ESTIMATION OF ROUNDABOUT ENTRY CAPACITY CONSIDERING THE IMPACT OF PEDESTRIANS

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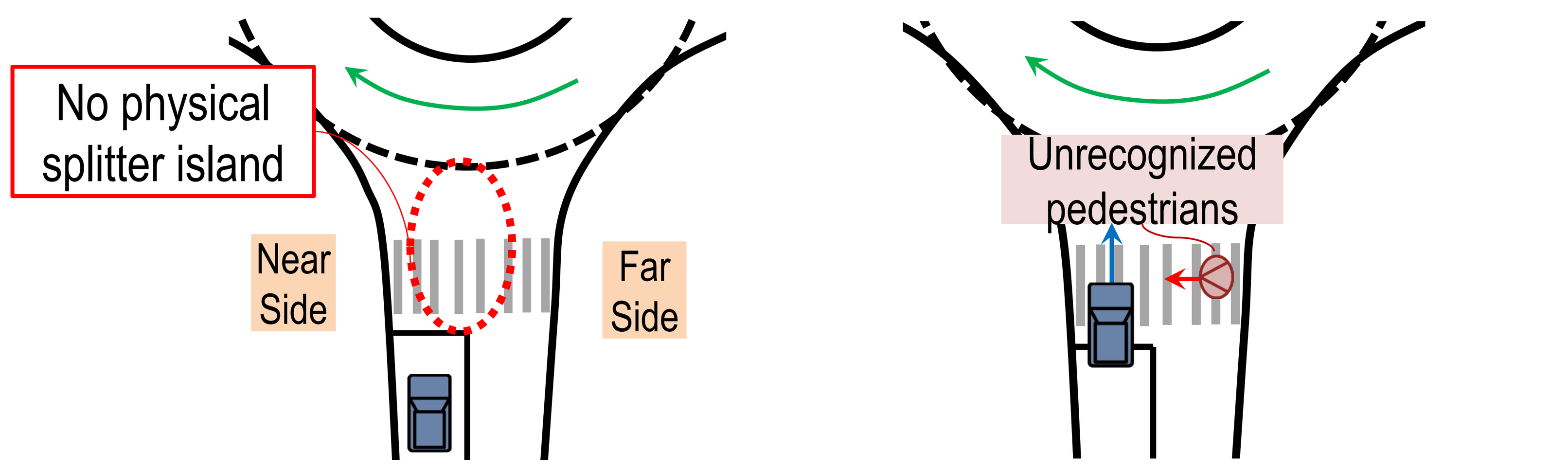
1. INTRODUCTION

- Pedestrians at roundabout
  - One of the most important factors significantly affecting entry capacity.
- Roundabouts in Japan
  - Physical splitter island is not always available due to limited space.
  - Not all drivers follow the traffic rule and give priority to far-side pedestrians when physical splitter island is uninstalled.



- In the existing method, pedestrian impact on entry capacity is considered as an adjustment f_{ped} (Brilon, et al, 1993) which is developed for standard roundabouts, e.g. with physical splitter island.
- An estimation method is needed for considering Japanese characteristics.
- Several influencing factors will be considered in new estimation method.
  - Physical splitter island,
  - Far-side pedestrian directional ratio r_{far},
  - Far-side pedestrian recognition rate FPRR ($FPRR=\frac{recognized\ far-side\ pedestrians}{all\ cases\ that\ entry\ drivers\ should\ react\ to\ far-side\ pedestrians}$),
  - Queue of circulating vehicles due to pedestrians across downstream exits.

Objectives

- To appropriately **estimate entry capacity** under **pedestrian impact** in **Japanese situation** considering various influencing factors by **microscopic simulation** and **theoretical model**.

2. METHODOLOGY AND RESULTS

Entry capacity estimation considering pedestrians

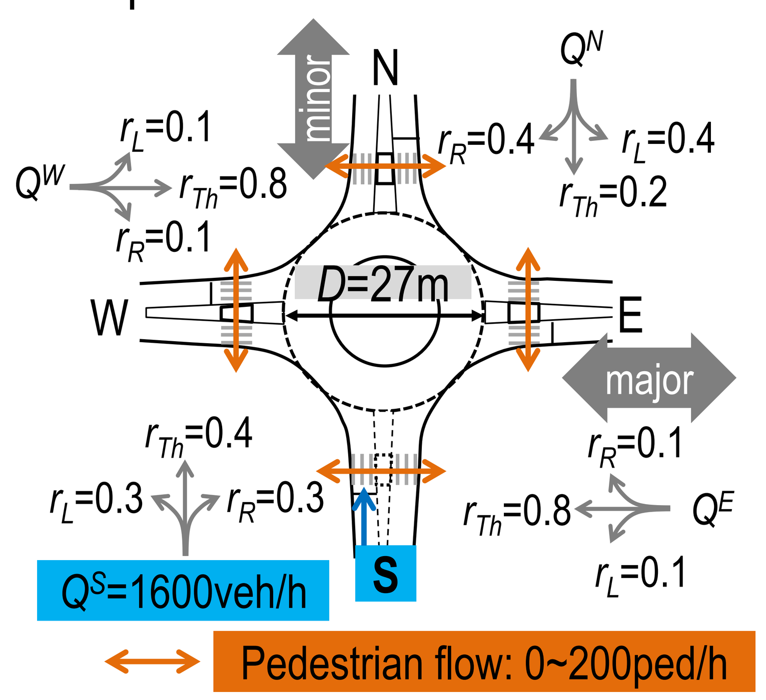
- **Simulation study (VISSIM 5.40)**
  - Examine influencing factors
    1. physical splitter island,
    2. r_{far},
    3. FPRR,
    4. queue in circulating roadway
- **Theoretical model**
  - Develop a theoretical model based on the situations of circulating flow, **flowing** or **queuing**, and with the examined influencing factors

Comparison

Conclusion

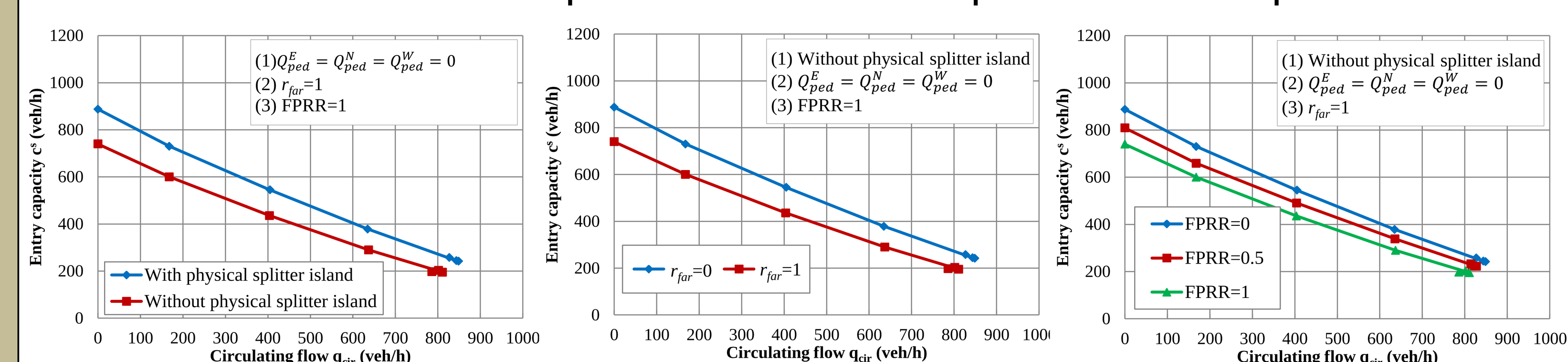
2.1 Simulation study (VISSIM 5.40)

- Basic information
  - Input conditions of traffic flow

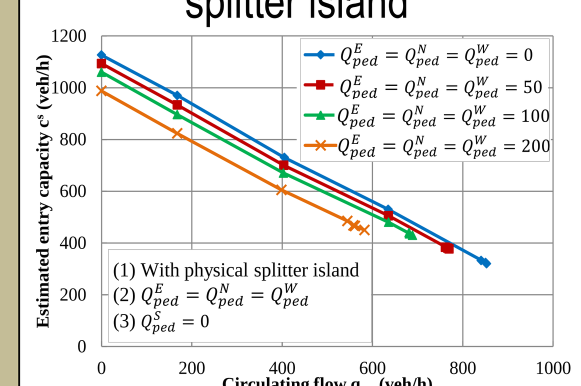


  - Simulation design regarding influencing factors to be examined.
    - ◇Physical splitter island: with/without
    - ◇r_{far}: 0, 0.5, 1
    - ◇FPRR: 0, 0.5, 1
  - Calibration
    - ◇Parameters are calibrated based on empirical data which is observed in Japan.

- Results and discussions: pedestrian flow=200ped/h for example



(a) Examination of physical splitter island (b) Examination of r_{far} (c) Examination of FPRR



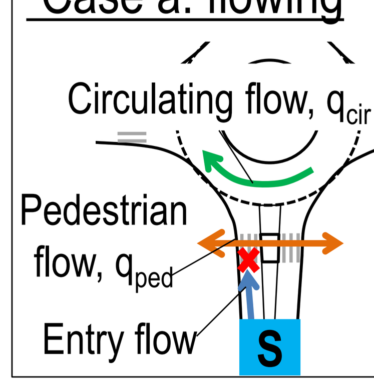
(d) Examination of pedestrian at downstream exits

Entry capacity is reduced more
- ✓ under the condition without physical splitter island,
- ✓ higher r_{far},
- ✓ higher FPRR and
- ✓ more pedestrians across downstream exits.

2.2 Theoretical model

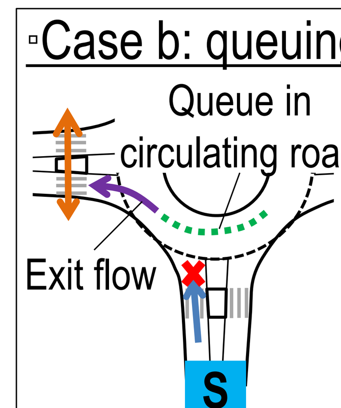
- Concept of the model

Case a: flowing



- ◇ Maximum entry flow considering q_{cir}, $f(q_{cir})$
- ◇ Maximum entry flow considering q_{cir} and q_{ped}, $g(q_{cir}, q_{ped})$
- ◇ Maximum number of n_a vehicles can store between crosswalk and yield line

Case b: queuing



- ◇ Probability of queuing vehicles reach to Entry S, P_{queue}

Examined influencing factors

$$c_a = \frac{n_a}{n_a+1} f(q_{cir}) - \frac{1}{n_a+1} g(q_{ped}, q_{cir})$$

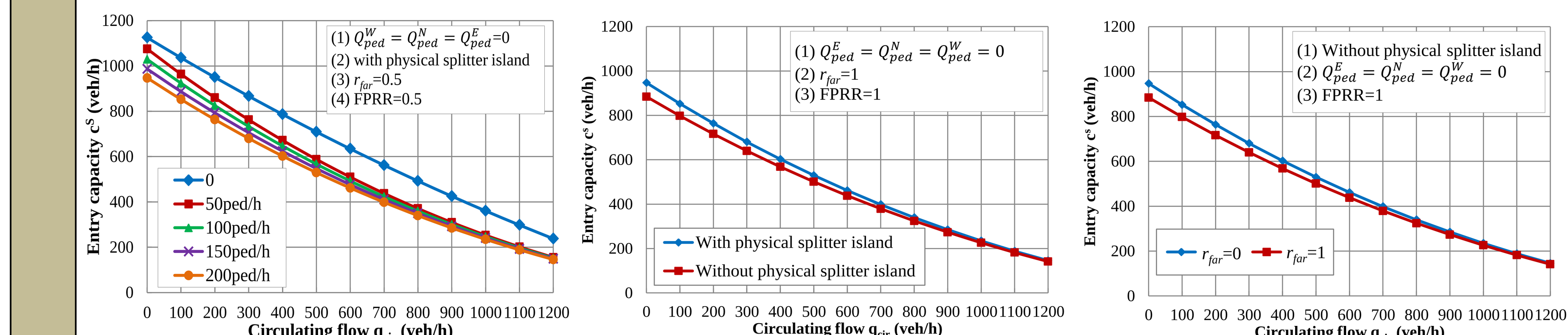
P_{queue} $c_b = 0$

$$P_{flowing} = 1 - P_{queue}$$

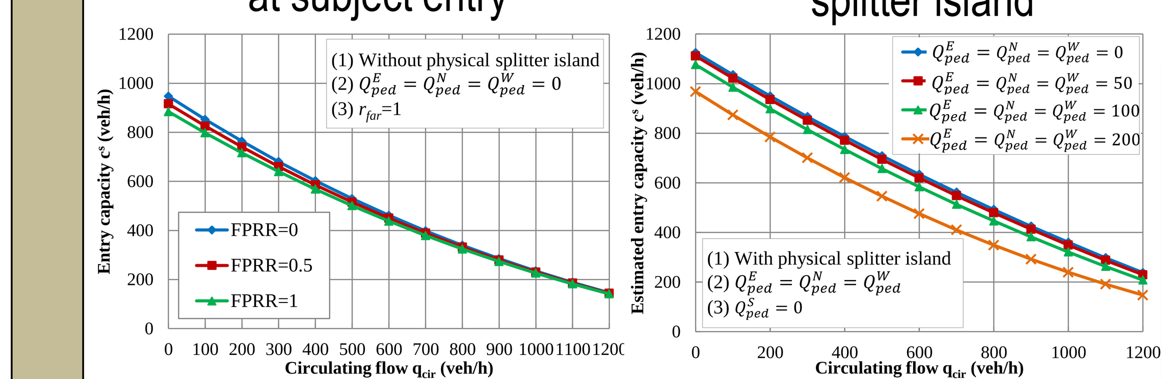
$$c_e = P_{flowing} c_a + P_{queue} c_b = (1 - P_{queue}) c_a$$

- c_a: Brilon,W. (1993), Capacity at Unsignalized Two-stage Priority Intersections.
- $g(q_{ped}, q_{cir})$: Wu, N. (1999), A Universal Procedure for Capacity Determination at Unsignalized (Priority-controlled) Intersections.

- Results and discussions: pedestrian flow=200ped/h for example



(a) Changing with pedestrians at subject entry (b) Changing with physical splitter island (c) Changing with r_{far}

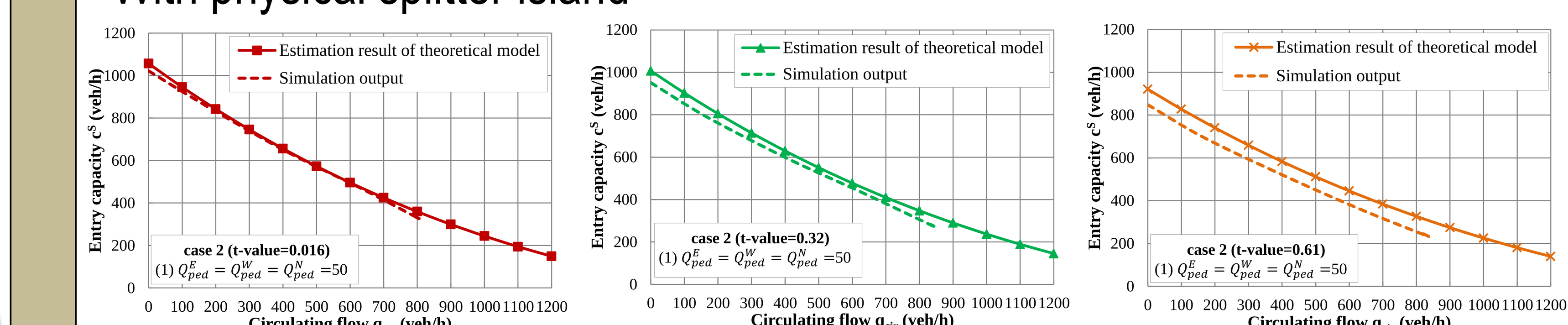


(d) Changing with FPRR (e) Changing with pedestrians at downstream exits

The impact of influencing factors can be reflected by the proposed model and all the tendency of factors follow the results from simulation.

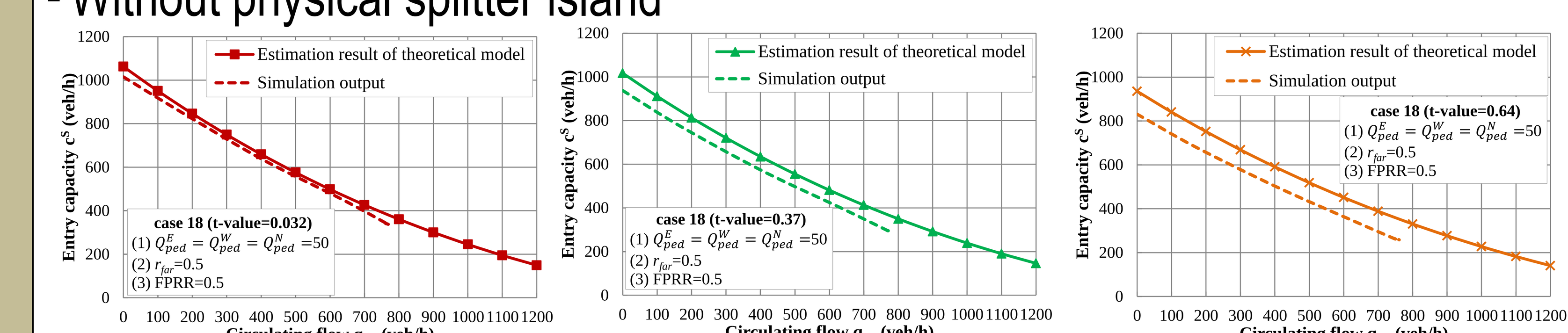
2.3 Comparison of the simulation and theoretical methods

- With physical splitter island



(a) Pedestrian: 50ped/h (b) Pedestrian: 100ped/h (c) Pedestrian: 200ped/h

- Without physical splitter island



(a) Pedestrian: 50ped/h (b) Pedestrian: 100ped/h (c) Pedestrian: 200ped/h

Simulation is the reference of entry capacity. The comparison results showed that the proposed model can provide reliable reason either under the condition with splitter island or without physical splitter island.

- The limitations of two proposed methods are considered as follows.

Simulation	Theoretical model
More calibration of pedestrian behavior is necessary	1.The discharge time of queue in circulating roadway is necessary to be considered
	2. Several influencing factors, i.e. priority of roads, turning ratio, queuing exit vehicles at the lag which have impact on headway distribution of circulating vehicles should be considered

3. CONCLUSION AND FUTURE WORK

- Two methods were proposed considering characteristics of roundabouts in Japan, e.g. without physical splitter island and several influencing factors, e.g. r_{far} and FPRR.
- In view of the limitations of the current models, improvement will be conducted in future.