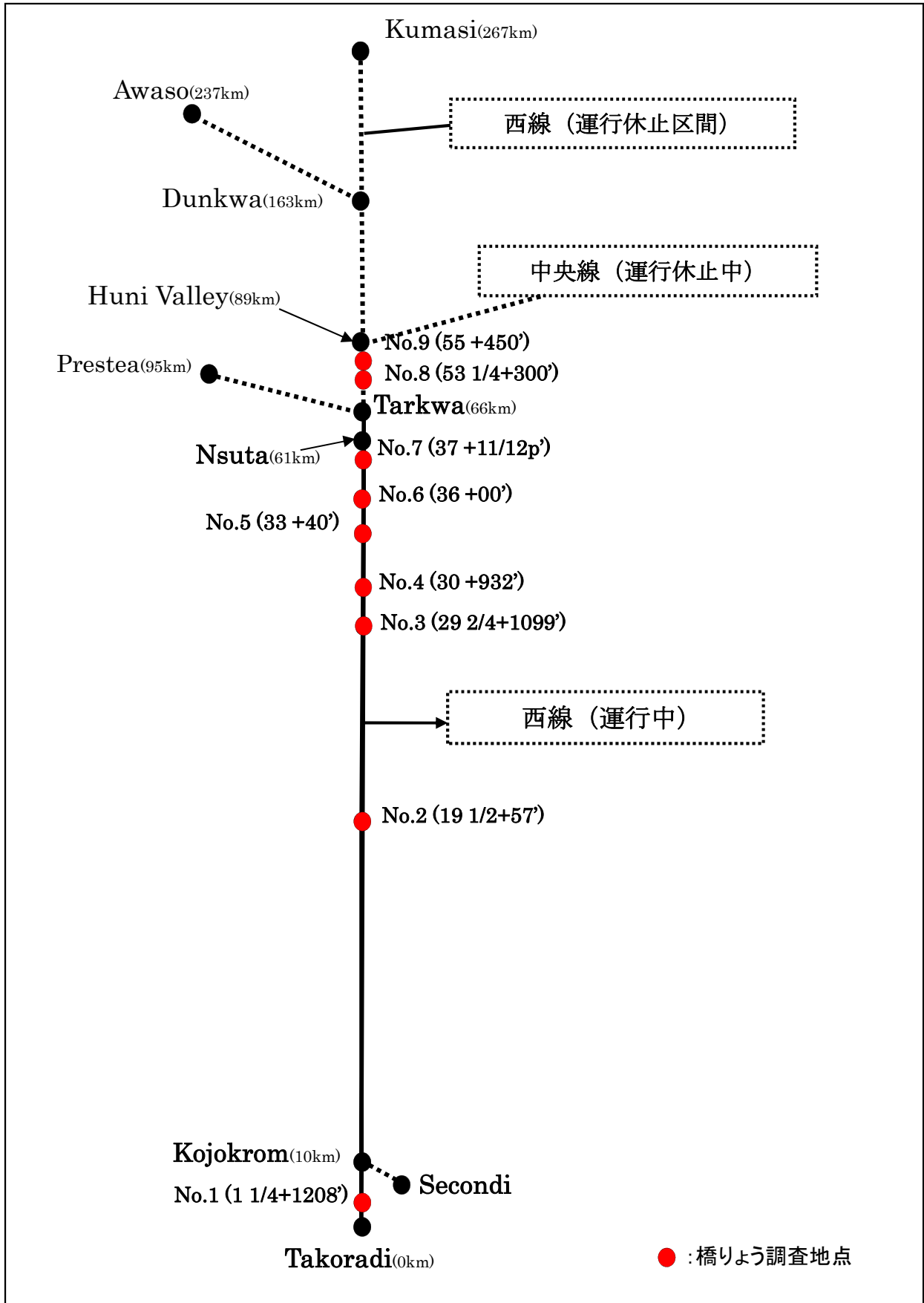


APPENDIX 2

橋梁検査台帳

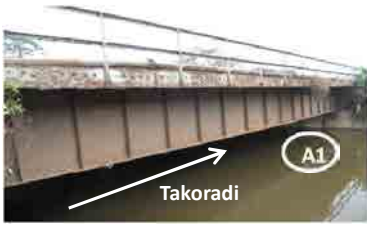
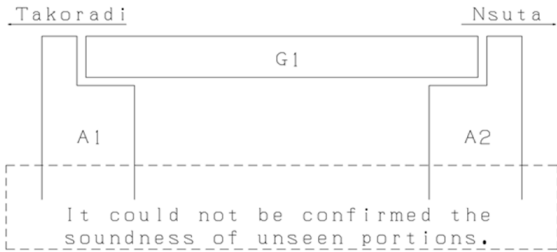
橋りょう調査地点



BRIDGE WEST LINE (TAKORADI~NSUTA)					
No	MILEAGE	TYPE	SPAN	LENGTH	REMARKS
1	1 1/4 + 1208'	Steel deck plate girder	1	66' 00"	
2	19 1/2 + 57'	Steel deck plate girder	1	20' 00"	
3	29 2/4 + 1099'	Steel deck plate girder	1	30' 00"	
4	30 + 932'	Steel through plate girder	3	63' 8 3/4"	
5	33 + 40'	Steel through plate girder	1	63' 00"	
6	36 + 00'	Steel deck plate girder	2	29' 8"	
7	37 + 11/12p'	Steel deck plate girder	1	29' 00"	

BRIDGE WEST LINE (HUNI VALLEY)					
No	MILEAGE	TYPE	SPAN	LENGTH	REMARKS
8	53 1/4 + 300'	Steel deck plate girder	1	23' 00"	
9	55 + 450'	Steel deck plate girder	1	23' 00"	

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		03/10/2012			
Bridge No.		1		Mileage		1 1/4 + 1208'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel deck plate girder 66' 00" × 1(span) = 66' 00"							
Type of Substructure		Plain concrete abutment							
Photograph									
Diagram		 <p>It could not be confirmed the soundness of unseen portions.</p>							
Evaluation of Superstructure	Condition	Girder 1		/					
		Usual							
		Rusty							
		Corroded							
		Cracked							
		Unstable							
Handling		Notice							
Evaluation of Substructure	Condition	Abut 1		Abut 2					
		Usual		Usual					
		Exposed Bar		Exposed Bar					
		Cracked		Cracked					
		Flaked		Flaked					
		Scoured		Scoured					
		Unstable		Unstable					
	Handling		Notice		Notice				
Comment		<p>鋼橋全体が錆びている。桁下空間が低い為の下フランジの腐食が激しく、断面欠損が見られる。 リベットの欠落は見られない。 下部工は錆汁が見られない。 パラペットのひび割れに対して、幅および長さを継続的に観察して、記録をとる必要がある。 基礎の洗掘に対してフトン籠により基礎を保護すべきである。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3 (Small Emergency)		Level-4 (Large Emergency)	



(Photo1)



(Photo2)



(Photo3)



(Photo4)



(Photo5)



(Photo6)



(Photo7)



(Photo8)



(Photo9)


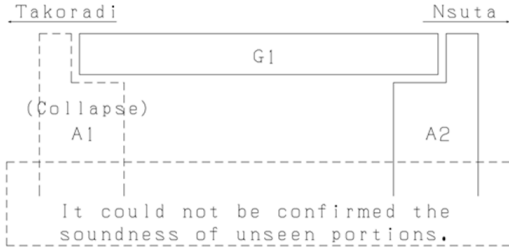


(Photo10)



(Photo11)

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		10/10/2012			
Bridge No.		2		Mileage		19 1/2 + 57'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel deck plate girder 20' 00" × 1(span) = 20' 00"							
Type of Substructure		Plain concrete abutment							
Photograph									
Diagram									
Evaluation of Superstructure	Condition	Girder 1		/					
		Usual							
		Rusty							
		Corroded							
		Cracked							
		Unstable							
Handling	Notice								
Evaluation of Substructure	Condition	Abut 1		Abut 2					
		Usual		Usual					
		Exposed Bar		Exposed Bar					
		Cracked		Cracked					
		Flaked		Flaked					
		Scoured		Scoured					
		Unstable		Unstable					
	Handling	Repair(Partial or All)		Repair(Partial or All)					
Comment		<p>洗掘によりTakoradi方の橋台(A1)が倒壊している。 上部工は、木枕木を使用して盛り替え、レール桁により軌道を保護している。 鋼橋全体が錆びている。リベットの欠落は見られない。 下部工は錆汁が見られない。 河川の切り回しはすでに完了していることから、早急に桁を撤去し、盛土により復旧することが望ましい。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3(Small Emergency)		Level-4(Large Emergency)	



(Photo1)



(Photo2)



(Photo3)



(Photo4)


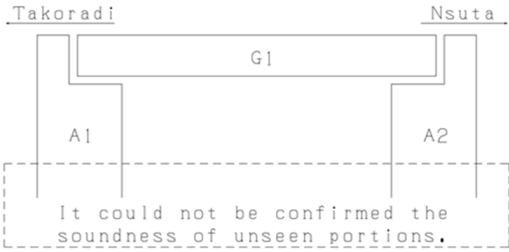


(Photo5)



(Photo6)

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		11/10/2012			
Bridge No.		3		Mileage		29 2/4 + 1099'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel deck plate girder 30' 00" × 1(span) = 30' 00"							
Type of Substructure		Plain concrete abutment							
Photograph									
Diagram									
Evaluation of Superstructure	Condition	Girder 1		/					
		Usual							
		Rusty							
		Corroded							
		Cracked							
		Unstable							
Handling	Notice								
Evaluation of Substructure	Condition	Abut 1		Abut 2					
		Usual		Usual					
		Exposed Bar		Exposed Bar					
		Cracked		Cracked					
		Flaked		Flaked					
		Scoured		Scoured					
		Unstable		Unstable					
	Handling	Notice		Notice					
Comment		<p>鋼橋全体が錆びている。 リベットの欠落は見られない。 A1,A2橋台ともにパラペット前面、躯体前面に乾燥収縮と思われる大きな水平のクラックが見られる。 下部工は錆汁が見られない。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3 (Small Emergency)		Level-4 (Large Emergency)	



(Photo1)



(Photo2)



(Photo3)



(Photo4)



(Photo5)



(Photo6)



(Photo7)



(Photo8)



(Photo9)



(Photo10)



(Photo11)



(Photo12)



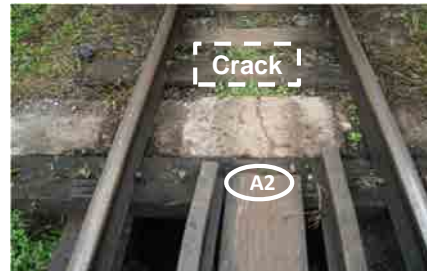
(Photo13)



(Photo14)


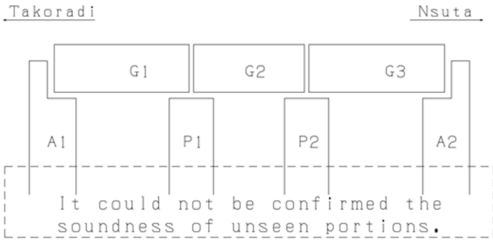


(Photo15)



(Photo16)

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		12/10/2012			
Bridge No.		4		Mileage		30 + 932'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel through plate girder 63' 8 3/4" × 3(span) = 189' 26 1/4"							
Type of Substructure		Plain concrete abutment , Plain concrete pier							
Photograph									
Diagram		<p style="text-align: center;">Takoradi Nsuta</p>  <p style="text-align: center;">It could not be confirmed the soundness of unseen portions.</p>							
Evaluation of Superstructure	Condition	Girder 1		Girder 2		Girder 3			
		Usual		Usual		Usual			
		Rusty		Rusty		Rusty			
		Corroded		Corroded		Corroded			
		Cracked		Cracked		Cracked			
		Unstable		Unstable		Unstable			
	Handling	Notice		Notice		Notice			
Evaluation of Substructure	Condition	Abut 1		Pier 1		Pier 2		Abut 2	
		Usual		Usual		Usual		Usual	
		Exposed Bar		Exposed Bar		Exposed Bar		Exposed Bar	
		Cracked		Cracked		Cracked		Cracked	
		Flaked		Flaked		Flaked		Flaked	
		Scoured		Scoured		Scoured		Scoured	
	Unstable		Unstable		Unstable		Unstable		
Handling	Notice		Notice		Notice		Notice		
Comment		<p>鋼橋全体が錆びている。 リベット、添接板のボルトの欠落は見られない。 A1,A2橋台ともにパラペット前面、躯体前面に乾燥収縮と思われる大きな水平のクラックが見られる。 P1,P2橋脚には水平力が微小であり、部材寸法が比較的大きいので特に問題は無い。 下部工は錆汁が見られない。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3(Small Emergency)		Level-4(Large Emergency)	



(Photo1)



(Photo2)



(Photo3)



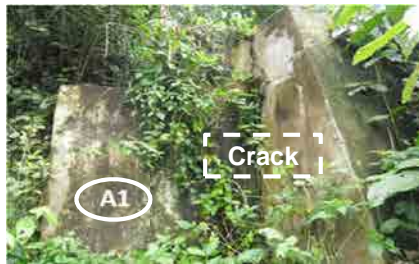
(Photo4)



(Photo5)



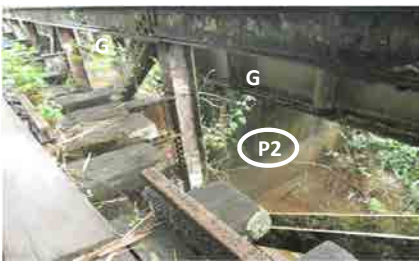
(Photo6)



(Photo7)



(Photo8)


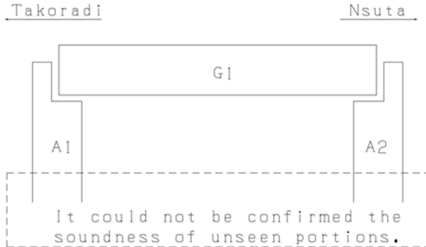


(Photo9)



(Photo10)

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		16/10/2012			
Bridge No.		5		Mileage		33 + 40'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel through plate girder 63' 00" × 1(span) = 63' 00"							
Type of Substructure		Plain concrete abutment							
Photograph									
Diagram		 <p>It could not be confirmed the soundness of unseen portions.</p>							
Evaluation of Superstructure	Condition	Girder 1		/	/	/	/		
		Usual							
		Rusty							
		Corroded							
		Cracked							
		Unstable							
Handling	Notice								
Evaluation of Substructure	Condition	Abut 1		/	/	Abut 2			
		Usual				Usual			
		Exposed Bar				Exposed Bar			
		Cracked				Cracked			
		Flaked				Flaked			
		Scoured				Scoured			
		Unstable				Unstable			
	Handling	Notice		Notice					
Comment		<p>鋼桁全体が錆びている。 リベットの欠落は見られない。 A1,A2橋台ともにパラペット前面、躯体前面に乾燥収縮と思われる大きな水平のクラックが見られる。 沓の移動によりパラペット前面側で、コンクリートの破壊が見られる。ボルトの緩みを改善する必要がある。 下部工は錆汁が見られない。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3 (Small Emergency)		Level-4 (Large Emergency)	



(Photo1)



(Photo2)



(Photo3)



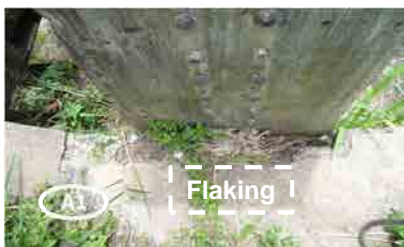
(Photo4)



(Photo5)



(Photo6)



(Photo7)



(Photo8)



(Photo9)



(Photo10)



(Photo11)


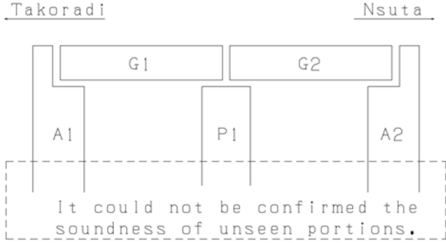


(Photo12)



(Photo13)

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		15/10/2012			
Bridge No.		6		Mileage		36 + 00'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel deck plate girder 29' 8" × 2(span) = 58' 16"							
Type of Substructure		Plain concrete abutment							
Photograph									
Diagram									
Evaluation of Superstructure	Condition	Girder 1		Girder 2		/			
		Usual		Usual					
		Rusty		Rusty					
		Corroded		Corroded					
		Cracked		Cracked					
		Unstable		Unstable					
Handling		Notice		Notice					
Evaluation of Substructure	Condition	Abut 1		Pier 1		Abut 2			
		Usual		Usual		Usual			
		Exposed Bar		Exposed Bar		Exposed Bar			
		Cracked		Cracked		Cracked			
		Flaked		Flaked		Flaked			
		Scoured		Scoured		Scoured			
		Unstable		Unstable		Unstable			
	Handling		Notice		Notice		Notice		
Comment		<p>鋼橋全体が錆びている。 リベットの欠落は見られない。 A1,A2橋台ともにパラペット前面、躯体前面に乾燥収縮と思われる大きな水平のクラックが見られる。 P1橋脚には水平力が微小であり、部材寸法が比較的大きいので特に問題は無い。 下部工は錆汁が見られない。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3 (Small Emergency)		Level-4 (Large Emergency)	



(Photo1)



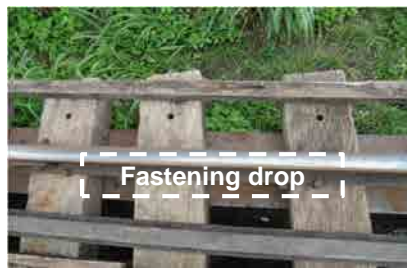
(Photo2)



(Photo3)



(Photo4)



(Photo5)



(Photo6)



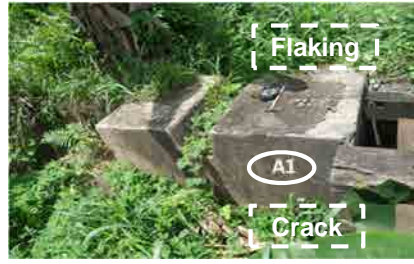
(Photo7)



(Photo8)



(Photo9)



(Photo10)



(Photo11)



(Photo12)



(Photo13)


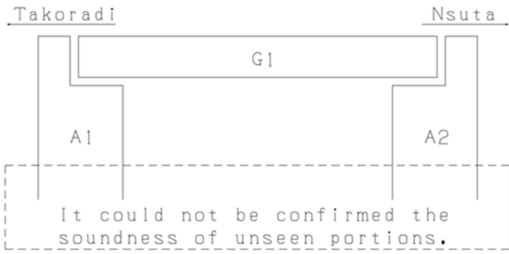


(Photo14)



(Photo15)

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		12/10/2012			
Bridge No.		7		Mileage		37 + 11/12p'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel deck plate girder 29'00" × 1(span) = 29'00"							
Type of Substructure		Plain concrete abutment							
Photograph									
Diagram		 <p>It could not be confirmed the soundness of unseen portions.</p>							
Evaluation of Superstructure	Condition	Girder 1		/	/	/	/		
		Usual							
		Rusty							
		Corroded							
		Cracked							
		Unstable							
Handling	Notice								
Evaluation of Substructure	Condition	Abut 1		/	/	/	Abut 2		
		Usual					Usual		
		Exposed Bar					Exposed Bar		
		Cracked					Cracked		
		Flaked					Flaked		
		Scoured					Scoured		
		Unstable					Unstable		
	Handling	Notice		Notice					
Comment		<p>桁下空間が低い為、洪水時に桁下面が水に浸かっている可能性がある。</p> <p>鋼橋全体が錆びている。</p> <p>リベットの欠落は見られない。</p> <p>A1,A2橋台ともにパラベット前面、躯体前面に乾燥収縮と思われる大きな水平のクラックが見られる。</p> <p>下部工は錆汁が見られない。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3 (Small Emergency)		Level-4 (Large Emergency)	



(Photo1)



(Photo2)



(Photo3)



(Photo4)



(Photo5)



(Photo6)


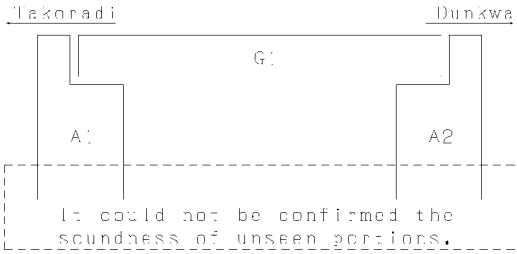


(Photo7)



(Photo8)

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		18/10/2012			
Bridge No.		8		Mileage		53 1/4 + 300'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel deck plate girder 23' 00" × 1(span) = 23' 00"							
Type of Substructure		Plain concrete abutment							
Photograph									
Diagram		 <p>It could not be confirmed the soundness of unseen portions.</p>							
Evaluation of Superstructure	Condition	Girder 1		/	/	/	/		
		Usual							
		Rusty							
		Corroded							
		Cracked							
		Unstable							
Handling	Nothing								
Evaluation of Substructure	Condition	Abut 1		/	/	/	/		
		Usual							
		Exposed Bar							
		Cracked							
		Flaked							
		Scoured							
		Unstable							
	Handling	Nothing						Abut 2	
		Usual							
		Exposed Bar							
		Cracked							
		Flaked							
		Scoured							
		Unstable							
		Nothing							
Comment		<p>鋼橋全体が錆びている。 リベットの欠落は見られない。 A1,A2橋台ともにパラペット前面、躯体前面に乾燥収縮と思われる大きな水平のクラックが見られる。 下部工は錆汁が見られない。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3(Small Emergency)		Level-4(Large Emergency)	



(Photo1)



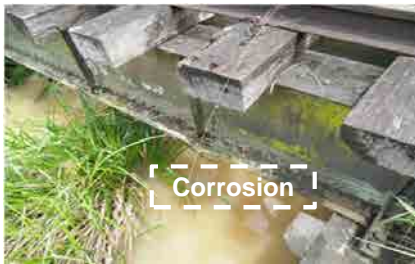
(Photo2)



(Photo3)


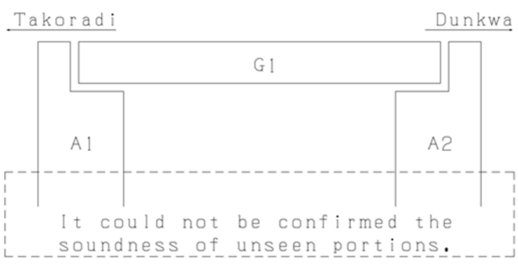


(Photo4)



(Photo5)

INVESTIGATION RECORD SHEET FOR BRIDGE

Line Name		Western Line		Date of Survey		18/10/2012			
Bridge No.		9		Mileage		55 + 450'			
Chief Civil Engineer		William Acken		Inspector		GRCL: Mr.Amissah JICA Study Team: Osamu Ohkawa			
Type of Superstructure (Bridge Length & Number of Spans)		Steel deck plate girder 23' 00" × 1(span) = 23' 00"							
Type of Substructure		Plain concrete abutment							
Photograph									
Diagram		 <p>It could not be confirmed the soundness of unseen portions.</p>							
Evaluation of Superstructure	Condition	Girder 1		/	/	/	/		
		Usual							
		Rusty							
		Corroded							
		Cracked							
		Unstable							
Handling	Nothing								
Evaluation of Substructure	Condition	Abut 1		/	/	Abut 2			
		Usual				Usual			
		Exposed Bar				Exposed Bar			
		Cracked				Cracked			
		Flaked				Flaked			
		Scoured				Scoured			
		Unstable				Unstable			
	Handling	Nothing		Nothing					
Comment		<p>鋼橋全体が錆びている。 リベットの欠落は見られない。 A1,A2橋台ともにパラペット前面、躯体前面に乾燥収縮と思われる大きな水平のクラックが見られる。 下部工は錆汁が見られない。</p>							
Overall Evaluation		Level-1 (Ordinary)		Level-2 (Notice)		Level-3 (Small Emergency)		Level-4 (Large Emergency)	



(Photo1)



(Photo2)



(Photo3)



(Photo4)



(Photo5)



(Photo6)

APPENDIX 3

ワークショップ 出席者リスト・質疑応答

ガーナ国鉄道安全運行整備計画プロジェクト(開発計画調査型技術協力)

ステークホルダー会議メモ

日 時：平成 24 年 9 月 27 日(木)15:30～17:00

場 所：JICA ガーナ事務所

出席者：【JICA 東京本社】今井調査役

【JICA ガーナ事務所】相良次長、櫻井調査役、岡崎調査役

【JICA インド事務所】大川調査役

【調査団】中村、菊入、大澤、川崎、菊地、宮本、大川、谷

※ ガーナ側の出席者は別紙に示す。

<GRCL 側の主張>

- ・従業員数が多すぎるとするのは納得できるが、人材の高齢化、若手不足は非常に重要な問題である。
- ・保有している設備、機材はどれも30年以上経過しており、古いものばかりである。保線用のトロリーが全て故障し修理不可能な為、沿線での保線作業ができない状況に陥っている。つまり、現場はメンテナンスをしたくてもできない状況下にある。また、各スペアパーツ、特に木マクラギの不足が深刻な問題となっている。
- ・マンガン輸送については、港のキャパシティに問題があり、鉄道の輸送力が向上したとしてもそれに比例して収入が増えるというわけではない。

<GRDA 側の主張>

- ・維持管理において、メンテナンスマニュアルが最も重要であると考えている。現状は50歳以上のスタッフが非常に多く、スタッフのモチベーションが低いことから、メンテナンスマニュアルが生かされていない。これらの問題が解決すれば改善される。
- ・GRCLは鉄道運営事業者として意識を改善すべきである。5Sシステムや改善システムを作成し実行すべきであり、予算をかけずにできる沿線の草刈り等から始めるべき。
- ・スペアパーツであるマクラギ、バラスト、スパイクについては在庫があるはず。現状、使用可能なものの数量を先に把握するべき。
- ・GRCLは毎月、政府から支援を受けている。そもそもGRCLはすでに民間企業なので政府側にライセンス料を支払うべき立場であることを忘れてはいけない。
- ・マンガン輸送については、鉄道輸送に対しての信用が得られない状況にあるため、トラックでの輸送を選択せざるを得ない状況に陥っている。トラック輸送に比べて輸送コストが低く貨物を大量に運べる鉄道輸送への信頼を得られれば、必然的に鉄道輸送を選択する。
- ・GRCLの改善にあたっては、50歳以上のスタッフのポジションをどうするか、組織を立て直すためには財政的、技術的に何が必要なのかを探る必要がある。しかし、中国融資によるセコンディータコラディ間、タコラディーアワソ間の軌道改修案件は政府からの承認が下り、着々と進行している。できるだけ早くGRCLの改善問題を解決する必要がある。
- ・調査団に対しては、GRCLが作成する維持管理プラン作成過程におけるアドバイス、レビューを期待している。また、GRCLの全ての技術的な分野における向上に貢献いただきたい。
- ・ドライバー（鉄道）の不足も一つの問題である。できれば本調査において、ドライバーのトレーニングも視野に入れて欲しい。

<MoT:Ministry of Transport 側の主張>

- ・政府からの支援が必要だと言うが、最低限必要な金額と、何が（施設、設備、アイテム等）必要なのかを明確に示して欲しい。詳細が分かれば判断ができる。

<MoFEP: Ministry of Finance and Economic Planning 側の主張>

- ・民間オペレーターをサポートするためにGRDAが発足した。GRDAはGRCLをサポートして頂きたい。
- ・オペレーターに関しては、以前、PPPの検討をしている。（世銀のプロジェクト）
- ・（調査団の質問に対しての返答）鉄道分野にこれ以上予算をかけることができるかどうかについては、現状では非常に厳しい。しかし、中国融資の軌道改修案件後を想定して鉄道分野専門のポジション設置を検討している。

<JICA、調査団側の主張>

- ・メンテナンスマニュアルの内容、GRCLの意識改革も重要な問題であるが、それだけではなくて、最低限の維持管理にはスペアパーツ（マクラギ、スパイク、バラスト）と設備は必要不可欠である。また、これらを保持するためには政府側の理解、支援が必要である。それと同時に、GRCLスタッフの意識改革を行ない、予算をかけなくても出来る沿線の草刈りや、側溝のゴミの掃等を徹底させる。以上の2点を持ってガーナ鉄道は改善する。
- ・現状保有しているスペアパーツを把握し、それらを有効に使うことができれば、現在運行中のタコラディーヌスタ間の維持管理状態を向上することが可能である。
- ・GRCL改善に向けては、GRDAの支援、ガーナ政府側との情報共有による民間オペレーターとGRDA、ガーナ政府側（MoT、MoFEP）との密接なコミュニケーションを図っていくことが重要なポイントである。
- ・GRCLは維持管理計画を作成し、必要予算を提案することとなった。国全体で鉄道交通分野を維持するためにも、政府側が実際に必要な経費については必要経費として確保すべき。

<その他>

- ・今後も民間オペレーター（GRCL）、GRDA、MoT、MoFEPで毎月又は二ヶ月に一度会議を実施する。
- ・GRDA側は民間オペレーター（GRCL）に対して、日本から1人又は2人程度の鉄道専門家の長期派遣について示唆し、事故が発生した場合の原因究明のサポートや事故報告体制の構築等に携わって欲しいと考えていることを述べた。

以 上

ガーナ国鉄道安全運行整備計画プロジェクト(開発計画調査型技術協力)

WS 質疑応答メモ

日 時：平成 24 年 9 月 27 日(木)9:00～15:30

場 所：JICA ガーナ事務所

出席者：【JICA 東京本社】今井調査役

【JICA ガーナ事務所】稲村所長、相良次長、櫻井調査役、岡崎調査役

【JICA インド事務所】大川調査役

【調査団】中村、菊入、大澤、川崎、菊地、宮本、大川、谷

※ ガーナおよびインド側の出席者は別紙に示す。

<質疑応答(組織・運営)>

- ・ Railway Actでは、GRDA（ガーナ政府側）は民間オペレーターにライセンスを与えることになっているが、現状では民間オペレーターが決まっていない。決まるまでの間はGRCLがO&Mを担当することはRailway Actに記載されており、法的には問題ない。
- ・ GRCL内では技術者の高齢化が進んでいることと若手の採用がないことから、今まで蓄積されてきたガーナ国における鉄道運営の技術の継承において大きな不安を抱えている。しかし、GRDA（政府側）としては、現在の運行本数に対して、従業員の数が多すぎるのでこれ以上若手といえども雇用できないのではないかと指摘。職員削減、業務量、若手採用のバランスをとることが重要。
- ・ メンテナンス費用について、

<質疑応答(運転・運行計画、安全設備)>

- ・ GRCL（オペレーター）より、空転をどのように防止すれば良いのかと質問があり、以下のようなやり取りがあった。
 - 調査団（菊地）：車輪のメンテナンスが重要である。
 - GRCL：機材とスペアパーツがないのでできない。石をレールの上に置いて空転を防いでいる。
 - 調査団（菊地）：石はリスクが高く、レールや車輪にダメージを与えてしまう。日本では「砂箱」を設置し、砂を使って空転を防いでいる。線路脇に置くか、列車に積載しておく。
 - 調査団（大澤）：空転の原因は大別して二つ。一つは車輪とレールのプロフィールこれをしっかり管理すること。もう一つは現在の悪状況を考慮すると積み荷が重すぎる。各ワゴンの荷重に問題がある可能性もある。荷重計を使う等して、貨物の輸送量に制限を与えるべきであると考える。
 - ・ インド技術者も同種の意見を述べる。

<質疑応答(土木:軌道、路盤・橋梁)>

- ・ GRDAより中国融資案件で軌道改修を実施後、マクラギは木マクラギからコンクリートマクラギになり、土木構造物は狭軌から標準軌対応、軸重も16トンから21トン対応になることから、それを踏まえ

た維持管理基準、検査体制のレビューをして欲しいという要望があり、調査団は以下の通り回答した。

調査団（宮本）：我々の調査の scope を踏まえて、今回の発表資料では安全運行のために今すぐ必要な事項を提案した。まずは、安全運行のための minimum な提案をしたいと考えている。

- ・ GRCL より何故レールが削れてしまうのか（※写真参照）質問があり、調査団は以下の通り回答した。

調査団（宮本）：レールと車輪の磨耗により形状が正常でないため空転が起きている。車輪旋盤等の保守機械が使えないため、形状の修正ができない場合は、砂をレール上に散布し応急的に対応することを提案する。

<質疑応答(車両)>

- ・ GRCL（オペレーター）側からは、メンテナンスが必要なことは重々理解しているが、そのためには予算措置が必要だと主張したことに対して、GRDA（政府側）は「5S」によるGRCLの改善やお金のかからない維持管理をまず実施すべきであるという返答があった。
- ・ 調査団としては、GRCLの意見に同意。プレゼンで示したように、メンテナンスは長期ではペイすることを理解してほしい。

以 上

ガーナ国 鉄道安全運行整備計画プロジェクト

ワークショップ 出席者リスト

実施日時:2012年9月27日(木)9:00~15:30 会場:JICAガーナ事務所会議室(アクラ)

No.	氏名	組織	役職
1	Emmanuel Opoku	GRDA	Ag. Chief Executive
2	G.J Bracke	GRDA	Board Member
3	A.A Sadigue	GRDA	Project Director
4	J.E Odotei	GRDA	Board Member
5	Sam K. Barnes	GRDA	Board Member
6	M.K Dzimah	GRCL	Chief Mech/Elect Engineer
7	Emmanuel Toff Gozo	GRCL	Ag.Traffic Engineer
8	William Acken	GRCL	Ag. Chief Civil Engineer
9	Derrick Anedeme	MoFEP	Assistant Economics Officer/Bilateral
10	Benjamin W-Kissi	MoFEP	Officer / Budget Division
11	Francis Mensah	MoFEP	Desk officer
12	Siisi E Ocrem	MoT	Director M&E
13	Akwasi Prempeh	MoT	Planning and Officer
14	Edward Agbodjan	MoT	Asst. Planning Officer
15	Doreen Anner	MoT	Asst. Director/Administration
16	J.K Fang	Ghana Bauxite Company	General Manager
17	J.K Nsiah	Ghana Bauxite Company	Board Secretary
18	Michele Nemesi	Team Engineering	Ghana Representative
19	Brozio Tonini	Team Engineering	Transport Engineer
20	Y Amoyaw Osei	Team Engineering	Director
21	Konina Out Okhne	Team Engineering	consultant
22	Puneet Kumar	RITES (India)	Group General Manager, Expotech Division
23	A. Jha	RITES (India)	General Manager (T&S)

APPENDIX 4

ワークショップ プレゼンテーション資料



Workshop in Ghana

Study for Safety Operation and Management of Railway in the Republic of Ghana

27 September 2012

JICA Study Team

0

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

1. Workshop agenda

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Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

Table of Contents

1. Workshop agenda
2. About Workshop
3. Outline of the JICA study

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Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

1. Today's Workshop

◆ Agenda:

- About Workshop
- Outline of the JICA study

Session 1: Organization and Management

Session 2: Train operation

Session 3: Track

Session 4: Civil structures/Bridges

Session 5: Rolling Stock

- Introduction of Indian railway system on safety operation

Note: The time will be set aside for question and answers after every session.

3

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

2. About Workshop

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2. Workshop / Main topics

■ Main Topics:

- **Current situation and issues** of the Western Line (Takoradi – Tarkwa – Dunkwa - Awaso)
- Introduction of **Japanese and Indian railway systems** for safety operation
- Suggestions on **setting goals**, which the Ghana Railway can actually reach, for **safety improvement and reinforcing systems**

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1. Workshop / Objectives

■ Objective:

- Sharing the reorganization of **the current situation and the improvement goals** with stakeholders
- Suggestions on **setting goals for safety improvement and reinforcing systems**

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3. Workshop / Schedule

Date	27th September	
AM	8	
	● 9:00–9:05 Opening speech : JICA Ghana Office	
	● 9:05–9:10 Opening speech : GRDA	
	9	● 9:10–9:20 Outline of this Study
		● 9:20–9:50 Railway operation and organization
	10	● 9:50–10:20 Train operation
		● 10:20–10:50 Short break
	11	● 10:50–11:20 Track
		● 11:20–11:50 Civil structures/Bridges
	12	● 11:50–12:20 Rolling stock
		● 12:20–13:20 Lunch break

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3. Workshop / Schedule



PM	13	●13:20-13:30 Speech : JICA India office ●13:30-15:00 Introduction of Indian railway system on safety operation
	14	●15:00-15:30 Q&A
	15	●15:30-15:40 Closing speech : JICA head office Tokyo ●15:40- Meeting with Ghana government
	16	
	Site	JICA Ghana Office (Accra)

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3. Outline of the JICA study

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1. Tasks of the study



Objective of the Study

- Create **appropriate maintenance** for railway system
- Reduce of accidents, **delay** and **suspension** of train operation

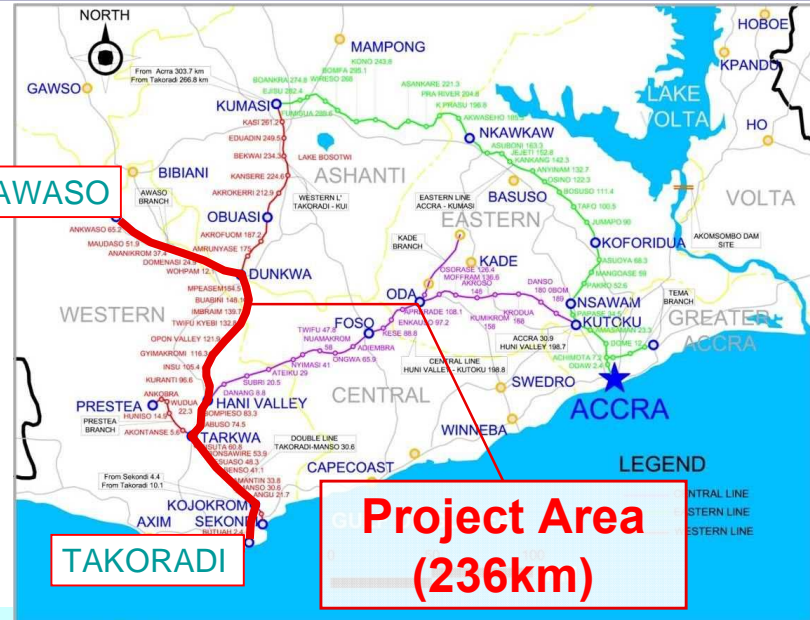
Activities

- To grasp and analyze the present situation of the railway in Ghana
- To set up **the improvement goals** for maintenance of track and rolling stock
- To **update the O&M plan**
- To support **the implementation of O&M plan**

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2. Project Area



11

To Grasp and Analyze the present situation of the railway in Ghana

Grasp, analyze and evaluate condition and deficiency of track bed, track and rolling stock based on analysis of existing data and site reconnaissance for the entire West Line



Waving Track



Derelict Locomotive in depot

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Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

To update the operation and maintenance plan

To Update the O&M plan suitable for present status

- Regulations, method and structure of O&M Plan
- Record and recurrence prevention measures
- Capital expenditure plan

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Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

To set up the improvement goals for maintenance of track and rolling stock

Setting improvement goals

- No accidents due to causes that are the responsibility of the railway
- Reduction of transport disorder (suspension, delay etc)
- Improvement of safety consciousness etc

Holding Workshop

- Sharing the recognition of the present situation and challenges with GRDA/GRCL
- Setting goals for safety improvement and an enforcement system
- Introduction of railway operation in Japan and India

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Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

To update the operation and maintenance plan

Conformity of the current system and project

- ENGINEERING MANUAL
- Railway Act, 2008
- GRDA scheme of service
- Regional development projects of Ghana
- Improvement project of the railway facilities
- Modernization and expansion project for the railway network

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Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013



3. Scope of Work (5)



To update the operation and maintenance plan

Cooperation with other donors' development project

- World Bank
 - Organization enhancement of GRDA
- European Development Fund (EDF)
 - Rehabilitation of the West Line and North Extension F/S
- Chinese Fund
 - Railway Network Extension and Locomotive Procurement
- Others



3. Scope of Work (6)



To support the implementation of operation and maintenance plan

Thorough implementation of the education and training for safe operation and maintenance management

Classification	Training Item
Soft	The measures for human error prevention
	Planning and technique of O&M plan
	Usage of preservation equipment, Planning of maintenance plan
Hard	Planning and Techniques of track maintenance
	Planning and Techniques of track bed maintenance
	Planning and Techniques of bridge maintenance
	Planning and Techniques of rolling stock maintenance



3. Scope of Work (7)



To support the implementation of operation and maintenance plan

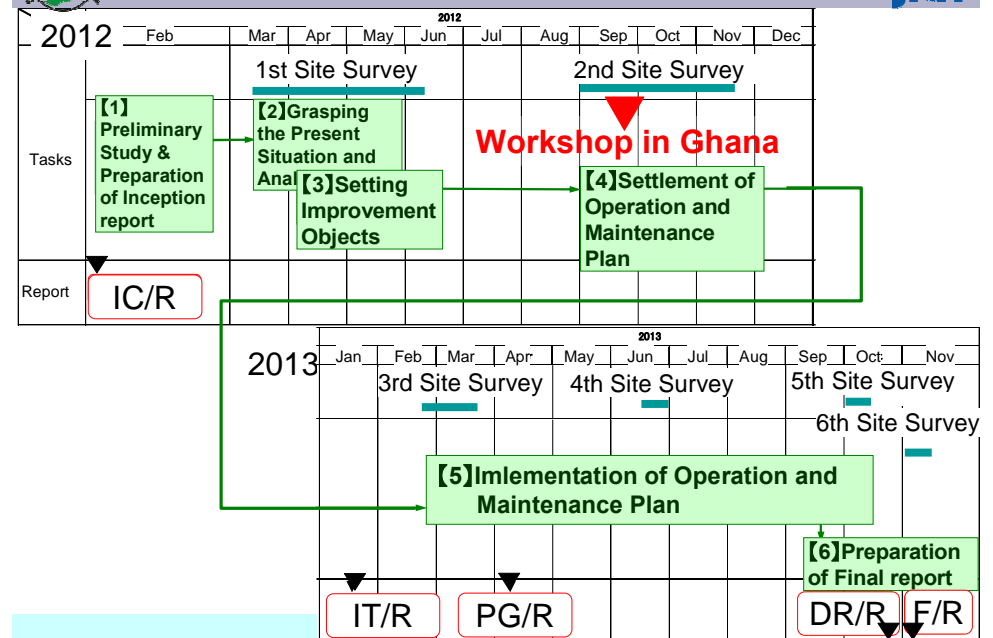
Monitoring and evaluation of the training results based on PDCA Cycle



- Plan:** Planning how to improve what
- Do:** Doing in accordance with the plan
- Check:** Checking and analyzing the contents done
- Act:** Acting to feedback improvement to the next plan



4. Study Schedule (Feb 2012 to Nov 2013)





5. Study Team Member



PROJECT MANAGEMENT GROUP

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Thank you

Japan International Cooperation Agency (JICA)

Oriental Consultants Co., Ltd.
Japan International Consultants for Transportation Co., Ltd.



Japan International Consultants for Transportation Co., Ltd

Study for Safety Operation and Management of Railway in the Republic of Ghana



Workshop Session 1 Organization and Management

27 September 2012
JICA Study Team
Deputy Team Leader/Railway Plan 2 : Takashi KIKUIRI

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1. Organization
2. Budget of the Maintenance
3. Procurement Procedure
4. Human Resource
5. Poorly-motivated Worker
6. Document Management by Conventional Means
7. Improvement Goals

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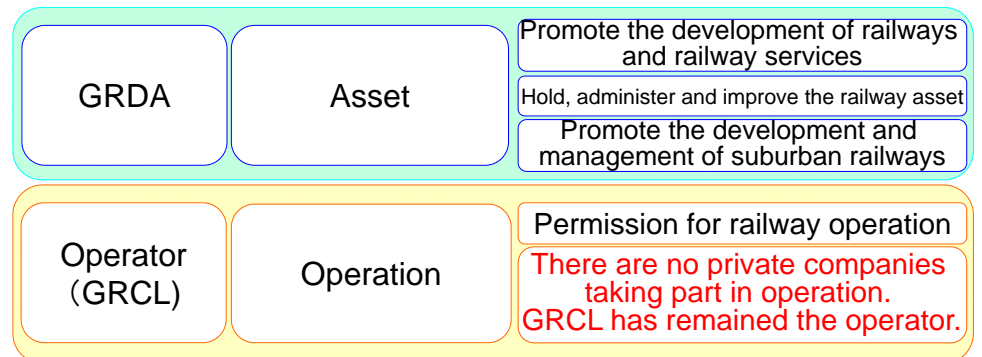


Establishment of Ghana Railway Development Authority (GRDA)



- 14 Nov., 2008 Railway Act, 2008 (Act 779) passed by Parliament

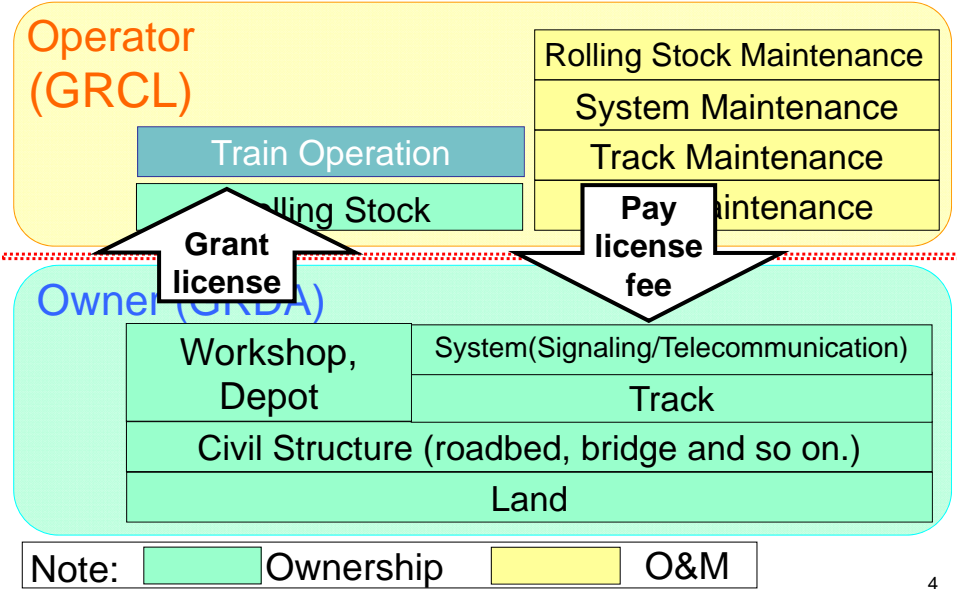
Objective of Railway Act, 2008
"Implementation of Vertical Separation"



2

3

1. Organization



4

■ Issue:

As of 2012, Owner (GRDA) has not granted the license of railway operation and service to Operator (GRCL) yet.

➤ Operator (GRCL) carry out railway operation and service without the license

5

■ Measures:

To contract with Operator (GRCL) railway operation and railway service and grant license as soon as possible

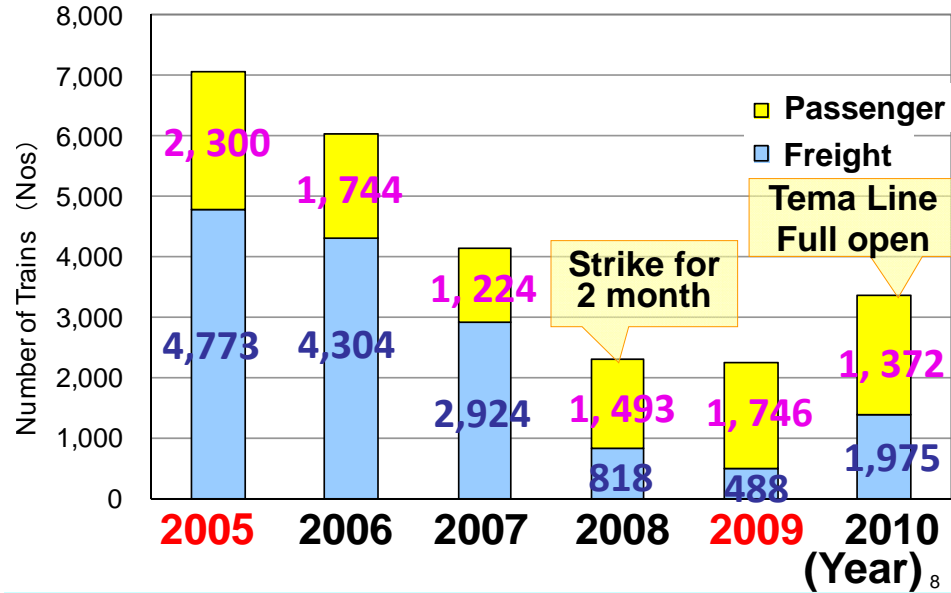
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2. Budget of the Maintenance

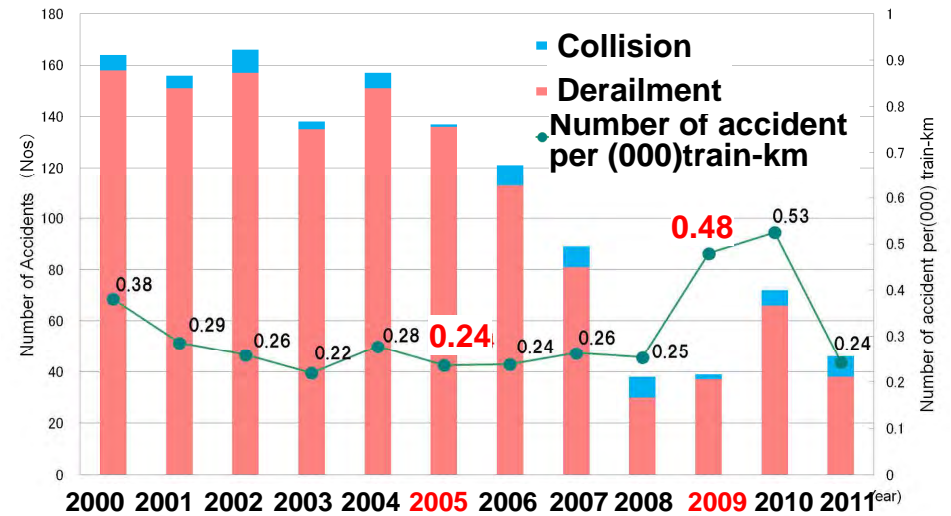
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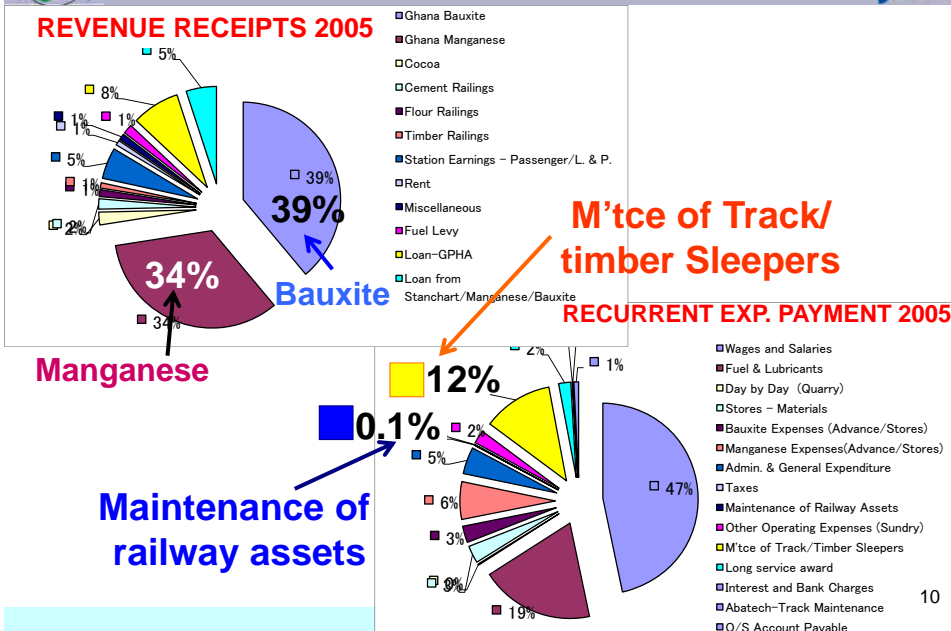
Number of Train Operation



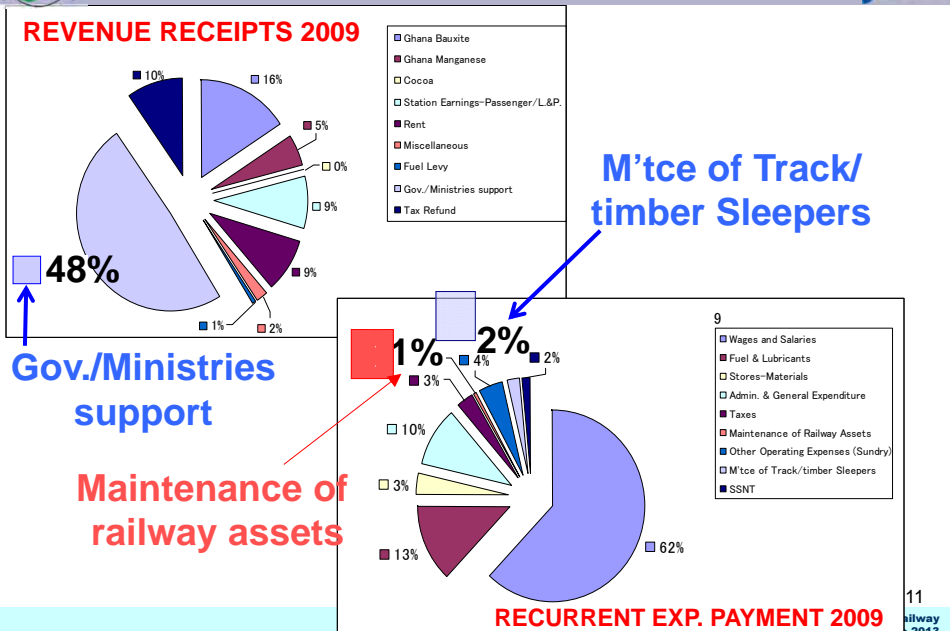
Number of Accidents



Maintenance Cost 2005



Maintenance Cost 2009



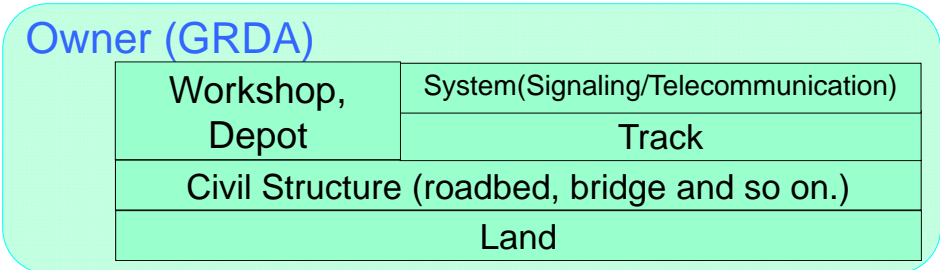
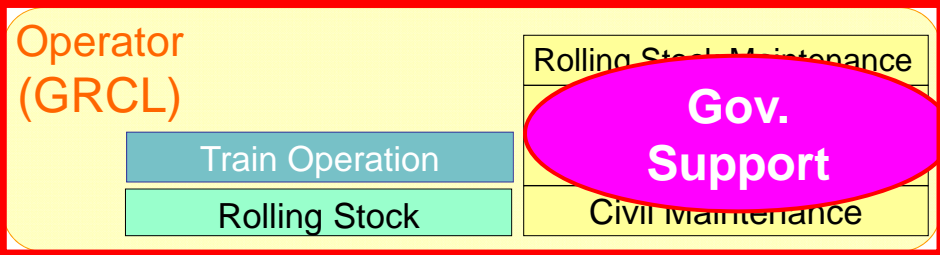
Issue :

The budget for the maintenance of track/structure/rolling stock is inadequate. This obviously affects spare parts acquisition.

➤ Accidents happen frequently because of lack of maintenance of aged assets.

Measures:

➤ To invest sufficient **budget in maintenance of railway assets.** Possibly, the **GRDA (Government) should provide subsidy .**



Note: Ownership O&M

3. Procurement Procedure

Issue:

Procurement procedure is complicated.
Operator (GRCL) lacks adequate budget to procure needed spare parts.

- Normal maintenance is delayed.
- Emergency maintenance cannot be done promptly.
- Plant and machinery break often and cannot be repaired.
- Operator (GRCL) is obliged to do cannibalization of assets.

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Operator (GRCL)

Civil Engineering Department

Mechanical/Electrical Department

Signal/Telecom Department

Other Department

Procurement Plan

Controller of Supplies (COS)

Check the prices of each items

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MD (Operator (GRCL))

Ministry of Transport (MoT)

Ministry of Finance and Economic Planning (MoFEP)

NOT approve

Operator (GRCL) could not procure the items

Approve

Procurement process can start

18

Operator (GRCL)

>5,000 Gh¢	> 5,000 ~ 25,000 Gh¢	> 25,000 ~ 800,000 Gh¢	< 800,000 Gh¢
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Head of Entity (MD)

Entity Tender Committee

Ministerial Tender Board

Central Review Board

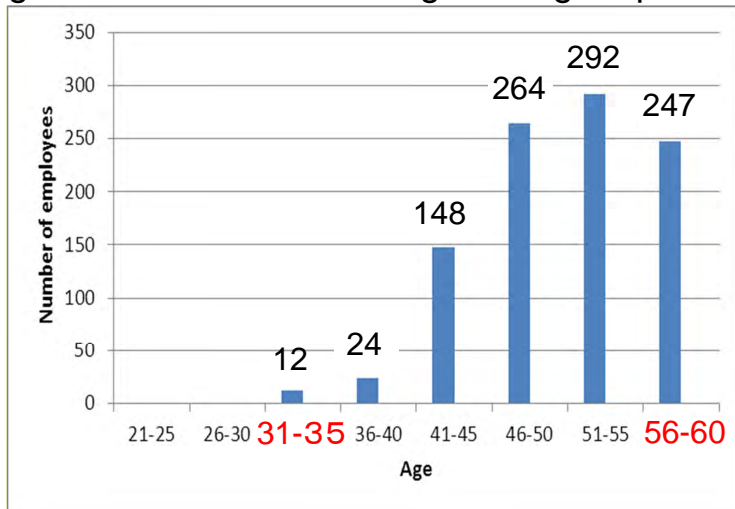
19

■ Measures:

- To **increase amount** which Operator (GRCL) can decide to procure.
- To **simplify** the procurement procedure to make GRCL operation efficient.
 - GRCL should improve earning capacity to procure items **in good time**.
 - GRCL should enter into **partnership** with other private organization.

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Age distribution of Civil Engineering department



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4. Human Resource

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■ Issue:

There is no younger generation because recruitment is not carried out for a long time and aging of organization is going.

- **Loss of know-how about operation and maintenance**
- **Scatter and Loss of data**

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■Measures:

- Recruit younger professional to take over know-how from retiring elder professional
- Training/Education to young generation
- Dispatch to abroad for training

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Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013

■Issue :

Daily maintenance work such as cutting grass in the track, drainage cleaning is insufficient.

Workers do not fully recognize the importance of daily maintenance work.

- **Poor motivation of workers is one of the cause of assets aging.**

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Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013

5. Poorly-motivated Worker

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Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013

■Measures:

- Awareness training for workers
- Commendation and Incentive
- Preparation of daily maintenance work manual

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Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013

6. Document Management by Conventional Means

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Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013



■ Measures:

- Preparation of Report Writing Manual
- Development of operation and inspection recording system with use of computer

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Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013



■ Issue:

Documents management is implemented without much use of computer basically by **conventional means**.

These documents is not unified format.

- The required information may not be lack.
- It is hard to review the past performance statistically.
- It may be hard to accumulate and share know-how about train operation and maintenance.

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Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013

7. Improvement Goals

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Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013

Short Term 2012~2013

- To contract railway operation and service with Operator (GRCL)
- To grant of license to Operator (GRCL)

32

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

Medium Term 2012~2015

- To secure sufficient budget for maintenance

33

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

Medium Term 2012~2015

- Development of the scheme that Operator can procure the spare parts and maintenance facilities whenever they need.

34

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

Short Term 2012~

- Recruit younger professional
- Training/Education to young generation



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Training school in Secondi

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013



Short Term 2012~2013

➤ **Development of operation and inspection recording system with use of computer**

Thank you

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Oriental Consultants Co., Ltd.



Japan International Consultants for Transportation Co., Ltd.

Study for Safety Operation and Management of Railway in the Republic of Ghana



Work shop Session 2; Train Operation

September 2012
JICA Study Team
Operation Plan/Safety system expert : Setsuo KIKUCHI

0

Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013

1. Present Situation of The Railway in Ghana

2

Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013

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1. Present Situation of the Ghana Railway
2. Issues and Measures
3. Japanese System for Securing Safety in Railway

1

Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013



Present Situation of the Ghana Railway: Train Operation



■ Site Survey at Derailment Points

- ① MAUDASO~ANKWASO (33M from DUNKWA) 22.MAY2012
- ② ANGU~KOJOKROM(13M ¾ from TAKORADI) 31.MAY.2012

Analysis of the site situation:

TRACK: Joints of rails is different between right and left side and bad condition of connection.

Rolling stock's wheels down at joints of rails and also lack of sleeper direct under the joint case the rolling stock's sink.

ROADBED: Lack of ballast sleepers end and the caved-in are observed.

Study for Safety Operation and Management of Railway
in the Republic of Ghana 2012 to 2013



Site Survey at Derailment Points



ROADBED CAVED IN



DEFECTIVE JOINTS



DEFECTIVE JOINTS



DEFECTIVE JOINTS



DEFECTIVE JOINTS



WAGON'S SINK



Rolling Stock's movement at derailment points



Irregular rolling happens wagon's right and left side case derailment easily. Especially curves with severe cant is most dangerous.



Rules and Regulations

GRCL's Rules and Regulations about Train Operation

- Rule Book
- Traffic Manual
- Staff Manual
- Appendix to Working Time Table
- Official Tariff
- Regulation for Train Signalling, Station Account Manual



For more than 40 years have passed after enactment , it is not suitable present situation. Management regulations is sloppy.



Present Rule book (1968)



Pages missing



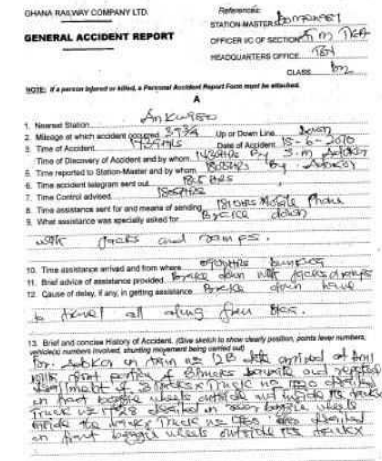
Rule book at NUSTA (1949)



Accidents Records

GRCL's accident records obey Accident Manual

- Accident Diary
- Accident Records
- General Accident Report



All data haven't been digitized

2. Issues and Measures

8

■ Issues of Operation Plan/Safety System

- ◆ Defective Track and Civil structures
- ◆ Defective Rolling Stocks
- ◆ Defective weight measure and weight balance
- ◆ Improper Traction capacity



**Rush of Wheel Slip
Irregular Rolling**

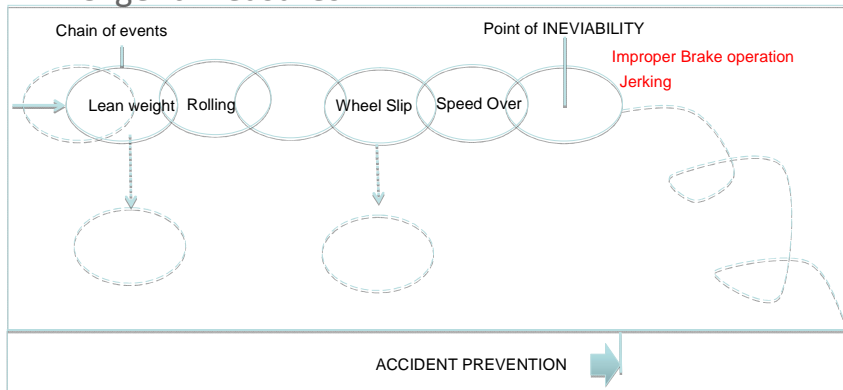


WHEEL SLIP



Irregular rolling

■ Urgent Measures



(source: ICAO Accident Prevention Manual 1984)

Prevention of Wheel Slip

Prevention of Improper Movement



**REEXAMINE HAULING CAPACITY
SAND BOX
WEIGHT MEASURE**

3. Japanese System for Securing Safety in Railway

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Japanese System for Securing Safety in Railway

Government (Ministry of Land, Infrastructure and Transport: MLIT)

- Standardization of facilities, rolling stocks, and operational handling
- Testing and licensing for power car operators (drivers)
- New and improvement facility inspection
- Regular-basis safety inspection
- On-the-spot investigation and cause finding in case of accident

Railway operator

- Establishment and strict usage of operation manuals
- Education and training of railway personnel in charge
- Maintenance management of facilities and rolling stocks and update of equipment
- Accident report to government and introduction of recurrence preventive measures

Users and general public

- Observation of transportation rules based on the provisions
- Prohibition obstructions including entry or level stone-throwing onto roadway, damage to signals or level crossing facilities by penal regulations
- Prohibition behaviors disturbing order in cars by penal regulations

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

Rules and Regulations

Railway Bureau

- ◉ Railway Business Act
- ◉ Railway Operation Act
- ◉ Ministerial Ordinance to Provide the Technical Standard on Railway
- ◉ Technical Regulatory Standards on Japanese Railways
- ◉ Explanation of Fire Prevention Standards for Underground Stations
- ◉ Environmental Quality Standards for Shinkansen Superspeed Railway Noise
- ◉ Nationwide Shinkansen Railway Development Act
- ◉ Order for Enforcement of the Nationwide Shinkansen Railway Development Act
- ◉ Ordinance for Enforcement of the Nationwide Shinkansen Railway Development Act
- ◉ Act on Special Provisions Concerning the Punishment for Conduct Impeding the Safety of the Train Operation on the Shinkansen Railway
- ◉ Ordinance for Enforcement of the Act on Special Provisions Concerning the Punishment for Conduct Impeding the Safety of the Train Operation on the Shinkansen Railway
- ◉ The Law Concerning Passenger Railway Companies and the Japan Freight Railway Company
- ◉ The Amendment to the Law concerning Passenger Railway Companies and Japan Freight Railway Company
- ◉ Policy Concerning Matters which the New Companies Must Consider in Conducting Their Business Operations
- ◉ The Japanese National Railways Restructuring Law

- ◆ Railway Business Act
- ◆ Railways Operation Act
- ◆ Ministerial Ordinance to Provide the Technical Standard on Railway

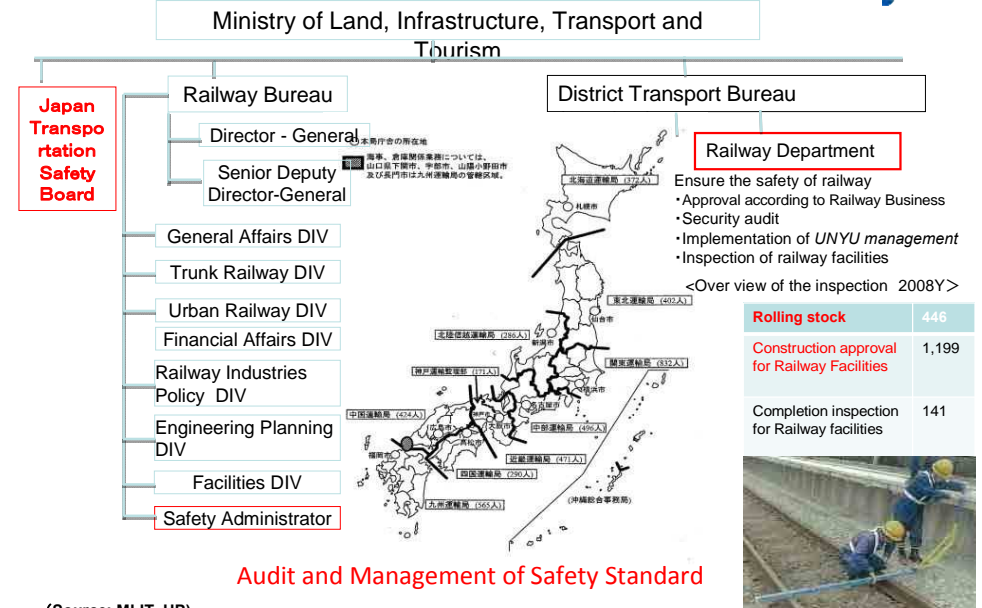
These are the bases of all rules and regulations of the company.

These are unofficial translations. Only the original Japanese texts of the laws and regulations have legal effect, and the translations are to be used solely as reference material to aid in the understanding of Japanese laws and regulations.

[The Japanese date is here \(e-gov system\)](#)

(Source: MLIT HP)

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013



Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

Structure :LAW, Ministerial Ordinance, Regulations of the private company (JR EAST)

Laws 法律	Ministerial Ordinance 省令	Regulations of the Private Company 実務規程等	
		実施基準	規程(細則・手続等)
Railway Business Act 鉄道事業法 (鉄道事業等の運営の適正化、利用者の保護等)	鉄道事業法施行規則 → 施設等検査規則 → 鉄道事故等報告規則 → 鉄道事業等監査規則 Railway Accident Reporting Rules		鉄道施設設計業務実施要領 → 運転事故報告手続 Railway Accident Reporting Procedures
(Optimization of business management, Protection of the user)			
Railway Operation Act 鉄道営業法 (鉄道の建設、車両、運転、保員、運営等)	鉄道に関する技術上の基準を定める省令 Ministerial Ordinance to Provide the Technical Standard on Railway 動力車操縦者運転免許に関する省令 → 運転の安全の確保に関する省令	運転取扱実施基準 Handling Train Operation Performance Standards 新幹線運転取扱実施基準(電車等)整備実施基準 車両構造実施基準 軌道施設実施基準 土木施設実施基準 電気設備実施基準 運転保安設備実施基準 運転安全規範	運転作業要領 → 列車運転速度表 Train Operation Task Procedure
(Construction, Rolling Stock Train Operation, The person in charge), Fare			

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013



Private Railway company's Standard



新幹線土木施設安全基準

○新幹線土木施設安全基準 平成14.3.22 鉄道03

改正 平成14.10 鉄道08 平成16.6 国12 平成17.3 国51 平成19.6 国12
平成19.9 国44 平成21.2 国11 平成21.3 国30

国鉄基準管理規程(平成14年3月改正版(4号) 第3条の規定に基づき、新幹線土木施設安全基準を次のように定める。

新幹線土木施設安全基準

第1章 総則

第1条 適用範囲

第2条 用語の定義

第3条 災害等の特徴

第4条 危険の防止

第5条 緊急停止

第6条 緊急停止の防止

第7条 緊急停止の防止

第8条 緊急停止の防止

第9条 緊急停止の防止

第10条 緊急停止の防止

第11条 緊急停止の防止

第12条 緊急停止の防止

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第95条 緊急停止の防止

第96条 緊急停止の防止

第97条 緊急停止の防止

第98条 緊急停止の防止

第99条 緊急停止の防止

第100条 緊急停止の防止

附 則

第1条 施行期日

第2条 特例の経過等の認可

第3条 経過措置

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013



Definitions and Types of Railway Operation Accidents

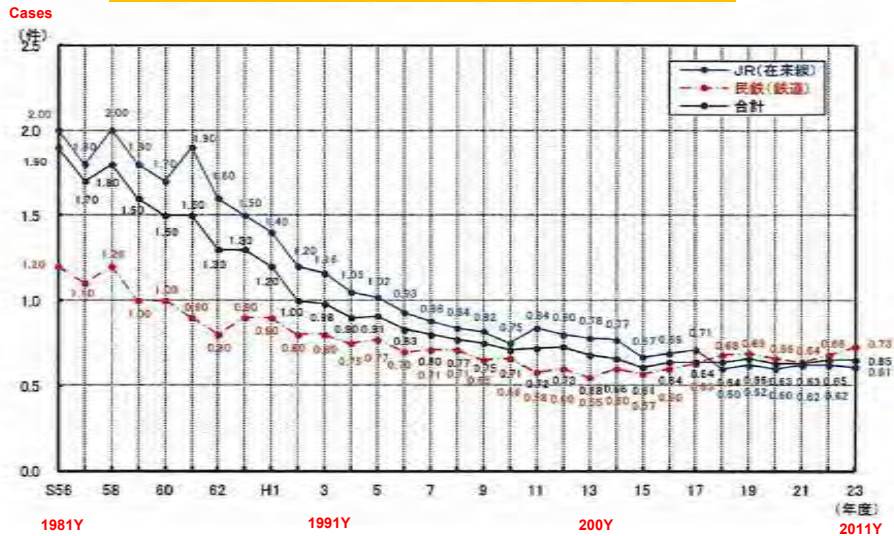
Obligated to immediately report any of accidents listed below to the government

Railway Operation Accident	Transportation Obstruction	Critical Incident
①Train accident ・Train collision ・Train derailment ・Train fire ②Level crossing obstruction accident ③Human obstruction accident ④Property damage accident	① Delay of passenger train by 30 min. or more ②Delay of freight train by 1 hr. or more ③Cancelled operation of train	Situation where railway operation accident is likely to occur, including ・Train moving forward when block handling is incomplete; ・Another train's route obstruction by driving through signals; ・Train overrun

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Railway Accidents in Japan (N/million Km)

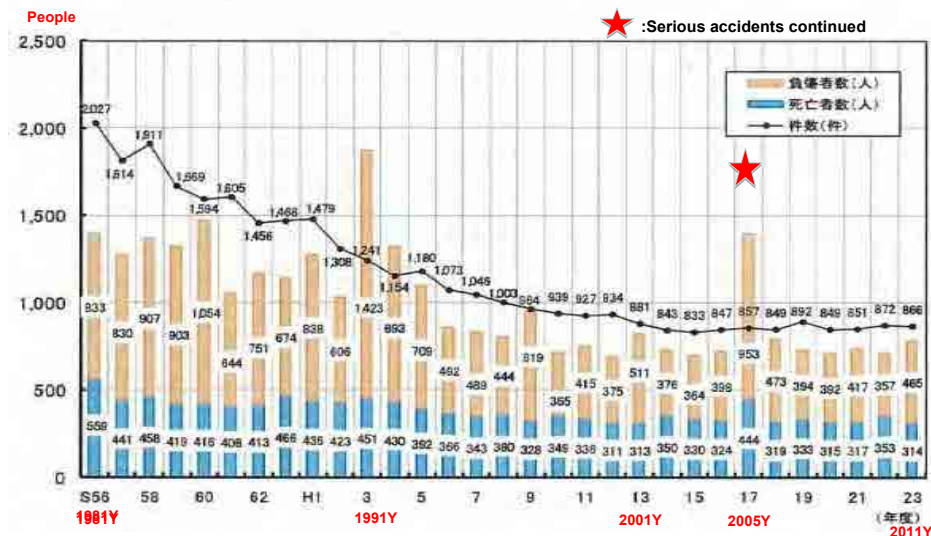


(Source: MLIT HP)

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Railway Accidents and Casualties in Japan



(Source: MLIT HP)

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013



Amend The Railway Business ACT

- Introduction of transportation safety management
- Implementation of transportation safety management evaluation

Ensure the safety of railway transportation

Establishment of safety management of Railway Operators

- Creating and notification of **SAFETY MANAEMENT CODE**
- Appointment and Notification of **THE SAFETY MANAGER** and **THE OPERATION MANEGER**

Monitoring by the User

- Publication of information relating to safety by Government
- Publication of The Safety report by Railway Operators

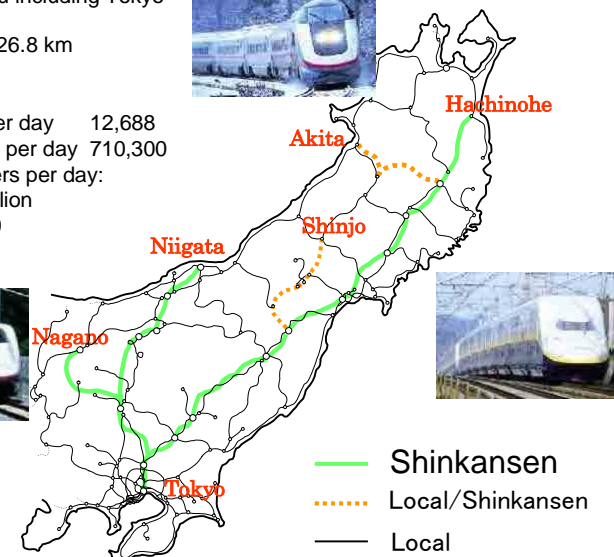
Government guidance and Supervision

- Change Order of the safety management code
- Dismissal Order of the safety manager and the Operation manager
- Strengthened Penalties

Activities of the private Railway company

JR East Overview

- Service Area: Eastern Honshu including Tokyo
- Number of railway lines: 70
- Passenger Line Network: 7,526.8 km
- Number of stations: 1,705
- Train operations:
 - average number of trains per day 12,688
 - average number of train km per day 710,300
- Average number of passengers per day: (2008) 16.86 million
- Units of Rolling Stock: 13,179
- Electrified lines: 5,512.7 km
- CTC installation: 6,992.1 km



Activities of the private Railway company

Settle on MEDIUM-TERM SAFETY PLAN

Overall view of the 2013 Safety Vision



2013 Safety Vision Brochure



Pursuing "Ultimate Safety Levels"



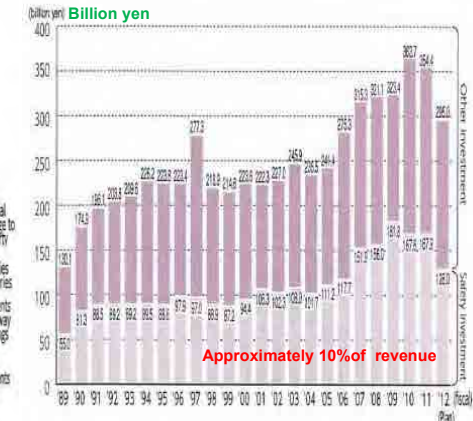
Activities of the private Railway company

Positively Investment in Equipment

Trends in railway accidents



Trends in safety investment



- Physical damage to property: accidents causing more than 5 million yen damage to property by train operation
- ▨ Fatalities or injuries: people killed or injured by train operation
- ▧ Accidents at railway crossings: people or automobiles being hit by trains
- Train accidents: train collisions, derailments, and train fires

Pursuing "Ultimate Safety Levels"

■ **Activities of the private Railway company**
Training : Never Fade Unfortunately Past Accidents



Driving cab simulator



Accident History Exhibition Hall



Pursuing "Ultimate Safety Levels"

(Source: JR East Group Sustainability Report 2011)

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

■ The main point at issues of Operation Plan/Safety System

- ◆ Prevention of Wheel Slip
- ◆ Prevention of Improper Movement of Wagons
- ◆ Improvement of Accidents Records

Activity of securing safety in Japan

History of securing safety in railway is a trace of persistent efforts with reconsideration of accidents as a lesson



Accident prevention by establishing operation manuals and observing rules

+

Prevention of accidents caused by human error through introduction of mechanization and backup facilities

//

Safety measures with integrated hardware and software

Study for Safety Operation and Management of Railway in the Republic of Ghana 2012 to 2013

Thank you



Japan International Cooperation Agency (JICA)

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Study for Safety Operation and Management of Railway in the Republic of Ghana



Workshop Session 3 Track

27 September 2012
JICA Study Team
Track Expert : Kiyoshi MIYAMOTO

0



Sleepers and Fastenings



1. Sleepers and Fastenings

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1. Sleepers and Fastenings
2. Track Irregularity
3. Other Issues and Measures
4. Proposed Track Equipment for Keeping Acceptable Maintenance Level between Takoradi and Nsuta.

1



Criteria for defective sleeper and fastening(1)



Sleepers(Wooden):

1. Sleepers which are not functional because of the rotten condition.
2. Sleepers of which parts are broken and are not functional because of the past derailment of vehicles.
3. Sleepers which the inside is assumed to be hollow by listening to the sound made when hit with hand hammer.
4. Plug holes - enlarged and not tight

3

Fastenings:

1. Fastenings that are missing from the appointed place.
2. Fastenings that rise up from the base of the rail and are not functional as connectors between rail and sleeper.
3. Fastenings that are able to be easily pulled out by hand
4. Fastenings that come loose when hit with a hand hammer.

4



- Broken sleeper by the past derailment of vehicles.
- Rotten sleepers.

5



- Fastenings that rise up from the base of the rail



- Fastenings that can be pulled up easily by hand

6



- Fastenings that is missing at the appointed place.

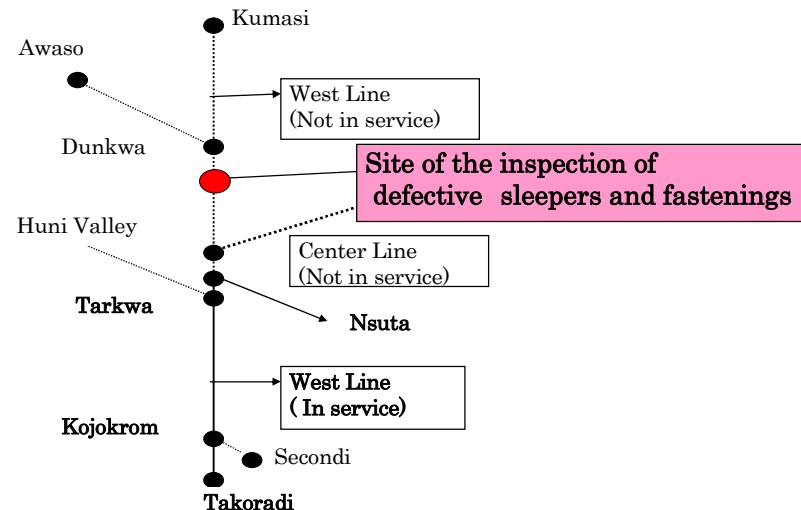
7

Result Example of the Inspection of Defective Sleepers and Fastenings (Imbraim~Buabin Section)

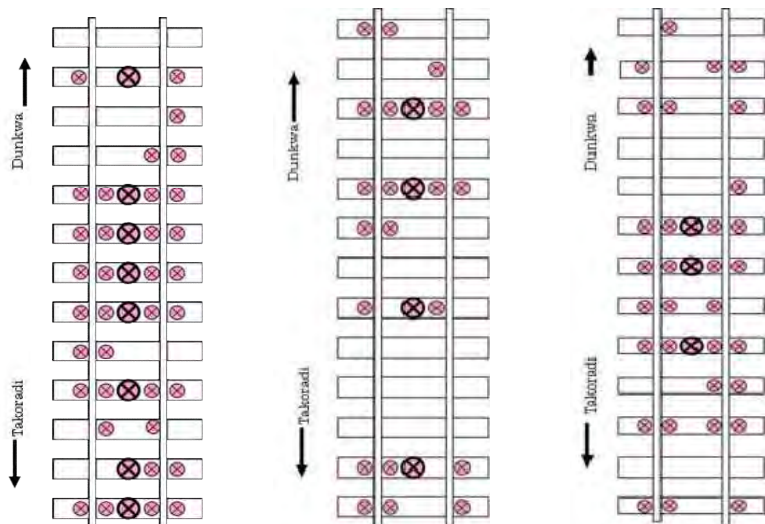
Defective Sleeper :

Defective Fastening :

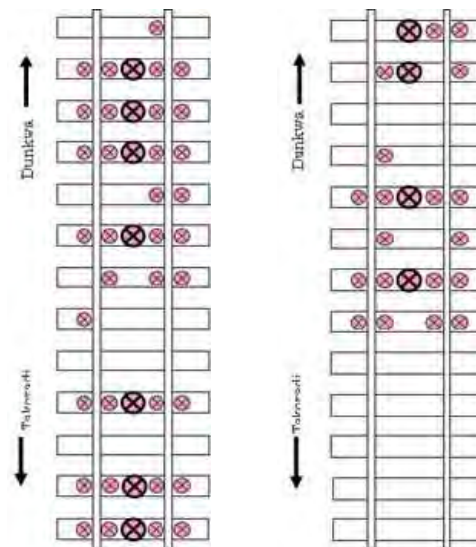
Sound Sleeper and Fastening : Nothing



Drawing of defective sleepers and fastenings (1)



Drawing of defective sleepers and fastenings (2)



Ratio of defective sleepers=43%
(26/60)

Ratio of defective fastenings=59%
(141/(60 × 4))

Japanese standard
Defective sleeper : ≤7%
Defective fastening: ≤5%

Current condition

- Visual inspection by GRCL staff – Not enough

Recommendation



- Establishment of standard for defective sleeper and fastening
- Periodical inspection (Once a year- Japanese Standard)
- Make drawings for controlling defective materials.
- This action should be carried out as soon as possible Between Takoradi and Nsuta .

Level of Urgency



(Urgent)

Track Irregularity

2 . Track Irregularity

Current condition

- Regular maintenance postponed due to lack of materials

Recommendation



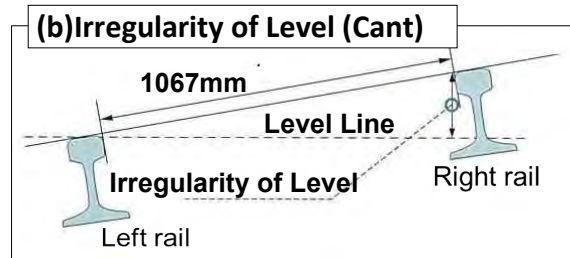
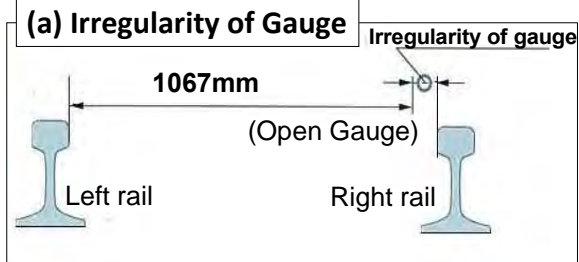
- There must be adequate materials to make regular maintenance possible .
- Immediate action must be taken to repair the Takoradi-Nsuta section which is currently operational.

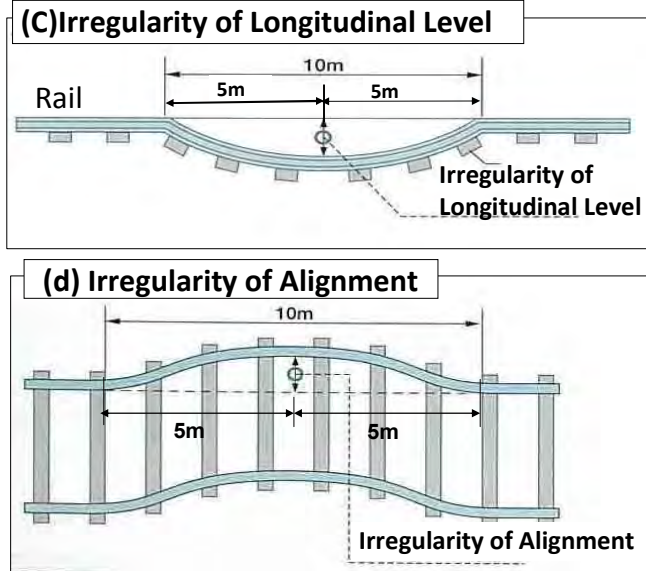
Level of Urgency



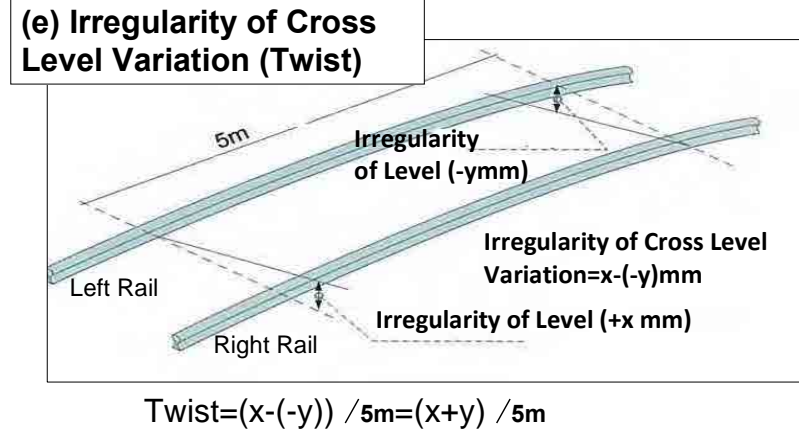
(Urgent)

Irregularity of Track (1)





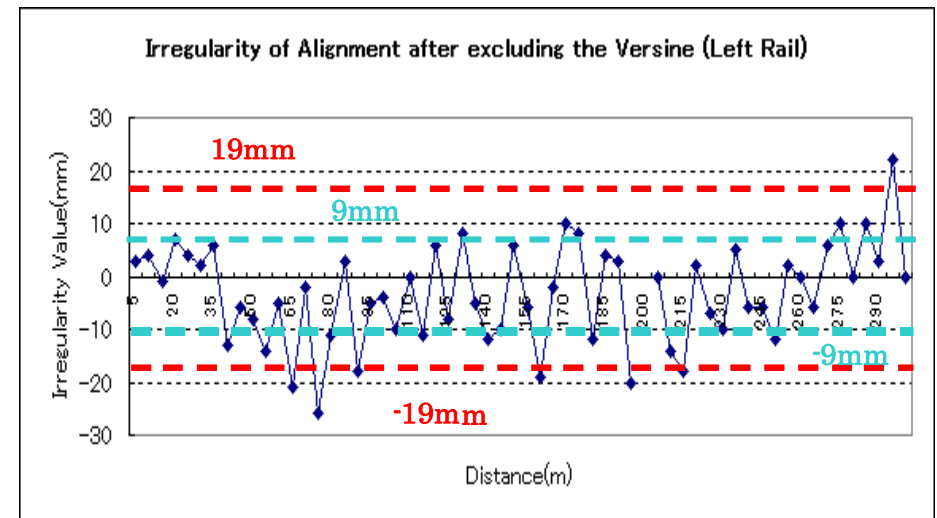
16



17



18



19

Kind of irregularity	gauge	Level	Longitudinal Level	Alignment	Cross Level variation
Tolerable Limit For Regular maintenance	+6 - 4		± 9		_____
Tolerable Limit for Urgency	_____	_____	± 19		± 18

20

Tolerable limit of track irregularity for urgency

(Remark)

- When the track irregularity is over the red dotted line, maintenance work has to be done immediately within three weeks
- The maintenance work result has to be reported to the director of maintenance section of area control branch division.
- If maintenance work is not carried out within three weeks, train speed has to be reduced.

22

Tolerable Limit of Track Irregularity for Regular Maintenance

(Remark)

- When the track irregularity is over the blue dotted line, maintenance work has to be done at some time
- Maintenance work result is reported by ordinary channels

21

Current condition

- Visual Inspection by GRCL staff.- Not enough
- Tolerable track irregularity limit is not clear.



Recommendation

- Establishment of the tolerable track irregularity standard (It is preferable to adopt the standard of Japanese 3rd class line for the time being.)
- Periodical inspection to measure track irregularity (4 times a year - Standard of Japanese 3rd class line)

Level of Urgency



(Urgent)

23

Current condition

- Regular maintenance postponed due to lack of fund.



Recommendation

- There must be adequate funds to make regular maintenance possible.
- Immediate action must be taken to repair the Takoradi-Nsuta section which is currently operational.

Level of Urgency (Urgent)

Defective rails



Wheel burn (Kojokrom ~ Angu section)



Joint gap is wider than 100mm, and end of right side rail is chipped(Kojokrom ~ Angu section)

3. Other Issues and measures

Rail Joint and Condition of Ballast and Formation



The rail joint structure is not correct (Dunkwa ~ Awaso section)



Ballast under the sleeper is too short and width of formation does not measure to standard (Takoradi ~ Kojokrom section)



Current condition and recommendation (1)



Current condition

(Rail)

Wheel burns are found on the top of rail in several sections.

Recommendation



(Rail)

Wheel burns have to be eliminated as soon as possible by changing to new rail.

Level of Urgency



(Urgent)

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Current condition and recommendation (2)



Current condition

(Rail Joint)

The structure of rail joints is not correct at many rail joints

- Joint gap is too much
- Two rails are connected with only one bolt
- Rail of insufficient length is inserted into the joint gap

Recommendation



(Rail Joint)

Pull back rail and insert full length rail or more than 5m length rail (-Japanese standard).

Level of Urgency



(Moderate)

29



Current condition and recommendation(3)



Current condition

(Ballast and Formation)

1. Ballast under the sleeper is too short and width of formation is insufficient at several locations.

Recommendation



(Ballast and Formation)

1. The study of these locations has to be carried out.
2. In the section of Takoradi~Nsuta. The study has to be carried out as soon as possible
3. If defective locations are found, suitable counter-measure has to be implemented as soon as possible.

Level of Urgency



(Urgent)

30



Proposed Equipment for Keeping the Acceptable Maintenance Level



4. Proposed Equipment for Keeping the Acceptable Maintenance Level between Takoradi and Nsuta

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Equipment for inspection		
Item	Measurement device for gauge and level irregularity	Block of Measuring for Longitudinal level and alignment irregularities
Purpose	Measurement of track irregularity	Measurement of longitudinal level and alignment irregularities
Required quantity	4 set (2 set to each DST)	8 pieces (4 pieces to each DST)
Cost	JPY 280,000 (1 set is JPY 70,000)	(It is possible to make the same block equipment in Ghana)

DST: District Superintendent of Track (Takoradi and Tarkwa DST)
JPY: Japanese Yen

32



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	The machine for conveyance	The machine for maintenance	
Item	Gang Trolley with crane	Tie Tamper	Generator for tie tamper
Purpose	Conveyance of track materials.	Maintenance for track	Power source of the tie tamper
Required quantity	2 gang trolleys (1 gang trolley to each DST)	2 set (1 set to each DST)	2 set (1 set to each DST)
Cost	Tens of millions of JPY	JPY 1.8 million (1 set is JPY 0.9 million)	JPY 0.8 million (1 set is JPY 0.4 million)

DST: District Superintendent of Track (Takoradi and Tarkwa DST)
JPY: Japanese Yen

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Tie Tamper and Generator



Tie Tamper



Generator

Thank you

Japan International Cooperation Agency (JICA)

Oriental Consultants Co., Ltd.

Japan International Consultants for Transportation Co., Ltd.



Oriental Consultants Co., Ltd.



Japan International Consultants for Transportation Co., Ltd.

Study for Safety Operation and Management of Railway in the Republic of Ghana



Workshop Session 4 Civil Structures / Bridges

27 September 2012
JICA Study Team
Civil / Bridge Expert : Osamu OKAWA

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1. Present Situation of Civil Structures / Bridge

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Table of Contents

1. Present Situation of Civil Structures / Bridges
2. Issues and Measures
3. Recommendations

1



Number of Bridges in Relation to the Construction Years



Structure \ Generation	1901	1922	1923	1927	1945	1949	1954	Ignorance
Over head conc./steel	0	0	0	1	0	0	1	1
Girder/Steel	0	0	0	0	0	1	0	0
Steel	0	1	0	0	0	0	0	1
Rivet(Abandoned)	0	1	0	0	0	0	0	0
Rivet Weded Plate	1	1	11	0	8	0	0	3
Con.	0	1	0	0	0	0	0	0
Rivet Steel Joint	0	1	0	0	8	0	0	1
Weded Plate	0	0	0	0	5	0	0	0
Trust Girder	0	0	0	0	2	0	0	0
Total	1	5	11	1	23	1	1	6

3



Number of Culverts in Relation to the Construction Years



Structure \ Generation	1916-1920	1921-1925	1926-1930	1931-1935	1936-1940	1941-1945	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980
Concrete Box	0	56	0	0	1	102	36	72	6	19	11	8	0
Concrete Pipe	0	15	0	0	0	113	4	2	2	1	2	1	1
Concrete Drain	0	6	0	0	0	0	0	2	0	0	0	0	0
Concrete Arch	0	22	0	0	0	0	5	11	1	1	1	1	0
Underground Subway	0	1	0	0	0	0	0	1	0	0	0	0	0
Amco Pipe	0	49	0	0	1	9	6	10	5	8	6	2	0
Pipe Culvert	0	4	0	0	0	0	0	0	0	0	0	0	0
Steel Pipe	0	40	0	0	0	3	9	18	2	1	0	2	0
Earthen Ware	0	3	0	0	0	0	0	0	0	0	0	0	0
Total	0	196	0	0	2	227	60	116	16	30	20	14	1



Superstructure



Steel Bridge in the Suburbs of Butuah



Corrosion



Steel Bridge in the Suburbs of Butuah



Section loss



Soil deposits



Corrosion



Corrosion

Substructure



Corrosion



Corrosion



Japanese Steel Bridge
26 years after painting,
but still good condition



Crack

Flaking



Crack



Collapse



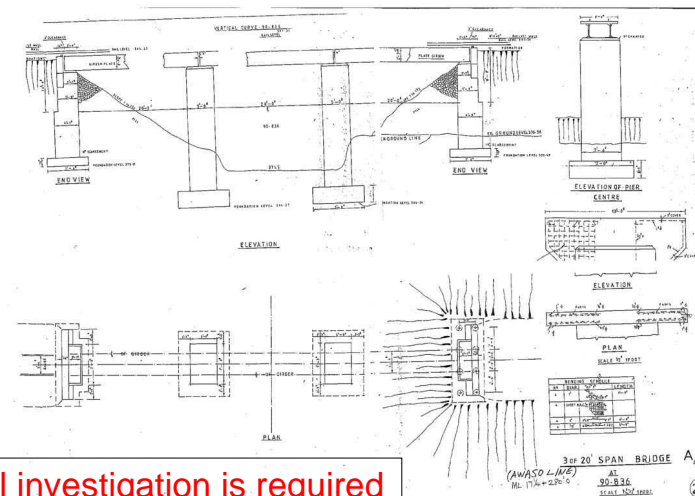
Flaking

Crack

Crack



Scouring



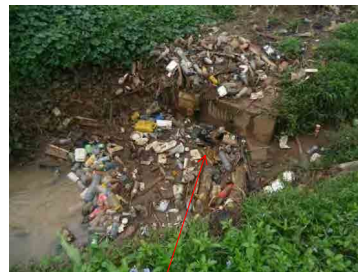
Soil investigation is required for bridge design

Drainage

Situation of Problems with Drainage due to Accumulated Soil and Garbage Deposits



Accumulated soil



Deposit of garbage

Situation of Problems with Drainage due to Accumulated Soil and Garbage Deposits



Accumulated soil

Banking and Cutting



In the Banking Area, Cracking and Landslides

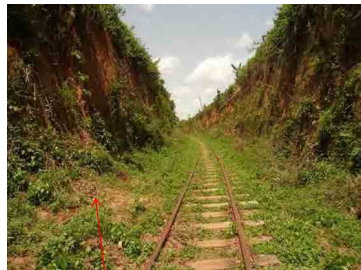


Cracking and landslide

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In the Cutting Area, Landslide Soil and Rock



Landslide soil



Landslide rock

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In the Banking Area, Deep Landslide Collapse



Deep landslide collapse

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2. Issues and Measures

23

Superstructure

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Substructure

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Measures

- Watch the progress of the rust and the situation of encrustation and deposits regularly.
- Remove the rust and repainting with durable materials.
- Remove the soil and garbage deposits in the shoes.
- Remove the loose rivets and replace them with high tensile bolts.

Level of Urgency

☆☆☆ (Measures must be carried out urgently)

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Measures

- Watch flaking of concrete and progression of crack.
- Hit the surface of the concrete with a hammer and determine the degree of floating.
- Strengthen visual checks on the abutment (collapse) of Manso.

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- For the abutment of Manso, construct a temporary support and pile sand bags to prevents the inflow of water.
- For cracks and flaking of the concrete, carry out the injection method.

Level of Urgency

☆☆☆ (Measures must be carried out urgently)



Measures

- Remove of accumulating soil in the station yard outside.
- Repair of the broken drainage system and improve water flow.
- Dig out the drains filled with soil and revive the function of the drainage system.
- Remove garbage in the drainage system regularly.

Level of Urgency

☆☆☆ (Measures must be carried out urgently)



Drainage



Banking and Cutting

Measures

- Watch for defects in the banking and cutting and signs of collapse regularly.
- Watch for defects in the banking and cutting immediately after heavy rain.
- When there is a risk of the collapse, the train service must be limited.

3. Recommendations

- In the banking area, infiltrated water must be prevented from entering the banking.
- In the cutting area, remove the risk of the collapse beforehand.

Level of Urgency

☆☆☆ (Measures must be carried out urgently)

- Judgment of the structure diagnosis by Japanese standards.



- The kinds of measures include:
 - ① Watching
 - ② Repair, Reinforcement
 - ③ Restrictions
 - ④ Reconstruction



(Reference1) Judgment Division of the State of the Structure and a Standard Diagnosis



Diagnosis	State of the structure
	Threatened security to safe driving, to travelers, the public and normal service of the train; or the fear of deformation
A	AA There is deformation threatening the security of driving, the travelers, the public and normal service of trains that urgently needs attention.
	A1 There is gradual deformation, and the stability of the structure is declining, which might be further affected by heavy rainfall, a flood or an earthquake.
	A2 It is certain that the deformation will reduce the stability of the structure in the future.
B	Future, deformation which might become level A.
C	Slight deformation.
S	Normal condition.

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Recommendations



- Considering lack of budget and rehabilitation in near future using Chinese fund
 - ① Watching
 - ② Repair, Reinforcement and
 - ③ Restrictions
 must be carried out as first measures.
- Establishment of Reporting Format

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(Reference2) Relationship Standard Diagnosis and the Degree of Deformation



Diagnosis	Influence on security such as driving preservation, travelers and the public	Degree of Deformation	Measures
A	AA Threatened	Serious	Implement measures urgently
	A1 Threats in the near future Threats at the time of action of the external force at abnormality	Deformation in progress with decline in performance	Implement measures Immediately
	A2 Threats in the future	Deformation with the fear of decline in performance	Implement measures at some stage
B	It will become diagnosis A if it progresses	It will become diagnosis A if it progresses	Observation if necessary
C	There is no influence under the present condition	Minimal	Investigate at the time of inspection as needed from time to time
S	There is no influence	Nothing	Nothing

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Specific Examples



- ① Watching
 - : Measuring cracks with crack gauge
 - : Measuring structure slant with level gauge
 - : Measuring thickness of steel materials with calipers
- ② Repair, Reinforcement
 - : Removing the rust with a rust collecting electric tool and painting
 - : Reinforcement using steel plate
 - : Enlargement of foundations
- ③ Restrictions
 - : Speed and Weight

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List of Instruments



① Check tools

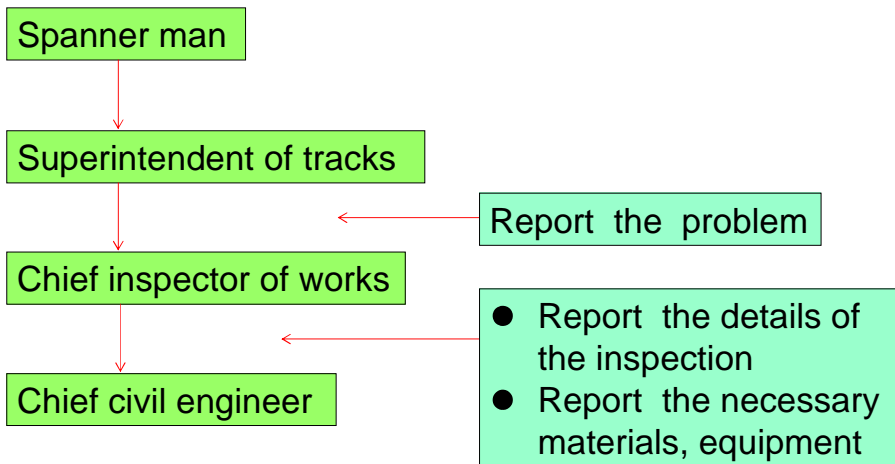
- Calipers: Measure thickness of steel material
- Crack gauge: Measure quantity of displacement of cracking in the concrete structure
- Laser distance meter: Measure span of bridge
- Rust collecting electric tool : Remove rust
- Level gauge: Measure level

② Recording tools

- Camera

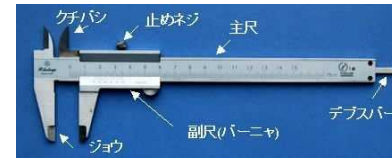


The system of the inspection



Instruments

(Target : Current operating section Takoradi to Nusta)



Calipers(n=3)



Crack gauge(n=5)



Rust collecting electric tool(n=3)



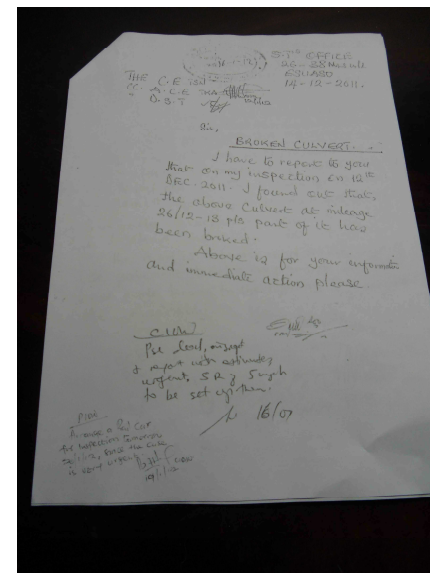
Laser distance meter (n=2)



Level gauge(n=5)



Report of the inspection



Formatting and digitalization are necessary