The Project for Urban Mobility Improvement in Kigali

The 6th Working Group 2 (5. Lecture 2: Case Study of Intersection Improvement (DBL Route))

22nd February 2023

JET Member

Traffic Flow Management

1. Mr. NISHINO: Traffic Flow Management/Traffic Control (1)

Traffic Management System

2. Mr. OKUDA: Smart Traffic/ICT
3. Mr. NODA: Traffic Flow Management/Traffic Control (2)
4. Mr. OTSUKA: System Design/Communication

Intersection Improvement

5. Mr. IWAMOTO: Road Planning & Design (1)
6. Mr. SUGANUMA: Road Planning & Design (2)
7. Mr. SHINYA: Road Planning & Design (3)

AGENDA

Session 1: Working Group

9:00-10:00	1h	Evaluation of Intersections and Prioritization of Improvement Projects
10:00-11:00	1h	Basic Design of Intersections (Civil Works)
11:00-12:00	1h	Basic Design of Intersections (Signal System)

12:00-13:00 Lunch Break

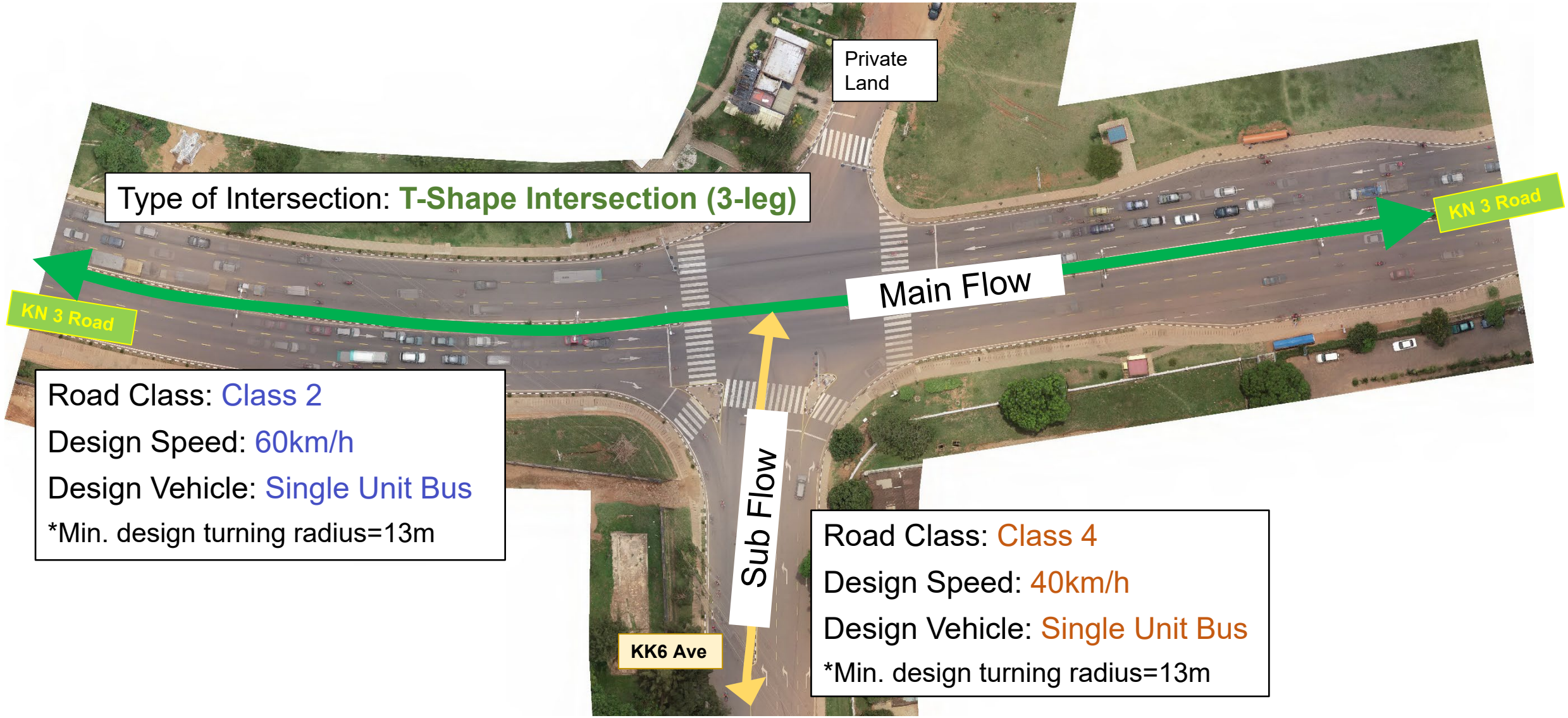
Session 2: Lectures

13:00-14:00	1h	Lecture 1: Roundabout Planning
14:00-15:30	1.5h	Lecture 2: Case Study of Intersection Improvement (DBL Route)
15:30-16:00	0.5h	Lecture 3: Signal Phase Planning

Lecture 2: Case Study of Intersection Improvement (DBL Route)

1. Existing Geometric Conditions

Current situation (Aerial survey photograph by drone)



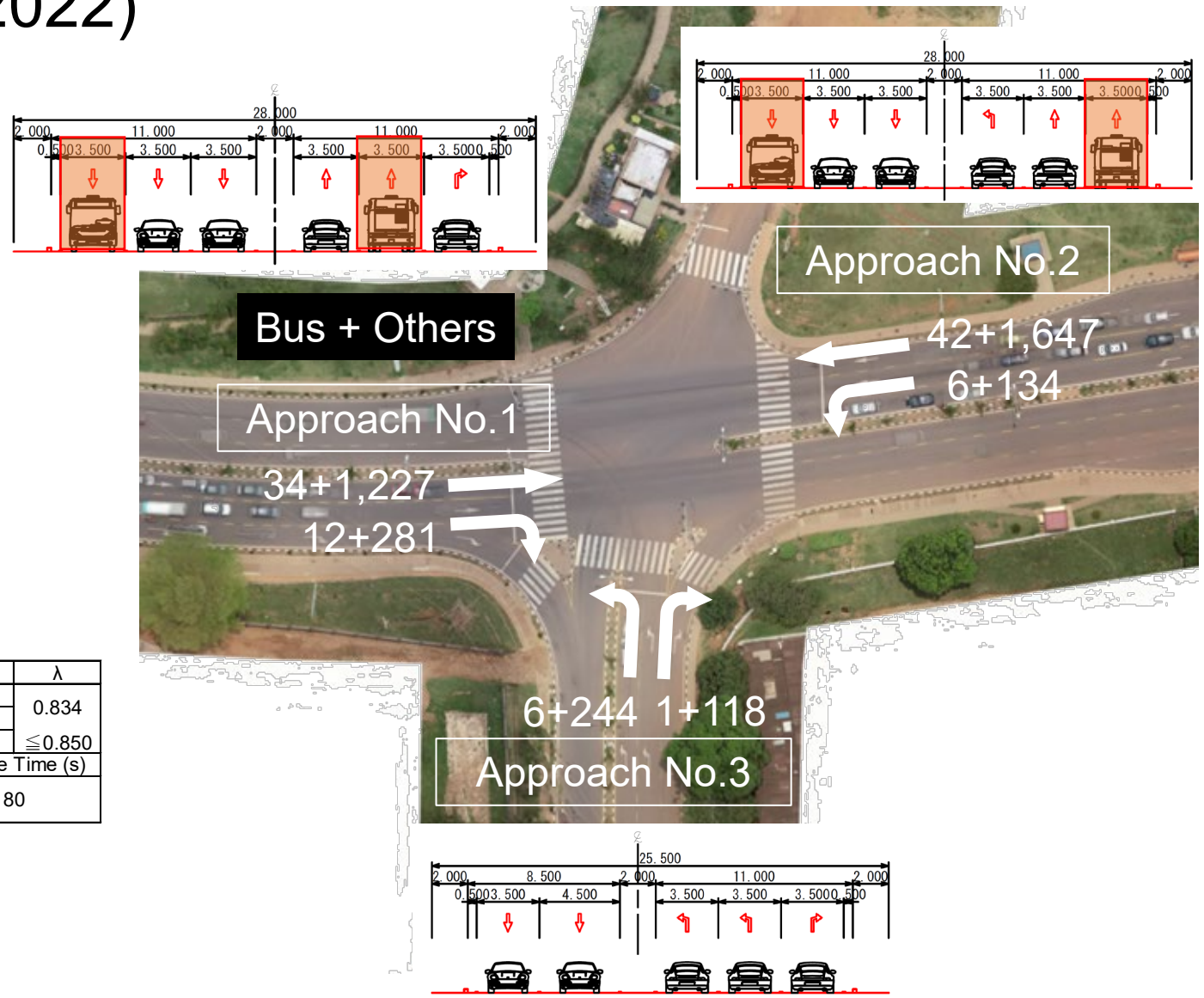
2. Current Traffic Situation

Directional Traffic Movement (2022)

Name of Intersection		S03-10					
Approach		①		②		③	
Lane		RT Free	TH	TH	LT	RT Free	LT
No. of Lanes		1	1	1	1	1	2
Base Saturation Flow S_0 (pcu/hr/lane		1,800	2,000	2,000	1,800	1,800	1,800
Lane width adjustment factor, f_w		1.000	1.000	1.000	1.000	1.000	1.000
Lane Width (m)		(3.50)	(3.50)	(3.50)	(3.50)	(3.50)	(3.50)
Vertical grade adjustment factor, f_g		1.000	1.000	1.000	1.000	1.000	1.000
Vertical Grade (%)		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Heavy vehicle adjustment factor, f_{HV}		0.985	0.990	0.988	0.990	0.988	0.989
Heavy Vehicle Rate (%)		(2.14)	(1.39)	(1.70)	(1.50)	(1.70)	(1.64)
Right-turn adjustment factor, f_{RT}							
Percentage of RT (%)							
Possibility of RT Passage F_R							0.850
Effective Green Time (s)							25
Pedestrian Green Time (s)							25
Left-turn adjustment facotr, f_{LT}							
Percentage of LT (%)							
Possibility of LT Passage F_L							
Effective Green Time (s)							
Cycle Time (s)							
Saturation Flow S (pcu/hr)		*1,773	1,980	1,976	1,782	*1,778	*946
Traffic Volume q		281	1,227	1,647	134	118	244
Flow Ratio		-	0.620	0.834	0.075	-	-
Phase Ratio	1φ		0.620	0.834			
	2φ			****	0.075		
	3φ						-
Effective Green Time (s)	1φ		35.0	36.0			
	2φ			11.0	11.0		
	3φ						25.0
Capacity C_i		1,773	866	1,136	245	1,778	946
Volume-to-Capacity Ratio q/C_i		0.158	1.417	1.450	0.547	0.066	0.258
Judgement		OK	NG	NG	OK	OK	OK
Queue Length L_s (m)					36.3		34.1

	λ_i	λ
1φ	0.834	0.834
2φ	****	
3φ	0.000	≦0.850

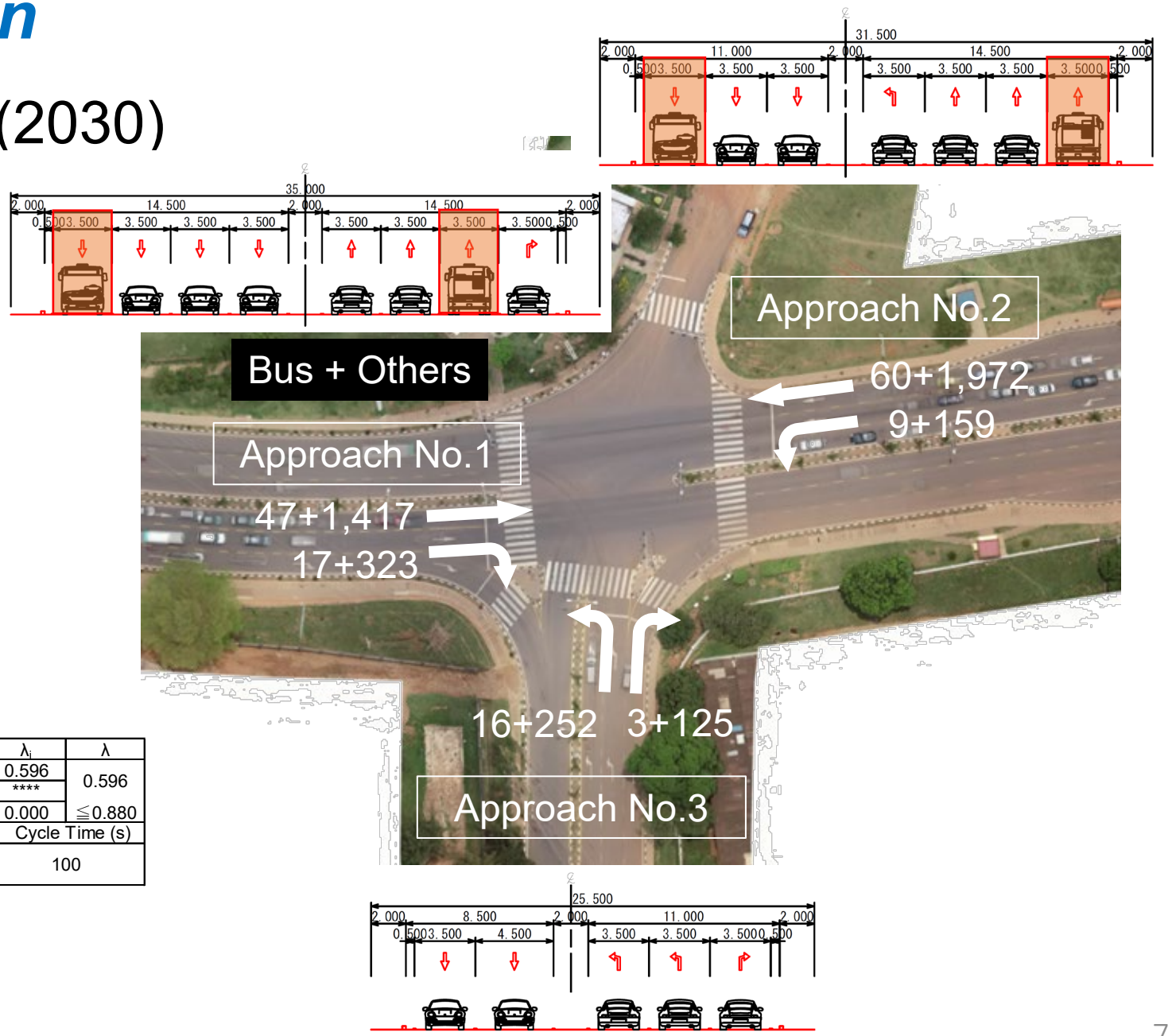
Cycle Time (s)	
80	



2. Current Traffic Situation

Directional Traffic Movement (2030)

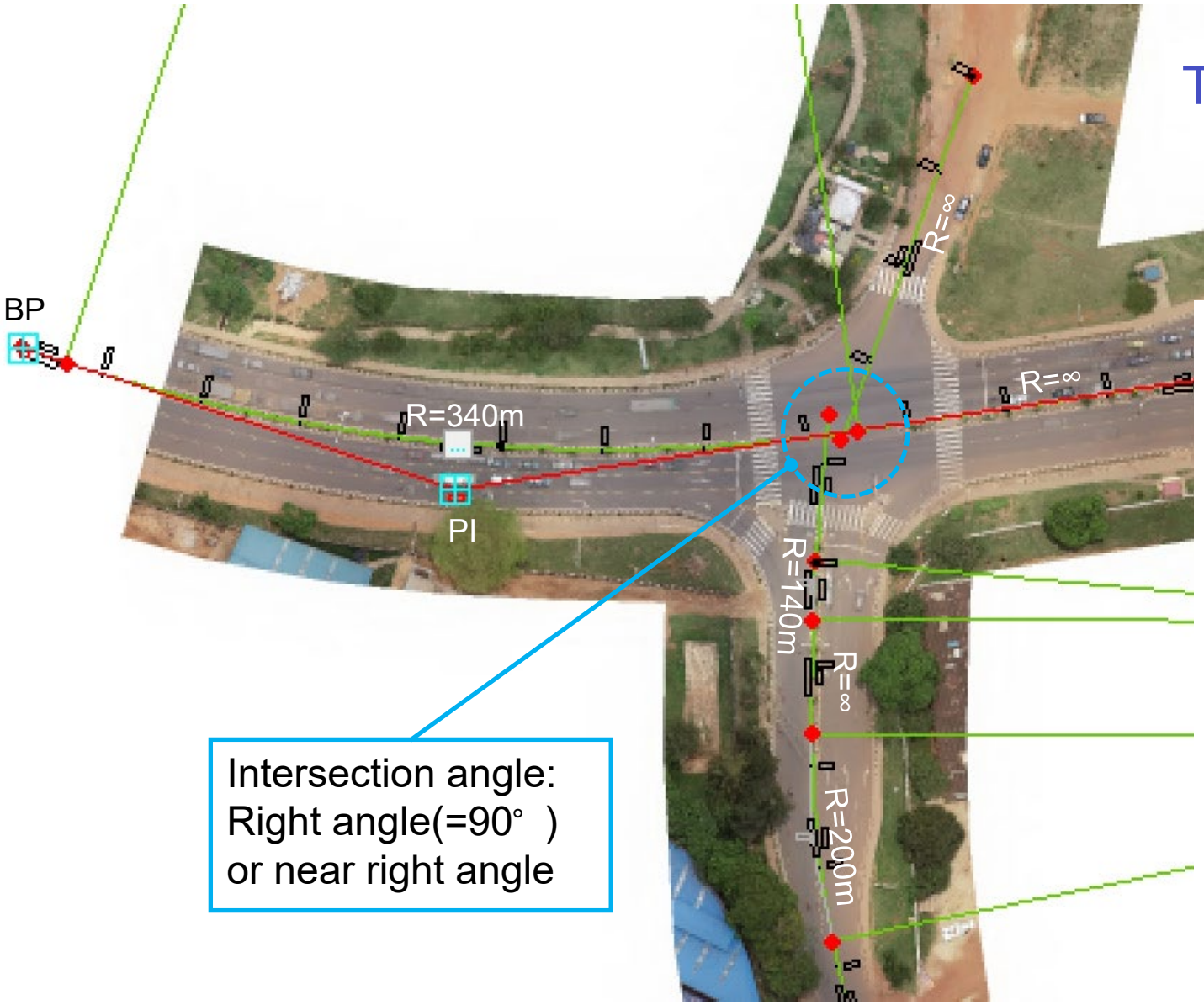
Name of Intersection		S03-10							
Approach		①		②		③			
Lane		RT Free	TH	TH	LT	RT	LT		
No. of Lanes		1	2	2	1	1	2		
Base Saturation Flow S_0 (pcu/hr/lane)		1,800	2,000	2,000	1,800	1,800	1,800		
Lane width adjustment factor, f_w Lane Width (m)		1.000 (3.50)	1.000 (3.50)	1.000 (3.50)	1.000 (3.50)	1.000 (3.50)	1.000 (3.50)		
Vertical grade adjustment factor, f_g Vertical Grade (%)		1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)	1.000 (0.00)		
Heavy vehicle adjustment factor, f_{HV} Heavy Vehicle Rate (%)		0.985 (2.14)	0.990 (1.39)	0.988 (1.70)	0.990 (1.50)	0.988 (1.70)	0.989 (1.64)		
Right-turn adjustment factor, f_{RT} Percentage of RT (%) Possibility of RT Passage F_R Effective Green Time (s) Pedestrian Green Time (s)						0.850 30 30	0.850 30 30		
Left-turn adjustment facotr, f_{LT} Percentage of LT (%) Possibility of LT Passage F_L Effective Green Time (s) Cycle Time (s)									
Saturation Flow S (pcu/hr)		*1,773	3,960	3,952	1,782	*453	*908		
Traffic Volume q		389	1,699	2,357	191	315	652		
Flow Ratio		-	0.429	0.596	0.107	-	-	λ_i	λ
Phase Ratio	1φ		0.429	0.596				0.596	0.596
	2φ			****	0.107			****	
	3φ					-	-	0.000	≦0.880
Effective Green Time (s)	1φ		49.0	50.0				Cycle Time (s)	
	2φ			12.0	12.0			100	
	3φ					30.0	30.0		
Capacity C_i		1,773	1,940	2,411	214	453	908		
Volume-to-Capacity Ratio q/C_i		0.219	0.876	0.978	0.893	0.695	0.718		
Judgement		OK	OK	OK	OK	OK	OK		
Queue Length L_s (m)					57.5	83.3	85.6		



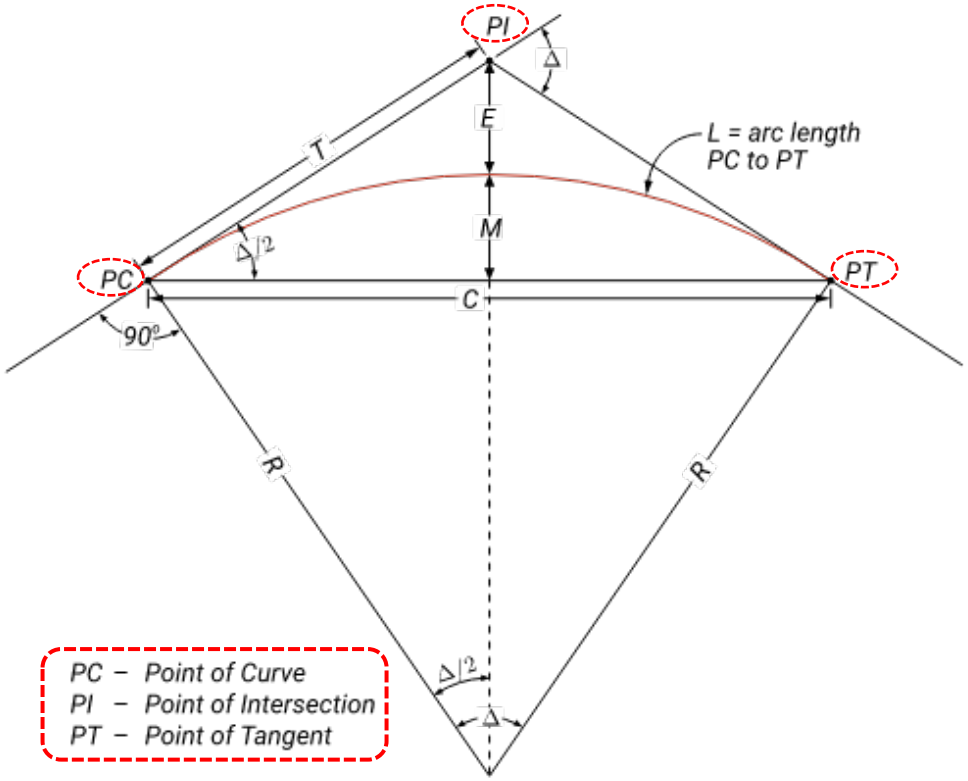
5. Setting Centerline Alignment

Design of the road centerline: Restoration of existing road centerline

Tangent (R=∞) + Simple curves

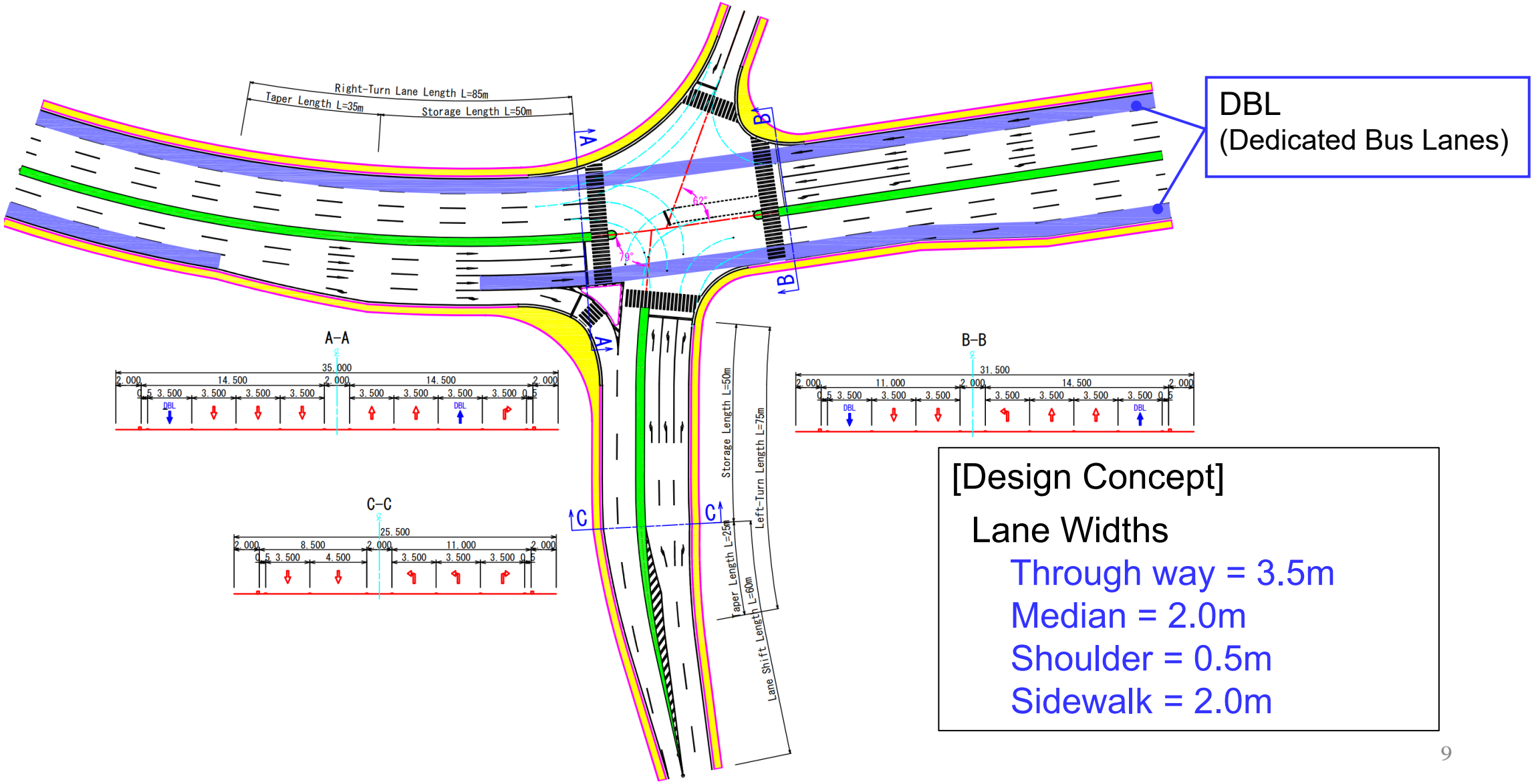


Intersection angle:
Right angle(=90°)
or near right angle



6. Basic Layout of Intersection

Overall view, without Aerial survey photograph



DBL
(Dedicated Bus Lanes)

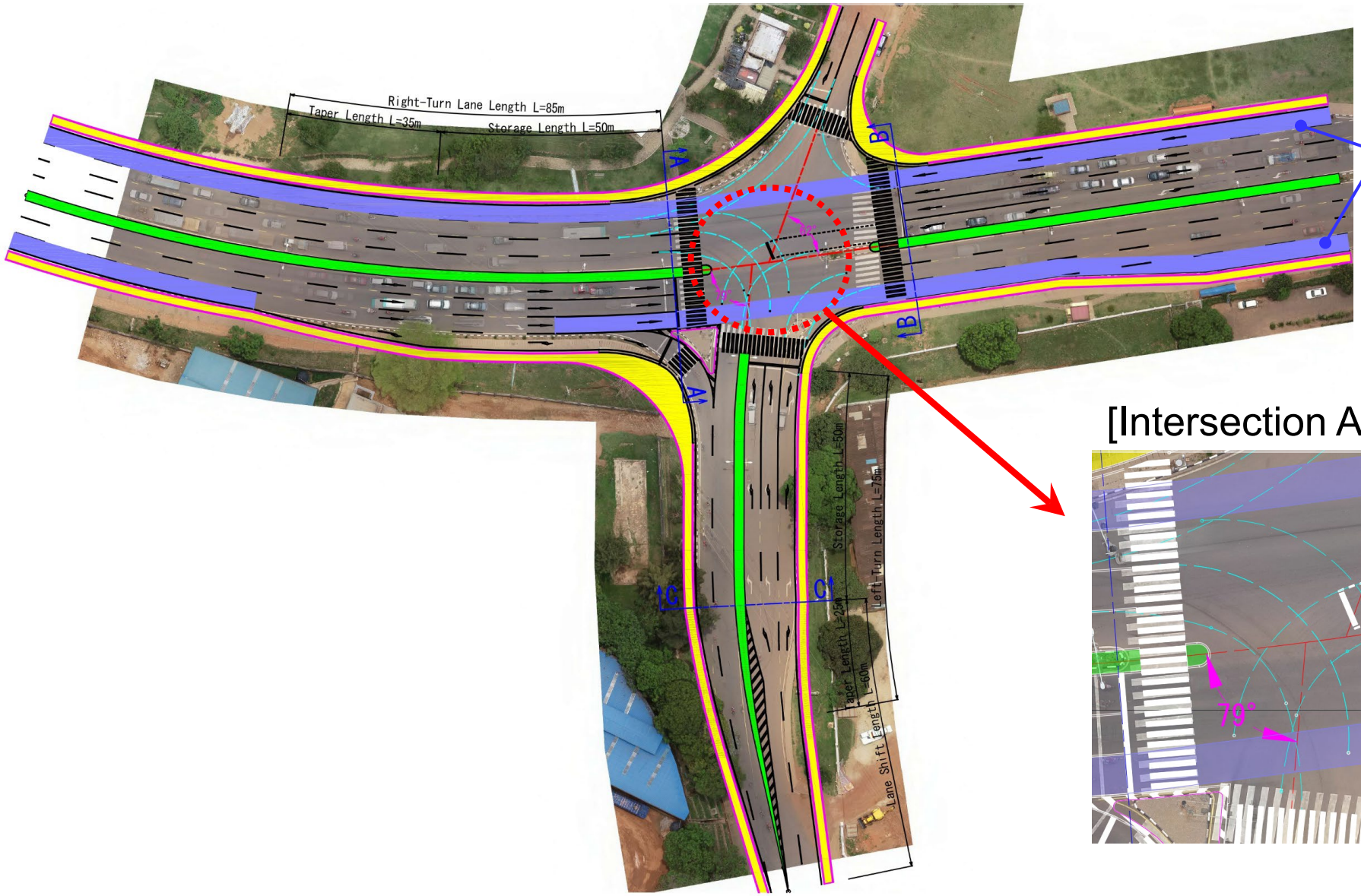
[Design Concept]

Lane Widths

- Through way = 3.5m
- Median = 2.0m
- Shoulder = 0.5m
- Sidewalk = 2.0m

6. Basic Layout of Intersection

Overall view, with Aerial survey photograph

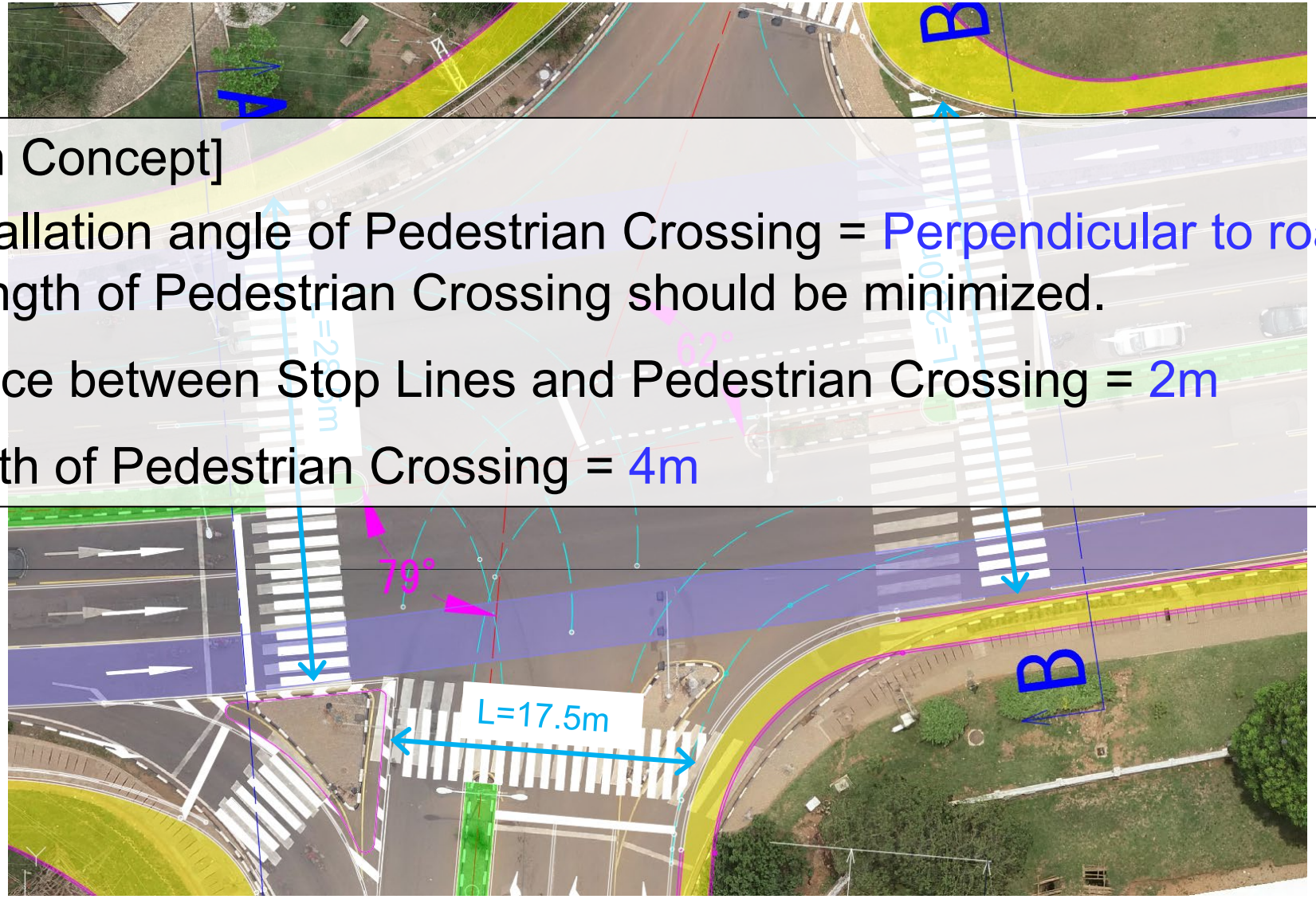


DBL
(Dedicated Bus Lanes)

[Intersection Angles]

7. Geometric Details

Stop Lines and Pedestrian Crossings

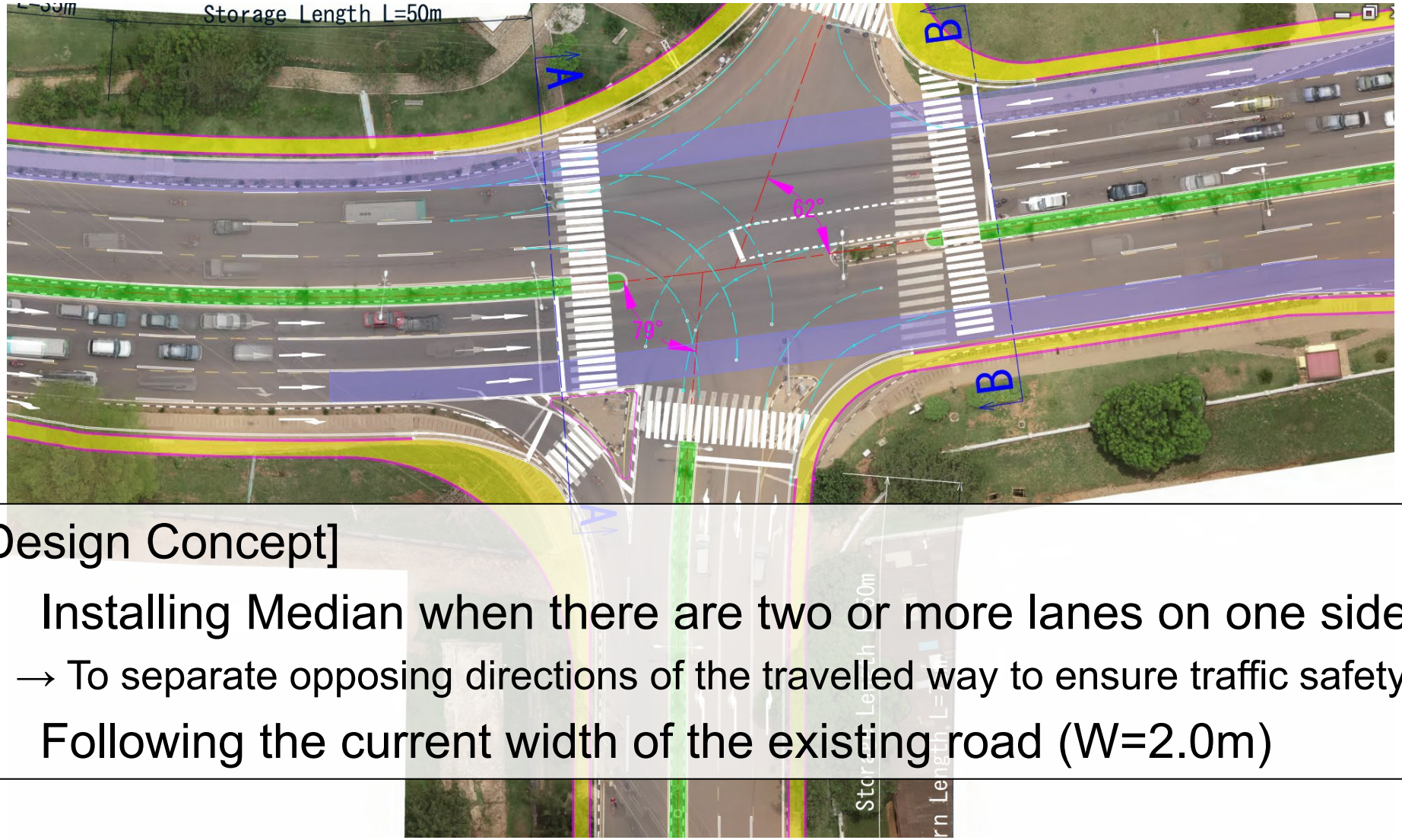


[Design Concept]

- Installation angle of Pedestrian Crossing = Perpendicular to road CL
  → Length of Pedestrian Crossing should be minimized.
- Space between Stop Lines and Pedestrian Crossing = 2m
- Width of Pedestrian Crossing = 4m

7. Geometric Details

Median



[Design Concept]

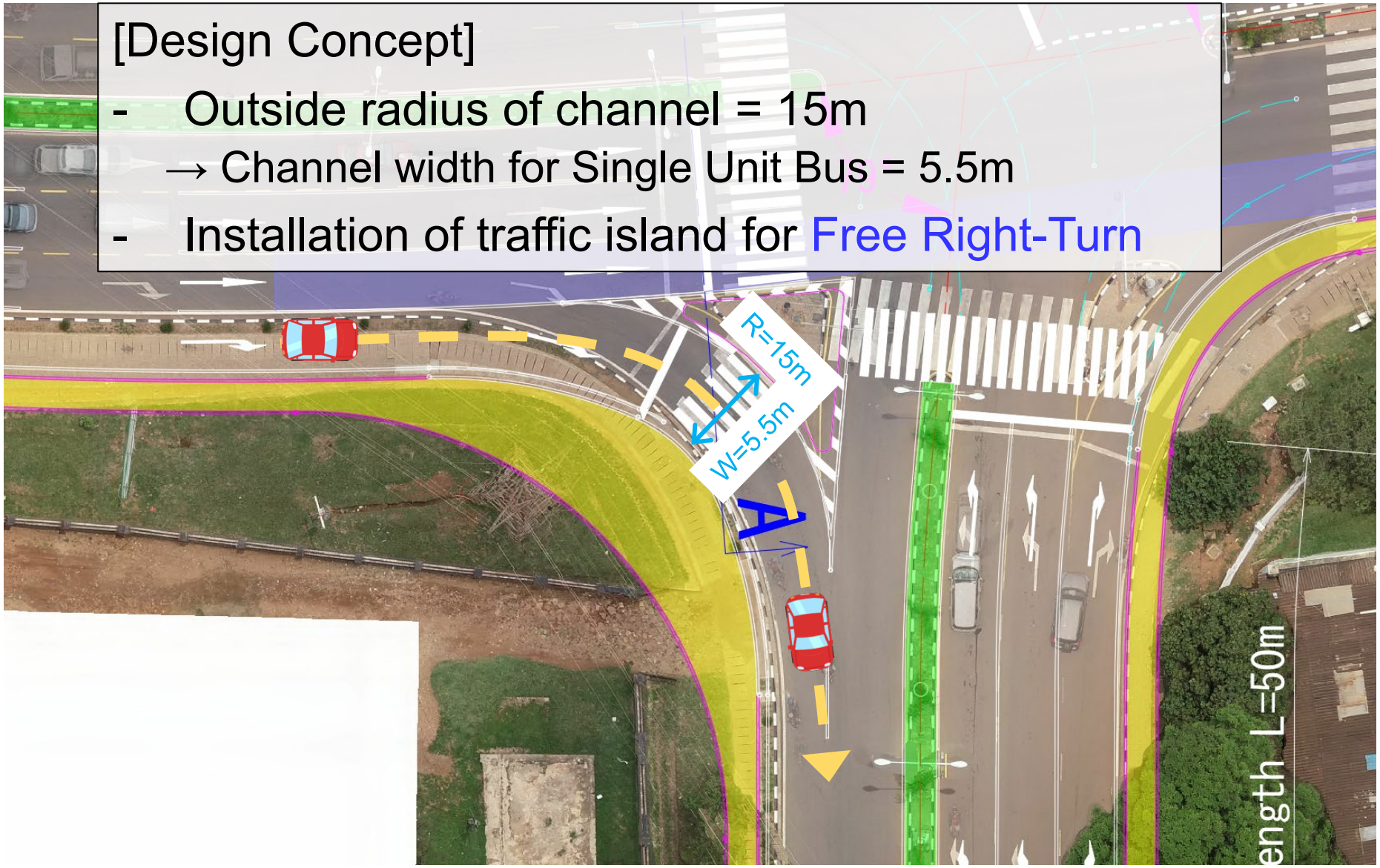
- Installing Median when there are two or more lanes on one side

  → To separate opposing directions of the travelled way to ensure traffic safety

- Following the current width of the existing road (W=2.0m)

7. Geometric Details

Right-Turn Channel

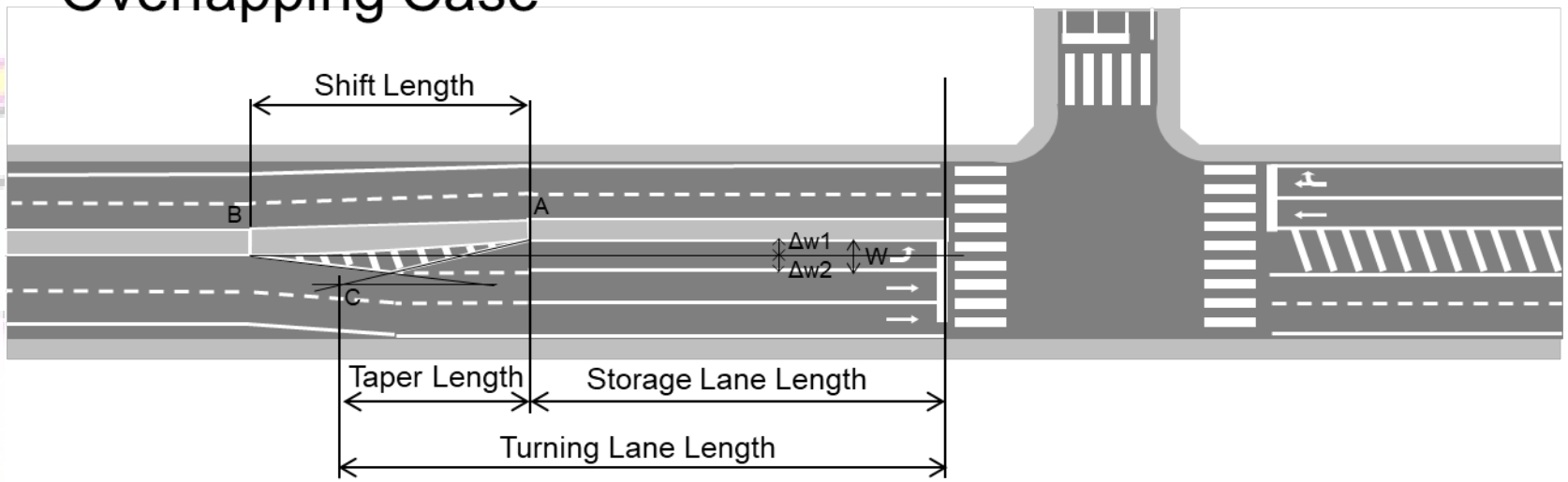


7. Geometric Details

Left Turn Lane: for minor road

[Design Concept]

Overlapping Case



$$\text{Shift Length} = \frac{V * \Delta w}{3} \text{ to } \frac{V * \Delta w}{2}$$

$$\text{Taper Length} = \frac{V * W}{6}$$

$\Delta w = \max(\Delta w1, \Delta w2)$

$\Delta w1$: Shift of Carriageway Centerline

$\Delta w2$: Shift of Lane Boundary

W: Lane Width