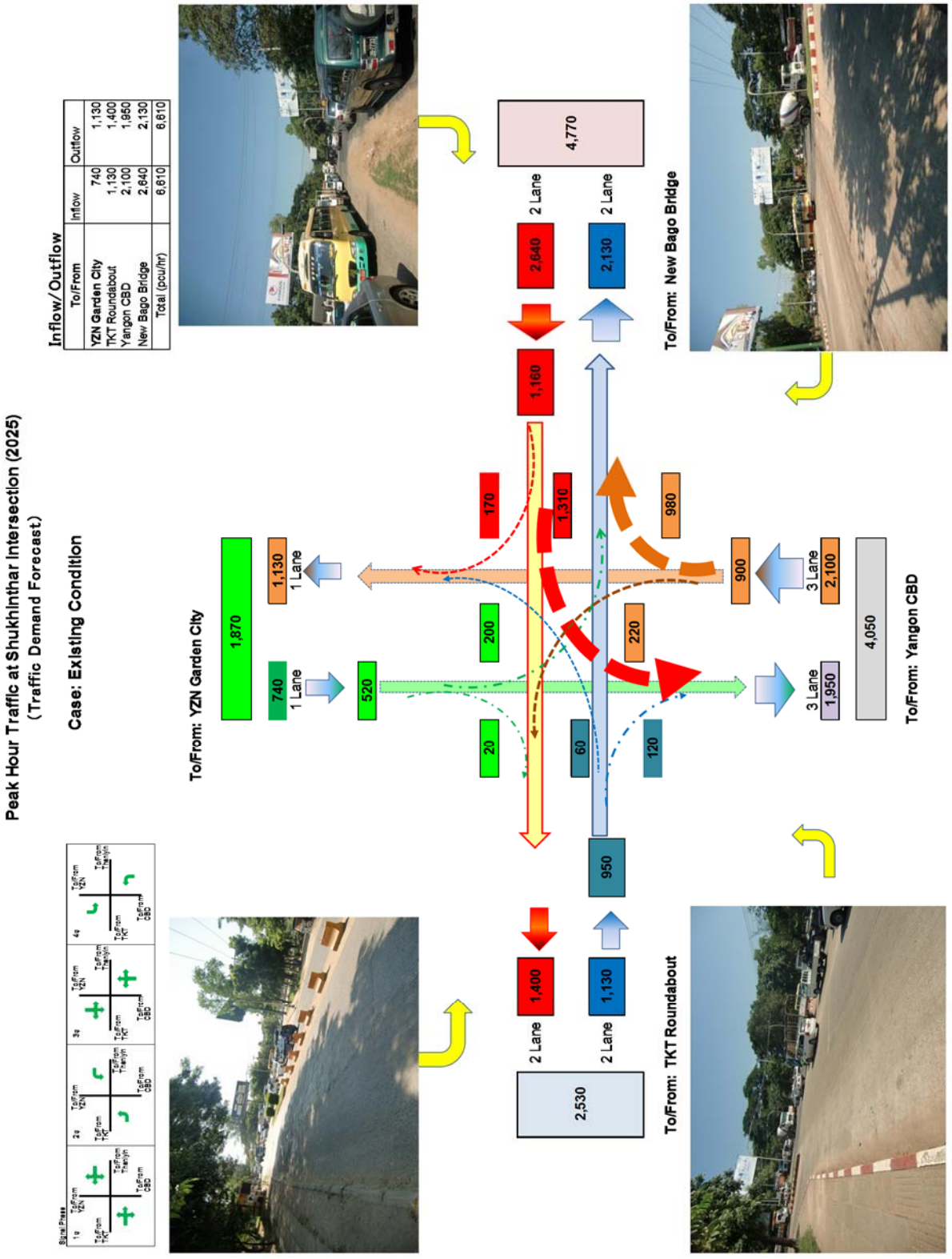
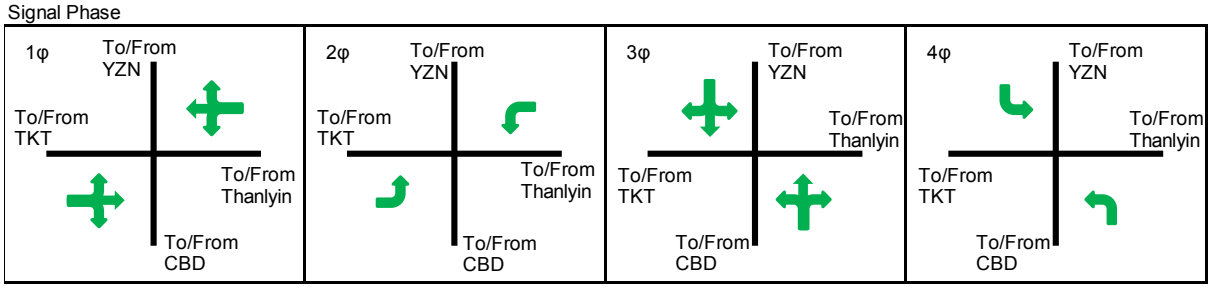
Appendix C Results of Intersection Analysis

Appendix C-1: Case of Existing Condition at Shukhinthar Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Shukhinthar Intersection

Case: 2025 Existing Condition

Entry		Thanlyin to TKT		YZN to CBD		TKT to Thanlyin		CBD to YZN		
Direction		LT	TH + RT	LT	TH + RT	LT	TH + RT	LT	TH	RT
Number of Lane: a		1	1	1	1	1	1	1	1	1
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	1,800	2,000	1,800	2,000	1,800	2,000	1,800
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)			0.986 (12.8)		0.996 (3.7)		0.988 (11.2)			
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h		2(72)		2(72)		2(72)		2(72)		
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	1,972	1,800	1,992	1,800	1,976	1,800	2,000	1,800
Traffic volume (pcu/hr): V		1,310	1,330 (170+1160)	200	540 (20+520)	60	1,070 (120+950)	220	900	980
Traffic volume with compensation of left turn (pcu/hr): V'=V-h		1,238		128		0		148		
Flow ratio: j=V/i or j=V'/i		0.688	0.674	0.071	0.271	0.000	0.541	0.082	0.450	0.544
Current cycle length (sec): k		100								
Phase ratio	1φ		0.674				0.541			
	2φ	0.688				0.000				
	3φ				0.271				0.450	0.544
	4φ			0.071				0.082		
Demand ratio of intersection *		1.988								
Current green time (sec): l	1φ		30				30			
	2φ	29				29				
	3φ				24				24	24
	4φ			5				5		
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		594	592	162	478	594	593	162	480	432
Degree of Saturation: V/C **		2.205	2.247	1.235	1.130	0.101	1.804	1.358	1.875	2.269
Check		NG	NG	NG	NG	OK	NG	NG	NG	NG

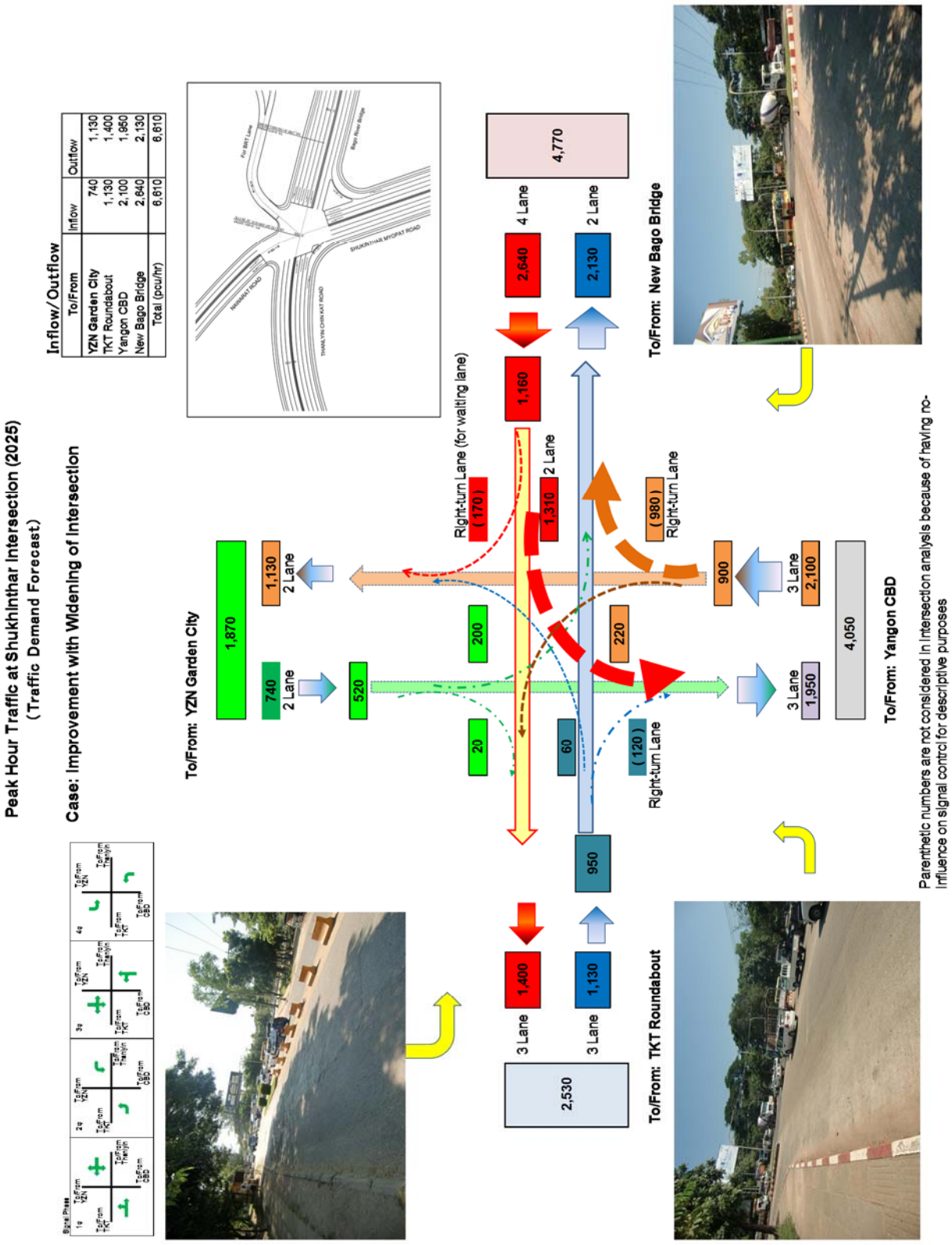
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

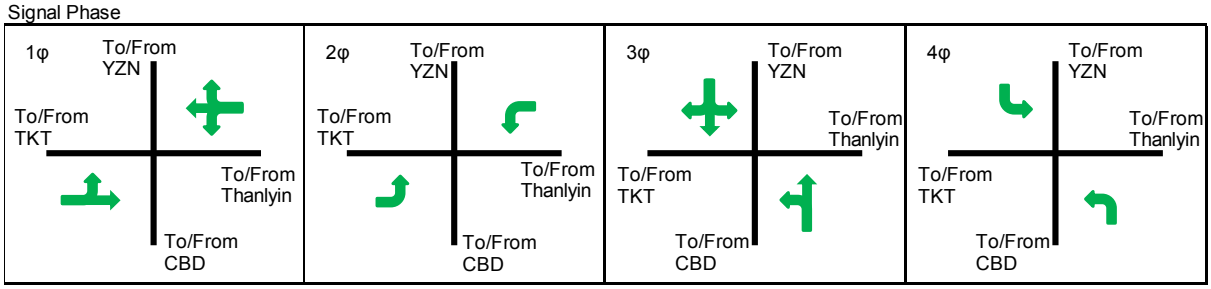
Source: JICA Study Team

Appendix C-2: Case of Improvement with Widening of Intersection at Shukhinthar Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Shukhinthar Intersection

Case: 2025 Improvement with Widening of Intersection

Entry		Thanlyin to TKT			YZN to CBD		TKT to Thanlyin		CBD to YZN	
Direction		LT	TH	RT	LT	TH +RT	LT	TH	LT	TH
Number of Lane: a		2	2	1	1	1	1	2	1	2
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	1,800	1,800	2,000	1,800	2,000	1,800	2,000
Reduction coefficient: c (Lane width: m)		1.000 (3.00)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)						0.996 (3.7)				
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h		2(72)			2(72)		2(72)		2(72)	
Saturation flow ratio: i=a*b*c*d*e*f*g		3,600	4,000	1,800	1,800	1,992	1,800	4,000	1,800	4,000
Traffic volume (pcu/hr): V		1,310	1,160	170	200	540 (20+520)	60	950	220	900
Traffic volume with compensation of left turn (pcu/hr): V'=V-h		1,238			128		0		148	
Flow ratio: j=V/i or j=V'/i		0.344	0.290	0.094	0.071	0.271	0.000	0.237	0.082	0.225
Current cycle length (sec): k		100								
Phase ratio	1φ		0.290	0.094				0.237		
	2φ	0.344					0.000			
	3φ					0.271				0.225
	4φ				0.071				0.082	
Demand ratio of intersection *		0.987								
Current green time (sec): l	1φ		26	26				26		
	2φ	31					31			
	3φ					24				24
	4φ				7				7	
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		1,188	1,040	468	198	478	630	1,040	198	960
Degree of Saturation: V/C **		1.103	1.115	0.363	1.010	1.130	0.095	0.913	1.111	0.938
Check		NG	NG	OK	NG	NG	OK	OK	NG	OK

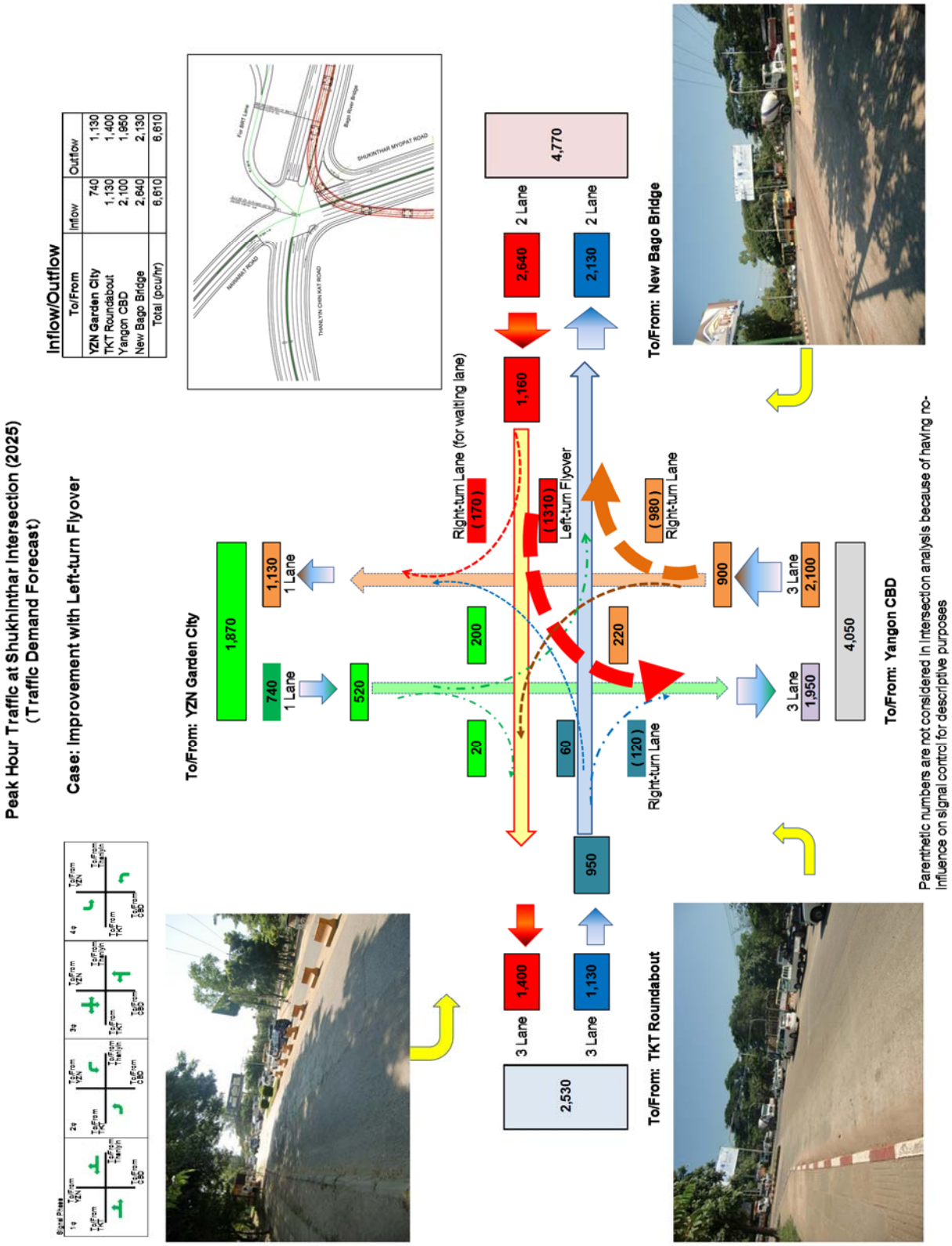
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

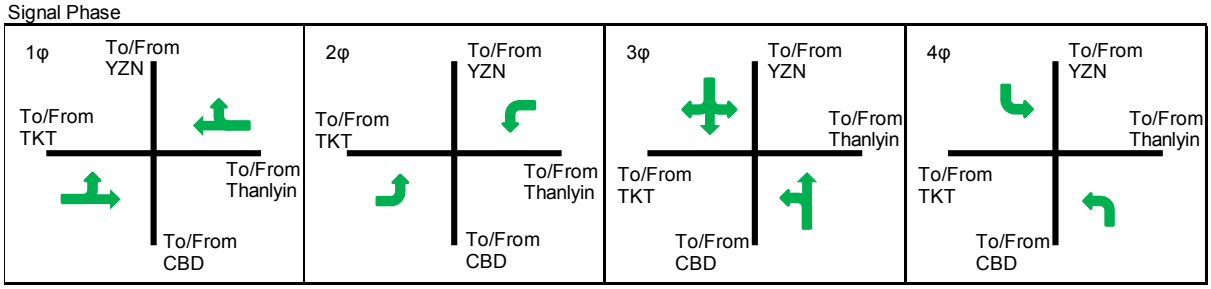
Source: JICA Study Team

Appendix C-3: Case of Improvement with Left-turn Flyover at Shukhinthar Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Shukhinthar Intersection

Case: 2025 Improvement with Left-turn Flyover

Entry		Thanlyin to TKT		YZN to CBD		TKT to Thanlyin		CBD to YZN	
Direction		TH	RT	LT	TH+RT	LT	TH	LT	TH
Number of Lane: a		2	1	1	1	1	2	1	2
Basic value of saturation flow rate (PCU/hr): b		2,000	1,800	1,800	2,000	1,800	2,000	1,800	2,000
Reduction coefficient: c (Lane width: m)		1.000 (3.00)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)					0.996 (3.7)				
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h				2(72)		2(72)		2(72)	
Saturation flow ratio: i=a*b*c*d*e*f*g		4,000	1,800	1,800	1,992	1,800	4,000	1,800	4,000
Traffic volume (pcu/hr): V		1,160	170	200	540 (20+520)	60	950	220	900
Traffic volume with compensation of left turn (pcu/hr): V'=V-h				128		0		148	
Flow ratio: j=V/i or j=V'/i		0.290	0.094	0.071	0.271	0.000	0.237	0.082	0.225
Current cycle length (sec): k		100							
Phase ratio	1φ	0.290	0.094				0.237		
	2φ					0.000			
	3φ				0.271				0.225
	4φ			0.071				0.082	
Demand ratio of intersection *		0.643							
Current green time (sec): l	1φ	37	37				37		
	2φ					5			
	3φ				34				34
	4φ			12				12	
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		1,480	666	288	677	162	1,480	288	1,360
Degree of Saturation: V/C **		0.784	0.255	0.694	0.798	0.370	0.642	0.764	0.662
Check		OK	OK	OK	OK	OK	OK	OK	OK

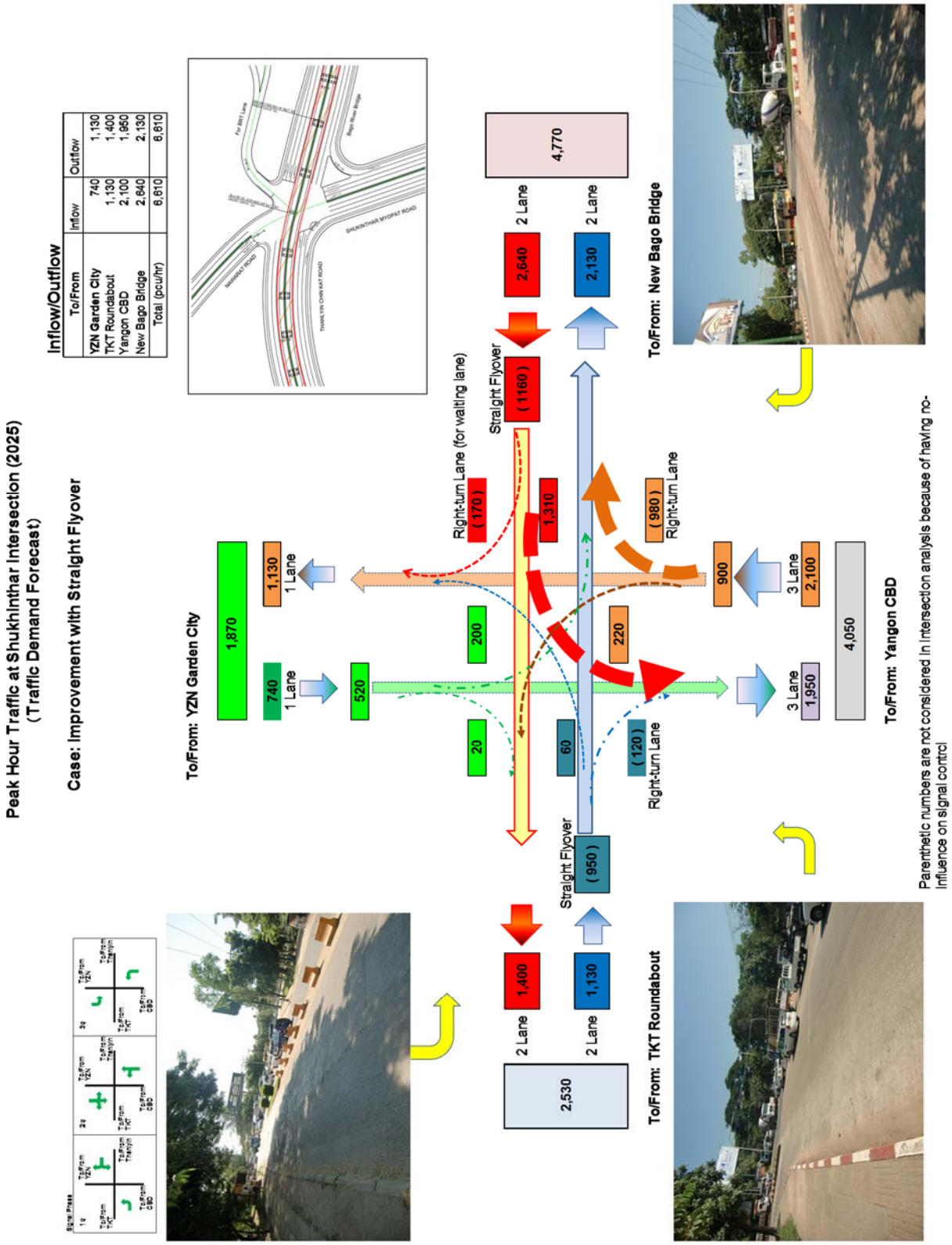
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

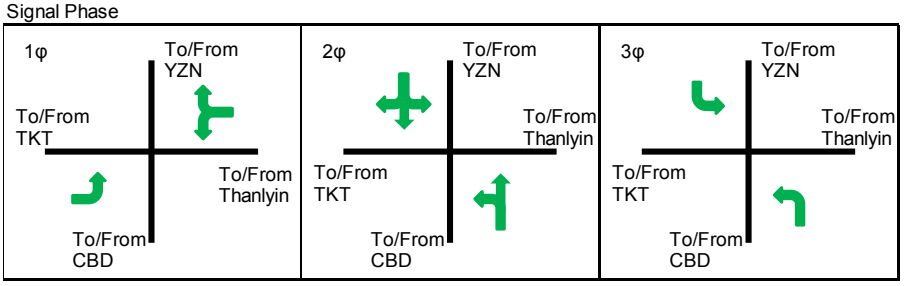
Source: JICA Study Team

Appendix C-4: Case of Improvement with Straight Flyover at Shukhinthar Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Shukhinthar Intersection

Case: 2025 Improvement with Straight Flyover

Entry		Thanlyin to TKT		YZN to CBD		TKT to Thanlyin	CBD to YZN	
Direction		LT	RT	LT	TH+RT	LT	LT	TH
Number of Lane: a		2	1	1	1	2	1	2
Basic value of saturation flow rate (PCU/hr): b		1,800	1,800	1,800	2,000	1,800	1,800	2,000
Reduction coefficient: c (Lane width: m)		1.000 (3.00)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)					0.996 (3.7)			
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h				2(72)			2(72)	
Saturation flow ratio: i=a*b*c*d*e*f*g		3,600	1,800	1,800	1,992	3,600	1,800	4,000
Traffic volume (pcu/hr): V		1,310	170	200	540 (20+520)	60	220	900
Traffic volume with compensation of left turn (pcu/hr): V'=V-h				128			148	
Flow ratio: j=V/i or j=V'/i		0.364	0.094	0.071	0.271	0.017	0.082	0.225
Current cycle length (sec): k		100						
Phase ratio	1φ	0.364	0.094			0.017		
	2φ				0.271			0.225
	3φ			0.071			0.082	
Demand ratio of intersection *		0.717						
Current green time (sec): l	1φ	45	45			45		
	2φ				34			34
	3φ			11			11	
Capacity (pcu/hr): C=i*l/k or i*l/k+h*3600/k		1,620	810	270	677	1,620	270	1,360
Degree of Saturation: V/C **		0.809	0.210	0.741	0.798	0.037	0.815	0.662
Check		OK	OK	OK	OK	OK	OK	OK

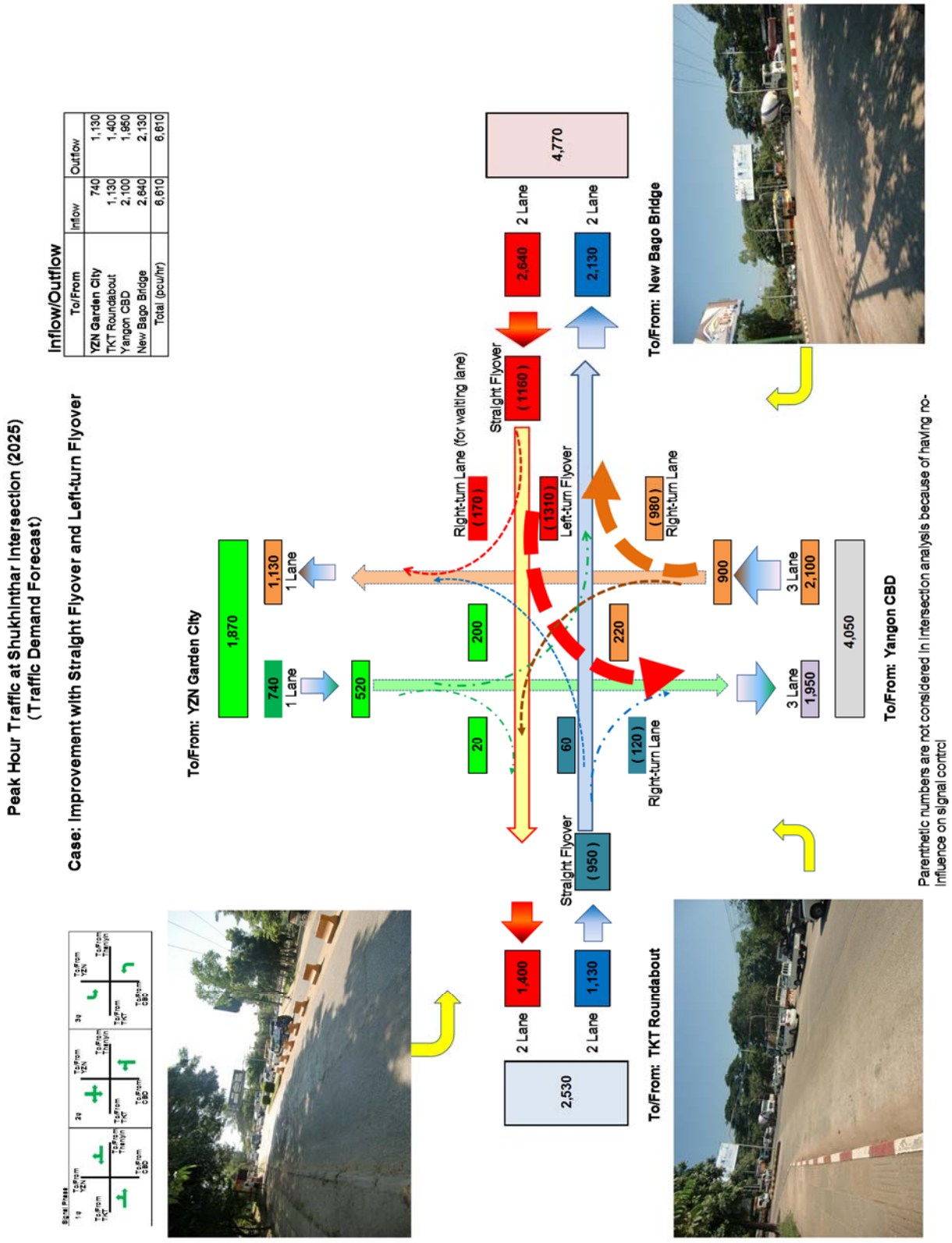
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

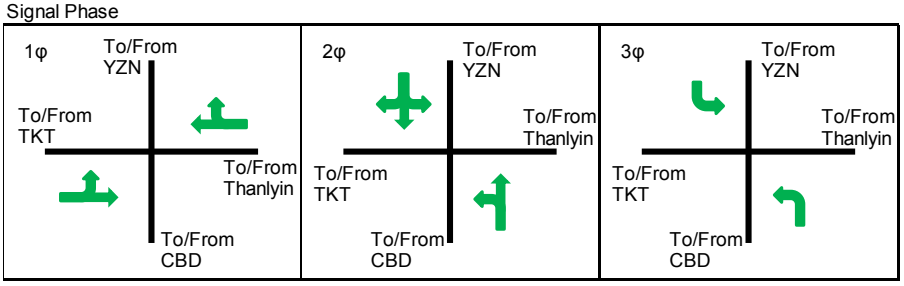
Source: JICA Study Team

Appendix C-5: Case of Improvement with Straight Flyover and Left-turn Flyover at Shukhinthar Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Shukhinthar Intersection

Case: 2025 Improvement with Straight and Left-turn Flyover

Entry		Thanlyin to TKT		YZN to CBD		TKT to Thanlyin		CBD to YZN	
Direction		TH	RT	LT	TH+RT	LT	TH	LT	TH
Number of Lane: a		1	1	1	1	1	1	1	2
Basic value of saturation flow rate (PCU/hr): b		2,000	1,800	1,800	2,000	1,800	2,000	1,800	2,000
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)					0.996 (3.7)				
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h				2(72)				2(72)	
Saturation flow ratio: i=a*b*c*d*e*f*g		2,000	1,800	1,800	1,992	1,800	2,000	1,800	4,000
Traffic volume (pcu/hr): V		0	170	200	540 (20+520)	60	0	220	900
Traffic volume with compensation of left turn (pcu/hr): V'=V-h				128				148	
Flow ratio: j=V/i or j=V'/i		0.000	0.094	0.071	0.271	0.033	0.000	0.082	0.225
Current cycle length (sec): k		100							
Phase ratio	1φ	0.000	0.094			0.033	0.000		
	2φ				0.271				0.225
	3φ			0.071				0.082	
Demand ratio of intersection *		0.447							
Current green time (sec): l	1φ	18	18			18	18		
	2φ				52				52
	3φ			20				20	
Capacity (pcu/hr): C=i*l/k or i*l/k+h*3600/k		360	324	432	1,036	324	360	432	2,080
Degree of Saturation: V/C **		0.000	0.525	0.463	0.521	0.185	0.000	0.509	0.433
Check		OK	OK	OK	OK	OK	OK	OK	OK

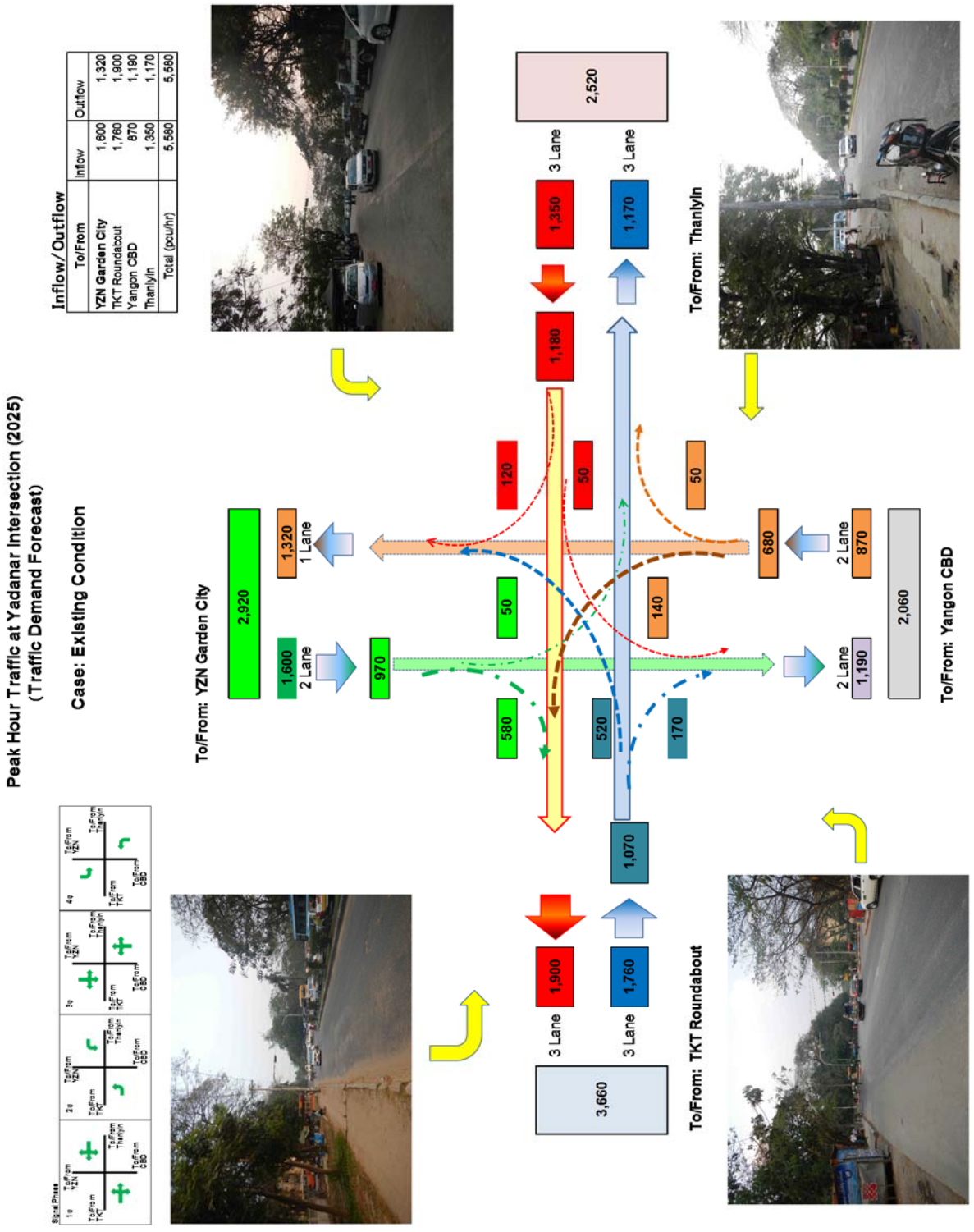
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

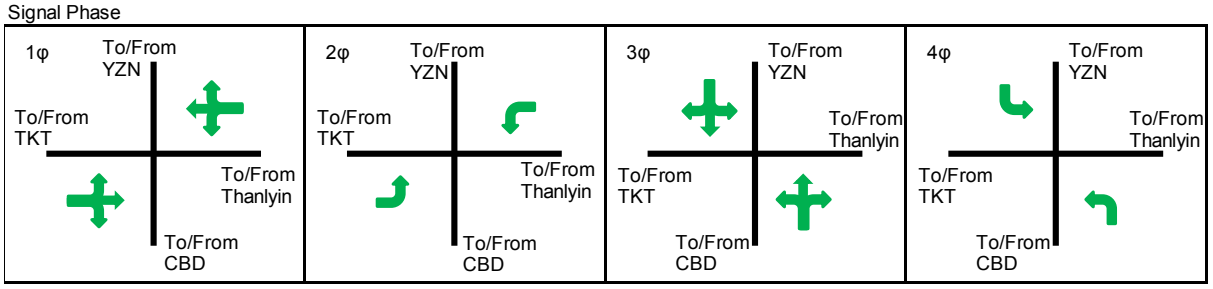
Source: JICA Study Team

Appendix C-6: Case of Existing Condition at Yadanar Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Yadanar Intersection

Case: 2025 Existing Condition

Entry		Thanlyin to TKT			YZN to CBD		TKT to Thanlyin			CBD to YZN	
Direction		LT	TH	TH+RT	LT	TH+RT	LT	TH	TH+RT	LT	TH+RT
Number of Lane: a		1	1	1	1	1	1	1	1	1	1
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	2,000	1,800	2,000	1,800	2,000	2,000	1,800	2,000
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)				0.980 (18.5)		0.960 (37.4)			0.971 (27.4)		0.993 (6.8)
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h		2(72)			2(72)		2(72)			2(72)	
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	2,000	1,960	1,800	1,920	1,800	2,000	1,942	1,800	1,986
Traffic volume (pcu/hr): V		50	1,300 (120+1180)		50	1,550 (580+970)	520	1,240 (170+1070)		140	730 (50+680)
Traffic volume with compensation of left turn (pcu/hr): V'=V-h		0			0		448			68	
Flow ratio: j=V/i or j=V'/i		0.000	0.328		0.000	0.807	0.249	0.315		0.038	0.368
Current cycle length (sec): k		100									
Phase ratio	1φ		0.328					0.315			
	2φ	0.000					0.249				
	3φ					0.807					0.368
	4φ				0.000					0.038	
Demand ratio of intersection *		1.422									
Current green time (sec): l	1φ		20					20			
	2φ	14					14				
	3φ					49					49
	4φ				5					5	
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		324	792		162	941	324	788		162	973
Degree of Saturation: V/C **		0.154	1.641		0.309	1.647	1.605	1.574		0.864	0.750
Check		OK	NG		OK	NG	NG	NG		OK	OK

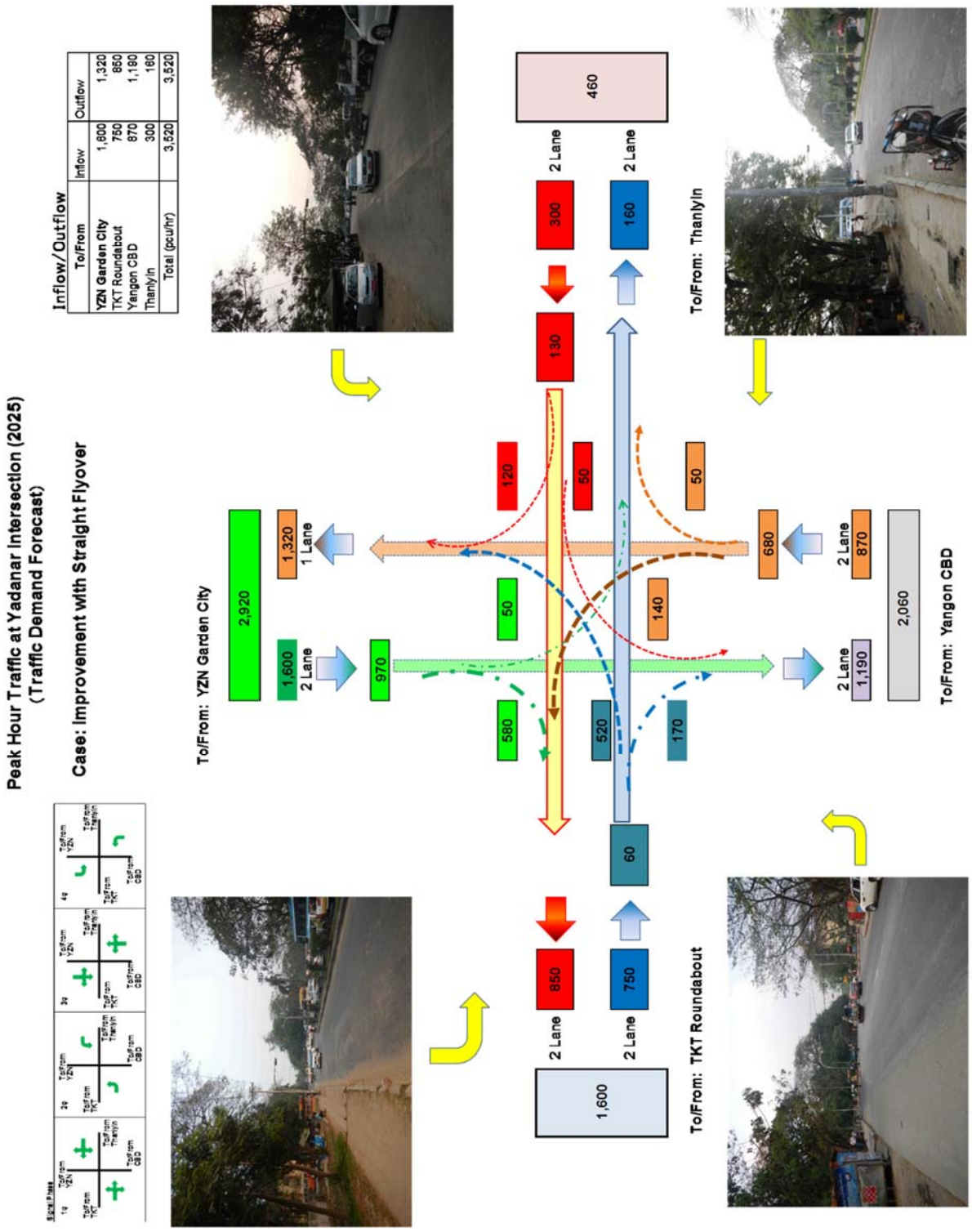
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

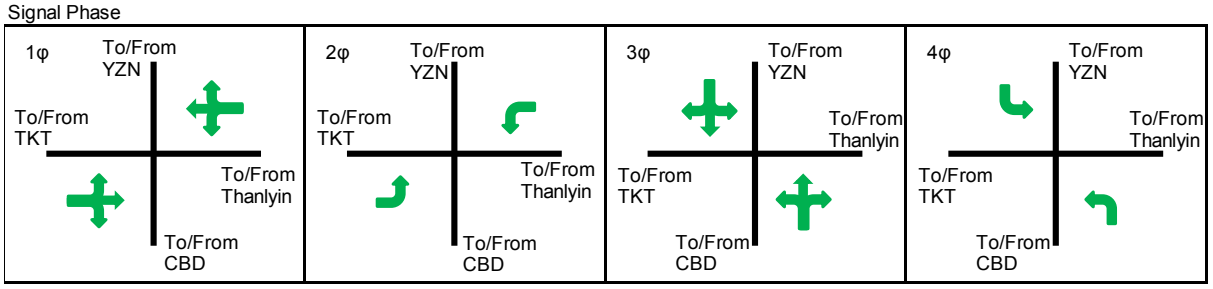
Source: JICA Study Team

Appendix C-7: Case of Improvement with Straight Flyover at Yadanar Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Yadanar Intersection

Case: 2025 Improvement with Straight Flyover

Entry		Thanlyin to TKT		YZN to CBD		TKT to Thanlyin		CBD to YZN	
Direction		LT	TH+RT	TH+LT	TH+RT	LT	TH+RT	TH+LT	TH+RT
Number of Lane: a		1	1	1	1	1	1	1	1
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	2,000	2,000	1,800	2,000	2,000	2,000
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)			0.950 (48.0)		0.926 (72.5)		0.925 (73.9)		0.988 (11.5)
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h		2(72)		0.917 (6.3) 2(72)		2(72)		0.542 (32.2) 2(72)	
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	1,900	1,834	1,852	1,800	1,850	1,084	1,976
Traffic volume (pcu/hr): V		50	250 (120+130)	1,600 (50+580+970)		520	230 (170+60)	870 (140+50+680)	
Traffic volume with compensation of left turn (pcu/hr): V'=V-h		0				448			
Flow ratio: j=V/i or j=V'/i		0.000	0.132	0.434		0.249	0.124	0.284	
Current cycle length (sec): k		100							
Phase ratio	1φ		0.132				0.124		
	2φ	0.000				0.249			
	3φ			0.434				0.284	
	4φ								
Demand ratio of intersection *		0.815							
Current green time (sec): l	1φ		16				16		
	2φ	23				23			
	3φ			41				41	
	4φ								
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		486	304	1,511		486	296	1,255	
Degree of Saturation: V/C **		0.103	0.822	1.059		1.070	0.777	0.693	
Check		OK	OK	NG		NG	OK	OK	

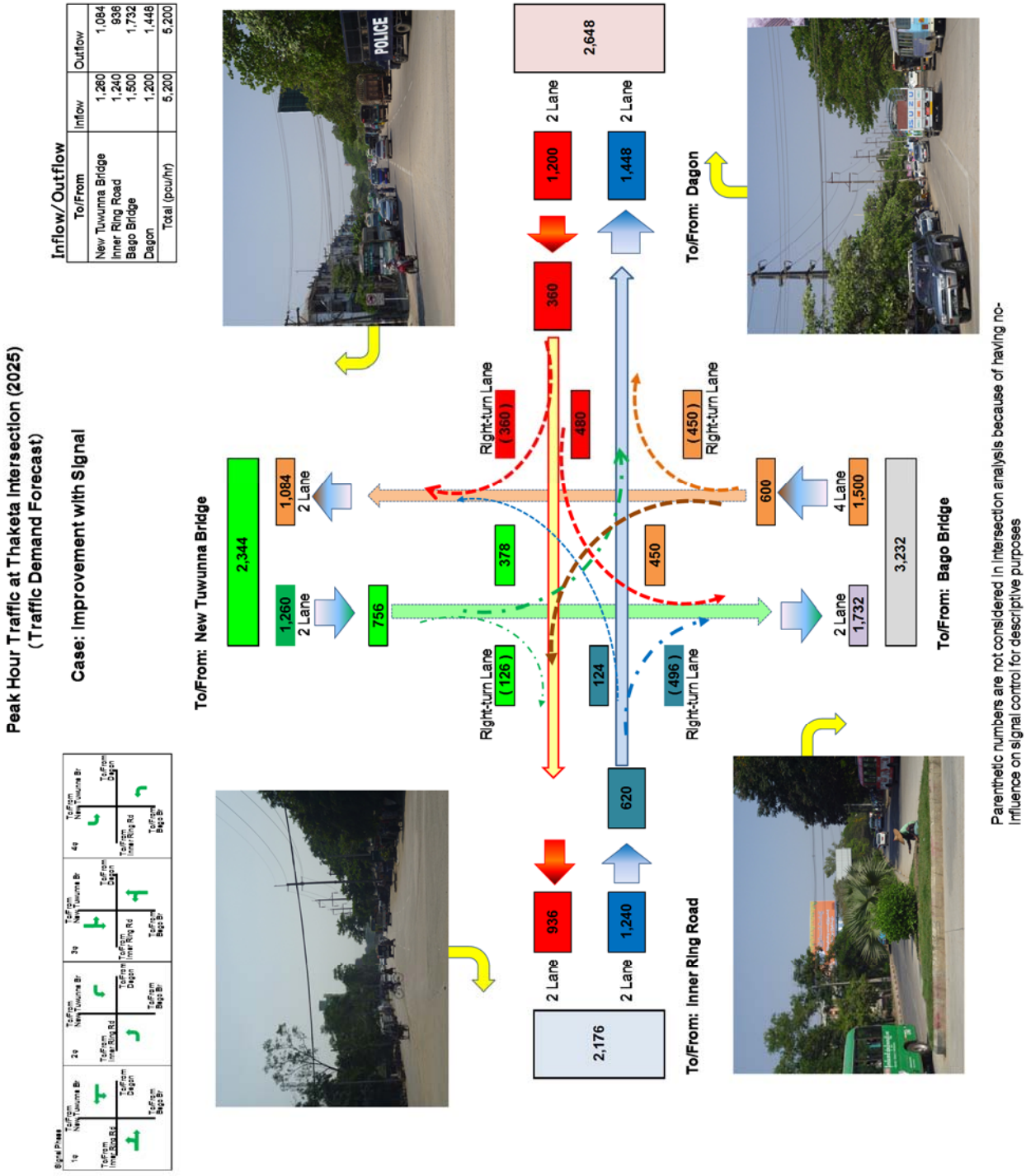
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

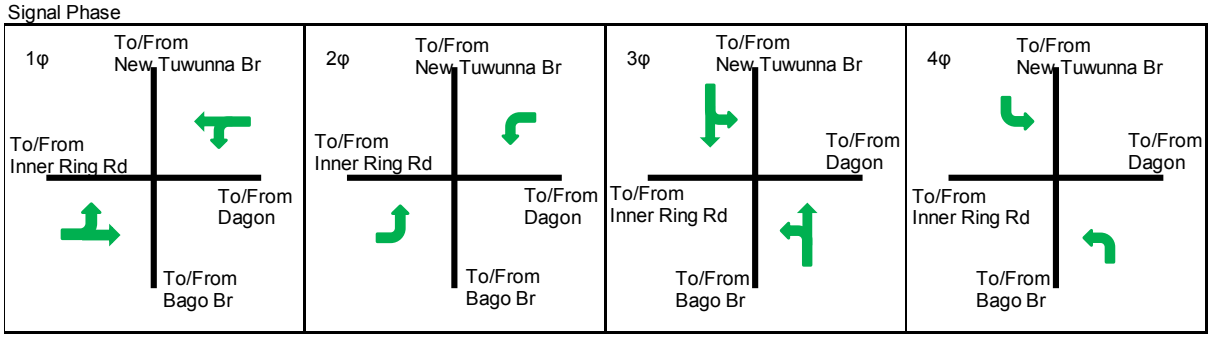
Source: JICA Study Team

Appendix C-8: Case of Improvement with Signal at Thaketa Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Thaketa Intersection

Case: 2025 Improvement with Signal

Entry		Dagon to Inner Ring Rd		New Tuwunna Br to Bago Br		Inner Ring Rd to Dagon		Bago Br to New Tuwunna Br	
Direction		LT	TH	LT	TH	LT	TH	LT	TH
Number of Lane: a		1	1	1	1	1	1	2	2
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	1,800	2,000	1,800	2,000	1,800	2,000
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.00)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)									
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h		2(72)		2(72)		2(72)		2(72)	
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	2,000	1,800	2,000	1,800	2,000	3,600	4,000
Traffic volume (pcu/hr): V		480	360	378	756	124	620	450	600
Traffic volume with compensation of left turn (pcu/hr): V'=V-h		408		306		52		378	
Flow ratio: j=V/i or j=V'/i		0.227	0.180	0.170	0.378	0.029	0.310	0.105	0.150
Current cycle length (sec): k		100							
Phase ratio	1φ		0.180				0.310		
	2φ	0.227				0.029			
	3φ				0.378				0.150
	4φ			0.170				0.105	
Demand ratio of intersection *		1.085							
Current green time (sec): l	1φ		26				26		
	2φ	18				18			
	3φ				31				31
	4φ			13				13	
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		396	520	306	620	396	520	540	1,240
Degree of Saturation: V/C **		1.212	0.692	1.235	1.219	0.313	1.192	0.833	0.484
Check		NG	OK	NG	NG	OK	NG	OK	OK

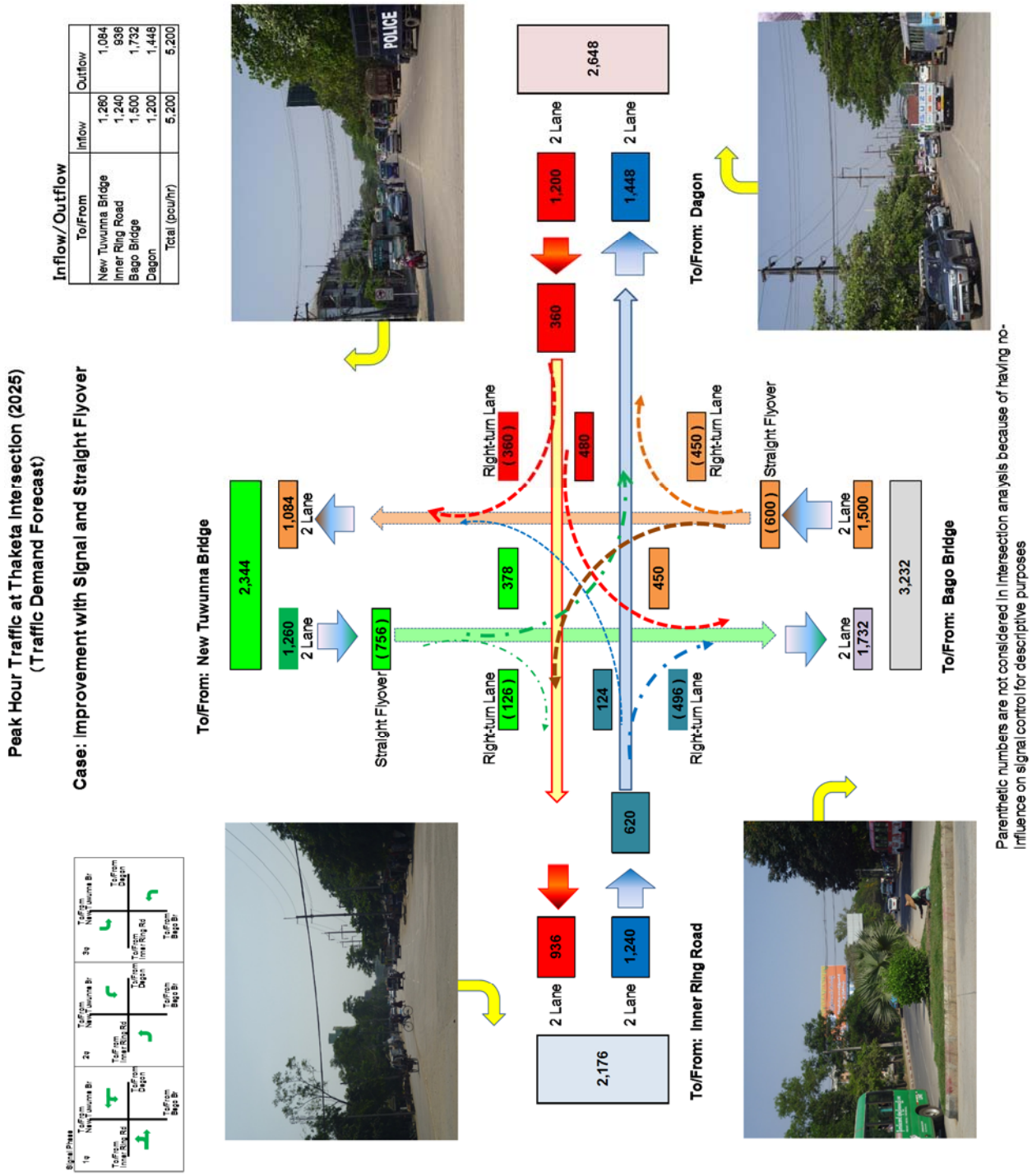
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

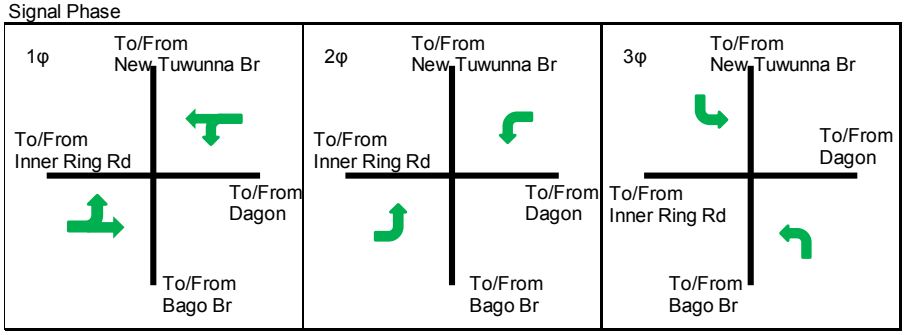
Source: JICA Study Team

Appendix C-9: Case of Improvement with Signal and Straight Flyover at Thaketa Intersection in 2025



Source: JICA Study Team

Signal Phase



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Thaketa Intersection

Case: 2025 Improvement with Signal and Straight Flyover

Entry		Dagon to Inner Ring Rd		New Tuwunna Br to Bago Br	Inner Ring Rd to Dagon		Bago Br to New Tuwunna Br
Direction		LT	TH	LT	LT	TH	LT
Number of Lane: a		1	1	2	1	1	2
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	1,800	1,800	2,000	1,800
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)							
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h		2(72)			2(72)		
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	2,000	3,600	1,800	2,000	3,600
Traffic volume (pcu/hr): V		480	360	378	124	620	450
Traffic volume with compensation of left turn (pcu/hr): V'=V-h		408			52		
Flow ratio: j=V/i or j=V'/i		0.227	0.180	0.105	0.029	0.310	0.125
Current cycle length (sec): k		100					
Phase ratio	1φ		0.180			0.310	
	2φ	0.227			0.029		
	3φ			0.105			0.125
Demand ratio of intersection *		0.662					
Current green time (sec): l	1φ		42			42	
	2φ	32			32		
	3φ			16			16
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		648	840	576	648	840	576
Degree of Saturation: V/C **		0.741	0.429	0.656	0.191	0.738	0.781
Check		OK	OK	OK	OK	OK	OK

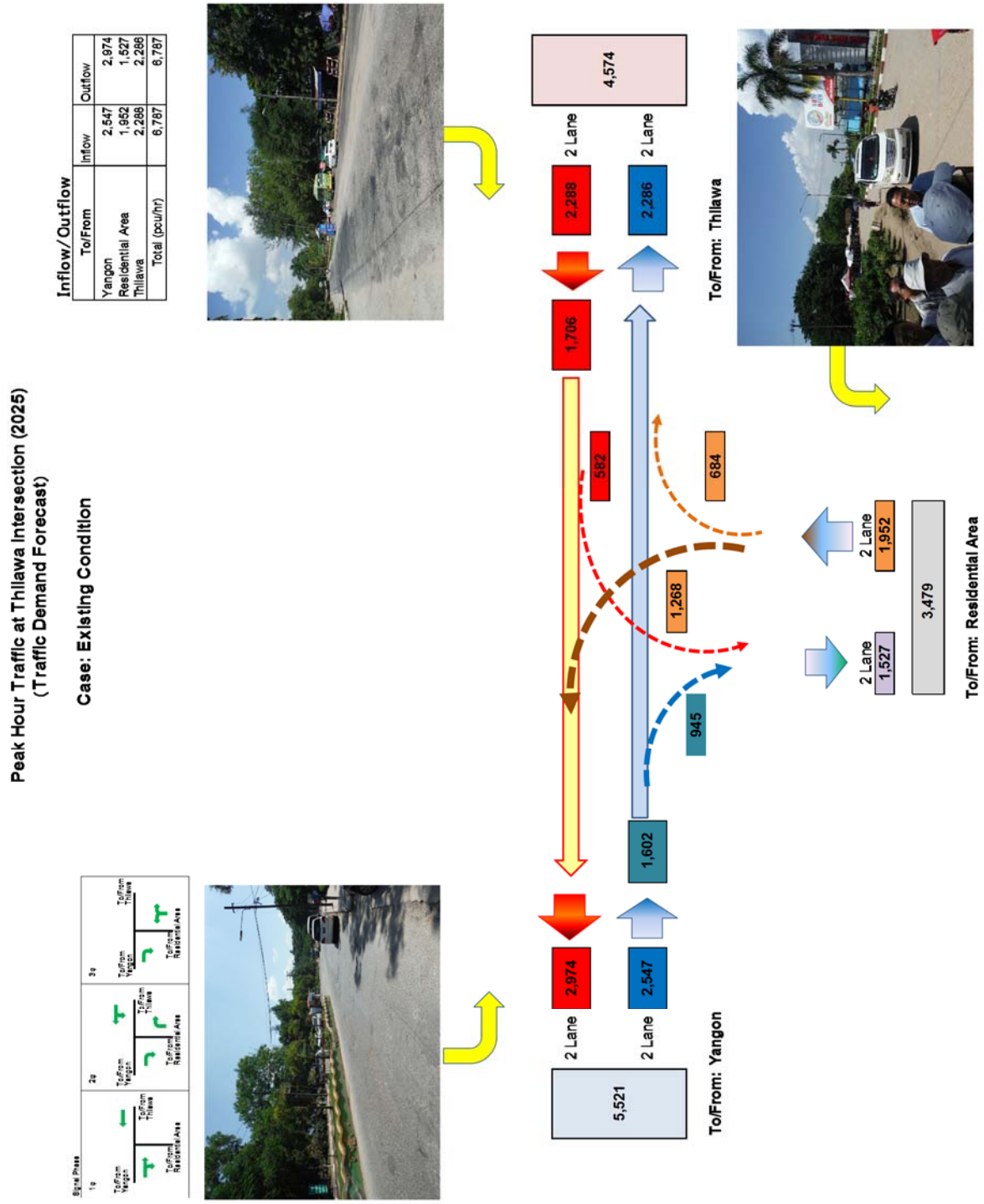
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

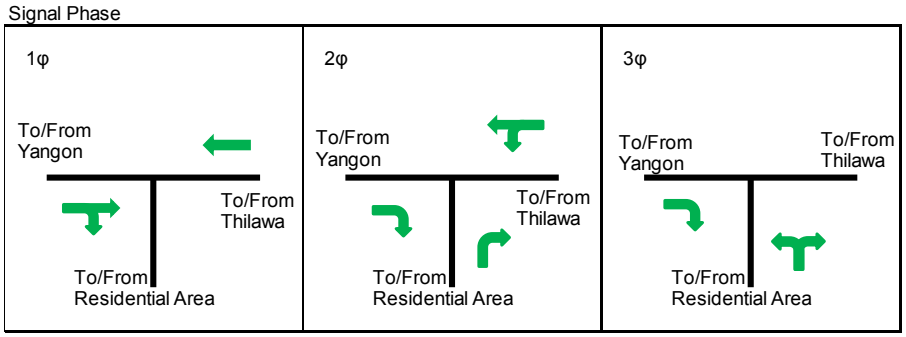
Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

Source: JICA Study Team

Appendix C-10: Case of Existing Condition at Thilawa Intersection in 2025



Source: JICA Study Team



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Thilawa Intersection

Case: 2025 Existing Condition

Entry		Thilawa to Yangon		From Residential Area		Yangon to Thilawa	
Direction		LT	TH	LT	RT	TH	RT
Number of Lane: a		1	1	1	1	1	1
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	1,800	1,800	2,000	1,800
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)							
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h							
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	2,000	1,800	1,800	2,000	1,800
Traffic volume (pcu/hr): V		582	1,706	1,268	684	1,602	945
Traffic volume with compensation of left turn (pcu/hr): V'=V-h							
Flow ratio: j=V/i or j=V'/i		0.323	0.853	0.704	0.380	0.801	0.525
Current cycle length (sec): k		100					
Phase ratio	1φ		0.801			0.801	0.525
	2φ	0.323	0.052		0.323		0.000
	3φ			0.704	0.057		0.000
Demand ratio of intersection *		1.828					
Current green time (sec): l	1φ		38			38	38
	2φ	16	16		16		16
	3φ			34	34		34
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		288	1,080	612	900	760	1,584
Degree of Saturation: V/C **		2.021	1.580	2.072	0.760	2.108	0.597
Check		NG	NG	NG	OK	NG	OK

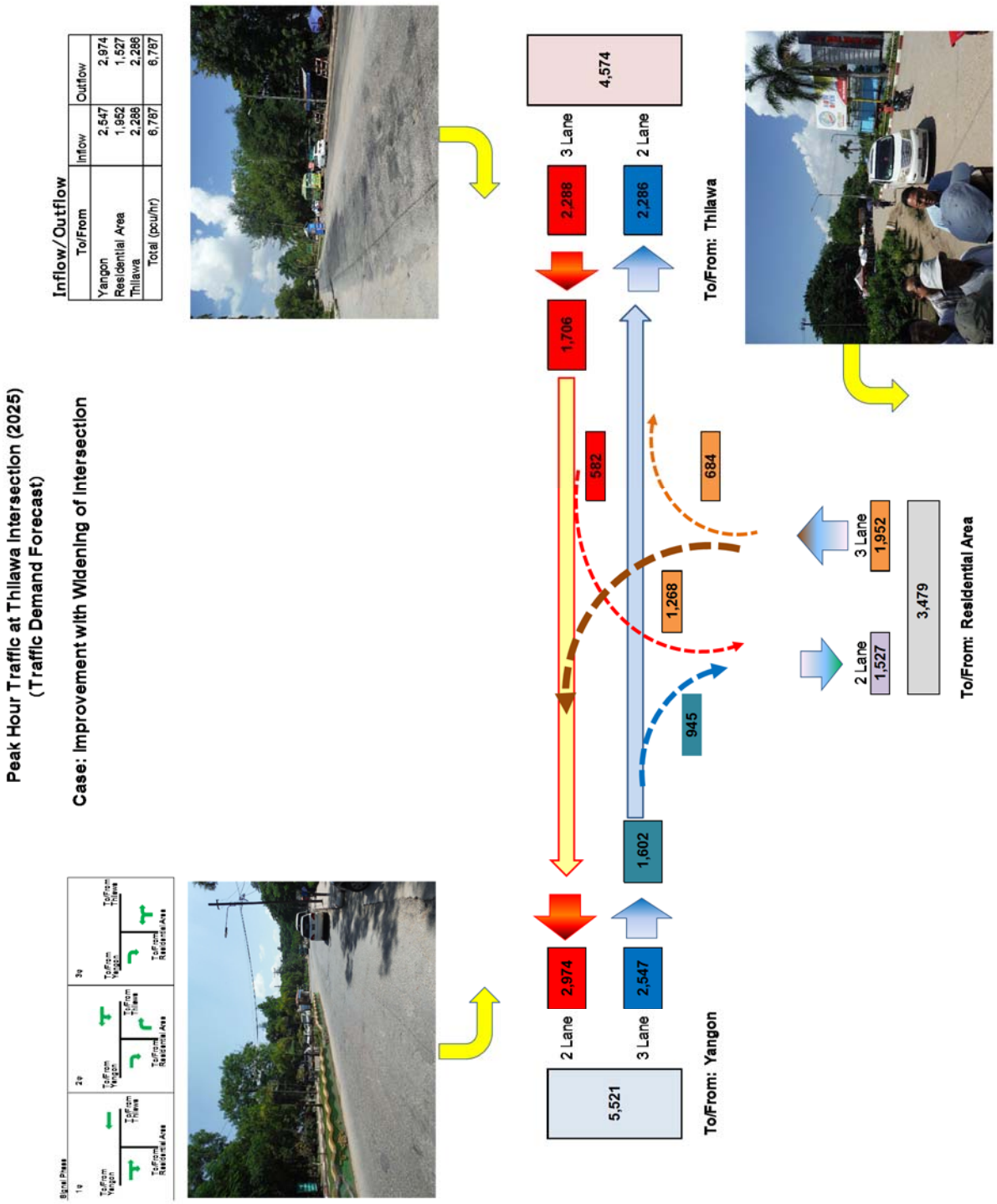
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

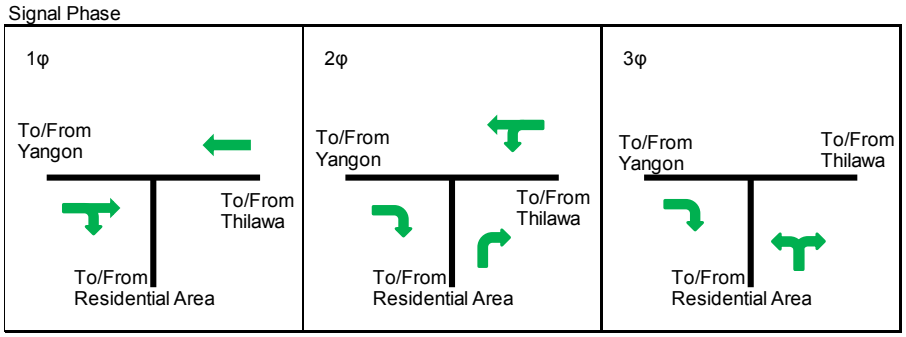
Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

Source: JICA Study Team

Appendix C-11: Case of Improvement with Widening of Intersection at Thilawa Intersection in 2025



Source: JICA Study Team



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Thilawa Intersection

Case: 2025 Improvement with Widening of Intersection

Entry		Thilawa to Yangon		From Residential Area		Yangon to Thilawa	
Direction		LT	TH	LT	RT	TH	RT
Number of Lane: a		1	2	2	1	2	1
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	1,800	1,800	2,000	1,800
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)							
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h							
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	4,000	3,600	1,800	4,000	1,800
Traffic volume (pcu/hr): V		582	1,706	1,268	684	1,602	945
Traffic volume with compensation of left turn (pcu/hr): V'=V-h							
Flow ratio: j=V/i or j=V'/i		0.323	0.426	0.352	0.380	0.400	0.525
Current cycle length (sec): k		100					
Phase ratio	1φ		0.400			0.400	0.400
	2φ	0.323	0.026		0.323		0.125
	3φ			0.352	0.057		0.000
Demand ratio of intersection *		1.075					
Current green time (sec): I	1φ		32			32	32
	2φ	27	27		27		27
	3φ			29	29		29
Capacity (pcu/hr): C=i*I/k or C=i*I/k+h*3600/k		486	2,360	1,044	1,008	1,280	1,584
Degree of Saturation: V/C **		1.198	0.723	1.215	0.679	1.252	0.597
Check		NG	OK	NG	OK	NG	OK

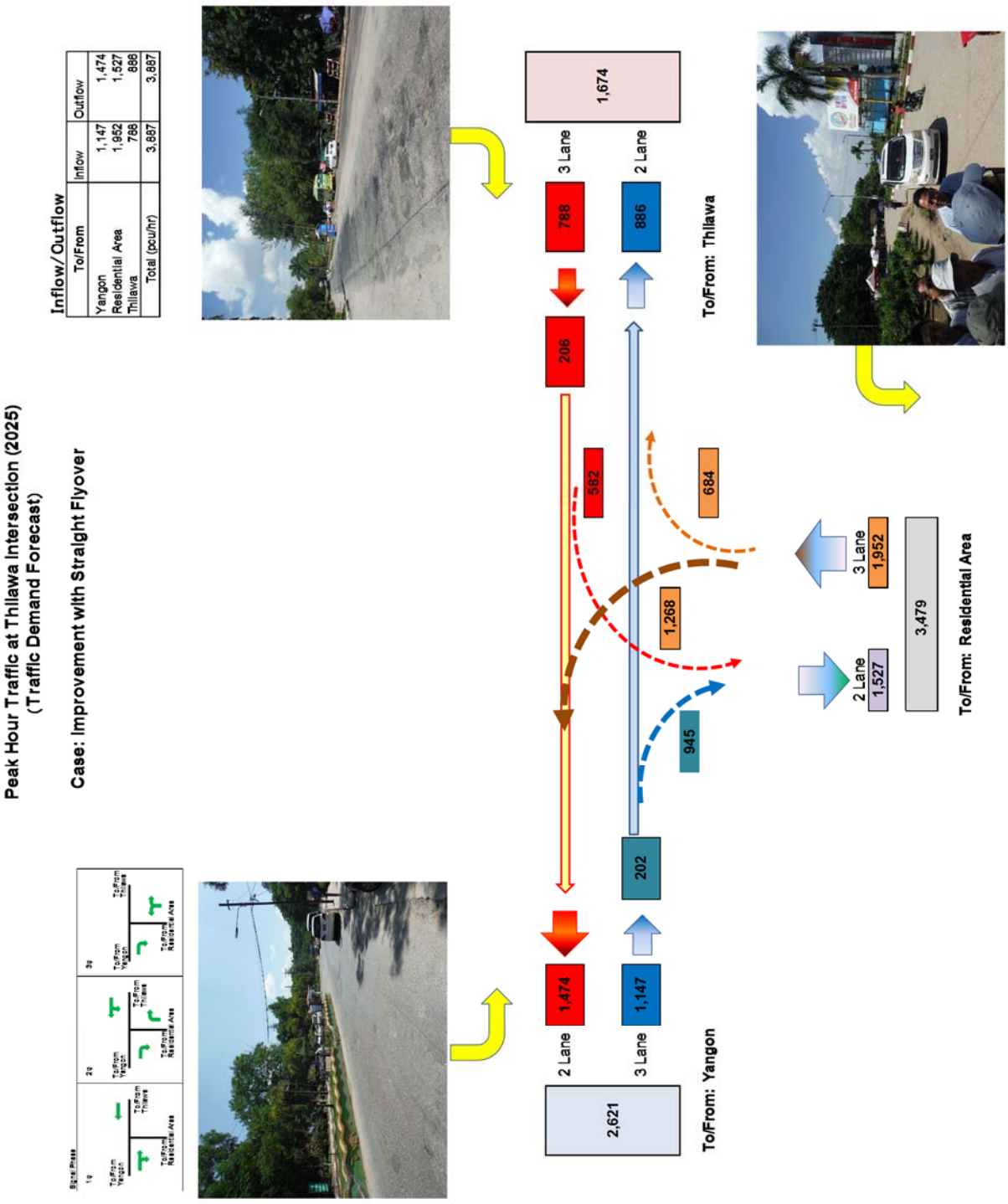
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

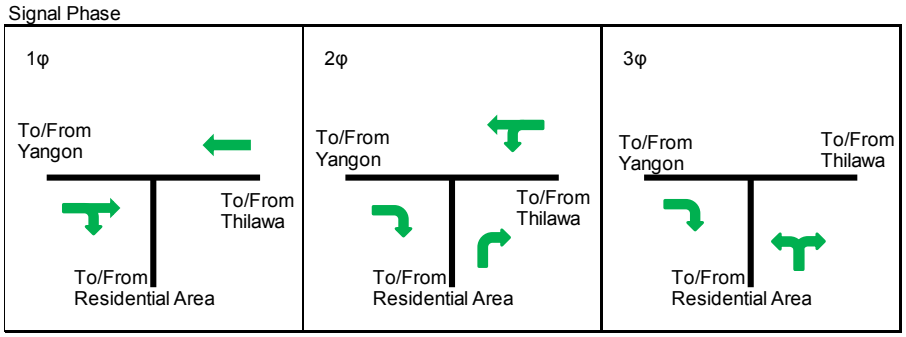
Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

Source: JICA Study Team

Appendix C-12: Case of Improvement with Straight Flyover at Thilawa Intersection in 2025



Source: JICA Study Team



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Thilawa Intersection

Case: 2025 Improvement with Straight Flyover

Entry		Thilawa to Yangon		From Residential Area		Yangon to Thilawa	
Direction		LT	TH	LT	RT	TH	TH+RT
Number of Lane: a		1	1	2	1	1	1
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	1,800	1,800	2,000	2,000
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)							0.901
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h							
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	2,000	3,600	1,800	2,000	1,802
Traffic volume (pcu/hr): V		582	206	1,268	684	1,147 (945+202)	
Traffic volume with compensation of left turn (pcu/hr): V'=V-h							
Flow ratio: j=V/i or j=V'/i		0.323	0.103	0.352	0.380	0.302	
Current cycle length (sec): k		100					
Phase ratio	1φ		0.103			0.302	
	2φ	0.323	0.000		0.323		
	3φ			0.352	0.057		
Demand ratio of intersection *		0.977					
Current green time (sec): l	1φ		27			27	
	2φ	29	29		29		
	3φ			32	32		
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		522	1,120	1,152	1,098	1,027	
Degree of Saturation: V/C **		1.115	0.184	1.101	0.623	1.117	
Check		NG	OK	NG	OK	NG	

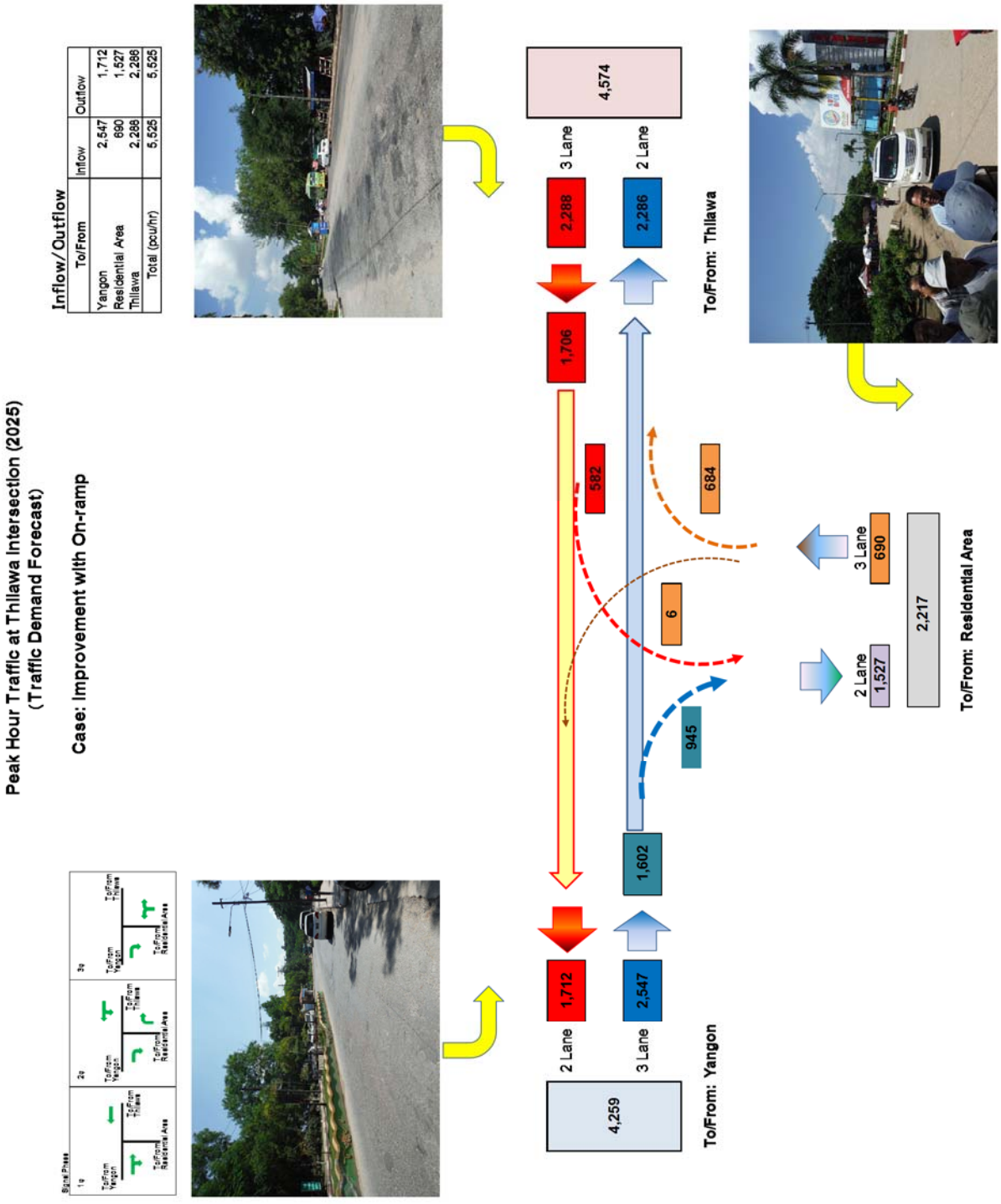
TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

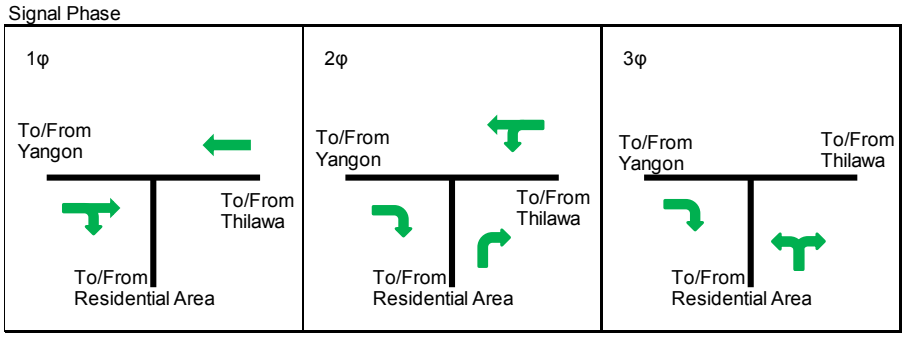
Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

Source: JICA Study Team

Appendix C-13: Case of Improvement with On-ramp at Thilawa Intersection in 2025



Source: JICA Study Team



Source: JICA Study Team

Sufficiency (Saturation) Analysis of Thilawa Intersection

Case: 2025 Improvement with On-ramp

Entry		Thilawa to Yangon		From Residential Area		Yangon to Thilawa	
Direction		LT	TH	LT	RT	TH	RT
Number of Lane: a		1	2	1	1	2	1
Basic value of saturation flow rate (PCU/hr): b		1,800	2,000	1,800	1,800	2,000	1,800
Reduction coefficient: c (Lane width: m)		1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)	1.000 (3.25)
Reduction coefficient: d (Gradient: %)		1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)	1.000 (0.30)
Reduction coefficient: e (Share of large vehicle: %)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Reduction coefficient: f (Share of right turn : %)							
Reduction coefficient: g (Share of left turn: %) (No. of left turn for transition time (nos./cycle)): h							
Saturation flow ratio: i=a*b*c*d*e*f*g		1,800	4,000	1,800	1,800	4,000	1,800
Traffic volume (pcu/hr): V		582	1,706	6	684	1,602	945
Traffic volume with compensation of left turn (pcu/hr): V'=V-h							
Flow ratio: j=V/i or j=V'/i		0.323	0.426	0.003	0.380	0.400	0.525
Current cycle length (sec): k		102					
Phase ratio	1φ		0.400			0.400	0.400
	2φ	0.323	0.026		0.323		0.125
	3φ			0.003	0.057		0.000
Demand ratio of intersection *		0.780					
Current green time (sec): l	1φ		46			46	46
	2φ	37	37		37		37
	3φ			7	7		7
Capacity (pcu/hr): C=i*l/k or C=i*l/k+h*3600/k		653	3,255	124	776	1,804	1,588
Degree of Saturation: V/C **		0.891	0.524	0.048	0.881	0.888	0.595
Check		OK	OK	OK	OK	OK	OK

TH: Through LT: Left turn RT: Right turn

Note(*): Evaluation of Demand Ratio of Intersection: Over 0.9 means that improvement of intersection is nesessary.

Note(**): Evaluation of Degree of Saturation: Over 1.0 means that improvement of intersection is nesessary.

Source: JICA Study Team

Appendix D Cost Data

Pre-Conditions for Cost Estimation

1. General Conditions

Exchange Rate

			USD	
(1)	JPY/USD	USD 1 =	109.9	JPY
(2)	LC/USD	USD 1 =	1	USD
(3)	JPY/USD	USD 1 =	109.9	JPY

Price Escalation

(1)	FC	1.6%	LC	5.8%	

Physical Contingency

Construction	10.0%	Consultant	5.0%

Base Year for Cost Estimation: 2016/5

Schedule Start 2016/4 End 2025/3

Billing Rate of Consultant

	FC JPY	LC USD
Pro-(A)	3,073,000	0
Pro-(B)	0	2,800
Supporting Staff	0	830

2. Others

Rate of Tax

VAT	5.0%	Import Tax	5.0%

Rate of Administration Cost 5.0%

Rate of Interest During Construction

Construction	0.01%	Consultant	0.01%

Rate of Front End Fee 0.0%

Payment Method for Interest during construction not loan_covered

Front End Fee not loan_covered

Fiscal Year Apr - Mar

VAT and Import TAX

	VAT		Import TAX	
	FC	LC	FC	LC
Construction/Procurement Works	TRUE	TRUE	TRUE	FALSE
Consultant Services	TRUE	TRUE	FALSE	FALSE
Land Acquisition	FALSE	FALSE	FALSE	FALSE

Advanced Payment and Retention Money

	Advanced Payment	Retention Money	After12M later
Construction	20.0%	0.0%	5.0%
Consultant Services	30.0%	0.0%	0.0%

Defect Liablity Period 12 months

Cost Breakdown for Package

USD =JPY 109.9

USD =JPY 109.9

item	Local	Total
	USD	JPY
Land Acquisition	296,592	32,595,461

Right Bank Side(Package 2) Loan Coverage Ratio 100

item	unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			JPY	USD	JPY	USD	JPY
Substructure (Reverse T-shaped Abutment A1)	L. S.	1			20,838,029	401,616	64,975,628
Substructure (Pier on land P1-P2)	L. S.	1			34,989,962	679,481	109,664,924
Substructure (Pier on river P3-P13)	L. S.	1			1,862,407,821	7,809,382	2,720,658,903
Steel box girder bridge (Superstructure)	L. S.	1			3,825,178,631	4,453,300	4,314,596,301
PC Precast Box Girder (Superstructure A1-P6)	L. S.	1			819,649,037	4,207,377	1,282,039,769
Access Road	L. S.	1			95,058,005	1,431,450	252,374,360
Miscellaneous work	L. S.	1			803,163,267	13,683,952	2,307,029,592
Dispute Board					70,226,100		70,226,100
Total					7,531,510,852	32,666,558	11,121,565,576

Left Bank Side(Packege 3) Loan Coverage Ratio 100

item	unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			JPY	USD	JPY	USD	JPY
Substructure (Reverse T-shaped Abutment A2)	L. S.	1			20,501,186	396,524	64,079,173
Substructure (Pier on land P21-P23)	L. S.	1			52,813,544	1,024,773	165,436,097
Substructure (Pier on river P14-P20)	L. S.	1			1,606,897,905	6,945,090	2,370,163,296
Steel cable stayed bridge (Superstructure)	L. S.	1			4,509,197,330	5,230,192	5,083,995,431
PC Precast Box Girder (Superstructure P16-A2)	L. S.	1			931,383,487	4,839,891	1,463,287,508
Approach Road	L. S.	1			242,280,045	3,652,050	643,640,340
Miscellaneous work	L. S.	1			539,118,406	6,581,584	1,262,434,488
Flyover at Thanlyin side	L. S.	1			167,541,451	1,346,355	315,505,866
Dispute Board	L. S.	1			70,226,100		70,226,100
Total					8,139,959,454	30,016,459	11,438,768,298

Flyover at Yangon side(Package 1) Loan Coverage Ratio 100

item	unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			JPY	USD	JPY	USD	JPY
Flyover at Yangon side	L. S.	1			1,265,165,613	7,566,349	2,096,707,368
Dispute Board	L. S.	1			15,990,450		15,990,450
Total					1,281,156,063	7,566,349	2,112,697,818

6-lane widening(Package 1)

Loan Coverage Ratio

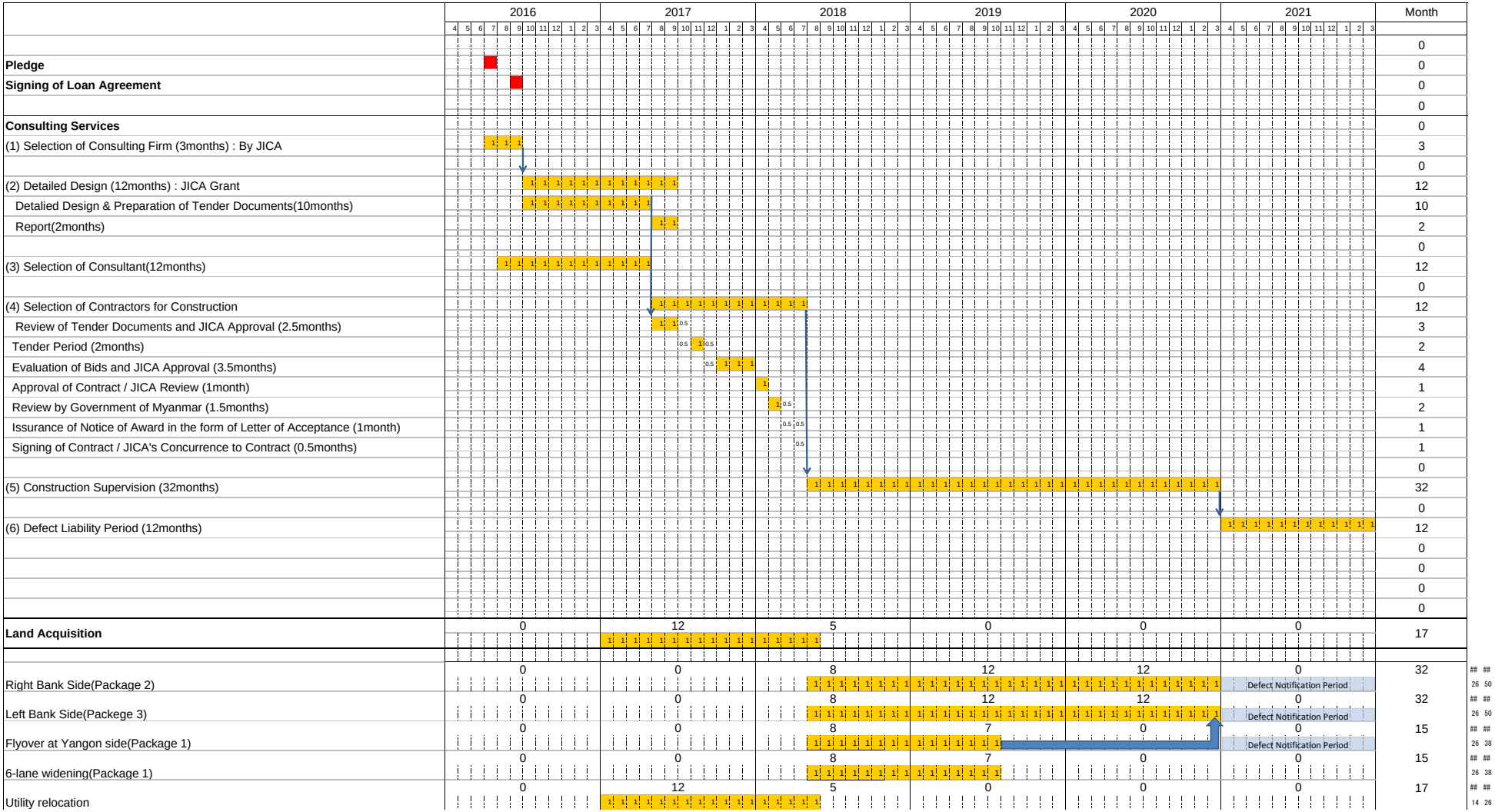
item	unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			JPY	USD	JPY	USD	JPY
6-lane widening	L. S.	1			0	1,582,600	173,927,740
Total					0	1,582,600	173,927,740

Utility relocation

Loan Coverage Ratio

item	unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			JPY	USD	JPY	USD	JPY
Utility relocation	L. S.	1				663,402	72,907,880
Total					0	663,402	72,907,880

Implementation Schedule



D-5

Cost Breakdown for the Consulting Services

USD = JPY 109.9
USD = JPY 109.9

	Unit	Qty.	Foreign Portion (JPY) Rate	Foreign Portion (JPY) Amount ('000)	Local Portion USD Rate	Local Portion USD Amount ('000)	Combined Total ('000) JPY
A Remuneration							
1 Professional (A)	M/M	314	3,073,000	964,922	0	0	964,922
2 Professional (B)	M/M	467	0	0	2,800	1,308	143,705
3 Supporting Staffs	M/M	222	0	0	830	184	20,250
Subtotal of A				964,922		1,492	1,128,877
B Direct Cost							
1 International Airfare	no	34	200,000	6,800		0	6,800
2 Domestic Airfare	no	215		0	250	54	5,907
3 Domestic Travel	no	34	30,000	1,020		0	1,020
3 Accommodation Allowance	Month	314	300,000	94,200		0	94,200
4 Vehicle Rental	Month	96		0	3,750	360	39,564
5 International Communications	Month	51	30,000	1,530		0	1,530
6 Domestic Communications (pre-construction)	Month	9		0	920	8	910
7 Domestic Communications (construction-supervision)	Month	2		0	1,310	3	288
8 Office Supply	Month	51		0	480	24	2,690
9 Office Furniture and Equipment	L.S	1		0	81,150	81	8,918
10 Field Allowance for Local Staff(Professional(B))	Month	467		0	100	47	5,132
11 Field Allowance for Local Staff(Supporting Staffs)	Month	222		0	70	16	1,708
12 Technology Transfer(OJT)	L.S	1	10,156,409	10,156		0	10,156
13 Technology Transfer (Operaiton Trainning in Japan)	L.S	1	15,000,000	15,000		0	15,000
Subtotal of B				128,706		593	193,824
Total				1,093,628		2,084	1,322,702

Manning Schedule for the Consulting Services

		Position	Billing Rate		2016												2017												2018												2019												2020												2021												Total
			F/C JPY	LC/ USD	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
			0	0																																																																						0
		Selection of Contractor	0	0																																																																						0
A	23	Project Manager	3,073,000	0																	1	1			1		1	1			1	1																																									7
A	24	Cost Estimator/Construction Planner	3,073,000	0																	1	1			1					1	1	1																																									6
A	25	Document Specialist	3,073,000	0																	1	1			1				1	1	1	1																																									7
A	26	Social Considerations Specialist	3,073,000	0																	1	1									1	1																																									4
			0	0																																																																							0
B	19	Deputy Project Manager	0	2,800																	1	1	1	1	1	1	1	1	1	1	1	1																																									12
B	20	Quantity Surveyor/Cost Estimator 1	0	2,800																							1	1	1	1	1	1																																									6
B	21	Document Specialist	0	2,800																	1	1	1	1	1	1	1	1	1	1	1	1																																									12
B	22	Social Considerations Expert	0	2,800																	1	1									1	1																																									4
			0	0																																																																							0
		Construction Supervision	0	0																																																																						0
A	27	Project Manager	3,073,000	0																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1											1	34
A	28	Senior Bridge Engineer 1	3,073,000	0																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
A	29	Senior Bridge Engineer 2	3,073,000	0																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
A	30	Resident Engineer 1	3,073,000	0																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
A	31	Resident Engineer 2	3,073,000	0																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
A	32	Senior Highway Engineer	3,073,000	0																													1	1	1															1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													20
A	33	Contract Specialist	3,073,000	0																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
A	34	Safety Engineer	3,073,000	0																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
A	35	Electrical Engineer	3,073,000	0																																																											1	1	1	1	1													5
A	36	Geotechnical/Soft Ground Specialist	3,073,000	0																																1	1	1	1	1	1						1	1	1																														9
A	37	Environmental Specialist	3,073,000	0																																					1	1	1									1	1	1										1	1	1													9
A	38	Social Considerations Specialist	3,073,000	0																																					1	1	1									1	1	1										1	1	1													9
A	39	Utility Engineer	3,073,000	0																																																1	1	1							1	1	1																6
A	40	O&M Specialist	3,073,000	0																																																1												1	1	1	1											1	6
			0	0																																																																							0
B	23	Deputy Project Manager/Structural Engineer	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							1				1	35
B	24	Assistant Resident Engineer	0	2,800																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
B	25	Road Engineer 1	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
B	26	Road Engineer 2	0	2,800																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
B	27	Strucutral Engineer (Flyover)	0	2,800																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
B	28	Document Specialist	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
B	29	Quantity Surveyor/Cost Estimator 1	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
B	30	Quantity Surveyor/Cost Estimator 2	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
B	31	Quantity Surveyor/Cost Estimator 3	0	2,800																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
B	32	Environmental Expert	0	2,800																													1	1	1					1	1	1									1	1	1						1	1	1	1	1	1	1	1							1				1	19
B	33	Social Cosiderations Expert	0	2,800																													1	1	1					1	1	1									1	1	1						1	1	1	1	1	1	1														16
B	34	Site Supervisor 1	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1								1				1	34
B	35	Site Supervisor 2	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
B	36	Site Supervisor 3	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
B	37	Site Supervisor 4	0	2,800																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
B	38	Site Supervisor 5	0	2,800																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
B	39	Site Supervisor 6	0	2,800																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
B	40	Site Supervisor 7	0	2,800																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
		[Total of Pro-A]			**0**												**13**												**77**												**107**												**113**												**4**												**314**
		[Total of Pro-B]			**0**												**20**												**94**												**139**												**206**												**8**												**467**
		[Total of Pro-A+Pro-B]			0												33												171												246												319												12												781
		Total Cost of FC for Each Month(Pro-A)			0												39,949,000												236,621,000												328,811,000												347,249,000												12,292,000												964,922,000
		Total Cost of FC for Each Month(Pro-B)			0												0												0												0												0												0												0
		Total Cost of LC for Each Month(Pro-A)			0												0												0												0												0												0												0
		Total Cost of LC for Each Month(Pro-B)			0												56,000												263,200												389,200												576,800												22,400												1,307,600
			0	0																																																																								0
		Pre-Construction & Construction Supervision	0	0																																																																								0
C	1	CAD Operator 1	0	830																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
C	2	CAD Operator 2	0	830																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
C	3	CAD Operator 3	0	830																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
C	4	CAD Operator 4	0	830																																																1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													15
C	5	CAD Operator 3	0	830																																																																									0
C	6	CAD Operator 4	0	830																																																																									0
C	7	CAD Operator 5	0	830																																																																									0
C	8	CAD Operator 6	0	830																																																																									0
C	9	Secretary	0	830																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
C	10	Accountant	0	830																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
C	11	Translator 1	0	830																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
C	12	Translator 2	0	830																													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													32
		[Total of Supporting Staff]			**0**												**0**												**48**												**78**												**96**												**0**												**222**
		Total Cost of LC for Each Month(SS)			0												0												39,840												64,740												79,680												0												184,260
		Grand Total			**0**												**33**												**219**												**324**												**415**												**12**												**1,003**

Annual Distribution of Cost

Item	Total			2016			2017			2018			2019			2020			2021			2022			2023			2024		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
Right Bank Side(Package 2)	100%	100%	0%	0%	0%		0%	0%		39%	39%		28%	28%		28%	28%		5%	5%		0%	0%		0%	0%		0%	0%	
Left Bank Side(Packege 3)	100%	100%	0%	0%	0%		0%	0%		39%	39%		28%	28%		28%	28%		5%	5%		0%	0%		0%	0%		0%	0%	
Flyover at Yangon side(Package 1)	100%	100%	0%	0%	0%		0%	0%		60%	60%		35%	35%		5%	5%		0%	0%		0%	0%		0%	0%		0%	0%	
6-lane widening(Package 1)	100%	100%	0%	0%	0%		0%	0%		60%	60%		35%	35%		5%	5%		0%	0%		0%	0%		0%	0%		0%	0%	
Utility relocation	100%	100%	0%	0%	0%		73%	73%		22%	22%		5%	5%		0%	0%		0%	0%		0%	0%		0%	0%		0%	0%	
Land Acquisition					0%			71%			29%			0%			0%			0%			0%			0%			0%	
Consultant	100%	100%	30%	0%	0%	0%	33%	33%	30%	17%	15%	0%	24%	22%	0%	26%	30%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Advanced Payment	0.2
Retention Money	0
RM-Completion	0.05
AP-Consultant Servises	0.3
RM-Consultant Servises	0
RM-After12M later	0

				2016			2017			2018			2019			2020			2021			2022			2023			2024		
	開始年	終了年	過1年	判定	数式1	数式2	判定	数式1	数式2	判定	数式1	数式2	判定	数式1	数式2	判定	数式1	数式2	判定	数式1	数式2	判定	数式1	数式2	判定	数式1	数式2	判定	数式1	数式2
Right Bank Side(Package 2)	2018	2020	2021	0	0	0.75	0	0	0.75	1	0.2	0.75	2	0	0.75	3	0	0.75	4	0.05	0.75	0	0	0.75	0	0	0.75	0	0	0.75
Left Bank Side(Packege 3)	2018	2020	2021	0	0	0.75	0	0	0.75	1	0.2	0.75	2	0	0.75	3	0	0.75	4	0.05	0.75	0	0	0.75	0	0	0.75	0	0	0.75
Flyover at Yangon side(Package 1)	2018	2019	2020	0	0	0.75	0	0	0.75	1	0.2	0.75	3	0	0.75	4	0.05	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75
Package4	1900	1900	1901	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75
Package5	1900	1900	1901	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75
6-lane widening(Package 1)	2018	2019	2020	0	0	0.75	0	0	0.75	1	0.2	0.75	3	0	0.75	4	0.05	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75
Utility relocation	2017	2018	2019	0	0	0.75	1	0.2	0.75	3	0	0.75	4	0.05	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75
Non Eligible3	1900	1900	1901	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75	0	0	0.75
Consultant	2017	2021	2022	0	0	0.7	1	0.3	0.7	2	0	0.7	2	0	0.7	2	0	0.7	3	0	0.7	4	0	0.7	0	0	0.7	0	0	0.7

Annual Fund Requirement

Base Year for Cost Estimation: 5, 2016 FC & Total: million JPY
Exchange Rates USD = JPY 109.9 LC : million USD
Price Escalation: FC: 1.6% LC: 5.8%
Physical Contingency for Constrution 10%
Physical Contingency for Consultant 5%

Item	Total			2016			2017			2018			2019			2020			2021		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION																					
Ⅰ) Procurement / Construction	19,545	91	29,579	0	0	0	0	0	0	7,768	35	11,669	5,602	26	8,505	5,241	25	7,969	933	5	1,435
Right Bank Side(Package 2)	7,532	33	11,122	0	0	0	0	0	0	2,918	13	4,310	2,118	9	3,128	2,118	9	3,128	377	2	556
Left Bank Side(Packege 3)	8,140	30	11,439	0	0	0	0	0	0	3,154	12	4,433	2,289	8	3,217	2,289	8	3,217	407	2	572
Flyover at Yangon side(Package 1)	1,281	8	2,113	0	0	0	0	0	0	769	5	1,268	448	3	739	64	0	106	0	0	0
Base cost for JICA financing	16,953	70	24,673	0	0	0	0	0	0	6,841	29	10,010	4,856	20	7,085	4,472	18	6,451	784	3	1,128
Price escalation	815	13	2,217	0	0	0	0	0	0	221	3	599	237	4	648	293	5	794	65	1	177
Physical contingency	1,777	8	2,689	0	0	0	0	0	0	706	3	1,061	509	2	773	476	2	724	85	0	130
Ⅱ) Consulting services	1,194	3	1,472	0	0	0	384	1	467	201	0	240	285	1	346	313	1	404	11	0	15
Base cost	1,094	2	1,323	0	0	0	360	1	435	185	0	219	259	0	308	280	1	349	10	0	12
Price escalation	44	0	79	0	0	0	6	0	10	6	0	10	13	0	22	18	0	36	1	0	2
Physical contingency	57	0	70	0	0	0	18	0	22	10	0	11	14	0	16	15	0	19	1	0	1
Total (Ⅰ + Ⅱ)	20,739	94	31,051	0	0	0	384	1	467	7,969	36	11,910	5,887	27	8,851	5,554	26	8,373	944	5	1,450
B. NON ELIGIBLE PORTION																					
a Procurement / Construction	0	3	306	0	0	0	0	1	62	0	1	148	0	1	84	0	0	12	0	0	0
6-lane widening(Package 1)	0	2	174	0	0	0	0	0	0	0	1	104	0	1	61	0	0	9	0	0	0
Utility relocation	0	1	73	0	0	0	0	0	53	0	0	16	0	0	4	0	0	0	0	0	0
Base cost for JICA financing	0	2	247	0	0	0	0	0	53	0	1	120	0	1	65	0	0	9	0	0	0
Price escalation	0	0	32	0	0	0	0	0	3	0	0	14	0	0	12	0	0	2	0	0	0
Physical contingency	0	0	28	0	0	0	0	0	6	0	0	13	0	0	8	0	0	1	0	0	0
b Land Acquisition	0	0	39	0	0	0	0	0	27	0	0	12	0	0	0	0	0	0	0	0	0
Base cost	0	0	33	0	0	0	0	0	23	0	0	10	0	0	0	0	0	0	0	0	0
Price escalation	0	0	2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	4	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0
c Administration cost	0	14	1,570	0	0	0	0	0	28	0	5	603	0	4	447	0	4	419	0	1	73
d VAT	0	14	1,568	0	0	0	0	0	26	0	5	603	0	4	447	0	4	419	0	1	73
e Import Tax	0	9	977	0	0	0	0	0	0	0	4	388	0	3	280	0	2	262	0	0	47
Total (a+b+c+d+e)	0	41	4,460	0	0	0	0	1	143	0	16	1,755	0	11	1,258	0	10	1,113	0	2	192
TOTAL (A+B)	20,739	134	35,511	0	0	0	384	2	610	7,969	52	13,664	5,887	38	10,109	5,554	36	9,486	944	6	1,642
C. Interest during Construction	9	0	9	0	0	0	0	0	0	1	0	1	2	0	2	3	0	3	3	0	3
Interest during Construction(Const.)	9	0	9	0	0	0	0	0	0	1	0	1	2	0	2	3	0	3	3	0	3
Interest during Construction (Consul.)	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Front End Fee	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL (A+B+C+D)	20,748	134	35,520	0	0	0	384	2	610	7,970	52	13,666	5,889	38	10,111	5,557	36	9,489	948	6	1,645
E. JICA finance portion (A)	20,739	94	31,051	0	0	0	384	1	467	7,969	36	11,910	5,887	27	8,851	5,554	26	8,373	944	5	1,450

Administration Cost = 5%
VAT= 5% of the expenditure in local currency of the eligible portion
Import Tax= 5%

Breakdown of Cost	Foreign Currency Portion (million JPY)			Local Currency Portion (million JPY)			Total (million JPY)		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others
Civil Works	16,953	16,953	0	7,967	7,720	247	24,920	24,673	247
Right Bank Side(Package 2)	7,532	7,532	0	3,590	3,590	0	11,122	11,122	0
Left Bank Side(Packege 3)	8,140	8,140	0	3,299	3,299	0	11,439	11,439	0
Flyover at Yangon side(Package 1)	1,281	1,281	0	832	832	0	2,113	2,113	0
6-lane widening(Package 1)	0	0	0	174	0	174	174	0	174
Utility relocation	0	0	0	73	0	73	73	0	73
Price Escalation(Construction)	815	815	0	1,433	1,402	32	2,249	2,217	32
Physical Contingency(Construction)	1,777	1,777	0	940	912	28	2,717	2,689	28
Consulting Services	1,194	1,194	0	278	278	0	1,472	1,472	0
Base cost	1,094	1,094	0	229	229	0	1,323	1,323	0
Price escalation	44	44	0	36	36	0	79	79	0
Physical contingency	57	57	0	13	13	0	70	70	0
Land Acquisition	0	0	0	39	0	39	39	0	39
Administration Cost	0	0	0	1,570	0	1,570	1,570	0	1,570
VAT	0	0	0	1,568	0	1,568	1,568	0	1,568
Import Tax	0	0	0	977	0	977	977	0	977
Interest during construction	9	0	9	0	0	0	9	0	9
Front End Fee	0	0	0	0	0	0	0	0	0
Total	20,748	20,739	9	14,772	10,312	4,460	35,520	31,051	4,469

Breakdown of Cost	Foreign Currency Portion (million JPY)			Local Currency Portion (millon USD)			Total (million JPY)		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others
Civil Works	16,953	16,953	0	72	70	2	24,920	24,673	247
Right Bank Side(Package 2)	7,532	7,532	0	33	33	0	11,122	11,122	0
Left Bank Side(Packege 3)	8,140	8,140	0	30	30	0	11,439	11,439	0
Flyover at Yangon side(Package 1)	1,281	1,281	0	8	8	0	2,113	2,113	0
6-lane widening(Package 1)	0	0	0	2	0	2	174	0	174
Utility relocation	0	0	0	1	0	1	73	0	73
Price Escalation(Construction)	815	815	0	13	13	0	2,249	2,217	32
Physical Contingency(Construction)	1,777	1,777	0	9	8	0	2,717	2,689	28
Consulting Services	1,194	1,194	0	3	3	0	1,472	1,472	0
Base cost	1,094	1,094	0	2	2	0	1,323	1,323	0
Price escalation	44	44	0	0	0	0	79	79	0
Physical contingency	57	57	0	0	0	0	70	70	0
Land Acquisition	0	0	0	0	0	0	39	0	39
Administration Cost	0	0	0	14	0	14	1,570	0	1,570
VAT	0	0	0	14	0	14	1,568	0	1,568
Import Tax	0	0	0	9	0	9	977	0	977
Interest during construction	9	0	9	0	0	0	9	0	9
Front End Fee	0	0	0	0	0	0	0	0	0
Total	20,748	20,739	9	134	94	41	35,520	31,051	4,469

Breakdown of Cost	Total	JICA Portion	Others
2016	0	0	0
2017	610	467	143
2018	13,666	11,910	1,756
2019	10,111	8,851	1,260
2020	9,489	8,373	1,116
2021	1,645	1,450	195
2022	0	0	0
2023	0	0	0
2024	0	0	0
Total	35,520	31,051	4,469

Comparison of Project Cost

	in March 2016			Latest				Comparison		
	(million JPY)			(million JPY)			%	(million JPY)		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Shere (Total)	Total	JICA Portion	Others
Right Bank Side(Package 2)	25,486	25,486	0	11,122	11,122	0	31.3%	−638	−812	174
Left Bank Side(Package3)				11,439	11,439	0	32.2%			
Flyover at Yangon side (Package 1)				2,113	2,113	0	5.9%			
6-lane widening(Package 1)				174	0	174	0.5%			
Price Escalation	1,914	1,914	0	2,249	2,217	32	6.3%	335	303	32
Physical Contingency	2,740	2,740	0	2,717	2,689	28	7.6%	−23	−51	28
Consulting Services	1,833	1,833	0	1,472	1,472	0	4.1%	−361	−361	0
Land Acquisition	45	0	45	39	0	39	0.1%	67	0	67
Utility relocation				73	0	73	0.2%			
Administration Cost	1,601	0	1,601	1,570	0	1,570	4.4%	−31	0	−31
VAT	1,599	0	1,599	1,568	0	1,568	4.4%	−31	0	−31
Import Tax	1,036	0	1,036	977	0	977	2.8%	−59	0	−59
Interest during construction	10	0	10	9	0	9	0.0%	−1	0	−1
Total	36,263	31,972	4,290	35,520	31,051	4,469	100.0%	−743	−921	179
Shere(Total)	100%	88%	12%	100%	87%	13%	−	−	−	−

	in March 2016			Latest				Comparison		
	(million USD)			(million USD)			%	(million USD)		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Shere (Total)	Total	JICA Portion	Others
Right Bank Side(Package 2)	215	215	0	101	101	0	31.3%	11	9	2
Left Bank Side(Package3)				104	104	0	32.2%			
Flyover at Yangon side (Package 1)				19	19	0	5.9%			
6-lane widening(Package 1)				2	0	2	0.6%			
Price Escalation	16	16	0	20	20	0	6.2%	4	4	0
Physical Contingency	23	23	0	25	24	0	7.7%	2	1	0
Consulting Services	15	15	0	13	13	0	4.0%	−2	−2	0
Land Acquisition	0	0	0	0	0	0	0.0%	1	0	1
Utility relocation				1	0	1	0.3%			
Administration Cost	14	0	14	14	0	14	4.3%	0	0	0
VAT	14	0	14	14	0	14	4.3%	0	0	0
Import Tax	9	0	9	9	0	9	2.8%	0	0	0
Interest during construction	0	0	0	0	0	0	0.0%	0	0	0
Total	307	270	36	323	283	41	100.0%	16	13	5
Shere(Total)	100%	88%	12%	100%	88%	13%	−	−	−	−

Exchange Rate	**US$ 1 = 118.3 YEN**	**US$ 1 = 109.9 YEN**
Price Escalation	**FC= 1.8 %**	**FC= 1.6 %**
	LC= 3.9 %	**LC= 5.8 %**

Appendix E Comparison for Width of Brdge between Bago River Bridge and Dala Bridge

E.1. Introduction

JICA Study Team compared width of bridge between Bago River Bridge and Dala Bridge and confirmed relevance of bridge plan for reference.

The conditions of Dala Bridge were refered to the Final Report for "The Feasibility Study for Korea-Myanmar Friendship Bridge Project".

E.2. Design Conditions for Width of Bago River Bridge

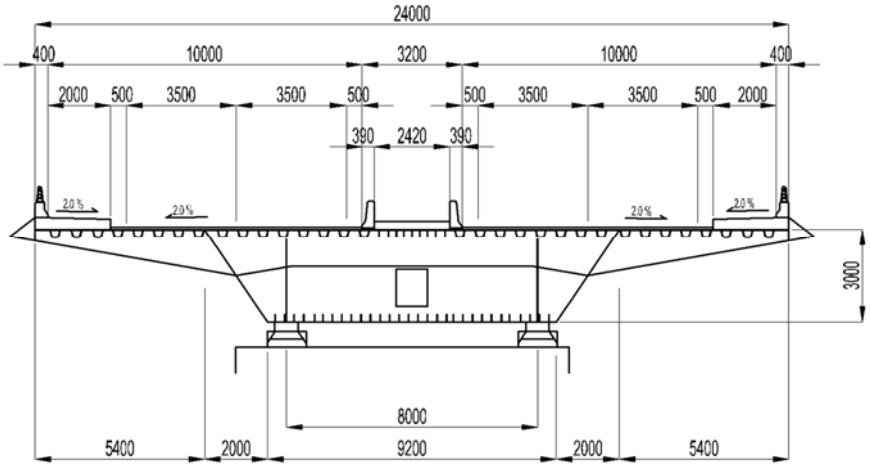
The design conditions for width of Bago River Bridge are shown below.

Table E.1 Design Conditions for Width of Bago River Bridge

Item	AASHTO	ASEAN Highway Standards	Japanese Road Design Standard	Recommendation for this study	Remarks
Road Classification	Urban Arterials	Class I	Class 4 (Urban Arterials)	Urban Arterials	
Width of Lane (m)	3.3 ~ 3.6	3.5	3.25	**3.5**	
Width of Right Shoulder (m)	0.3 ~ 3.6	3.0	0.5	**0.5**	
Width of Left Shoulder (m)	-	-	0.5	**0.5**	
Width of Median (m)	1.2 ~ 24.0	3.0	1.0	**2.5 ~ 4.2**	Include width of left shoulder
Width of Sidewalk (m)	1.2 ~ 2.4	-	2.0 or more	**2.0**	

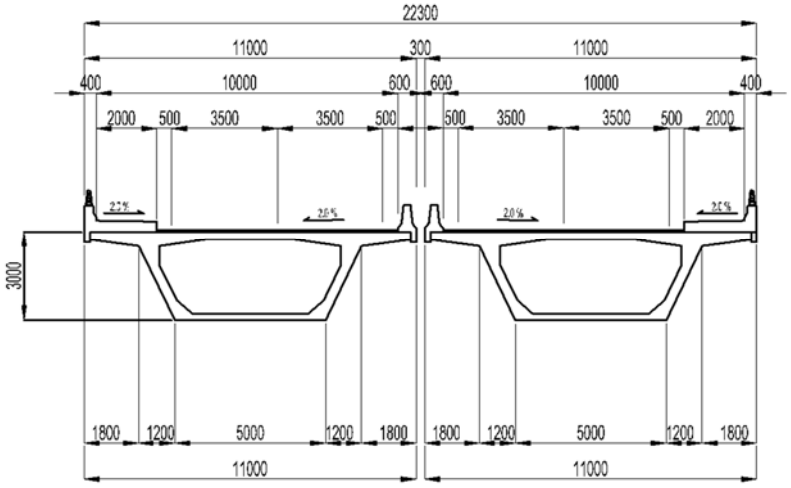
Source: JICA Study Team

The typical cross sections of bridge are shown in the figure below.



Source: JICA Study Team

Figure E.1 Typical Cross Section of Bridge (Steel Cable Stayed Bridge)



Source: JICA Study Team

Figure E.2 Typical Cross Section of Bridge (Precast PC Box Girder Bridge)

E.3. Design Conditions of Dala Bridge

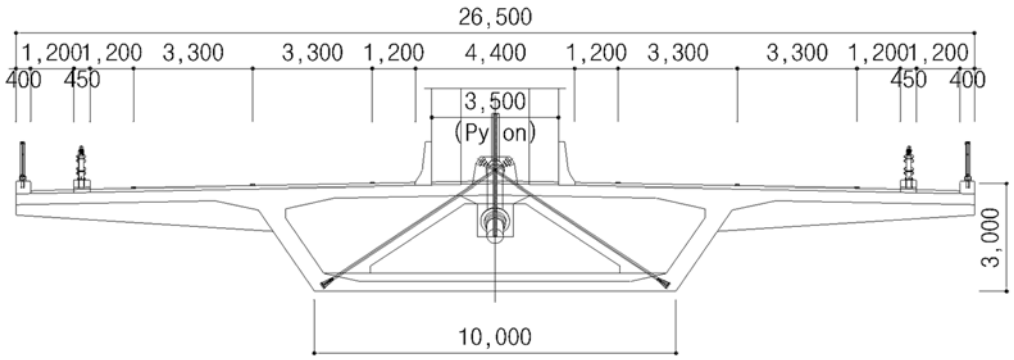
The design conditions for width of Dala Bridge are shown below.

Table E.2 Design Conditions for Width of Dala Bridge

Item		Earthwork	Bridge
Lane	Main roads	3.0 ~ 3.6	3.3
	Connection roads	Longer than 5.0 pavement including shoulder	3.3
Median Strip		1.2 ~ 24.0	1.2
Shoulder	Main roads	0.3 ~ 3.6	1.2
	Right side of connection roads	1.8 ~ 3.6	1.8
	Left side of connection roads	1.2 ~ 3.0	1.2
Sidewalk		Longer than 1.2	1.2

Source: Final Report for "The Feasibility Study for Korea-Myanmar Friendship Bridge Project"

The typical cross sections of bridge are shown below.



Source: Final Report for "The Feasibility Study for Korea-Myanmar Friendship Bridge Project"

Figure E.3 Typical Cross Section of Bridge (Cable-stay Bridge)

E.4. Comparison for Width of Bago River Bridge and Dala Bridge

The following table shows the comparison for width of Bago River Bridge and Dala Bridge.

Table E.3 Comparison for Width of Bago River Bridge and Dala Bridge

Item	Condition of Bago River Bridge	Dala Bridge	Remarks
Road Classification	Urban Arterials	Urban Arterials	
Width of Lane (m)	3.5	3.3	
Width of Right Shoulder (m)	0.5	1.2	
Width of Left Shoulder (m)	0.5	1.2	
Width of Median (m)	2.5 ~ 4.2	6.8	Include width of left shoulder
Width of Sidewalk (m)	2.0	1.2	
Total Width (m)	22.3 ~ 24.0	26.5	Include width of guard rail

Source: JICA Study Team

The width of Bago Bridge and Dala Bridge are pursuant to relevant standards.

For assessing the relevance of the bridge width, an economical efficiency and a safety are considered.

Bago Bridge is much better at the economical efficiency than Dala Bridge because the width of Bago Bridge is narrower than Dala Bridge.

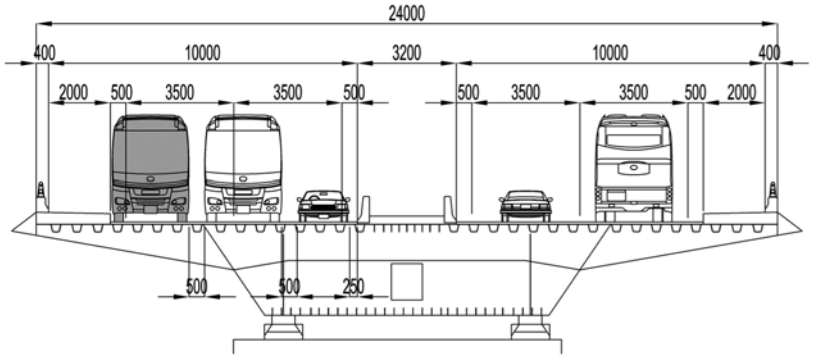
It should be considered in safety of vehicle and pedestrian at assessing the safety.

Considering the vehicular safety, the width of Bago Bridge is enough for emergency passing as shown in the figure below.

Considering the pedestrian safety, the width of Dala Bridge, 1.2m, is narrow for passing each other.

The width of sidewalk is necessary at least 2.0m in accordance with the Japanese Road Design Standards and the width of the existing sidewalk of Thanlyin chin Kat Road and Shukhinthar Road is 2.0m.

Therefore, the width of Bago Bridge is appropriate at the economical efficiency and the safety.

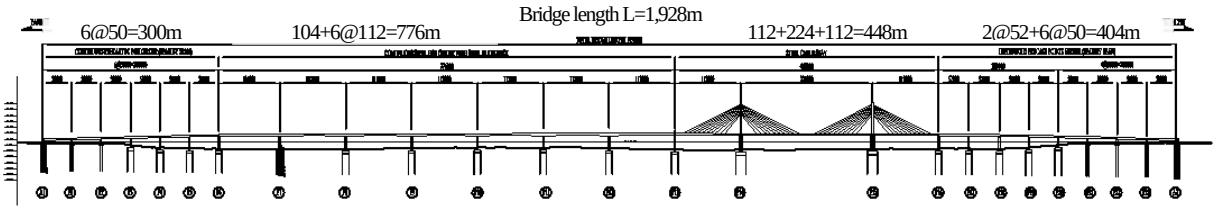


Source: JICA Study Team

Figure E.4 Cross Section of Bago River Bridge in Emergency Case

Appendix F Structural comparison of Bago River Bridge and Dala Bridge

In order to justify the validity of the cost estimate of the Project, the estimated cost was compared with that of a similar project.



Source: JICA Study Team

Figure F-1 Profile of Bago River Bridge

Table F-1 Brief description of Bago River Bridge

Item	Span	Superstructure type	Length (m)	Width (m)
A1-P6	6	PC box girder (span-by-span erection)	300m	11.0 x 2
P6-P13	7	Steel box girder with steel deck slab	776m	11.0 x 2
P13-P16	3	Steel cable stayed girder	448m	22.4
P16-A2	8	PC box girder (span-by-span erection)	404m	11.0 x2
		Total length	1,928m	

Source: JICA Study Team

1.1.1 Outlines of the similar project

Yangon-Dala Bridge Construction Project funded by South Korean loan is ongoing similar bridge project to connect two lands split by the wide river as Bago River Bridge.

Source: http://myanmarcs.focuscoregroup.com/loan-approved-for-construction-of-yangon-dala-bridge/

Figure F-2 Rendering perspective of Yangon-Dala Bridge

According to the F/S report, outline of Yangon-Dala Bridge is;

- Soft Loan of USD 137.8 million from South Korea, and total project cost amounts USD 168 .2 million (approximately JPY 2.02 billion)
- Payment period of 40years including grace period of initial 15years
- Low interest (0.01%)
- 5years of construction period
- Total bridge length 6,144 feet (approximately 1,872meter)
- linking Phone Gyi Road, Landmadaw Township in Yangon CBD to Bo Min Yaung Road in Dala Township over Yangon River

The proportion of the each span are shown in Table F-2.

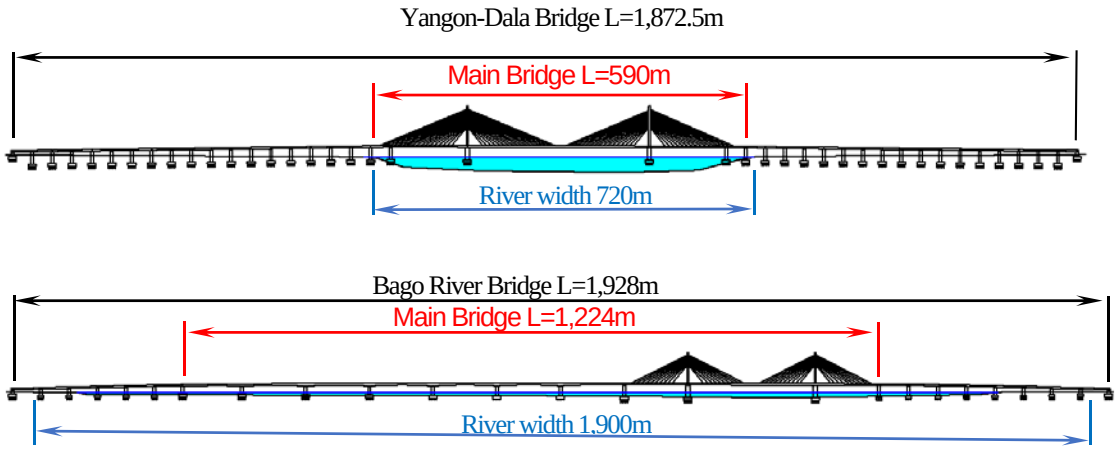
Table F-2 Bridge length and width of Yangon-Dala Bridge

Item	Description	Length (m)	Width (m)
Approach Bridge 1	19-span PC Beam	665	20.9
Main Bridge	3-span PC cable stayed	590	26.5
Approach Bridge 2	2-span steel box+16-span PC beam	540	14.3
Total of Main Bridge		1,872	-
Ramp A	3-span steel box+12-span PC beam	525	7.1
Ramp B	3-span steel box+11-span PC beam	490	7.1

Source: Feasibility Study for Korea-Myanmar Friendship Bridge Project

1.1.2 Conditions for comparison

Though Yangon-Dala Bridge and Bago River Bridge have similar bridge length shown in Figure F-3, two bridges have different proportions because of the difference in the widths of these rivers, 720m and 1,900m, respectively. The length of Main Bridge of Yangon-Dala Bridge is 590m, while that of Bago River Bridge is 1,224m.



Source: JICA Study Team

Figure F-3 Profiles of Bridges (Main Bridge)

1.1.3 Results of cost comparison

(1) Project cost comparison per river width

If the most important function of the river bridge is "crossing the river", it can be said that the index of "project cost per bridge width" makes sense, because the wider the river is, the more challenging the bridge construction is.

The comparison result of Yangon-Dala Bridge (across Yangon River) and Bago River Bridge (across Bago River) is shown in Table F-3.

Table F-3 Comparison of total project cost per river width

Bridge Name	Project cost (Eligible portion, USD)	River width (m)	Cost per bridge length (USD/m)	Rate
Yangon-Dala Bridge	137.8	720	0.19	1.36
Bago River Bridge	266,8	1900	0.14	1.00

Source: JICA Study Team

Even though the eligible portion of project cost of Bago River Bridge is as twice as that of Yangon-Dala Bridge, the cost per river width of Bago River Bridge is cheaper.

(2) Cost comparison by Construction cost per Bridge length

Focused on the main bridge, the result of the comparative study is shown in Table F-4.

Table F-4 Comparison of main span (on the river)

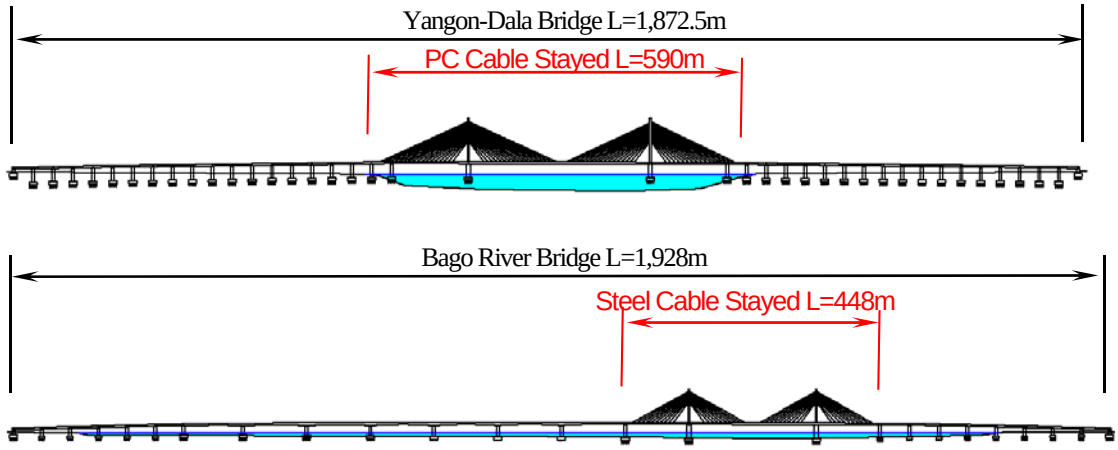
Bridge Name	Construction cost (USD)	Length (m)	Cost per bridge length (USD/m)	Rate
Yangon-Dala Bridge	65,757,524	590	111,453	1.08
Bago River Bridge	126,264,000	1,224	103,156	1.00

Source: JICA Study Team

Even though the construction cost of main bridge of Bago River Bridge is as twice as that of Yangon-Dala Bridge, the unit cost, the costs per bridge length, are similar and Bago River Bridge is slightly lower.

In a part of Main Bridge, there is Steel Cable Stayed Bridge in Bago Bridge as shown in Figure F-4.

On the other hand, the main bridge of Yangon-Dala Bridge is PC cable stayed bridge. The following table shows the comparison specifically between PC Cable Stayed Bridge in Yangon-Dala Bridge and Steel Cable Stayed Bridge in Bago River Bridge.



Source: JICA Study Team

Figure F-4 Profiles of Bridges (Superstructure Types)

Table F-5 Comparison of cable stayed bridge section

Bridge Name	Construction cost (USD)	Length (m)	Cost per bridge length (USD/m)	Rate
Yangon-Dala Bridge	65,757,524	590	111,453	0.78
Bago River Bridge	63,825,000	448	142,467	1.00

Source: JICA Study Team

It is found that the unit cost (cost-per-bridge area value of the span of Steel Cable-stayed Bridge in Bago River Bridge (224m) is relatively higher than that of PC Cable-stayed Bridge in Yangon-Dala Bridge. One of the major reasons for the difference in unit cost is that the main span length of Bago River Bridge is controlled by that of Thanlyin Bridge and the resultant span length is not in the range of economical span.

Mentioned about the other portion, in other words on-land portion, they also are in different situations for bridge design. At the location of Yangon-Dala Bridge, Yangon River and the land are distinctively separated by the revetment. Therefore, the approach bridge are designed with no consideration of effective river flow but economic spanning.

On the other hand, at the location of Bago River Bridge, there is no definitive revetment but very narrow slope and natural dump area on the both sides of the river where the large flood water or storm surge comes at intervals. So the spans of the approach bridge are planned 50m to secure the smooth river flow.

Appendix G Case Study on Toll Fee covering Construction Cost

G.1. Objectives and Methodology

The construction of Bago River Bridge is planned to be financed by Japan's ODA loan. The loan amount is estimated at about USD 282.5 million and national government is required to repay the loan and pay the interest every year over a long period of time. In this appendix, financial analysis is conducted to ascertain whether toll revenue covers the principal and interest payment by calculating net cash flow during the loan period. This analysis takes operation and maintenance cost into account as expenditure in addition to the principal and interest payment and does not consider payback of investment cost to ascertain financial viability. When cumulative net cash flow during the loan period is positive, the project is regarded as financially viable.

The financial analysis is conducted for two cases: (1) Do Nothing + Bago Bridge case as a base case and (2) YUTRA Master Plan case (YUTRA MP case) as an alternative case in the same way as economic analysis in chapter 7.

G.2. Assumptions

Financial analysis of this Project was conducted based on the following assumptions and standardization.

(1) Period of Analysis

Period of analysis is 37 years that includes the period of construction funded by Japan's ODA loan from 2018 to 2021 and the operation period from 2022 to 2055 when the debt is paid off.

(2) Loan Conditions

Interest Rate: 0.1%
Repayment Period: 40 years including Grace Period
Grace Period: 10 years
Repayment method: capital equal system repayment

(3) Traffic Assignment

Traffic assignment of two cases was conducted for the year of 2020, 2025, 2030 and 2035, the economic benefits were estimated for the four years and an interpolation was done for intermediate years. The economic benefits have been calculated from the results of traffic assignment. After 2035, the traffic volume was assumed to keep the same amount.

(4) Toll

On the assumption that toll is collected from car, taxi, van, passenger truck and small bus and truck, toll by mode of transport was set based on the current toll of Thanlyin Bridge. Assumed toll by mode of transport is summarized below.

Table G.1 Assumed Toll Fee

Transport mode	Car, Taxi	Van	Pass Truck & Small Bus	Small truck	Truck (2 axels)	Truck (3 axels)	truck (4 axels)
Toll (USD)	0.2	0.2	0.7	0.3	0.4	1.1	1.5

Source: JICA Study Team

(5) Social Discount Rate:

12% per annum was assumed as the social discount rate.

(6) Annual Maintenance Cost

0.5% of construction cost of the project was assumed.

(7) Exchange Rate

The following exchange rate on March 2016 was applied.

US $ 1.00 = MKK 1,218

US $ 1.00 = JPY 109.9

MMK1.00 = JPY 0.0902

G.3. Loan Plan and Expenditure

(1) Loan Disbursement

Estimated construction cost of Bago River Bridge is USD282.5 million, all of that is funded by Japan's ODA loan. Loan disbursement is divided into three times from 2018 to 2020. Disbursement schedule and amount of each disbursement are as follows.

Table G.2 Loan Disbursement

Year	2018	2019	2020	Total
Loan amount (mill. USD)	112.6	80.5	89.4	282.5

Source: JICA Study Team

(2) Repayment Schedule

As stated above, repayment period is 40 years including 10 years of grace period since loan agreement which is scheduled to be signed in 2016. Thus, repayment will start in 2026 and continue until 2055. Interest payment will begin when the loan disbursement is made, namely it will start in 2018 for the first disbursement followed by the second in 2019 and the final in 2020. Capital and interest payment schedule is shown in Table G.3.

Table G.3 Principal and Interest Payment Schedule

Unit: Million USD

Year	1st				2nd				3rd				total				
	Disbursement	Balance	Principal payment	Interest payment	Disbursement	Balance	Principal payment	Interest payment	Disbursement	Balance	Principal payment	Interest payment	Disbursement	Balance	Principal payment	Interest payment	Debt Service
2013																	
2014																	
2015																	
2016																	
2017													4.3	4.3		0.000	0.00
2018	112.6	112.6		0.005									108.4	113		0.006	0.01
2019		112.6		0.011	80.5	80.5		0.004					80.5	193		0.015	0.02
2020		112.6		0.011		80.5		0.008	89.4	89.4		0.004	76.2	269		0.023	0.02
2021		112.6		0.011		80.5		0.008		89.4		0.009	13.2	283		0.028	0.03
2022		112.6		0.011		80.5		0.008		89.4		0.009		283		0.028	0.03
2023		112.6		0.011		80.5		0.008		89.4		0.009		283		0.028	0.03
2024		112.6		0.011		80.5		0.008		89.4		0.009		283		0.028	0.03
2025		112.6		0.011		80.5		0.008		89.4		0.009		283		0.028	0.03
2026		108.9	3.75	0.008		77.9	2.68	0.008		86.4	2.98	0.009		273	9.42	0.027	9.45
2027		105.1	3.75	0.008		75.2	2.68	0.008		83.4	2.98	0.008		264	9.42	0.026	9.44
2028		101.4	3.75	0.007		72.5	2.68	0.007		80.4	2.98	0.008		254	9.42	0.025	9.44
2029		97.6	3.75	0.007		69.8	2.68	0.007		77.5	2.98	0.008		245	9.42	0.024	9.44
2030		93.8	3.75	0.007		67.1	2.68	0.007		74.5	2.98	0.007		235	9.42	0.024	9.44
2031		90.1	3.75	0.006		64.4	2.68	0.006		71.5	2.98	0.007		226	9.42	0.023	9.44
2032		86.3	3.75	0.006		61.7	2.68	0.006		68.5	2.98	0.007		217	9.42	0.022	9.44
2033		82.6	3.75	0.006		59.1	2.68	0.006		65.5	2.98	0.007		207	9.42	0.021	9.44
2034		79	3.75	0.007		56	2.68	0.005		63	2.98	0.006		198	9.42	0.020	9.44
2035		75	3.75	0.007		54	2.68	0.005		60	2.98	0.006		188	9.42	0.019	9.44
2036		71	3.75	0.007		51	2.68	0.005		57	2.98	0.006		179	9.42	0.018	9.44
2037		68	3.75	0.006		48	2.68	0.005		54	2.98	0.005		170	9.42	0.017	9.43
2038		64	3.75	0.006		46	2.68	0.004		51	2.98	0.005		160	9.42	0.016	9.43
2039		60	3.75	0.005		43	2.68	0.004		48	2.98	0.005		151	9.42	0.015	9.43
2040		56	3.75	0.005		40	2.68	0.004		45	2.98	0.004		141	9.42	0.014	9.43
2041		53	3.75	0.005		38	2.68	0.003		42	2.98	0.004		132	9.42	0.013	9.43
2042		49	3.75	0.004		35	2.68	0.003		39	2.98	0.004		122	9.42	0.012	9.43
2043		45	3.75	0.004		32	2.68	0.003		36	2.98	0.004		113	9.42	0.011	9.43
2044		41	3.75	0.004		30	2.68	0.003		33	2.98	0.003		104	9.42	0.010	9.43
2045		38	3.75	0.003		27	2.68	0.002		30	2.98	0.003		94	9.42	0.009	9.43
2046		34	3.75	0.003		24	2.68	0.002		27	2.98	0.003		85	9.42	0.008	9.43
2047		30	3.75	0.003		21	2.68	0.002		24	2.98	0.002		75	9.42	0.008	9.43
2048		26	3.75	0.002		19	2.68	0.002		21	2.98	0.002		66	9.42	0.007	9.42
2049		23	3.75	0.002		16	2.68	0.001		18	2.98	0.002		57	9.42	0.006	9.42
2050		19	3.75	0.001		13	2.68	0.001		15	2.98	0.001		47	9.42	0.005	9.42
2051		15	3.75	0.001		11	2.68	0.001		12	2.98	0.001		38	9.42	0.004	9.42
2052		11	3.75	0.001		8	2.68	0.001		9	2.98	0.001		28	9.42	0.003	9.42
2053		8	3.75	0.000		5	2.68	0.000		6	2.98	0.001		19	9.42	0.002	9.42
2054		4	3.75	0.000		3	2.68	0.000		3	2.98	0.000		9	9.42	0.001	9.42
2055		-0	3.75	-0.000		0	2.68	0.000		-0	2.98	0.000		-0	9.42	0.000	9.42

Source: JICA Study Team

(3) Operation and Maintenance (O&M) Cost

Annual O&M cost is estimated at 0.5% of construction cost including detail design and construction. Total construction cost is USD 215 million and thus annual O&M cost is about USD 1.1million.

G.4. Revenue

As described in Chapter 8, only toll revenue is considered and the total toll revenue is estimated by multiplying the forecasted traffic volume by the toll amount taking into account different toll rates by vehicle type. Revenue was estimated for two cases with the forecasted traffic demand and the unit price of toll.

(4) Traffic Demand

Estimated traffic volume by mode of transport was summarized in Tables G.4 and G.5.

Table G.4 Traffic Demand in Do Nothing + Bago Bridge Case in Benchmark Years

Unit: trip/day

Year	Car & Taxi	Van	Pass Truck & Small Bus	Small Truck	Truck (2 axles)	Truck (3 axles)	Truck (4- axles) & Trailer
2020	16,945	3,285	2,817	842	191	257	57
2025	34,328	7,206	7,851	1,785	989	792	255
2030	37,780	7,920	8,130	2,230	1,232	987	318
2035	45,039	9,457	9,956	2,518	1,389	1,114	359

Source: JICA Study Team

Table G.5 Traffic Demand in YUTRA MP Case in Benchmark Years

Unit: trip/day

Year	Car & Taxi	Van	Pass Truck & Small Bus	Small Truck	Truck (2 axles)	Truck (3 axles)	Truck (4- axles) & Trailer
2020	15,014	3,141	6,990	827	451	364	117
2025	20,046	4,197	6,800	1,026	559	451	145
2030	25,149	5,282	2,447	1,266	690	557	179
2035	30,247	6,360	2,715	1,504	820	661	212

Source: JICA Study Team

(5) Revenue

Estimated revenue in benchmark years is summarized in the following table.

Table G.6 Revenue in Do Nothing + Bago Bridge and YUTRA MP Case

Unit: Million USD

Year	Do Nothing + Bago Bridge Case	YUTRA MP Case
2022 (opening)	3.8	4.7
2025	7.7	6.0
2030	11.0	6.5
2035	16.6	9.9

Source: JICA Study Team

G.5. Evaluation Result

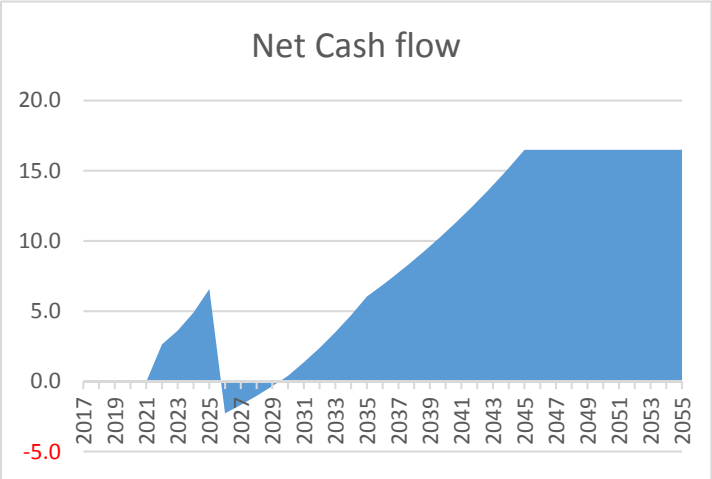
(6) Do Nothing + Bago Bridge Case

As Table G.7 and Figure G.1 and Figure G.2 show, net cash flow and cumulative net cash flow are turned positive in 2022 when operation starts. The net cash flow and cumulative cash balance keep positive values in the period of analysis except from 2026 when the repayment begins to 2029. The table shows that the cumulative net cash flow reaches USD 309 million in 2055 when the final repayment is done and the toll revenue will cover the repayment cost which is composed of principal and interest payment as well as O&M cost in the whole loan period. Thus, considering only O&M cost and repayment, the project is financially viable as long as toll is collected.

Table G.7 Net Cash Flow

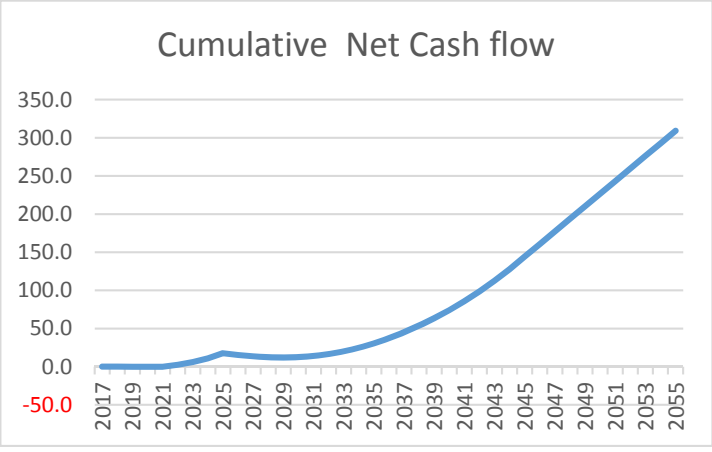
Year	Net cash flow excl. construction cost	Cumulative net cash balance
2017	-0.0	-0.0
2018	-0.0	-0.0
2019	-0.0	-0.0
2020	-0.0	-0.0
2021	-0.0	-0.1
2022	2.6	2.6
2023	3.6	6.2
2024	4.9	11.1
2025	6.6	17.7
2026	-2.3	15.4
2027	-1.7	13.7
2028	-1.0	12.7
2029	-0.3	12.3
2030	0.4	12.7
2031	1.4	14.1
2032	2.4	16.5
2033	3.5	20.0
2034	4.7	24.7
2035	6.0	30.7
2036	6.9	37.6
2037	7.7	45.3
2038	8.7	54.0
2039	9.6	63.6
2040	10.6	74.2
2041	11.7	85.9
2042	12.8	98.7
2043	14.0	112.7
2044	15.2	127.9
2045	16.5	144.4
2046	16.5	160.9
2047	16.5	177.3
2048	16.5	193.8
2049	16.5	210.3
2050	16.5	226.8
2051	16.5	243.3
2052	16.5	259.8
2053	16.5	276.3
2054	16.5	292.8
2055	16.5	309.3

Source: JICA Study Team



Source: JICA Study Team

Figure G.1 Net Cash Flow in Do Nothing +Bago Bridge Case



Source: JICA Study Team

Figure G.2 Cumulative Net Cash Flow in Do Nothing +Bago Bridge Case

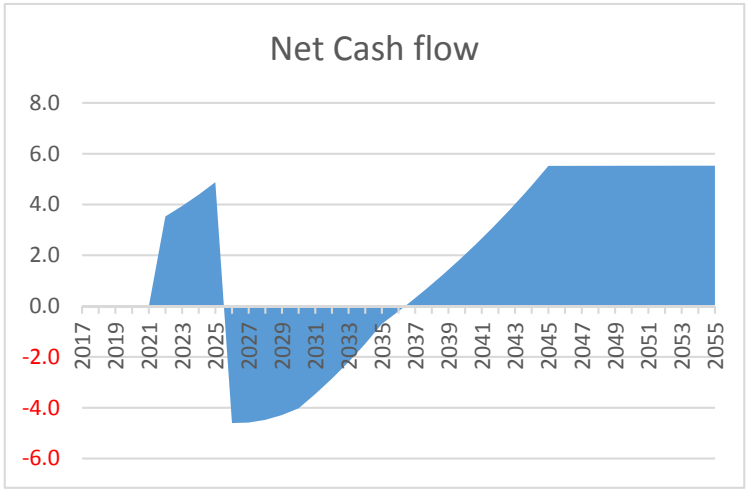
(7) YUTRA Master Plan Case (YUTRA MP Case)

Net cash flow in YUTRA MP case and cumulative net cash flow are shown in Table G.8 and Figures G.3 and G.4. Before starting operation, net cash flow is negative and it will increase after opening. From 2026 when the repayment starts, net cash flow keeps negative for ten years in a row because the traffic demand is lower than Do Nothing + Bago Bridge case. However, the total amount of negative value is small compared with positive value from the perspective of whole loan period. Thus, cumulative net cash flow in 2055 is USD 64 million which shows that toll revenue is large enough to cover the repayment, interest payment and O&M cost. Even in YUTRA MP case, the project is financially viable if toll is collected.

Table G.8 Net Cash Flow

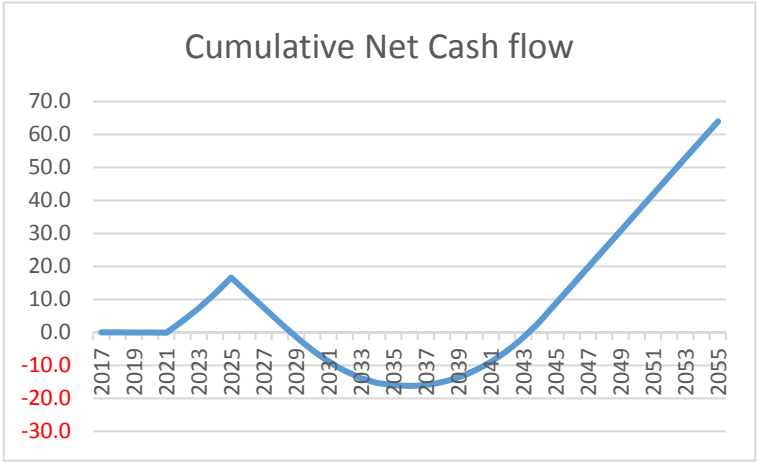
Year	Net cash flow excl. construction cost	Cumulative net cash balance
2017	-0.0	-0.0
2018	-0.0	-0.0
2019	-0.0	-0.0
2020	-0.0	-0.0
2021	-0.0	-0.1
2022	3.5	3.5
2023	3.9	7.4
2024	4.4	11.8
2025	4.9	16.7
2026	-4.6	12.1
2027	-4.6	7.5
2028	-4.5	3.0
2029	-4.3	-1.3
2030	-4.0	-5.3
2031	-3.5	-8.8
2032	-2.9	-11.6
2033	-2.2	-13.8
2034	-1.5	-15.3
2035	-0.7	-16.0
2036	-0.2	-16.2
2037	0.3	-15.9
2038	0.9	-15.0
2039	1.4	-13.6
2040	2.0	-11.6
2041	2.7	-8.9
2042	3.3	-5.6
2043	4.0	-1.5
2044	4.8	3.2
2045	5.5	8.7
2046	5.5	14.3
2047	5.5	19.8
2048	5.5	25.3
2049	5.5	30.8
2050	5.5	36.3
2051	5.5	41.9
2052	5.5	47.4
2053	5.5	52.9
2054	5.5	58.5
2055	5.5	64.0

Source: JICA Study Team



Source: JICA Study Team

Figure G.3 Net Cash Flow in YUTRA MP Case

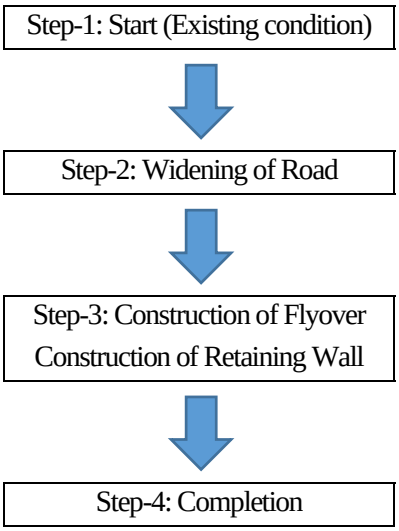


Source: JICA Study Team

Figure G.4 Cumulative Net Cash Flow in YUTRA MP Case

Appendix H Construction Plan of Flyover on Yangon Side

The Flyover on Yangon side was constructed as following steps.



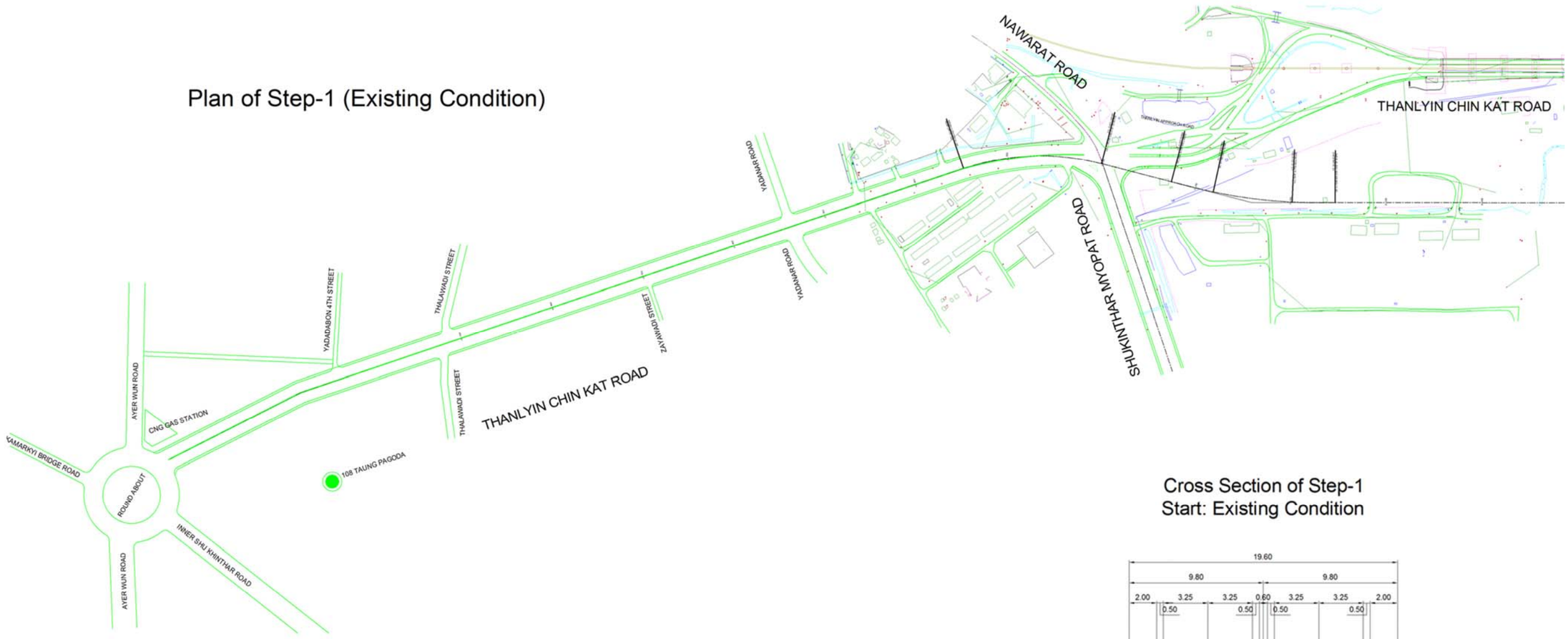
Source: JICA Study Team

The conditions of construction plan were set as below.

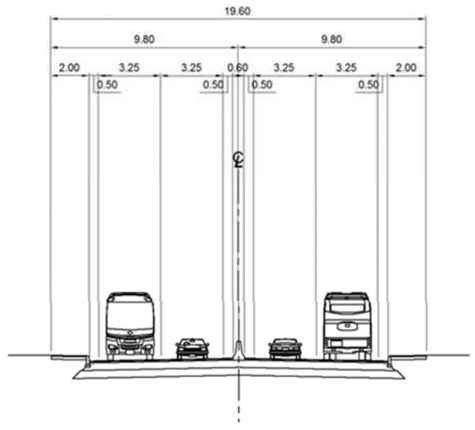
- Minimum width of carriage way is adopted 3.0m in consideration of the maximum width of design vehicle (trailer: 2.6m) mentioned in AASHTO and lateral margin.
- Width between carriage way and construction area is kept over 1.0m. It is assumed 0.5m for shoulder and 0.5m for space of temporary safety measure (fence and etc.).
- Width of sidewalk is adopted 2.0m in accordance with minimum width mentioned in Japanese Road Design Standars.

The drawings of construction steps are shown in the figures below.

Plan of Step-1 (Existing Condition)

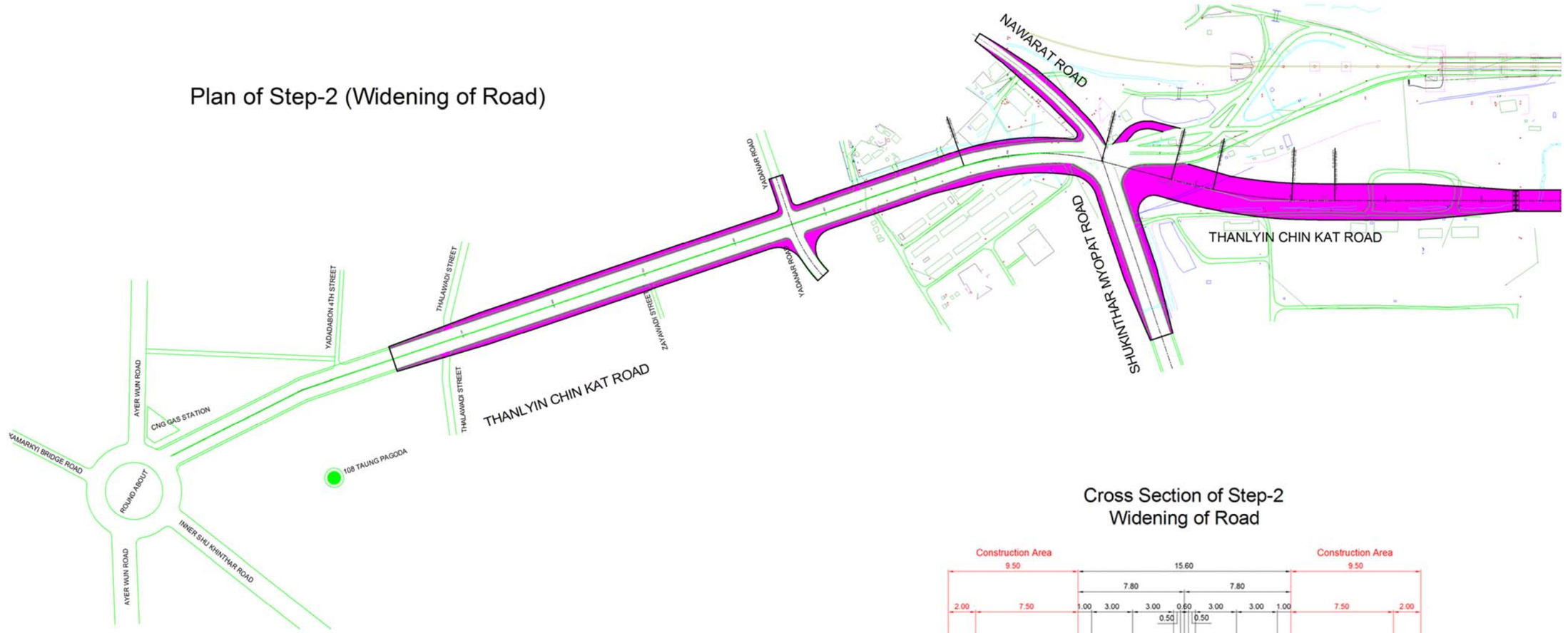


Cross Section of Step-1
Start: Existing Condition

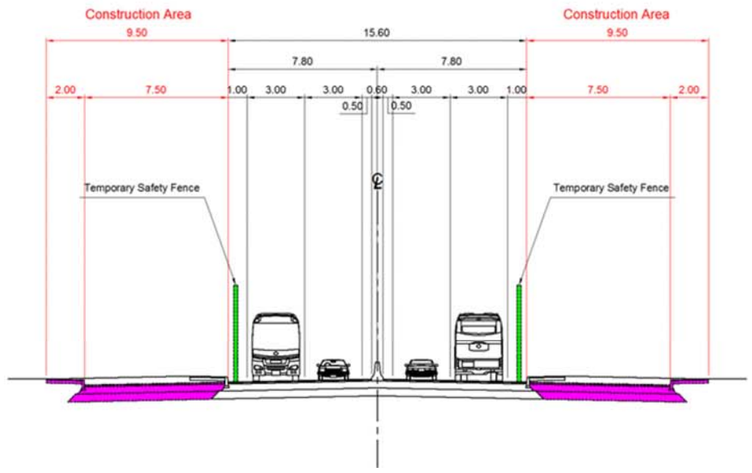


Source: JICA Study Team

Plan of Step-2 (Widening of Road)

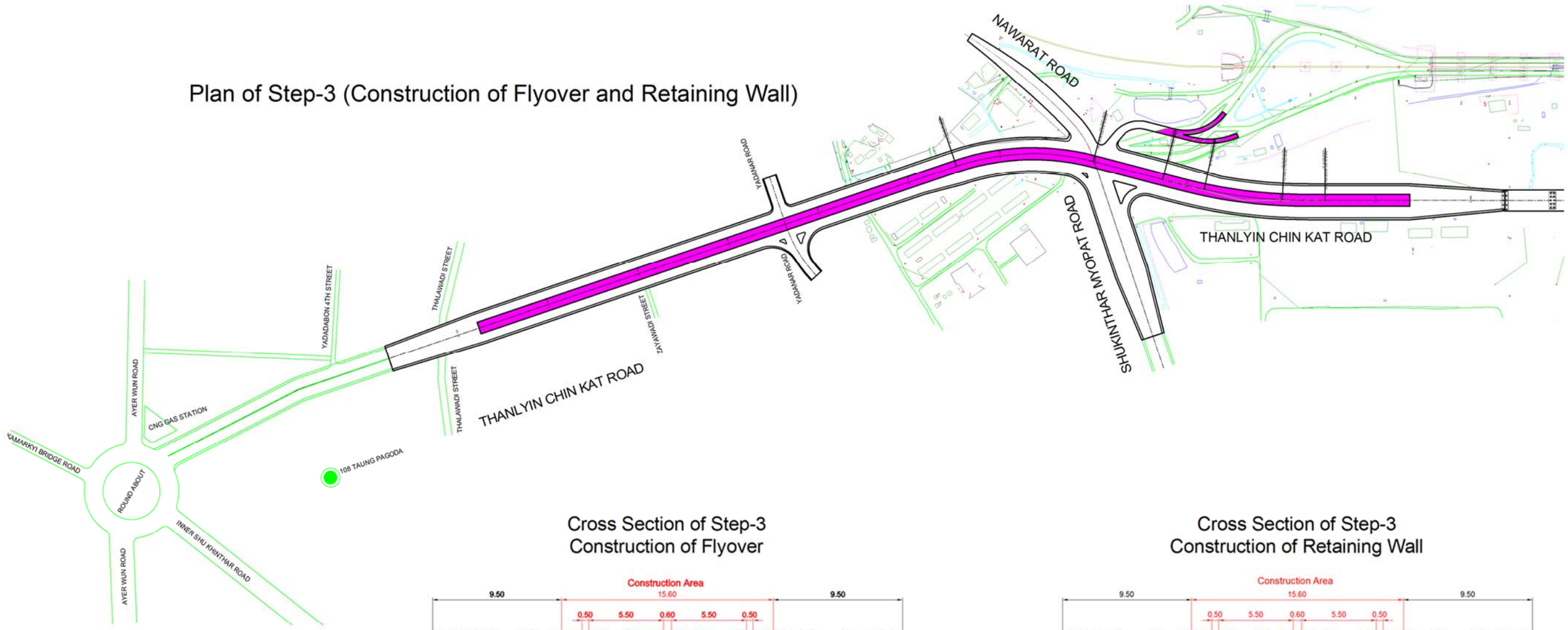


Cross Section of Step-2 Widening of Road

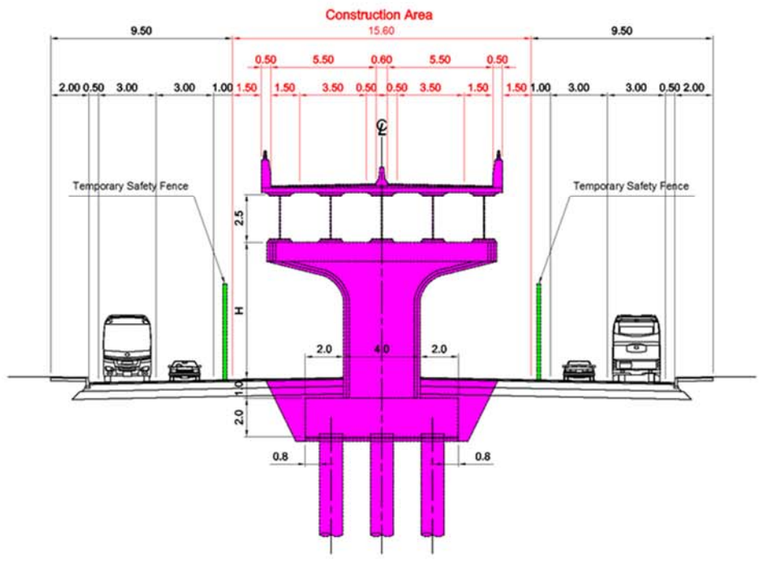


Source: JICA Study Team

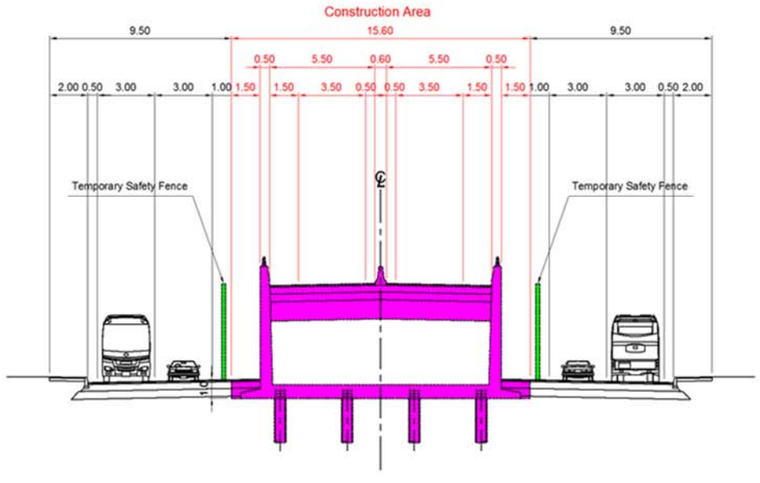
Plan of Step-3 (Construction of Flyover and Retaining Wall)



Cross Section of Step-3 Construction of Flyover

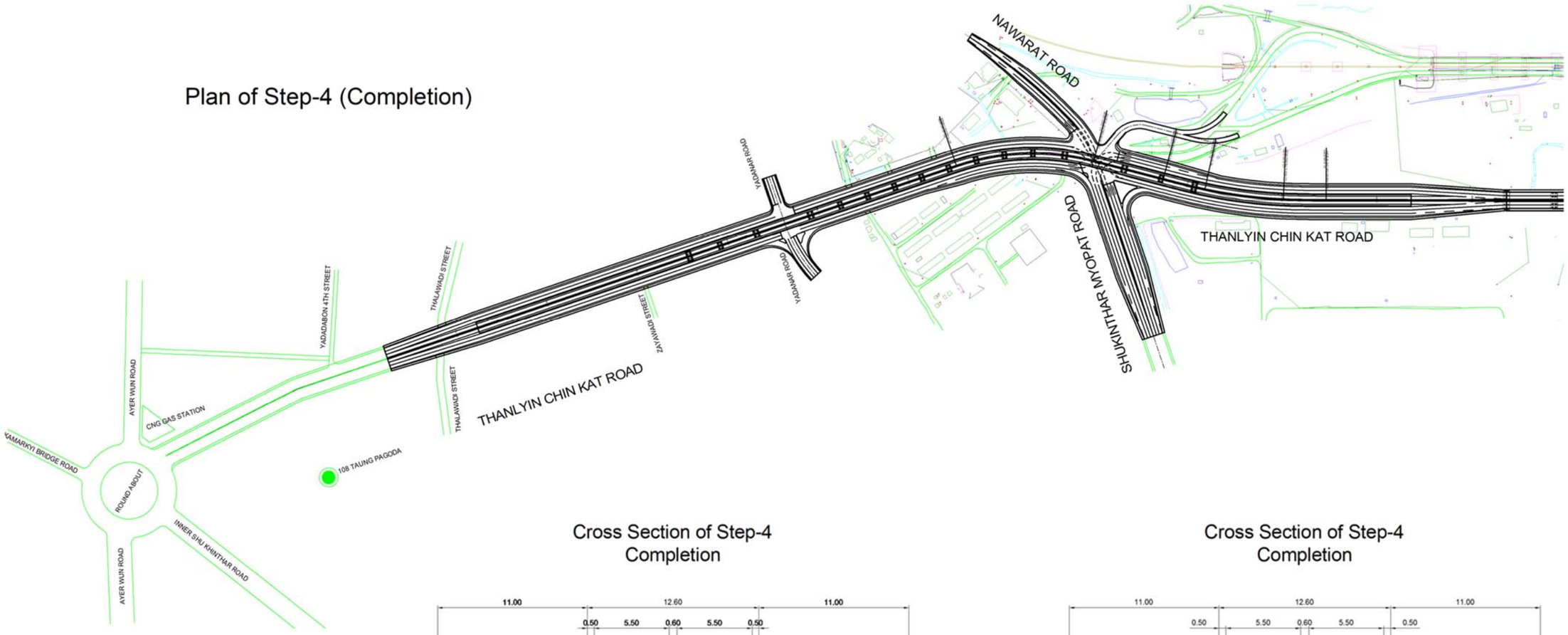


Cross Section of Step-3 Construction of Retaining Wall

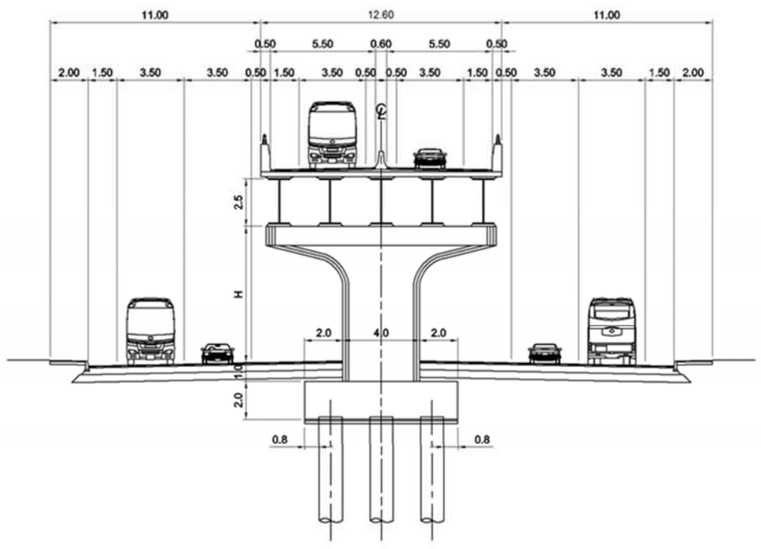


Source: JICA Study Team

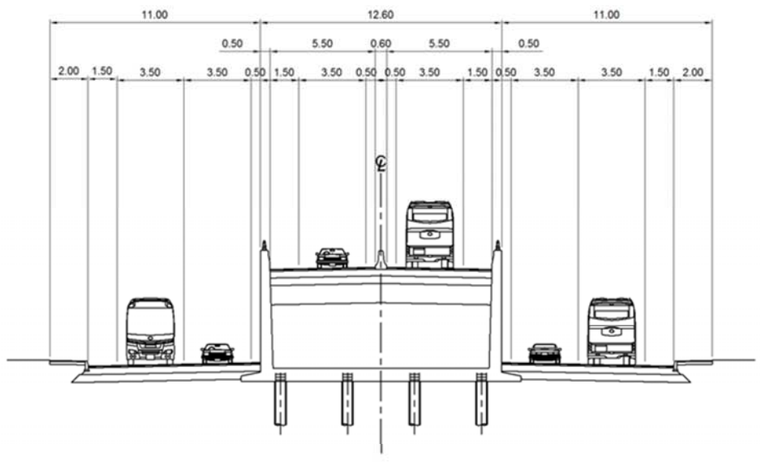
Plan of Step-4 (Completion)



Cross Section of Step-4 Completion



Cross Section of Step-4 Completion



Source: JICA Study Team

Appendix I Area for Construction Yards

(1) Introduction

In this chapter, necessary areas for construction yards are estimated and compare with the available vacant land for clarify whether temporary land acquisition will be necessary or not.

(2) Estimated Areas of Construction Yards

The following table shows the preliminary estimation of necessary areas of construction yards for the bridge and flyover construction.

Table I.1 Preliminary Estimation of Necessary Areas of Construction Yards

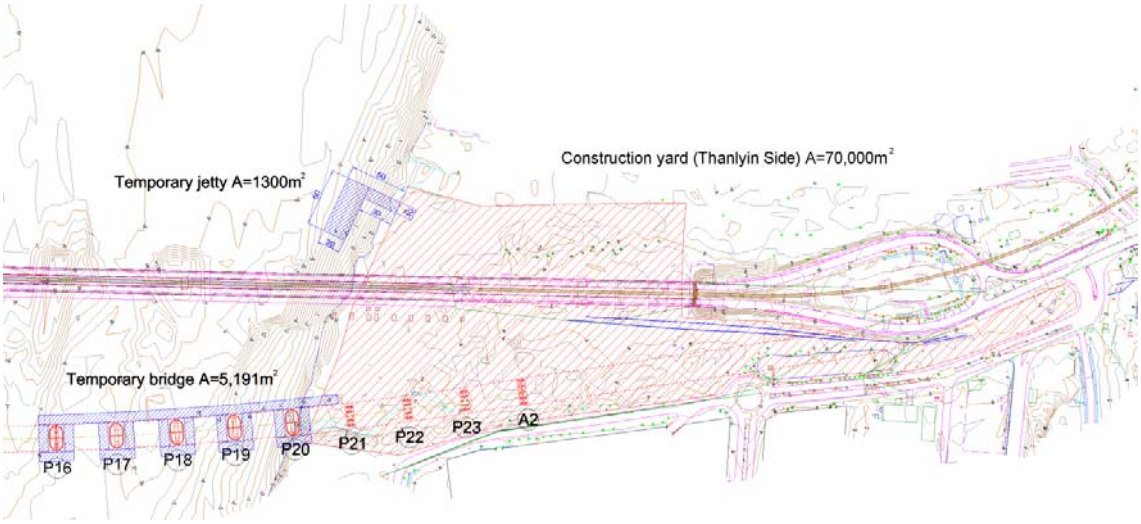
Item	Bridge Section		Flyover Section
	Taketa Side	Thanlyin Side	
Concrete & Asphalt Plant	8,000	8,000	3,000
Precast Segment	9,000	12,000	
Stockyard for Reinforcement Bar, Form Work	13,000	15,000	5,000
Material & Equipment	30,000*	30,000*	8,000
Office, Dormitory, Car Parking, Shed	3,000	3,000	2,000
Total Area (m^2)	63,000	68,000	18,000

Note*: ROW can be utilized.

Source: Study Team

(3) Construction Yard on Thanlyin Side

As stated in FS Report of 2014, Construction Yard on Thanlyin Side is expected to be located in the Compound of Myanmar Railway which is large enough as shown in the following figure.



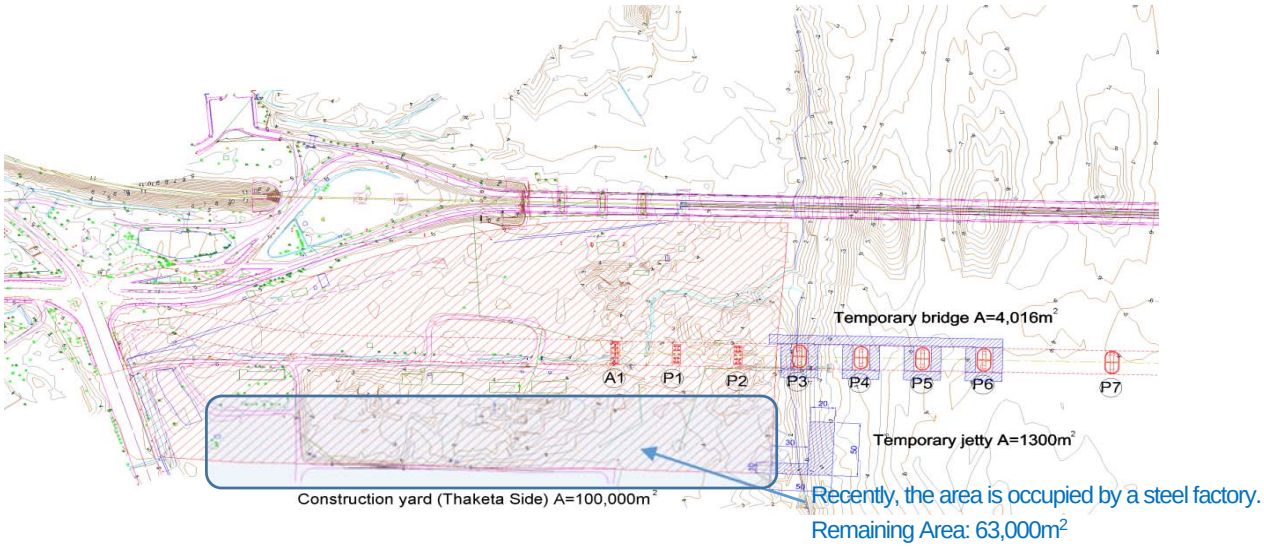
Source: F/S Final Report

Figure I.1 Available Land for Construction Yard on Thanlyin Side

(4) Construction Yard on Thaketa Side

On Thaketa side, Construction yards is expected to be located in the compound of MOC and Myanmar Railway.

However, the compound of MOC is now occupied by a factory and remaining available area is estimated as 63,000m^2, which is equal to estimated necessary area for construction yard. Further occupation may need additional land acquisition.



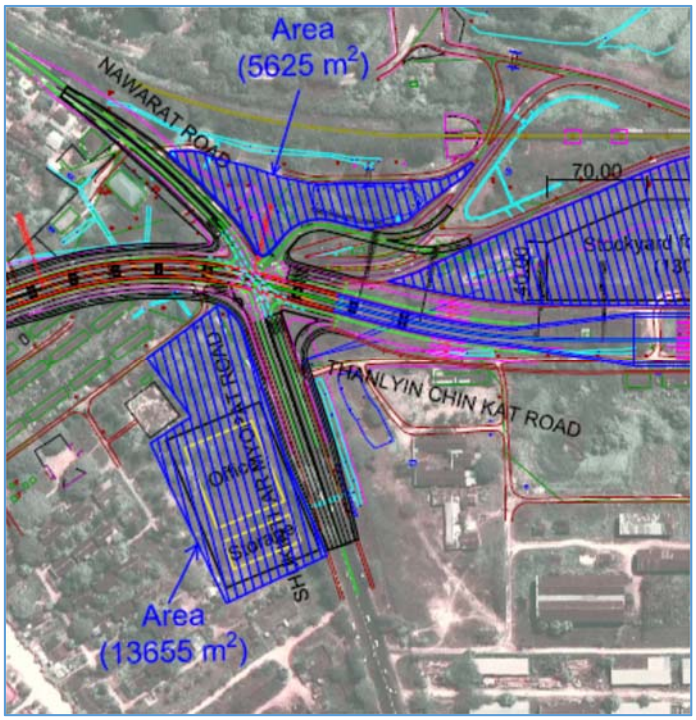
Source: F/S Final Report, added by Study Team

Figure I.2 Available Land for Constructtion Yard on Thaketa Side

(5) Construction Yard for Flyover

For Flyover, possible construction yard is as shown in the slide.

It is considered that the area of 19,280m^2 (=5,625m^2＋13,655m^2, Myanmar Railway Compound) is available, which is more than the estimated necessary area for construction yard.



Source: Study Team

Figure I.3 Area available for Yard of Flyover Construction.

Appendix J Study of Toll Gate for Bago Bridge

The Toll Gate for Bago Bridge was studied based on the Design Standard of NEXCO (Nippon Expressway Company).

(1) Number of Toll Booth

The number of toll booth was calculated by using following formula in accordance with the Design Standard of NEXCO.

$$U = \frac{B \times DHV}{3600 \times S} < 1.0$$

Where:

U: Unit Strength of Traffic per 1 lane (veh)

B: Time of Service (sec); Generally, the time of service is 8 second.

DHV: Design Hourly Volume (veh/hr)

S: Number of Toll Booth (nos)

The results of caluculation for number of toll booth is shown in the table below.

Table J.1 Calculation of Necessary Number of Toll Booths

Direction	DHV		B	S	U	Remarks
	(pcu/hr)	(veh/hr)	(sec)	(nos)	(veh)	
Flyover to Bago Bridge	950	798	8	3	0.591	
Bago Bridge to Flyover	1,160	974		3	0.721	
Bago Bridge to Shukhinthar Intersection	1,480	1,243		3	0.921	
Shukhinthar Intersection to Bago Bridge	1,180	991		3	0.734	

Source: JICA Study Team

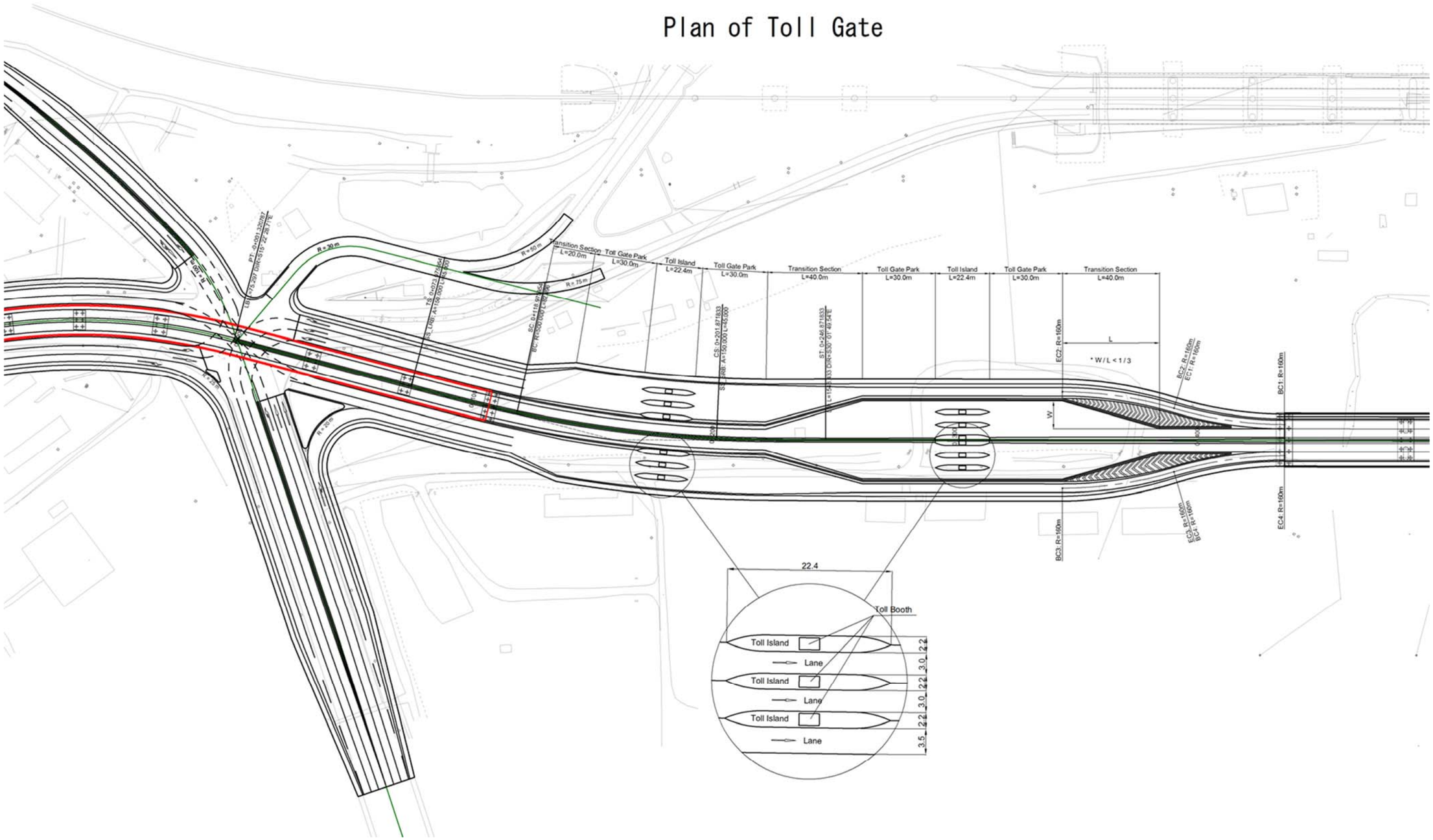
As a result, the number of toll booth is adopted 3 numbers per lane.

(2) Layout of Toll Gate

The layout of toll gate was planned as following conditions in accordance with the Design Standard of NEXCO.

- Ratio of lateral transition (W / L) was adopted 1 / 3 and over (W: width of lateral transition, L: length of transition section).
- Length of toll gate park was adopted 30m.
- Length of toll island was adopted 22.4m and width of it was adopted 2.2m.
- Width of lane at toll gate was adopted 3.0m. However, width of most right lane was adopted 3.5m in consideration of large vehicle passing.

The plan of toll gate is shown in the figure below.



Source: JICA Study Team

Figure J.1 Plan of Toll Gates and Layout of Toll Booths