Application of Tandem Sorting Strategy to Increasing Urban Intersection Capacity: A Case Study

タンデムソーティング戦略による信号交差点の容量増強のケーススタディ

Background

Protected (Separate) Turning Phase
To minimize conflict between turning vehicles and opposing through traffic.

DISADVANTAGES:
• Decreases through traffic green time.
• Turning phases are not given enough green time. High delay for turning vehicles.

Benefits of TSS

• Increased discharge lanes
• Higher overall capacity
• Lower required green times = Less delay
• Flexible in time and space

Tandem Sorting Strategy (TSS)

Step 1: Vehicles are separated by turning movement before reaching the pre-signal.
Step 2: Vehicles occupy (at most) all lanes in the storage area.
First, the right turners. Then, the through traffic.

TSS vs Conventional Intersection

Capacity of TSS is larger than that of non-TSS.

\[
\text{Capacity} = \min \left\{ \frac{G}{n_T + n_R} \cdot \left( \frac{1}{r_T} + \frac{1}{r_R} \right) \right\}
\]

\( r_T, n_T, n_R, r_R \): right-turn %
\( n_T, n_R \): Number of lanes upstream of pre-signal (Through and Right-turn)

Case Study of TSS in Manila

T-intersection in Manila, Philippines

Capacity Improvement Strategy by applying TSS

[Stage 1] TSS is applied to Approach

2 tandem lanes only due to limited exit lanes
Added Green arrow signals install Pre-signals that can turn off when flows are low

Results of Capacity Improvement

Results of Strategy 1
Pareto Improvement: Phases not served by TSS can also benefit.
Capacity of Non-TSS lanes can be increased by ~20%

Results of Strategy 2
Cycle length can be decreased to 140 seconds (75 seconds difference) and benefits are still achieved.

Challenges

TSS Capacity may be affected by:
• Storage length
• Overall link length
• Discharge failure

Failure to discharge leads to lane blockage!
Blocked vehicles are delayed by 1 cycle.
Approach Capacity reduced by half.