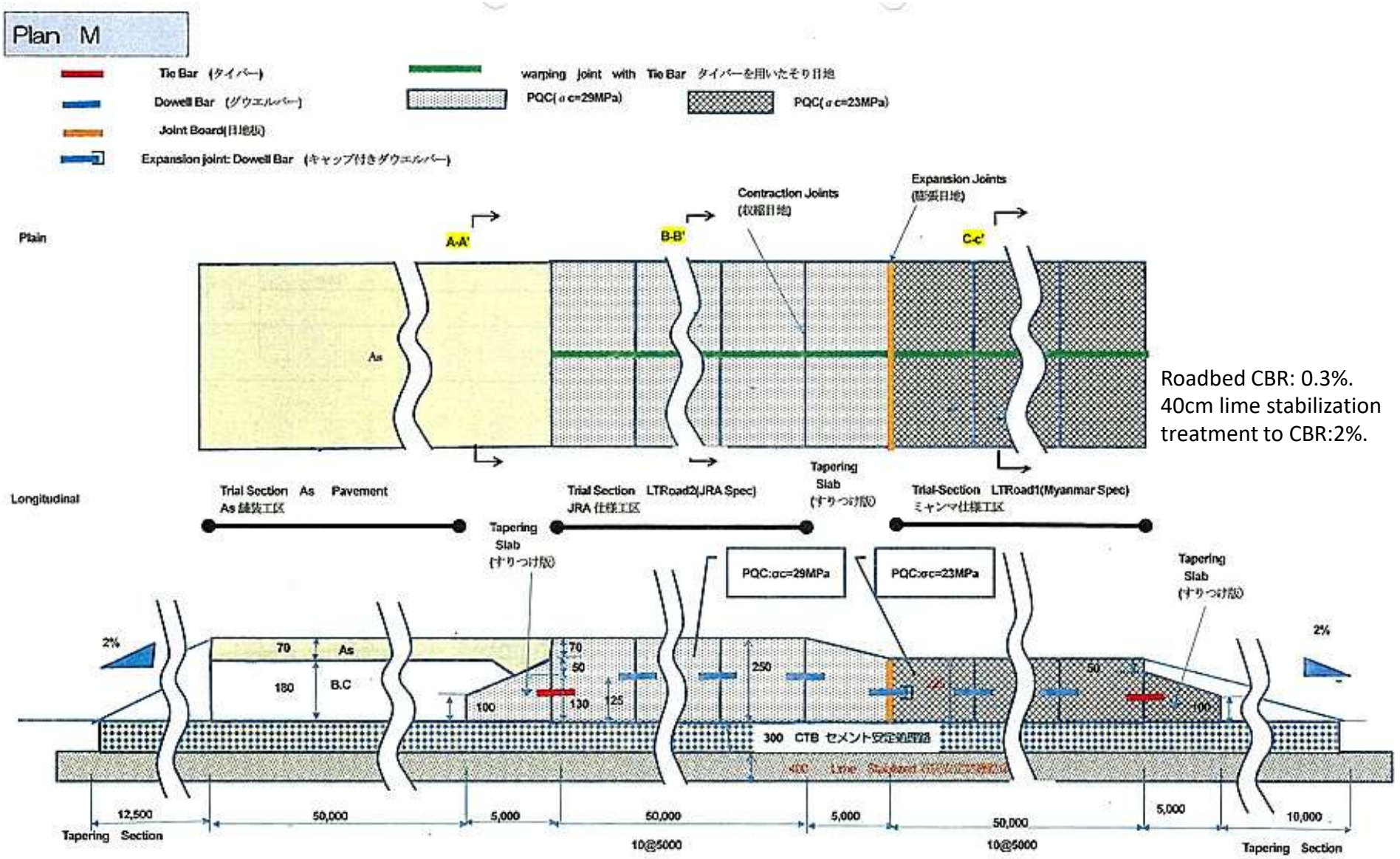
■Standard cross-section of road pavement in Myanmar Region (cement type)





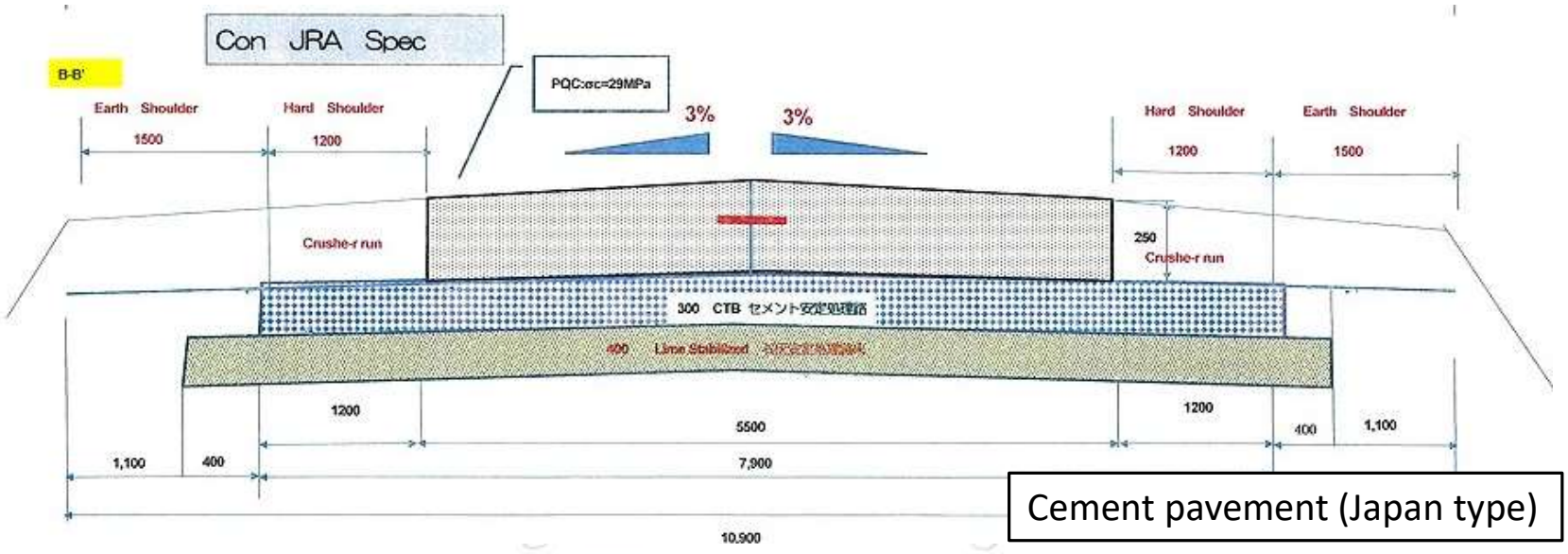
(Above) Cross section of the pilot section according to Myanmar's specifications, with the drainage layer omitted.
(Left) Standard cross-section of cement pavement used in Myanmar, similar to the cross-section of asphalt pavement (at the MOC test lab, RRL).

Phase II: Plan section (top) and cross section (bottom) of pilot construction section

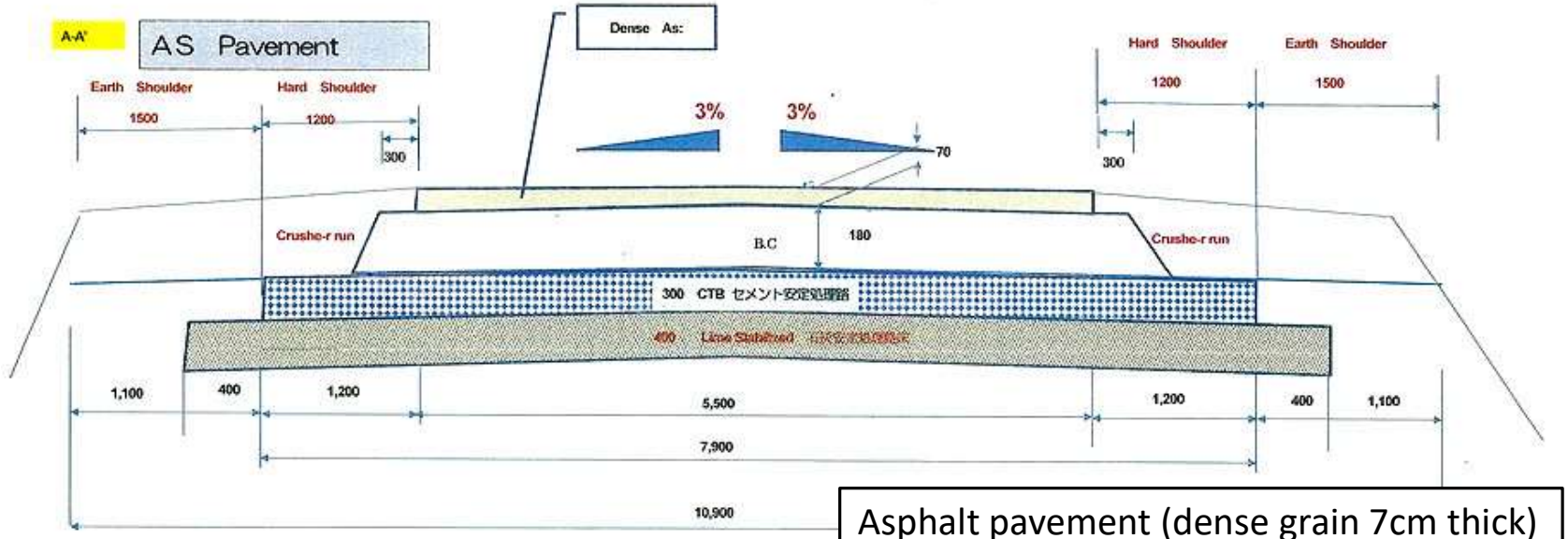


Roadbed CBR: 0.3%.
40cm lime stabilization treatment to CBR:2%.

Phase II: Pavement cross section of pilot construction section



Cement pavement (Japan type)



Asphalt pavement (dense grain 7cm thick)

Taken in
February 2018

Pilot construction area, the building on the left is the field office.

The day starts with a morning meeting to discuss today's process, what was good yesterday, and what we need to pay attention to.

Roadbed leveling operator is MOC staff

Arrival of concrete mixer truck

Taken in
February 2018

Slump test conducted. Slump 8cm, slightly hard.

Finishing with a simple finisher

Hand-made brooms were used for broom seeding,
and the work took a long time and was done at night.

The next day, cutters were inserted into the struck
seams and shrinkage joints at a pitch of 5 m.

Taken in
February 2018

After curing for about a week, the formwork is removed and the shoulder construction is prepared.

Putting good quality material (crushed stone) on the shoulder (1.2m width). Cement bags are used as transport containers.

The road body is built with a side-borrow-pit, so the side of the road becomes a canal. The photo shows gas station.

Interview with a private house next to the site. She would send her children to college with only her income, and she would bring me snacks (left) every day.

■Pavement in Myanmar

Taken in
February 2018

Main line between Pyapon and Yangon
The unevenness of the asphalt suggests that it is a PM pavement.

Pavement of main road (↑)

I was surprised to see that even the main road is PM pavement. The size of the aggregate underneath proves it. However, due to the inability to withstand the increased traffic, turtle shell cracks have developed widely, which may lead to damage in the next rainy season.

Yangon - Mandalay Expressway (→)

Originally paved with cement, an asphalt overlay is now in progress.

■Pavement in Myanmar

10km south of Pyapon, the road was so muddy that even the Land Cruiser had to turn back. 0-1% CBR?

The gravel pavement they call Metal road, a macadam pavement of British origin.

Large crushed stone pavement for PM pavement (left) and repair of damaged road using "water tightening method". (From PPT released by MOC in 2013)

4. Challenges of pavement in Myanmar

(1) Nationwide issues

1) Problems with basic road systems and standards (as background)

- The development and operation of a system of regulations and standards that determine the structure of roads is an urgent issue
  ・・・Road Act, Road Structure Ordinance
- Road network classification and road network planning: Expressways, national highways, and local roads
- Necessity of the Road Structure Order

2) Problems with pavement

- What to do with the pavement design system?
- In the meantime, what to do about pavement rehabilitation of main roads... Importance of pavement diagnosis by FWD
- Need for asphalt plant maintenance to extend pavement length

(2) Soft ground areas and light traffic pavements

1) Traditional Penetration Macadam vs. DBST
2) Diagnosis of damage mechanism and pavement/roadbed・・・CBR, FWD
3) Use and revision of light traffic pavement standards
4) Formulate and implement a renovation plan using Ayeyarwady as a model

■Main road network in Myanmar

↑ Asia Highway Network

← "National Highway" in Ayeyarwady District

■Estimated mechanism of pavement failure in the Ayeyarwady region

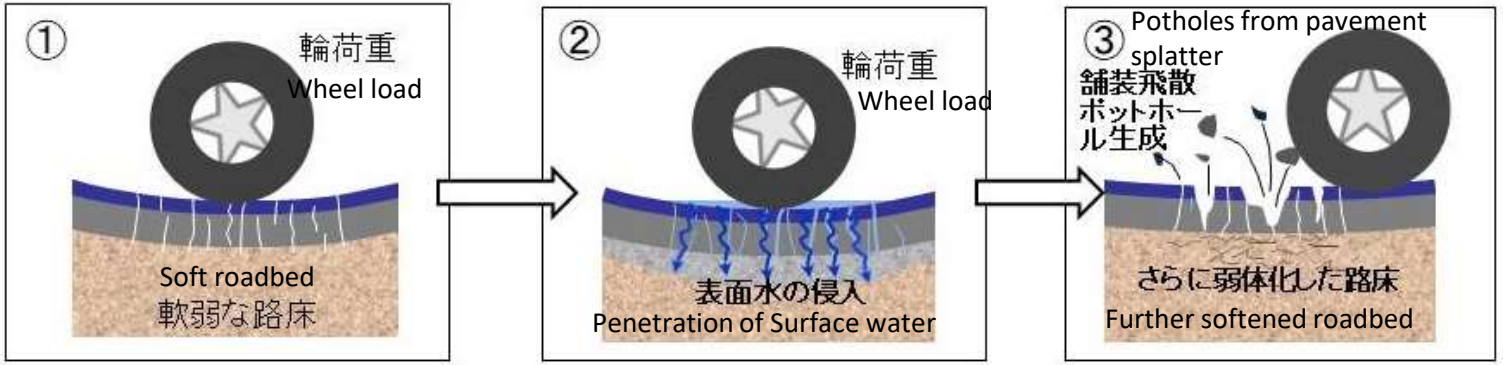
(1) In this region, newly constructed PM pavement becomes damaged in a few years.

(2) Characteristics of the ground (roadbed) and PM (seepage macadam)

- ➢ Soft roadbed (less than CBR3)
- ➢ PM pavement with insufficient thickness
- ➢ PM pavement with low impervious performance (thin layer of asphalt)

⇒ Flexes and cracks easily ⇒ Rainwater penetrates easily

(3) Estimated pavement failure mechanism



①Pavement flexes easily (insufficient bearing capacity)
Cracks in the surface layer of asphalt and gravel (tortoise shell cracks)

②In the rainy season, rainwater penetrates into the cracks, causing the aggregate and asphalt to separate and the cracks to progress, which in turn causes rainwater to penetrate the roadbed, further reducing the bearing capacity.

③Detached aggregates disperse and develop into pot holes.

■FWD (Falling Weight Deflectometer)

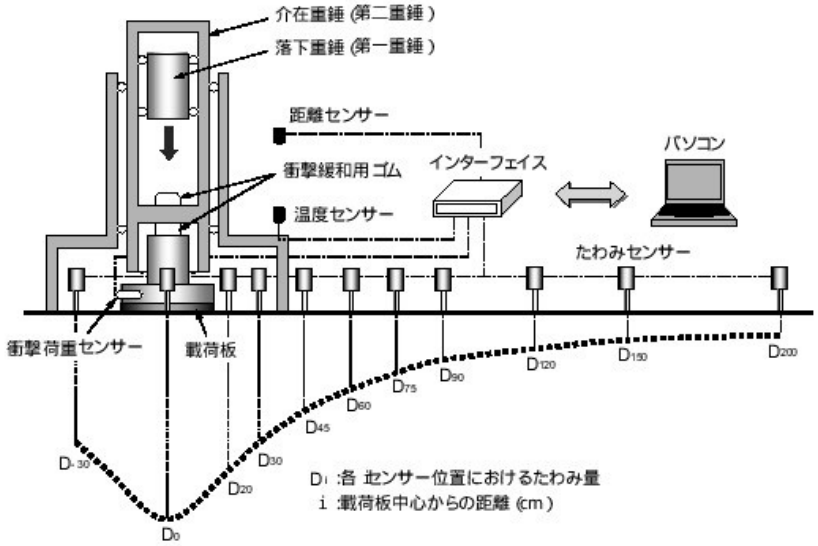


図-1 Example of FWD configuration

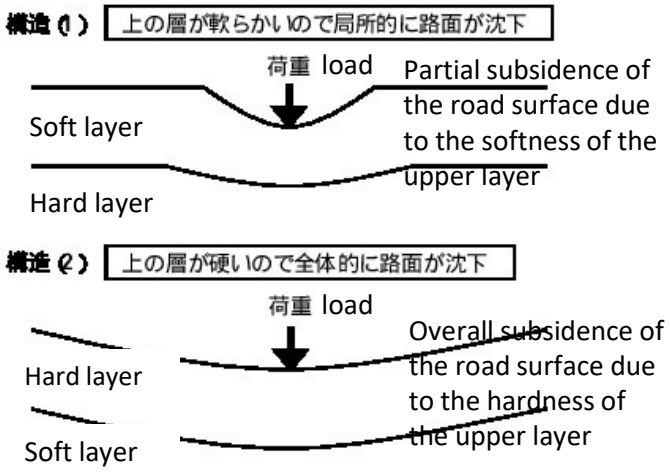


図-2 たわみ量と形状による舗装構造評価の概念

Concept of pavement structure evaluation by deflection and shape

Civil Engineering Materials 48-7 (2006)

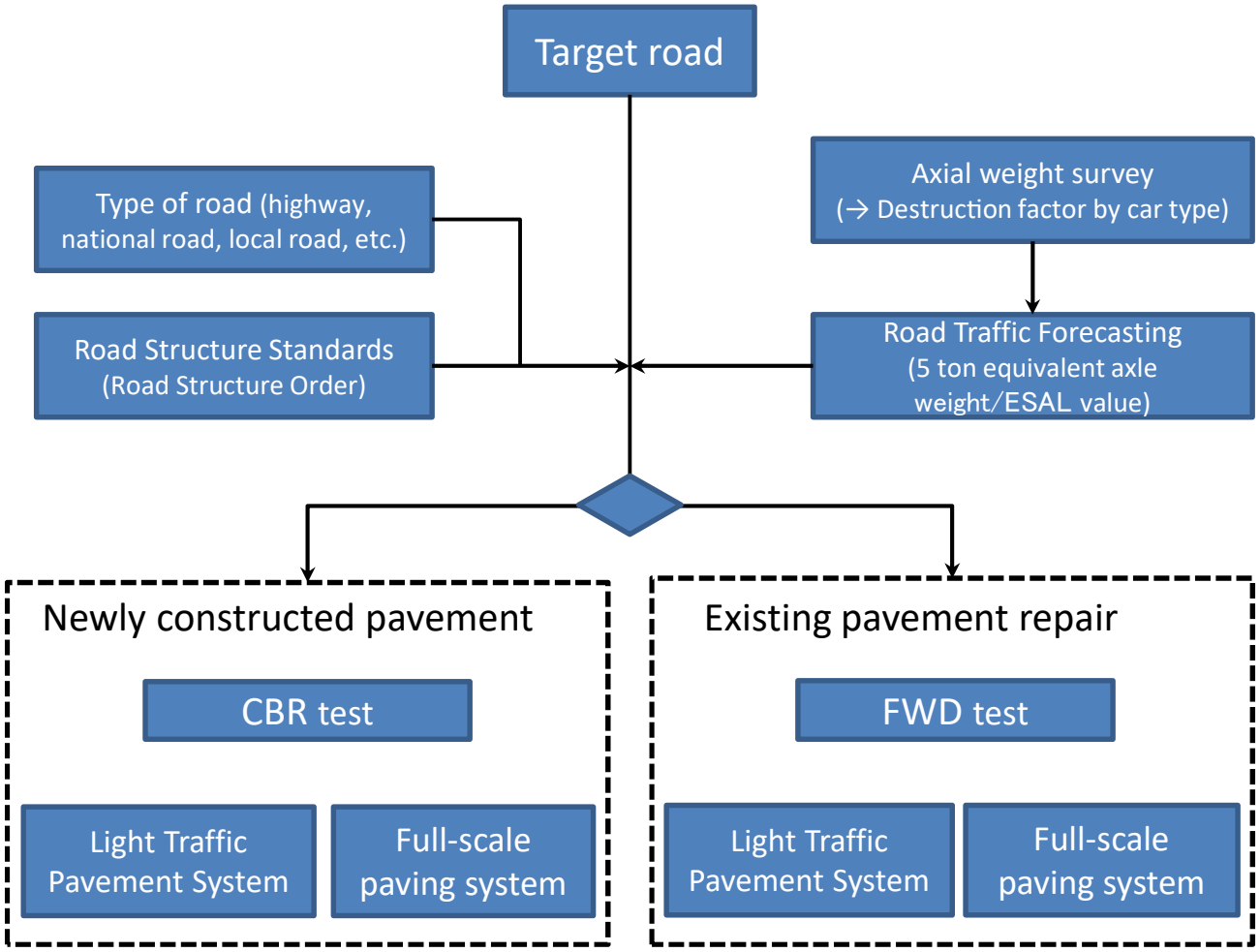
FWD test vehicle (Japanese model)

Necessities for Faster and Systematic Development of Road and Bridge Infrastructure in Myanmar

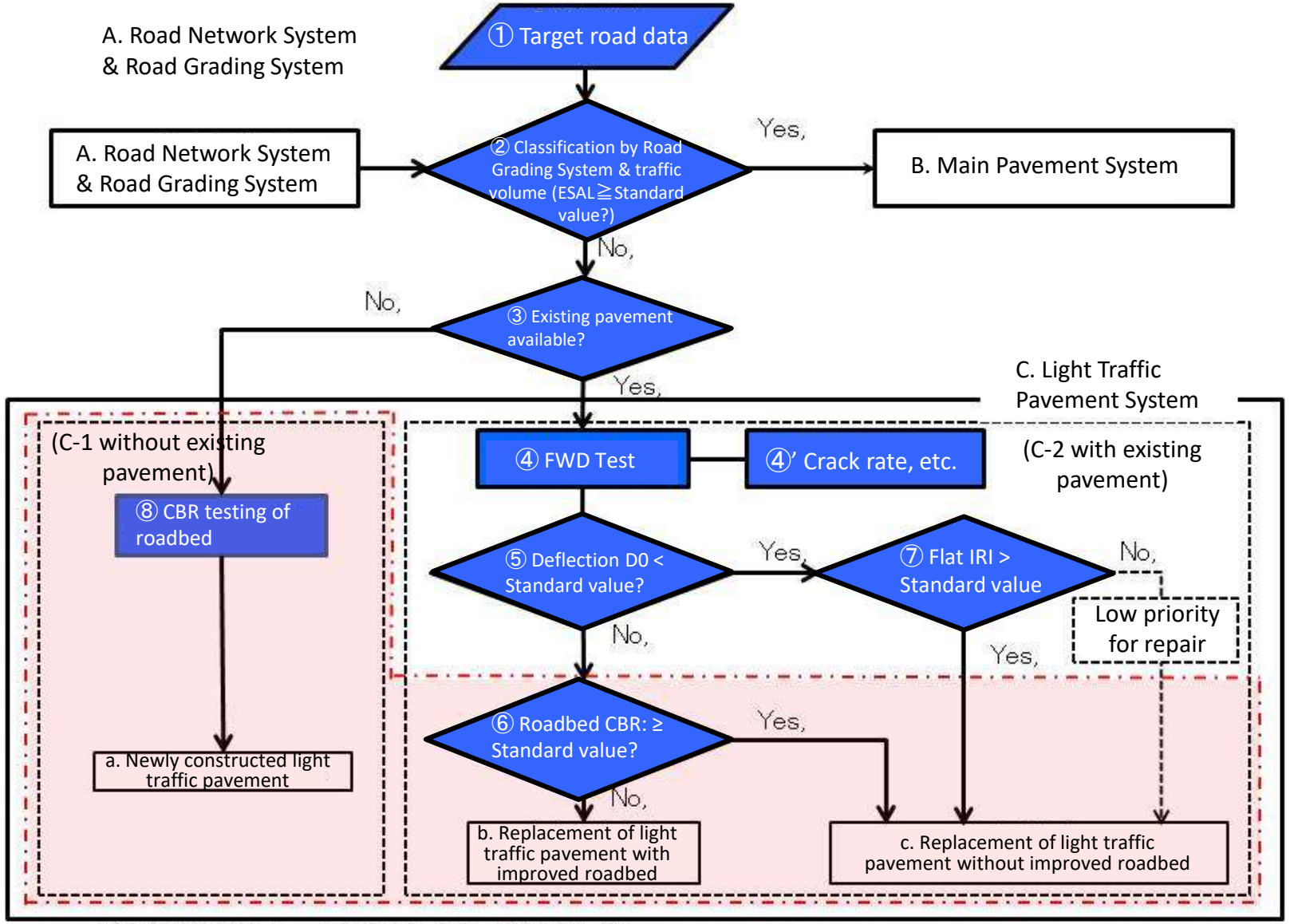
- Approach Methods
- Computer Software
- GIS systems
- Computer and GIS based designing and management systems
- Data Base Software
- Trainings

(Reference) Road surface condition measuring vehicle (announced by Myanmar MOC)

National Pavement Planning and Design Procedure Outline



Outline of Systematization of Pavement Design in Myanmar



※The single-dotted line indicates the range covered by the manual.

U Han Zow Minister of Construction
He is also a former president of the Myanmar Engineering Society and has a deep interest in engineering development.

Young and talented fellow engineers
U Aung Myo Oo
Director, MOC Pyapon Regional Office（at that time)
Director, Pyapon Region (Yangon)