Republic of the Union of Myanmar

Myanma Railways, Ministry of Rail Transportation

PROJECT ON IMPROVEMENT OF SERVICE AND SAFETY OF RAILWAY IN MYANMAR

PROJECT PROGRESS REPORT

May 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN INTERNATIONAL CONSULTANTS FOR TRANSPORTATION CO., LTD
ORIENTAL CONSULTANTS CO., LTD
SUMITOMO CORPORATION

Project on Improvement of Service and Safety of Railway in Myanmar

Progress Report, May 2014

Table of Contents

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1. Preface

Since we started the Project in June 2014, one year has passed and the Project has been implemented effectively under the close cooperation between MR officials concerned and JICA Expert Team.

We, JICA Expert Team, would like to express our sincere appreciation to MR officials concerned for their kindness extended to us during the execution of the Project.

This Progress Report deals with the major activities of the Project implemented around between February and May of this year.

We should be grateful, if MR senior officials concerned review the Report and provide us with the various advices so that the Project will be implemented more fruitfully in the coming period.

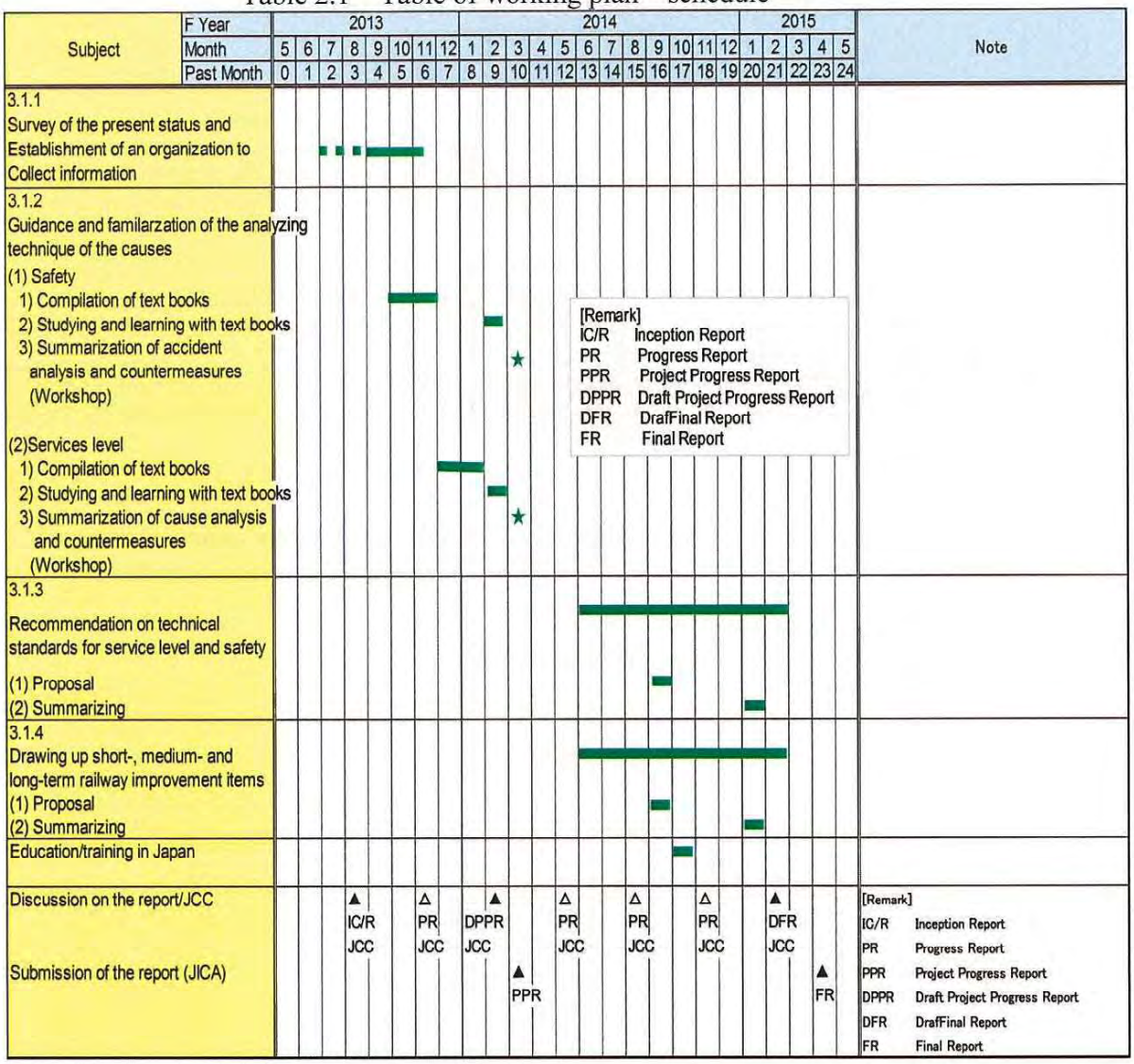
2. Major progress of the Project

2.1. Recommendation of technical standard relating to administrative and maintenance aspect and drawing up railway facilities improvement plan to improve service and safety level

2.1.1 Preparation of a working plan

The Project is progressing as scheduled in Table 2.1.

Table 2.1 Table of working plan schedule



2.1.2 Survey of the present status and establishment of organization to collect information

The present situation of safety and service level of MR was reported in the Appendix 8-1 of the Progress Report, Feb. 2014, and the organization to collect information was established as the Counterpart Team as shown in Table 4.1 of the Progress Report, Feb., 2014.

2.1.3 Guidance and familiarization of the technique to analyze the present status and causes of accident and poor service

(1) Training program of cause analysis of accidents/ low service level and establishment of countermeasures

Training program, of which purpose is to guide MR staff and to make them be familiarized about the technique to analyse the cause of accident and low service level, and establishment of countermeasures, was held from Feb. 10 to Feb. 28 jointly by the MR and JICA in the meeting room of MR Headquarters.

19 experts (originally 20, but one expert was absent) of manager level (Track

maintenance, Civil works, Signaling, Rolling stocks and Train Operation) of Divisions or Head office of MR participated in the training program.

The whole training program consists of there parts. The first part is class room lecture of the text book prepared by JICA experts. The second one is workshop. The third one is training of vibration measurement of rolling stock.
Further it should be mentioned that interview survey to investigate the customer's satisfaction level of MR's passenger transport was conducted following the training program.

The whole schedule is as shown in Table 2.2

Table: 2.2 Schedule of Training Program and Interview Survey

Date	Hour	Contents	Note
Mon. 10 Feb.	AM	Opening Ceremony -Greeting from MR side and Japanese Side -Introduction of MR Participants and JICA Experts Orientation	
	PM	Orientation continued as required Analysis of the Present Situation of Safety and Service Level of MR Lectured by Dr. S. Kuroda	
Tue. 11 Feb	AM	Derailment Accident in Japan and Discussion on Derailment: Lectured by Mr. KURODA	
		Derailment Accident in Japan : Lectured by Mr. MIYAMOTO	
	PM	Workshops: Derailment 2 items	
Wed. 12 Feb		National holiday	
Thu. 13 Feb	AM	Rolling stocks accident : Lectured by Mr. ISHIKAWA Level crossing accidents : Lectured by Mr. MITANI	
	PM	Workshops: Derailment 2 items	
Fri. 14 Feb	AM	Natural disasters : Lectured by Mr. TAKAMI	
	PM	Workshops: Level Crossing 2 items	
Sat. 15 Feb		Holiday	
Sun. 16 Feb		Holiday	

Date	Hour	Contents	Note
Mon. 17 Feb.	AM	Brake systems on rolling stocks Lectured by Mr. ISHIKAWA	
		Train Protection System Lectured by Mr. MITANI	
	PM	Workshops: Train separation 2 items	
Tue. 18 Feb	AM	Prevention for Accidents Lectured by Mr. IGARASHI	
		Measures for speed up on Track side: Lectured by Mr. KURODA	
	PM	Workshops: Train delay 2 items	
Wed. 19 Feb	AM	Measures for Punctualities on track side : Lectured by Mr. MIYAMOTO	
		Measures for Riding Comfortabilities on track side: Lectured by Mr. MIYAMOTO	
	PM	Workshops: Train delay 1 item and Speed limited 1 item	
Thu. 20 Feb	AM	Measures for Riding Comfortabilities on rolling stocks side: : Lectured by Mr. ISHIKAWA	
		Maintenance of Long Rail : Lectured by Mr. MIYAMOTO	
	PM	Workshops: Speed limited 2 items	
Fri. 21 Feb	AM	Workshops: Currents situations of Procedure/ system/ organization for reporting, cause analysis and establishment of countermeasures of MR	
	PM	General Discussion	
Sat. 22 Feb		Holiday	
Sun. 23 Feb		Holiday	

Date	Hour	Contents	Note
Mon. 24 Feb.	AM	Workshops: Improvement of Technical Standards relating to administrative and maintenance aspect to improve the service and safety of MR	
	PM	Turnout: Lectured by Mr. MIYAMOTO	
Tue. 25 Feb		General Discussion	
Wed. 26 Feb	AM	General Discussion	
	PM.	General Discussion	
Thu. 27 Feb	AM	Joint Coordinating Committee: Practice for Measurements of Train Vibrations (Lecture on measurement and data analysis)	
	PM.	Practices for Measurements of Train Vibrations (Practical measurement of vibration)	
Fri. 28 Feb	AM	Practices for Measurements of Train Vibrations (Analysis of measured data)	
	PM	Closing ceremony -Hand over the Certification, -Greeting from MR side and Japanese Side	
Sat. 1 Sun. 2 Mar		Holiday	
Mon. 3 Mar	AM	10:00 Interview survey preparation meeting	
Tue. 4 Mar		Interview survey	
Wed. 5 Mar		Interview survey	
Thu. 6 Mar		Interview survey	
Fri. 7 Mar		Interview survey	

Class room lecture of the text book was held form Feb.11 to Feb. 21 between 9:00 – 12:00 in the morning. Workshop was held from Feb. 11 to Feb.26, mainly between 14:00 – 16:00 in the afternoon. Training of rolling stock vibration measurement was implemented from Feb. 27 to Feb. 28.

(2) Class room lecture of text book

JICA experts explained, based on the text book, about the past accidents and countermeasures in the world mainly in Japan (for examples, derailment, train collision, level crossing, natural disaster and so on), and introduced the measures for improvement of the service level (for examples, increasing train speed, punctuality, riding comfortabilities, train protections and so on).

There were various discussions between JICA lecturers and MR participants. Major advices to MR by JICA experts based on the discussion are given below.

1) Level Crossing Accident Prevention

(a) MR has many level crossing accidents. Knowing that JR has also not a few level crossing accidents, they are interested in how JR tries to prevent level crossing accidents.

(b) There are many illegal level crossings in MR, some of which are necessary for the nearby residents. MR is worried about how to secure the budget for protection devices of these level crossings.

(c) MR is interested in how JR group gives guidance to school children about the safe way to cross the level crossing.

(d) MR experts realize the significance of installing alarm signals at the level crossing, and on the other hand they are worried about how to secure the maintenance budget for them. They are also anxious about how to secure electric power sources necessary for installing various protection devices for level crossing.

(e) In order to decrease the level crossing accidents, not only the installment of protection devices, but also the guidance to road vehicle drivers about the safe way to cross the level crossing and efforts to eliminate the level crossings (such as by grade separation, by unification) are significant.

2) ATP

(a) In introducing ATP, there are many issues to be solved such as securing constant braking distance.

(b) MR experts have understood the history and the reason how and why JR has introduced the ATP.

(c) MR experts have understood that safety sidings, automatic warning devices for obstructing construction gauges, emergency protection devices etc. are also significant devices for preventing derailment and double accidents.

3) Natural disasters

(a) In case of abnormal weather including heavy rainfall, inspectors are stationed at the bridges, and inform the train drivers of the dangerous situations as required. MR wants to install the warring signals on the track side, but the budget issue makes it difficult.

4) Rolling stock

(a) In MR, both vaccum brake and compressed air brake are adopted. Vacuum brake should be replaced by compressed air brake. MR is adopting vacuum brake even in new production passenger coaches; it is not recommendable.

(b) Continuous braking is not working; only locomotive is braked, but passenger coaches are not braked. It is not recommendable.
Continuous braking is necessary for speed up

(c) Derailment mechanism
MR should be familiar with how to analyse the derailment mechanism.

(d) Bogie
Spring system of bogie is closely related with riding comfort of vehicles.MR should investigate the vibration of bogies and try to improve the spring system of the bogie.

5) Measures for Riding Comfortability on the track side

(a) To grasp the track condition precisely, inspection device should be applied.
Allowances for track irregularities should be set for two levels: one for emergency repair, and the other for regular repair.

(b) At present, track repairing power is not so strong, By and by mechanical repair machines such as MTT, Ballast regulator should be introduced for strengthening the repairing power.

(c) Shortage of track ballast is conspicuous. It should be understood that ballast at the end of sleeper, below the bottom of sleeper, and on the sides of sleeper all contribute to the

lateral resistance of track, which is important for securing stable track, especially significant for preventing buckling of long welded rail track.
It should be also recommended to improve the quality control of ballast production.

(d) Low joints of track are conspicuous in many sections, which cause progress of track deterioration and large vehicle vibration. Adoption of long wedded rail is the best solution.
However, in the sharp curve sections and on the long bridges sections, jointed rail will be remained. In such cases, strengthening of rail joint by such methods as adoption large rail joint sleeper, end hardened rail, are recommended.

(e) Maintenance of turnout is in poor conditions .Maintenance manual should be reviewed and training of turnout maintenance should be intensified.

(f) It is recommended to fill the gap between guard rail and running rail at the level crossing track by rubber material, so that the waste/ garbage/ soil filling the gap will be jumped out while vehicle wheel flanges are running through the gap.

(g) In the track sections before and after the bridges or turnouts, horizontal track alignments is in many cases poor, causing large vehicle vibration. These poor alignments should be rectified.

6) Measures for Punctualities on track side
Items (a) – (g) described in 5) above all contribute to improving punctualities. Further, it should be recommended to implement periodical checking of rail ultra sonic inspection so as to find out the initiation of the rail breakage in advance.

7) Maintenance of long welded rail
Adopting of long welded rail is one of the best solutions for improving riding comfort, speeding up and safety.
However, in order to make long welded rail display its splendid role, smooth finishing of rail welded part, ultra sonic inspection of welded part are significant.
Also in maintaining long welded track, track work executed during the hot temperature should be carefully planned or sometimes limited to avoid track buckling accidents.
Maintenance manuals for long welded rail track should be established, and training of maintenance of long-welded track should be strengthened.

(3) Workshops

1) Items selected for presentation by MR experts
The purpose of the workshop is to make MR experts be familiarized with analysis of causes of accidents and low service levels and establishment of countermeasures through making MR staff themselves analyse the causes of actual accidents or low service levels of MR and making themselves establish suitable countermeasures.
In this regard, 25 items relating to accidents and low service levels (train delay and speed restrictions) were selected from the actual MR's events in 2012/ 2013, and MR experts by themselves tried to analyse the causes and to establish the appropriate countermeasures. The 25 items selected are given in Table 2-3.

Table 2.3 Presentation by MR experts in Workshop

Topics		No. of presentations
Accident		10
Derailment	Between stations	3
	In the station yards	3
Train Parting		2
Level crossing accident		2
Service Level		8
Train delay		5
Speed restriction		3
Others		7
Existing situation of Y – M Line		1
Review of Technical standards (track, signal/ telecom, operation)		3
Review of inspection / maintenance of rolling stock		I
Current issues of MR		1
General questions to JICA experts		I
Total		25

2) Discussion between MR experts and JICA experts on presentation by MR experts
For each presentation of MR experts, JICA experts made comments on method of cause analysis and establishment of countermeasures presented by MR experts. JICA experts also presented advices to MR regarding major issues identified through discussion in the workshop.
These comments and advices were prepared for each of all presentations which are classified according to kinds of items for presentation.
They are given in Apppendix 2-1.

Summarizing the advices of JICA experts on major issues of MR identified through discussion in the Workshop, the following advices can be provided according to the kinds of accidents/ low service levels.

(a) Derailment (between stations & in the station yards)
(i) Not only the track cross level irregularity, but also track twist should be measured and controlled because twist is more related with derailment than level crossing irregularity.
(ii) At present in MR, inspection of track conditions is executed by eye-sight. Measurement devices including string should be used to grasp the track irregularities precisely. For example, extent of twist cannot be evaluated by eye-sight inspection.
(iii) Derailments due to gauge-widening caused by rotten wooden sleeper or derailment due to large cross level have occurred in the station yard.
① These events makes us have a question why such situations could not have been found out by regular inspection before occurrence of derailment. Then regular track inspection must be executed according to the rules. This may require training of inspectors.
② These events also make us estimate that the similar track conditions may exist in other siding tracks of the station concerned or in the other situations. Overall examination of important sidings of the station concerned and other stations are recommended.
(iv) Regarding installment of drainage pipes for roadbed sinkage prevention, spacing

of drainage pipes and maintenance of drainage pipes should be examined.

(v) For prevention of derailment caused by spring coil breakage, specification of material of coil, inspection system of coil (magnetic powder, endurance test etc.), periodical replacement according to age, quality control of coil production should be examined.

(vi) The vehicle should be designed and maintained so that brake should be continuously applied to every wheel axle, in order to avoid train buckling (causing decrease of wheel load, increase of wheel lateral pressure leading to derailment) due to sudden braking of locomotive.

(vii) In order to confirm the precise completion of track work, encouragement of practice of confirmation by finger-pointing is recommended.

(b) Train parting

i) Improvement of track and rolling stock which is important for reducing impact load applied to coupler, is the basic countermeasures for accidents like this. However, it may take time for execution of the above recommendation. .In this regards, retaining device for lock of coupler is effective.

ii) Braking system should be improved (compressed air brake is better than vacuum brake) so as to ensure continuous braking, by which the parted parts will automatically stop, preventing the dangerous situations.

(c) Level crossing accident

i) ①First the basic information about the level crossing concerned (No. of trains per day, train speed, traffic volume of road vehicles, length, width, visibility distance from the train driver and from the road vehicle driver etc.) should be collected. Then according to these basic information, all level crossings should be classified according to their importance. According to the classification, suitable protection devices should be planned.
②The guidance to stop once before crossing the level crossing should be given to road vehicle drivers.
③All illegal level crossings should be classified into two groups based on basic information of level crossing: the one to be remained and the other to be abolished.

ii) Air brake should be adopted instead of vacuum brake. Further braking forces should be applied to all wheel axles by continuous braking system, which will ensure standard braking distance of train necessitated at the level crossing.

(d) Train delay

i) Slow down during track maintenance occupies the large share of total delay time. How to decrease the slow down during track maintenance must be examined. Track maintenance needing train slow down should be limited by rules

ii) Inventory control of spare parts for rolling stock and signaling system should be improved so as to provide necessary spare parts timely.

iii) With respect to bridge repair, firstly present situations of bridges should be fully grasped, through investigation of endurance of the bridges etc.

(e) Recommendation on how to decrease train speed down during the track maintenance work

According to the statistics in 2012/2013 regarding the delay of the express trains of Yangon – Mandalay line at the terminal stations of Yangon, Nay Pyi Taw and Mandalay, the average delay time at Yangon and Mandalay is 65 minutes, and that at Nay Pyi Taw is 57 minutes, indicating large delay time.

According to the results of the analysis of train delay by MR experts presented in the Workshop, delay due to train speed down during the track maintenance work occupies a large share of the total delay time (50 – 24 %).
In MR, trains are slowing down the speed during almost all medium/ large track maintenance works.
At present in Myanmar, large train delays have not yet caused any social problems. However, along with socio – economic development of the country, most socio – economic activities will be implemented on time table basis. Then large train delay will cause various social and business problems. Further, in order to compete favourably with road vehicles, punctuality of train trip should be ensured.
Then, how to decrease train delay due to slow down during the track maintenance which occupies a large share of total train delay time should be seriously studied.
JR practices regarding this issue is attached as Appendix 2-2 for the reference of MR.
In case of JR, all track maintenance work are executed in principle in the blocked time-interval. As all track works will be completed in the blocked time-interval, any train speed slow down will not be implemented after the track work.
In case of large scale track maintenance work (such as continuous replacement of rails, or sleepers, or ballast), sometimes the whole work cannot be completed in the given blocked time-interval. In such cases, a part of work, namely preparatory work is implemented before the start of blocked time-interval accompanied by train speed slow down. That is, some limited track work specified by the regulations can be implemented outside the blocked time-interval accompanied by slowing down of train.
Small scale spot track maintenance work can be executed not in the blocked time-interval, but in the regular interval between two consecutive trains. Even in that case, all track works will be completed in the interval, thus without necessitating slow down of train after the work.
It is recommended that MR tries to reduce the train delay time due to slowing down of train during track maintenance, referring to JR practices.

(f) Speed restriction
Poor track conditions, unstable embankment, old aged bridges are major locations necessitating speed restrictions. These locations should be rectified step by step.
In removing the speed restriction locations, priority should be given based on the overall evaluation of ①increase of journey speed, ②rectification cost, ③degree of danger of the situations concerned, etc.

(g) Others
i) No.1 Outline of Y – M line explaining present situation of Y–M line including poor conditions of track and their countermeasures
- Modernization of Y – M line is being planned with the financial support of JICA Yen loan. Modernization should be executed with full cooperation of MR experts
- Track conditions are being grasped through riding on the vehicles. It is recommended to grasp track conditions with use of vibration measurement device..

ii) No.2 Present issues of MR. Major issues of MR are presented by this presentation paper.
It is praiseworthy that MR staff himself tries to identify major issues of MR.

iii) No.3 Review of technical standards of track, signaling a& operation
Major technical standards of track, signaling and operation were reviewed and presented.
These presentation are useful for JICA Experts to review these technical

standards in order for them to present recommendations on these technical standards from the viewpoint of improving safety and service level of MR.

(4) Comments of training program by MR participants

In order to find out the major response of MR experts to the Training Program (the lectures by JICA experts and Workshop), the following four questions were asked to each MR participant.

Question 1 According to your opinion, what information/ matters/ Japanese examples were especially useful for improvement of safety and service level of MR?

Question 2 Are there any other information/ matters/ Japanese experiences you would like to know more?

Question 3 Do you think the way/ method by which JICA expert team organized the workshop was satisfactory to you?

Question 4 Do you have any advice how to improve the way/ method of workshop?

The answers to each question by MR participants are as shown in Table 2.4.

1) With respect to Question 1, namely lectures in which MR participants were especially interested, 63% of participants felt interest in all lectures; 53% of participants felt in level crossing accident prevention, and each of signal & train operation, track, brake system, natural disaster prevention attracted interest of 16 – 20 % of participants.
2) With respect to Question 2, namely about any other topics in which participants want to know, nearly 40% of participants want to know Japanese railway as a whole; other topics about which participants want to know are distributed evenly among rolling stock, signal/ telecom., track, management, station yard planning, operating system, various guided transport systems.
3) With respect to Question 3, namely about the execution method of workshop, all participants were satisfactory.
4) With respect to Question 4, namely about any advice to improve the method of workshop, there were various useful comments which will be a good basis for workshops which JICA will hold in the future.

Table 2.4 Comments on Training Program by MR Participants

Question	Comments	No.of the same comment: (*1)
1 According to your opinion,what information/matters /Japanese examples were especially useful for improvement of safety and sevice level of MR?	**1.All lectures were useful** *Japanese experiences on improvement of safty/ seivice level are useful for drawing MR's improvement plan *MR can learn research,facilities,regulation,management ,especially spirit from JR	9
	2.Level Crossing Accident Pevention *countermeasures against level crossing accidents,level crossing protection facilities	10
	3.Signal and train operation *train protection radio,signal failure prevention,signal visibility,electric point,block system,	5
	4.Track and turnout	3
	5.Brake system	3
	6.Natural disaster prevention,earthquake detection system	3
2 Are there any other information/matters/Japanese experiences you would like to know more?	1.want to know more about various matters of Japanese railways	7
	2.Want to know more about maintenance,technology of rolling stock,.	2
	3.Want to know more about signalling and telecommunimation system of Japanese railways	2
	4.Wat to know about effective design of station yard,plannning principle of diagram of station yard	1
	5 Want to know standard construction method ,,maintemance ,organization of railway	1
	6.Want to know how JR Goup increase their income	1
	7.Want to know more aout track inspection and maintenance	1
	8.Shinkansen,Maglev,Metro,Monorail,train operation system(TDCS,OC,CTCS,ATC,JTSS etc..	1
	9.No specific opinions	3
3 Do you think the way/method by which JICA expert team organized the workshop was satisfactory to you?	**.Aii participants are satisfactory** :*Want to have more free discussion ,more workshops,more discussion on signal&telecom *Made up his mind to apply what he learned in the workshop toimprovemento of MR *Learned how to analyse the causes of accidents,how to establish the countermeasures	19
4 Do you have any advice how to improve the way/method of workshop?	1.Senior staff of MR should attend the workshop at least 5days	1
	2.To hold workshop once a month chaired by GM(civil),joined by other departments, on track maintenance	1
	3.Participants of workshop should visit various facilities,institutes ,field sites of Japanese railways	1
	4.To make small groups consisting of experts of various fields hold workshop and discuss accidents	2
	5.Should have more workshop	3
	6.Shold have not only lectures,but aiso visual material such as videos	1
	7.Should use interpreters of Englishh-Myanmar language to understand more precisely workshop	1
	8.Participants should know the contents of presentation beforehand to make discussion more fruitfully	4
	9 Should have more discussion on track maintnance with JICA experts	1
	10.Others	4

(:*1)Wirh respect to Question 1,if one participant has plural comments ,say comment on Item 5 Brake system and comment on Item 4 Track and turnout, his comment on each item is counted as one comment for each item.

(5) Training for measurement of train vibration

In order to make MR experts farmiliarize how to apply the vibration measurement of train to control of track maintenance and improvement of vehicle performance, JICA experts instructed measurement and analysis of actual Train Vibrations on Feb. 27, and 28th. Trainings were implemented by using the device [Digital Vibration Measurement Device W0031]. Trainings included 1) how to use the device to measure the vibration and how to analyses the measured data, 2) measurement of actual MR's express train, and 3) analysis of the measured data.

The details of the training of measurement of train vibration are given below.

1) Training method of vehicle vibration measurement

(a) Measurement method

In the morning of 27th, Feb., JICA experts explained how to measure the vehicle vibration acceleration by using a measurement device with use of a guidance paper.

The device used for training is Digital Vibration Measurement Device W0031, the one which is used for measuring vehicle vibrations on the track before and after track maintenance work in the Pilot Section located between Yangon and Bago.

The device should be placed above the center of the bogie, and by connecting it to PC, measured vibration acceleration (longitudiral, lateral, vertical) can be expressed as waveforms on the screen of PC, together with the locations and train speeds corresponding to the vibration measurement values.

(b) Actual measurement of vehicle vibration

In the afternoon of 27th, Feb., vibration of two trains were measured between Nay Pyi Taw and Pyinmana.

The one is express passenger train, and the other is DC train of Japanese production.

In addition to vibration measurement, positions and times corresponding to vibration measurement values were obtained by use of GPS logger.

MR participants received training through watching how JICA experts implement vibration measurement by using the device.

(c) Analysis of the measured data

In the morning of 28th, Feb., the measured data were plotted on the riding comfort index curves prepared by JR group with the use of data analysis software programmed by JR group.

2) Recommendation

(a) At present, large vehicle vibration caused by poor track conditions are monitored by inspectors through subjective sensual feelings while riding on the train.

In place of such subjective sensual feelings, vehicle vibration measurement device should be used to evaluate objectively and precisely the vehicle vibration caused by poor track conditions.

After setting some suitable criterial values for vibration acceleration, the locations of the track where the vehicle vibration accelerations exceed the criterial values should be identified, and such locations should be rectified within allowable time limit.

Control of track conditions through vehicle vibration measurement is very effective for maintaining track for safe and comfortable train operation.

(b) Analysis of the vehicle vibration data is also useful for identifying the various issues of vehicle performance.

The "Vibration Measurement Report" attached indicates a good example how the analysis of vibration data can lead to improvement of rolling stock performance.

(c) Use of measurement device provided by JICA.

JICA provided UHA-3 Type vibration measurement device. However in the training, the UHA-3 type was not used, but the one which is used for measurement of vibration before and after the track maintenance work in the Pilot section was used.

The reason why UHA-3 type was not used is because UHA-3 type cannot apply the

data analysis software which can plot the measured data on the riding comfort index curves prepared by the JR Group.
However, UHA-3 type can print out the analogue wave forms of longitudinal, horizontal and vertical vibration acceleration on the recording chart, together with the information of kilometrage distance and train speed.
Then by drawing manually the lines of allowable values for vibration acceleration on the waveforms on the recording chart, we can identify the locations of track where vibration accelerations exceed the allowable limits.
In this way we can maintain the track efficiently based on these locations so as to ensure safe and comfortable train operation.
It is recommended that MR should try to use UHA-3 type for measuring the train vibration of the lines periodically and identify the locations of the track where the vibration acceleration values exceed the allowable limits by drawing the threshold lines on the waveform chart.

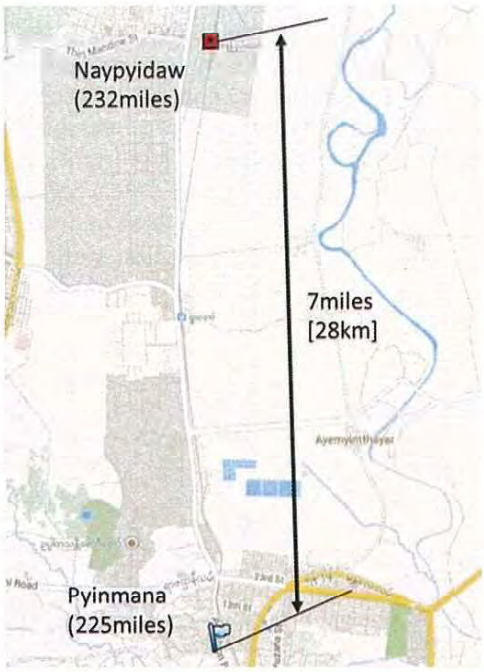
Vibration Measurement Report

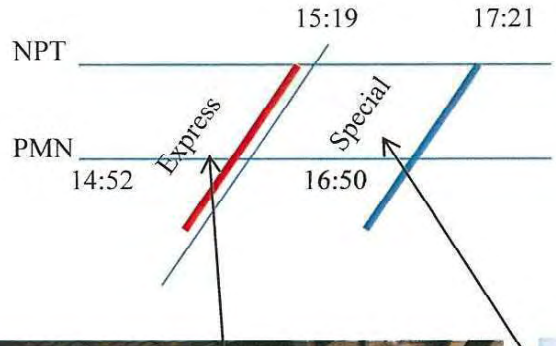
1. Purpose

To observe difference of vibration between vehicles produced in Japan and Myanmar-made vehicle by using vibration meter and also to analyze the waveform.

2. Measured Section and Train Schedule

Date 27th February, 2014





Myanmar Passenger Coach Train and its bogie

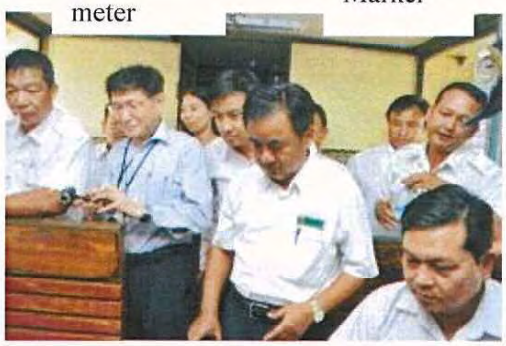
Japanese DC (KIHA 141-8) and its bogie(DT21)

3. Measurements tools

-Vibration meter
-Lap-top PC installed with analysis software
-GPS logger or marker
-connecting cable and battery

Vibration meter

Marker



Picture: on Myanmar Passenger Coach

4. Result

Results of vibration measurement are shown in Fig.1 and Fig.2
Sections A, B, C, D shown in Fig.1 and Fig.2 were expanded and are shown in Fig.3 and Fig.4.
Result of the ride comfort, which is analyzed by software of Railway Technical Research and Institute, are shown in Fig.5 and Fig.6.

- Amplitude of vibration is higher in passenger coach than in diesel car, especially with respect to vertical direction. (red line)
- It is estimated that resonance is happening, causing big vibration, and vibration frequency can be estimated about 2 Hz from the chart. Source of the vibration is deemed to be the low joint of rail.

5. Note

a)Obviously Japanese DC is more comfortable than Myanmar PC
b) It might be possible to improve the riding comfort by rolling stocks improvement.

6. Recommendation

a) To avoid the resonance, two measures are considered.
One is to change the frequency of vibration system of the vehicle.
The other is to increase the damping power.

b) Changing frequency is possible by changing the spring factor of vibration system.
However range of frequency cannot be changed widely, therefore resonance will happen in other train speed.

c) Oil damper is installed to stabilize the vibration, however it is deemed that designed damping force is too small or oil damper is not properly working because of oil leakage or other reasons.
It is recommenced to confirm the specification of oil damper whether it has sufficient damping power and confirm the maintenance procedure of oil damper whether it is properly maintained.

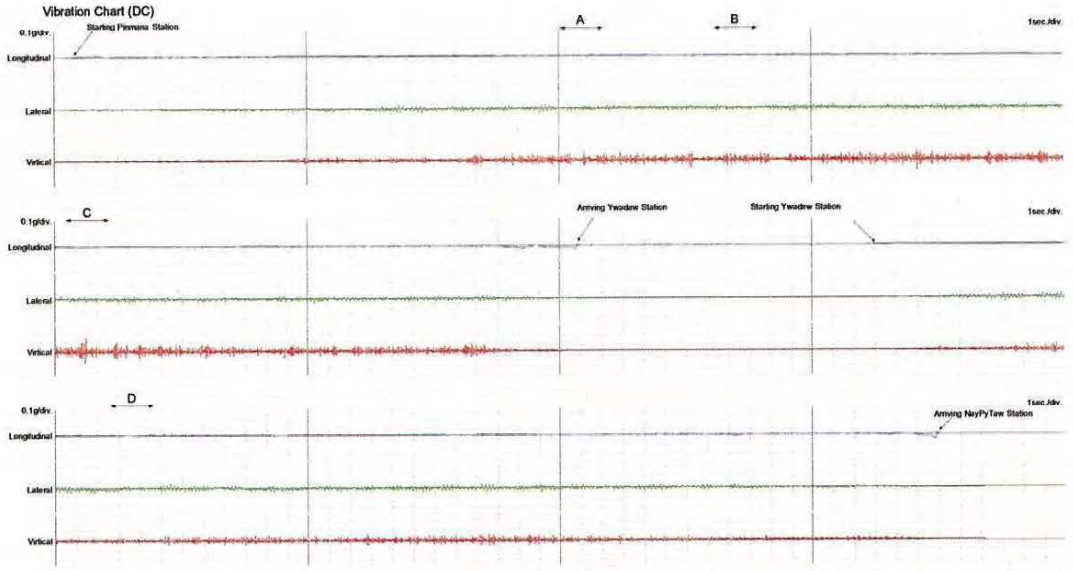


Fig1: Vibration Data of Japanese DC

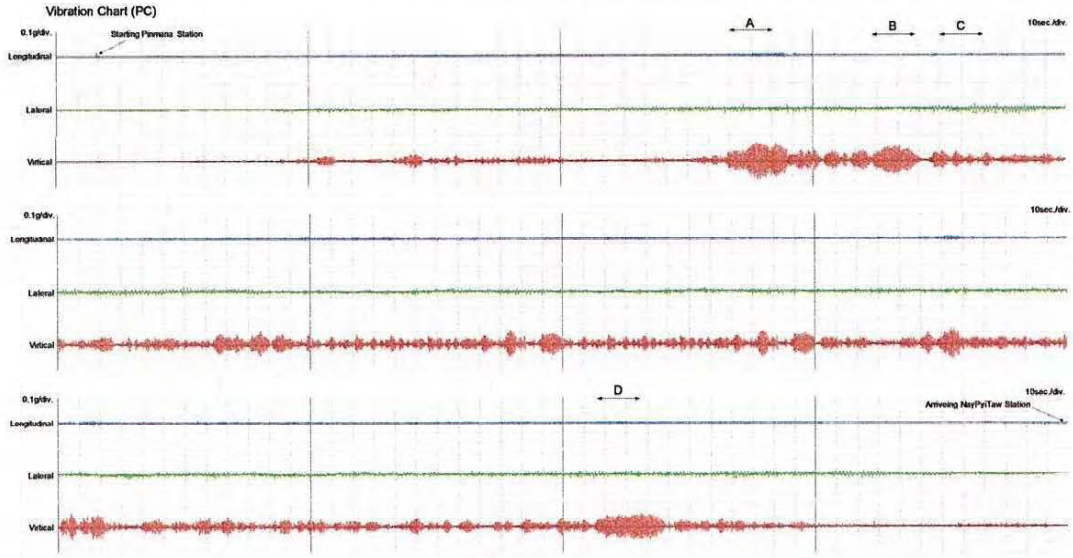


Fig.2: Vibration Data Myanmar PC

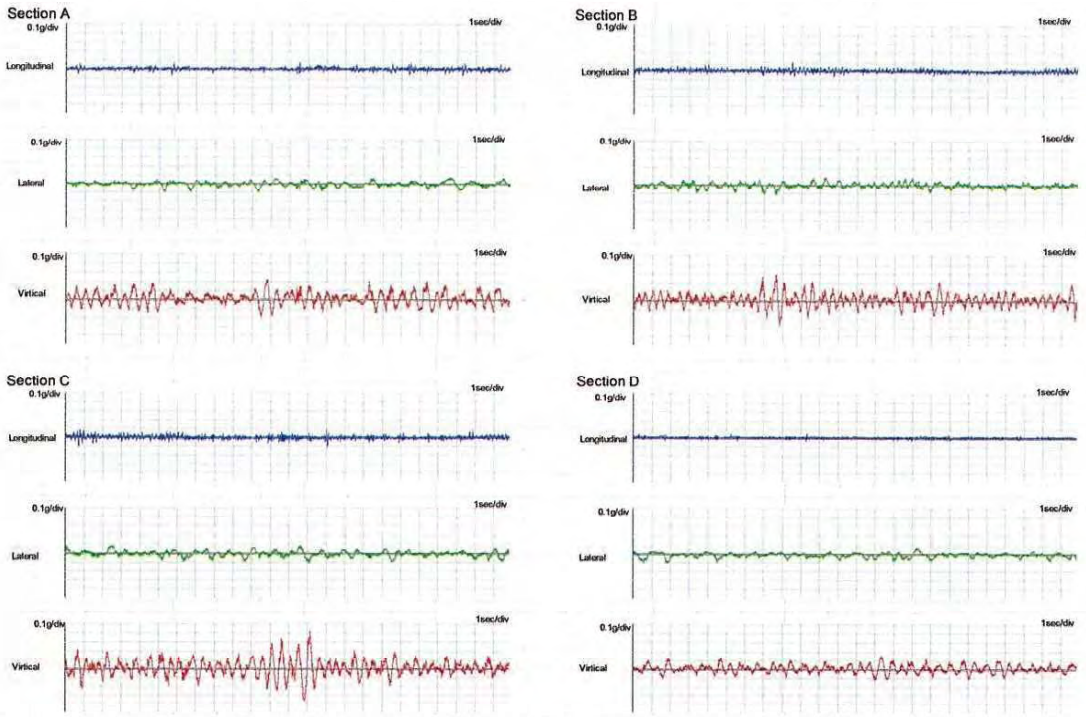


Fig3: Vibration Data of Japanese DC (Expanded Section)

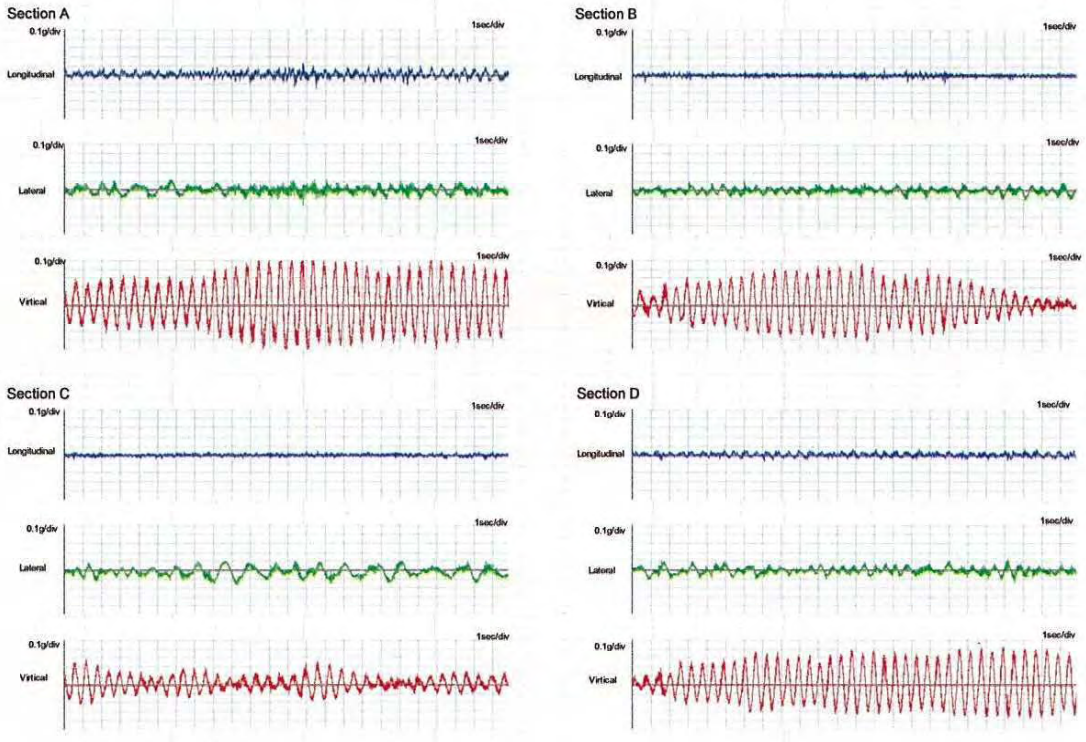


Fig.4: Vibration Data of Myanmar PC (Expanded Section)

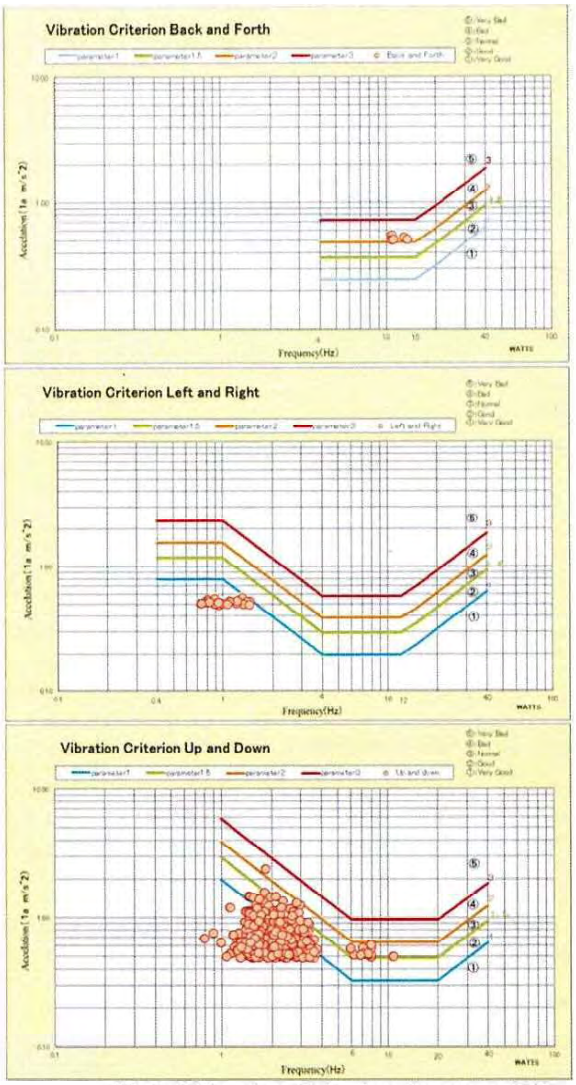


Fig5: Vibration Criterion Japanese DC

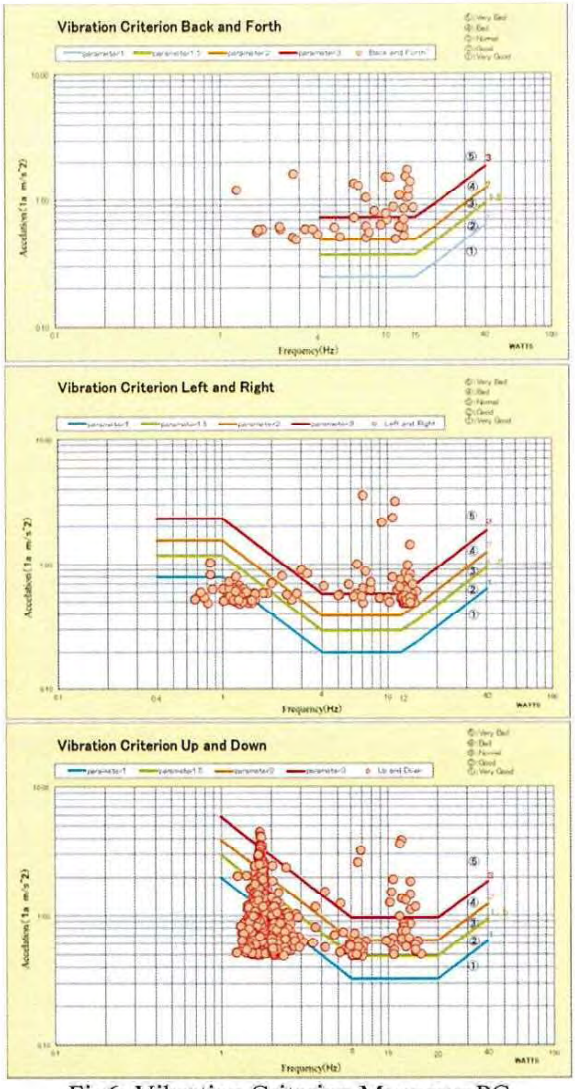


Fig6: Vibration Criterion Myanmar PC

(6) Investigation on customer satisfaction level

After implementation of the training program, Interview Survey to investigate customers satisfaction level of MR's passenger train was carried out from March 3 (preparing meeting) to March 7. The details of the interview survey and the analysis of the results are given in the following report.

Report on Result of Investigation on Customer Satisfaction Level

1. **Purpose:**
As one of the activities of technical supporting project "Railway Safety and Service Improvement Project", to give guidance to the counterpart with respect to the way of analysis and way of doing the questionnaire survey and the baseline survey of Myanmar Railways.

2. **Investigation days and Section of investigation:**
March 4 to 7, 2014
Between Yangon Station and Nay Pyi Taw Station on Yangon-Mandalay Trunk Line

3. **Targeted Customer and methods for investigation:**
Targeted for Myanmar Railway passengers, except foreign travelers, and interviewing on the running trains. In case of a group trip, only one passenger of the group was interviewed.

4. **Sampling number:**
Targeted 3 kinds of train and class, "Express Upper", "Express Ordinary" and "Local", and at least 120 passengers were sampled for each train kind/class.

Table1 : 5. Sampling number

Train kind/class	Sampling Number/Train	Train number /day	days	Target number	**Actual Number**
Express (Upper)	20	3	2	120	**120**
Express (Ordinary)	20	3	2	120	**122**
Local	30	2	2	120	**123**

5. **Questionnaire item:**
Refer to Attached Appendix ①

6. **Analyzing Methods:**
A) Subjective Evaluation items (Q1~16) are scored and the difference of evaluation by Train kind and passenger class was analyzed
B) The survey items (Q17~20) are for investigating the fundamental properties of passengers such as gender, age, purpose of travel and occupation.
C) The boarding sections of passengers are plotted on the graph for each train.
D) Due to lack of explanation, Q19 was not properly investigated. So it was excluded from analysis.

7. **Result**
Refer to Attached Appendix ②

8. **Discussions**
In general, evaluations were almost negative. Because it was assumed in advance that a negative evaluation is prevailing, evaluation levels were set at four-levels, "No particular opinion," "little bit dissatisfied", "dissatisfied" and " very dissatisfaction". The propose of this was to clarify the "level of dissatisfaction".
All questions were classified into 7 categories and comments were added as follows.

A) Riding Comfort and Train Diagram (Q 1 ,2,3,12, 13,14)
Passengers of every class evaluate each question very strictly. Especially about"Q1 Riding Comfortability", passengers of local train indicate displeasure more than Express passengers, even though their traveling time and distance are shorter than those of Express

train passengers. By contrast, about "Q3 Train delay", passengers of local train indicate tolerant evaluation slightly.

Further MR should recognize that passengers of more than 90% are anxious for the increased frequency of train.

B) Facilities of Train or Station (Q4,5,6,9,10)

Compared to evaluation in A above, some more passengers evaluate these items as "nothing in Particular". That evaluation might tend to be relatively tolerant. However, MR should recognize that passengers desire to improve them. So it can be said "Facilities are not comfortable" in general; significant improvement in facilities may be expected. It is necessary to start the improvement as early as possible.

C) Staff of MR (Q7,11)

Compared to evaluation of other questions, evaluation for station staff and train conductor is clearly severe for each class. The reason why passengers evaluated such that, may be because it is related with problems peculiar to State-owned company. MR should recognize that it is necessary to raise awareness of staff in this regard.

Improvement in this field does not require a large investment, however, as it requires a long time to achieve the target, MR should begin as soon as possible. Mind innovation of staff can expect a lot of effects. It is recommended to learn from Customer Serves Training practiced in Hotel, Air Line, and Amusement park.

D) Ticketing and fare/ charge(Q8,15)

Express passengers evaluated them relatively tolerantly, but local passengers' evaluations are severe. For the passengers to use railway frequently, increase of number of passengers can be expected by providing them with a discount ticket, such as monthly pass and commuting tickets.

E) Use again train? (Q16)

Local passengers' evaluations are severe in the same way as that for D above.

F) Reason why they chose the Train (Q17)

It can be understood clearly and easily that passengers of Express and local trains have different reasons for choosing Train. As also mentioned in D above, it can be a solution for increasing the number of passengers of frequent use to provide them with a discount ticket. It is necessary for MR improve services in the future by these measures according to each class. It is rather strange that more than 95 % of local train passengers are not satisfied with the fare/ charge but 70% of them indicated that reason why they chose the train is cheapness in fare. It needs more detailed investigation.

G) Frequency of Train using (Q18)

In the same way as F above, there is a clear difference between Express and local passengers. The Marketing Strategy should be established depending on the travel behaviors of passengers. For example, long-distance passengers are less frequent users, but short distance guests use trains frequently.

H) Passengers' Personalities

a. male or female

Majority was male in Express train but female was majority in local train. This information may be useful in considering the target of service improvements in the future.

b. Generation

Any class has a similar composition of generations.

c. Propose

Any class has a similar composition of trip purposes.

d. Occupations

Reflecting that many passengers working in the market are using local trains, obvious difference of occupation can be observed between the express train and local train. In case of Express train, Occupation and "Male or Female" are correlated closely.

e. Boarding Section

The data is just a reference level. Due to small number of samples per one train, statistical analysis is difficult. At least more than 100 samples per train will be necessary for meaningful analysis. Further the survey section should be similar to each other for accurate analysis.
In the furfure, extensive Origin and Destination (OD) Research should be done by MR.

9. Recommendations

A) MR should recognize that severe evaluation results were indicated for all of the items and should consider a good improvement plan as soon as possible. Of course by giving the order of priority to each item, MR must start improvement from something easy and necessary.

B) MR should accept theses results frankly and also periodically implement this kind of investigation by themselves, and remind themselves that the transportation market is in the servere competitive situations. Namely the long distant trains compete with bus or aeroplane, and short or middle distant trains compete with the mobile car.

C) All subjects need improvement, but improvement should be started from the field where a lot of passengers are involved. By doing so, not only large effect and impact can be expected, but also improvement results can be disseminated to the media

Finally, we express our thanks to every person who cooperated with executing the survey and also to the executives of MR who supported our activities.

Pictures: Ongoing invitation


Express Upper Class on Mar. 4


Express Ordinary Class on Mar. 4


Local on Mar. 7

Appendix ①

Please answer the following questions about the Myanmar railway passenger Services.

Q1 About riding comfortability.

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q2 About Train speed

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q3 About Train Delay

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q4 About Cleanness in Train Cabin

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q5 About Cleanness in Train Restroom

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q6 About Comfortability of Train Seat

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q7 About Attitude of Train staff (Guard)

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q8 About Ticket booking at Station

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q9 About waiting facilities at Station

Nothing in Particular	Little bit	Dissatisfaction	Very Dissatisfaction

		Dissatisfaction				
4	—	3	—	2	—	1

Q10 About Cleanness in Station Restroom

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q11 About Attitude of Station staff

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q12 About Train Departure Time Table

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q13 About Train Arrival Time Table

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q14 About Train Frequency

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q15 About Train Fare/ Charge

Nothing in Particular		Little bit Dissatisfaction		Dissatisfaction		Very Dissatisfaction
4	—	3	—	2	—	1

Q16 Do you want to use Railway Service again?

Little bit Agree		Nothing in Particular		Rather Disagree		Disagree
4	—	3	—	2	—	1

Q17 What is the reason for choosing Railway? (Multiple choice is OK)

☐ Cheap Fare/ charge
☐ Railway Station Close to departure/arrival place
☐ A lot of luggage
☐ Other ( )

Q18 How often do you use the Railway service?

☐ Almost every day
☐ 2 or 3 times every week

☐ 1 time every week
☐ 1 time every month
☐ 5 or 6 times annually
☐ 1 to 4 times annually
☐ the first time

Q19 What kind of improvement do you want for Railway service? (Please put the priority order in the box)

☐ Punctuality
☐ Faster than Bus
☐ Less rattling and more comfortable
☐ No accident
☐ Cleanness in the Cabin

Q20 Please tell us about yourself。

☐ Male ☐ Female age _____s' years old

☐ Boarding section
From _____ Station to _____ Station

Purpose of trip

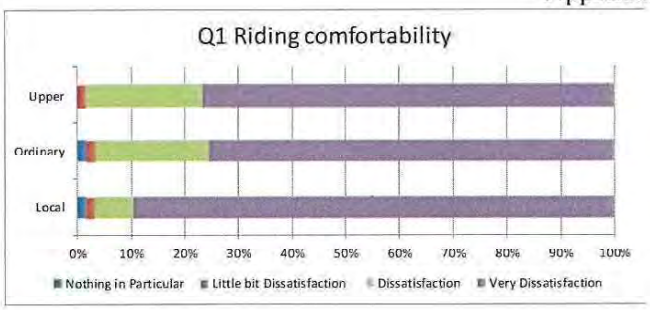
☐ Business ☐Leavening from/Returning to home ☐Sightseeing
☐ Other( )

Occupation

☐ Public officials ☐Company employee ☐Commerce or self-employed
☐ Farmer or fisher ☐ Students ☐other ( )

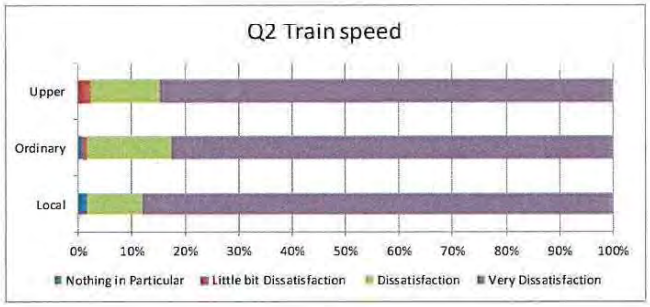
Q1 Riding comfortability

	Local	Ordinary	Upper
Nothing in Particular	2	2	0
Little bit Dissatisfaction	2	2	2
Dissatisfaction	9	25	25
Very Dissatisfaction	113	89	89



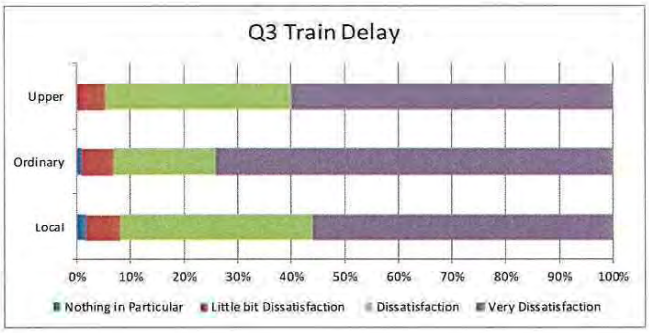
Q2 Train speed

	Local	Ordinary	Upper
Nothing in Particular	2	1	0
Little bit Dissatisfaction	0	1	3
Dissatisfaction	13	18	15
Very Dissatisfaction	109	95	100



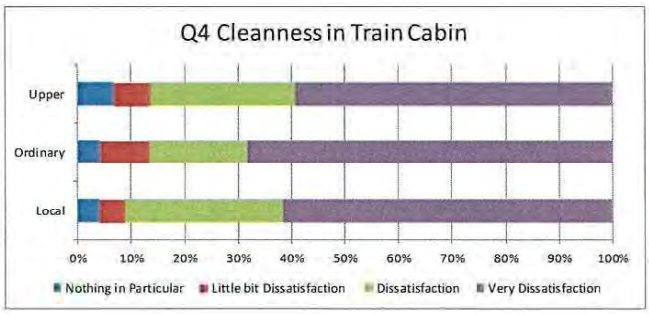
Q3 Train Delay

	Local	Ordinary	Upper
Nothing in Particular	2	1	0
Little bit Dissatisfaction	8	7	6
Dissatisfaction	45	22	40
Very Dissatisfaction	70	86	69



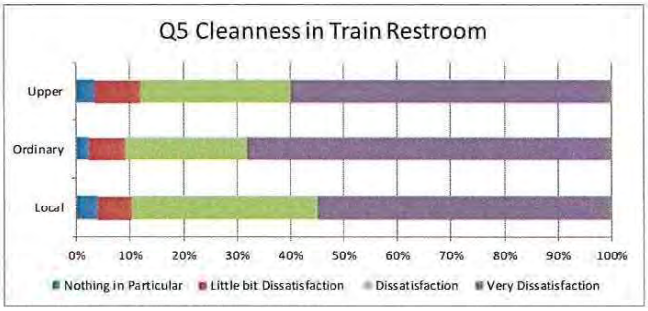
Q4Cleanness in Train Cabin

	Local	Ordinary	Upper
Nothing in Particular	5	5	8
Little bit Dissatisfaction	6	11	8
Dissatisfaction	37	22	32
Very Dissatisfaction	77	82	70



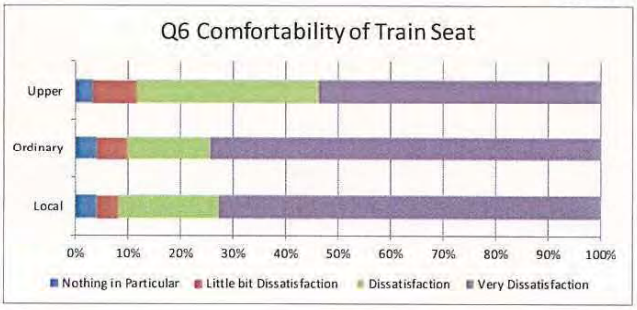
Q5Cleanness in Train Restroom

	Local	Ordinary	Upper
Nothing in Particular	5	3	4
Little bit Dissatisfaction	8	8	10
Dissatisfaction	43	27	33
Very Dissatisfaction	68	81	70



Q6Comfortability of Train Seat

	Local	Ordinary	Upper
Nothing in Particular	5	5	4
Little bit Dissatisfaction	5	7	10
Dissatisfaction	24	19	41
Very Dissatisfaction	91	90	64

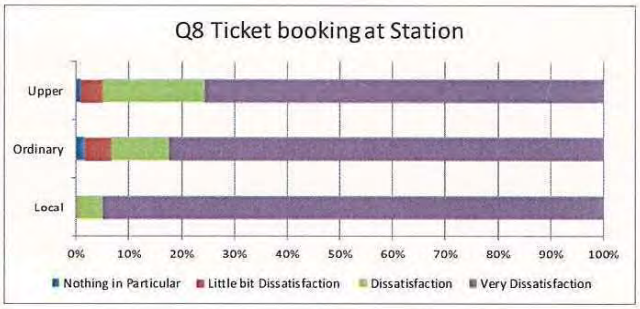


Q7Attitude of Train staff (Guard)

	Local	Ordinary	Upper
Nothing in Particular	1	0	0
Little bit Dissatisfaction	0	5	2
Dissatisfaction	6	13	11
Very Dissatisfaction	96	102	106

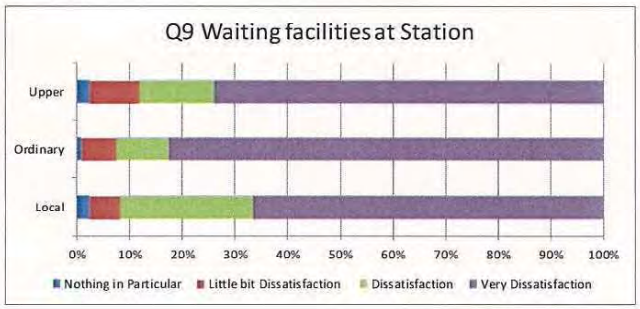
Q8Ticket booking at Station

	Local	Ordinary	Upper
Nothing in Particular	0	2	1
Little bit Dissatisfaction	0	6	5
Dissatisfaction	6	13	23
Very Dissatisfaction	114	98	90



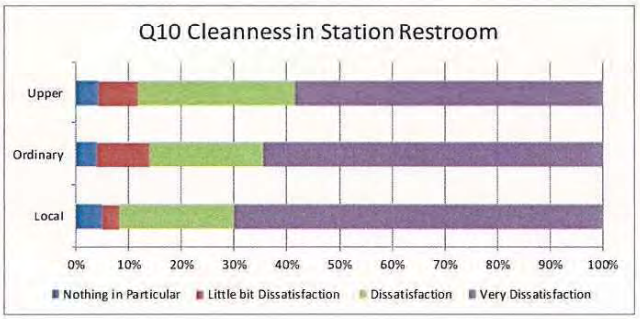
Q9Waiting facilities at Station

	Local	Ordinary	Upper
Nothing in Particular	3	1	3
Little bit Dissatisfaction	7	8	11
Dissatisfaction	30	12	17
Very Dissatisfaction	80	100	88



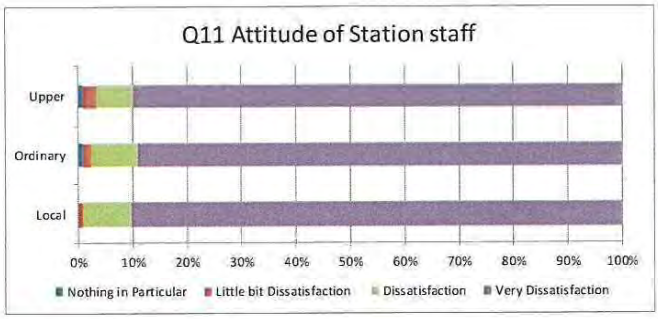
Q10Cleanness in Station Restroom

	Local	Ordinary	Upper
Nothing in Particular	6	5	5
Little bit Dissatisfaction	4	12	9
Dissatisfaction	26	26	35
Very Dissatisfaction	84	78	69



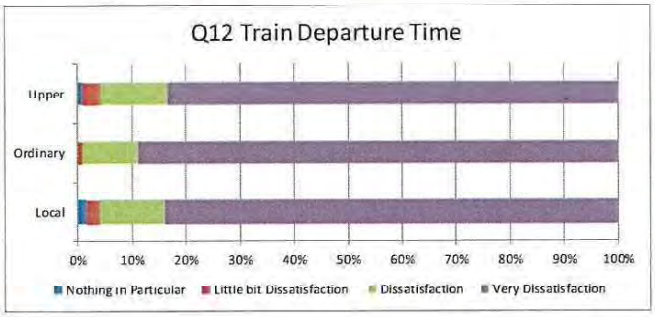
Q11Attitude of Station staff

	Local	Ordinary	Upper
Nothing in Particular	0	1	1
Little bit Dissatisfaction	1	2	3
Dissatisfaction	11	10	8
Very Dissatisfaction	112	106	106



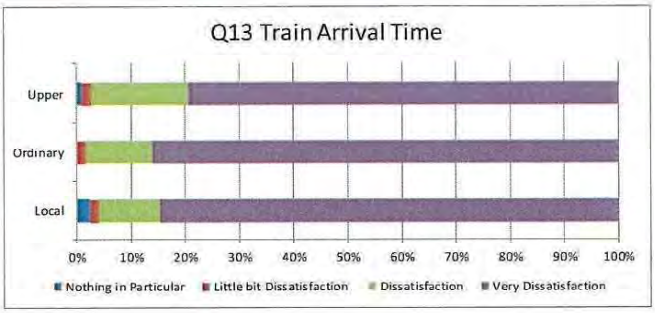
Q12Train Departure Time

	Local	Ordinary	Upper
Nothing in Particular	2	0	1
Little bit Dissatisfaction	3	1	4
Dissatisfaction	15	12	15
Very Dissatisfaction	104	104	99



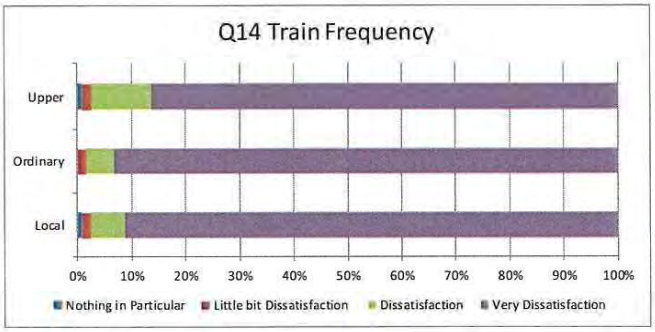
Q13Train Arrival Time

	Local	Ordinary	Upper
Nothing in Particular	3	0	1
Little bit Dissatisfaction	2	2	2
Dissatisfaction	14	14	21
Very Dissatisfaction	106	99	92



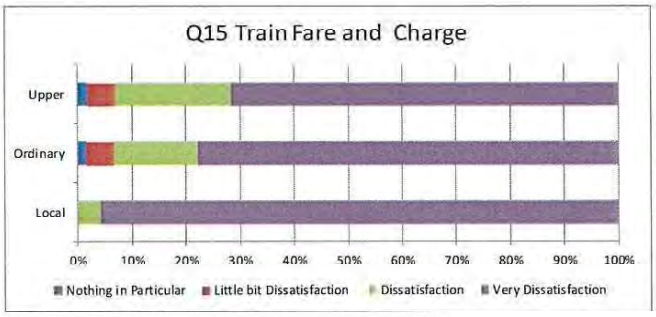
Q14Train Frequency

	Local	Ordinary	Upper
Nothing in Particular	1	0	1
Little bit Dissatisfaction	2	2	2
Dissatisfaction	8	6	13
Very Dissatisfaction	113	111	101



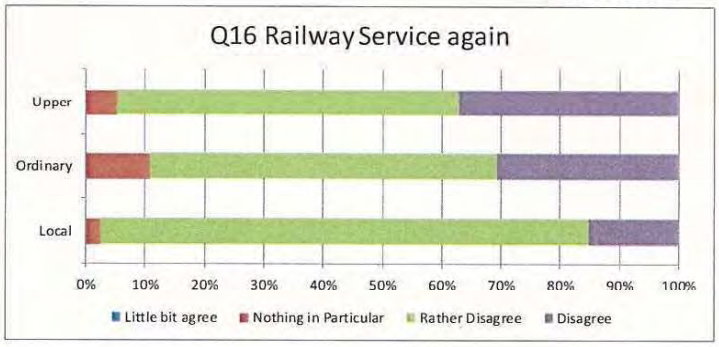
Q15Train Fares and Charge

	Local	Ordinary	Upper
Nothing in Particular	0	2	2
Little bit Dissatisfaction	0	6	6
Dissatisfaction	5	18	24
Very Dissatisfaction	116	91	81



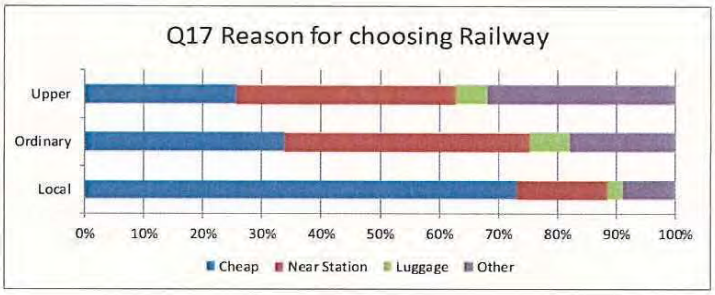
Q16Railway Service again

	Local	Ordinary	Upper
Little bit agree	0	0	0
Nothing in Particular	3	12	6
Rather Disagree	98	65	65
Disagree	18	34	42



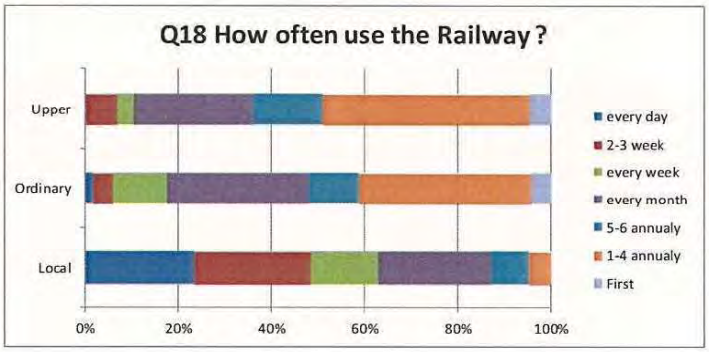
Q17 Reason for choosing Railway

	Local	Ordinary	Upper
Cheap	90	40	29
Near Station	19	49	42
Luggage	3	8	6
Other	11	21	36



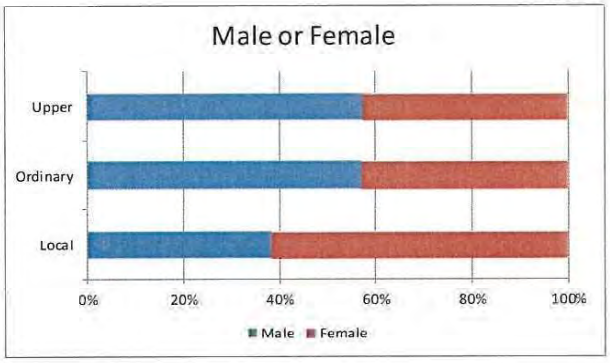
Q18 How often do you use the Railway service ?

	Local	Ordinary	Upper
every day	29	2	0
2-3 week	31	5	8
every week	18	14	4
every month	30	36	29
5-6 annualy	10	13	17
1-4 annualy	6	44	51
First	0	5	5



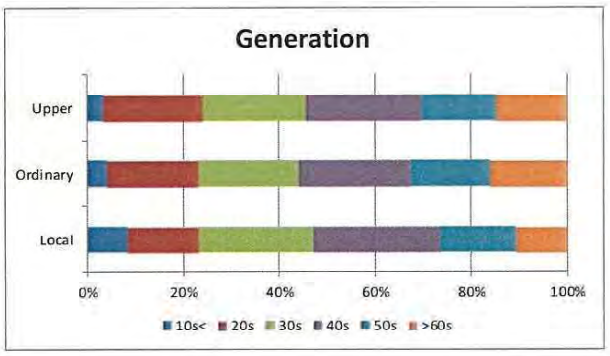
Male or Female

	Local	Ordinary	Upper
Male	45	69	67
Female	73	52	50



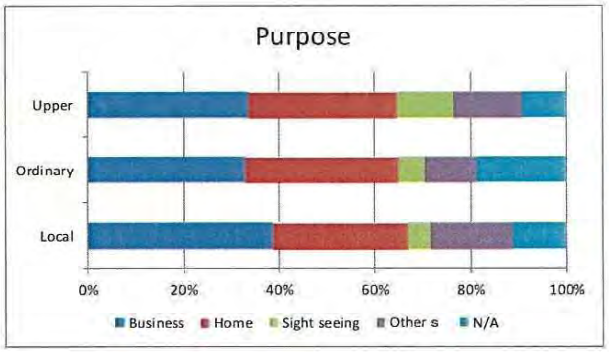
Generation

	Local	Ordinary	Upper
10s<	10	5	4
20s	18	23	24
30s	29	25	25
40s	32	28	28
50s	19	20	18
>60s	13	19	17



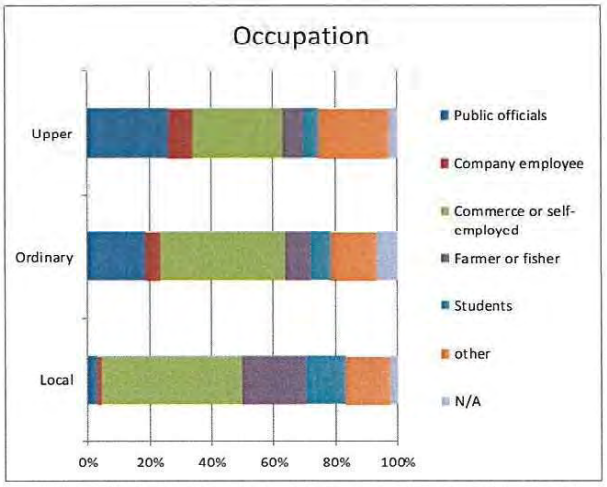
Purpose

	Local	Ordinary	Upper
Business	48	40	40
Home	35	39	37
Sight seeing	6	7	14
Others	21	13	17
N/A	14	23	11



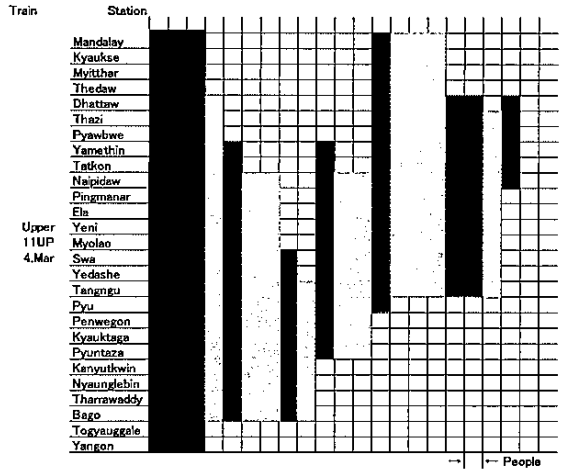
Occupation

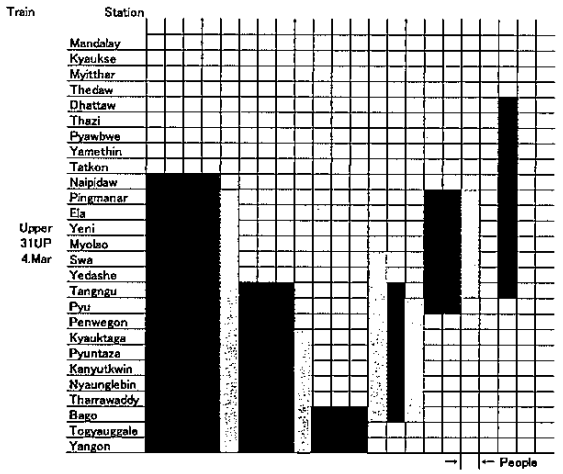
	Local	Ordinary	Upper
Public official	4	23	31
Company em	2	6	10
Commerce o	57	49	34
Farmer or fis	26	10	8
Students	16	8	6
other	18	18	27
N/A	3	8	3

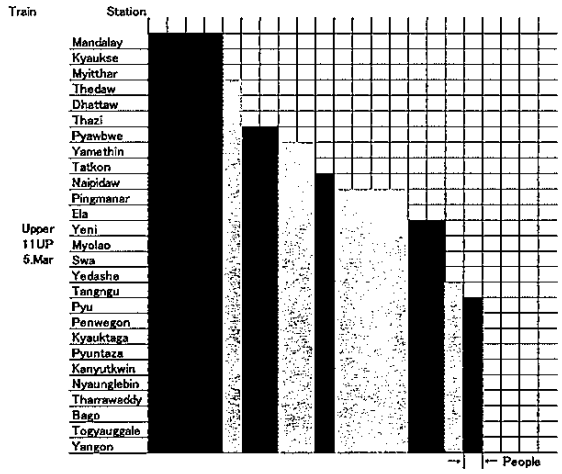


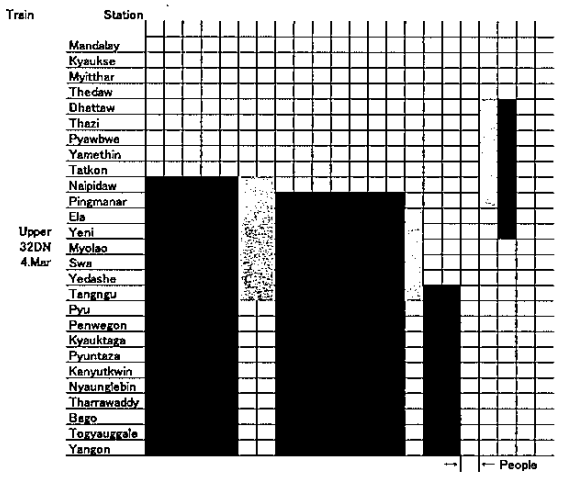
Appendix②

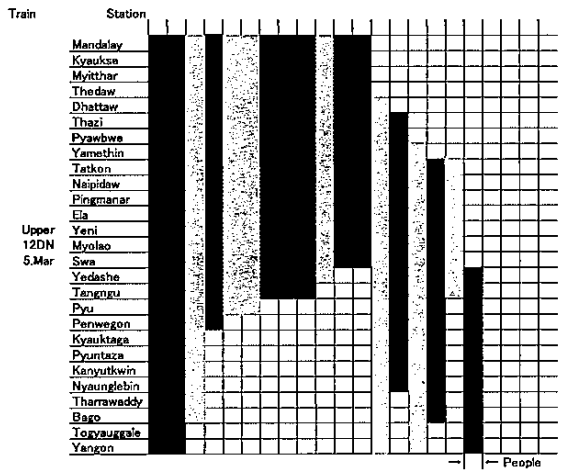
Train Ridership (Express Upper Class)

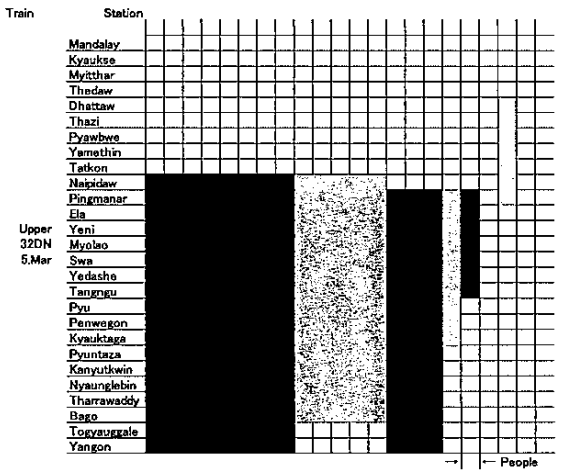






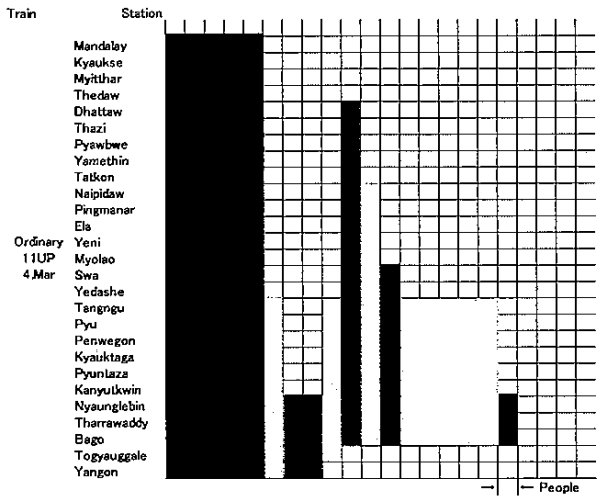


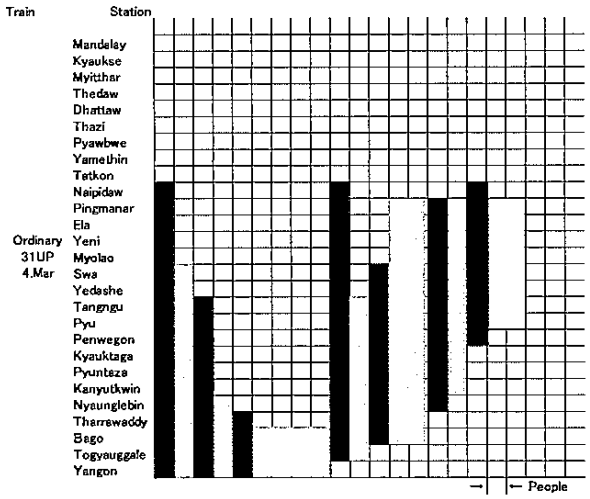


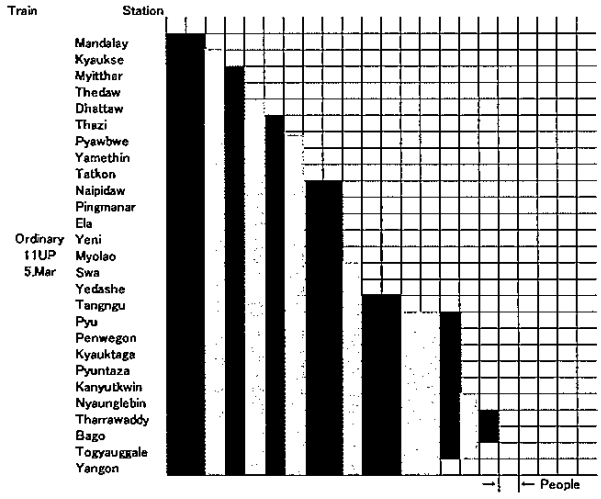


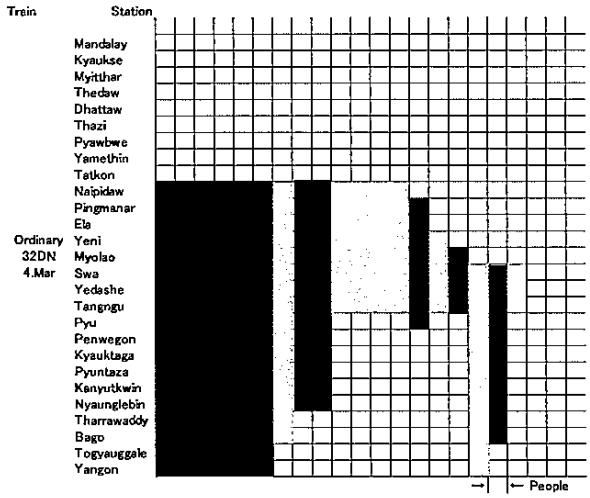
Appendix②

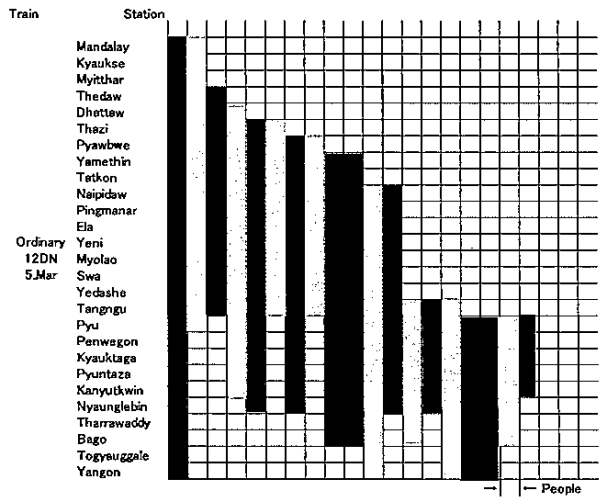
Train Ridership (Express Ordinary Class)

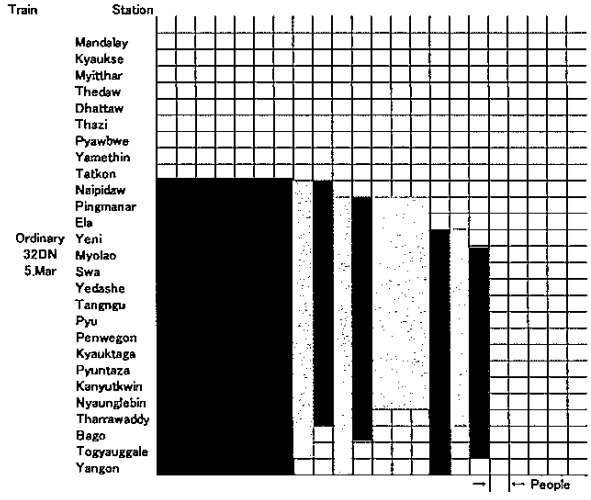






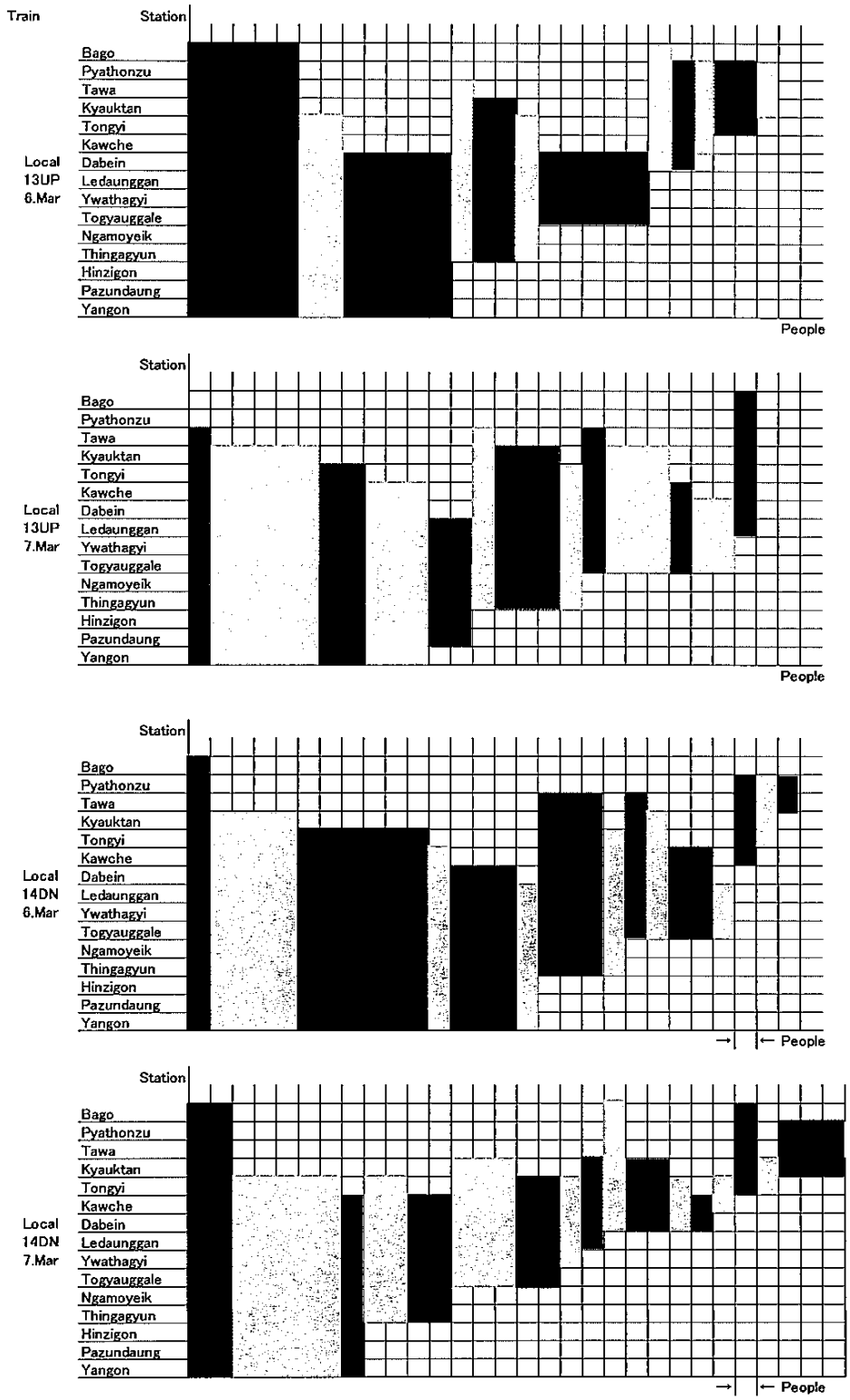






Appendix②

Train Ridership (Local)



2.1.4 Recommendation on technical standards relating to administrative and maintenance aspect to improve the service level and safety
Relevant technical standards in the fields of civil, signal/ telecommunication, operation, rolling stock engineering have been supplied by MR. Preparation of recommendations on these technical standards have been just started.

2.1.5 Drawing up of short-, medium-, and long-term railway facilities improvement plan
The activity has just been started. The improvement plans will be prepared through discussion in the Working Group consisting of MR senior officials concerned and JICA experts. The plan will take into account MP and FS by JICA study Team

2.1.6 Education/ training in Japan
11 officers for MR will be invited to Japan for two weeks in October, 2014.
The training program is going to be proposed. Kindly review the program after submission; we are pleased to modify the program with due consideration on suggestions/ advices of MR.

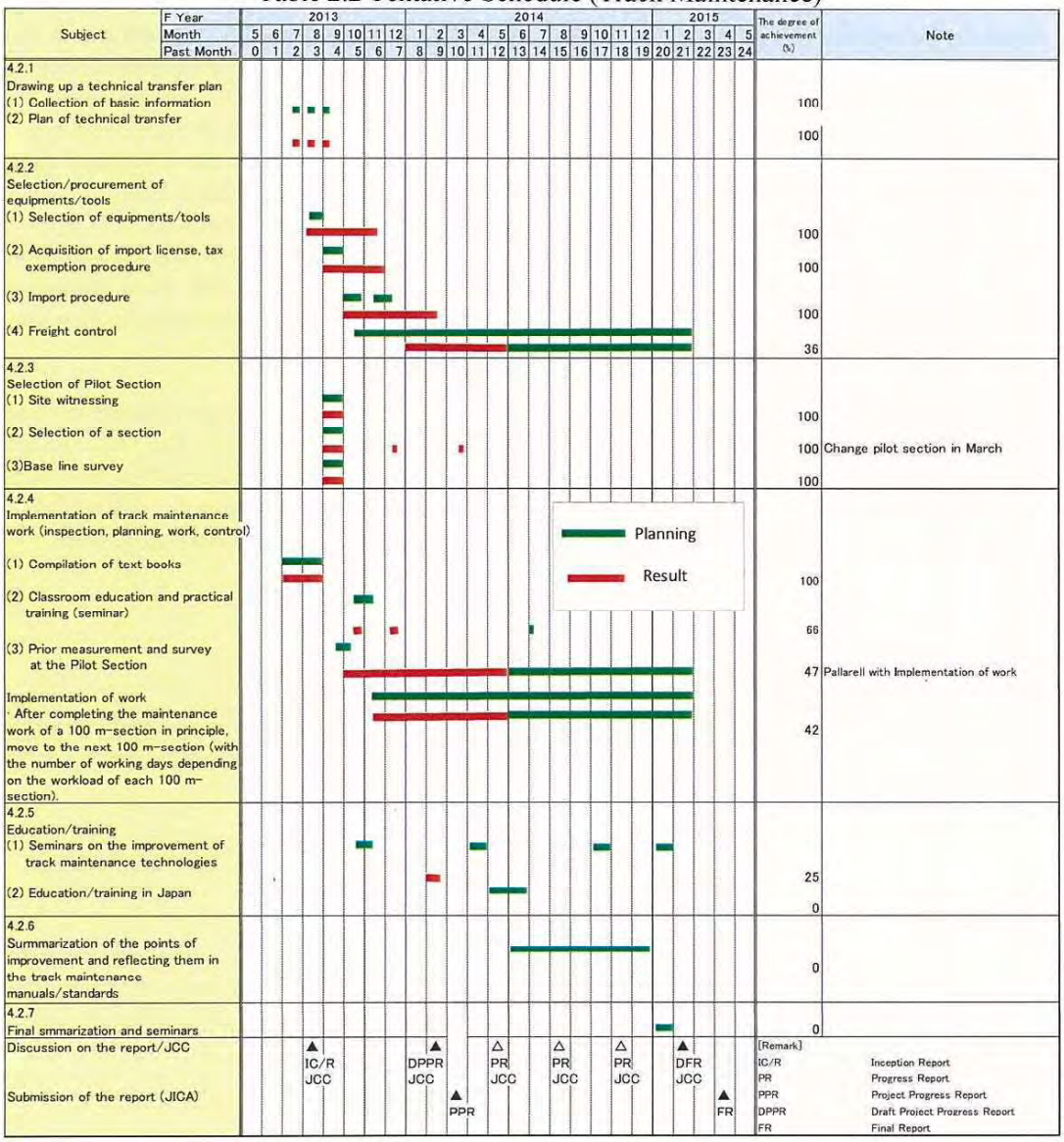
2.2 Technology Transfer of Track Maintenance Technology to improve the level of Service and Safety through Implementation of The Pilot Project

2.2.1 Drawing up a plan for technology transfer

The system of track maintenance work currently in practice in Myanmar is a version of the old-fashioned system implemented in the past in Japan. Through this Project, track maintenance workers of MR shall receive education/training of basic track maintenance works, while aiming at a mechanized maintenance system to use large-scale maintenance machines in the future. This means a conversion from the current gang system to a larger sized maintenance depot system or a re-construction of maintenance system. Bearing in mind this long-term vision, we prepare a plan for technology transfer focused on the track maintenance OJT for two years.

See Table 2.2 for the schedule (planning and result) of technology transfer.

Table 2.2 Tentative Schedule (Track Maintenance)



2.2.2 Procurement of the required equipments / tools

74 kinds of equipments/tools were imported to Myanmar from Japan and maintenance staffs are using them now. 74 kinds of equipments/tools are explained in the 2nd JCC Report

2.2.3 Selection of Pilot Section

In the 46.5 mile section (74.8 km long) between Yangon and Bago, we implement track maintenance as a means of technical transfer in the approximately 20 km-long Pilot Section, which was selected through a site survey to allow experiencing maintenance of different track structures, such as defective, sound, straight and curved tracks, turnouts in station yards and bridges, so that the effect of technical transfer is readily obtainable.

Japan side proposed the pilot section consisting of Pilot Section 1 and Pilot Section 2 at the 1st JCC. This is selected by the reason that there are many types of tracks and structures such as straight line, curve, turnouts and bridges, etc in Pilot Section 1 and the vehicle vibration acceleration values are big according to the results of vibration measurement in Pilot Section 2.

We proposed the Pilot Section by the formal letter which was agreed by the Myanmar side, and the Myanmar side wanted to start the track maintenance practice in Pilot Section 2 earlier than that in the Pilot Section 1 because Pilot Section 2 has very bad track conditions.

After that, there was a request of early start of track maintenance practice in the section from 12km200m to 14km550m between Toekyaungkalay Sta. and Ywathargyi Sta. from Myanmar side on 11th December. Thereby, the order of track maintenance practice in the Pilot Section was changed from 16th December.

At bthe end of March, we were requested by MR to include not only Yangon-Mandalay line but also Dagon University line and Thilawa line branching at Toekyaungkalay Sta. Now we are implementing training on these branch lines. At first, we selected the Pilot Section of 20km, but as track maintenance training progresses, Pilot Section was requested to be enlarged and implementation priority order of training sections was changed under mutual agreement.

2.2.4 Implementation of track maintenance (inspection, planning, work and control)

Implementation items of track maintenance training are as shown below. Contents are the same as those indicated in the 2nd JCC Report. So kindly refer to the 2nd JCC Report.

(1) Compilation of text book

(2) Classroom education and practices (seminars)

(3) Implementation of prior measurement and surveys of the Pilot Section

(4) Implementation of inspection, planning and work in the Pilot Section

1) Ballast compacting work (use of hand tie-tampers, beaters or shovels)

①Inspection of track irregularities and conditions

② Correction of track irregularities

2) Ballast sieving

① Inspection of ballast

② Execution of work

3) Rail renewal work

① Inspection of rail

②Rail renewal work

4) Rail joint work (rework on rail clearance (rail joint clearance), correction of rail joint depression)

①Inspection of rail joint

②Clearance correcting work

③ Fail joint correcting work

5) Track realignment work

① Inspection of track displacement

② Irregular alignment correcting work

6) Turnout maintenance work

① Inspection of turnout

② Repair and renewal of turnouts

7) Inspection and maintenance of bridge sections

① Inspection

② Maintenance work

8) Correction of track gauge

① Inspection

② Correction work

9) Welding of rails (preparation of long-rails and a measure to strengthen rail joints)

10) Improvement of formation

① Inspection of ballast and roadbed

②Although a standard width of formation is specified in Myanmar, we found through site surveys that sufficient widths are not maintained. To fully exert the effect of aforementioned ballast compacting work, we guide MR to expand the width of formation where it is insufficient.

11) Control and evaluation of track conditions

At the beginning, the members of track maintenance training were about 30 workers living in Yangon suburbs. At the middle of May, the members from Bago went back to their own depots, and are implementing maintainance of track by themselves now. New members from Division 5, 8 and 9 have been added and are now tackling with track maintenance. We are expecting that in the near future they will improve or maintain Yangon – Mandalay line and other lines as leaders of track maintenance groups.

2.2.5 Education/training

In Myanmar, a rainy season starts every year at the end of May. As the track maintenance work in a rainy season is apprehended to adversely affect track beds, we are going to implement education/training from the end of May to October, 2014..

(1) Seminars to improve track maintenance technologies

We assess the level of track maintenance technologies of MR employees and compile appropriate text books. Thereafter, we hold seminars to improve track maintenance technologies for those participated in the maintenance of pilot section (approximately 20 members) three times: at the start of track maintenance OJT, after completion of track maintenance and at the final summarization of track maintenance OJT.

(2) Education/training in Japan

We implement a two-week education/training program twice in Japan (1st group is from 9th to 20th in June and 2nd group is 23th in June to 4th in July.) each for approximately 11 trainees including some MTT operators, in which education/training on track technologies (centering on lectures and practical training) will be performed under the cooperation of JR East and Japan Railway Track Consultants, at the Integrated Education/Training Center (Shin-Shirakawa), JR

East. MTT operators are included in the above program to prepare for introduction of MTTs into track maintenance in the future.

Trainees will practice actual work at the side tracks, and observe the nighttime work to use MTTs in the suburbs of Tokyo.

We will discuss the detailed contents of curriculum with MR so as to make training to meet the needs of MR engineers, and will also discuss with MR about suitable timing of training in Japan.

2.2.6 Summarization of the points of improvement and reflecting them in the track maintenance manuals/standards

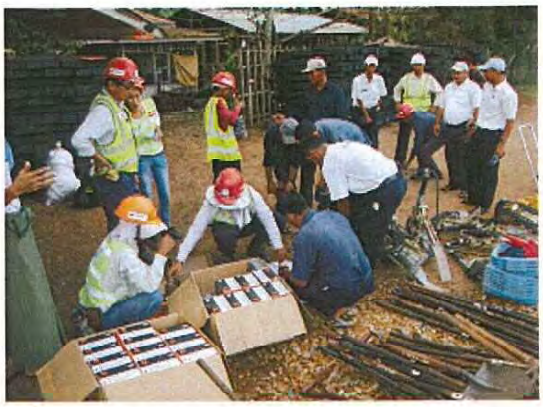
We summarize the points of reflection through the whole of maintenance work and compile the maintenance manuals to meet the present status of the track maintenance in Myanmar in consideration of the local organizations, working conditions and climates. The essentials of maintenance manuals will be easy to use, while including the steps of work and handling of machines/materials for track maintenance.

2.2.7 Final summarization and seminars

In closing the above technical transfer course on track maintenance work, we will open seminars for the trainees participated in the program and track maintenance members for other sections selected through consultation with MR. As this is the final step for MR employees to receive technology transfer, which is expected to evolve as a model shop to every section of the country in the future, we will avail ourselves of this opportunity to totally wipe unknowns out of MR members regarding the whole of track maintenance work.

2.2.8 Others

To implement the Project more smoothly, some JICA track experts were added to the original JICA experts.



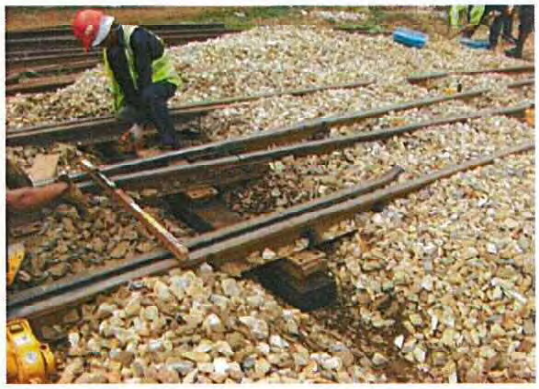
Distribution of safety shoes to new members

Morning assembly

Sign Board in Toekyaungkalay Sta.

Temporary Dormitory for trainee

Track Raising of turnout



Exchanging sleeper of turnout

Motor Raising of turnout

After track maintenance

3. Concluding remarks

We are still halfway in the whole completion of the Project, and have various significant activities to be executed in the coming period.

We would like to continue our activities effectively with the cooperation from MR officials concerned.

Table 1 Discussion in the Workshop, Comments, Advice

Classification	Presentation by MR Experts	Comments Major issues of MR and Advice By JICA Experts
Derailment between stations	1. Cause Analysis 2. Establishments of countermeasure	1. Comments on Method of Cause Analysis 2. Comments on Establishments of countermeasures 3. Major issues of MR made clear through discussion, and advice
No.1 Magyinbin – Takton	1. Caused by large cross level irregularity 2. Intensification of track inspection and maintenance of track	1. ・Twist of track should be checked. ・Why the regular inspection cannot find this large cross level irregularity should be examined. 2. Twist of the track should be checked. Why the regular inspection cannot find out this large cross level irregularity should be examined and inspection system should be revised as required. 3. ・Twist of the track should be checked regularly. ・Inspection of track irregularity should be executed not by eye-sight but by measurement by string or measuring devices.
No.2 Nyaunglaybin – Tawwi	1. Caused by large cross level irregularity caused by roadbed settlement. 2. Placement of sand layer and installment of drainage pipe for roadbed sinkage prevention	1. The same comment as that for No.1 derailment 2. ・Twist of the track should be inspected. ・Measurement of track irregularity not by eye-sight, but by measuring devices Spacing of drainage pipe should be smaller. 3. ・Twist track should be checked. ・Measurement of track irregularity should be executed by measuring device ・spacing of drainage pipe and maintenance of drainage pipe should be examined.
No. 3 Kyedaw – Kyungon	1. Breakage of coil spring of wheel axle 2. Replacement of coil spring, & intensification of coil spring inspection	1. Shock by bad track and fatigue of metal should be examined. 2. ・Inspection such as magnetic powder inspection should be considered. ・specification of material of coil, quality control of coil production should be examined, 3. Specification of coil, inspection system of coil (magnetic powder, endurance test etc.), periodical replacement according to ages, quality control of coil production should be examined.

Table 2 Discussion in the Workshop, Comments, Advice

Classification	Presentation by MR Experts	Comments and Advice By JICA Experts
Derailment in station yards	1. Cause Analysis 2. Establishments of countermeasure	1. Comments on Cause Analysis 2. Comments on Establishments of countermeasure 3. Major issues of MR made clear through discussion, and advice
No.1 (Nay Pyi Taw station)	1. Clamp to fix tong-rail was not fixed completely, and the tong-rail shifted during the movement of wagon, resulting in derailment. Human error not to fix clamp completely. 2. Training and punishment	1. Cause analysis to judge as the human-error is proper. 2. In addition to training and punishment, practice of confirmation by finger-pointing should be encouraged 3. Review of Work manual, intensification of training and encouragement of practice of confirmation by finger-pointing are recommended.
No.2 (Taungoo station)	1. Caused by combination of ① rapid growth of cross level irregularity due to the mud pumping roadbed and ② sudden braking of locomotive. 2. Maintenance of cross level and training of locomotive drivers,	1. Analysis of causes by combination of cross level and sudden braking of locomotive (causing decrease of wheel load or increase of lateral pressure of wheel) is appropriate. 2. In addition to cross level maintenance and training of loco. drivers, twist of track should be checked. Further overall examination of similar track conditions in the station concerned and other stations should be executed. 3. ・Twist of the track should be maintained. ・Brake should be applied to every wheel axle. The vehicle should be designed and maintained in this way.
No.3 (Yamethin station)	1. Gauge widening due to decrease of rail supporting force of dog spike because of deterioration of wooden sleeper. 2. Strengthening of the track concerned and review of inspection system	1. Why regular inspection could not find the dangerous situation should be examined. 2. Overall examination of the similar track conditions should be executed for the station concerned and other stations. 3. ・Why regular inspection could not find out the track condition concerned should be examined. ・Overall examination of important sidings of the station concerned and other stations should be executed.

Table 3 Discussion in the Workshop, Comments, Advice

Classification	Presentation by MR Experts	Comments, Major issues of MR, and Advice By JICA Experts
Train Parting	1. Method of Cause Analysis 2. Establishments of countermeasures	1. Comments on Method of Cause Analysis 2. Comments on Establishments of countermeasures 3. Major issues of MR made clear through discussion, and advice
No.1 Express Train (7 up) Train parting between BDUEZ 12723 and BBEZ 10571	1. Spacer pin for locking of coupler was removed, and in place of it, temporary galvanized wire tie was used, and it was broken. Then coupler was unfastened 2. Checking and replacement of coupler parts. 3. improvement of maintenance standards of coupler	1. Spacer pin was installed by modification because decoupling occurs frequently. Normally coupler may not be unfastened 、 even if space pin comes out. Initial cause of the accident is different. 2. If the braking system is well arranged, after parting, the parted parts will automatically stop, preventing the dangerous situations. 3. Braking system should be improved (compressed air brake is better than vacuum brake) so as to ensure continuous braking.
No.2 Express train (3 up) Train parting between BDTEZ 12508 and BDTEZ 12557	1. Coupler was unlocked and knuckle was open due to impact load of track 2. Fix completely the coupler parts.	1. There is no accident like this in Japan. 2&3 Improvement of track and rolling stock which is important for reducing impact load applied to coupler, is the basic countermeasures for accidents like this. However, it may take time for execution of the above recommendation. .In this regards, retaining device for lock of coupler is effective.

Table 4 Discussion in the Workshop, Comments, Advice

Classification	Presentation by MR Experts	Comments, Major issues of MR, and Advice By JICA Experts
Level crossing accident	1. Method of Cause Analysis 2. Establishments of countermeasures	1. Comments on Method of Cause Analysis 2. Comments on Establishments of countermeasures 3. Major issues of MR made clear through discussion, and advice
No. 1 Illegal level crossing. collision with motor cycle (Ingyigan – Shwedar)	1. Accident cause is "nothing to protect level crossing" 2. To provide protection devices to all illegal level crossings	1. The guidance to stop once before crossing the level crossing should be given to road vehicle drivers. 2. Before planning protection devices for all illegal level crossings, they should be classified into two groups: the one to be remained as level crossing and the other to be abolished. Then depending on the importance of illegal level crossings to be remained, appropriate protection devices should be provided. 3. ①First the basic information about the level crossing concerned (No. of trains per day, train speed, traffic volume of road vehicles, length, width, visibility distance from the train driver and from the road vehicle driver etc.) should be collected. Then according to these basic information, all level crossings should be classified according to their importance. According to the classification, suitable protection devices should be planned. ②The guidance to stop once before crossing the level crossing should be given to road vehicle drivers. ③All illegal level crossings should be classified into two groups based on basic information of level crossing: the one to be remained and the other to be abolished. The remained ones should be provided with appropriate protection devices.
No. 2 Illegal level crossing. collision with motor cycle (Taungoo – Kyae Daw)	1. Poor vacuum brake train. Braking was very bad. 2. Full vacuum brake train should be prepared. Guidance of traffic rules to road vehicle drivers.	1. The same comment as that for the No. 1 Accident. 2. In addition, suitable protection devices should be provided. 3. In addition to the comments ①,②,③for No.1 Accident, air brake should be adopted instead of vacuum brake. Further braking forces should be applied to all wheel axles by continuous braking system.

Table 5 Discussion in the Workshop, Comments, Advice

Classification	Presentation by MR Experts	Comments, Major issues of MR, and Advice By JICA Experts
Train Delay	1. Method of Cause Analysis 2. Establishments of countermeasures	1. Comments on Method of Cause Analysis 2. Comments on Establishments of countermeasures 3. Major issues of MR made clear through discussion, and advice
No. 1 Y–M Line Express (11 up) Total delay 118 minutes Make up time 48 min. Final delay 70min.	1. Brake down of total delay Slow down during track maintenance 47% Locomotive failure 27% Slow down on bridge 11% Signal failure 3% Others 12% 2. Bridge repair, improvement of locomotive repair system, track maintenance improvement, preparation of parts for signals.	1. Break down of total delay time is praise-worthy. 2. Slow down during track maintenance occupies the large share. How to decrease the slow down during track maintenance must be examined. 3. Track maintenance needing train slow down should be limited by rules.
No.2 Y – M line Express (5up) Total delay 118min. Make up time 33 min, Final delay 85min.	1. Break down of total delay Slow down during track maintenance 50% Coach failure 21% Slow down on bridges 13% Locomotive failure 7% Others 9% 2. Repair of loco, coach, bridges	1. Brake down of total delay time is praiseworthy. 2. The same comment as that for Accident No.1 3. The same advice as that for Accident No..1 In addition, parts relating to braking system should be appropriately prepared. Maintenance standards for braking system should be reviewed.
No.3 Y-M Line Express (11up) Total delay 55min Make up time 45min Final delay 10min	1. Break down of total delay time Slow down during track maintenance 40% Slow down on bridges 29% Signal failure 7% Others 24% 2. Preparation of signal parts, repair of bridges, double tracking on gauntlett bridge	1. Brake down of total delay time is praiseworthy. 2. The same comment as that for Accident No.1 3. The same advice as that for Accident No.1.

No.4 Y – M line Express (5up) Total delay 81min. Make up time 31 min, Final delay 50min.	1. Break down of total delay time Slow down during track maintenance 28% Slow down on bridges 28% Coach failure 37% Others 7% 2. Bridge repair, and coach repair	1. Brake down of total delay time is praiseworthy. 2. The same comment as that for Accident No.1 3. The same advice as that for Accident No.1.
No.5 Y-M Line Express (11up) Total delay 118 min Make up time 33 min Final delay 85min	1. Break down of total delay time Slow down during track maintenance 24% Slow down on bridges 11% Loco failure 27% Signal failure 13% Others 25% 2. Bridge repair, preparation of signal parts, improvement of maintenance system and preparation of parts for locomotive and how to decrease the slow down during track maintenance.	1. Brake down of total delay time is praiseworthy. 2. Appropriate countermeasures 3. ・Track maintenance needing train slow dawn should be limited by rules. ・Inventory control of spare parts for rolling stock and signaling system should be improved ・With respect to bridge repair, firstly present situations of bridges should be fully grasped, through investigation of endurance of the bridges etc.

Table 6 Discussion in the Workshop, Comments, Advice

Classification	Presentation by MR Experts	Comments, Major issues of MR, and Advice By JICA Experts
Speed restriction	1. Method of Cause Analysis 2. Establishments of countermeasures	1. Comments on Method of Cause Analysis 2. Comments on Establishments of countermeasures 3. Major issues of MR made clear through discussion, and advice
No.1 (gauntlett bridge and poor track condition)	1. Speed restriction by gauntlett bridge No. 263, 829, and poor track conditions 2. Double tracking of gauntlett bridges, rectification of poor track conditions	1. No specific comments 2. No specific comments 3. In removing speed restriction locations, priority of rectification should be given, based on overall evaluation on ①increase of journey speed, ② rectification cost, ③degree of danger of the situations concerned, etc.
No. 2 (unstable embankment)	1. Explanation of speed restriction in the sections of Y–M Line Major causes of speed restriction are unstable embankment 2. No specific countermeasures were presented	1. No specific comments 2. No specific comments 3. Countermeasures for making embankment stable should be established.
No.3 Up & down line at 375km35	1. Speed restriction at the location 375km35 (up & down line). Major causes are improper track conditions (shortage of sleeper, ballast) 2. Track improvement by supplying sleeper and ballast	1. No specific comments 2. No specific comments 3. In removing the speed restriction at the poor track locations, priority should be given based on the overall evaluation of ①increase of journey speed, ② degree of poor condition of track (degree of danger), ③rectification cost

Table 7 Discussion in the Workshop, Comments, Advice

Classification	Presentation by MR Experts	Comments, Major issues of MR, and Advice By JICA Experts
Others	1. Method of Cause Analysis 2. Establishments of countermeasures	1. Comments on Method of Cause Analysis 2. Comments on Establishments of countermeasures 3. Major issues of MR made clear through discussion, and advice
No.1 Outline of Y–M line	1 & 2 Present situation of Y–M line including poor conditions of track and their countermeasures	1. The paper is well prepared. The major issues are well analysed. 2. Countermeasures should be more concretely established 3. ・Modernization of Y – M line is being planned with the financial support of JICA Yen loan. Modernization should be executed with full cooperation of MR experts. ・Track conditions are being grasped through riding on the vehicles. It is recommended to grasp track conditions with use of vibration measurement device.
No. 2 Present issues of MR	1 & 2 Major issues of MR are presented by this presentation paper	1 & 2 & 3 It is praiseworthy that MR staff himself tries to identify major issues of MR.
No. 3 Inspection and maintenance system of rolling stock	1 &2 Inspection and maintenance system of rolling stock is explained in the presentation paper.	1 & 2 &3 No specific comments
No.4 Review of technical standards of track, signaling & operation	Major technical standards of track, signaling and operation were reviewed and presented.	1 & 2 & 3 These presentation are useful for JICA Experts to review these technical standards in order for them to present recommendations on these technical standards from the viewpoint of improving safety and service level of MR.

Appendix: 2-2

Train Speed Slowing Down During Track Maintenance Work (Practices of JR East)

1. All track maintenance works should be implemented in principle in the blocked time-interval. Namely time for track work and time for train operation should be separated.
2. In case of large scale track work, sometimes the whole work cannot be completed in the given blocked time-interval.

   In such case, a part of work, limited to the preparatory work, is implemented before the start of the blocked time-interval. In this case, the work is implemented accompanied by train slow down.

   The kinds or work accompanied by train slow down are given as follows;

   (1) Rail fastening removing work
   See Table 1 (a), 1 (b)

   (2) Ballast removing work
   See Table 2

   (3) Fook bolt removing work
   See table 3

   (4) In case of removing derailment prevention guard/ rail, safety guard rail, bridge guard rail
   See table 4

3. Small scale spot track maintenance work can be executed not in the blocked time-interval, but in the regular interval between two consecutive trains. In that case, all the track works should be completed in the interval, so as not to necessitate the train slow down.

Table 1-(a) In case of removing rail fastening device(*1)

Kind of sleeper	Track structure				allowable rate of sleepers of which fastenings can be removed (*3)(*4)	restricted speed (km/h)	allowable temperature change from the rail installing temperature
	tangent or curve	rail (kg/m)	no. of sleeper /25m	with or without tie-plate			
PC sleeper	Tangent & R≧600m	60, 50 long rail (*2)	≧38		1/3	≦55	+14℃ -20℃
					1/2	≦45	+12℃ -18℃
	Tangent & R≧600m	60, 50 ℓ≦25m (*2)	≧39		1/3	≦55	up to rail gap =0mm
					1/2	≦45	
	600m>R≧400m				1/3	≦45	
					1/2	≦30	
Wodden sleeper	Tangent & R≧600m	60, 50, 40 long rail (*2)	≧43	with	1/3	≦50	+8℃ -10℃
					1/2	≦40	
			≧30	with	1/3	≦45	
					1/2	≦30	
		60, 50 ℓ≦25m (*2)	≧44	with	1/3	≦50	up to rail gap =0mm
					1/2	≦40	
				without	1/3	≦30	
		40, 37 ℓ≦25m (*2)	≧39	with	1/3	≦45	
					1/2	≦30	
				without	1/3	≦30	
		30 ℓ≦25m (*2)	≧34	with	1/3	≦40	
					1/2	≦30	
				without	1/3	≦30	
	600m>R≧400m	60, 50, 40, 37, 30 ℓ≦25m (*2)	≧44	with	1/3	≦45	up to rail gap =0mm
			≧39		1/3	≦40	
			≧34		1/3	≦35	

(*1) Rail fastening revmoval work and ballast removal work should be executed separately.

(*2) ℓ (m)=rail length. In case 25m≦ℓ<200m, this rail is considered to be long rail.

(*3) In case of deteriorated sleeper, rail fastening devices of that steeper are considered to have been removed.

(*4) In the section where 30kg/m rail is used, allowable rate of sleeper of which rail fastening devices can be removed should be 1/3.

Table 1-(b) In case of removing rail fastening device

Kind of sleeper	Track structure				allowable rate of sleepers of which fastenings can be removed (*1)	restricted speed (km/h)	allowable temperature change from the rail installing temperature
	tangent or curve	rail (kg/m)	no. of sleeper /25m	with or without tie-plate			
Bridge sleeper	Tangent & R≧600m	60, 50 long rail (*2)	≧63	with	1/3	≦50	-13℃
	Tangent & R≧600m	60, 50 ℓ ≦ 25m (*2)	≧63	with	1/3	≦50	
					1/2	≦40	
				without	1/3	≦30	
		40, 37 ℓ≦ 25m (*2)	≧46	with	1/3	≦45	
					1/2	≦35	
				without	1/3	≦30	
		30 ℓ≦ 25m (*2)	≧41	with	1/3	≦40	
					1/2	≦30	
				without	1/3	≦30	
	600m＞R≧ 400m	60, 50, 40, 37, 30 ℓ≦ 25m (*2)	≧63	with	1/3	≦45	
			≧46		1/3	≦40	
			≧41		1/3	≦35	

(*1) In case of deteriorated sleeper, rail fastening devices of that steeper are considered to have been removed.
(*2) ℓ (m)=rail length. In case 25m≦ℓ<200m, this rail is considered to be long rail.

Table 2 In case of removing ballast (*1)

Kind of work (*4)	Track structure				restricted speed (km/h)	allowable temperature change from the rail installing temperature
	rail length	tangent or curve	rail (kg/m) (*3)	no. of sleeper /25m		
scraping out the shoulder ballast (Fig 1)	long rail (*2)	Tangent & R≧600m	60 50	≧38	≦50	+13℃ -14℃
	ℓ≦ 25 (*2)	Tangent & R≧600m	60 50 40 37 30	≧43	≦50	Up to rail gap =0mm
				≧39	≦40	
				≧34	≦40	
		600m>R≧400m	60 50 40 37	≧43	≦35	
				≧39	≦30	
removal of whole surface ballast (above the sleeper botttom) (Fig 2)	turnout		60 50 40 37 30		≦35	

(*1) Rail fastening revmoval work and ballast removal work should be executed separately.
(*2) ℓ (m)=rail length. In case 25m≦ℓ<200m, this rail is considered to be long rail.
(*3) The rule applied to the section of 30kg/m should be established separately.
(*4) Standard methods to scrape out the ballast are shown in Fig 1. and 2.

Table 3 Fook Bolt Removal Work

Restricted speed	Remark
According to Table 1 (b)	1. Limited to sleepers of which rail fastening are removed. 2. Not applied to the section where 30kg/m rail is used.

Table 4. In case of removal of derailment prevention guard, derailment prevention rail, safe guard rail, guard rail on the bridge

Restricted speed (km/h)	Remark
Tangent & curve ≦45	Only applied to trains to which freight wagons are attached.

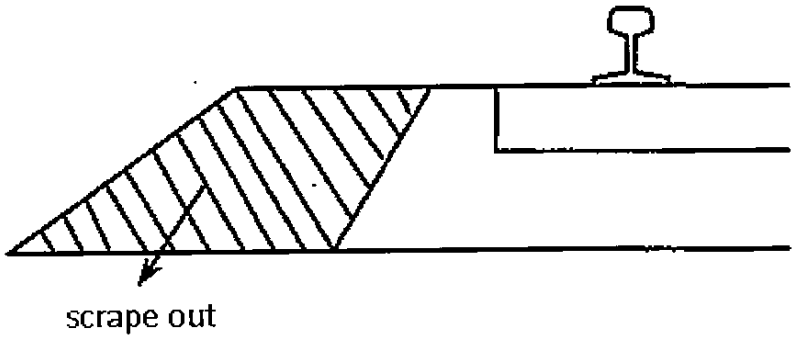


Fig 1 Shoulder ballast

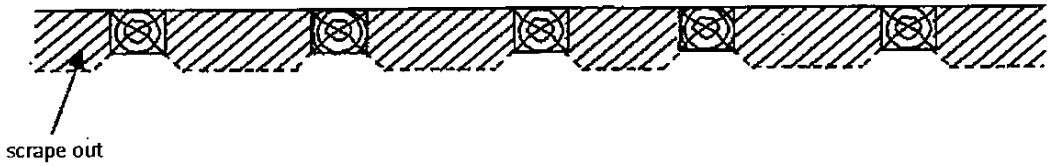


Fig 2 Whole surface ballast (turnout) (above this bottom of sleeper)

The Republic of the Union of Myanmar

Myanma Railways, Ministry of Rail Transportation

PROJECT ON IMPROVEMENT OF SERVICE AND SAFETY OF RAILWAY IN MYANMAR
PROGRESS REPORT

May 2014

JAPAN INTERNATIONAL COOPERATION AGENCY
JAPAN INTERNATIONAL CONSULTANTS FOR TRANSPORTATION CO., LTD
ORIENTAL CONSULTANTS CO., LTD
SUMITOMO CORPORATION

This PR Explains major activities between around Feb. and May, 2014

Two Subprograms of the Project

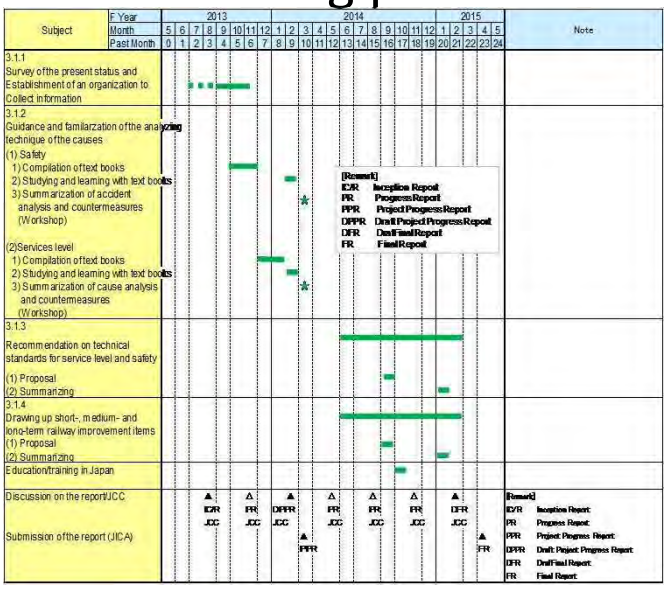
1. Recommendation of technical standards relating to administrative and maintenance aspects and drawing up railway facilities improvement plan to improve service and safety level, based on cause analysis of accidents/ low service level.
2. Technology Transfer of Track Maintenance Technology to improve the level of Service and Safety through Implementation of the Pilot Project

3

Major Progress of Subprogram 1

4

Table of working plan schedule

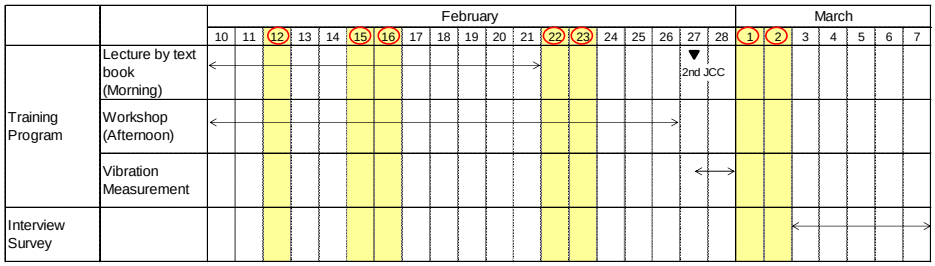


Major activities of Subprogram 1 between February and May

1. Training program of cause analysis of accidents/ Low service level and establishment of countermeasures
   (1) Class room lecture of textbook
   (2) Workshop
   (3) Comments on training program by MR participants
   (4) Training for measurement of Train Vibration

2. Investigation of customer satisfaction level

Training Program & Interview Survey



(1) Class room lecture of text book

JICA experts explained, based on the text book, about the past accidents and countermeasures in Japan (for examples, derailments, train collision, level crossing, natural disaster and so on), and introduced the measures for improvement of the service level (for examples, increasing train speed, punctuality, riding comfortabilities, train protections and so on).

There were various discussions between JICA lecturers and MR participants. Major advices to MR by JICA experts based on the discussion are given below.

1) Level Crossing Accident Prevention

In order to decrease the level crossing accidents, not only the installment of protection devices, but also the guidance to road vehicle drivers about the safe way to cross the level crossing and efforts to eliminate the level crossings (such as by grade separation, by unification) are significant.

2) ATP

In introducing ATP, the are many issues to be solved such as securing constant braking distance. In addition, safety sidings, automatic warning devices for obstructing construction gauges, emergency protection devices etc. are also significant devices for preventing derailment and double accidents.

3) Rolling Stock

- Vacuum brake should be replaced by compressed air brake
- Continuous braking is necessary for safety and speed up
- Spring system of bogie is closely related with riding comfort of vehicles. MR should investigate the vibration of bogies and try to improve the spring system of the bogie

9

4) Track

- To grasp the track condition precisely, inspection device should be applied.
- By and by mechanical repair machines such as MTT, Ballast regulator should be introduced for strengthening the repairing power
- Shortage of track ballast is conspicuous. It should be understood that ballast contributes to the lateral resistance of track, which is important for securing stable track, especially significant for preventing buckling of long welded rail track.
- Low joints of track are conspicuous in many sections, which cause progress of track deterioration and large vehicle vibration. Adoption of long wedded rail is the best solution.
- Adopting of long welded rail is one of the best solutions for improving riding comfort, speeding up and safety. Maintenance manuals for long welded rail track should be established, and training of maintenance of long-welded track should be strengthened.

10

(2)Workshop

1)Purpose of the Workshop

The purpose of the workshop is to make MR experts be familiarized with analysis of causes of accidents and low service levels and establishment of countermeasures through making MR staff themselves analyse the causes of actual accidents or low service levels of MR and making themselves establish suitable countermeasures.

- In this regard, 25 items relating to accidents and low service levels (train delay and speed restrictions) were selected from the actual MR's events in 2012/ 2013. The 25 items selected are given in Table 2-3.

11

Table 2.3 Presentation by MR experts in Workshop

Topics		No. of presentations
Accident		**10**
Derailment	Between stations	3
	In the station yards	3
Train Parting		2
Level crossing accident		2
Service Level		**8**
Train delay		5
Speed restriction		3
Others		**7**
Existing situation of Y – M Line		1
Review of Technical standards (track, signal/ telecom, operation)		3
Review of inspection / maintenance of rolling stock		1
Current issues of MR		1
General questions to JICA experts		1
Total		**25**

12

2) Advices by JICA Experts

Summary of advices of JICA experts on major issues of MR identified through discussion in the Workshop

(a) Derailment (between stations & in the station yards)

i. Not only the track cross level irregularity, but also track twist should be measured and controlled

ii. Measurement devices including string should be used to grasp the track irregularities precisely.

iii. For prevention of derailment caused by spring coil breakage, specification of material of coil, inspection system of coil, periodical replacement according to age, quality control of coil production should be examined.

iv. The vehicle should be designed and maintained so that brake should be continuously applied to every wheel axle, in order to avoid train buckling (causing decrease of wheel load, increase of wheel lateral pressure leading to derailment) due to sudden braking of locomotive.

13

(b) Train Parting

i. Improvement of track and rolling stock which is important for reducing impact load applied to coupler, is the basic countermeasures for accidents like this.

ii. Braking system should be improved so as to ensure continuous braking, by which the parted parts will automatically stop, preventing the dangerous situations.

14

(c) Level crossing accident

①First the basic information about the level crossing concerned (No. of trains per day, train speed, traffic volume of road vehicles, length, width, visibility distance from the train driver and from the road vehicle driver etc.) should be collected. Then according to these basic information, all level crossings should be classified according to their importance. According to the classification, suitable protection devices should be planned.

②The guidance to stop once before crossing the level crossing should be given to road vehicle drivers.

15

(d) Train delay

i. Slow down during track maintenance occupies the large share of total delay time. How to decrease the slow down during track maintenance must be examined. Track maintenance needing train slow down should be limited by rules.

ii. Inventory control of spare parts for rolling stock and signaling system should be improved so as to provide necessary spare parts timely.

iii. With respect to bridge repair, firstly present situations of bridges should be fully grasped, through investigation of endurance of the bridges etc.

16

(e) Recommendation on how to decrease train speed down during the track maintenance work

- According to the statistics in 2012/2013 regarding the delay of the express trains of Yangon – Mandalay line, the average delay time at Yangon and Mandalay is 65 minutes, and that at Nay Pyi Taw is 57 minutes. According to the analysis of train delay by MR experts presented in the Workshop, delay due to train speed down during the track maintenance work occupies a large share of the total delay time (50 – 24 %).

17

In MR, trains are slowing down the speed during almost all medium/ large track maintenance works.

Large train delays will cause social problems, along with socio – economic development of the country.

Further, in order to compete favourably with road vehicles, punctuality of train trip should be ensured.

Then, how to decrease train delay due to slow down during the track maintenance should be seriously studied.

18

- In case of JR, all track maintenance work are executed in principle in the blocked time-interval. Any train speed slow down will not be implemented after the track work.
- In case of large scale track maintenance work, sometimes a part of work, namely preparatory work is implemented before the start of blocked time-interval accompanied by train speed slow down.
- Small scale spot track maintenance work can be executed not in the blocked time-interval, but in the regular interval between two consecutive trains. Even in that case, all track works will be completed in the interval, thus without necessitating slow down of train after the work.
- It is recommended that MR tries to reduce the train delay time due to slowing down of train during track maintenance, referring to JR practices

19

(f) Speed Restrictions

- Poor track conditions, unstable embankment, old aged bridges are major locations necessitating speed restrictions. In removing the speed restriction locations, priority should be given based on the overall evaluation of ① increase of journey speed, ②rectification cost, ③degree of danger of the situations concerned, etc

20

(3) Comments on training program by MR participants

Comments on Training Program by MR Participants

Question	Comments	No.of the same comments (*1)
1 According to your opinion,what information/matters /Japanese examples were especially useful for improvement of safety and sevice level of MR?	1.AII lectures were useful *Japanese experiences on improvement of safty/ seivice level are useful for drawing MR's improvement plan *MR can learn research,facilities,regulation,management ,especially spirit from JR	9
	2.Level Crossing Accident Pevention *countermeasures against level crossing accidents,level crossing protection facilities	10
	3.Signal and train operation *train protection radio,signal failure prevention,signal visibility,electric point,block system,	5
	4.Track and turnout	3
	5.Brake system	3
	6.Natural disaster prevention,earthquake detection system	3
2 Are there any other information/matters/Japanese experiences you would like to know more?	1.want to know more about various matters of Japanese railways	7
	2.Want to know more about maintenance,technology of rolling stock,.	2
	3.Want to know more about signalling and telecommunimation system of Japanese railways	2
	4.Wat to know about effective design of station yard,plannning principle of diagram of station yard	1
	5 Want to know standard construction method ,,maintemance ,organization of railway	1
	6.Want to know how JR Goup increase their income	1
	7.Want to know more aout track inspection and maintenance	1
	8.Shinkansen,Maglev,Metro,Monorail,train operation system(TDCS,OC,CTCS,ATC,JTSS etc.	1
	9.No specific opinions	3

21

Question	Comments	No.of the same comments (*1)
3 Do you think the way/method by which JICA expert team organized the workshop was satisfactory to you?	.Aii participants are satisfactory :*Want to have more free discussion ,more workshops,more discussion on signal&telecom *Made up his mind to apply what he learned in the workshop toimprovemento of MR *Learned how to analyse the causes of accidents,how to establish the countermeasures	19
4 Do you have any advice how to improve the way/method of workshop?	1.Senior staff of MR should attend the workshop at least 5days	1
	2.To hold workshop once a month chaired by GM(civil),joined by other departments, on track maintenance	1
	3.Participants of workshop should visit various facilities,institutes ,field sites of Japanese railways	1
	4.To make small groups consisting of experts of various fields hold workshop and discuss accidents	2
	5.Should have more workshop	3
	6.Shold have not only lectures,but aiso visual material such as videos	1
	7.Should use interpreters of Englishh-Myanmar language to understand more precisely workshop	1
	8.Participants should know the contents of presentation beforehand to make discussion more fruitfully	4
	9 Should have more discussion on track maintnance with JICA experts	1
	10.Others	4

(:*1)Wirh respect to Question 1,if one participant has plural comments ,say comment on Item 5 Brake system and comment on Item 4 Track and turnout, his comment on each item is counted as one comment for each item.

22

(4) Training for measurement of train vibration

In order to make MR experts be familiarized with how to apply the vibration measurement of train to control of track maintenance and improvement of vehicle performance, JICA experts instructed measurement and analysis of actual Train Vibrations on Feb. 27, and 28th. Trainings were implemented by using the device [Digital Vibration Measurement Device W0031]. Trainings included 1) how to use the device to measure the vibration and how to analyses the measured data, 2) measurement of actual MR's express train, and 3) analysis of the measured data.

23

- Recommendation

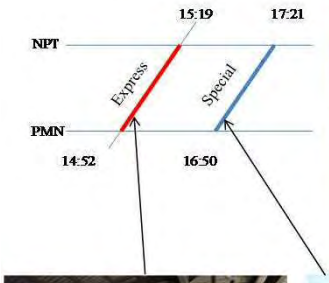
(a) At present, large vehicle vibration caused by poor track conditions are monitored by inspectors through subjective sensual feelings while riding on the train.In place of such subjective sensual feelings, vehicle vibration measurement device should be used to evaluate objectively and precisely the vehicle vibration caused by poor track conditions

(b) Analysis of the vehicle vibration data is also useful for identifying the various issues of vehicle performance.

24

Measured Section and Train Schedule

Date 27th February, 2014



Myanmar Passenger Coach Train and its bogie

Japanese DC (KIHA 141-8) and its bogie (DT21)

25

3. Measurements tools

Vibration meter

-Lap-top PC installed analysis software

-GPS logger or marker

-connecting cable and batter

Picture: on Myanmar Passenger Coach

26

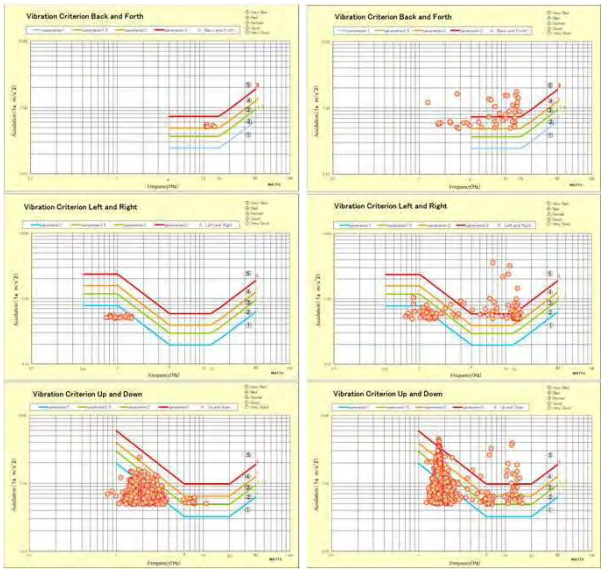


Fig5: Vibratio Criterion Japanese DC Fig6: Vibration Criterion Myanmar PC

27

2. Investigation on customer satisfaction level

After implementation of the training program, Interview Survey to investigate customers satisfaction level of MR's passenger train was carried out from March 3 (preparing meeting) to March 7. The details of the interview survey and the analysis of the results are given in the following report.

28

Report on Result of Investigation on Customer Satisfaction Level

Table Sampling number

Train kind/ class	Sampling Number/Train	Train number/ day	days	Target number	Actual Number
Express (Upper)	20	3	2	120	120
Express (Ordinary)	20	3	2	120	122
Local	30	2	2	120	123

Questionnaire item:

Refer to Attached Appendix ①

29

Pictures: Ongoing invitation

Express Upper Class on Mar. 4

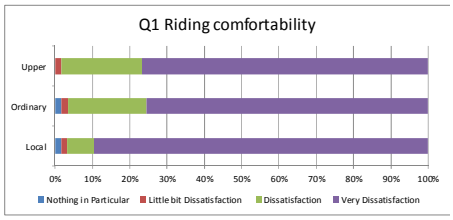
Express Ordinary Class on Mar. 4

Local on Mar. 7

30

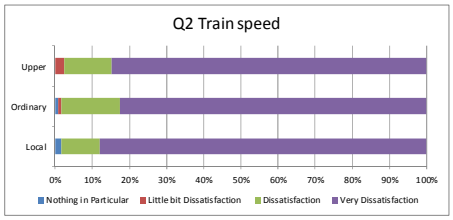
Q1 Riding comfortability

	Local	Ordinary	Upper
Nothing in Particular	2	2	0
Little bit Dissatisfaction	2	2	2
Dissatisfaction	9	25	25
Very Dissatisfaction	113	89	89



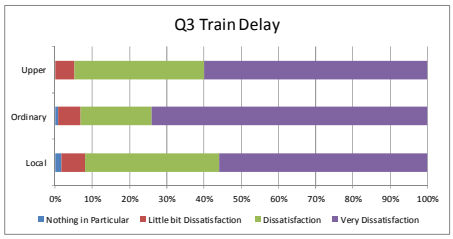
Q2 Train speed

	Local	Ordinary	Upper
Nothing in Particular	2	1	0
Little bit Dissatisfaction	0	1	3
Dissatisfaction	13	18	15
Very Dissatisfaction	109	95	100



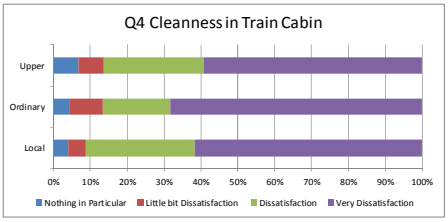
Q3 Train Delay

	Local	Ordinary	Upper
Nothing in Particular	2	1	0
Little bit Dissatisfaction	8	7	6
Dissatisfaction	45	22	40
Very Dissatisfaction	70	86	69



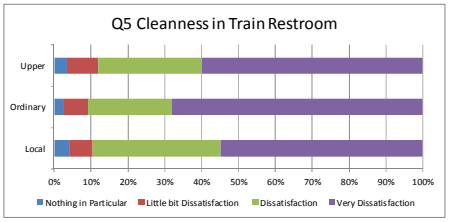
Q4Cleanness in Train Cabin

	Local	Ordinary	Upper
Nothing in Particular	5	5	8
Little bit Dissatisfaction	6	11	8
Dissatisfaction	37	22	32
Very Dissatisfaction	77	82	70



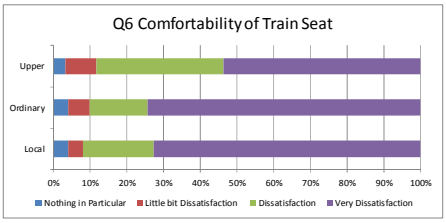
Q5Cleanness in Train Restroom

	Local	Ordinary	Upper
Nothing in Particular	5	3	4
Little bit Dissatisfaction	8	8	10
Dissatisfaction	43	27	33
Very Dissatisfaction	68	81	70



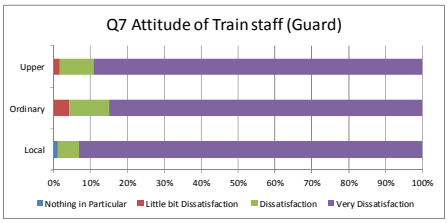
Q6Comfortability of Train Seat

	Local	Ordinary	Upper
Nothing in Particular	5	5	4
Little bit Dissatisfaction	5	7	10
Dissatisfaction	24	19	41
Very Dissatisfaction	91	90	64



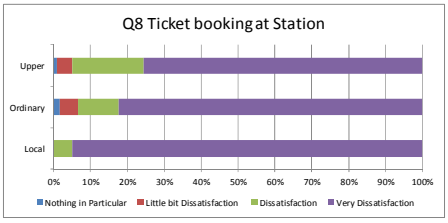
Q7Attitude of Train staff (Guard)

	Local	Ordinary	Upper
Nothing in Particular	1	0	0
Little bit Dissatisfaction	0	5	2
Dissatisfaction	6	13	11
Very Dissatisfaction	96	102	106



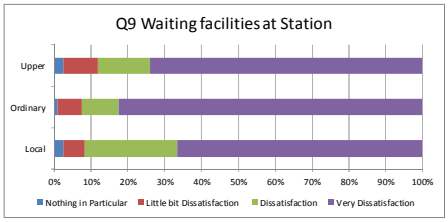
Q8Ticket booking at Station

	Local	Ordinary	Upper
Nothing in Particular	0	2	1
Little bit Dissatisfaction	0	6	5
Dissatisfaction	6	13	23
Very Dissatisfaction	114	98	90



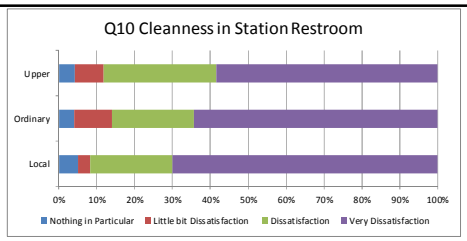
Q9Waiting facilities at Station

	Local	Ordinary	Upper
Nothing in Particular	3	1	3
Little bit Dissatisfaction	7	8	11
Dissatisfaction	30	12	17
Very Dissatisfaction	80	100	88



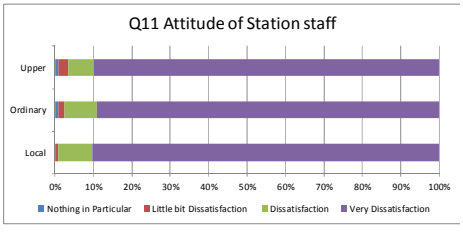
Q10Cleanness in Station Restroom

	Local	Ordinary	Upper
Nothing in Particular	6	5	5
Little bit Dissatisfaction	4	12	9
Dissatisfaction	26	26	35
Very Dissatisfaction	84	78	69



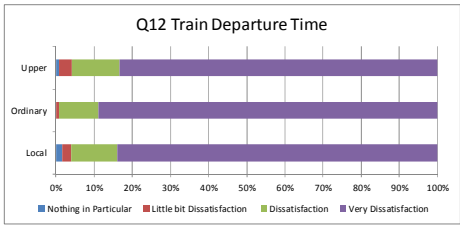
Q11Attitude of Station staff

	Local	Ordinary	Upper
Nothing in Particular	0	1	1
Little bit Dissatisfaction	1	2	3
Dissatisfaction	11	10	8
Very Dissatisfaction	112	106	106



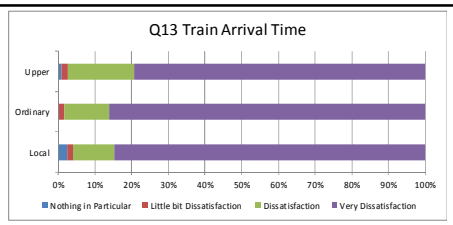
Q12Train Departure Time

	Local	Ordinary	Upper
Nothing in Particular	2	0	1
Little bit Dissatisfaction	3	1	4
Dissatisfaction	15	12	15
Very Dissatisfaction	104	104	99



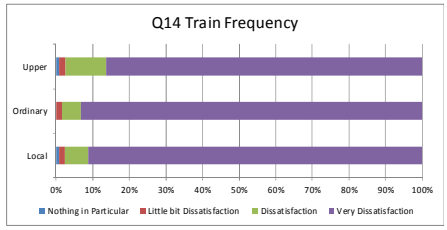
Q13Train Arrival Time

	Local	Ordinary	Upper
Nothing in Particular	3	0	1
Little bit Dissatisfaction	2	2	2
Dissatisfaction	14	14	21
Very Dissatisfaction	106	99	92



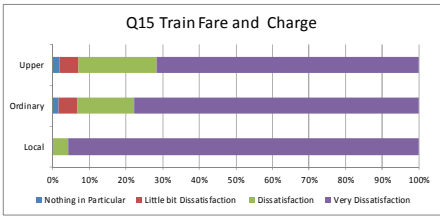
Q14Train Frequency

	Local	Ordinary	Upper
Nothing in Particular	1	0	1
Little bit Dissatisfaction	2	2	2
Dissatisfaction	8	6	13
Very Dissatisfaction	113	111	101



Q15Train Fares and Charge

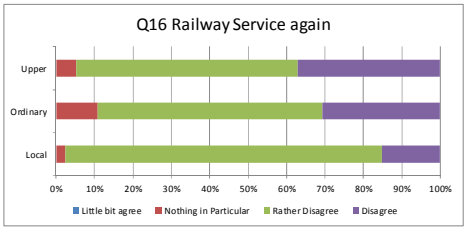
	Local	Ordinary	Upper
Nothing in Particular	0	2	2
Little bit Dissatisfaction	0	6	6
Dissatisfaction	5	18	24
Very Dissatisfaction	116	91	81



35

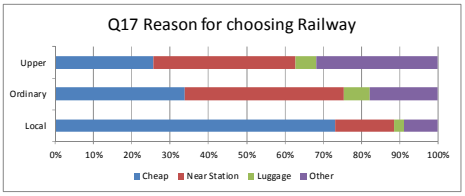
Q16Railway Service again

	Local	Ordinary	Upper
Little bit agree	0	0	0
Nothing in Particular	3	12	6
Rather Disagree	98	65	65
Disagree	18	34	42



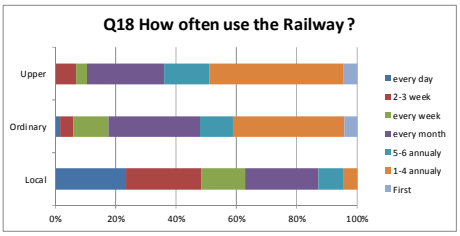
Q17 Reason for choosing Railway

	Local	Ordinary	Upper
Cheap	90	40	29
Near Station	19	49	42
Luggage	3	8	6
Other	11	21	36



Q18 How often do you use the Railway service ?

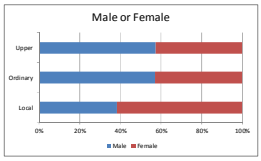
	Local	Ordinary	Upper
every day	29	2	0
2-3 week	31	5	8
every week	18	14	4
every month	30	36	29
5-6 annualy	10	13	17
1-4 annualy	6	44	51
First	0	5	5



36

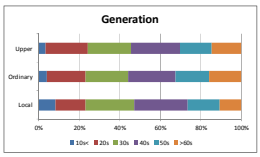
Male or Female

	Local	Ordinary	Upper
Male	45	68	67
Female	73	52	50



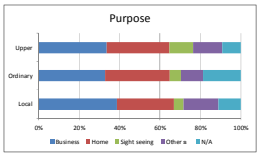
Generation

	Local	Ordinary	Upper
10s<	10	5	4
20s	18	23	24
30s	29	25	25
40s	32	28	28
50s	19	20	18
>60s	13	19	17



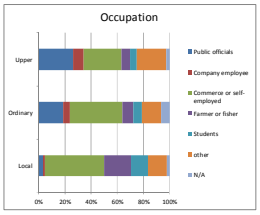
Purpose

	Local	Ordinary	Upper
Business	48	40	40
Home	35	39	37
Sight seeing	6	7	14
Others	21	13	17
N/A	14	23	11



Occupation

	Local	Ordinary	Upper
Public officials	4	23	31
Company em	2	6	10
Commerce or	57	49	34
Farmer or fis	26	10	8
Students	16	8	6
other	18	18	27
N/A	9	8	3



37

2.1.4 Recommendation on technical standards relating to administrative and maintenance aspect to improve the service level and safety

Relevant technical standards in the fields of civil, signal/ telecommunication, operation, rolling stock engineering have been supplied by MR. Preparation of recommendations on these technical standards have been just started.

2.1.5 Drawing up of short-, medium-, and long-term railway facilities improvement plan

The activity has just been started. The improvement plans will be prepared through discussion in the Working Group consisting of MR senior officials concerned and JICA experts. The plan will take into account MP and FS by JICA study Team

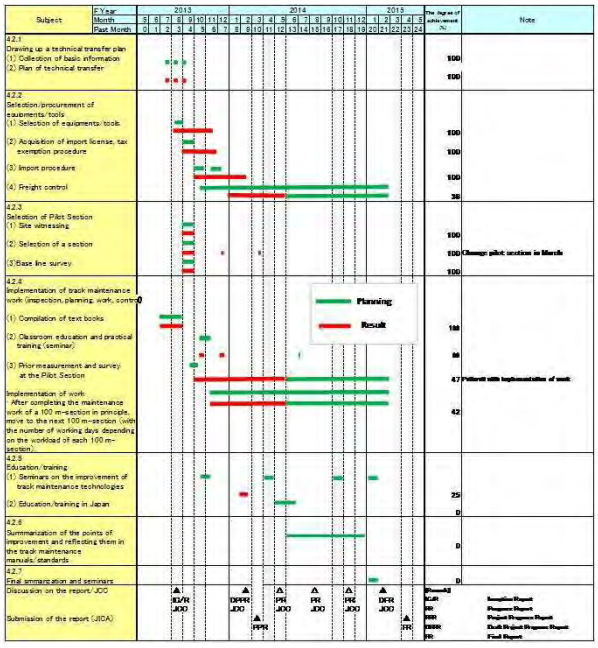
2.1.6 Education/ training in Japan

11 officers for MR will be invited to Japan for two weeks in October, 2014. The training program is going to be proposed soon. Kindly review the program after submitted; we are pleased to modify the program with due consideration on suggestions/ advices of MR.

38

Major Progress of Subprogram 2

Table of working plan schedule(Track Maintenance)



Major activities of Subprogram 2 between February and May

・Selection of Pilot Section

We were requested by MR to include not only Yangon-Mandalay line but also Dagon University line and Thilawa line branching at Toekyaungkalay Sta. Now we are implementing training on these branch lines.

・Substitution of trainee

The members from Bago went back to their own depots, and are implementing maintenance of track by themselves now. New members from Division 5, 8 and 9 have been added and are now tackling with track maintenance.

41

Major activities of Subprogram 2 between February and May

・Education/training in Japan

We are preparing for implementation two-week education/training program twice in Japan.

1st group is from 9th to 20th in June

2nd group is from 23th in June to 4th in July.

42

Training Photo

Distribution of safety shoes to new members

Morning assembly

Training Photo

Sign Board in Toekyaungkalay Sta.

Temporary Dormitory for trainee

Training Photo

Track Raising of turnout

Exchanging sleeper of turnout

45

Training Photo

Motor Raising of turnout

After track maintenance

46