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Incorporating Pedestrian Level of Service into Traffic Analysis for Improved Decision-Making

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Presentation outline

- **Issues with incorporating pedestrians in traffic analysis**
- **Pedestrian behaviour**
- **Techniques for evaluating pedestrian LOS**
  - Highway Capacity Manual (HCM 2010)
  - New York City Method (based on HCM)
  - Dynamic methods
- **Case studies**
- **Conclusion**

INTRODUCTION

Issues with incorporating pedestrians in traffic analysis

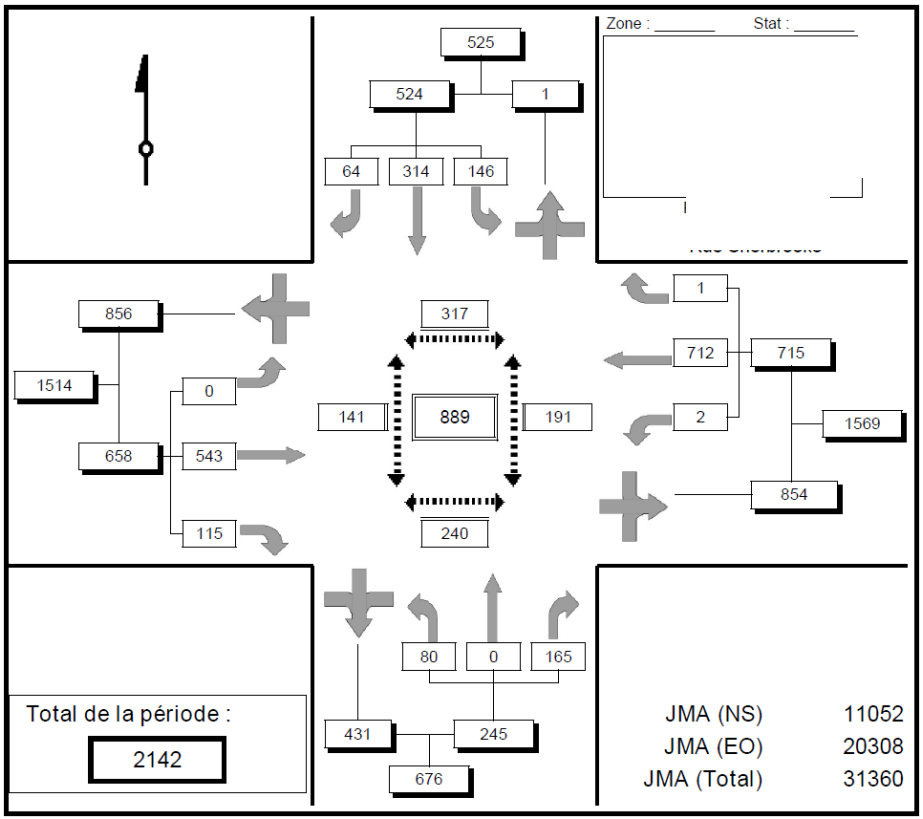
Introduction : Issues with incorporating pedestrians in traffic analysis

- **Pedestrians are generally not well integrated in typical traffic analysis**
- **General methodologies exist to incorporate pedestrians for a LOS analysis (static and dynamic)**
- **Some methodologies are used in specific contexts where there is high pedestrian demand (public transit stations, airports, etc.). Often, this is not even done at high demand intersections.**
- **Apart from these specific contexts, when incorporated in traffic analysis, pedestrians are mainly used as an impedance to cars**

Introduction : Issues with incorporating pedestrians in traffic analysis

→ **Pedestrian data collection techniques:**

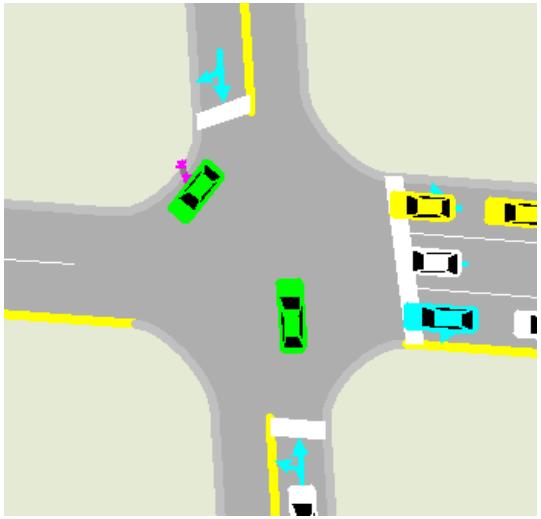
- Data collection techniques are often not adapted for pedestrians (number of pedestrians use a crosswalk, instead of knowing their direction, their destination, etc.)
- Typical counting apparatus does not have buttons for the direction of pedestrians in a typical traffic count
- New video counting technologies could allow for improved count methods at intersections (pedestrians not entering intersection, itinerary of pedestrians, etc.)

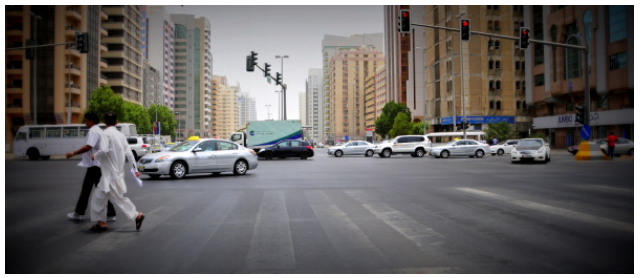


Introduction : Issues with incorporating pedestrians in traffic analysis

→ **Traffic microsimulation techniques**

- Representation of the number of pedestrians (bunching)
- Representation of pedestrian behaviour in models. Models are not adapted for high pedestrian demand
- Pedestrian movement representation through an intersection
- Typical microsimulation software does not give information on pedestrian delays





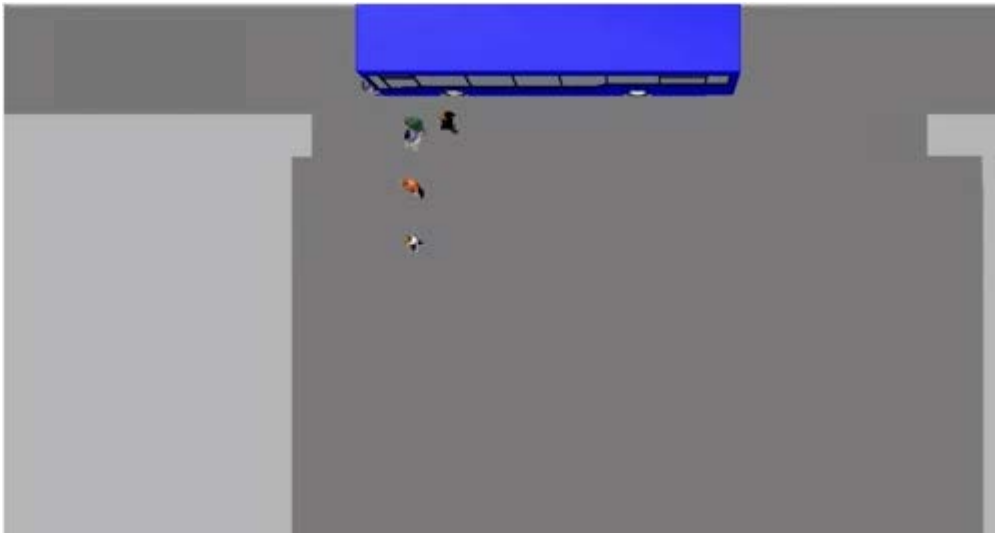
Introduction : Issues with incorporating pedestrians in traffic analysis

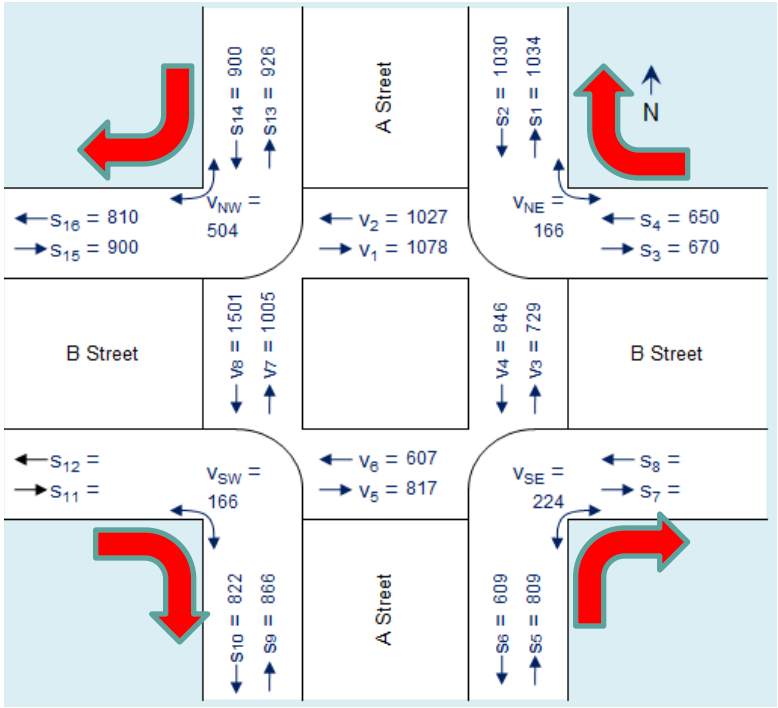
→ **More generally, no analysis is made for:**

- Trips that don't cross an intersection
- Trips that cross multiple intersections

(looking at the itineraries of pedestrians)

- Multimodal trips (bus to walk, etc.)





Introduction : Issues with incorporating pedestrians in traffic analysis

→ **Most agencies and cities do not require an evaluation. If it is required, often standard methodologies are not used. Many do require proper pedestrian clearance times.**

Why consider pedestrian conditions?

- **Every trip starts and ends by foot**
- **Some modes are dependent on walking (transit, biking, on-street parking, etc.)**
- **Improved safety for all modes of travel**
- **Some users do not have alternatives**
- **“If you cannot measure it, you cannot improve it.”**

Pedestrian Behaviour

- **Do not abide by as many specific rules when compared to vehicles**
- **Vast range of characteristics which are not the same for all pedestrians based on individual characteristics, type of area and social preferences (walking speeds, reactiveness, compliance, etc.)**

STATE OF THE PRACTICE

State of the practice

- **Many analysis techniques exist and have been refined**
- **Incorporate the notion of the quality of pedestrian infrastructure, the quality of pedestrian crossings and delays**

Good Level of Service

Deficient Level of Service

State of the practice

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State of the practice

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Good Level of Service

Deficient Level of Service

State of the Practice : HCM 2010 and NCHRP 616 pedestrian LOS

- **Revised from HCM2000**
- **Average space per pedestrian : circulation area (other measures for stairwells, platforms, etc.)**
- **Average pedestrian speed**
- **Inclusion of external variables to the pedestrian :**
  - Number of car lanes
  - Traffic flows
  - Speed of vehicles
  - Buffer space between vehicles (bikes, cars, etc.) and pedestrians
  - Geometric considerations
- **HCM 2010 Analysis is included in Synchro 8**

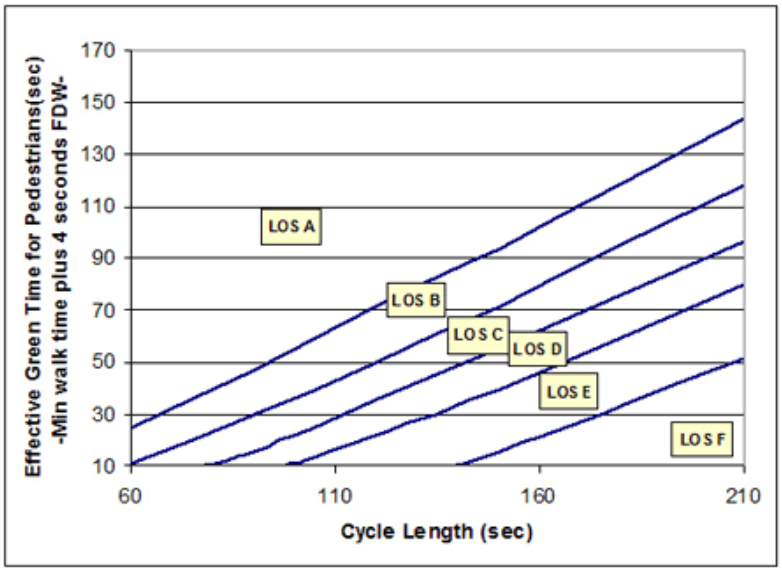
State of the Practice : NYC City pedestrian LOS

- **NYC is unique in North-America in terms of transportation modes and in particular pedestrian trips**
- **HCM methodology can be adapted for the NYC context to improve LOS analysis**
  - Pedestrian impedance as predictor of LOS
  - Delay as a method of evaluating LOS
  - « Shy distance » evaluation using video data collection
- **NYC DP wants to include more variables in pedestrian LOS analysis in Phase II of this project**

State of the Practice : Level of service based on delays

- **Pedestrian Level of Service based on average delays (FHWA, 2004)**
- **Shorter delays increase the likelihood of traffic signal compliance, although other factors have an incidence**
- **Very sensitive to cycle length, type of pedestrian priority, pedestrian detection and pedestrian green engagement time (usually shorter on longer cycle lengths)**

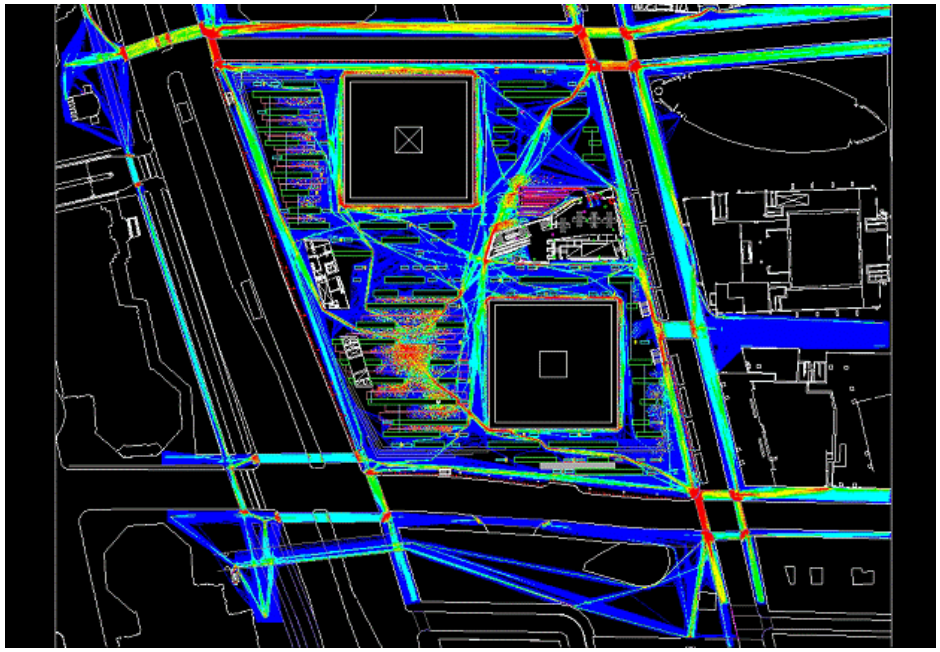
LOS	Pedestrian Delay (sec/ped)	Likelihood of Noncompliance
A	< 10	Low
B	≥ 10-20	
C	> 20-30	Moderate
D	> 30-40	
E	> 40-60	High
F	> 60	Very High



Source: FHWA, 2004

State of the Practice : Microsimulation techniques

- **Pedestrian capacity and microsimulation methods used for high demand areas (transit stations, airports, stadiums, etc.)**
- **Some software packages incorporate pedestrians and traffic (SimWalk)**



CASE STUDIES

Case Study 1: Pedestrian phasing

- **Urban intersection with exclusive pedestrian phase and two successive phases for vehicles with a short cycle length (70 seconds). Pedestrian crossing is not allowed during vehicular phases, but very low compliance.**
- **Level of service developed using the delay approach**
- **Even though pedestrians were given an exclusive phase, they had much higher delays than vehicles and bicycles**
- **The elimination of the pedestrian phase can reduce delays by reducing the cycle length to 50 seconds**

Case Study 1: Pedestrian phasing

- **The elimination of the pedestrian phase can reduce delays by reducing the cycle length to 50 seconds.**
- **Delay for vehicles was also reduced**

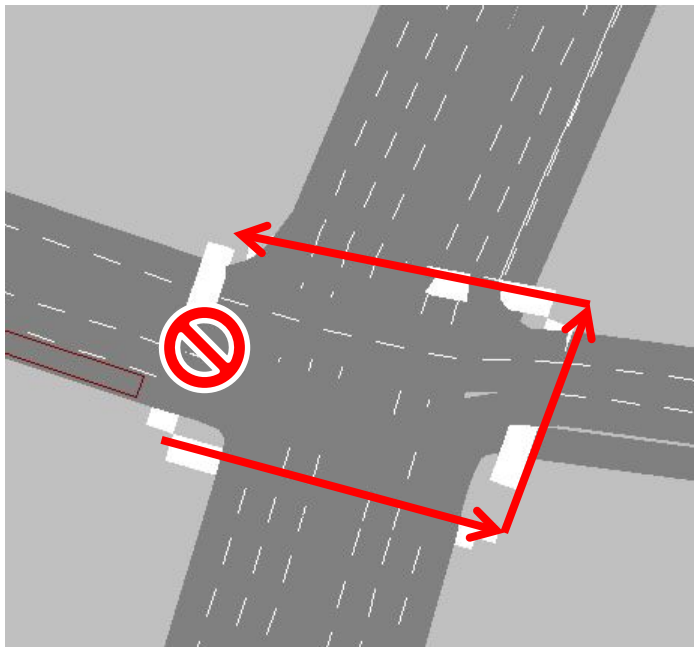
Intersection Level of Service by Mode

	Vehicles	Bicycles	Pedestrians
Existing	B	B	C (27 s.)
Without exclusive pedestrian phase	B	B	B (16 s.)

Existing Traffic Signal Phasing

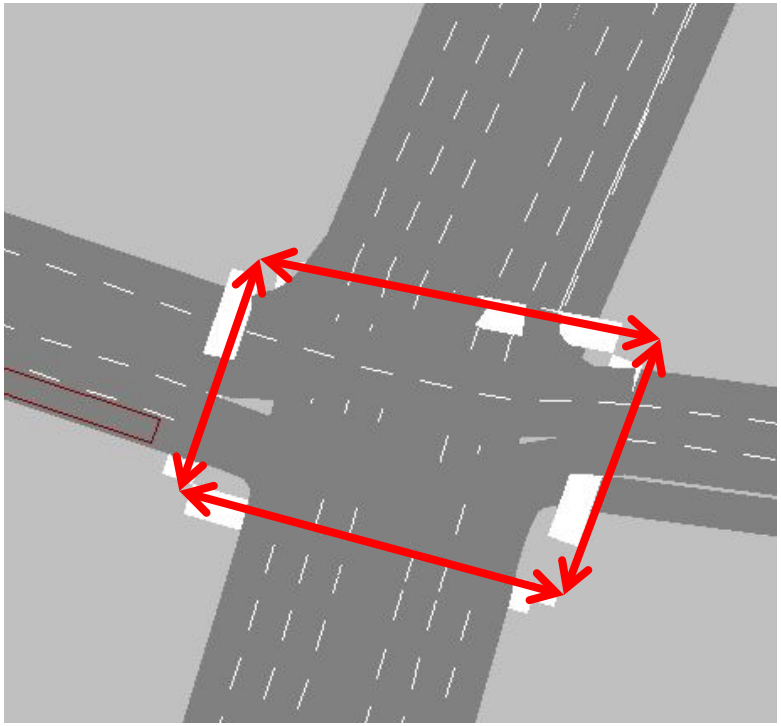
Case Study 2: Management of pedestrian crossings

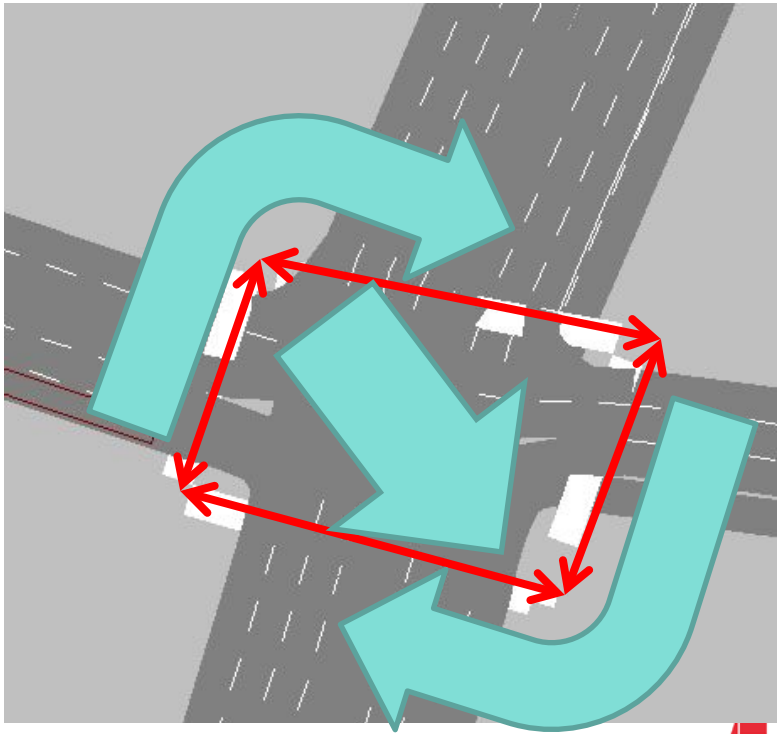
- **Crossings are often considered “separately”, without considering “trips” combining two or more crossings within an intersection**
- **In the case of high left-turn volumes, often the pedestrian crossing is eliminated. That said, pedestrians must use three crossings instead of one and need to wait between 1.5 to 2 cycles to cross to the other side (150 to 200 seconds with a 100 second cycle). Leads to high risk of non-compliance.**



Case Study 2: problems with movements : Combined pedestrian crossings

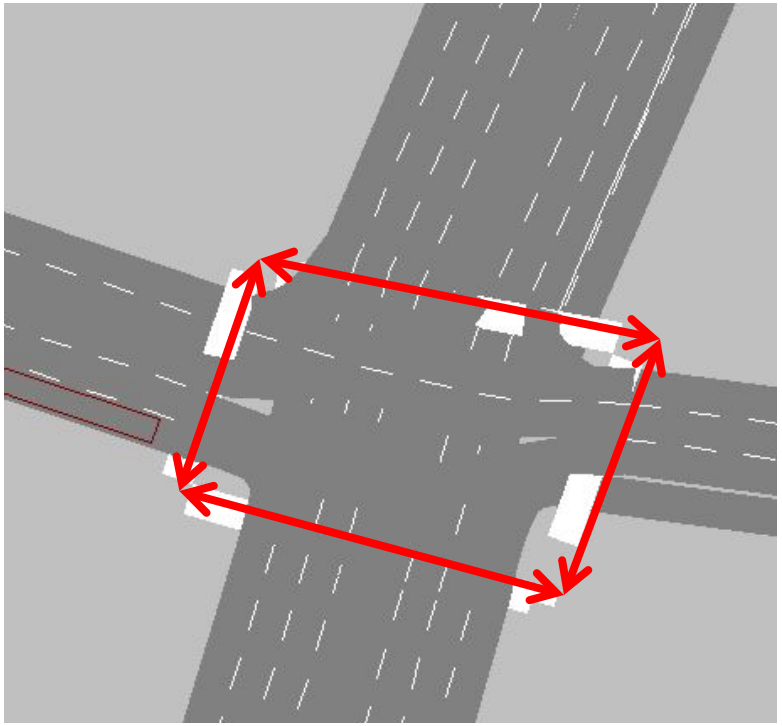
Bus stops and pedestrians as traffic « obstacles »	Bus stops and pedestrians are studied in traffic study
Pedestrian travel in straight lines	Pedestrian travel in a combination of lines (or …)

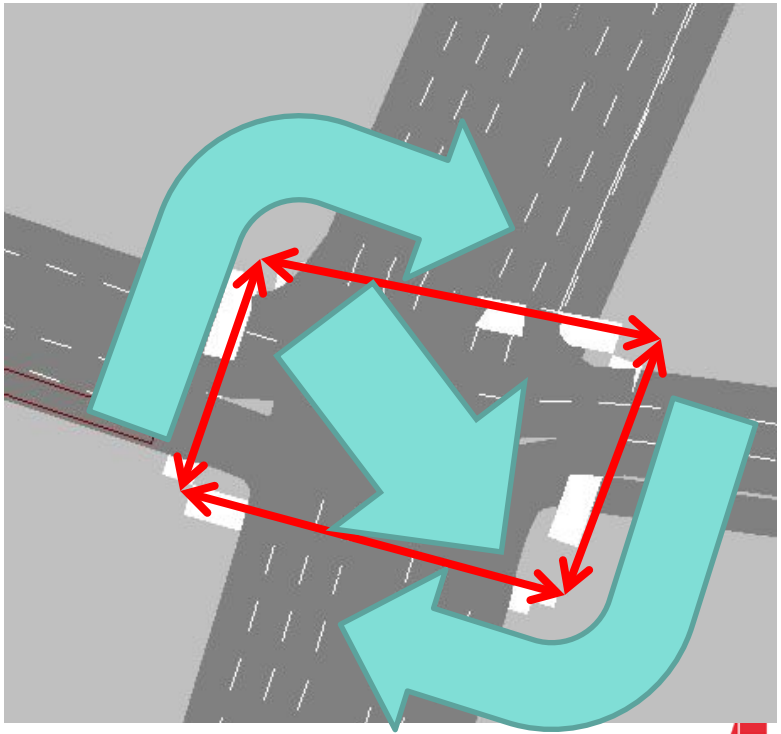




Case Study 2: problems with movements : Combined pedestrian crossings

Bus stops and pedestrians as traffic « obstacles »	Bus stops and pedestrians are studied in traffic study
Intersection LOS : C	Intersection LOS : D



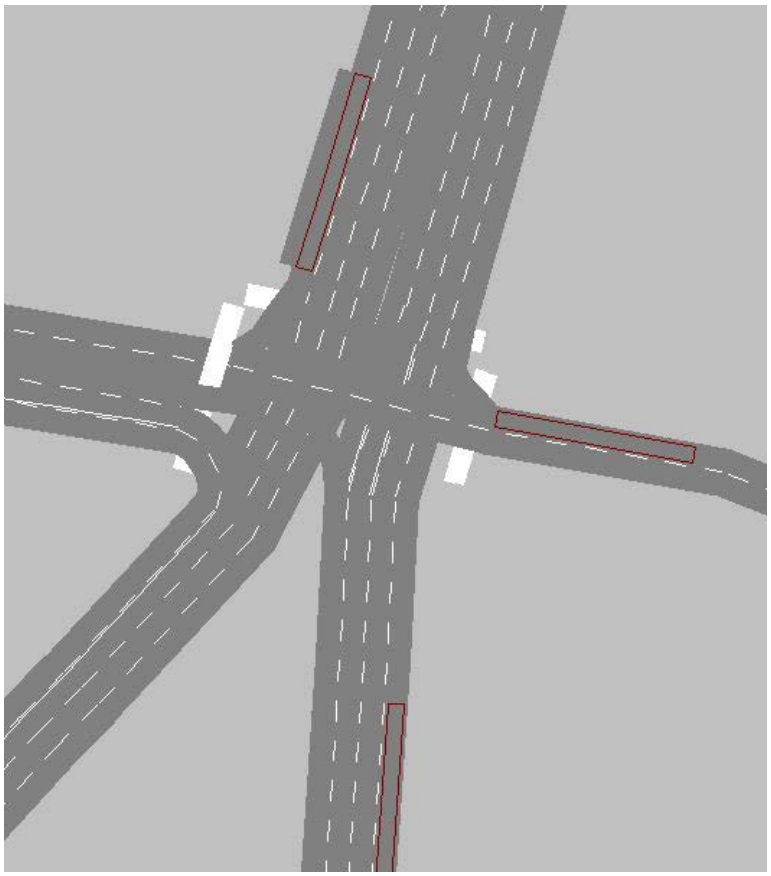


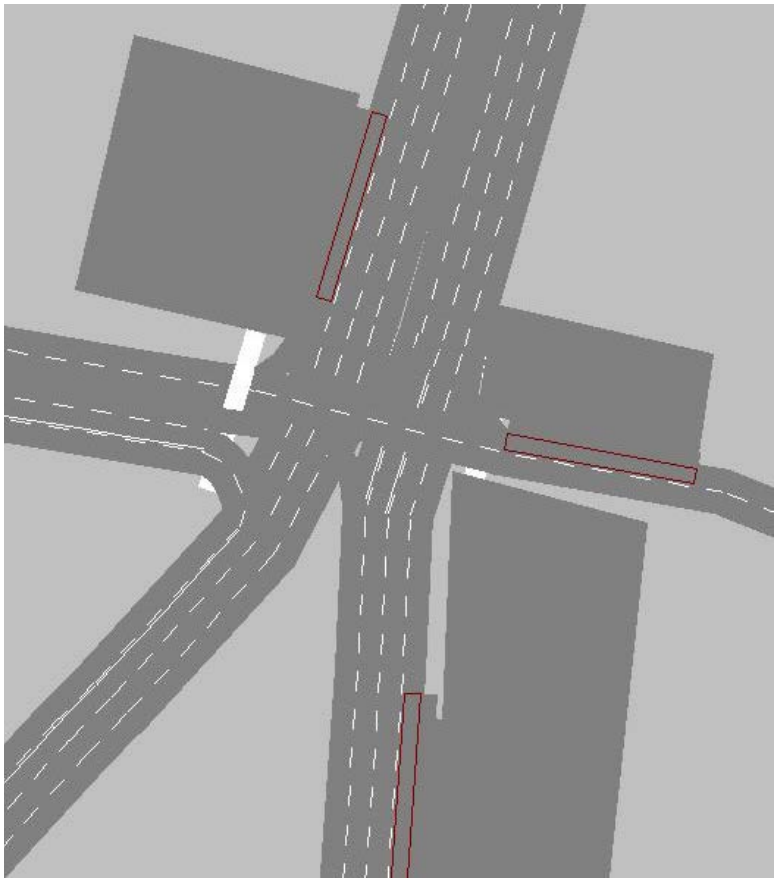
Case Study 3: bus stops

- **Bus stops are often not considered as pedestrian generators in an intersection**
- **Pedestrians are counted at the intersection with no knowledge of their origin or their arrival distribution**

Case Study 3: bus stops

Bus stops and pedestrians as traffic « obstacles »	Bus stops and pedestrians are included in traffic study
Pedestrian crossings are separated from the bus stop; bus riders are not linked with pedestrians on the street	Pedestrian crossings are linked to the bus plateforms edges; bus riders are linked with pedestrians on the street





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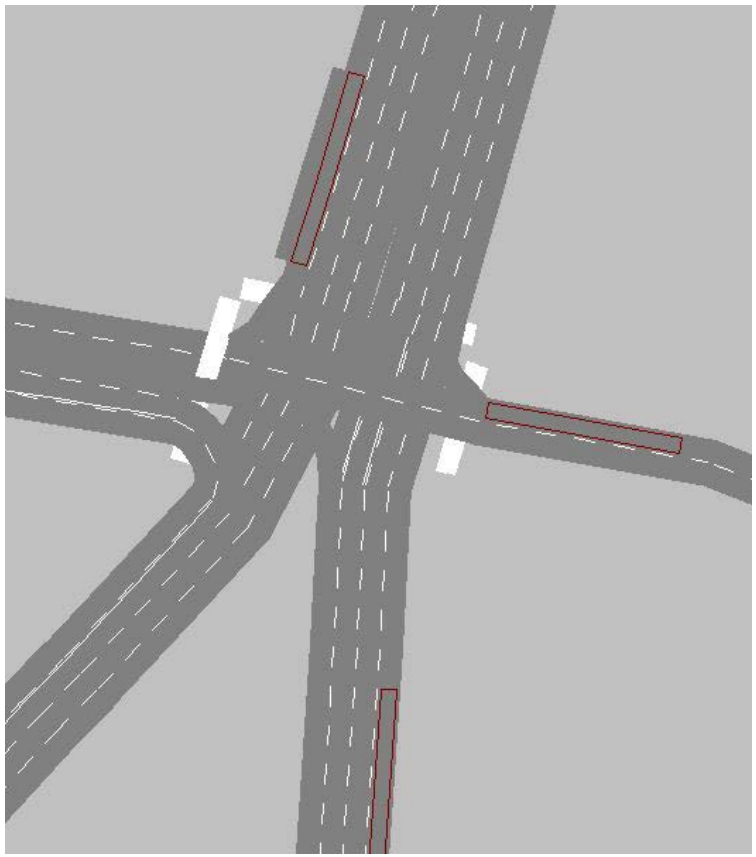

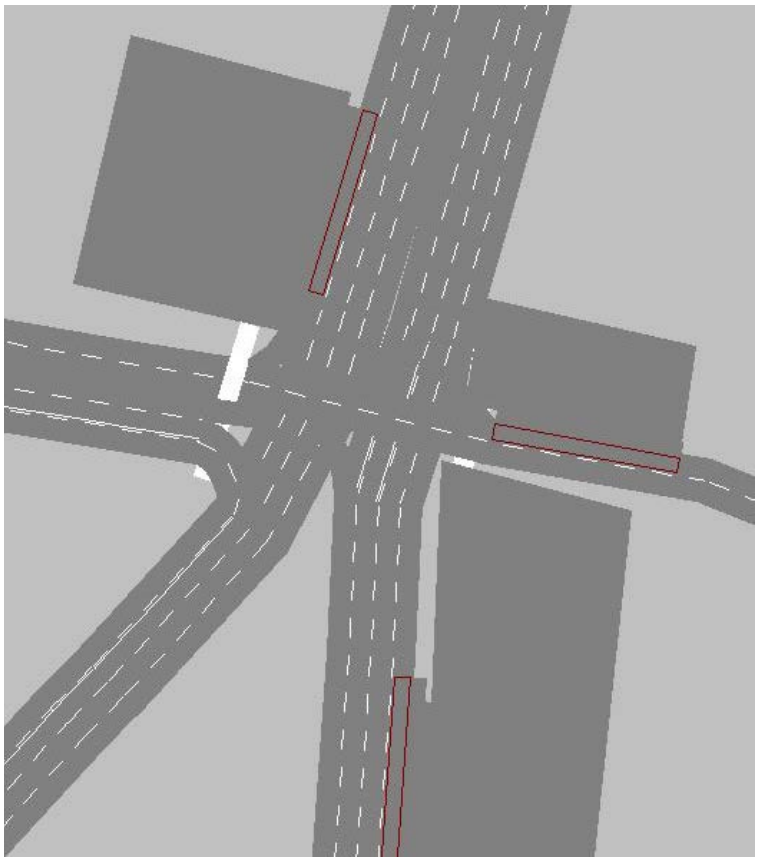

CONCLUSION

Conclusion

- **Essential to incorporate pedestrians into decision-making and the development of solutions**
- **Requires changes to data collection and use new analysis techniques. Agencies and cities have a crucial role to play to require evaluations of pedestrian levels of service (“If you cannot measure it, you cannot improve it.”)**
- **Could lead to improved solutions and safer travel for all modes of travel**
- **Pedestrian levels of service should be presented separately from vehicular levels of service instead of an average-weighted score, but still need to balance decision based on other considerations**
- **Best level of services are more easily attainable if land use and the connectivity of the street grid allows that improves traffic distribution (narrower streets = shorter crossings with fewer conflicting vehicles)**

References

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Questions?

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