





RESTRICTED

REPORT  
OF  
THE STUDY  
ON  
THE TRACK, TELECOMMUNICATION AND SIGNALLING  
IMPROVEMENT PROJECT  
IN  
THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

APPENDIX

FEBRUARY 1987

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**LONG-TERM MODERNIZATION  
PROGRAMME**



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LONG-TERM MODERNIZATION PROGRAMME

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Appendix 10-3 Wage and Unit Price

(1) Average Wage by Occupation

1) Rail

Occupation	Skilled/ unskilled	Category	Nos. of personnel	Ave. wage  Ks/month
Driver (Working day: 23 days Basic wage Additional allowance Daily allowance)	Skilled	Driver scale I	77	645
		Driver scale II	142	585
		Driver scale III	225	425
		Shunter	165	320
		Fireman	411	287
		Total	1,020	391
Guard (Working day: 23 day BW AA DA)	Skilled	Guard, A grade	65	460
		Guard, B grade	261	435
		Total	326	440
Stationmaster (BW BA)	Skilled	Station superintendent	2	550
		Selected stationmaster	18	465
		Senior stationmaster	128	400
		Junior stationmaster	280	350
		Asst. stationmaster	361	275
Total	789	327		
Station clerk (BW AA)	Skilled	A grade station clerk	40	325
		B grade station clerk	125	325
		C grade station clerk	437	240
		Total	602	263
Other station staff (BW AA)	Skilled	Shunting jemader	72	188
	Unskilled	Shunting porter	187	175
		Menial staff	729	175
		Total	916	175
				(125 1/)

1/ Economic cost (conversion factor: 0.713)

Source: BRC

2) Road

Occupation	Skilled/ unskilled	Category	Nos. of personnel	Ave. wage
Driver	Skilled		3,766	275
Conductor	Skilled		2,322	200
Asst.	Unskilled		485	175 (125)

Source: RTC

3) Inland water

Occupation	Skilled/ unskilled	Category	Nos. of personnel	Ave. wage
Captain	Skilled		321	610
Sailor	Skilled	Deck	3,413	276
		Engine	1,279	285
		Total	4,692	278

Source: IWTC

(2) Procurement Cost of Vehicle and Vessel

1) Truck

Market price (6.5 ton truck)	225.6 Kyats in thousand
Sales tax (15%)	<u>29.4</u>
	196.2

196.2 x 0.742 = 146 Kyats in thousand

	Composition structure ①	Foreign currency (1.0)	Skilled labour (1.0)	Unskilled labour (0.713)	Tax (0.0)	Conversion factor ②	① x ②
Foreign currency	70%	65% (0.65)			35% (-)	0.65	0.455
Local currency	15	35 (0.35)	35 (0.35)	30 (0.214)		0.914	0.137
Labour cost	15		100 (1.0)			1.0	0.15
<b>Total</b>	<b>100</b>						<b>0.742</b>

2) Bus

Market price (BM Bus)	322 Kyats in thousand
Sales tax (15%)	<u>42</u>
	280

280 x 0.716 = 200 Kyats in thousand

	Composition structure ①	Foreign currency (1.0)	Skilled labour (1.0)	Unskilled labour (0.713)	Tax (0.0)	Conversion factor ②	① x ②
Foreign currency	80%	65% (0.65)			35% (-)	0.65	0.52
Local currency	5	35 (0.35)	35 (0.35)	30 (0.214)		0.914	0.046
Labour cost	15		100 (1.0)			1.0	0.15
<b>Total</b>	<b>100</b>						<b>0.716</b>

3) Vessel

Market price (Pass. cum cargo)	7000 Kyats in thousand
Sales tax (15%)	$\frac{913}{6087}$

6087 x 0.900 = 5478 Kyats in thousand

	Composition structure ①	Foreign currency (1.0)	Skilled labour (1.0)	Unskilled labour (0.713)	Tax (0.0)	Conversion factor ②	① x ②
Foreign currency	30%	75% (0.75)			25% (-)	0.75	0.225
Local currency	30	45 (0.45)	40 (0.4)	15 (0.107)		0.957	0.287
Labour cost	40		90 (0.9)	10 (0.071)		0.971	0.388
<b>Total</b>	<b>100</b>						<b>0.900</b>

Appendix 10-4 Cost Benefit Table

(Plan A)	Cost Benefit Table (1)										MANDALAY LINE			Kyats in thousand			
	Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995							
1. Investment Cost																	
1-1 With the project																	
(1) Track	6440	6440	45880	58000	58250	54750	42760	64660	64660								
(2) Telecom.	6470	1960	27910	53320	52670	32670	20320	2790	2790								
(3) Signalling	6560	0	24160	47060	39430	16540	0	4280	16900								
(4) Rolling stock	0	0	62640	62640	62640	62880	0	0	0								
(5) Vehicle	0	0	0	0	0	0	0	0	0								
(6) Vessel	0	0	0	0	0	0	0	0	0								
(7) Total	19470	8400	160590	221020	222990	166840	63080	71730	81560								
1-2 Without the project																	
(1) Rolling stock	0	0	62640	62640	62640	62880	0	0	103920								
(2) Vehicle	0	0	0	0	0	0	0	15501	15501								
(3) Vessel	0	0	0	0	0	0	0	2040	2040								
(4) Total	0	0	62640	62640	62640	62880	0	17542	121462								
1-3 With - Without	19470	8400	97950	158380	160350	103960	63080	54188	-39902								
2. Benefit																	
2-1 Time saving																	
(1) Passenger	0	0	0	0	0	0	0	10418	11339								
(2) Freight	0	0	0	0	0	0	0	122	129								
(3) Total	0	0	0	0	0	0	0	10540	11468								
2-2 Maintenance cost reduction																	
(1) With the project	5300	5300	6093	6887	7680	8477	10527	13287	13287								
(2) Without the project	10580	10580	11373	12167	12960	13757	13757	15191	17942								
(3) Benefit (without-with)	5280	5280	5280	5280	5280	5280	3230	1905	4656								
2-3 Operating cost reduction																	
(1) With the project	78320	80850	83456	86137	88920	91778	94738	98211	103354								
(2) Without the project	78320	80850	83456	86137	88920	91778	94738	105179	115722								
(3) Benefit (without-with)	0	0	0	0	0	0	0	6968	12368								
2-4 Decrease of traffic accident																	
(1) With the project	0	0	0	0	0	0	0	2383	2453								
(2) Without the project	5280	5280	5280	5280	5280	5280	3230	21796	30945								
(3) Benefit (without-with)	5280	5280	5280	5280	5280	5280	3230	21796	30945								
2-5 Benefit total	5280	5280	5280	5280	5280	5280	3230	21796	30945								
3. Benefit - Investment Cost	-14190	-3120	-92670	-153100	-155070	-98680	-59850	-32392	70847								

Source: Study Team

Cost Benefit Table (2) [ MANDALAY LINE] Kyats in thousand

Fiscal Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
<b>1. Investment Cost</b>										
<b>1-1 With the project</b>										
(1) Track	44840	17730	0	0	0	0	0	0	0	-356148
(2) Telecom.	26280	26280	0	260	0	7730	0	3400	0	-78530
(3) Signalling	40240	23330	0	0	2060	12210	20360	8150	0	-144644
(4) Rolling stock	0	0	0	0	44457	144978	153008	153227	153227	-764089
(5) Vehicle	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0
(7) Total	111360	67340	0	260	46517	164918	173368	164777	153227	-1343411
<b>1-2 Without the project</b>										
(1) Rolling stock	103920	0	0	0	100740	100959	114829	117019	117019	-828113
(2) Vehicle	15501	15501	24727	24727	24727	24727	24727	24727	24727	167655
(3) Vessel	2040	2040	3146	3146	3146	3146	3146	3146	3146	-22899
(4) Total	121462	17542	27873	27873	128613	128832	142702	144892	144892	-1018667
<b>1-3 With - Without</b>	<b>-10102</b>	<b>49798</b>	<b>-27873</b>	<b>-27613</b>	<b>-82096</b>	<b>36086</b>	<b>30666</b>	<b>19885</b>	<b>8335</b>	<b>-324745</b>
<b>2. Benefit</b>										
<b>2-1 Time saving</b>										
(1) Passenger	12340	13428	17582	19227	21025	22989	25133	27475	30032	32824
(2) Freight	135	142	165	174	183	192	202	213	224	236
(3) Total	12476	13570	17746	19401	21208	23181	25336	27688	30257	33060
<b>2-2 Maintenance cost reduction</b>										
(1) With the project	13287	13287	13047	13047	13664	15699	17857	20019	23210	23210
(2) Without the project	20693	22128	24419	26710	30400	34093	37998	41938	45877	48168
(3) Benefit (without-with)	7406	8841	11372	13664	16736	18394	20141	21919	22667	24958
<b>2-3 Operating cost reduction</b>										
(1) With the project	108748	114439	117862	124376	131268	138517	146190	154310	162853	171886
(2) Without the project	126416	137262	153068	169050	185210	201572	218162	234929	251923	269170
(3) Benefit (without-with)	17668	22823	35205	44675	53942	63055	71971	80619	89070	97284
<b>2-4 Decrease of traffic accident</b>	<b>2526</b>	<b>2601</b>	<b>2685</b>	<b>2772</b>	<b>2860</b>	<b>2591</b>	<b>3046</b>	<b>3141</b>	<b>3239</b>	<b>3341</b>
<b>2-5 Benefit total</b>	<b>40076</b>	<b>47835</b>	<b>67009</b>	<b>80511</b>	<b>94746</b>	<b>107581</b>	<b>120494</b>	<b>133367</b>	<b>145233</b>	<b>158643</b>
<b>3. Benefit - Investment Cost</b>	<b>50178</b>	<b>-1963</b>	<b>94882</b>	<b>108124</b>	<b>176842</b>	<b>71495</b>	<b>89828</b>	<b>113482</b>	<b>136898</b>	<b>483388</b>

Cost Benefit Table (1)  
 (Plan A) [ MARTABAN LINE ]  
 Kyats in thousand  
 Fiscal Year 1987 1988 1989 1990 1991 1992 1993 1994 1995

	1987	1988	1989	1990	1991	1992	1993	1994	1995
<b>1. Investment Cost</b>									
1-1 With the project									
(1) Track	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	0	2310	25740	54590	0	0
(3) Signalling	0	0	0	1410	0	14800	14800	330	0
(4) Rolling stock	0	0	960	960	1200	1200	0	0	5760
(5) Vehicle	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0
(7) Total	0	0	960	2370	3510	41740	69390	330	5760
1-2 Without the project									
(1) Rolling stock	0	0	960	960	1200	1200	0	0	5760
(2) Vehicle	0	0	0	0	0	0	0	1771	369
(3) Vessel	0	0	0	0	0	0	0	0	0
(4) Total	0	0	960	960	1200	1200	0	1771	6129
1-3 With - Without	0	0	0	1410	2310	40540	69390	-1441	-369
<b>2. Benefit</b>									
2-1 Time saving									
(1) Passenger	0	0	0	0	0	0	0	842	896
(2) Freight	0	0	0	0	0	0	0	0	0
(3) Total	0	0	0	0	0	0	0	843	896
2-2 Maintenance cost reduction									
(1) With the project	1820	1820	1832	1844	1860	1875	1875	3485	3558
(2) Without the project	1820	1820	1832	1844	1860	1875	1875	2045	2153
(3) Benefit (without-with)	0	0	0	0	0	0	0	-1440	-1405
2-3 Operating cost reduction									
(1) With the project	25093	25902	26736	27597	28486	29403	30350	32421	33770
(2) Without the project	25093	25902	26736	27597	28486	29403	30350	33240	34753
(3) Benefit (without-with)	0	0	0	0	0	0	0	819	983
2-4 Decrease of traffic accident	0	0	0	0	0	0	0	558	576
2-5 Benefit total	0	0	0	0	0	0	0	780	1051
3. Benefit - Investment Cost	0	0	0	-1410	-2310	-40540	-69390	2221	1420

Source: Study Team

Cost Benefit Table (2)

	MARTABAN LINE										Kyats in thousand			
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005				
1. Investment Cost														
1-1 With the project														
(1) Track	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	0	0	0	0	0	0	0	0	0	0	-28813
(3) Signalling	2610	2610	0	0	0	0	0	0	0	0	0	0	0	-18760
(4) Rolling stock	10560	0	0	0	13651	14381	14381	14600	14600	14600	14600	14600	14600	-80232
(5) Vehicle	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(7) Total	13170	2610	0	0	13651	14381	14381	14600	14600	14600	14600	14600	14600	-127804
1-2 Without the project														
(1) Rolling stock	11360	0	0	0	12921	12921	12921	13870	13870	13870	13870	13870	13870	-76217
(2) Vehicle	369	443	480	517	517	627	627	664	701	701	701	701	701	-4793
(3) Vessel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(4) Total	11729	443	480	517	13438	13548	13548	14534	14571	14571	14571	14571	14571	-81010
1-3 With - Without														
	1441	2167	-480	-517	213	833	833	66	29	29	29	29	29	-46794
2. Benefit														
2-1 Time saving														
(1) Passenger	953	1014	1088	1167	1252	1343	1441	1545	1658	1658	1658	1658	1658	1778
(2) Freight	0	0	0	0	0	1	1	1	1	1	1	1	1	1
(3) Total	954	1015	1089	1168	1252	1343	1441	1546	1658	1658	1658	1658	1658	1779
2-2 Maintenance cost reduction														
(1) With the project	3698	3698	3808	3808	4008	4220	4431	4646	4860	4860	4860	4860	4860	4860
(2) Without the project	2340	2382	2429	2478	2717	2966	3215	3482	3753	3753	3753	3753	3753	3827
(3) Benefit (without-with)	-1358	-1315	-1379	-1330	-1291	-1254	-1216	-1163	-1107	-1107	-1107	-1107	-1107	-1033
2-3 Operating cost reduction														
(1) With the project	35175	36639	38357	40157	42040	44013	46077	48239	50502	50502	50502	50502	50502	52871
(2) Without the project	36307	37978	39919	41959	44061	46341	48690	51147	53716	53716	53716	53716	53716	56437
(3) Benefit (without-with)	1132	1339	1562	1802	2021	2328	2612	2908	3214	3214	3214	3214	3214	3566
2-4 Decrease of traffic accident														
	595	614	637	661	685	711	738	765	794	794	794	794	794	823
2-5 Benefit total														
	1322	1653	1908	2300	2667	3129	3575	4056	4559	4559	4559	4559	4559	5135
3. Benefit - Investment Cost														
	-119	-515	2388	2817	2454	2297	2742	3990	4530	4530	4530	4530	4530	51929



(Plan A)  
 Cost Benefit Table (1)  
 [ PROME LINE ]  
 Kyats in thousand

Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995
<b>1. Investment Cost</b>									
<b>1-1 With the project</b>									
(1) Track	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	2000	1290	52070	24050	0	0
(3) Signalling	0	0	0	1680	10680	17240	6550	450	1600
(4) Rolling stock	0	0	18720	19520	19760	19760	0	0	31920
(5) Vehicle	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0
(7) Total	0	0	18720	23200	31730	89070	30600	450	33520
<b>1-2 Without the project</b>									
(1) Rolling stock	0	0	17920	18720	18960	18960	0	0	32720
(2) Vehicle	0	0	0	0	0	0	0	1247	241
(3) Vessel	0	0	0	0	0	0	0	0	0
(4) Total	0	0	17920	18720	18960	18960	0	1247	32961
<b>1-3 With - Without</b>									
	0	0	800	4480	12770	70110	30600	-797	559
<b>2. Benefit</b>									
<b>2-1 Time saving</b>									
(1) Passenger	0	0	0	0	0	0	0	731	780
(2) Freight	0	0	0	0	0	0	0	2	2
(3) Total	0	0	0	0	0	0	0	733	782
<b>2-2 Maintenance cost reduction</b>									
(1) With the project	2290	2290	2530	2782	3037	3291	3291	4891	5302
(2) Without the project	2290	2290	2519	2759	3003	3246	3246	3366	3811
(3) Benefit (without-with)	0	0	-11	-22	-34	-45	-45	-1525	-1491
<b>2-3 Operating cost reduction</b>									
(1) With the project	19251	20010	20820	21629	22489	23375	24311	25879	26891
(2) Without the project	19251	20010	20820	21629	22489	23375	24311	26431	27559
(3) Benefit (without-with)	0	0	0	0	0	0	0	552	668
<b>2-4 Decrease of traffic accident</b>									
	0	0	0	0	0	0	0	608	628
<b>2-5 Benefit total</b>									
	0	0	-11	-22	-34	-45	-45	367	587
<b>3. Benefit - Investment Cost</b>									
	0	0	-811	-4502	-12804	-70155	-30645	1164	27

Source: Study Team

Cost Benefit Table (2)

	PROME LINE]							Kyats in thousand			
	Fiscal Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Investment Cost											
1-1 With the project											
(1) Track	0	0	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	0	0	0	0	0	0	0	-26029
(3) Signalling	3200	1610	0	0	0	0	0	0	0	0	-20687
(4) Rolling stock	31920	0	0	0	35259	35259	35259	52505	52505	53454	-307552
(5) Vehicle	0	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0	0
(7) Total	35120	1610	0	0	35259	35259	35259	52505	52505	53454	-354267
1-2 Without the project											
(1) Rolling stock	32720	0	0	0	33799	34529	34529	51775	51775	51994	-302393
(2) Vehicle	241	263	284	328	306	372	372	416	416	437	-3055
(3) Vessel	0	0	0	0	0	0	0	0	0	0	0
(4) Total	32961	263	284	328	34105	34901	34901	52147	52191	52431	-305447
1-3 With - Without	2159	1348	-284	-328	1154	358	358	358	314	1023	-48820
2. Benefit											
2-1 Time saving											
(1) Passenger	832	888	955	1027	1105	1189	1189	1279	1375	1479	1591
(2) Freight	2	2	2	2	2	2	2	3	3	3	3
(3) Total	834	890	957	1030	1107	1191	1191	1281	1378	1482	1594
2-2 Maintenance cost reduction											
(1) With the project	5713	5713	5853	5853	6352	6851	6851	7616	8382	9162	9162
(2) Without the project	4256	4281	4309	4340	4846	5370	5370	6160	6954	7753	7797
(3) Benefit (without-with)	-1457	-1431	-1544	-1513	-1506	-1481	-1481	-1457	-1428	-1408	-1364
2-3 Operating cost reduction											
(1) With the project	27953	29041	30331	31697	33089	34556	34556	36099	37693	39363	41108
(2) Without the project	28713	29940	31365	32860	34384	36025	36025	37716	39527	41386	43343
(3) Benefit (without-with)	760	898	1034	1163	1295	1469	1469	1617	1834	2023	2235
2-4 Decrease of traffic accident	647	669	694	719	746	774	774	802	833	863	895
2-5 Benefit total	784	1026	1141	1399	1643	1952	1952	2243	2617	2960	3360
3. Benefit - Investment Cost	-1375	-322	1425	1727	489	1594	1594	1885	2303	1937	52180

(Plan A) Cost Benefit Table (1) [ MYIKYINA LINE] Kyats in thousand

Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995
1. Investment Cost									
1-1 With the project									
(1) Track	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	4170	31550	47890	60790	0	0
(3) Signalling	0	0	0	20450	33040	39600	22490	0	0
(4) Rolling stock	0	0	23760	24000	24000	24000	0	0	93660
(5) Vehicle	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0
(7) Total	0	0	23760	48620	88590	111490	83280	0	93660
1-2 Without the project									
(1) Rolling stock	0	0	23760	24000	24000	24000	0	0	84210
(2) Vehicle	0	0	0	0	0	0	0	1508	309
(3) Vessel	0	0	0	0	0	0	0	7237	1483
(4) Total	0	0	23760	24000	24000	24000	0	8745	86003
1-3 With - Without	0	0	0	24620	64590	87490	83280	-8745	7657
2. Benefit									
2-1 Time saving									
(1) Passenger	0	0	0	0	0	0	0	1480	1673
(2) Freight	0	0	0	0	0	0	0	5	5
(3) Total	0	0	0	0	0	0	0	1485	1678
2-2 Maintenance cost reduction									
(1) With the project	1690	1690	1991	2295	2599	2903	2903	6763	8030
(2) Without the project	1690	1690	1991	2295	2599	2903	2903	3074	4243
(3) Benefit (without-with)	0	0	0	0	0	0	0	-3689	-3787
2-3 Operating cost reduction									
(1) With the project	34075	35568	37111	38755	40450	42221	44068	46800	48748
(2) Without the project	34075	35568	37111	38755	40450	42221	44068	47780	49965
(3) Benefit (without-with)	0	0	0	0	0	0	0	980	1217
2-4 Decrease of traffic accident	0	0	0	0	0	0	0	2689	2787
2-5 Benefit total	0	0	0	0	0	0	0	1466	1895
3. Benefit - Investment Cost	0	0	0	-24620	-64590	-87490	-83280	10211	-5762

Source: Study Team

Cost Benefit Table (2)

	[ MYITKYINA LINE ]										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
1. Investment Cost											
1-1 With the project											
(1) Track	0	0	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	0	0	0	0	0	0	0	-46635
(3) Signalling	0	0	0	0	0	0	0	0	0	0	-51348
(4) Rolling stock	105900	0	0	0	100867	101597	101816	101816	101816	101816	-665379
(5) Vehicle	0	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0	0
(7) Total	105900	0	0	0	100867	101597	101816	101816	101816	101816	-763363
1-2 Without the project											
(1) Rolling stock	89250	0	0	0	100867	100867	109709	109709	109709	109709	-668892
(2) Vehicle	309	309	387	387	387	425	464	503	541	541	-3732
(3) Vessel	1486	1483	1855	1857	1855	2041	2225	2413	2597	2597	-19365
(4) Total	91045	1793	2242	2244	103109	103334	112398	112625	112847	112847	-691989
1-3 With - Without	14855	-1793	-2242	-2244	-2242	-1737	-10582	-10809	-11031	-11031	-71374
2. Benefit											
2-1 Time saving											
(1) Passenger	1885	2118	2327	2556	2806	3078	3375	3699	4053	4438	4438
(2) Freight	5	6	6	6	6	7	7	7	8	8	8
(3) Total	1890	2123	2333	2562	2812	3085	3382	3707	4060	4446	4446
2-2 Maintenance cost reduction											
(1) With the project	9469	9469	9469	9469	10967	12476	13989	15501	17014	17014	17014
(2) Without the project	5483	5518	5562	5606	7148	8694	10382	12073	13769	13835	13835
(3) Benefit (without-with)	-3986	-3951	-3907	-3863	-3819	-3782	-3607	-3428	-3245	-3179	-3179
2-3 Operating cost reduction											
(1) With the project	50797	52922	55300	57779	60359	63066	65899	68859	71945	75158	75158
(2) Without the project	52200	54511	57178	59897	62741	65713	68838	72117	75547	79157	79157
(3) Benefit (without-with)	1403	1589	1879	2118	2382	2647	2939	3257	3602	3999	3999
2-4 Decrease of traffic accident	2886	2989	3108	3227	3356	3486	3621	3762	3907	4060	4060
2-5 Benefit total	2193	2751	3413	4044	4731	5436	6335	7298	8324	9325	9325
3. Benefit - Investment Cost	-12662	4544	5655	6289	6973	7173	16918	18106	19356	80699	80699

(Plan B)	MANDALAY LINE]										Kyats in thousand		
	Cost Benefit Table (1)												
Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995				
<b>I. Investment Cost</b>													
1-1 With the project													
(1) Track	6440	6440	44470	55710	65640	52710	41170	62260	62260				
(2) Telecom.	6880	2080	29680	56710	56030	34750	21610	0	0				
(3) Signalling	6370	0	23460	45700	38290	16060	0	0	0				
(4) Rolling stock	0	0	62640	62640	62640	62880	0	0	0				
(5) Vehicle	0	0	0	0	0	0	0	0	0				
(6) Vessel	0	0	0	0	0	0	0	0	0				
(7) Total	19690	8520	160250	220760	222600	166400	62780	62260	62260				
<b>1-2 Without the project</b>													
(1) Rolling stock	0	0	62640	62640	62640	62880	0	0	0			103920	
(2) Vehicle	0	0	0	0	0	0	0	15501	15501			15501	
(3) Vessel	0	0	0	0	0	0	0	2040	2040			2040	
(4) Total	0	0	62640	62640	62640	62880	0	17542	121462			121462	
1-3 With - Without	19690	8520	97610	158120	159960	103520	62780	44718	-59202				
<b>2. Benefit</b>													
2-1 Time saving													
01) Passenger	0	0	0	0	0	0	0	10418	11339				
(2) Freight	0	0	0	0	0	0	0	122	129				
(3) Total	0	0	0	0	0	0	0	10540	11468				
<b>2-2 Maintenance cost reduction</b>													
(1) With the project	5280	5280	6073	6867	7660	8457	10437	13387	13387				
(2) Without the project	10580	10580	11373	12167	12960	13757	13757	15191	17942				
(3) Benefit (without-with)	5300	5300	5300	5300	5300	5300	3320	1805	4556				
<b>2-3 Operating cost reduction</b>													
(1) With the project	78320	80850	83456	86137	88920	91778	94738	104110	109561				
(2) Without the project	78320	80850	83456	86137	88920	91778	94738	105179	115722				
(3) Benefit (without-with)	0	0	0	0	0	0	0	1070	6161				
2-4 Decrease of traffic accident	0	0	0	0	0	0	0	2107	2163				
2-5 Benefit total	5300	5300	5300	5300	5300	5300	3320	15521	24347				
3. Benefit - Investment Cost	-14390	-3220	-92310	-152820	-154660	-98220	-59460	-29197	83549				

Source: Study Team

Cost Benefit Table (2)

	MANDALAY LINE									
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. Investment Cost										
1-1 With the project										
(1) Track	43470	17080	0	0	0	0	0	0	0	-343527
(2) Telecom.	0	0	0	0	0	0	0	0	0	-52888
(3) Signalling	0	0	0	0	0	0	0	0	0	50647
(4) Rolling stock	0	0	0	0	46647	151548	155417	155417	156147	-778922
(5) Vehicle	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0
(7) Total	43470	17080	0	0	46647	151548	155417	155417	156147	-1225985
1-2 Without the project										
(1) Rolling stock	103920	0	0	0	100740	100959	114829	117019	117019	-828113
(2) Vehicle	15501	15301	24727	24727	24727	24727	24727	24727	24727	-167655
(3) Vessel	2040	2040	3146	3146	3146	3146	3146	3146	3146	-22899
(4) Total	121462	17542	27873	27873	128613	128832	142702	144892	144892	-1018667
1-3 With - Without	-77992	-462	-27873	-27873	-81966	22716	12715	10525	11255	207319
2. Benefit										
2-1 Time saving										
(1) Passenger	12340	13428	14697	16086	17605	19265	21078	23060	25225	27590
(2) Freight	135	142	150	158	166	175	184	194	204	215
(3) Total	12476	13370	14847	16244	17771	19440	21263	23254	25429	27805
2-2 Maintenance cost reduction										
(1) With the project	13387	13387	10297	10297	10944	13077	15269	17461	19664	19664
(2) Without the project	20693	22128	24419	26710	30400	34093	37998	41938	45877	48168
(3) Benefit (without-with)	7306	8741	14122	16414	19456	21016	22729	24477	26213	28504
2-3 Operating cost reduction										
(1) With the project	115279	121312	124930	131834	139140	146824	154957	163563	172618	182194
(2) Without the project	126416	137262	153068	169050	185210	201572	218162	234929	251923	269170
(3) Benefit (without-with)	11137	15950	28137	37216	46070	54748	63205	71366	79305	86977
2-4 Decrease of traffic accident	2220	2279	2345	2413	2482	2552	2625	2696	2770	2846
2-5 Benefit total	33139	40540	59452	72287	85779	97756	109821	121793	133717	146132
3. Benefit - Investment Cost	111131	41002	87325	100161	167746	75040	97107	111268	122463	353450

(Plan B)  
 Cost Benefit Table (1)  
 [ MARTABAN LINE ]  
 Kyats in thousand

Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995
<b>1. Investment Cost</b>									
<b>1-1 With the project</b>									
(1) Track	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	0	460	7830	13270	0	0
(3) Signalling	0	0	0	0	1410	14800	14800	0	0
(4) Rolling stock	0	0	0	0	0	0	0	0	0
(5) Vehicle	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0
(7) Total	0	0	0	0	1870	22630	28070	0	0
<b>1-2 Without the project</b>									
(1) Rolling stock	0	0	960	960	1200	1200	0	0	5760
(2) Vehicle	0	0	0	0	0	0	0	1771	369
(3) Vessel	0	0	0	0	0	0	0	0	0
(4) Total	0	0	960	960	1200	1200	0	1771	6129
<b>1-3 With - Without</b>									
	0	0	-960	-960	670	21430	28070	-1771	-6129
<b>2. Benefit</b>									
<b>2-1 Time saving</b>									
(1) Passenger	0	0	0	0	0	0	0	824	876
(2) Freight	0	0	0	0	0	0	0	0	0
(3) Total	0	0	0	0	0	0	0	824	877
<b>2-2 Maintenance cost reduction</b>									
(1) With the project	1820	1820	1820	1820	1820	1820	1820	2280	2280
(2) Without the project	1820	1820	1832	1844	1860	1875	1875	2045	2153
(3) Benefit (without-with)	0	0	12	24	40	55	55	-235	-127
<b>2-3 Operating cost reduction</b>									
(1) With the project	25093	25902	26736	27597	28486	29403	30350	32421	33770
(2) Without the project	25093	25902	26736	27597	28486	29403	30350	33240	34753
(3) Benefit (without-with)	0	0	0	0	0	0	0	819	983
<b>2-4 Decrease of traffic accident</b>									
	0	0	0	0	0	0	0	497	513
<b>2-5 Benefit total</b>									
	0	0	12	24	40	55	55	1905	2246
<b>3. Benefit - Investment Cost</b>									
	0	0	972	984	-630	-21375	-28015	3676	8375

Source: Study Team

Cost Benefit Table (2)

Fiscal Year	MARTABAN LINE							Kytas in thousand		
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
<b>1. Investment Cost</b>										
<b>1-1 With the project</b>										
(1) Track	0	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	0	0	0	0	0	0	-10237
(3) Signalling	0	0	0	0	0	0	0	0	0	-14901
(4) Rolling stock	6480	0	0	0	12337	13067	13067	13067	13286	-63698
(5) Vehicle	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0
(7) Total	6480	0	0	0	12337	13067	13067	13067	13286	-88836
<b>1-2 Without the project</b>										
(1) Rolling stock	11360	0	0	0	12921	12921	12921	13870	13870	-76217
(2) Vehicle	369	443	480	517	517	627	627	664	701	-4793
(3) Vessel	0	0	0	0	0	0	0	0	0	0
(4) Total	11729	443	480	517	13438	13548	13548	14534	14571	-81010
1-3 With - Without	-5249	-443	-480	-517	-1101	-481	-481	-1467	-1285	-7826
<b>2. Benefit</b>										
<b>2-1 Time saving</b>										
(1) Passenger	932	992	1064	1141	1224	1313	1408	1510	1620	1737
(2) Freight	0	0	0	0	0	0	0	1	1	1
(3) Total	933	992	1064	1141	1224	1313	1408	1511	1620	1738
<b>2-2 Maintenance cost reduction</b>										
(1) With the project	2369	2369	2369	2369	2551	2744	2937	3130	3327	3327
(2) Without the project	2340	2382	2429	2478	2717	2966	3215	3482	3753	3827
(3) Benefit (without-with)	-29	14	60	110	166	222	278	352	426	501
<b>2-3 Operating cost reduction</b>										
(1) With the project	35175	36639	38357	40157	42040	44013	46017	48239	50502	52871
(2) Without the project	36307	37978	39919	41959	44061	46341	48690	51147	53716	56437
(3) Benefit (without-with)	1132	1339	1562	1802	2021	2328	2612	2908	3214	3566
<b>2-4 Decrease of traffic accident</b>										
	529	545	565	585	606	628	651	674	699	724
<b>2-5 Benefit total</b>										
	2565	2891	3251	3638	4017	4492	4970	5445	5959	6528
<b>3. Benefit - Investment Cost</b>										
	7814	3334	3731	4155	5118	4973	5431	6912	7244	14354



Cost Benefit Table (1)

(Plan B)	PROME LINE]										Kyats in thousand		
	Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995			
1. Investment Cost													
1-1 With the project													
(1) Track	0	0	0	0	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	400	7720	10980	3230	0	0	0	0	0	0
(3) Signalling	0	0	0	1680	10680	17240	6550	0	0	0	0	0	0
(4) Rolling stock	0	0	15280	15280	16080	16320	0	0	0	0	0	0	32560
(5) Vehicle	0	0	0	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0	0	0	0
(7) Total	0	0	15280	17360	34480	44540	9780	0	0	0	0	0	32560
1-2 Without the project													
(1) Rolling stock	0	0	17920	18720	18960	18960	0	0	0	0	0	0	32720
(2) Vehicle	0	0	0	0	0	0	0	1247	241	0	0	0	0
(3) Vessel	0	0	0	0	0	0	0	0	0	0	0	0	0
(4) Total	0	0	17920	18720	18960	18960	0	1247	241	0	0	0	32961
1-3 With ~ Without	0	0	-2640	-1360	15520	25580	9780	-1247	-401				
2. Benefit													
2-1 Time saving													
(1) Passenger	0	0	0	0	0	0	0	0	0	0	0	0	754
(2) Freight	0	0	0	0	0	0	0	0	0	0	0	0	2
(3) Total	0	0	0	0	0	0	0	0	0	0	0	0	756
2-2 Maintenance cost reduction													
(1) With the project	2290	2290	2486	2681	2888	3078	3098	3898	4319				
(2) Without the project	2290	2290	2290	2630	3100	3580	4050	4170	4193				
(3) Benefit (without-with)	0	0	-196	-51	212	492	952	271	-127				
2-3 Operating cost reduction													
(1) With the project	19251	20010	20820	21629	22489	23375	24311	25879	26891				
(2) Without the project	19251	20010	20820	21629	22489	23375	24311	26431	27559				
(3) Benefit (without-with)	0	0	0	0	0	0	0	552	668				
2-4 Decrease of traffic accident	0	0	0	0	0	0	0	0	0	0	0	0	559
2-5 Benefit total	0	0	-196	-51	212	482	952	2073	1857				
3. Benefit - Investment Cost	0	0	2444	1309	-15308	-25098	-8828	3320	2257				

Source: Study Team

Cost Benefit Table (2)

	PROME LINE]										Kyats in thousand			
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005				
1. Investment Cost														
1-1 With the project														
(1) Track	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	0	0	0	0	0	0	0	0	0	0	-9522
(3) Signalling	0	0	0	0	0	0	0	0	0	0	0	0	0	-16416
(4) Rolling stock	33600	0	0	0	33288	33507	50753	50753	50753	51483	51483	51483	51483	-291571
(5) Vehicle	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(7) Total	33600	0	0	0	33288	33507	50753	50753	50753	51483	51483	51483	51483	-317508
1-2 Without the project														
(1) Rolling stock	32720	0	0	0	33799	34529	51775	51775	51775	51994	51994	51994	51994	-302393
(2) Vehicle	241	263	284	328	306	372	372	416	437	437	437	437	437	-3055
(3) Vessel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(4) Total	32961	263	284	328	34105	34901	52147	52191	52431	52431	52431	52431	52431	-305447
1-3 With - Without														
	639	-263	-284	-328	-817	-1394	-1394	-1438	-1438	-948	-948	-948	-948	-12061
2. Benefit														
2-1 Time saving														
(1) Passenger	805	859	924	993	1069	1150	1237	1330	1431	1431	1431	1431	1431	1539
(2) Freight	2	2	2	2	2	2	2	3	3	3	3	3	3	3
(3) Total	807	861	926	996	1071	1152	1239	1333	1433	1433	1433	1433	1433	1542
2-2 Maintenance cost reduction														
(1) With the project	4755	4755	4755	4755	5226	5701	6442	7184	7936	7936	7936	7936	7936	7936
(2) Without the project	4896	5571	5598	5630	5659	6435	7341	8231	9153	9153	9153	9153	9153	10077
(3) Benefit (without-with)	141	816	844	875	433	734	898	1047	1217	1217	1217	1217	1217	2141
2-3 Operating cost reduction														
(1) With the project	27953	29041	30331	31697	33089	34556	36099	37693	39363	39363	39363	39363	39363	41108
(2) Without the project	28713	29940	31365	32860	34384	36025	37716	39527	41386	41386	41386	41386	41386	43343
(3) Benefit (without-with)	760	898	1034	1163	1295	1469	1617	1834	2023	2023	2023	2023	2023	2235
2-4 Decrease of traffic accident														
	576	595	617	638	662	685	710	737	763	763	763	763	763	790
2-5 Benefit total														
	2283	3170	3420	3672	3461	4040	4464	4950	5436	5436	5436	5436	5436	6708
3. Benefit - Investment Cost														
	1644	3433	3704	4000	4278	5434	5858	6388	6384	6384	6384	6384	6384	18768

(Plan B)  
 Cost Benefit Table (1)  
 [ MYITKYINA LINE ]  
 Kyats in thousand

Fiscal Year	1987	1988	1989	1990	1991	1992	1993	1994	1995
<b>1. Investment Cost</b>									
1-1 With the project	0	0	0	0	0	0	0	0	0
(1) Track	0	0	0	940	12770	13860	26560	0	0
(2) Telecom.	0	0	0	17510	15400	11150	11680	0	0
(3) Signalling	0	0	17760	18000	18000	18000	0	0	82050
(4) Rolling stock	0	0	0	0	0	0	0	0	0
(5) Vehicle	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	17760	36450	46170	43010	38240	0	0
(7) Total	0	0	17760	36450	46170	43010	38240	0	82050
<b>1-2 Without the project</b>									
(1) Rolling stock	0	0	23760	24000	24000	24000	0	0	84210
(2) Vehicle	0	0	0	0	0	0	0	1508	309
(3) Vessel	0	0	0	0	0	0	0	7237	1483
(4) Total	0	0	23760	24000	24000	24000	0	8745	86003
<b>1-3 With - Without</b>	0	0	-6000	12450	22170	19010	38240	-8745	-3953
<b>2. Benefit</b>									
2-1 Time saving	0	0	0	0	0	0	0	1408	1596
(1) Passenger	0	0	0	0	0	0	0	4	5
(2) Freight	0	0	0	0	0	0	0	1413	1600
(3) Total	0	0	0	0	0	0	0		
<b>2-2 Maintenance cost reduction</b>									
(1) With the project	1690	1690	1915	2143	2371	2599	2599	3989	5096
(2) Without the project	1690	1690	1991	2295	2599	2903	2903	3074	4243
(3) Benefit (without-with)	0	0	76	152	228	304	304	-915	-852
<b>2-3 Operating cost reduction</b>									
(1) With the project	34075	35568	37111	38755	40450	42221	44068	46800	48748
(2) Without the project	34075	35568	37111	38755	40450	42221	44068	47780	49965
(3) Benefit (without-with)	0	0	0	0	0	0	0	980	1217
<b>2-4 Decrease of traffic accident</b>									
(1) With the project	0	0	0	0	0	0	0	2400	2486
(2) Without the project	0	0	76	152	228	304	304	3878	4450
<b>2-5 Benefit total</b>	0	0	76	152	228	304	304	3878	4450
<b>3. Benefit - Investment Cost</b>	0	0	6076	-12298	-21942	-18706	-37936	12623	8403

Source: Study Team

Cost Benefit Table (2)

	MYITKYINA LINE]										Kyats in thousand			
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005				
1. Investment Cost														
1-1 With the project														
(1) Track	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(2) Telecom.	0	0	0	0	0	0	0	0	0	0	0	0	0	-23922
(3) Signalling	0	0	0	0	0	0	0	0	0	0	0	0	0	-24188
(4) Rolling stock	90290	0	0	0	98531	99261	99261	107884	107884	108103	108103	108103	108103	-636148
(5) Vehicle	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(6) Vessel	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(7) Total	90290	0	0	0	98531	99261	99261	107884	107884	108103	108103	108103	108103	-984258
1-2 Without the project														
(1) Rolling stock	89250	0	0	0	100867	100867	109709	109709	109709	109709	109709	109709	109709	-668892
(2) Vehicle	309	309	387	387	387	425	464	503	541	541	541	541	541	-3732
(3) Vessel	1486	1483	1855	1857	1855	2041	2225	2413	2597	2597	2597	2597	2597	-19365
(4) Total	91045	1793	2242	2244	103109	103334	112398	112625	112847	112847	112847	112847	112847	-691989
1-3 With - Without	-755	-1793	-2242	-2244	-4578	-4073	-13137	-4741	-4744	-4744	-4744	-4744	-4744	7731
2. Benefit														
2-1 Time saving														
(1) Passenger	1802	2029	2232	2453	2695	2959	3248	3562	3906	3906	3906	3906	3906	4280
(2) Freight	5	5	5	5	6	6	6	7	7	7	7	7	7	7
(3) Total	1807	2034	2237	2459	2701	2965	3254	3569	3912	3912	3912	3912	3912	4287
2-2 Maintenance cost reduction														
(1) With the project	6318	6318	6318	6318	7784	9263	10741	12352	13966	13966	13966	13966	13966	13966
(2) Without the project	5483	5518	5562	5606	7148	8694	10382	12073	13769	13769	13769	13769	13769	13835
(3) Benefit (without-with)	-835	-800	-756	-712	-637	-568	-359	-279	-197	-197	-197	-197	-197	-131
2-3 Operating cost reduction														
(1) With the project	50797	52922	55300	57779	60359	63066	65899	68859	71945	71945	71945	71945	71945	75158
(2) Without the project	52200	54511	57178	59897	62741	65713	68838	72117	75547	75547	75547	75547	75547	79157
(3) Benefit (without-with)	1403	1589	1879	2118	2382	2647	2939	3257	3602	3602	3602	3602	3602	3999
2-4 Decrease of traffic accident	2572	2662	2766	2870	2983	3096	3214	3336	3462	3462	3462	3462	3462	3595
2-5 Benefit total	4947	5486	6126	6735	7429	8141	9048	9884	10780	10780	10780	10780	10780	11749
3. Benefit - Investment Cost	5702	7278	8368	8979	12007	12214	22185	14625	15524	15524	15524	15524	15524	4019

# **SHORT-TERM IMPROVEMENT PROJECT**



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SHORT-TERM IMPROVEMENT PROJECT

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Appendix 4-3 (1) Train Diagram

(1) After completion of Phase-2 (1996/97)

Type of Trains	Train Number	Number of Trains (Total)
Mandalay line	Express 1 - 12	12
	Ordinary 21 - 34	8
	Local 51 - 66	10
	Freight 901 - 922	10
From/to Martaban line	Express 1001 - 1008	8
	Ordinary 1021 - 1024	4
	Freight 1901 - 1904	4
Suburban	-	48
		(Grand) 104

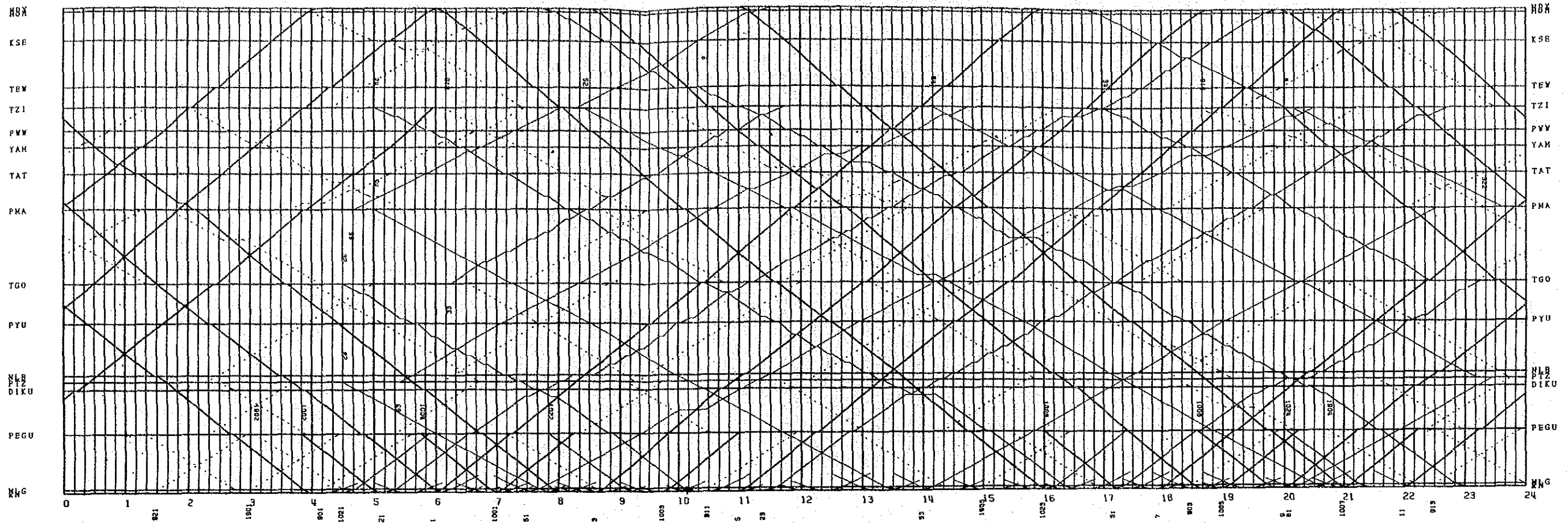
Some numbers are missing in the train numbers on the Mandalay line.

(2) After 30 years (2016/17)

Type of Trains	Train Number	Number of Trains (Total)
Mandalay line	Express 8001 - 8026	26
	Ordinary 21 - 35	15
	Local 51 - 68	18

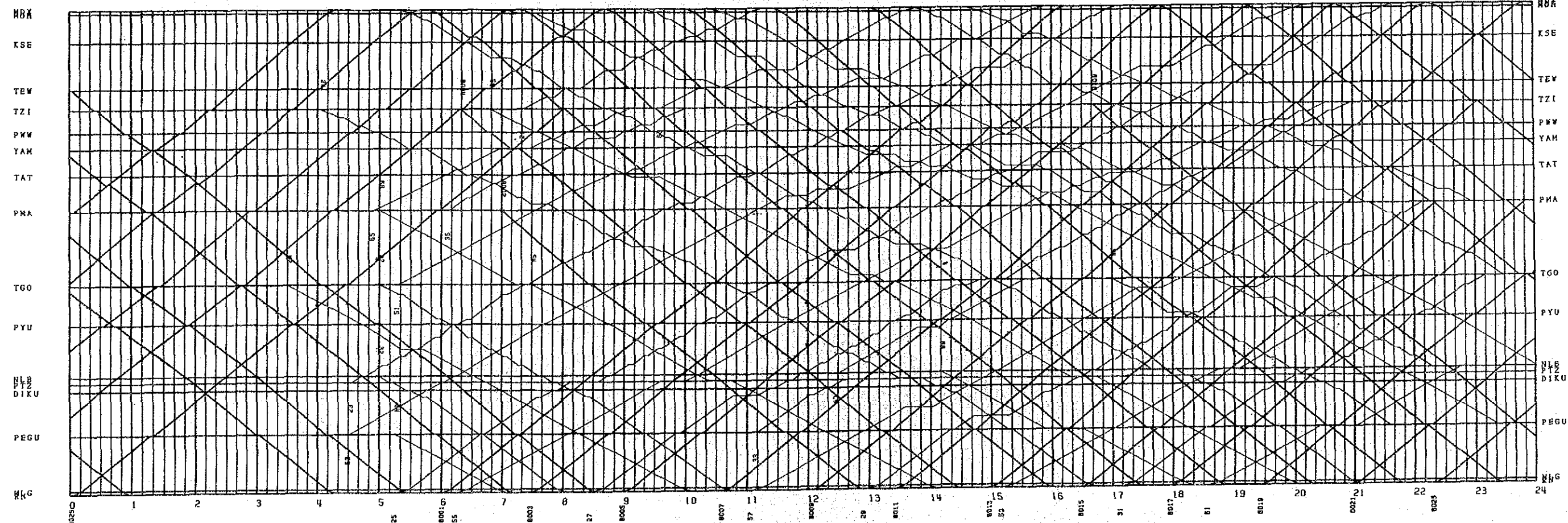
Excluding Suburban trains and trains from and to the Martaban line.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24



Train Diagram after Completion of Phase-2 (1996/97)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24



Train Diagram after 30 years (2016/17)



Appendix 4-3 (2) Calculation Method for Scheduled Time of 10 Hours

(1) Premises

- Maximum speed : 80 km/h (50 mph)
- Speed restriction on pass-through turnouts
  - Straight side : 72 km/h (45 mph)
  - Turnout side : 32 km/h (20 mph)
- Train make-up : DF1600 + 330 tons (11 cars)
- Gradient : 0 %
- Acceleration rate
  - 0 - 40 km/h : 0.83 km/h/sec
  - 40 - 80 km/h : 0.19 km/h/sec
- Deceleration rate: 1.25 km/h/sec
- Average distance in between block stations: 7.65 km

(2) Fig. 4.3.1 shows running curve and time curve in between block stations.

(3) Calculation results

- Running time : 561 min  
(Allowance time includes about 7 percent.)
- Stopping time : 21 min (7 stations x 3 min)
- Loss time in speed restriction through curve: 18 min
- Scheduled time : 600 min (10 hours = 561 min + 21 min + 18 min)

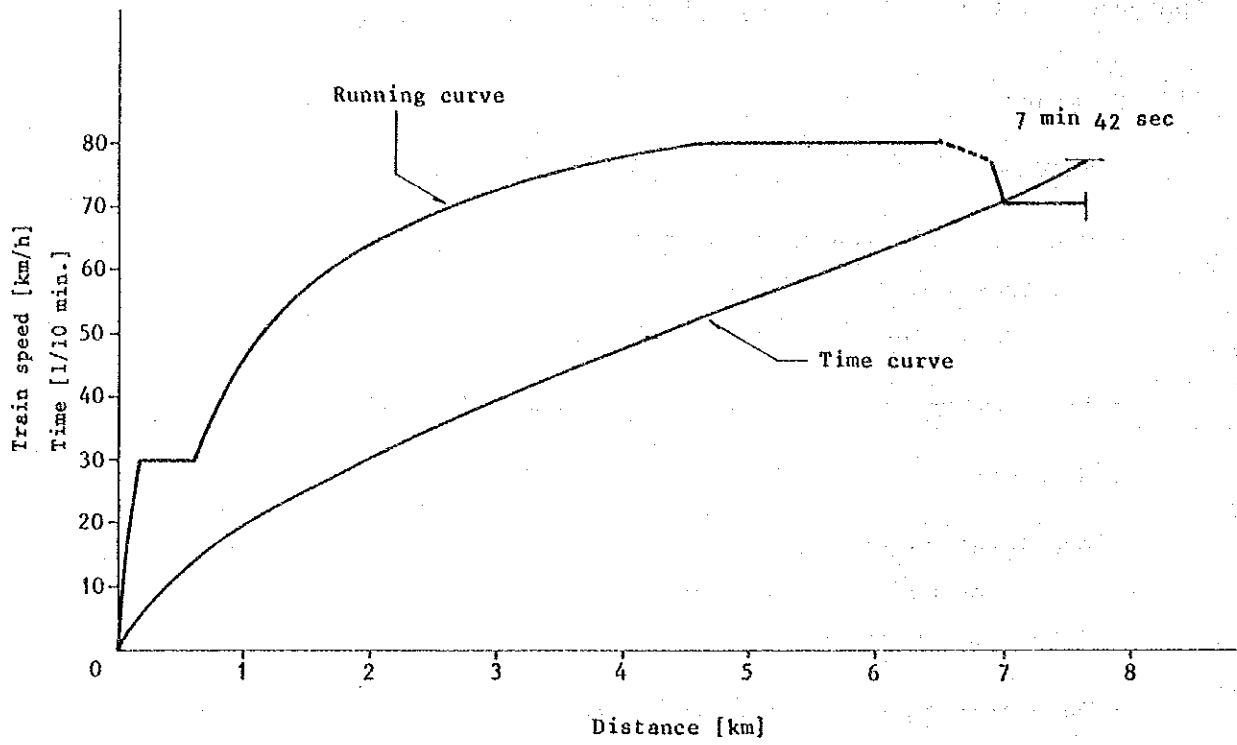


Fig. 4.3.1 Running Curve and Time Curve in between Block Stations (1)

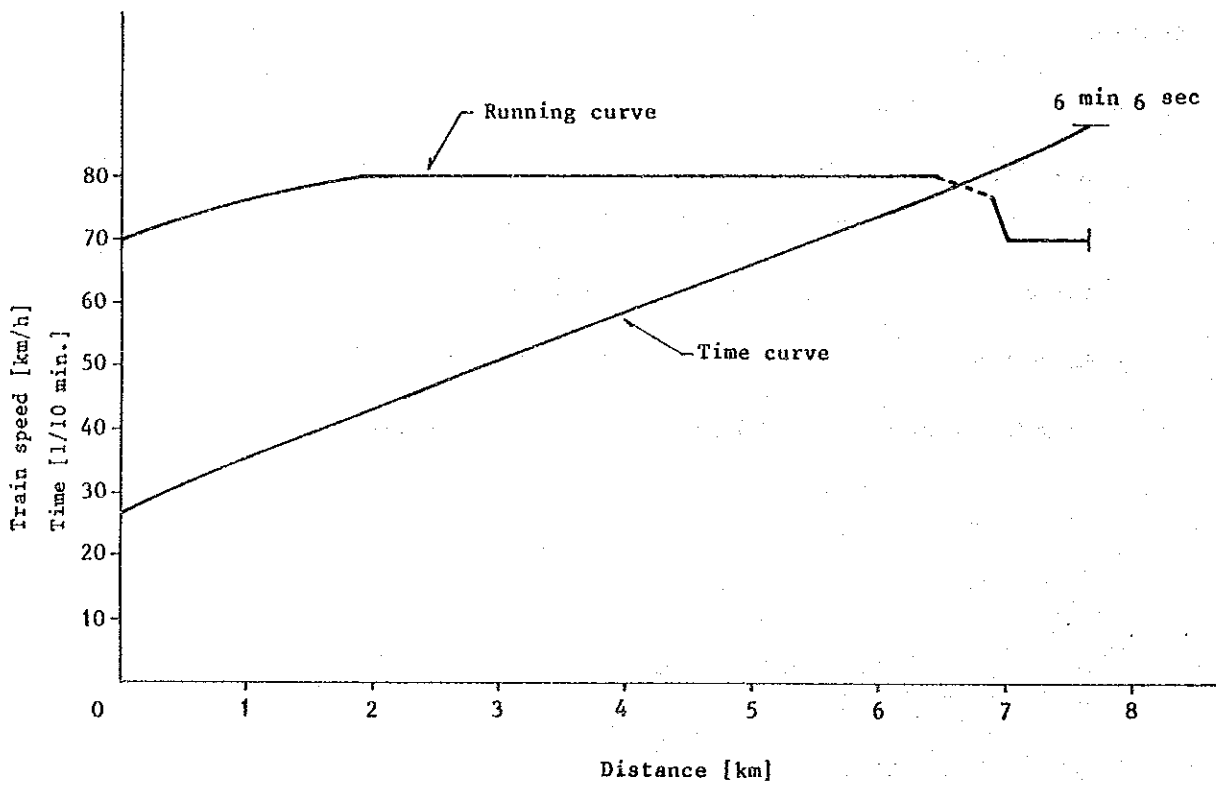


Fig. 4.3.1 Running Curve and Time Curve in between Block Stations (2)

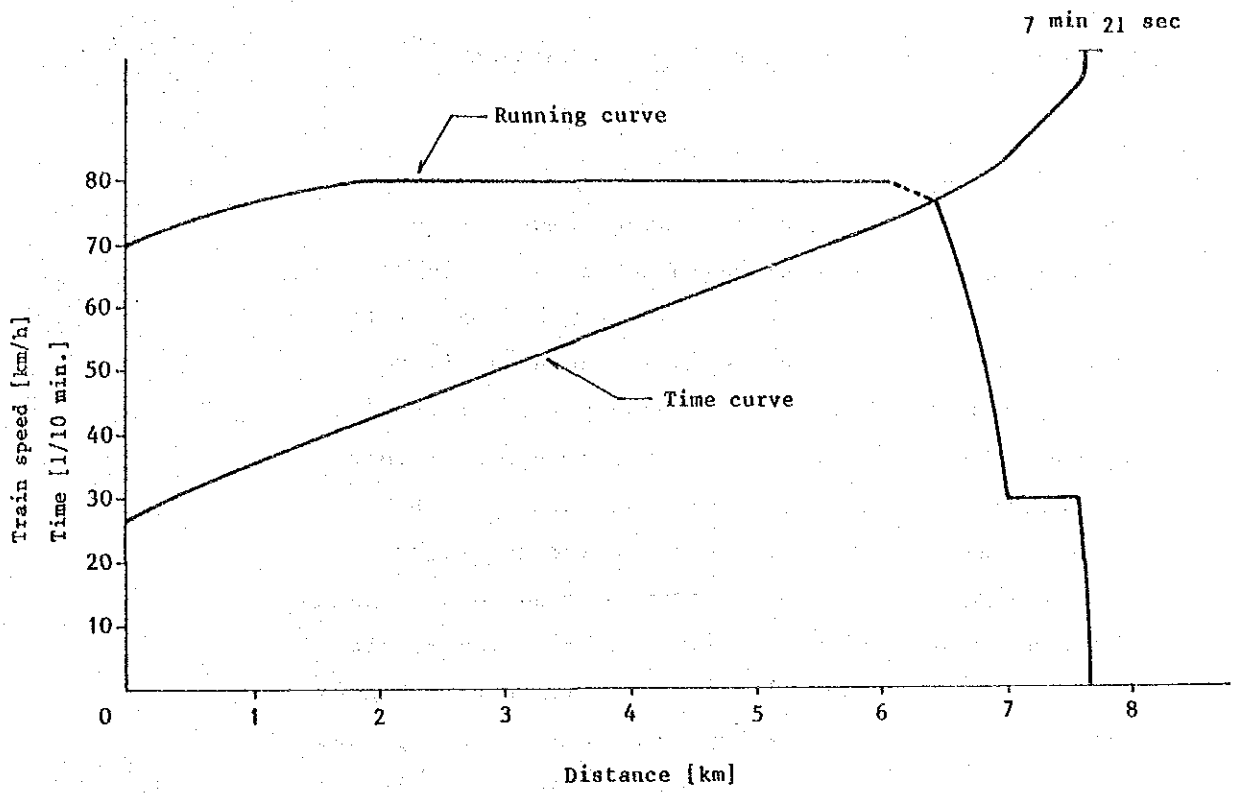


Fig. 4.3.1 Running Curve and Time Curve in between Block Stations (3)



Appendix 5-2 Plan for Removal of Useless Turnout

(1) Locations of turnout for siding

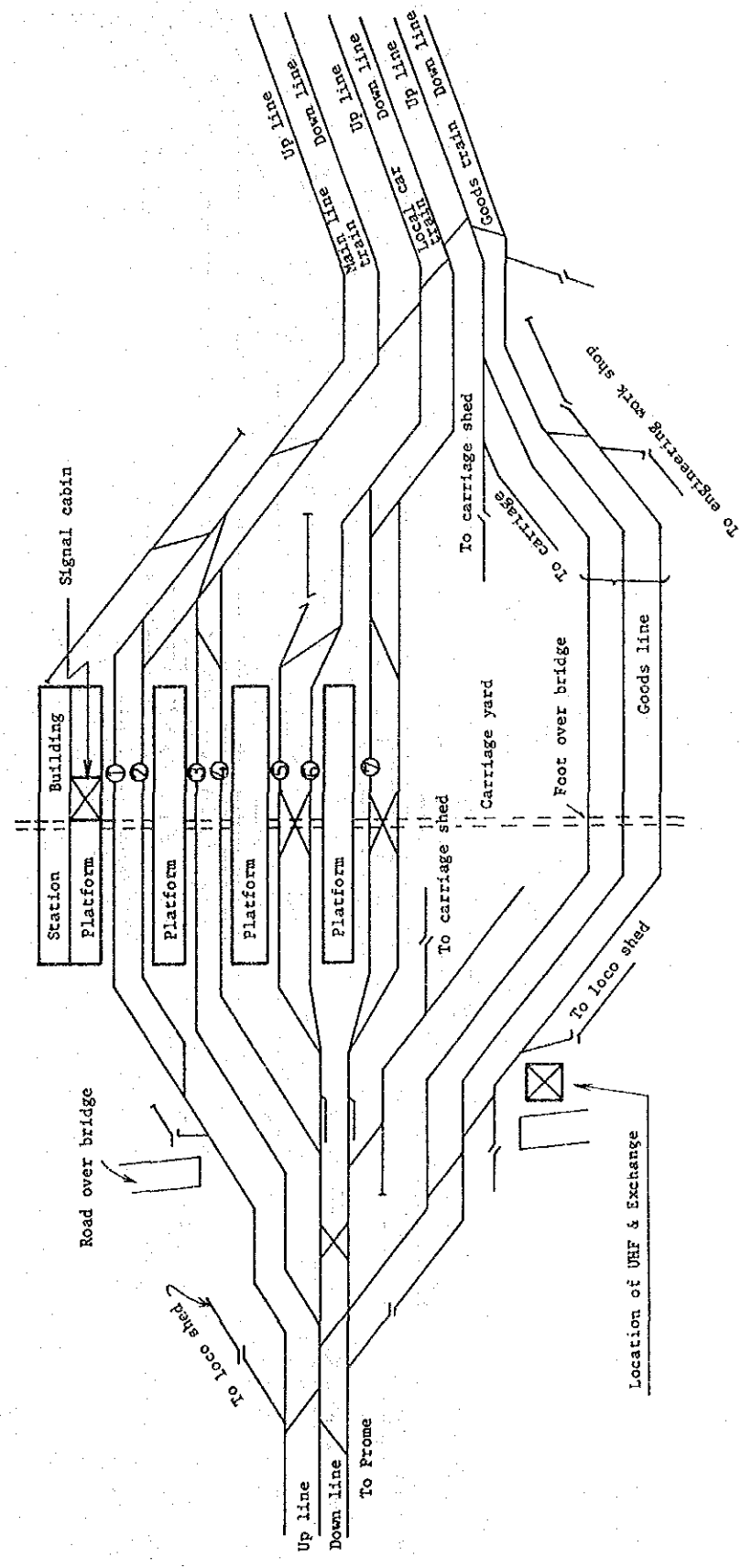
Ywathagui	Side of beginning point - right
Ledaunggan	Side of beginning point - right
Thategon	Side of railway termination - left
Tawaywe-in	Side of beginning point - right
Nyaungbintha	Side of beginning point - left
Nyaungbintha	Side of railway termination - left
Banbwagon	Side of beginning point - left
Thaungdainggon	Side of beginning point - right
Thaungdainggon	Side of railway termination - right
Thaungdainggon	Side of railway termination - left
Kyedaw	Side of railway termination - right
Magyibin	Side of beginning point, and side of railway termination - left
Shanywa	Side of beginning point, and side of railway termination - right

(2) Locations of turnout for cross-over

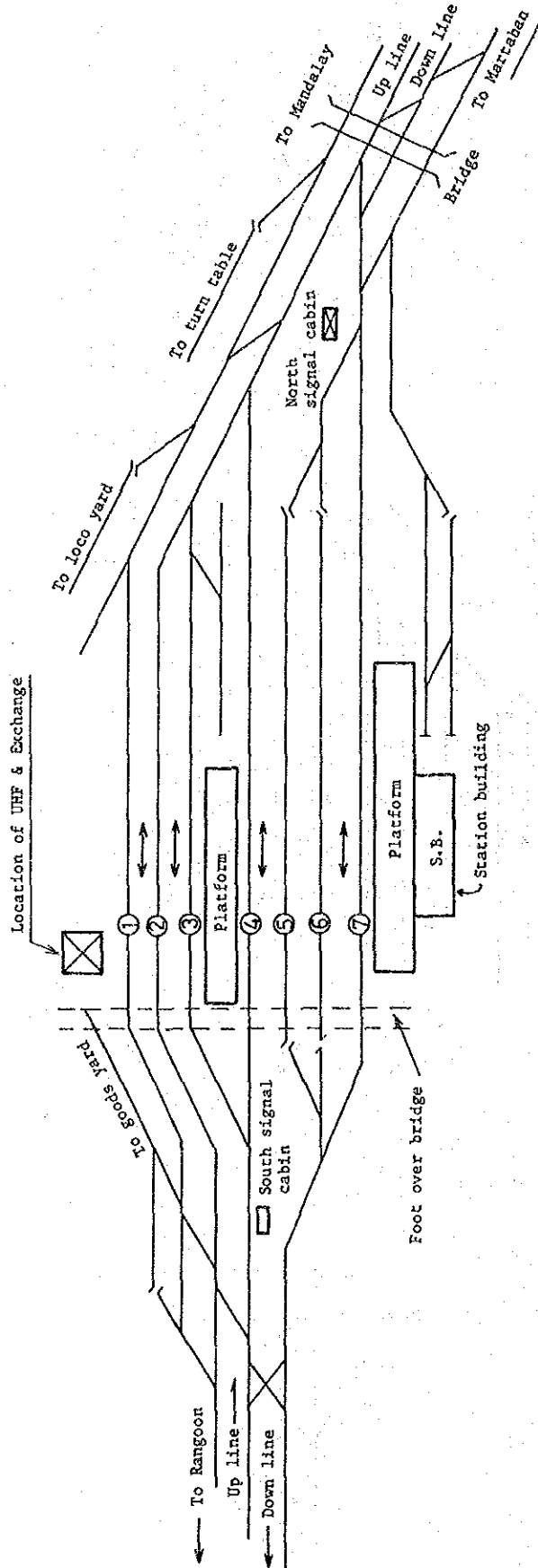
Mahlwagon	Side of railway termination
Togyauungale	Side of railway termination
Dabein	Side of beginning point
Payagyi	Side of railway termination
Kadok	Side of railway termination
Paungdawthi	Side of beginning point
Daik-U	Side of railway termination
Pyu	Side of railway termination
Oktwin	Side of railway termination
Thaungdaingon	Side of railway termination
Kyedaw	Side of railway termination

Appendix 5-3 Location of UHF and Exchange

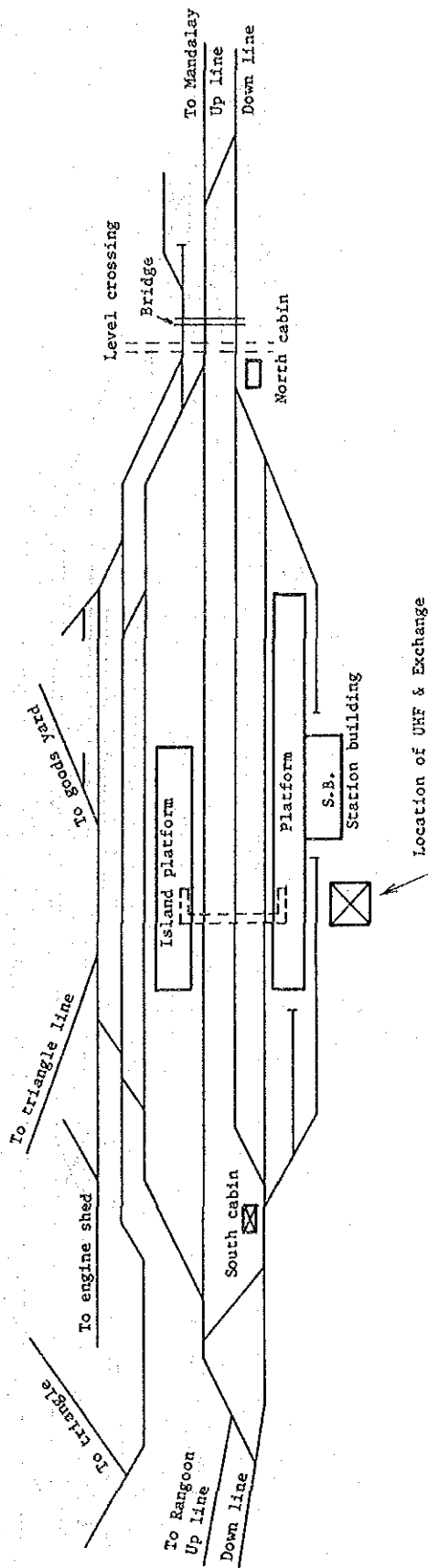
RANGOON STATION YARD (MAIN STATION)



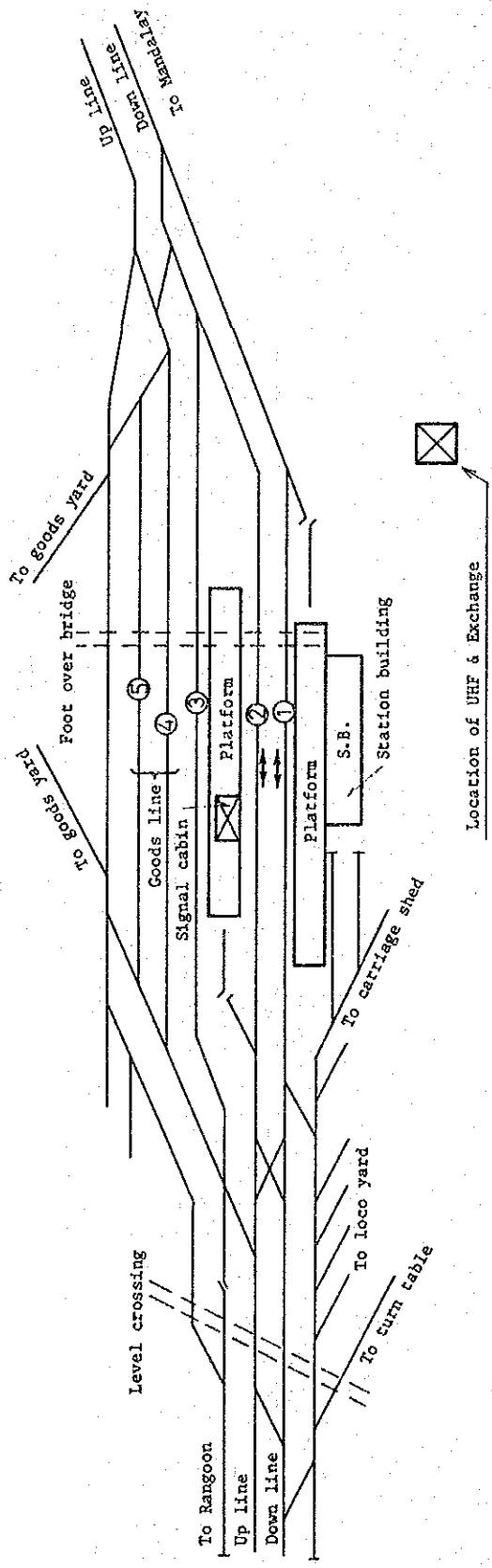
PEGU STATION YARD (JUNCTION)



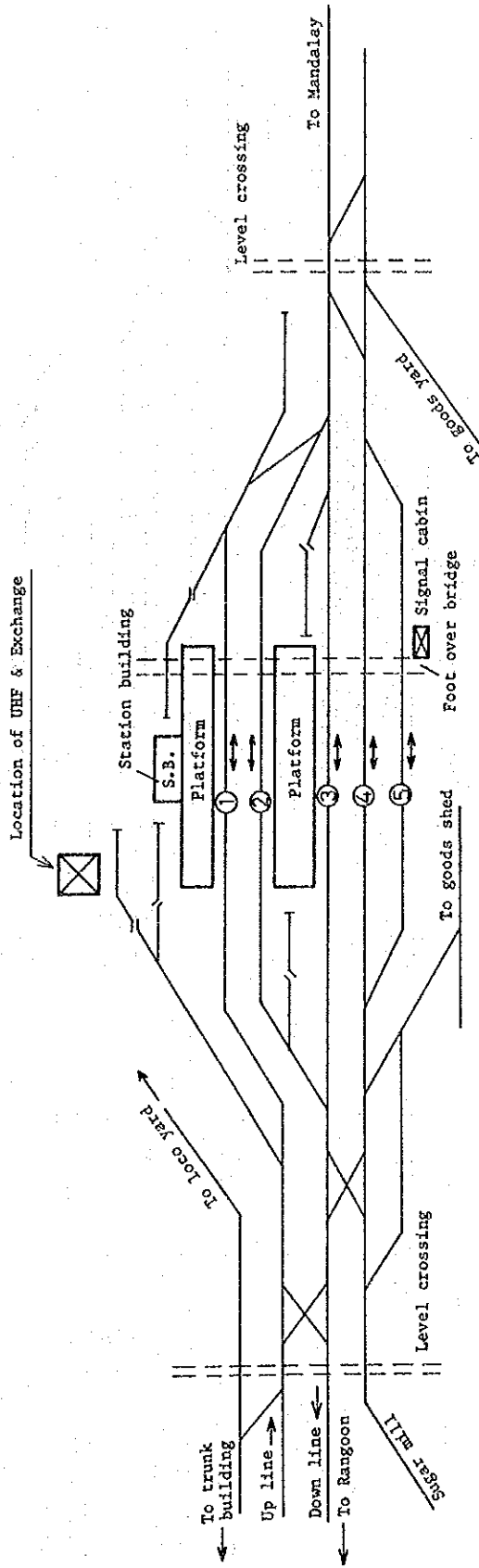
PYUNTAZA STATION YARD (MAIN LINE)



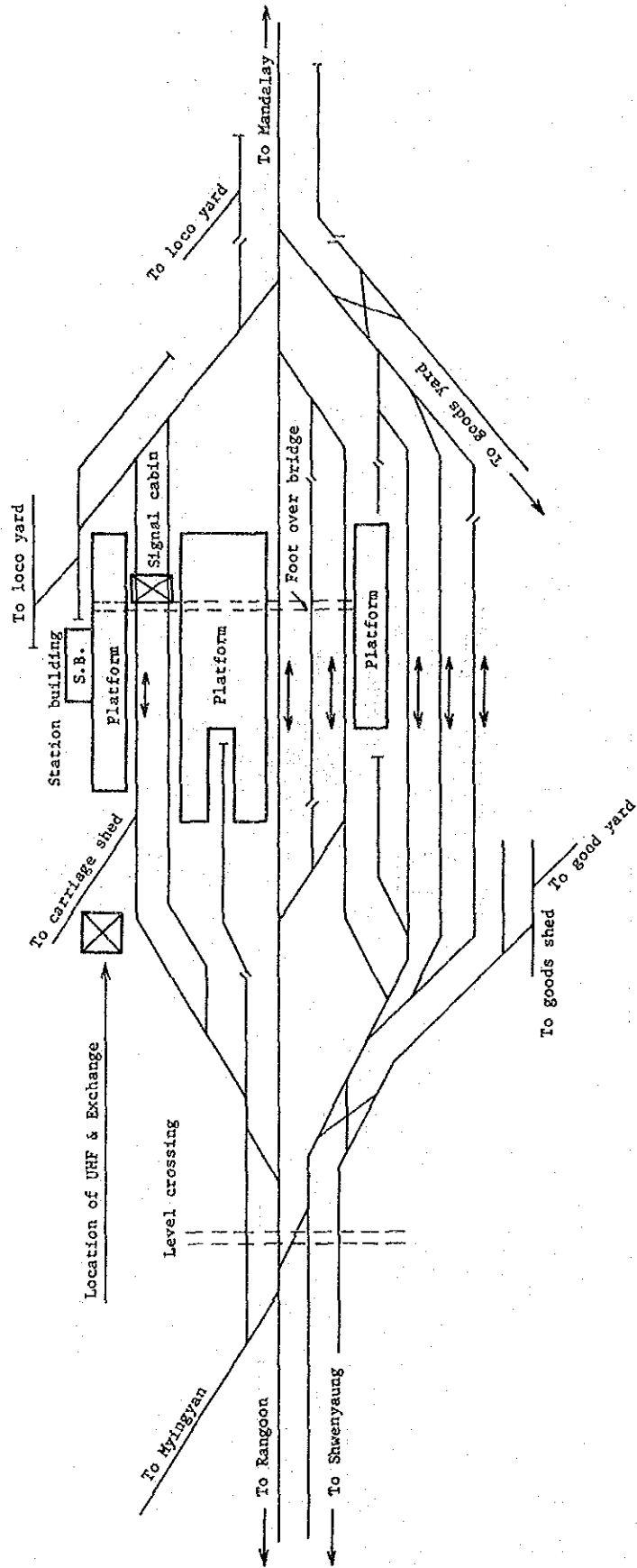
TOUNGOO STATION YARD (MAIN STATION)



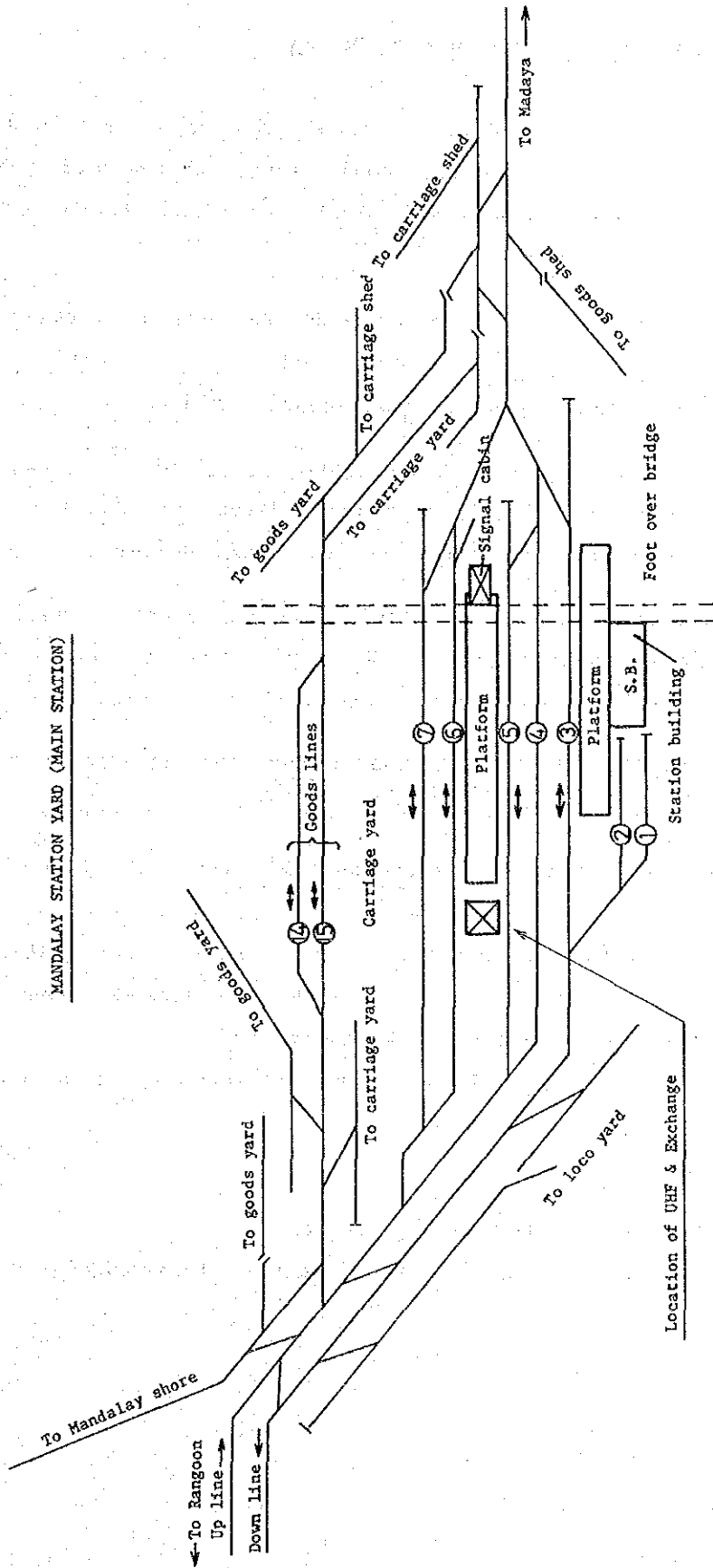
PYINMANA STATION YARD (JUNCTION)



THAZI STATION YARD (JUNCTION)



MANDALAY STATION YARD (MAIN STATION)



Location of UHF & Exchange



## Appendix 5-4 (1) Electronic Interlocking Device

The electronic interlocking device controls the switch machines in the station yard, and signals. The electronic interlocking device has the following major functions which are different from those of relay interlocking devices.

- All interlocking functions are designed by the use of software. The electronic interlocking device is connected with the field device by means of the input/output relay or photo coupler element.
- For ensuring safety in maintenance work, the software within the electronic interlocking device controls all deterring functions such as track closure and suspension of use of signalling equipment.
- As a man-machine device, the CRT display control board is used instead of the conventional control board. CRT replacement in case of failure is easy because same types of devices are used in each station.
- The device automatically records and stores the set train route by purpose.
- The train routes at station yards are automatically set by the key code of train number.

The shunting routes for rolling stock can be also set automatically by its pattern number. Therefore, the diagram and schedule required for the automatic route setting have to be registered.

In the plan proposed, the route is to be set manually in consideration of the train frequency.

### 1) System configuration

Fig. 5.4.1 shows the system configuration.

Table 5.4.1 shows the Function of Electronic Interlocking Device by each part.

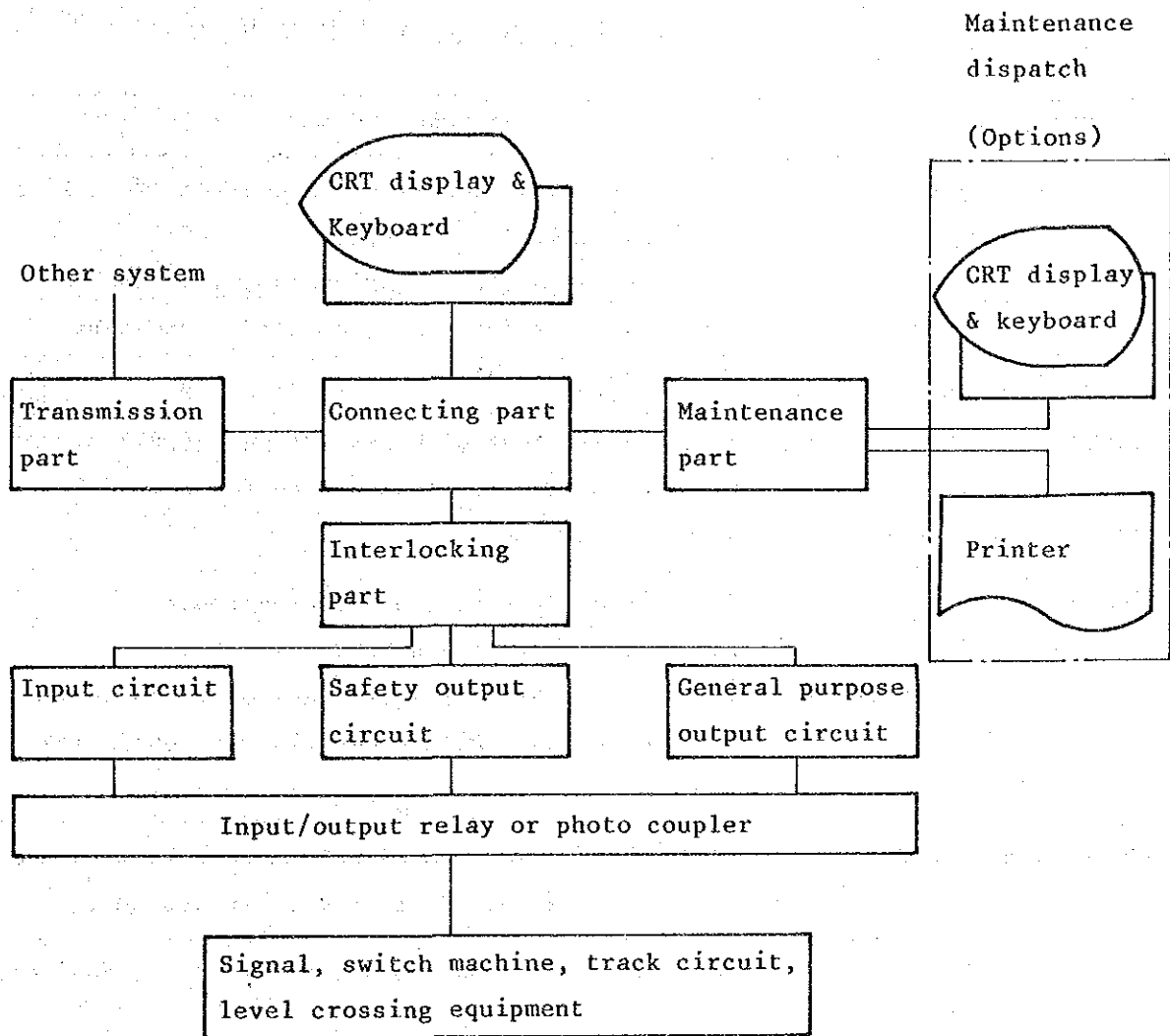


Fig. 5.4.1 System Configuration

Table 5.4.1 Functions of Electronic Interlocking Device

Structural part	Description
Interlocking part	Route selection, interlocking control of locking and unlocking. Connected with signalling equipment by the input/output relay, or with field devices by photo coupler element.
Connecting part	Data input/output with display unit (CRT) or optional machines, or data transfer among the interlocking device.
Maintenance part	Maintenance data control of electronic interlocking device and signals. Central control of failure data of field devices by entering the failure details via connecting systems.
Transmission part	Transfer of the control and display data to the operational display part and other systems.
Input circuit	Input of operational condition of signal devices.
Safety output circuit	Data output for signals (for those requiring high reliability).
General purpose output circuit	Same as above (for those not requiring high reliability).
Display control board	Man-machine control, manual route setting, route storage and track diagram display.
Input/output relay racks	Interface with signalling equipment and other facilities.

## 2) Function

Table 5.4.2 shows the functions of Electronic Interlocking Device.

Table 5.4.2 Function of Electronic Interlocking Device

Function	Description
Interlocking function	Route selection Switching instruction is given to the electric switch machine on the route between departing and arrival points by entering route selection (selection of departing and arrival points).
Locking & unlocking	Locking and unlocking of train route, locking and unlocking of switch machines after switching, and locking and unlocking of signal indication.
Control of signal device	Control of signals, shunting signal and switch machine. To provide level crossing in station yard with instructions on sounding of alarms. If the switching is not made, an alarm is given to the operator. All signals within the station yard are simultaneously operated to display the stop aspect in an emergency.

	Function	Description
Inter-locking function	Operational diagnosis of track circuit	To monitor the time and order of operation of track circuit according to the movement of rolling stock between adjacent track circuits.
	Blocking of track control	By designating the blocking of track, the route setting of all rolling stock except the maintenance car within the section, and independent lever of switch machines are nullified.
	Route control of maintenance car	By designating the 'maintenance car' and changing the route from the display control board, the switch machine on the route is controlled and the route is locked.
	Suspension of signal operation	In case of signal failure and maintenance, the setting of related routes and independent operation of switch machines are disabled by inputting 'suspension of operation' from the key board.
	Monitor of signal failure	The operational condition of signals is monitored and the signal is activated to the safety-side when a failure is detected.

	Function	Description
Function of display control	Display	To display the track diagram, and operational condition of signal facilities, etc.
	Input data	To enter route selection, route restoration, independent point machine operation, lock lever operation, automatic and manual blocking of track, route selection of maintenance car and suspension of operation of signal.
	Operating method of keyboard	Manual route setting and independent point machine operation are made by inputting through function keys and ten keys.
Maintenance data control function	Maintenance of electronic interlocking device	Maintenance data control of whole system including the failure restoration data detected at each structural part of the electronic interlocking device.
	Maintenance of signal facilities	In case of failure of signals, switch machine and track circuit, to output the record of operational condition of all signal facilities, details of failure and the time.
	Maintenance of facilities	To control the data for the maintenance of peripheral facilities.

3) Performance

Table 5.4.3 shows the Performance of Electronic Interlocking Device.

Table 5.4.3 Performance of Electronic Interlocking Device

Performance	Characteristics	
Power voltage	AC 200 $\pm$ 40 V	50 Hz
Control voltage	DC 24 V $\pm$ 10 percent	
Environmental characteristics	Temperature	0° - 50°C
	Humidity	95 percent or less
Insulation characteristics	AC 500 V	100 M $\Omega$ or more
Endurance voltage	AC 1000 V	1 minute or more
Vibration resistance	1G 20 Hz vertically and horizontally	
Max. capacity of facilities	No. of routes	max. 80
	No. of signal lever	max. 48
	No. of switch machines	24
	No. of track circuits	48
	No. of signals	48

## Appendix 5-4 (2) Electronic Token Block System (cab-signal)

The electronic token block system consists of the station equipment, and the on-board equipment. The station equipment has; the station unit with wireless, transmission, logical unit, and the control board; the wayside coil to give the information on train position; the tail check device. The on-board equipment has: the cab signal unit with wireless, display, and logical unit; the position detector to receive the train position signal; the pick-up coil.

- The boundary of the block section is at the position of tail check device.
- Train departure and arrival are checked by the information of the position detector and tail check device, and station master's pressing of arrival and departure push-buttons.
- The blocking is set between the station units using the train number.
- The cab signal unit displays the indications on start, outer, and distant signals, wireless link, and train position.
- When the cab signal indication changes, a bell rings.

### 1) System configuration

Fig. 5.4.2 shows the system configuration of Electronic Token Block System.



Station equipment

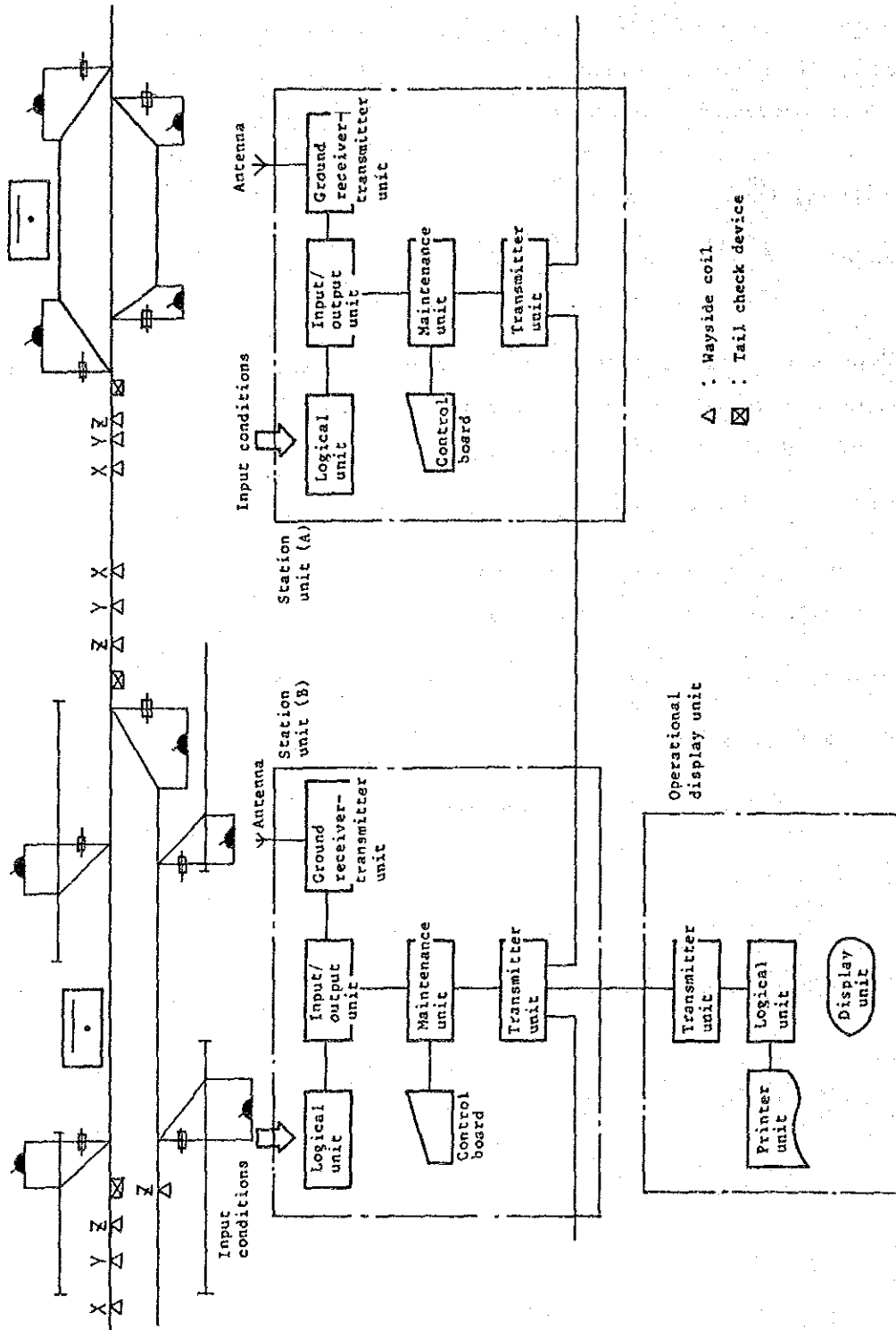


Fig. 5.4.2 System Configuration of Electronic Token Block System (1)

On-board equipment

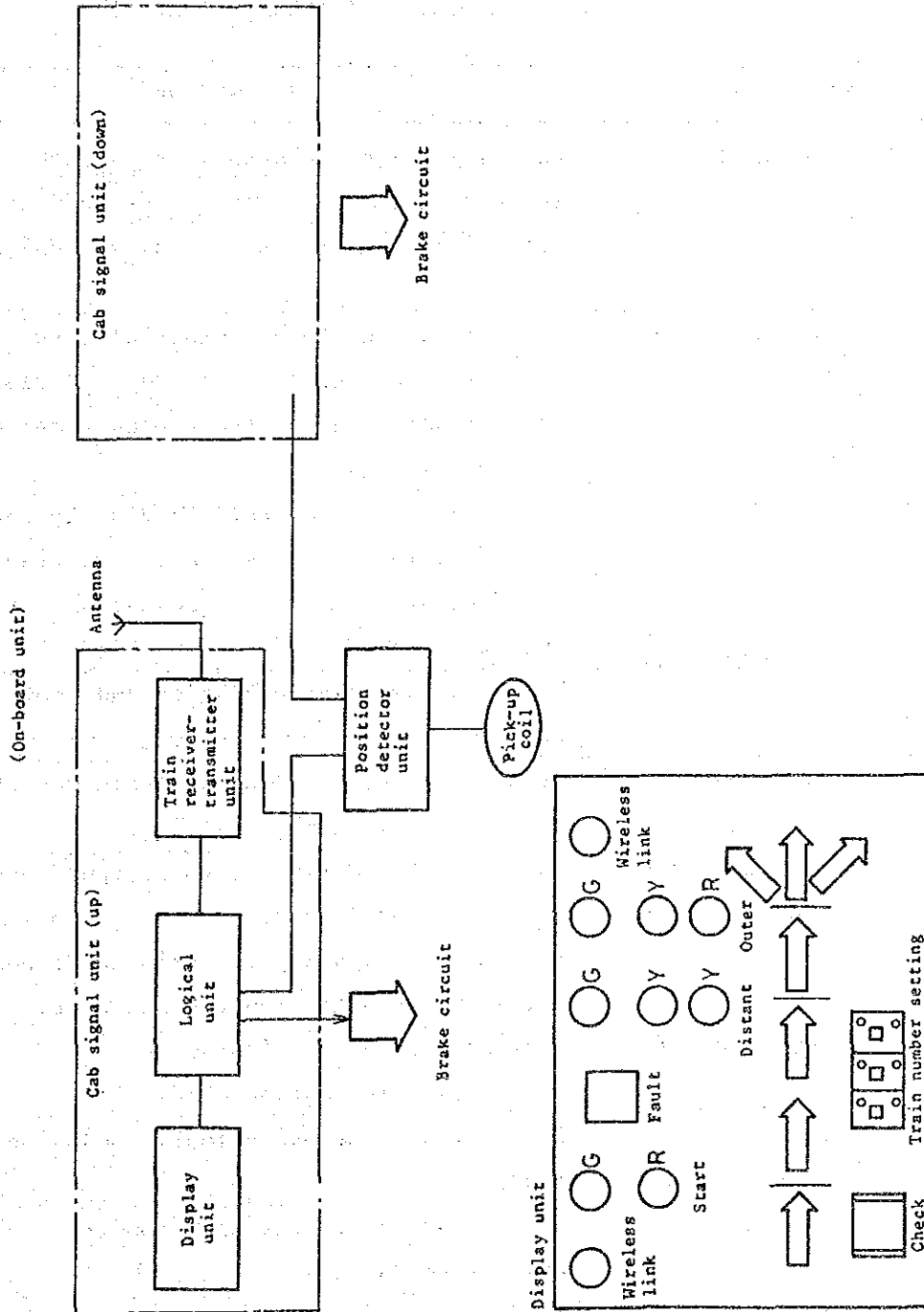


Fig. 5.4.2 System Configuration of Electronic Token Block System (2)

Table 5.4.4 shows the configuration of Electronic Token Block System by each part.

Table 5.4.4 Function of Electronic Token Block System

	Constituent unit	Description
Station unit	Safety unit	Blocking, signal control, train number identification and control, train detection, point lock, detection of faulty condition, etc.
	Input/output unit	To transfer the input/output data to point machines and electric lock devices via the logical unit, and to the ground receiver-transmitter unit.
	Transmission unit	To transfer the control and display data to the operational display unit. To transfer the blocking data to the transmission unit of an adjacent station.
	Logical unit	To check the point condition and route condition.
	Control board	Point display, handling of train departure and arrival, train number setting.
	Ground receiver-transmitter unit	To transmit the signal from output/input unit to the on-board unit. To read the signal from train and transfer the necessary data to input/output unit.
Operational display unit	Transmitter unit	Control between station unit. To transmit indication data.
	Printer unit	To print out the operational condition of train.
	Display unit	To display the operational condition of train and system failure.
	Logical unit	To display the operational condition of train and system failure, and print them out.

Constituent unit	Description
On-board unit	<p>To display the signal received from the on-board receiver-transmitter.</p> <p>To give ATS command to locomotive.</p> <p>To make the data transfer of the signal received through the position detector to the on-board receiver-transmitter.</p>
On-board receiver-transmitter unit	<p>To read the signal from the ground unit and transfer the necessary data to the logical unit.</p> <p>To transfer the data from the logical unit to the ground unit.</p>
Display unit	<p>Signal aspects display like wayside signal and train position display. This unit has the function to set the train number.</p>
Position detector unit	<p>To transfer the information of the position to the logical unit when a train passes the wayside coil.</p>
Pick-coil	<p>To receive the signal of the wayside coil when a train passes it.</p>

(2) Function

Table 5.4.5 shows the function of Electronic Token Block System.

Table 5.4.5 Function of Electronic Token Block System

Unit	Function	Description
Station unit	Blocking	Setting and unlocking of block
	Train detection	To detect a train by position information of the wayside coils at station yard, tail check device and train number transferred from train.
	Interlocking	(At non-interlocking station) Point lock and check of route conflicts.
		(At interlocking station) Point control, route lock, stick locking, indication locking and other necessary locking.
	Display	Point lock display, switching direction display.
	Input	Input of train number and train departure/arrival by pressing push buttons.
Operational display unit	Receiving transmitting	Signal transmission to on-board unit. To receive data like train number, etc. from on-board unit and transfer necessary data to input/output unit.
	Transmission control	To receive and transfer the control and display data to each station unit. To detect the transmission failure.
	Display	To display train number, train signal and position detection data. To display the malfunction of each station unit (option).

Unit	Function	Description
Operational display unit	Train type control	To make data of the stations where each number of train passes and have station unit store it.
	Blocking of track	To close the track to be occupied by the maintenance work.
	Alarm	To sound buzzer when failure of station unit, is detected.
	Recording	To print out the arrival and departure records of train.
	Keyboard input	To process data input at keyboard and execute it by each function.
On-board unit	Display function	To display indication of cab signals and train position based on the data transferred from the station unit.
	Position detection	To transfer the detecting data of train position when a train passes the wayside coil.
	ATS	According to the train signal condition, to give the brake command to the locomotive.
	Alarm	To give an alarm at display change, braking command and failure of train unit.

3) Method of operation

Table 5.4.6 shows the Method of Electronic Token Block System.

Table 5.4.6 Method of Electronic Token Block System

	Setting	Method
Operation by station master	Route	Manual setting of departure and arrival routes.
	Blocking the section	By pressing the push-button for blocking.
	Train number	To set the train number of departing trains at the starting station.
	Train departure	To display a departure signal at the on-board unit by pressing the departure push-button.
	Train arrival	To press the arrival push-button when a train arrives.
Operation by engine driver	Train number	An engine driver sets the train number at the starting station.
	Lamp check of wireless link	If the train number set at station yards coincides with that on the train, the light of wireless link goes on.

4) ATS function and cab signal indication

a) At departure

A brake is not released when an on-board unit is linked with the station unit, indicating the start signal the stop. In case of shunting, however, the brake is released even when the start signal is the stop indication.

b) After train's departure

When the train passes Z point normally, the wireless link from the starting station is shut down. A white light between stations on the on-board display goes on.

If an emergency stop of the train is required just after departure, the stop is possible by the function of simultaneous stop while the wireless link is available up to Z point.

c) Reach within wireless link of next station

When the train reaches the distance of wireless link from the next station, the indication light of wireless link goes on. The light of outer signal makes red-flush to secure safety when the position detector misses the signal of X or Y points.

d) Passing X point

On passing X point the lights of distant and outer signals on the on-board display go on and the white light indicating the train position shifts to the inside of X point.

e) Passing Y point

On passing Y point, the light of distant signal and red-flush of outer signals go off, and the light of outer and start signals go on. The white light at the inside of X point shifts to the inside of Y point. The indication for arriving route goes on.

f) Passing Z point

On passing Z point, the outer signal goes off, and the white lamp shifts to the inside of Z point.

g) When the polling between the station and on-board wireless units is cut off.

If the response from the station unit is not given more than the fixed number of times after the start of polling, a brake command for ATS is given, judging the failure of wireless system.

5) Function for safety

a) A train number is set at the starting station, whose train number is checked among a station master, a driver, and a controller. When the station master set the block ahead for the train, the train number is automatically transferred to the next station unit.



b) On the train's approaching the next station, the train number on the on-board unit is also checked at every transmission between the train and the station.

c) The signal indication of the on-board unit is maintained as it is if the polling from the station unit is not received (transmission link is not made).

If the polling is suspended for a certain time, the failure of station unit is judged, and a brake command is given from the on-board unit.

6) Safety at trouble and failure

Safety can be assured at the following cases of trouble and failure.

Table 5.4.7 shows the trouble or failure of Electronic token block system.

Table 5.4.7 Trouble or Failure of Electronic Token Block System  
At departure

Number	Trouble or failure	Train operation	Remarks
1	Failure of token block and on-board equipment	x	Cab signal indication goes off. Stop a train automatically by emergency brake.
2	On-board unit failure after departure	x	Same as above
3	Wayside coil failure	o	The Green light of start signal keeps on, and the white light of train position does not shift to the section from the station yard. Such condition becomes normal when the train goes far beyond the wireless link of the station, or a driver handles the on-board unit panel.

On arrival

Number	Trouble or Failure	Train operation	Remarks
1	On-board unit failure, before polling start	x	A brake command is given on passing X point.
2	Same as above, after polling	x	The wireless link light goes off and a brake command is given.
3	Block equipment failure	x	A brake command is given on passing X point.
4	Failure of X way-side coil only	o	A red-flush light of an outer signal goes on, whose light turns to normal indication at Y point.
5	Failure of Y way-side coil only	o	Normal indication at certain time after X point.
6	Failure of Z way-side coil only	o	Normal indication at certain time after Y point.
7	Failure of X, Y, wayside coils	x	A train goes in slowly by instruction of a station master after the train stops at the position of an outer signal. The red-flush light keeps on.
8	Failure of X, Y, Z wayside coils	x	Same as above

Note o: no disturbance, x: disturbance

7) Performance

Table 5.4.8 shows the performance of Electronic token block system.

Table 5.4.8 Performance of Electronic Token Block System

Performance	Characteristics		
	Operational display unit	Station unit	On-board unit
Power source voltage	AC100V $\pm$ 10V 50 Hz	AC200V $\pm$ 40V 50 Hz	DC72V $\pm$ 7V
Control voltage	-	DC24V $\pm$ 10 percent	
Environmental characteristics	Temperature Humidity	0 - 50°C 95 percent or less	
Insulation characteristics	DC500V	100 M $\Omega$ or more	
Endurance voltage	AC1000V	1 min. or more	
Vibration resistance	1G 20Hz in vertical & horizontal directions		1 - 5G amplitude 10mm 1G 5 - 30Hz
Impact	-	-	3G (29.4 m/s <sup>2</sup> ) 4 repetitions
Wireless frequency	-	400 MHz	400 MHz
Output	-	1 W	1 W
Signal system		1200 BPS	
Interstational transmission speed	2400 BPS	2400 BPS	

Cab signal indication system (Reference)

Cab signal indication system of the on-board unit

Start signal, distant signal, outer signal, wireless link and train position lamps are equipped on the on-board unit panel.

- 1) Start signal has 2 aspects: proceed G and stop R
- 2) Distant signal has 3 aspects: proceed G, caution Y, Attention YY
- 3) Outer signal has 3 aspects: proceed G, caution Y and stop R
- 4) Fig. 5.4.3 shows the cab signal indication system
- 5) When the cab signal changes its indication, a bell rings.

Table 5.4.9 shows the timing of cab signal.

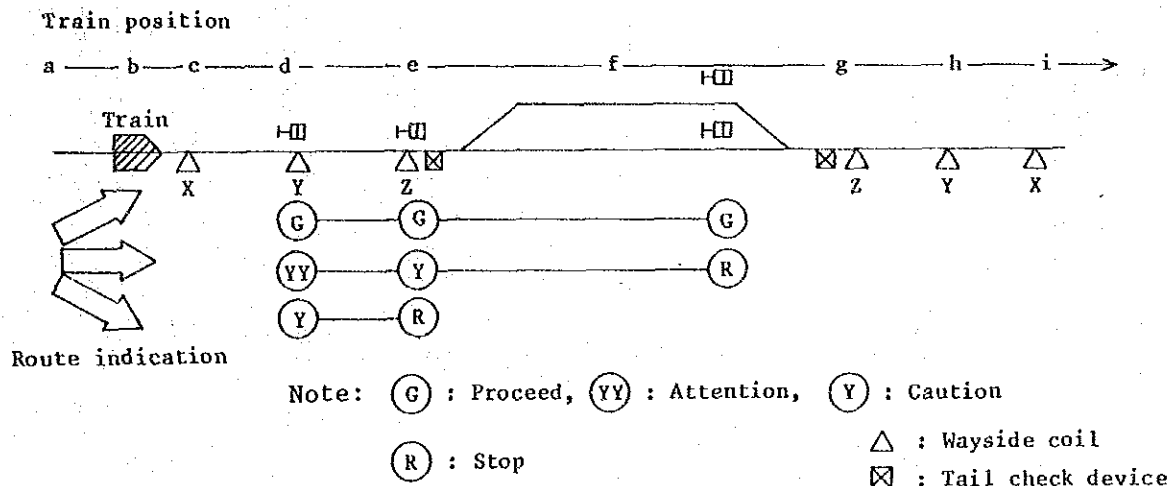


Fig. 5.4.3 Cab Signal Indication System

Table 5.4.9 Timing of Cab Signal

Cab Indication Lamp										
Train position	Wireless	Starting Signal	Station Yard	Z-X	X-Y	Distant Signal	Y-Z	Outer signal route display	Station Yard	Wireless
- a				W						
a - b				W						g
b - c				W				r		g
Station Stop										
c - d					W	YY		Y		g
d - e		R					W	Y		g
e - f	g	R	W							
Station Pass										
c - d					W	G		G		g
d - e		G					W	G	W	g
e - f	g	G	W							
f - g	g	G	W							
g - h				W						
h - i				W						
i -				W						
Stop outer signal										
c - d					W	Y		R		g
d - e		R					W	R		g
Start										
f - g	g	R	W							
Departure	g	G	W							
g - h				W						
h - i				W						
i -				W						
X point failure										
				W				r		g
Station Stop										
c - d				W				r		g
d - e		R					W	Y	W	g
e - f	g	R	W							
Station Pass										
c - d				W				r		g
d - e		G					W	G	W	g
e - f	g	G	W							
f - g	g	G	W							
g - h				W						
h - i				W						
i -				W						
Y point failure										
				W				r		g
Station Stop										
c - d					W	YY		Y		g
d - e								Y		g
A certain time after passing X point		R					W	Y		g
e - f	g	R	W						W	

Cab Indication Lamp

Train position	Signal wireless	Starting Signal	Station Yard	Z-X	X-Y	Distant Signal	Y-Z	Outer Route display	Station display Yard	Wireless
Y point failure				W				r		g
Station Pass					W	G		G		g
c - d					W	G		G		g
d - e										
A certain time after passing		G					W	G		g
X point										
e - f	g	G	W							
f - g	g	G	W							
g - h				W						
h - i				W						
i -				W						
Z point failure				W				r		g
Station Stop					W	YY		r		g
c - d					W	YY		r		g
d - e		R					W	Y		g
e - f		R					W	Y	W	g
A certain time after passing	g	R	W							
Y point										
Station Pass					W	G		G		g
c - d					W	G		G		g
d - e		G					W	G		g
e - f		G					W	G	W	g
A certain time after passing	g	G	W							
Y point										
f - g	g	G	W							
g - h					W					
h - i					W					
i -					W					
X and Y points failure					W			r		g
Station Stop or Pass					W			r		g
c - d					W			r		g
d - e					W			r		g
Waiting for the station master's dispatch to stop at station									W	
e - f	g	R	W							
X, Y and Z points failure					W			r		g
Station Stop, or Pass					W			r		g
c - d					W			r		g
d - e					W			r		g
Waiting for the station master's dispatch to stop at station					W			r		g
e - f					W			r	W	g
Arrival push-button to be pressed	g	R	W							
Receiver-transmitter failure	On the train, the receiver-transmitter failure is detected by receiving the signal, of a wayside coil, and the stop signal or fault display on the on-board panel is made. The train stops waiting for the station master's instruction.									

Note: g: Green flush    W: White    G: Green  
r: Red flush    R: Red    Y: Yellow

### Appendix 5-4 (3) Electronic Token Block System

To logically check train arrival and departure, each station is equipped with a simple tokenless system, which semi-automatically ensures train blocking and safe train operation. The tail checking device that is mounted on the rear part of the train checks its entrance into and departure from the station yard. Each station is equipped with a simple tokenless system, with the data from these stations collected by the train operation display unit (the target is for about 15 stations) at the central control office.

#### Block control and train check systems

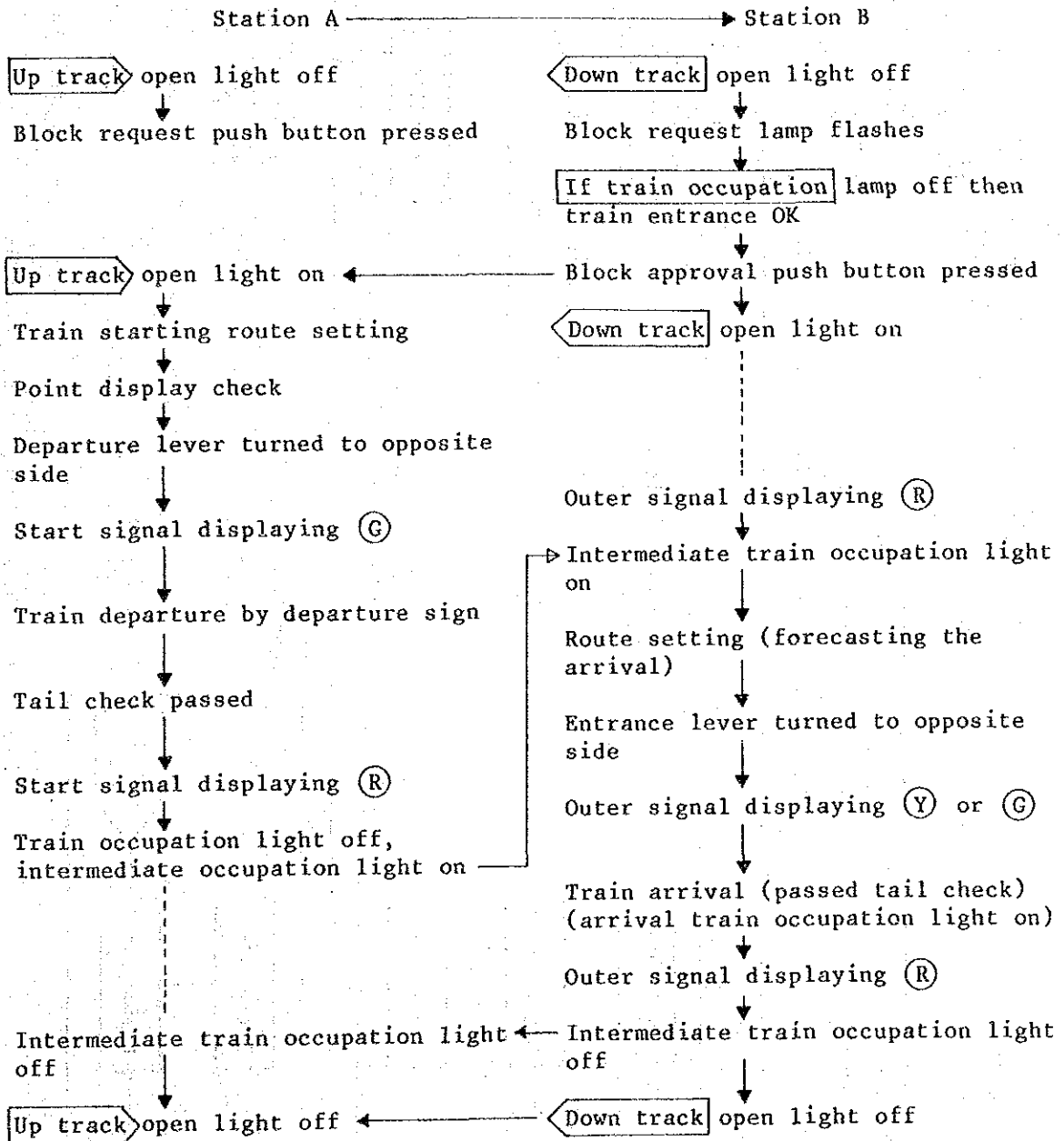
- 1) The tail checking device that is mounted on the rear of rolling stock conducts train checks.
- 2) The presence of train between stations and within a station yard is stored by the tail check and entering route.
- 3) The start of a train is checked by the departure route and tail check.
- 4) Block control is done through the control table at each station.
- 5) In times of a tail check failure, an approval key held by the station master allows the emergency button to be pressed, which releases the block.

Figs. 5.4.4 and 5.4.5 show the whole system configuration and control table, respectively.

A and B are two block stations and the process of signalling an UP train from A to B is as follows:

Procedures of train operation

Procedures of train operation





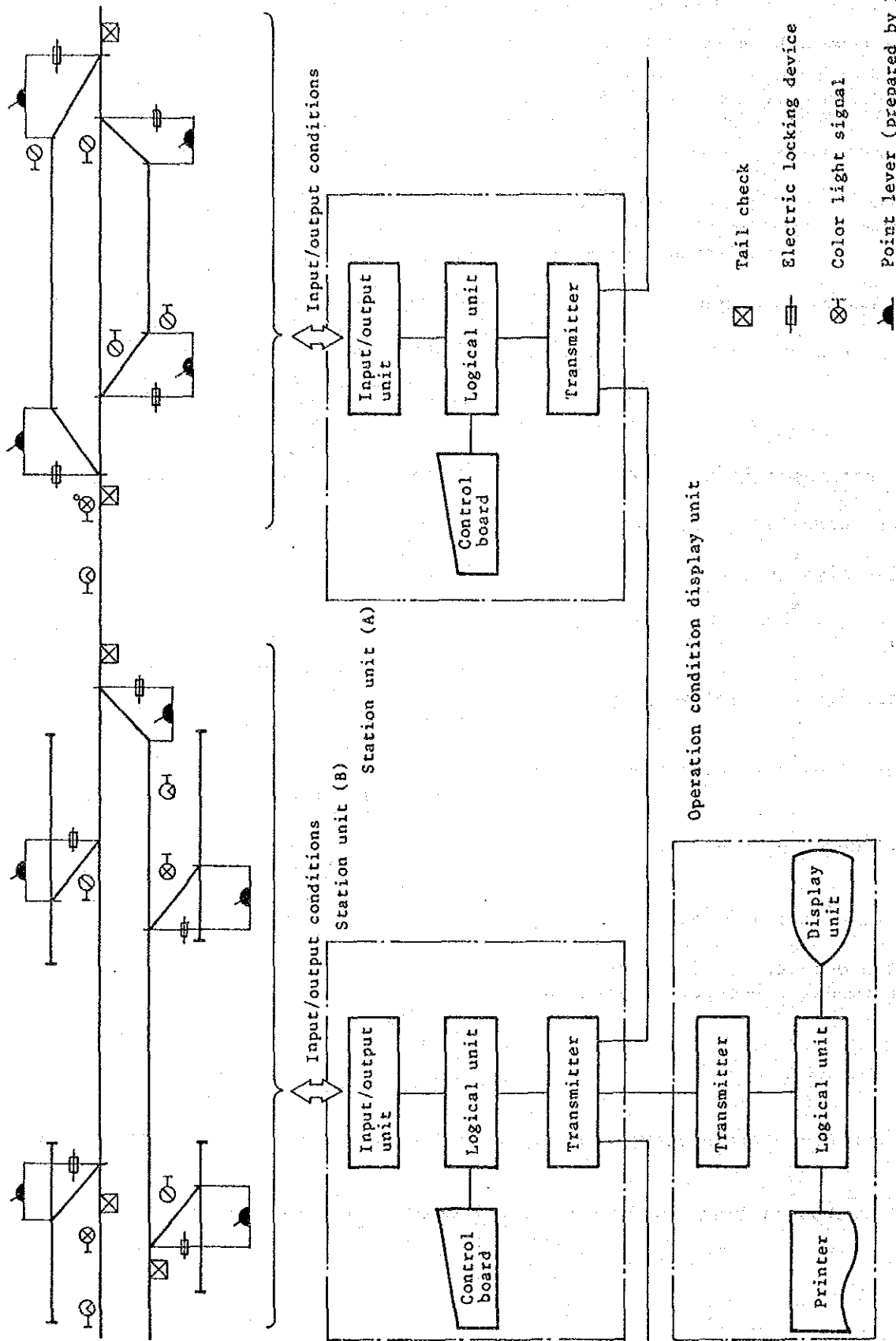


Fig. 5.4.4 Whole System Configuration

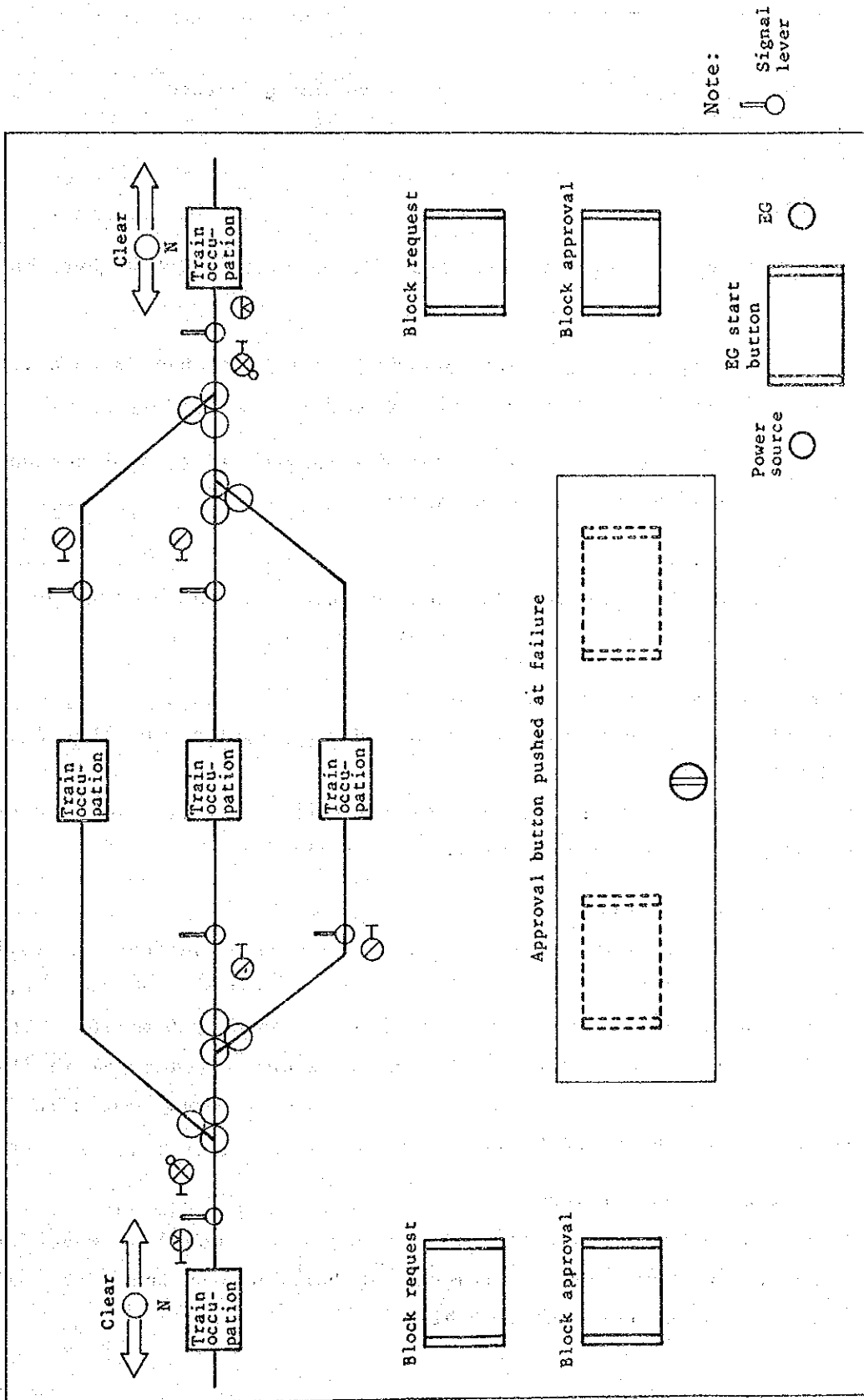


Fig. 5.4.5 Control Board (draft-2)

## Appendix 5-6 Method of Track Works

The track works will be conducted by the following method.

### (1) Rail replacement

#### 1) New rail layout

(a) The ballast should be so laid that its surface is not higher than the surface of sleepers.

(b) The new rails are to be put on the bearer more than 75 cm apart from the old rails and temporarily fixed by the dog spikes.

(c) The jointed rail should be fastened with greased fish plates and bolts securing necessary expansion space.

#### 2) Handling of rail

The rails should be carefully handled under the instruction of a supervisor so that no breakage nor casualty accident may occur.

#### 3) Replacement of defective material

The defective materials at the place of rail replacement should be replaced beforehand.

If a new rail is connected with an old rail, the extent of wear of the old rail should be measured to make the rails fit.

#### 4) Method of rail replacement

For the replacement of rail, rail over-raise shifter or rail replacer is generally used. The former is suited to the rail replacement for rather short distances of up to about 500 metres. The latter is for long rail replacement, which allows a reduction in the number of workers. Therefore, for the replacement of long-welded rail, the rail replacer had better be used.

#### 5) Daily preparation for work

Before starting the actual work, arrangements should be made for slow speed train operation and removal of half or one third of rail fastenings to conduct the work smoothly.

6) Post-replacement work

- (a) After a train has passed, and the rail has settled, gauge correction and re-alignment are to be conducted if required.
- (b) If tamping of ballast and correction of the position of sleepers are required, they should be done as soon as possible.
- (c) Put the ballast in good condition, solidifying the surface layer sufficiently.
- (d) Check the joint bolts, fastenings and anti-creeper for looseness and tighten them if required.
- (e) Replaced old rails are to be carried to their specified position for disposal as early as possible.

(2) Turnout replacement

(a) Turnout assembling

Correctly assemble the turnout based on the design drawing at a place convenient for the transportation and mounting. After the assembling, measure the dimensions of each part.

(b) Mounting of new turnout

Mount a new turnout in the safest manner. Transport it under the instruction of a supervisor. Tighten the joints in front of and behind the turnout, providing necessary expansion space.

(c) Tamping of ballast and re-alignment

After installing the new turnout, fully tamp the ballast, especially at the point and crossing parts. Never fail to do re-alignment.

(d) Partial replacement

a) Carefully check the materials beforehand.

b) Measure the extent of wear of rails before and after the replacement. If the difference in level occurs, use the staged fish plate.

(e) Inspection after the turnout replacement

After replacing the whole turnout, check the contact of tongue rail and measure the guard check gauge and track irregularities of each part. Repair the defective part, if any.

(f) Post-replacement work

Several days after the turnout replacement, inspect the track irregularities, joint bolts and fastenings and correct them if required. The replaced old turnouts are to be carried to their specified position for disposal after studying the possibility of their reuse.

(3) Sleeper replacement

(a) When replacing the sleepers simultaneously and continually make the arrangement for track closure.

(b) Measure the position of sleeper beforehand and mark it on the web of rail by paint.

(c) In tightening the fastenings, carry it out while checking the gauge.

(d) After replacing the sleepers, solidify the ballast to prevent the floating of sleepers.

(e) After completing the work, check the sleepers in the entire section, and carry out gauge correction or re-alignment of the track as required.

(f) Promptly remove the replaced old sleepers to the specified place to prevent their being stolen and the possibility of their obstructing train operation.

(4) Ballast tamping

(a) If the track is to be raised by more than 30 mm continuously over a section, make the arrangement for slow speed train operation beforehand.

(b) Prepare for ample quantity of ballast so that there may not be an extreme shortage due to the raising of track.

(c) Before tamping the ballast, tighten the floated dog spikes if any.

(d) If the rail is distorted, correct it beforehand.

(e) In principle, raise the track in the following manner.

a) Raise track at the straight part first, and then at the curved part.

b) Raise track first at the lower part and then at the higher part in a gradient section.

(f) When the track is raised, the ratio of the longitudinal length to the raised height of the temporary grade to be set should be more than 400 to 1, provided that this may be reduced to more than 200 to 1 when no severe train vibration is caused.

Tamp the ballast sufficiently in this section.

(g) After tamping, do the re-alignment if required.

(5) Method of curve compensation and re-alignment

1) Make the arrangement for track closure and slow speed operation when carrying out the compensation of curve with large shift.

2) In the curved part, the curve compensation should be carried out before replacing the rail since a large shift influences the rail length.

3) For the curve compensation, measure the versine at the site and determine the extent of shifting by calculating the compensation. The use of transit is more effective curve setting.

4) Before the curve compensation, build standard pegs.

5) In case of the re-alignment at the point where the shifting volume exceeds 20 mm, loosen the end of sleepers for easy movement. If it is not enough, take out the ballast at the end of sleepers according to the shifting volume.

6) At the straight part re-alignment is usually conducted with the left side rail as standard and at the curved part with the outer rail as standard.

7) When the curve compensation and re-alignment are done, fully tighten the end of sleepers to prevent their returning.

## Appendix 7-1 (1) Method of Track Inspection

### 1) Patrol inspection

The patrol inspection is done throughout the tracks to take action if required.

The patrol may be done on foot, by trolley, track motor car or on train, among which, the patrol on foot is desirable in order to grasp the detailed condition of track.

### 2) Inspection for track irregularities

This inspection is done by track inspection car or measuring on the spot to grasp the track irregularities.

The items of inspection are:

- Gauge
- Cross level
- Longitudinal level
- Alignment
- Twist (part of transition curve)

In addition, the vibration of train and expansion space of rail have to be inspected.

#### (a) Inspection of train vibration

This inspection is done by riding a train to sense the vibration, or by using a train vibration measuring instrument.

#### (b) Inspection of rail expansion space

The expansion space inspection of jointed rail sections is conducted during the season when the temperature change is small. The items of inspection are:

- Existence of excessive expansion space
- Existence of continuous tight expansion space

When a train passes over the excessive expansion space, it receives a large impact, which leads to track irregularities at joint parts and damage of rail ends.

At the part of continuous tight expansion space, on the other hand, the combination of ballast shortage, floated sleepers and rail irregularities causes accidents due to buckling.

In such parts, therefore, proper expansion space has to be maintained through compensation.

### 3) Inspection of track materials

The rail, turnout, sleeper, ballast and accessories are checked for corrosion, damage and wear in this inspection.

#### (a) Rail inspection

In this inspection, the rail is checked for corrosion, wear and damage with the naked eye or by using a rail flaw detector. The jointed parts should be inspected after disassembling fish plates. If a rail defect is detected, but replacement of the rail is not yet required, a check mark should be put on it to see if the defect makes any progress.

#### (b) Turnout inspection

The rail within a turnout is inspected as mentioned above. For the functional inspection of turnout, check the adhesion of tongue rail, guard check gauge and other critical accessories.

#### (c) Inspection of sleeper, ballast and accessories

In this inspection, the following items are checked.

- PC sleeper ..... Concrete crack, loosened fastenings
- Wooden sleeper ... Corrosion, crack, rail biting, supporting force of fastenings
- Ballast ..... Decreased cross section, grit mixture
- Accessories ..... Damage, wear

### 4) Period of inspection

In principle, the period of inspection is once a year.

### 5) Report on inspection result

The submission of report on results of the inspection concerning designated items has to be instructed.



Appendix 7-1 (2) Maintenance Standard Values

(1) Standard values for track maintenance

Table 7.1.1 shows the standard values for track maintenance.

Table 7.1.1 Standard Values for Track Maintenance

(Unit: mm)

Item	Kind of repair	Periodical repair			Emergency repair			Finish
		1	2	3	1	2	3	
Track classification								Same in all classification
Gauge			+6 -4		-	-	-	+1 -3
Cross level		8	9	11	-	-	-	4
Longitudinal level		8	9	11	17	19	22	4
Alignment		8	9	11	17	19	22	4
Twist						18		4
					(Includes diminishing of cant)			(Excludes diminishing of cant)

Remarks: The track is classified by the following line:

- 1 : Rangoon - Mandalay line
- 2 : Other main lines
- 3 : Branch lines

Source: Study Team

Each standard value is applied in the following manner.

(a) Standard value for periodical repair

This standard value is applied to the daily and planned repair. The section with many track irregularities exceeding the value has to be repaired in the first priority.

(b) Standard value for emergency repair

The track whose irregularities exceeds the standard value has to be immediately repaired, within two weeks at the latest. If the repair within the period is impossible, a measure for the slow speed operation has to be taken promptly.

(c) Standard value for finish

On carrying out a repair, the track has to comply with the standard value for finish.

(2) Standard value for material replacement

1) Rail replacement

If a rail shows the following condition, it has to be replaced with a new or reused rail.

(a) Maximum wearing depth of rail

Type of rail	Main line	Branch line
	(mm)	(mm)
60 lb (30 kg)	7	11
75 lb (37 kg)	12	15

Remarks: The main line is applied to four lines.

Source: Study Team

(b) Decreasing ratio of rail cross-section

Type of rail	Main line	Branch line
	(%)	(%)
60 lb (30 kg)	12	20
75 lb (37 kg)	22	28

Source: Study Team

(c) Wearing depth of corrugated rail

The wear which shows the continuous wave form of more than 1.5 mm height.

(d) Rail damage

The rail damage, if deteriorated, may cause some danger to the operation of train.

2) Replacement of turnout rail

If a turnout rail shows the following condition, it has to be replaced by a new or reused rail.

Type of rail		Wearing depth	
		Main line	Branch line
		(mm)	(mm)
Tongue rail	60 lb	7	8
	75 lb	8	9
Crossing	60 lb	7	8
	75 lb	8	10
Common rail	60 lb	7	8
	75 lb	8	9
Guard rail		The volume of wear for which the adjustment of guard check gauge is not impossible.	

Source: Study Team

3) Replacement of wooden sleeper

The wooden sleeper have to be replaced if they show the following conditions.

(a) Corrosion for which the decreasing ratio of cross section has surpassed more than 20 percent.

(b) Bit by rail of more than 10 mm.

(c) No supporting force by dog spikes is obtained.

(d) Cracks seen in the entire length.

(e) Broken ones.

4) Screening or addition of ballast

(a) Screening of ballast

If the ballast includes more than 30 percent of grit, it has to be screened.

(b) Addition of ballast

If the thickness of ballast under the sleepers is not enough, or when sides of sleepers are exposed by more than 20 mm, the ballast has to be added.

Appendix 9-3 Cost/Benefit Table

ERR and NPV were calculated based on the following tables.

ALT. - 5 )	COST BENEFIT TABLE(1)						Kyats in Thousand			
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1. INVESTMENT COST										
1-1 WITH THE PROJECT										
(1) TRACK	33470	41794	33893	30424	45200	46168	25233	24190	24166	0
(2) TELECOM.	0	0	25265	25265	25265	25265	44655	44655	44655	0
(3) SIGNALLING	0	0	19038	19038	19038	19038	33118	33118	33118	0
(4) ROLLING STOCK	19680	19680	19920	19920	19920	0	0	0	0	57360
(5) TOTAL	53150	61474	98116	94647	109423	90471	103006	101963	101939	57360
1-2 WITHOUT THE PROJECT										
(1) ROLLING STOCK	19680	19680	19920	19920	19920	19920	0	0	0	60960
(2) VEHICLE	0	0	0	0	0	0	45539	14777	19608	26030
(3) VESSEL	0	0	0	0	0	0	0	0	0	0
(4) TOTAL	19680	19680	19920	19920	19920	19920	45539	14777	19608	86990
1-3 WITH - WITHOUT	33470	41794	78196	74727	89503	70551	57467	87186	82331	-29630
2. BENEFIT										
2-1 TIME SAVING										
(1) PASSENGER	0	0	0	0	0	0	6513	6588	6638	16041
(2) FREIGHT	0	0	0	0	0	0	464	475	487	950
(3) TOTAL	0	0	0	0	0	0	6977	7063	7125	16991
2-2 MAINTENANCE COST REDUCTION										
(1) WITH THE PROJECT	34570	34549	35120	35200	35281	35361	28396	28868	29460	27778
(2) WITHOUT THE PROJECT	38863	38943	39024	39105	39187	39268	37553	38923	40740	43150
(3) BENEFIT (without-with)	4293	4294	3904	3905	3906	3907	9157	10055	11280	15372
2-3 OPERATING COST REDUCTION										
(1) WITH THE PROJECT	114203	118300	122562	126995	131606	136401	149582	159311	169727	176625
(2) WITHOUT THE PROJECT	114203	118300	122562	126995	131606	136401	163972	170894	179952	191808
(3) BENEFIT (without-with)	0	0	0	0	0	0	14389	11584	10225	15183
2-4 DECREASE OF TRAFFIC ACCIDENT										
(1) WITH THE PROJECT	0	0	0	0	0	0	929	770	600	2115
(2) WITHOUT THE PROJECT	0	0	0	0	0	0	0	0	0	0
2-5 BENEFIT TOTAL	4293	4294	3904	3905	3906	3907	31452	29472	29230	49662
3 BENEFIT - INVESTMENT COST	-29177	-37500	-74292	-70822	-85597	-66644	-26015	-57715	-53101	79292

Source: Study Team

ALT.- FISCAL YEAR	COST BENEFIT TABLE(2)					MANDALAY LINE J					Kyats in Thousand					
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
1. INVESTMENT COST																
1-1 WITH THE PROJECT																
(1) TRACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(2) TELECOM.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(3) SIGNALLING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(4) ROLLING STOCK	63072	63072	63072	63072	63291	63291	63072	63072	63291	63291	63291	65481	65481	118917	118917	118917
(5) TOTAL	63072	63072	63072	63072	63291	63291	63072	63072	63291	63291	63291	65481	65481	118917	118917	118917
1-2 WITHOUT THE PROJECT																
(1) ROLLING STOCK	55626	55626	55845	55845	55845	55845	55845	55845	55845	55845	55845	55845	55845	70080	70080	70080
(2) VEHICLE	10133	11111	12184	13361	14653	16070	17626	19334	21209	23126	25081	27076	29111	31196	33321	35486
(3) VESSEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(4) TOTAL	65759	66737	68029	69206	70498	71915	73471	75179	77235	78971	80866	82821	84836	86916	89061	91289
1-3 WITH - WITHOUT	-2687	-3665	-4957	-6134	-7207	-8624	-10180	-11856	-13646	-15550	-17570	-19715	-21994	-24407	-26954	-31167
2. BENEFIT																
2-1 TIME SAVING																
(1) PASSENGER	16910	17886	18918	20011	21167	22391	23686	25057	26508	28018	29594	31236	32945	34721	36564	38476
(2) FREIGHT	979	1008	1039	1070	1102	1135	1169	1204	1240	1276	1313	1351	1390	1430	1471	1513
(3) TOTAL	17889	18894	19957	21081	22269	23526	24855	26261	27748	29294	30909	32595	34355	36195	38115	40089
2-2 MAINTENANCE COST REDUCTIO																
(1) WITH THE PROJECT	28358	28947	29536	30127	30716	31425	32135	32844	33554	34265	35000	35752	36521	37307	38111	38934
(2) WITHOUT THE PROJECT	44480	45900	47429	49186	51063	53070	55220	57527	60007	62270	64956	67983	71361	75111	79254	83711
(3) BENEFIT (without-with)	16122	16953	17893	19059	20347	21645	23085	24683	26453	28486	30756	33281	36048	39044	42343	46077
2-3 OPERATING COST REDUCTION																
(1) WITH THE PROJECT	181318	186144	191108	196213	201464	206864	212418	218131	224007	230050	236271	242681	249281	256081	263081	270281
(2) WITHOUT THE PROJECT	198228	205084	212415	220263	228672	237691	247374	257780	268971	281000	293917	307761	322581	338421	355311	373281
(3) BENEFIT (without-with)	16910	18940	21308	24050	27208	30827	34956	39648	44965	50931	57710	65481	74361	84481	95961	109000
2-4 DECREASE OF TRAFIC ACCIDENT	2131	2148	2163	2179	2194	2210	2224	2239	2253	2268	2283	2298	2313	2328	2343	2358
2-5 BENEFIT TOTAL	53052	56935	61322	66369	72019	78208	85120	92832	101419	110916	121381	132941	145641	159501	174661	191161
3 BENEFIT - INVESTMENT COST	55740	60600	66278	72503	79226	86832	95301	102530	110916	120000	129831	140441	151861	164111	177241	191281

COST BENEFIT TABLE(3)

( ALT.- 5 )	MANDALAY LINE ]										
	FISCAL YEAR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. INVESTMENT COST											
1-1 WITH THE PROJECT											
(1) TRACK	0	0	0	0	0	0	0	0	0	0	-224492
(2) TELECOM.	0	0	0	0	0	0	0	0	0	0	-14247
(3) SIGNALLING	0	0	0	0	0	0	0	0	0	0	-254
(4) ROLLING STOCK	119647	119866	145735	154358	154358	154358	162981	162981	162981	162981	-1712785
(5) TOTAL	119647	119866	145735	154358	154358	154358	162981	162981	162981	162981	-1951778
1-2 WITHOUT THE PROJECT											
(1) ROLLING STOCK	70080	70080	70080	70080	76650	77380	77380	77380	77380	103249	-1056581
(2) VEHICLE	18966	20357	21850	23454	25175	27023	29067	31137	33424	33424	-307096
(3) VESSEL	0	0	0	0	0	0	0	0	0	0	0
(4) TOTAL	89046	90437	91930	93534	101825	104403	106387	108517	136673	136673	-1363677
1-3 WITH - WITHOUT	30501	29429	53805	60824	52533	49955	56594	54464	26308	26308	-588101
2. BENEFIT											
2-1 TIME SAVING											
(1) PASSENGER	29614	31301	33085	34970	36964	39072	41301	43658	46150	48784	48784
(2) FREIGHT	1313	1351	1390	1431	1472	1514	1558	1603	1649	1697	1697
(3) TOTAL	30927	32652	34475	36401	38436	40587	42860	45261	47799	50481	50481
2-2 MAINTENANCE COST REDUCTIO											
(1) WITH THE PROJECT	35697	36778	37861	38942	40025	41107	42189	43389	44591	45791	45791
(2) WITHOUT THE PROJECT	64772	67401	70168	73084	76158	79403	82839	86472	90316	94385	94385
(3) BENEFIT (without-with)	29075	30623	32307	34142	36133	38296	40650	43083	45725	48594	48594
2-3 OPERATING COST REDUCTION											
(1) WITH THE PROJECT	241897	251401	261297	271603	282335	293510	305148	317266	329886	343027	343027
(2) WITHOUT THE PROJECT	296343	311212	326934	343562	361154	379768	399470	420328	442415	465807	465807
(3) BENEFIT (without-with)	54446	59811	65636	71959	78819	86258	94323	103052	112529	122781	122781
2-4 DECREASE OF TRAFFIC ACCIDENT	2418	2504	2594	2687	2783	2883	2986	3092	3203	3317	3317
2-5 BENEFIT TOTAL	116866	125590	135012	145189	156171	168023	180818	194499	209256	225174	225174
3 BENEFIT - INVESTMENT COST	86264	96161	81208	84365	103638	118069	124224	140035	182949	813274	813274

Appendix 9-4 (1) Cash Flow Table

FIRR and NPV were calculated based on the following tables.

C.ALT. 5 FISCAL YEAR	CASH FLOW TABLE(1) MANDALAY LINE					Kyals In Million				
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
**WITH PROJECT**										
1. EARNING										
(1)COACHING	148.7	152.8	157.0	161.3	165.7	170.3	192.5	203.1	214.3	226.1
(2)GOODS	29.5	30.4	31.4	32.4	33.4	34.4	38.3	40.6	43.1	45.7
(3)OTHERS	12.5	12.8	13.2	13.6	13.9	14.3	16.2	17.1	18.0	19.0
(4)TOTAL	190.7	195.0	201.5	207.2	213.1	219.1	246.9	260.7	275.3	290.9
2. EXPENSES										
2-1 INVESTMENT COST										
(1)TRACK	45.2	57.3	47.4	42.5	64.2	65.6	34.8	33.4	33.4	0.0
(2)TELCOM.	0.0	0.0	36.3	36.3	36.3	36.3	54.1	64.1	64.1	0.0
(3)SIGNALLING	0.0	0.0	27.1	27.1	27.1	27.1	47.2	47.2	47.2	0.0
(4)ROLLING STOCK	27.9	27.9	28.2	28.2	28.2	0.0	0.0	0.0	0.0	81.3
(5)TOTAL	73.1	85.2	139.0	134.1	155.8	129.0	146.1	144.7	144.7	81.3
2-2 MAINTENANCE/OPERATING COST										
(1)ADMINISTRATION COST	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
(2)MAINTENANCE COST	41.8	41.9	42.8	43.0	43.0	43.1	34.1	34.7	35.4	33.5
(3)OPERATING COST	48.3	49.8	51.3	52.9	54.5	56.2	60.6	64.0	67.7	69.7
(4)TOTAL	103.9	105.5	107.9	109.5	111.3	113.1	108.4	112.5	116.9	117.0
2-STURN OVER TAX	9.7	10.0	10.3	10.6	10.9	11.2	12.6	13.3	14.0	14.8
3. CASH FLOW	3.9	-4.6	-55.6	-47.0	-64.9	-34.1	-20.2	-9.8	-0.3	77.8
**WITHOUT PROJECT**										
1. EARNING										
(1)COACHING	148.7	152.8	157.0	161.3	165.7	170.3	175.0	179.6	184.3	189.1
(2)GOODS	29.5	30.4	31.4	32.4	33.4	34.4	35.5	36.6	37.7	38.8
(3)OTHERS	12.5	12.8	13.2	13.6	13.9	14.3	14.7	15.1	15.5	15.9
(4)TOTAL	190.7	196.0	201.5	207.2	213.1	219.1	225.2	231.3	237.4	243.8
2. EXPENSES										
2-1 INVESTMENT COST										
(1)ROLLING STOCK	27.9	27.9	28.2	28.2	28.2	28.2	0.0	0.0	0.0	86.4
2-2 MAINTENANCE/OPERATING COST										
(1)ADMINISTRATION COST	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
(2)MAINTENANCE COST	44.8	44.9	45.0	45.1	45.2	45.3	37.6	37.6	37.6	37.6
(3)OPERATING COST	48.3	49.8	51.3	52.9	54.5	56.2	58.0	58.0	58.0	58.0
(4)TOTAL	106.9	108.5	110.1	111.8	113.5	115.3	109.4	109.4	109.4	109.4
2-STURN OVER TAX	9.7	10.0	10.3	10.6	10.9	11.2	11.5	11.8	12.1	12.4
3. CASH FLOW	46.1	49.6	52.9	56.7	60.5	64.4	104.4	110.1	116.0	35.7
CASH FLOW (WITH - WITHOUT)	-42.2	-54.3	-108.6	-109.6	-125.4	-98.5	-124.7	-119.9	-116.3	42.1

Source: Study Team



CASH FLOW TABLE(2)

( ALT.- 5 ) MANDALAY LINE J Kyats in Million

FISCAL YEAR 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

\*\*WITH PROJECT\*\*

1. EARNING																			
(1) COACHING	235.0	244.3	253.9	263.9	274.3	285.2	295.4	308.1	320.2	332.7									
(2) GOODS	47.8	50.0	52.2	54.6	57.0	59.6	62.3	65.1	68.1	71.1									
(3) OTHERS	19.8	20.6	21.4	22.3	23.2	24.1	25.1	26.1	27.2	28.3									
(4) TOTAL	302.6	314.9	327.6	340.8	354.6	368.9	383.8	399.4	415.5	432.0									

2. EXPENSES

2-1 INVESTMENT COST																			
(1) TRACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
(2) TELECOM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
(3) SIGNALLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
(4) ROLLING STOCK	88.4	88.4	88.4	88.4	88.7	88.7	88.7	91.8	166.7	166.7									
(5) TOTAL	88.4	88.4	88.4	88.4	88.7	88.7	88.7	91.8	166.7	166.7									
2-2 MAINTENANCE & OPERATING COST																			
(1) ADMINISTRATION COST	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8									
(2) MAINTENANCE COST	34.3	35.0	35.8	36.5	37.3	38.2	39.1	40.0	40.9	42.2									
(3) OPERATING COST	71.3	73.0	74.8	76.5	78.4	80.3	82.2	84.2	86.3	89.4									
(4) TOTAL	119.4	121.8	124.3	126.9	129.4	132.2	135.1	138.0	140.9	145.4									
2-3 TURN OVER TAX	15.4	16.0	16.7	17.3	18.0	18.7	19.4	20.2	21.0	21.8									

3. CASH FLOW

	79.4	88.6	98.2	108.2	118.4	129.3	140.5	149.4	86.8	98.1
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\*\*WITHOUT PROJECT\*\*

1. EARNING																			
(1) COACHING	194.2	199.4	204.8	210.4	216.1	221.9	227.9	234.1	240.5	246.9									
(2) GOODS	40.0	41.3	42.6	43.9	45.3	46.7	48.2	49.7	51.3	52.9									
(3) OTHERS	16.4	16.8	17.3	17.8	18.3	18.8	19.3	19.9	20.4	21.0									
(4) TOTAL	250.6	257.6	264.7	272.1	279.7	287.5	295.5	303.7	312.2	320.8									

2. EXPENSES

2-1 INVESTMENT COST																			
(1) ROLLING STOCK	78.0	78.0	78.3	78.3	78.3	78.3	78.3	78.3	78.2	98.2									
2-2 MAINTENANCE & OPERATING COST																			
(1) ADMINISTRATION COST	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8									
(2) MAINTENANCE COST	38.1	38.6	39.1	39.7	40.4	41.0	41.7	42.4	43.0	43.8									
(3) OPERATING COST	58.7	59.4	60.1	60.8	61.5	62.2	62.9	63.7	64.4	65.4									
(4) TOTAL	110.5	111.7	112.9	114.3	115.6	117.0	118.4	119.8	121.2	124.0									
2-3 TURN OVER TAX	12.7	13.1	13.4	13.8	14.2	14.6	14.9	15.4	15.8	16.2									

3. CASH FLOW

	49.3	54.8	60.1	65.8	71.6	77.6	83.8	90.2	76.9	82.3
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CASH FLOW (WITH - WITHOUT)

	30.1	33.8	38.1	42.5	46.9	51.7	56.8	59.1	9.9	15.8
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CASH FLOW TABLE(3)

Kyats In Million

MANDALAY LINE J

( ALT - 5 )

FISCAL YEAR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
**WITH PROJECT**										
1. EARNING										
(1) COACHING	345.6	359.1	373.0	387.5	402.6	418.3	434.5	451.5	469.0	487.3
(2) GOODS	74.2	77.4	80.8	84.4	88.1	91.9	96.0	100.2	104.6	109.1
(3) OTHERS	29.4	30.6	31.8	33.0	34.3	35.7	37.1	38.6	40.2	41.7
(4) TOTAL	449.2	467.1	485.6	505.0	525.0	545.9	567.6	590.2	613.7	638.2
2. EXPENSES										
2-1 INVESTMENT COST										
(1) TRACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-288.6
(2) TELECOM.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-20.5
(3) SIGNALING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
(4) ROLLING STOCK	167.7	168.0	204.3	216.4	216.4	216.4	228.5	228.5	228.5	-2402.1
(5) TOTAL	167.7	168.0	204.3	216.4	216.4	216.4	228.5	228.5	228.5	-2711.6
2-2 MAINTENANCE & OPERATING COST										
(1) ADMINISTRATION COST	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
(2) MAINTENANCE COST	43.6	45.0	46.3	47.7	49.1	50.4	51.8	53.3	54.9	56.4
(3) OPERATING COST	92.6	95.9	99.4	103.0	106.7	110.6	114.7	119.0	123.4	128.0
(4) TOTAL	149.9	154.6	159.5	164.5	169.6	174.9	180.3	186.1	192.0	198.2
2-3 TURN OVER TAX	22.7	23.5	24.5	25.4	26.4	27.4	28.5	29.6	30.8	32.0
3. CASH FLOW	108.9	120.8	97.4	98.7	112.6	127.2	130.3	146.0	162.4	3119.6
**WITHOUT PROJECT**										
1. EARNING										
(1) COACHING	253.6	260.5	267.5	274.7	282.1	289.8	297.6	305.5	313.9	322.3
(2) GOODS	54.5	56.2	57.9	59.7	61.5	63.4	65.3	67.3	69.4	71.5
(3) OTHERS	21.6	22.2	22.8	23.4	24.1	24.7	25.4	26.1	26.8	27.6
(4) TOTAL	329.7	338.8	348.1	357.8	367.7	377.8	388.3	399.0	410.1	421.4
2. EXPENSES										
2-1 INVESTMENT COST										
(1) ROLLING STOCK	98.2	98.2	98.2	98.2	107.5	108.5	108.5	108.5	144.8	-1482.2
2-2 MAINTENANCE & OPERATING COST										
(1) ADMINISTRATION COST	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
(2) MAINTENANCE COST	44.8	45.7	46.7	47.6	48.6	49.5	50.5	51.5	52.4	53.4
(3) OPERATING COST	68.5	70.6	72.8	75.2	77.5	80.0	82.6	85.3	88.1	91.0
(4) TOTAL	127.0	130.1	133.3	136.6	139.9	143.3	146.9	150.5	154.3	158.1
2-3 TURN OVER TAX	16.6	17.1	17.5	18.0	18.5	19.0	19.5	20.0	20.6	21.1
3. CASH FLOW	87.8	93.3	99.1	105.0	101.8	107.0	113.4	120.0	90.5	1724.4
CASH FLOW (WITH - WITHOUT)	21.1	27.5	-1.7	-6.3	10.8	20.2	16.9	26.1	72.0	1395.2

Appendix 9-4 (2) Financial Statements

The financial statements of the Mandalay line were estimated as follows.

(a) PROFIT & LOSS STATEMENT

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1. EARNINGS	0.0	173.3	178.2	183.2	188.4	193.7	199.2	224.5	237.0	250.3
COACHING		135.2	138.9	142.7	146.6	150.7	154.8	175.0	184.6	194.8
GOODS		28.8	27.7	28.5	29.4	30.3	31.3	34.8	36.9	39.2
OTHERS		11.3	11.7	12.0	12.3	12.7	13.0	14.7	15.5	16.4
2. EXPENSES	0.0	121.0	123.2	126.1	128.2	130.6	133.1	150.5	154.5	158.6
WORKING EXPENSES		103.9	105.5	107.9	109.5	111.3	113.1	108.4	112.5	116.9
ADMINISTRATION		13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
MAINTENANCE		41.8	41.9	42.8	42.9	43.0	43.1	34.1	34.7	35.4
OPERATION		48.3	49.8	51.3	52.9	54.5	56.2	60.6	64.0	67.7
DEPRECIATION		17.1	17.7	18.2	18.7	19.3	20.0	42.1	42.0	41.7
3. OTHER CHARGES	1.9	34.1	34.1	34.8	37.5	40.3	44.1	47.9	51.1	54.9
INTEREST	1.9	25.2	25.0	25.4	27.9	30.4	33.9	37.4	40.4	43.9
TURN OVER TAX		8.9	9.1	9.4	9.6	9.9	10.2	10.4	10.7	11.0
4. EXTRAORDINARY ITEMS	0.0	1.7	10.2	10.3	10.3	16.8	15.2	8.3	8.3	8.3
ASSETS SOLD(+)		2.1	12.6	12.6	12.6	20.5	18.4	10.0	10.0	10.0
REDUCTION OF ASSETS(-)		0.4	2.3	2.3	2.3	3.6	3.2	1.7	1.7	1.7
4. PROFIT	-1.9	19.9	31.1	32.6	33.0	39.7	37.2	34.4	39.8	45.1
5. RETAINED PROFIT	-1.9	18.0	49.2	81.8	114.8	154.4	191.6	226.0	265.8	310.9

Source: Study Team

(b) BALANCE SHEET

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
TOTAL ASSETS	836.5	894.2	981.6	1122.8	1258.8	1422.7	1557.8	1720.8	1856.8	2007.7
FIXED ASSETS	489.9	547.6	625.3	756.4	882.0	1035.4	1159.5	1271.8	1382.8	1494.1
GROUND FACILITIES		472.4	453.0	433.9	415.1	394.9	943.9	903.6	863.4	1374.7
ROLLING STOCK(NEW)		27.9	55.1	81.9	108.0	133.4	129.9	126.4	122.9	119.4
CONSTRUCTION A/C		47.3	117.2	240.5	358.9	507.0	85.7	241.8	396.5	0.0
CURRENT ASSETS	346.6	346.6	356.4	366.4	376.7	387.3	398.3	448.9	474.0	513.5
LIABILITIES & CAPITAL	836.5	894.2	981.6	1122.8	1258.8	1422.7	1557.8	1720.8	1856.8	2007.7
TOTAL LIABILITIES	541.6	579.3	635.7	744.2	847.2	971.5	1069.4	1197.9	1294.3	1400.0
CURRENT LIABILITIES	116.6	146.2	165.9	171.7	164.2	145.9	123.7	125.0	101.4	100.1
DEFERRED LIABILITIES										
M.E.B.LOAN	283.2	249.2	231.9	241.0	262.6	298.3	331.1	363.9	392.5	413.6
FOREIGN LOAN	141.8	183.9	237.9	331.5	420.5	527.3	614.5	709.0	800.3	886.3
EQUITY	294.9	314.8	346.0	378.6	411.6	451.2	488.4	522.8	562.6	607.7
ACCUMULATED EARNINGS	-1.9	18.0	49.2	81.8	114.8	154.4	191.6	226.0	265.8	310.9
GOVNT. EQUITY	296.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8

Source: Study Team

PROFIT & LOSS STATEMENT

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1. EARNINGS	264.5	275.1	286.2	297.8	305.8	322.4	335.4	348.9	363.0	377.7
COACHING	205.6	213.7	222.1	230.8	239.9	249.4	259.2	269.5	280.1	291.1
GOODS	41.6	43.5	45.4	47.5	49.6	51.9	54.2	56.7	59.2	61.9
OTHERS	17.3	18.0	18.7	19.5	20.3	21.1	21.9	22.8	23.8	24.7
2. EXPENSES	183.7	188.1	192.7	197.4	201.3	205.2	210.2	214.7	219.8	225.1
WORKING EXPENSES	117.0	110.4	121.8	124.3	126.9	129.4	132.2	135.1	138.0	140.9
ADMINISTRATION	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
MAINTENANCE	33.6	34.3	35.0	35.8	36.5	37.3	38.2	39.1	40.0	40.9
OPERATION	69.7	71.3	73.0	74.8	76.5	78.4	80.3	82.2	84.2	86.3
DEPRECIATION	66.7	68.7	70.9	73.1	74.5	75.7	78.0	79.6	81.8	84.1
3. OTHER CHARGES	58.5	59.2	59.3	59.0	58.4	57.8	57.0	56.6	56.3	56.4
INTEREST	47.2	47.6	47.4	46.8	45.9	44.9	43.8	43.0	42.4	42.0
TURN OVER TAX	11.3	11.6	11.9	12.2	12.5	12.9	13.2	13.6	14.0	14.3
4. EXTRAORDINARY ITEMS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ASSETS SOLED(+)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
REDUCTION OF ASSETS(-)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. PROFIT	22.3	27.8	34.2	41.3	50.1	59.4	68.2	77.7	87.0	96.3
5. RETAINED PROFIT	333.1	361.0	395.1	436.5	486.5	545.9	614.1	691.8	778.8	875.1
BALANCE SHEET										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TOTAL ASSETS	2061.7	2108.7	2151.2	2192.1	2239.7	2292.0	2358.4	2437.1	2530.6	2710.9
FIXED ASSETS	1508.7	1528.4	1545.9	1561.2	1575.1	1588.1	1598.9	1608.0	1618.0	1700.6
GROUND FACILITIES	1311.5	1248.4	1185.2	1122.1	1059.8	998.4	937.0	876.3	815.5	754.8
ROLLING STOCK(NEW)	197.1	280.0	360.7	439.1	515.4	589.7	661.8	731.7	802.5	945.8
CONSTRUCTION A/C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CURRENT ASSETS	553.0	580.3	605.3	630.8	664.5	703.9	759.5	829.0	912.6	1010.2
LIABILITIES & CAPITAL	2061.7	2108.7	2151.2	2192.1	2239.7	2292.0	2358.4	2437.1	2530.6	2710.9
TOTAL LIABILITIES	1431.8	1450.9	1459.3	1458.8	1456.4	1449.3	1447.5	1448.5	1455.0	1539.0
CURRENT LIABILITIES	105.8	110.0	114.5	119.1	123.9	128.9	134.1	139.6	145.2	151.1
DEFERRED LIABILITIES	402.7	381.4	353.7	322.1	293.2	264.1	243.0	227.5	218.4	236.8
H.E.B. LOAN	923.3	959.5	991.1	1017.6	1039.3	1056.2	1070.4	1081.4	1091.4	1151.2
FOREIGN LOAN										
EQUITY	629.9	657.8	691.9	733.3	783.3	842.7	910.9	988.6	1075.6	1171.9
ACCUMULATED EARNINGS	333.1	361.0	395.1	436.5	486.5	545.9	614.1	691.8	778.8	875.1
GOV'T. EQUITY	296.8	290.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8

PROFIT & LOSS STATEMENT

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. EARNINGS											
COACHING	392.7	408.4	424.6	441.5	459.0	477.3	490.3	510.0	536.6	557.9	580.1
GOODS	302.4	314.2	326.4	339.1	352.3	366.0	380.3	395.0	410.4	426.4	443.0
OTHERS	61.6	67.4	70.4	73.5	76.7	80.1	83.6	87.2	91.1	95.1	99.2
	25.7	26.7	27.8	28.9	30.0	31.2	32.5	33.8	35.1	36.5	38.0
2. EXPENSES											
WORKING EXPENSES	233.3	241.9	230.8	245.9	256.4	249.0	257.6	267.9	278.6	290.5	303.0
ADMINISTRATION	145.4	149.9	154.6	159.5	164.5	169.6	174.9	180.3	186.1	192.0	198.2
MAINTENANCE	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
OPERATION	42.2	43.6	45.0	46.3	47.7	49.1	50.4	51.8	53.3	54.9	56.4
DEPRECIATION	89.4	92.6	95.9	99.4	103.0	106.7	110.6	114.7	119.0	123.4	128.0
	87.0	91.9	82.1	86.4	92.0	79.4	82.7	87.6	92.5	98.5	104.8
3. OTHER CHARGES	59.2	62.2	65.2	68.2	72.3	76.8	80.8	84.6	88.4	92.0	95.2
INTEREST	44.5	47.1	49.7	52.2	55.9	59.9	63.6	66.8	70.2	73.3	76.1
TURN OVER TAX	14.7	15.1	15.5	15.9	16.4	16.8	17.3	17.7	18.2	18.7	19.2
4. EXTRAORDINARY ITEMS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ASSETS SOLED(+)	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
REDUCTION OF ASSETS(-)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. PROFIT	100.3	104.3	122.6	127.4	139.3	151.6	157.9	163.5	169.6	175.4	181.9
5. RETAINED PROFIT	975.4	1079.6	1202.3	1329.7	1466.0	1611.6	1769.5	1933.0	2102.5	2277.9	2459.8
BALANCE SHEET											
TOTAL ASSETS	2897.7	3086.3	3291.8	3535.5	3791.0	4057.6	4320.6	4594.4	4867.4	5139.0	5183.1
FIXED ASSETS	1779.4	1855.3	1941.2	2059.0	2183.5	2320.5	2454.2	2595.1	2731.1	2861.1	2756.3
GROUND FACILITIES	694.5	634.5	588.6	542.6	496.7	469.2	444.4	420.6	398.2	376.2	354.2
ROLLING STOCK(NEW)	1084.9	1220.8	1352.6	1516.4	1680.8	1851.2	2009.7	2174.4	2332.8	2484.9	2402.1
CONSTRUCTION A/C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CURRENT ASSETS	1118.2	1231.0	1350.6	1476.4	1607.5	1737.1	1866.4	1999.3	2136.3	2277.9	2426.8
LIABILITIES & CAPITAL	2897.7	3086.3	3291.8	3535.5	3791.0	4057.6	4320.6	4594.4	4867.4	5139.0	5183.1
TOTAL LIABILITIES	1625.5	1709.8	1792.7	1909.0	2034.2	2149.2	2254.4	2364.6	2468.0	2564.3	2426.5
CURRENT LIABILITIES	157.1	163.3	169.8	176.6	183.6	190.9	198.5	206.4	214.6	223.2	232.0
DEFERRED LIABILITIES											
M.E.B. LOAN	260.4	283.9	307.5	341.8	379.5	412.6	441.0	468.4	491.0	507.0	452.2
FOREIGN LOAN	1208.0	1282.6	1315.4	1380.6	1471.1	1545.7	1614.8	1689.8	1762.4	1834.1	1742.3
EQUITY	1272.2	1376.4	1499.1	1626.5	1756.8	1908.4	2066.3	2229.8	2399.3	2574.7	2756.6
ACCUMULATED EARNINGS	975.4	1079.6	1202.3	1329.7	1460.0	1611.6	1769.5	1933.0	2102.5	2277.9	2459.8
GOVNT. EQUITY	296.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8	296.8

## (c) CHANGES IN FINANCIAL POSITION

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
SOURCE OF FUNDS	769.1	214.7	268.6	328.6	317.2	337.8	285.8	306.9	285.1	287.1
FUNDS BY OPERATIONS	0.0	62.6	76.2	78.6	81.8	93.0	94.3	115.6	123.8	132.4
EQUITY TRANSFERRED	296.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERM LOAN RAISED										
FOREIGN LOAN	0.0	52.6	63.9	99.6	95.9	112.7	93.0	102.7	102.0	102.0
DOMESTIC LOAN	0.0	22.6	33.8	52.0	50.8	63.6	54.4	53.4	52.7	52.7
LOAN TRANSFERRED	425.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FINANCIAL LOAN	47.3	76.9	94.6	98.5	88.8	68.5	44.1	35.3	6.6	0.0
USE OF FUNDS	491.8	214.7	260.7	320.6	309.0	329.3	277.0	266.4	265.0	252.8
INVESTMENT										
FOREIGN CURRENCY	0.0	52.6	63.9	99.6	95.9	112.7	93.0	102.7	102.0	102.0
LOCAL CURRENCY	0.0	22.6	33.8	52.0	50.8	63.6	54.4	53.4	52.7	52.7
TRANSFERRED	489.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
REPAYMENT										
FOREIGN LOAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	5.8	10.8
DOMESTIC LOAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	11.3	21.7
LOAN TRANSFERRED	0.0	67.0	61.1	48.9	36.0	33.8	27.3	21.7	17.6	15.2
FINANCIAL LOAN	0.0	47.3	76.9	94.6	98.5	88.8	68.5	44.1	35.3	6.6
INTEREST FOR TERM LOAN										
FOREIGN LOAN	0.0	0.0	1.4	3.2	5.9	8.6	11.7	14.2	17.0	19.6
DOMESTIC LOAN	0.0	0.0	1.1	2.8	5.4	8.0	11.1	13.9	16.3	18.4
LOAN TRANSFERRED	0.0	22.1	18.7	15.5	13.0	11.1	9.3	7.9	6.8	5.9
INTEREST FOR FINANCIAL LOAN	1.9	3.1	3.8	3.9	3.6	2.7	1.8	1.4	0.3	0.0
INCREASE IN WORKING CAPITAL	277.3	0.0	7.8	8.0	8.3	8.5	8.7	40.5	20.1	34.3
CASH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0
ADVANCE PAYMENT & INVENTORY	346.6	0.0	9.8	10.0	10.3	10.6	10.9	50.6	25.1	26.6
PAYABLES	-69.3	0.0	-2.0	-2.0	-2.1	-2.1	-2.2	-10.1	-5.0	-5.3

Source: Study Team

CHANGES IN FINANCIAL POSITION

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SOURCE OF FUNDS	217.4	232.6	240.9	249.7	258.9	268.8	278.6	289.0	302.9	389.2
FUNDS BY OPERATIONS	136.2	144.2	152.5	161.3	170.4	180.0	189.9	200.3	211.1	222.4
EQUITY TRANSFERRED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TERN LOAN RAISED										
FOREIGN LOAN	57.4	62.2	62.2	62.2	62.2	62.4	62.4	62.4	64.6	117.3
DOMESTIC LOAN	23.9	26.2	26.2	26.2	26.2	26.3	26.3	26.3	27.2	49.4
LOAN TRANSFERRED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FINANCIAL LOAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
USE OF FUNDS	183.7	209.5	220.4	228.7	230.0	234.4	228.2	224.9	225.0	297.4
INVESTMENT										
FOREIGN CURRENCY	57.4	62.2	62.2	62.2	62.2	62.4	62.4	62.4	64.6	117.3
LOCAL CURRENCY	23.9	26.2	26.2	26.2	26.2	26.3	26.3	26.3	27.2	49.4
TRANSFERRED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
REPAYMENT										
FOREIGN LOAN	15.6	21.2	25.9	31.0	36.1	41.2	44.1	47.2	50.3	53.4
DOMESTIC LOAN	31.8	44.5	50.9	54.8	55.0	55.4	47.4	41.8	36.4	31.0
LOAN TRANSFERRED	7.7	7.7	7.7	7.7	4.6	4.2	4.2	4.2	4.2	4.2
FINANCIAL LOAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST FOR TERN LOAN										
FOREIGN LOAN	22.1	23.3	24.4	25.4	26.3	27.0	27.6	28.1	28.5	28.9
DOMESTIC LOAN	19.9	19.5	18.6	17.4	15.9	14.5	13.1	12.0	11.2	10.8
LOAN TRANSFERRED	5.2	4.8	4.4	4.0	3.7	3.4	3.1	2.9	2.6	2.4
INTEREST FOR FINANCIAL LOAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INCREASE IN WORKING CAPITAL	33.8	23.0	20.5	21.0	28.9	34.3	50.4	64.1	77.9	91.8
CASH	11.1	6.0	2.8	2.5	9.6	14.3	29.6	42.4	55.3	68.3
ADVANCE PAYMENT & INVENTORY	28.3	21.4	22.2	23.1	24.1	25.0	26.1	27.1	28.2	29.4
PAYABLES	-5.7	-4.3	-4.4	-4.6	-4.8	-5.0	-5.2	-5.4	-5.6	-5.9

CHANGES IN FINANCIAL POSITION

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
SOURCE OF FUNDS											
FUNDS BY OPERATIONS	389.4	411.0	422.5	470.4	494.6	507.3	520.6	546.5	560.8	575.7	362.8
EQUITY TRANSFERRED	232.6	243.3	254.4	266.1	278.2	290.9	304.2	318.0	332.3	347.2	362.8
TERM LOAN RAISED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOREIGN LOAN	117.3	118.0	118.2	143.7	152.2	152.2	152.2	160.7	160.7	160.7	0.0
DOMESTIC LOAN	49.4	49.7	49.8	60.6	64.2	64.2	64.2	67.8	67.8	67.8	0.0
LOAN TRANSFERRED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FINANCIAL LOAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
USE OF FUNDS											
INVESTMENT	297.4	304.5	309.4	351.3	370.5	385.0	398.9	421.5	432.0	442.7	222.7
FOREIGN CURRENCY	117.3	118.0	118.2	143.7	152.2	152.2	152.2	160.7	160.7	160.7	0.0
LOCAL CURRENCY	49.4	49.7	49.8	60.6	64.2	64.2	64.2	67.8	67.8	67.8	0.0
TRANSFERRED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
REPAYMENT											
FOREIGN LOAN	56.5	59.6	62.8	65.9	69.1	75.0	80.8	84.1	86.8	89.0	91.9
DOMESTIC LOAN	25.7	26.2	26.2	26.3	26.5	31.1	35.7	40.4	45.1	51.8	54.7
LOAN TRANSFERRED	3.9	3.8	2.7	2.7	2.6	2.6	2.3	1.7	1.3	0.0	0.0
FINANCIAL LOAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INTEREST FOR TERM LOAN											
FOREIGN LOAN	30.6	32.3	33.9	35.4	37.6	39.9	42.0	44.0	46.1	48.1	50.1
DOMESTIC LOAN	11.7	12.9	14.0	15.2	16.9	18.8	20.5	21.9	23.3	24.4	25.2
LOAN TRANSFERRED	2.1	1.9	1.7	1.5	1.4	1.2	1.1	1.0	0.9	0.8	0.8
INTEREST FOR FINANCIAL LOAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INCREASE IN WORKING CAPITAL	102.0	106.5	113.1	119.1	124.1	122.3	121.7	125.0	128.8	133.0	140.1
CASH	78.0	81.5	87.1	92.0	96.0	93.1	91.3	93.4	96.0	98.9	104.5
ADVANCE PAYMENT & INVENTORY	30.0	31.2	32.5	33.8	35.1	30.5	38.0	39.5	41.1	42.7	44.4
PAYABLES	-6.0	-6.2	-6.5	-6.8	-7.0	-7.3	-7.6	-7.9	-8.2	-8.5	-8.9







