DUTCH CYCLING EMBASSY

Inclusive Street design

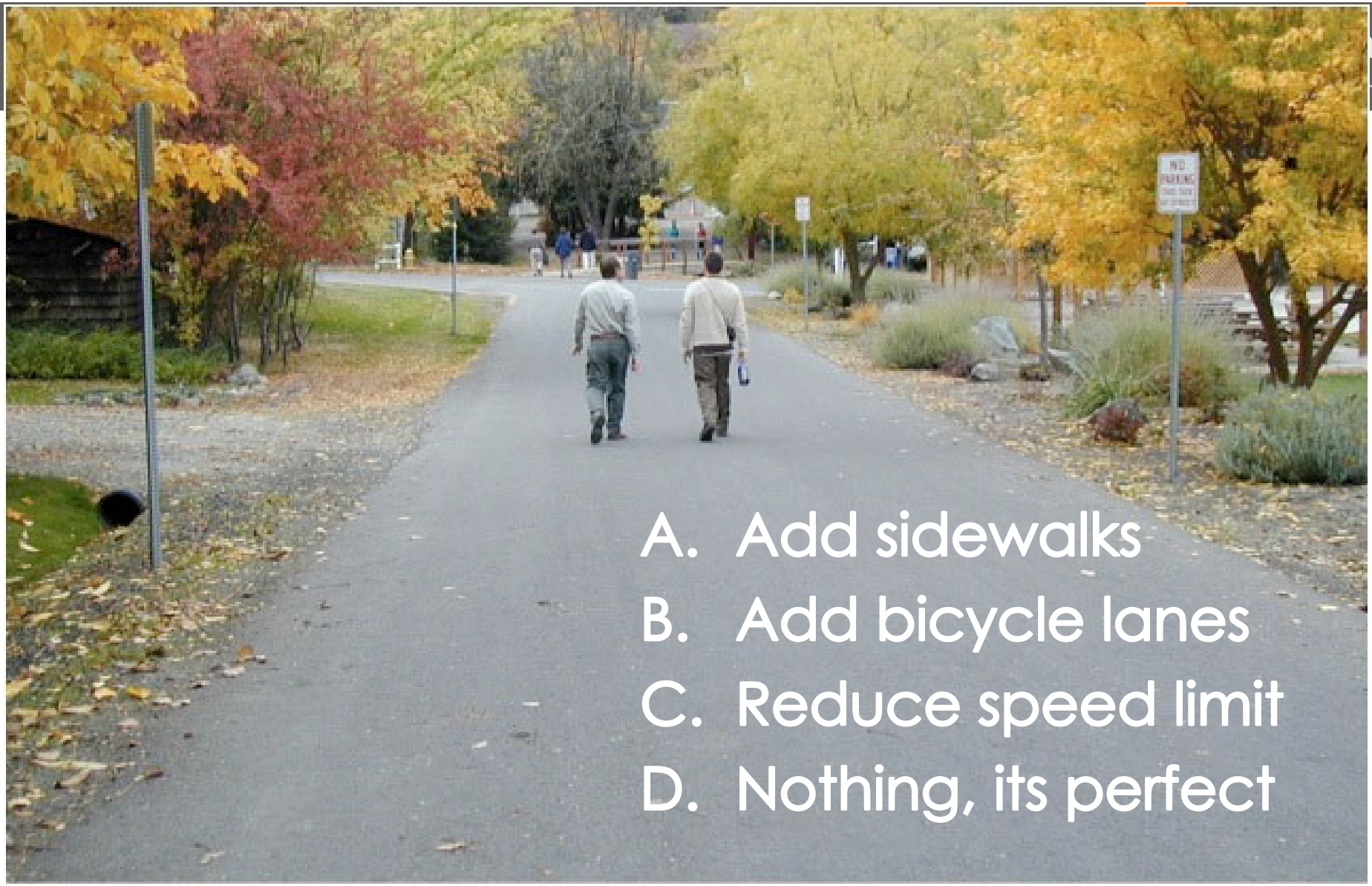
ThinkBike Workshop West Palm Beach, Florida

Dick van Veen

January 14, 2026

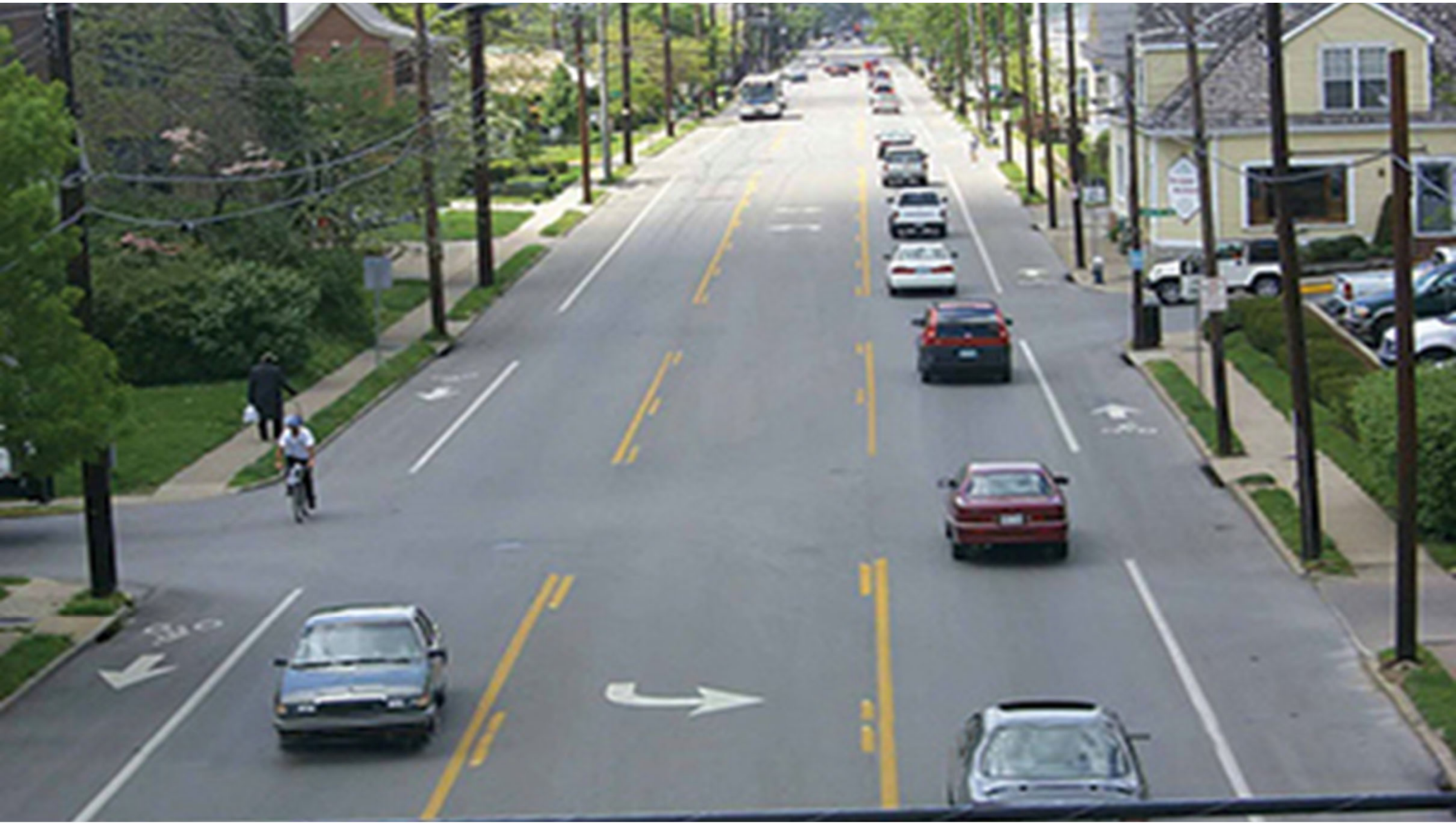

A. Ban on street parking
B. Add bicycle lanes
C. Narrow the road
D. Nothing, its perfect

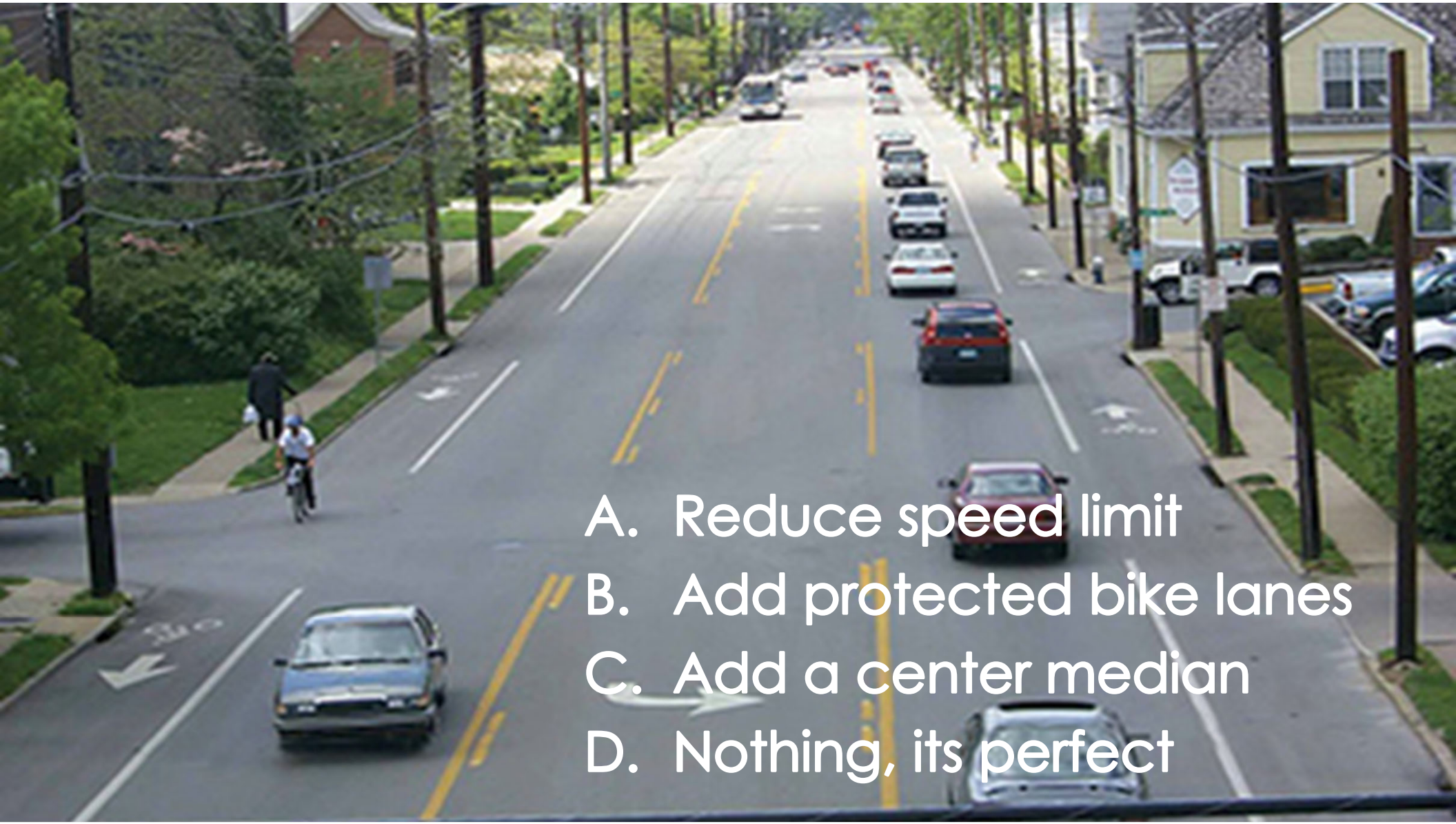

NO


A. Add sidewalks
B. Add bicycle lanes
C. Reduce speed limit
D. Nothing, its perfect


SCHOOL


SCHOOL
A. Narrow road
B. Add bicycle lanes
C. Reduce speed limit
D. Nothing, its perfect




A. Reduce speed limit
B. Add protected bike lanes
C. Add a center median
D. Nothing, its perfect

Coherent Network Design

Connected networks for all modes in West Palm Beach.

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STREET DESIGN PUBLIC SPACE

Road classification

Highway

Urban highway

Network level separation

Arterial/connector road

Arterial/connector road

Separated bike track

Rural road

Local street

Mixed traffic

Road classification in build up areas

Highway

Urban highway

Network level separation

Arterial/connector road

Arterial/connector road

Separated bike track

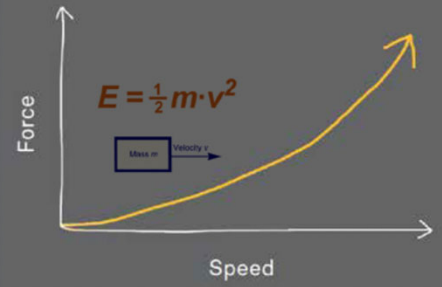
Rural road

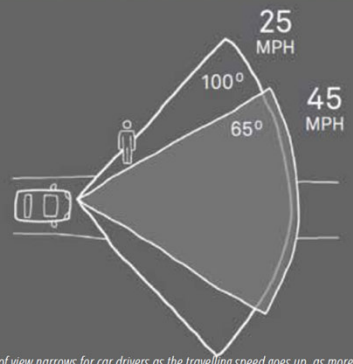
Local street

Mixed traffic

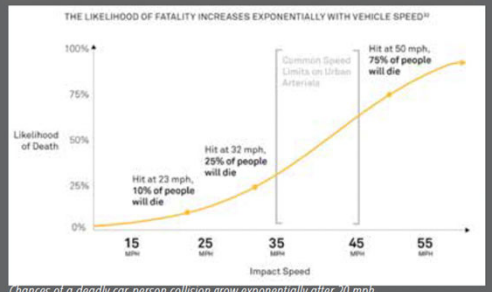
Design for vulnerable road users first

A human body is highly vulnerable when interacting with vehicles traveling at higher speeds.

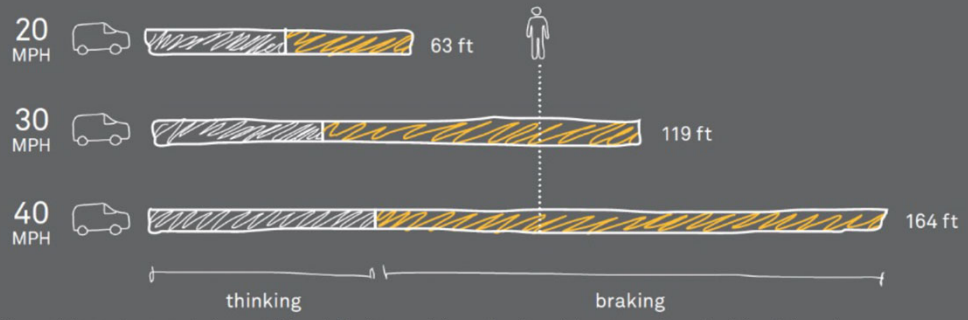




The field of view narrows for car drivers as the travelling speed goes up, as more attention is needed to look at traffic situations that are approaching at a faster pace.



Chances of a deadly car-person collision grow exponentially after 20 mph.



The same thinking time (reaction time) and exponentially longer braking distances at higher speeds result in much longer stopping distances for vehicles at higher speeds.

Source: NACTO, "How Speed Kills", https://nacto.org/publication/city-limits/the-need/how-speed-kills/

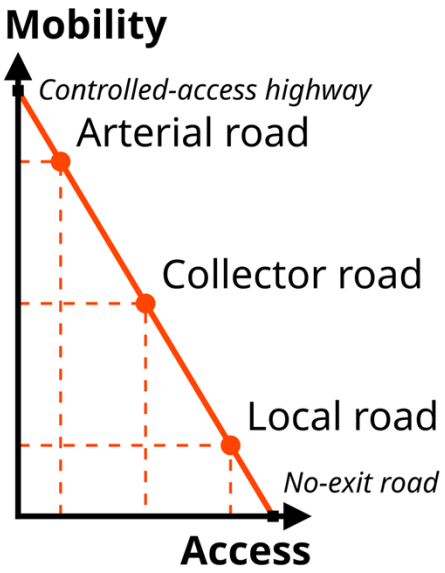
PHYSICS AS DESIGN PRINCIPLE

Basic Principles of Traffic Safety

The following core principles guide the design of a safe and efficient traffic system:

- Minimize Differences in Mass and Speed – Large differences in vehicle mass and speed increase crash risk and severity. Road users with significant variations in these factors should be separated where possible.
- Separate Modes with Large Mass or Speed Differences – Motor vehicles, bicycles, and pedestrians should each have dedicated spaces where feasible to reduce exposure to risk.
- Minimize the Number of Conflict Points – The design should reduce areas where different traffic movements intersect or overlap.
- Separate Modes at Conflict Points in Time or Space – When physical separation is not possible, traffic flow should be managed through signal timing or other measures to prevent simultaneous conflicts between modes.

Systematic Safety Approach (US)

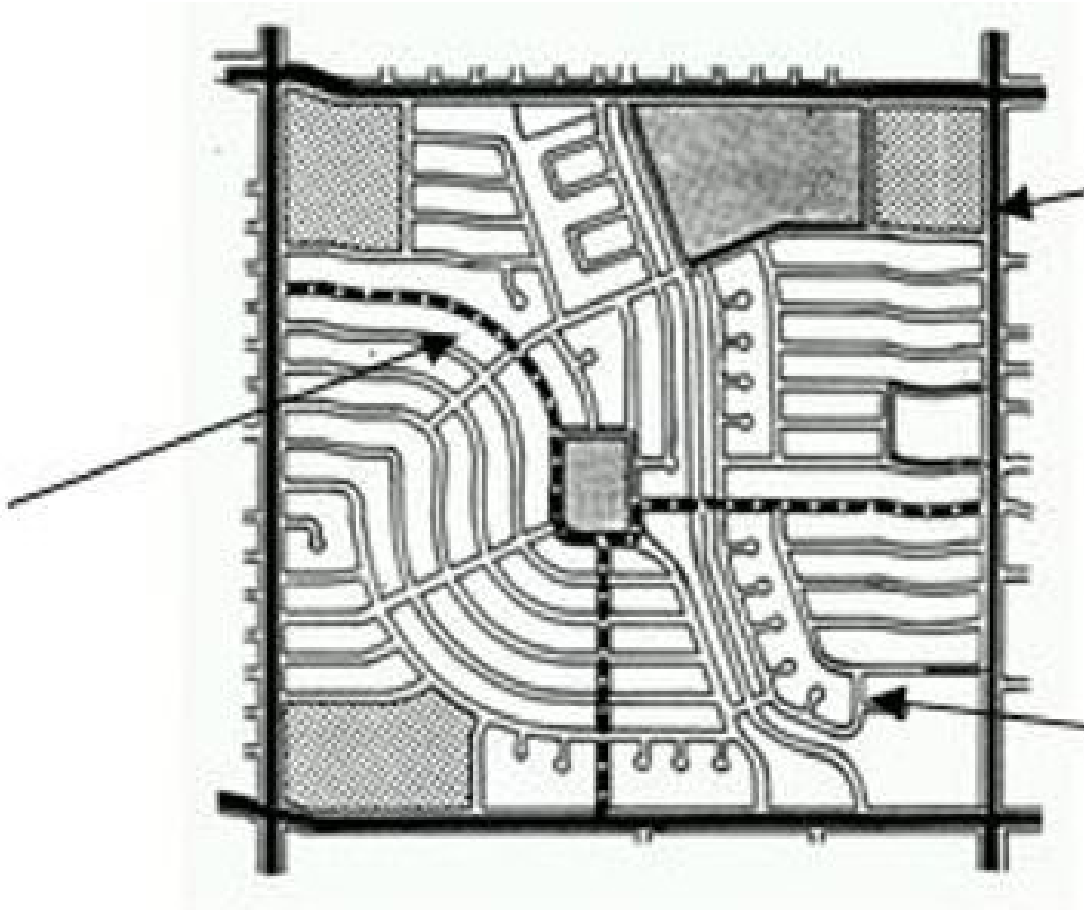


Arterial

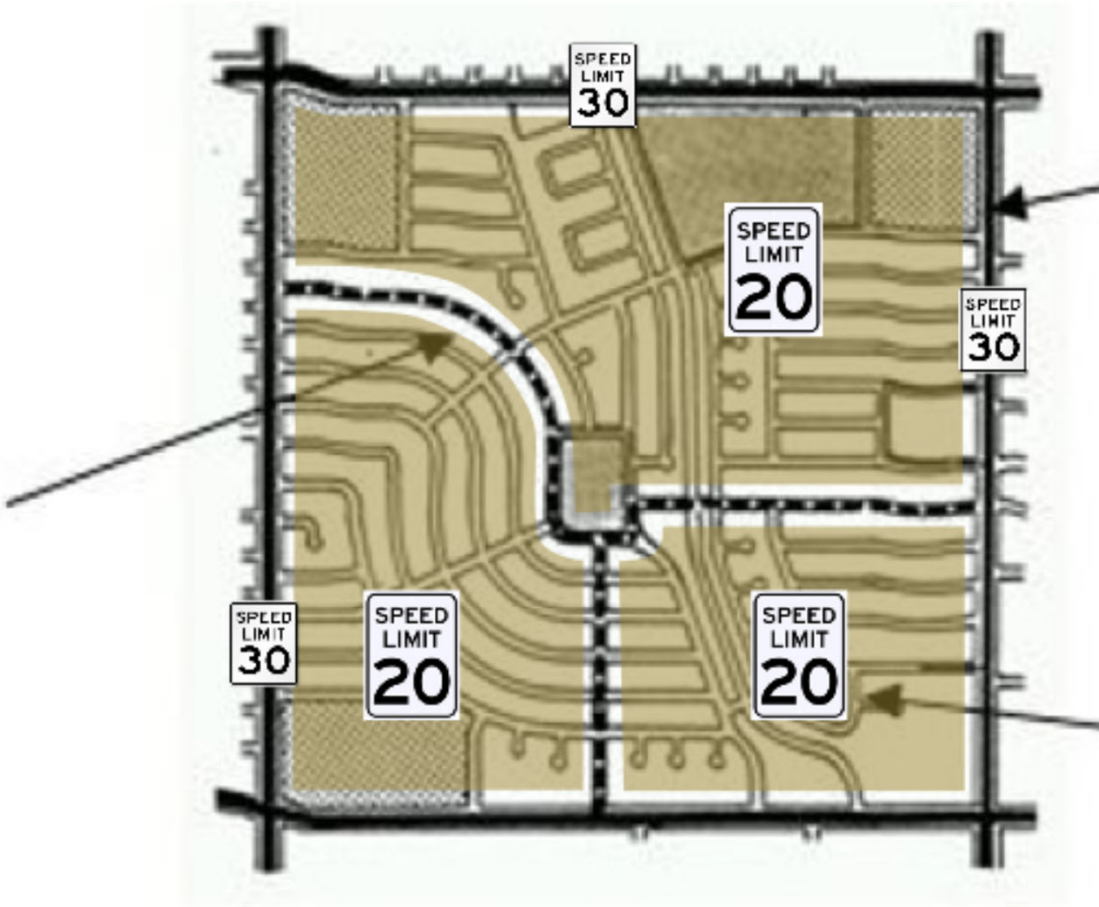
Collector

Local

Road categorization



Road categorization; a touch of Dutchness



Safe Street Design

Integrating new design principles in West Palm Beach.

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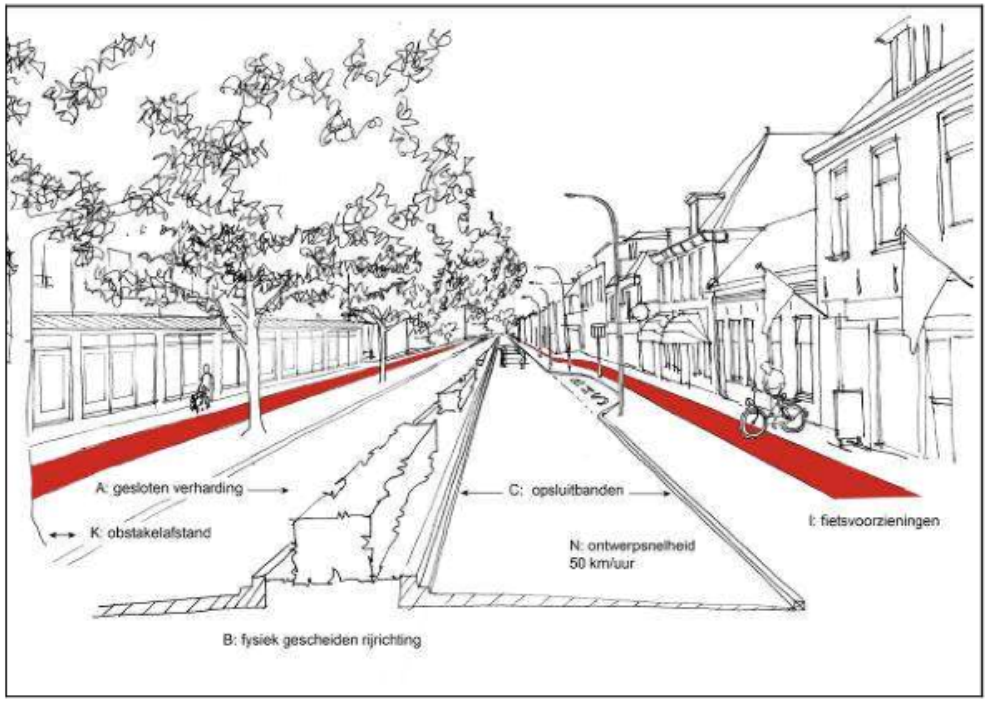
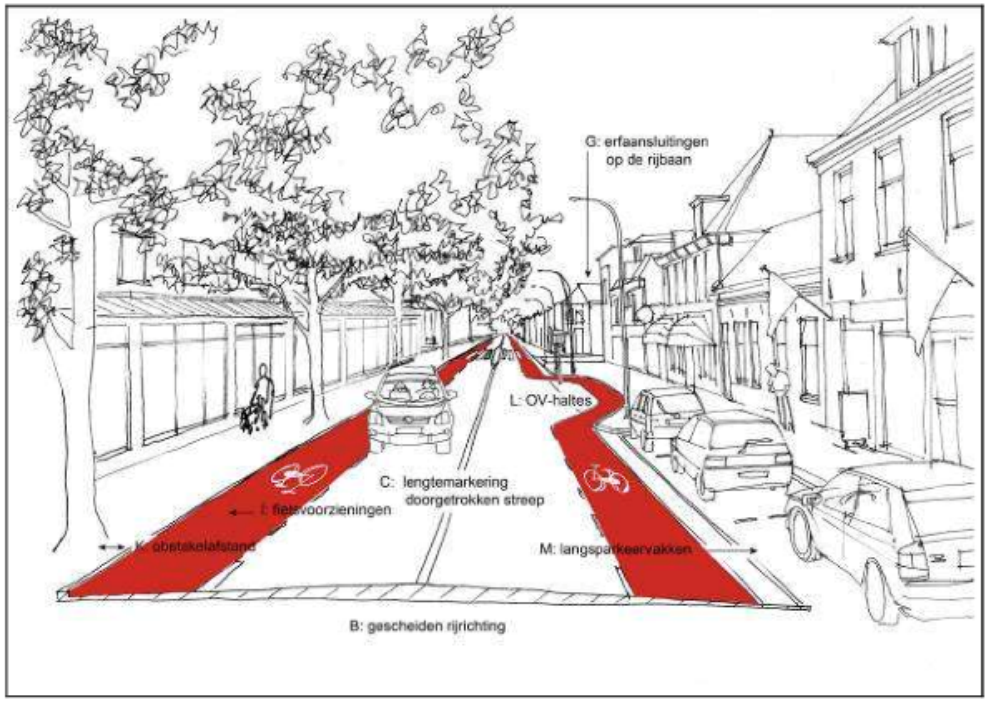
STREET DESIGN PUBLIC SPACE

Design features Arterials: separation

30 mph roads: Arterial road, flow function



Ideal form of arterial road



Minimal form of arterial

Essential elements for arterial roads

Mix when you can, **separate when you must**.

- Continuous car travel flow: Guarantee continuous travel speeds along the corridor
  continuous, smooth asphalt, lineair, recognizable (uniform), absence *of exchanges (parking, side streets), absence of houses/developments.*
- Focus on through traffic: Create a corridor which functions to transport traffic conveniently, so that traffic won't 'rat run'.
- Separated infrastructure per mode Higher speeds make mixing impossible; physical separation between cars (directional), bicycle users and pedestrian.
- Hierarchy at intersections: Intersections are prioritized, often signalized or roundabouts. Side streets 'feel' of lower order.

Continuous travel flow

Focus on through traffic

Focus on through traffic

Separation where needed

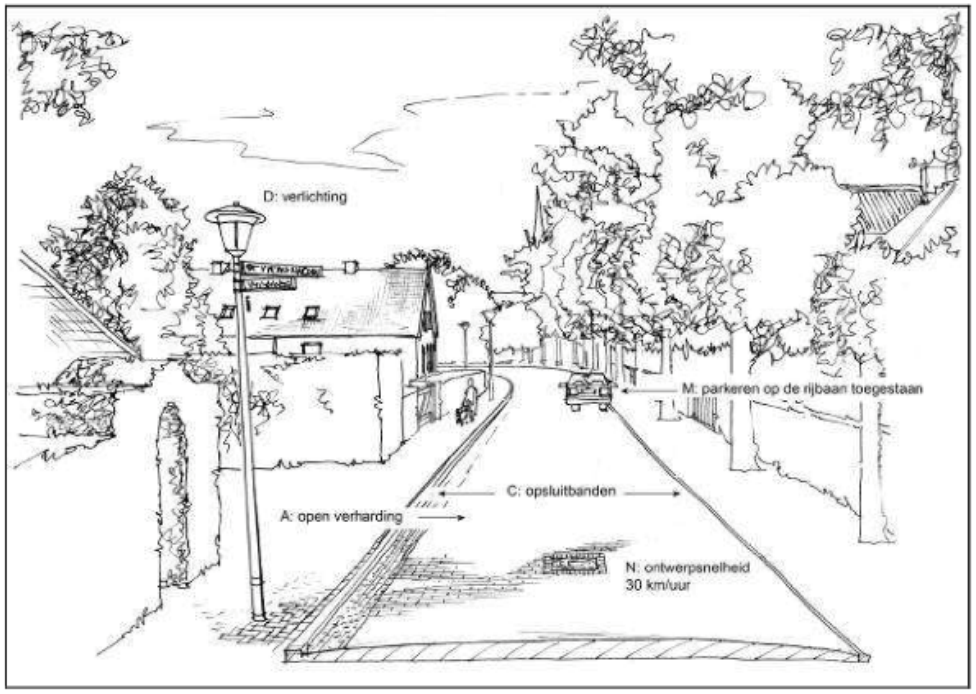
Separation where needed

Separation where needed

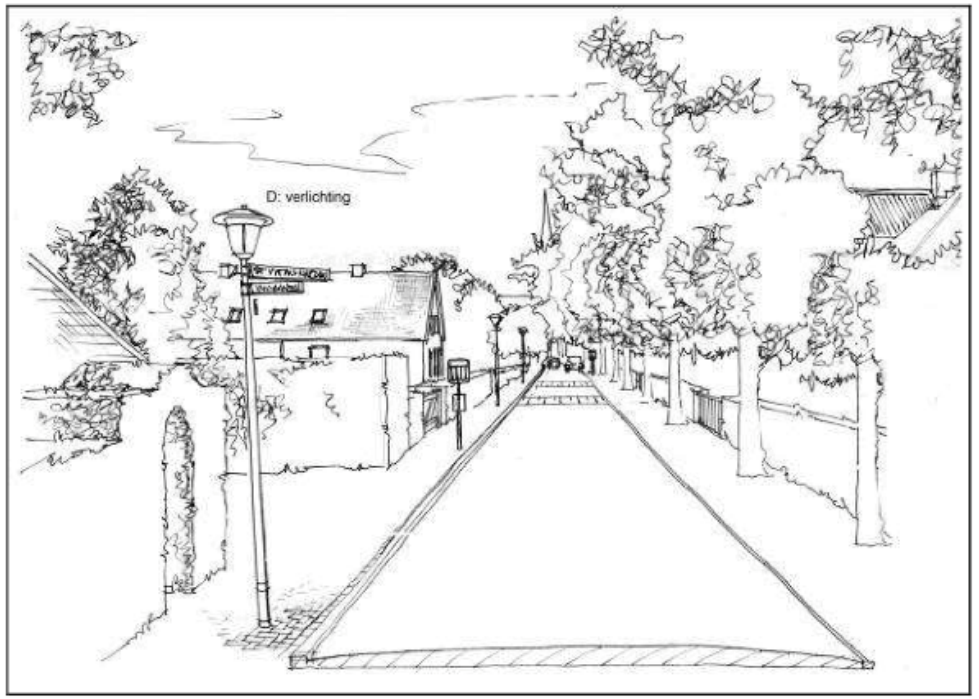
Hierarchy at intersections

Design features Locals: mix and mingle

20 mph roads: Local streets, access function



Ideal form of local street



Minimal form of local street

Essential elements for local streets

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Mix when you can, separate when you must.

- Traffic calming: Guarantee low travel speeds within the zone
  narrow, non-asphalt, different coloring, disalignments, uncommon, *subjective insecurity*
- Prevent through traffic: Create a network which accommodates local traffic but is unattractive for through traffic.
- Intuitive Gateways: Create a logical transferpoint between to road of different categories
- Interaction at intersections: Emphasize equality between roads of the same order
- Differentiation and non-uniform Different textures of surface materials, subtle suggestions, like trees, benches, angled parking, etc

Traffic calming: nice and tight

Traffic calming: even narrower

Traffic calming: Home Zones

Traffic calming: Place aspects

Traffic calming: bumps

Traffic calming: bumps

Traffic calming: pinchers

Preventing through traffic

Gateways: visible hierarchy

Gateways: visible hierarchy

Equality at intersections

Equality at intersections

Equality at intersections

Forgiving bicycle infrastructure

Rumble and/or recovery strip

(tactile difference)

Everyone makes mistakes. Outcomes should not be severe; mistakes should be forgiven.

Forgiving bicycle infrastructure

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Smooth bike path surface

Tapered/roll-over curb

Everyone makes mistakes. Outcomes should not be severe; mistakes should be forgiven.

Forgiving bicycle infrastructure

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Removal of bollards
Or 'announcing' them

Clear road markings

Rumble and/or recovery strip

Everyone makes mistakes. Outcomes should not be severe; mistakes should be forgiven.

Separated bike infrastructure, traffic calming

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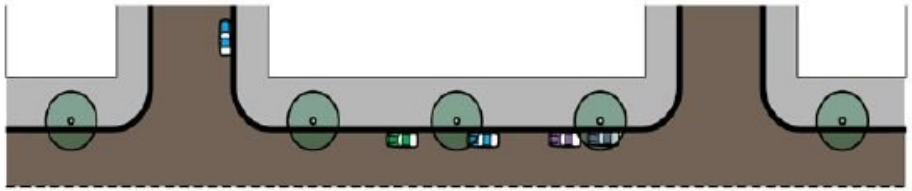
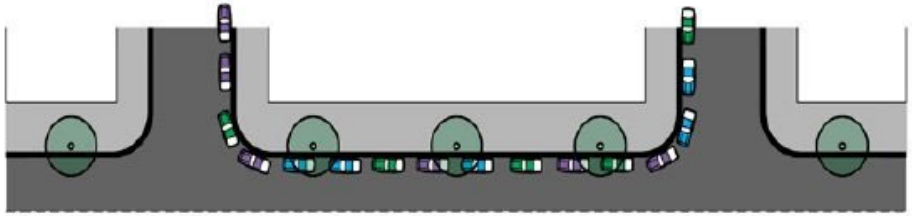
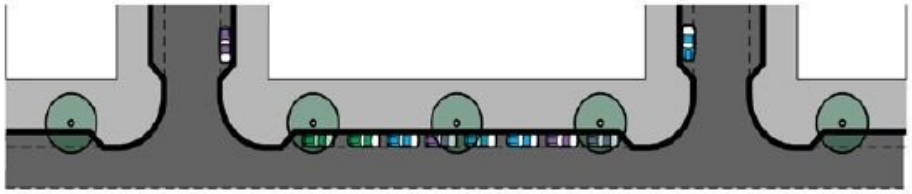


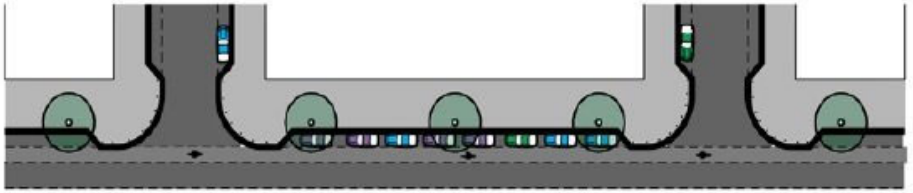
1950: De straat heeft een eenvoudige opbouw met rijbanen, weinig auto's en trottoirs. Het materiaal is overwegend baksteen, soms nog granieten keien.



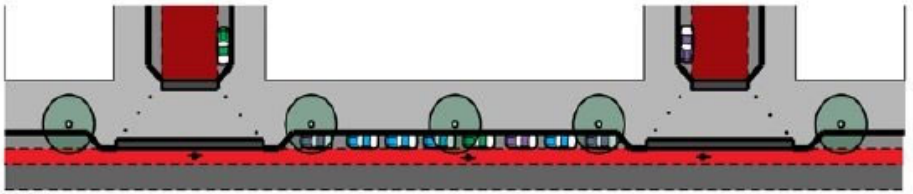
1965: De druk van het autoverkeer neemt toe, er zijn steeds meer parkeerplaatsen nodig. De straat wordt geasfalteerd.



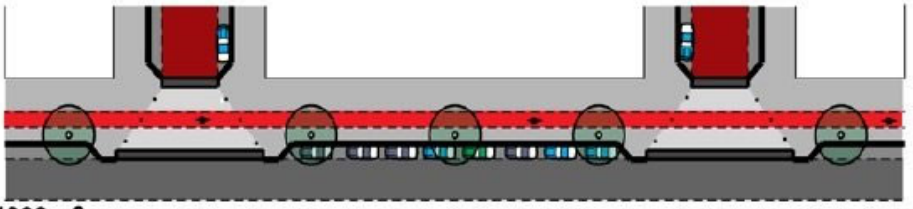
1975: De straat krijgt 'koppen' om parkeren op de hoeken van de staat tegen te gaan. De trottoirbandenlijn begint te verspringen en is niet meer continu.



1985: Het toenemende fietsverkeer krijgt eigen fietsstroken ter verbetering van de veiligheid.



1995: De 30 km/u buurtstraten krijgen een verharding van rode betonstraatsteen, soms baksteenverharding, de drukke 50km uur straten blijven van asfalt. Er komen verhoogde trottoirs die voetgangers voorrang geven t.o.v. afslaand verkeer. De fietsstrook krijgt een eigen kleur door toepassing van rood asfalt.

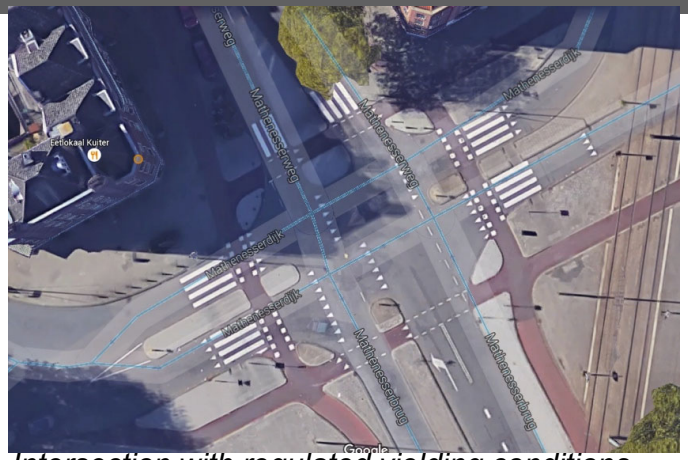


1998 - ?: Ter verdere verbetering van de verkeersveiligheid worden de fietsstroken vervangen door vrijliggende fietspaden op het trottoir.

Intersections:

the weakest link

Intersections: the weakest link – 20 mph



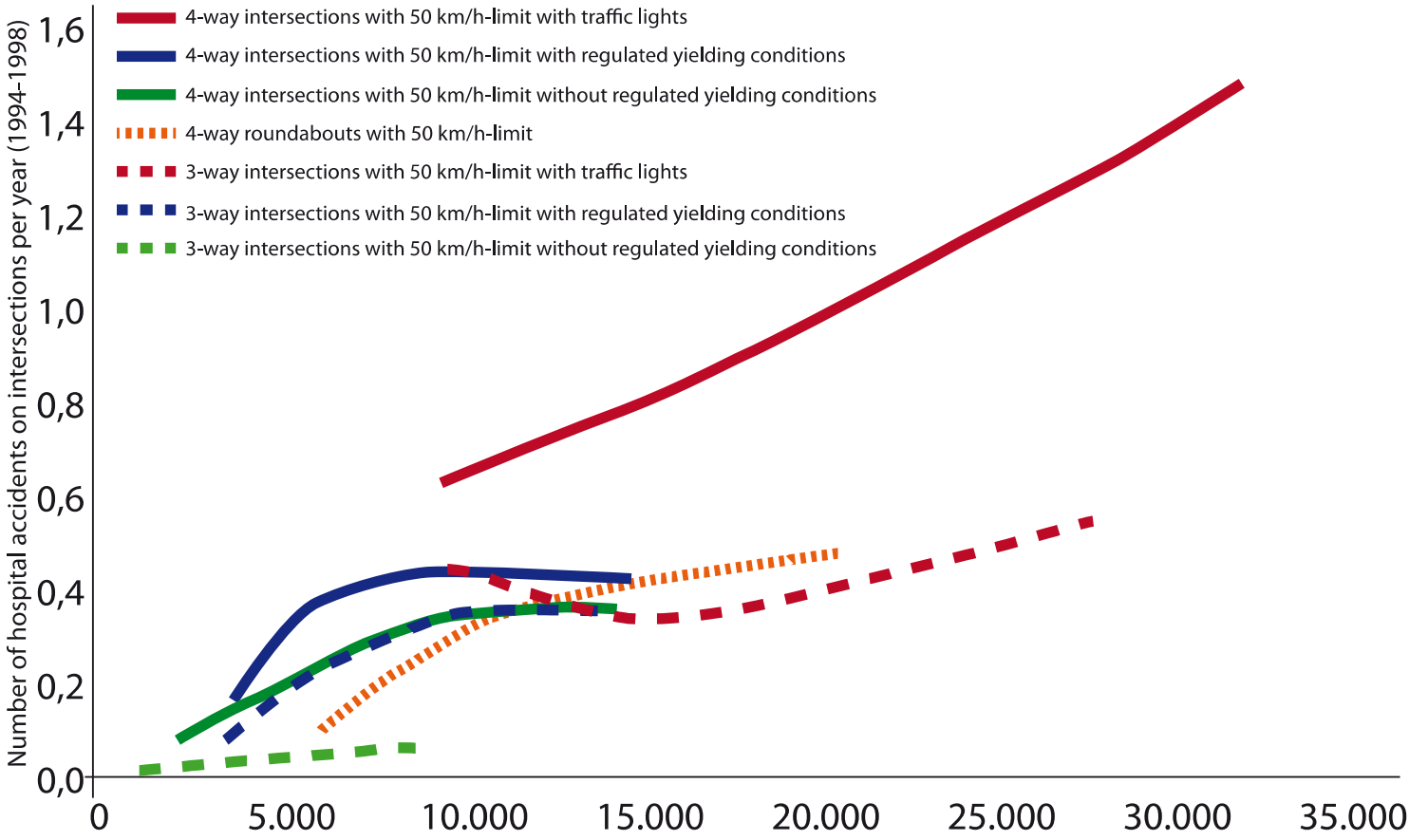
Intersection with regulated yielding conditions

Intersection with yielding conditions + table

Intersection with yielding conditions + pin

local side street entrance: continuous sidewalk

Safety at intersections



source: SWOV, 2004, NL

Intersections: the weakest link – 30 mph

Signalized intersections

Roundabouts (single, double, turbo)

49

What not to do!

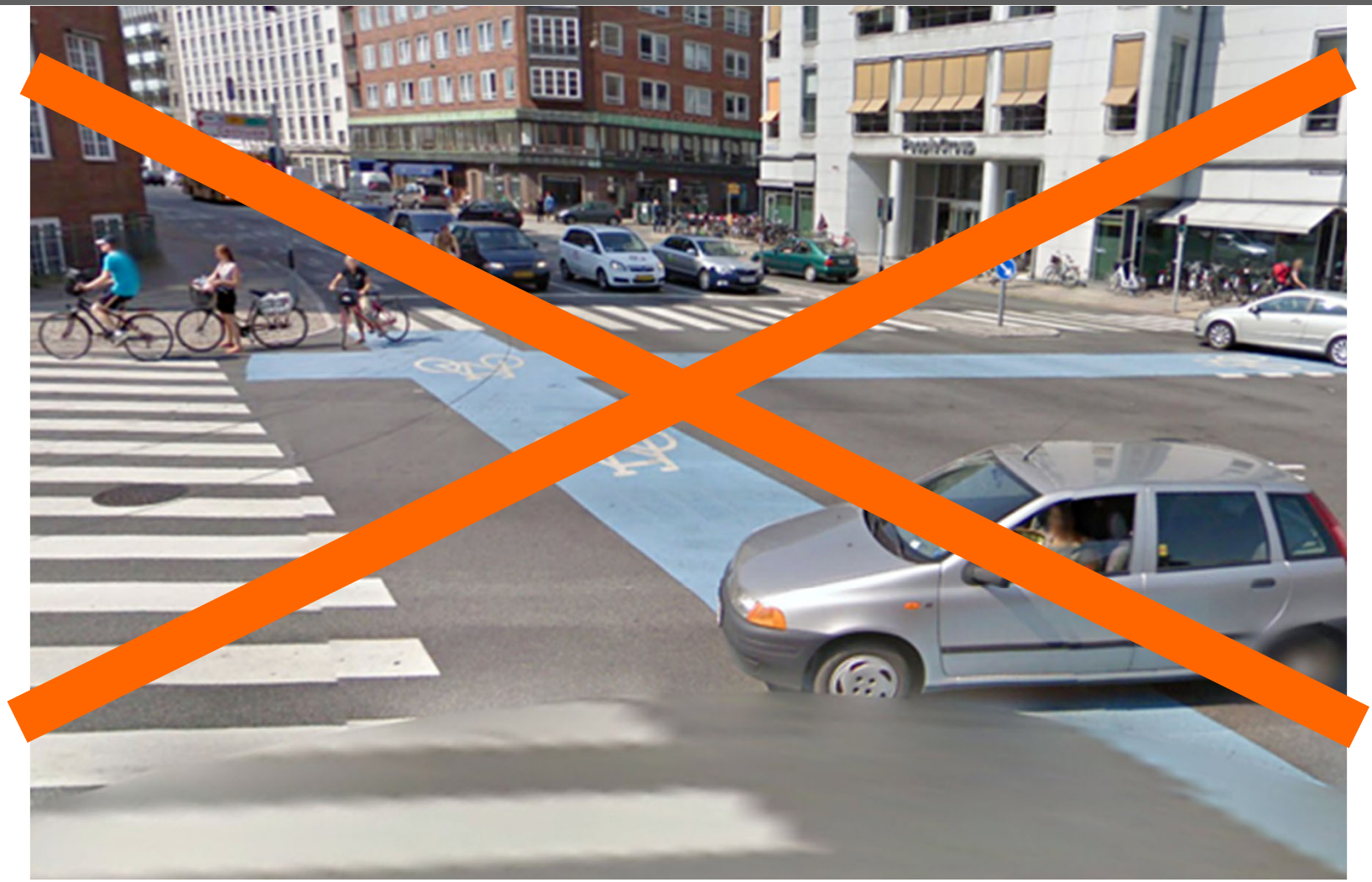
What not to do!

What not to do!

What not to do!

What not to do!

What not to do!

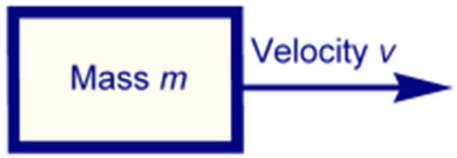


Basic principles for traffic safety

minimize difference in mass and speed

separate modes with large mass / speed difference

$$E = \frac{1}{2} m \cdot v^2$$



minimize amount of conflict points

separate modes at conflict points in time or space

Recommended intersection type per road

setting	hierarchy	recommended intersection type	traffic regulation?	traffic calming?
Urban area	30 - 30 kmph	yielding conditions	no	optional traffic calming measure (pin, table, bump)
	30 - 50 kmph	single lane roundabout	no	
		neighborhood entry with sidewalk bump over	no	
		regulated yielding conditions	no	traffic calming measure on 30 kmph street (bump, chicane)
	50 - 50 kmph	single or multiple lane roundabout	no	
		regulated yielding conditions	no	
		protected intersection	signalized	
Rural area	30 - 30 kmph	regulated yielding conditions	no	
	30 - 50 kmph	single or multiple lane roundabout	no	
		regulated yielding conditions	no	
		protected intersection	signalized	
	50 - 50 kmph	single or multiple lane roundabout	no	
		regulated yielding conditions	no	
		protected intersection	signalized	

Protected intersections: principles

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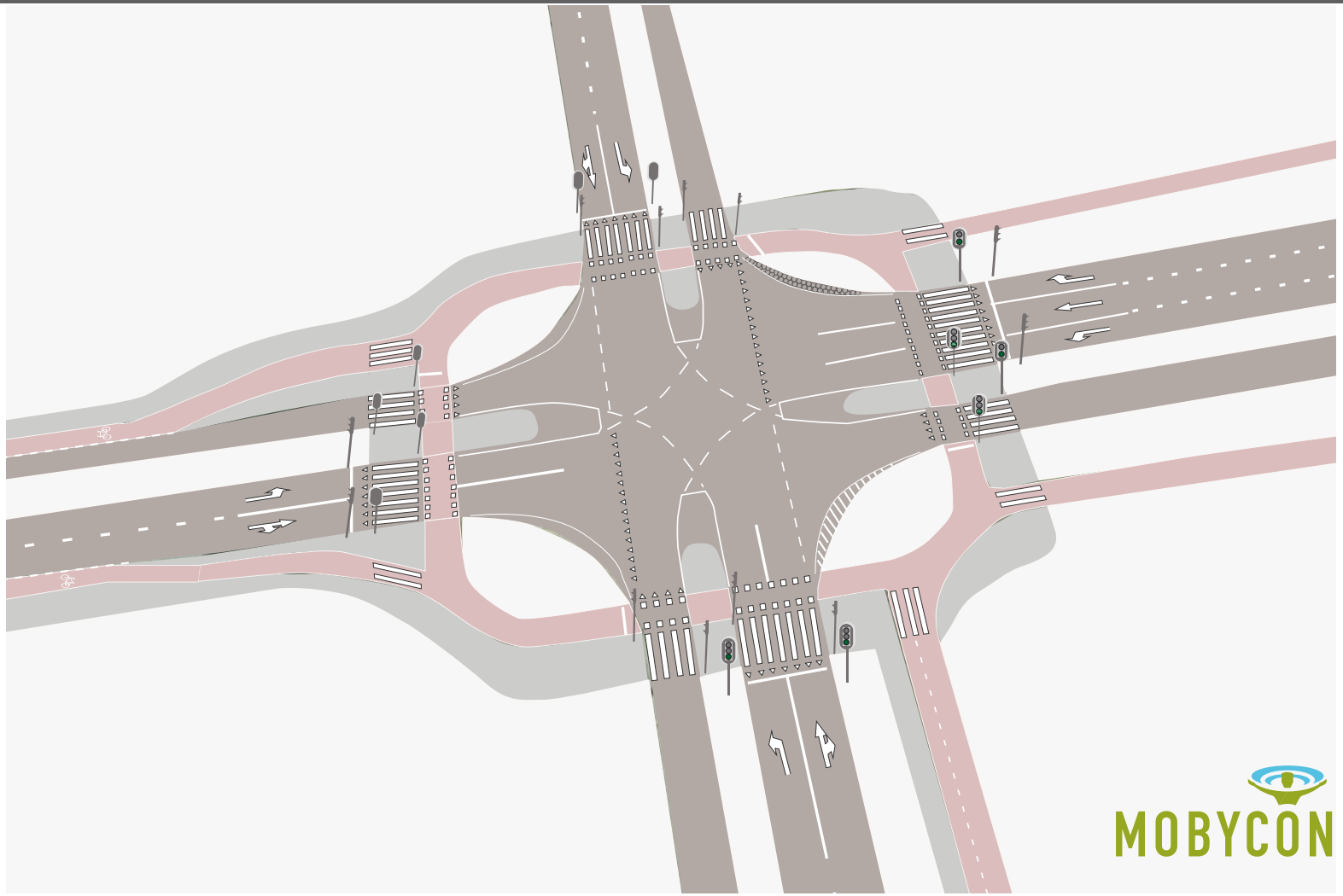
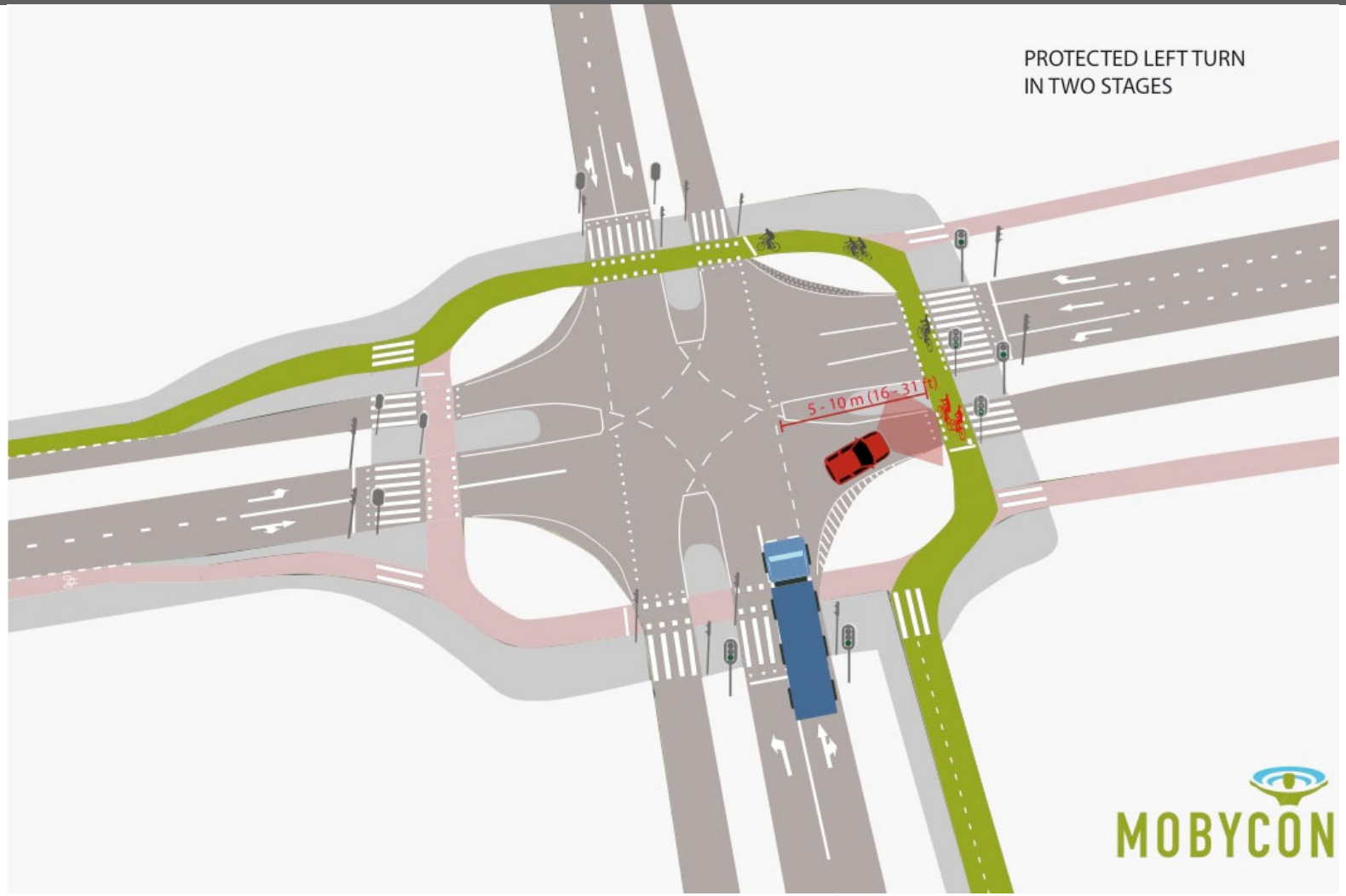
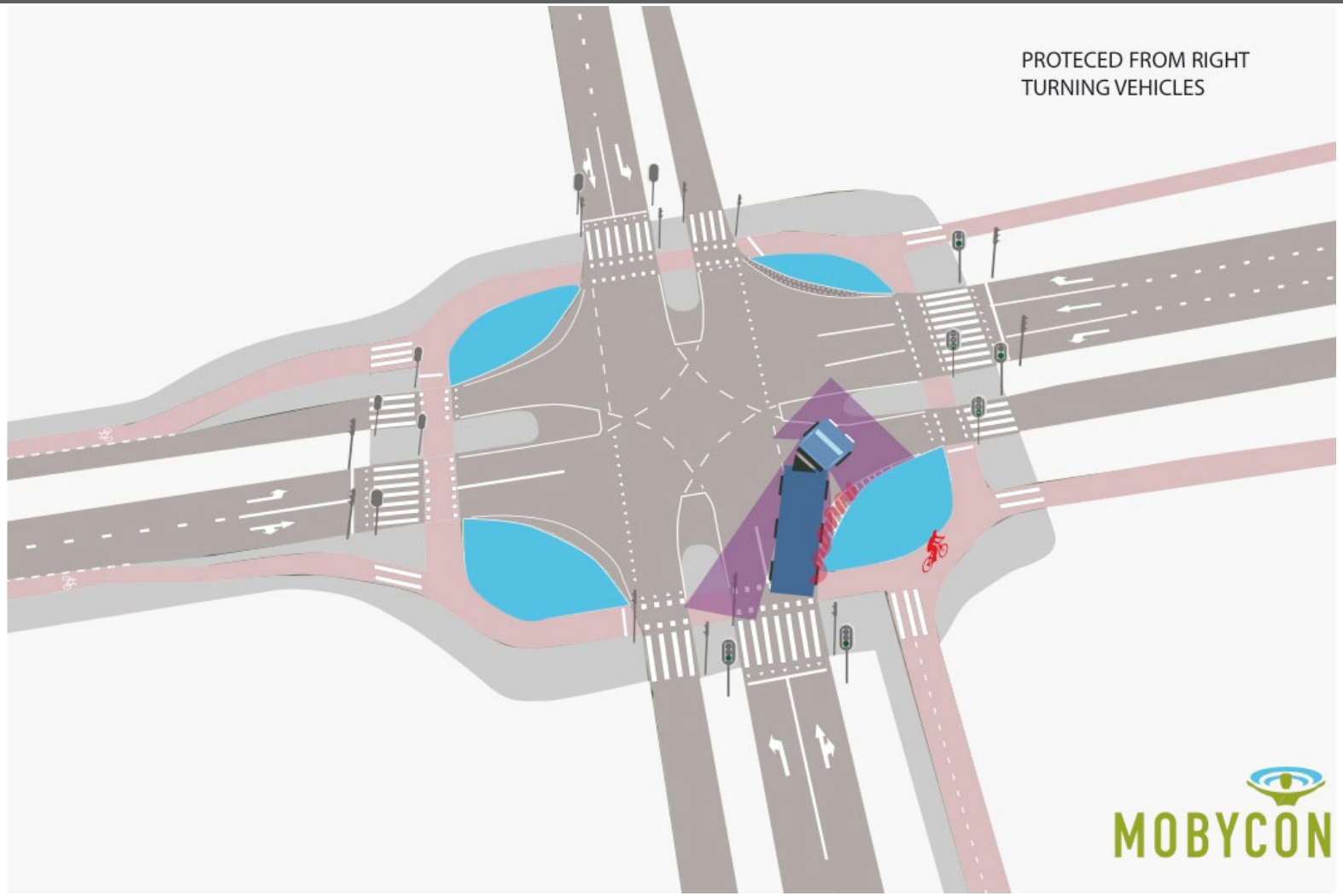


Protected intersections: principles



Protected intersections: principles



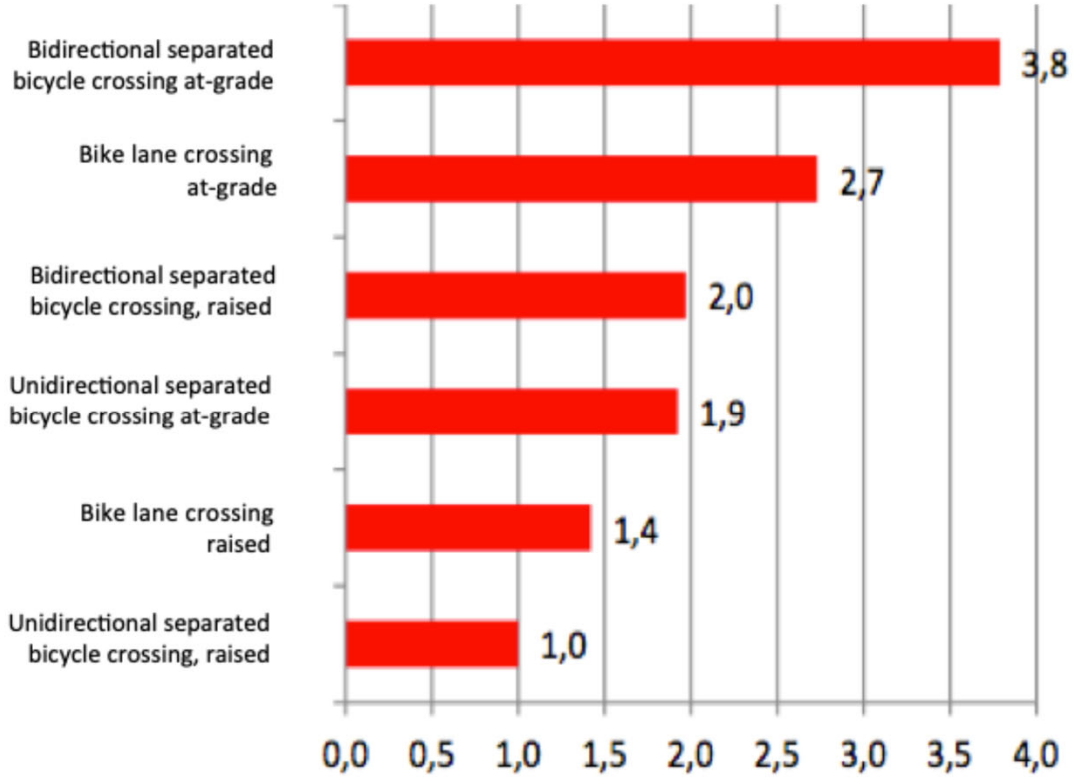
Safety of bicycle crossings

Unidirectional versus bidirectional bicycle crossings:

Bidirectional crossings are twice as unsafe as unidirectional crossings

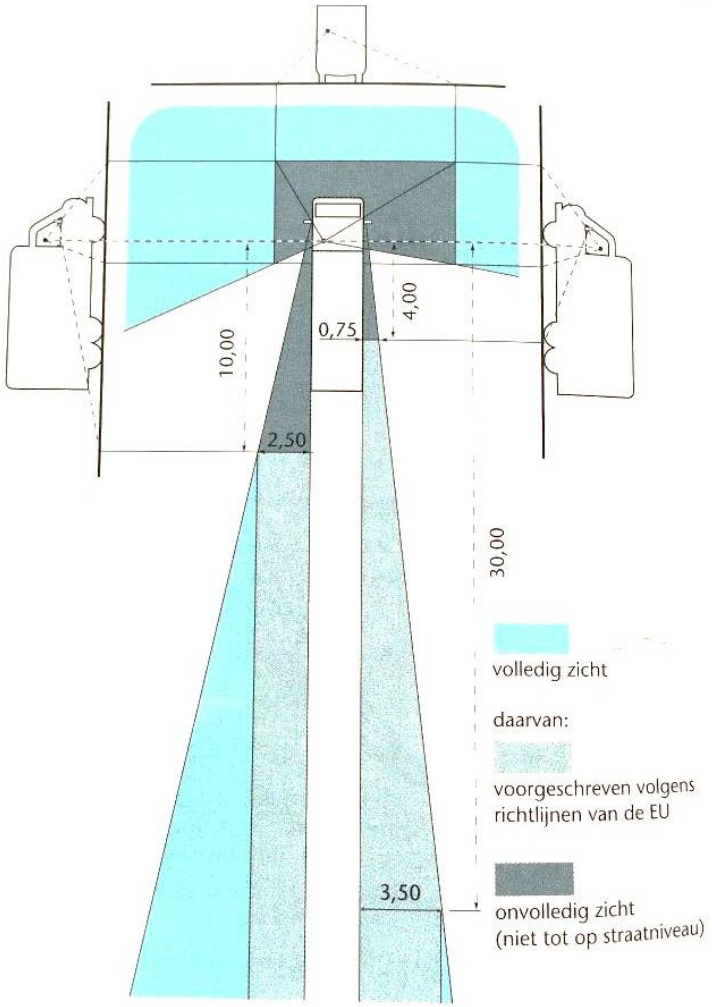
At-grade crossings are twice as unsafe as raised crossings.

The safest way for cyclists to cross a collector or arterial is raised, unidirectional.



Sources:
Fietsberaadpublicatie 19b, 2011, The Netherlands
Schepers, J.P., Waard, D. 2010: fietspaden met twee richtingen op kruispunten onveiliger, IN : fietsverkeer 26, okt 2010, The Netherlands

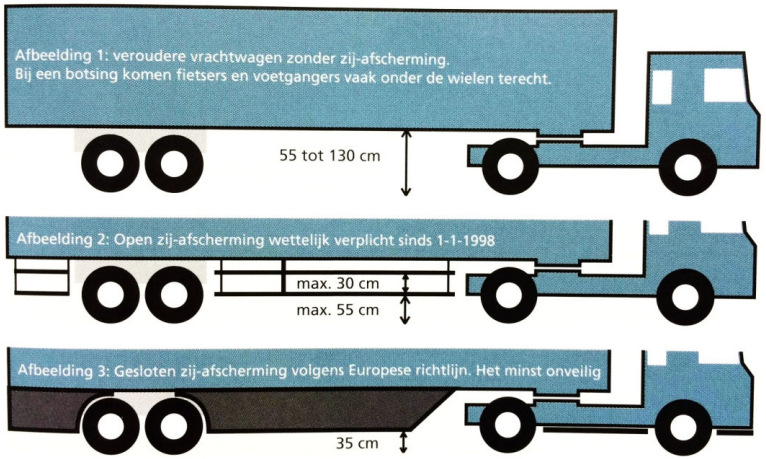
Protected intersections: principles



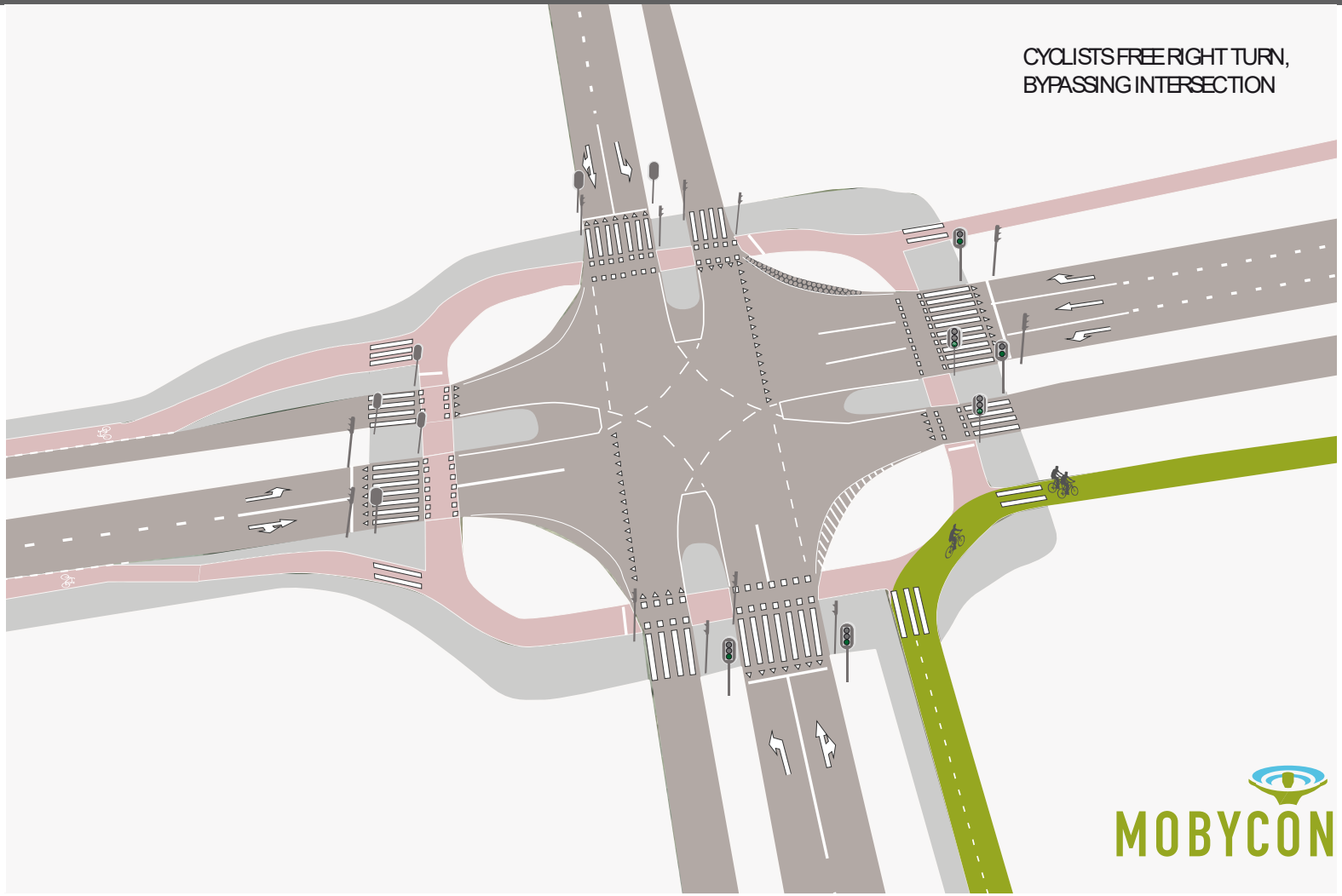
Right turn: Vehicle characteristics

Blind spot prevention: camera and mirror

Guardrail on side trailer.

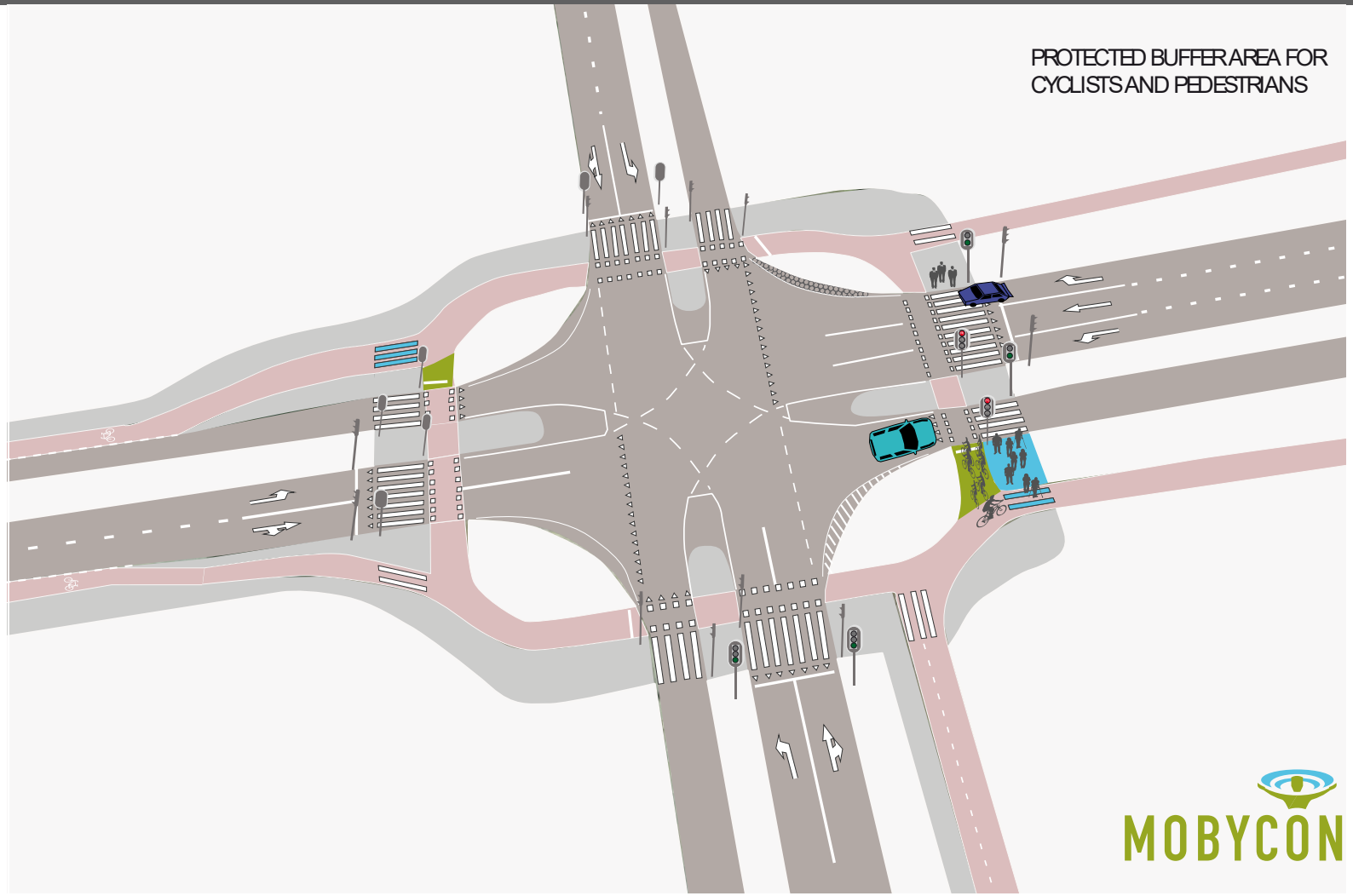


Design principles: Free right turn



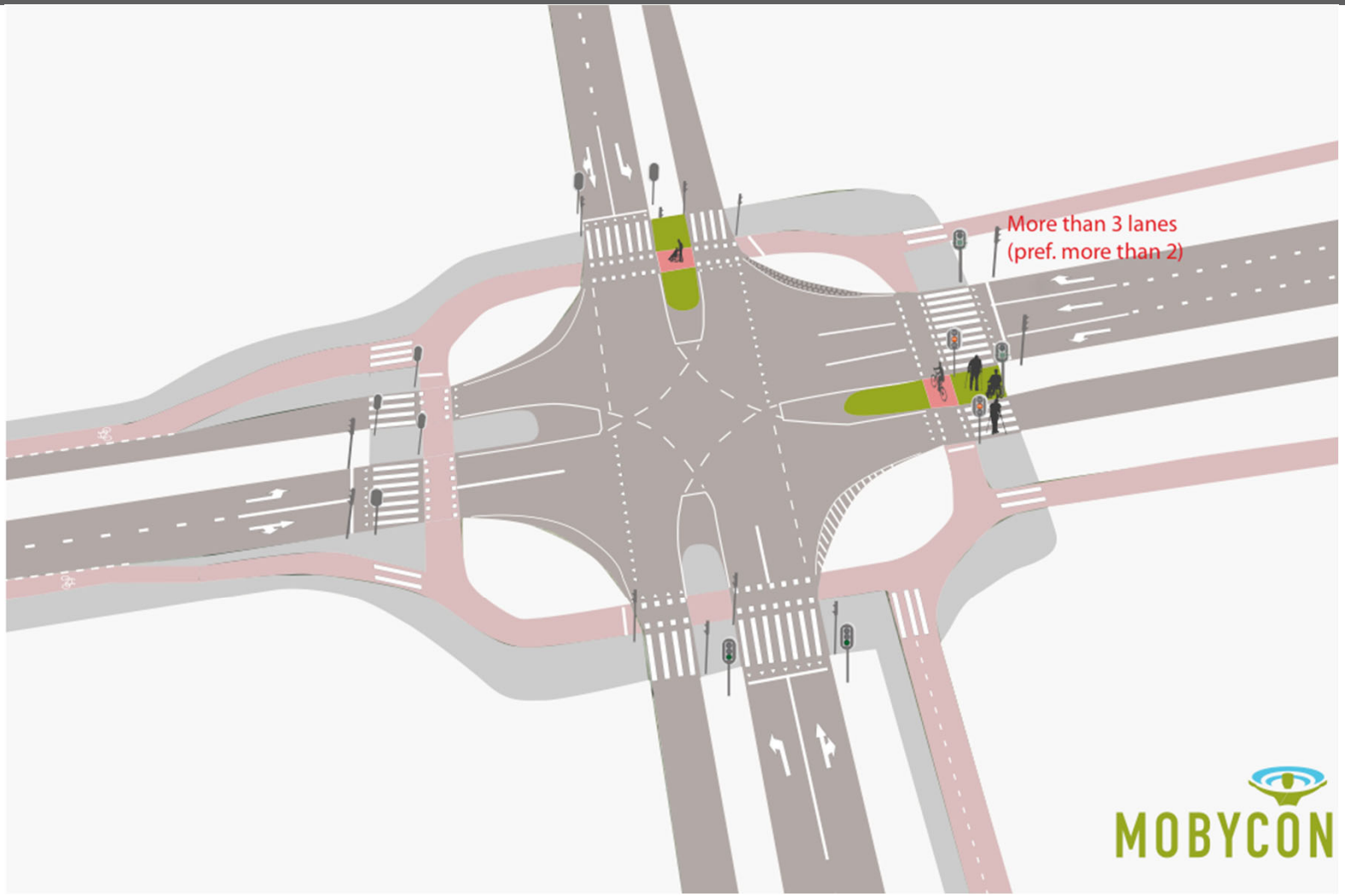
Design principles: Free right turn

Design principles: Buffer locations



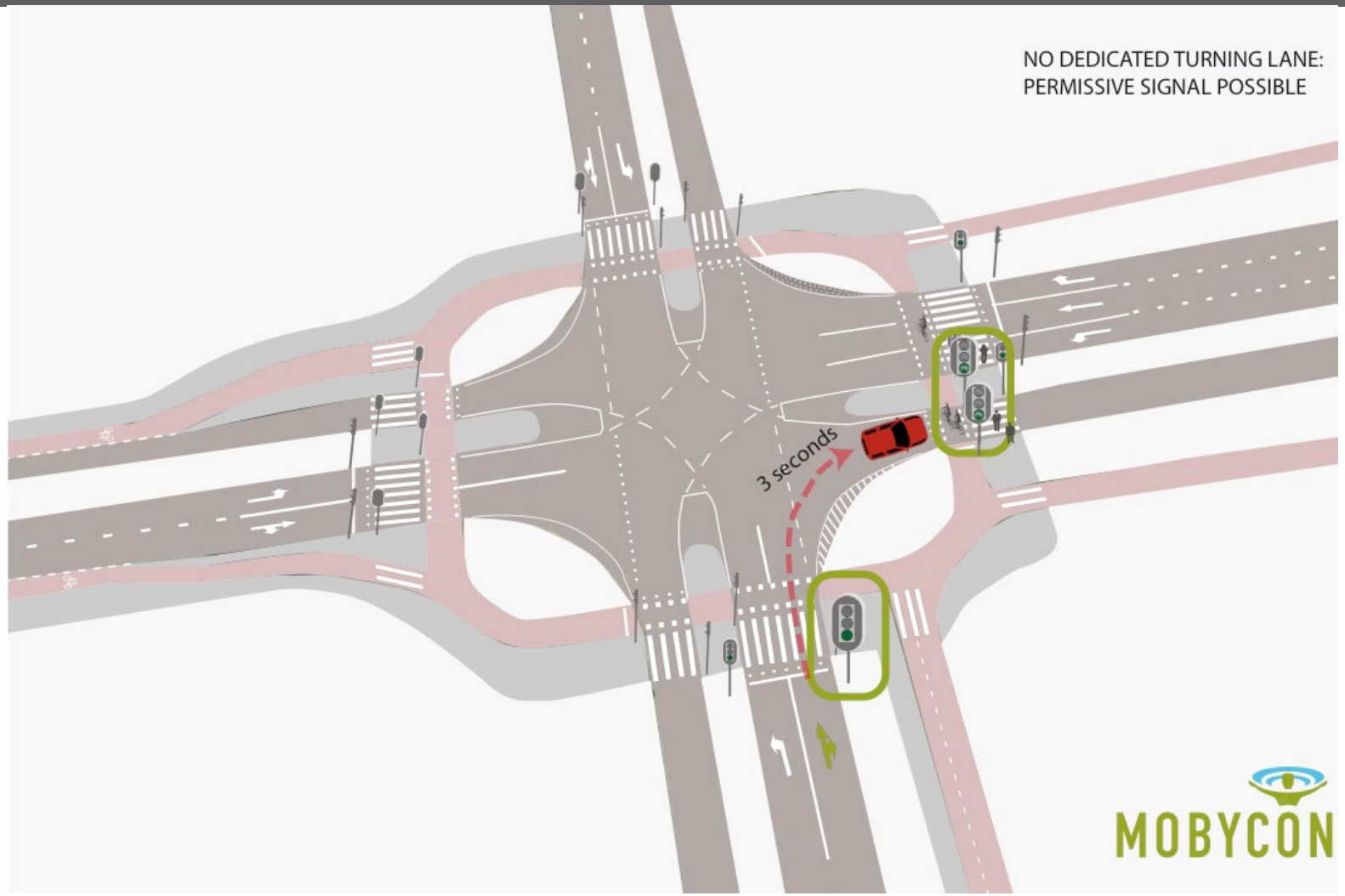
Design principles: Buffer locations

Design principles: Refuge islands

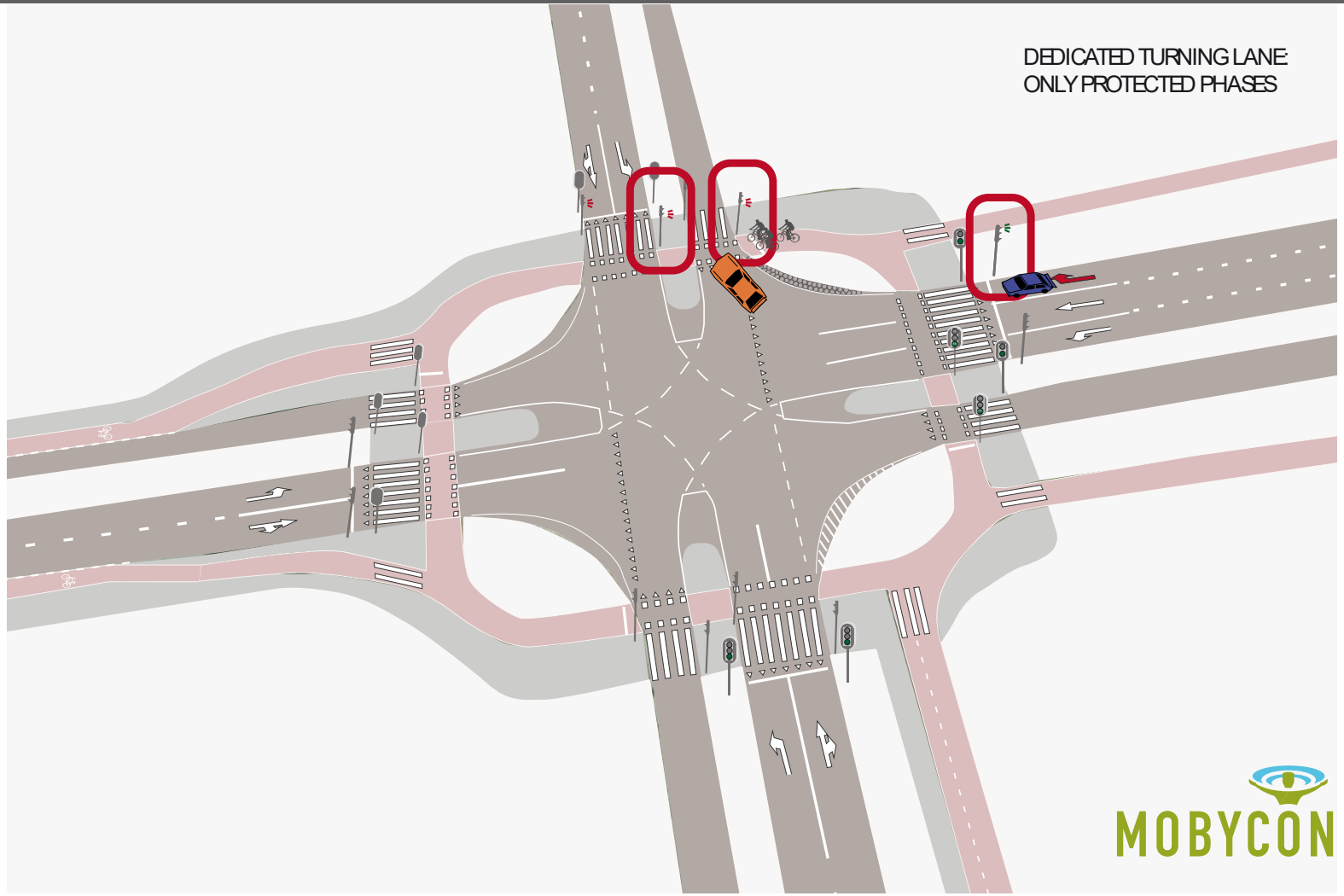


Design principles: Refuge islands

Design principles: Signal phases



Design principles: Signal phases

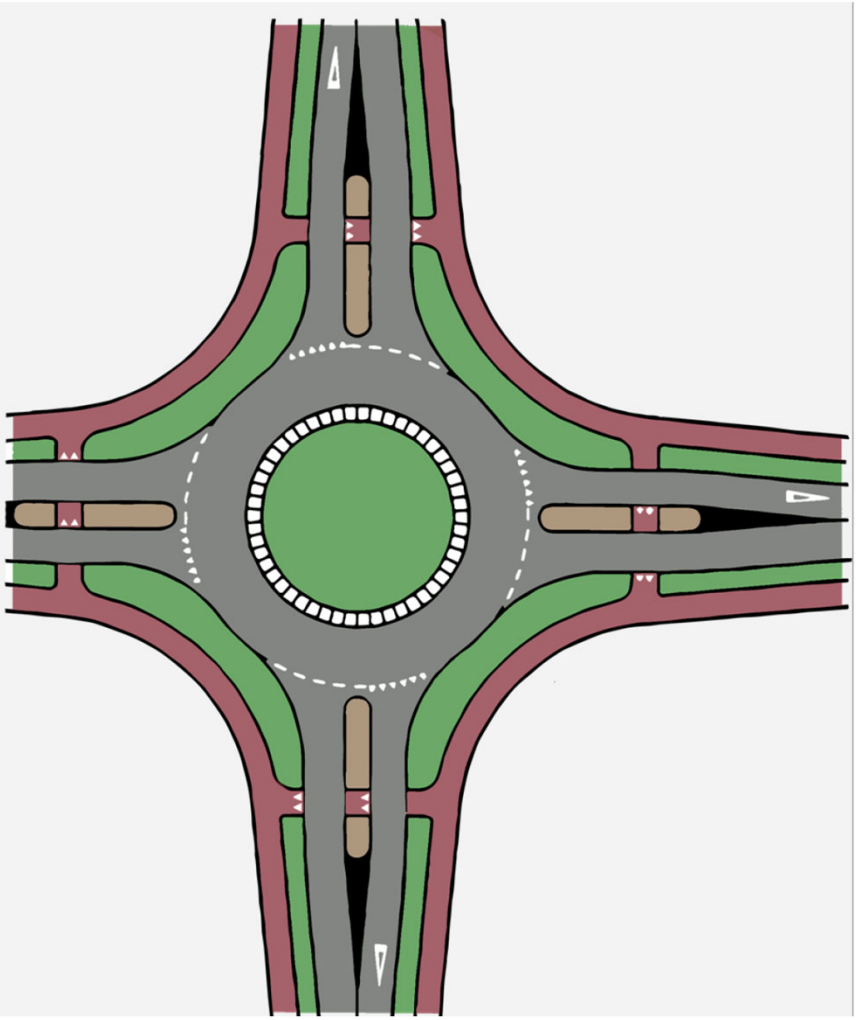


Design principles: Signal phases

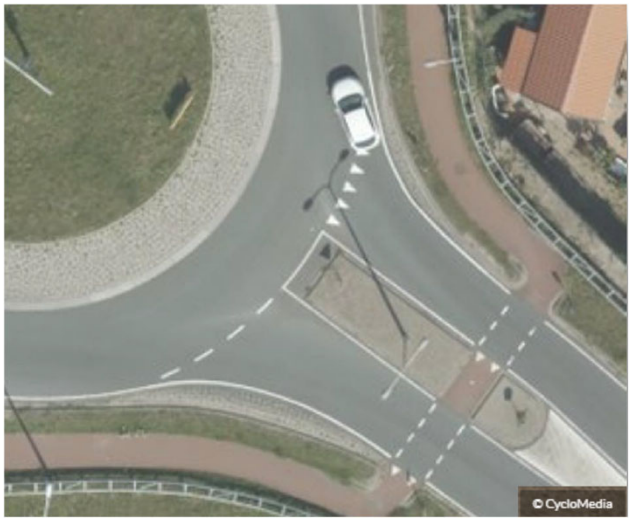
Downtown: spatial restrains

Unsignalized intersections

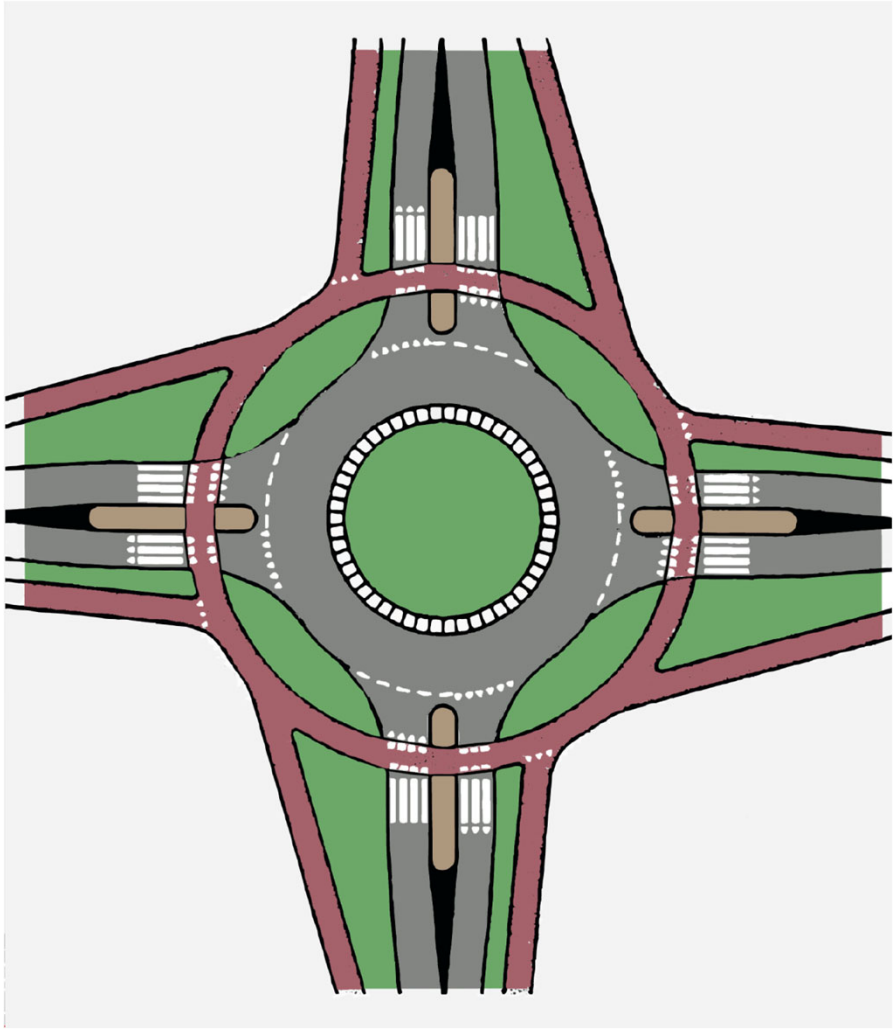
Protected Roundabouts



- Cyclists without priority
- No colored bike path on crossings
- 10m (at least 2 car length) out of the roundabout
- Refuge island halfway each road
- If bicyclist without priority, than pedestians as well.



Protected Roundabouts

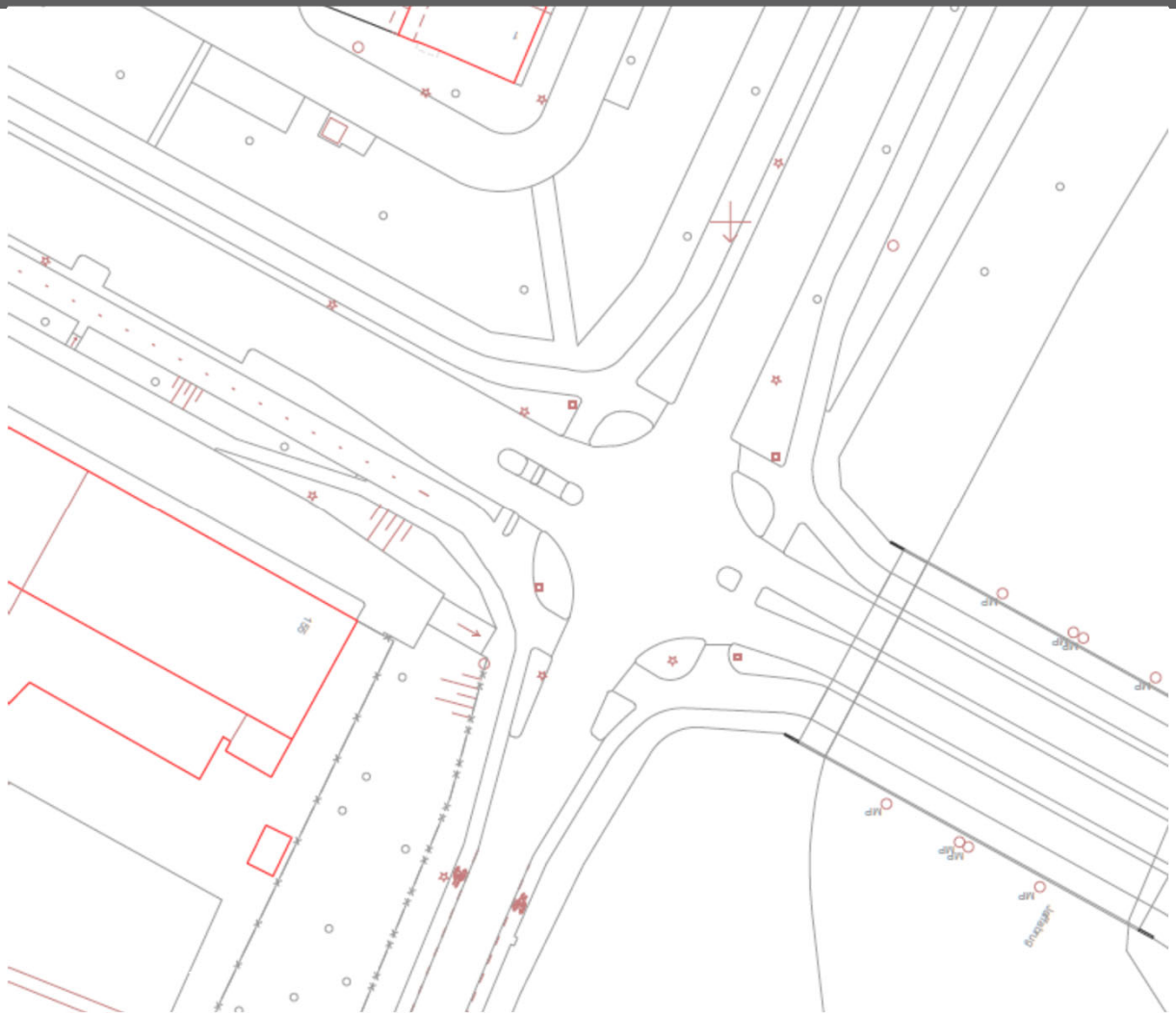


- Cyclists with priority
- Colored bike path through and through
- 5m (1 car length) out of the roundabout
- Refuge island halfway each road
- Ideally crossing on a bump

Protected Roundabouts

Protected Roundabouts

Protected Roundabouts



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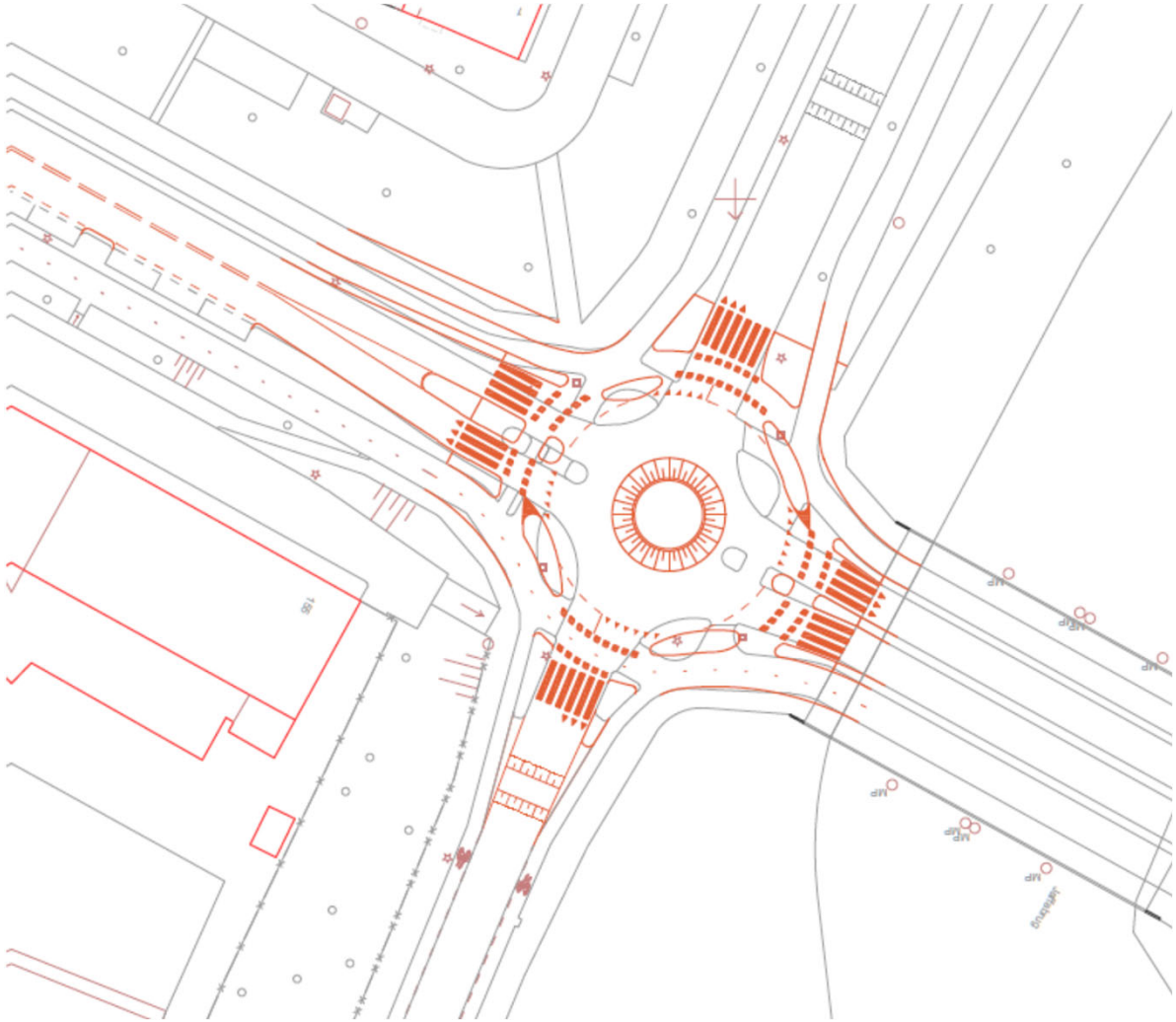
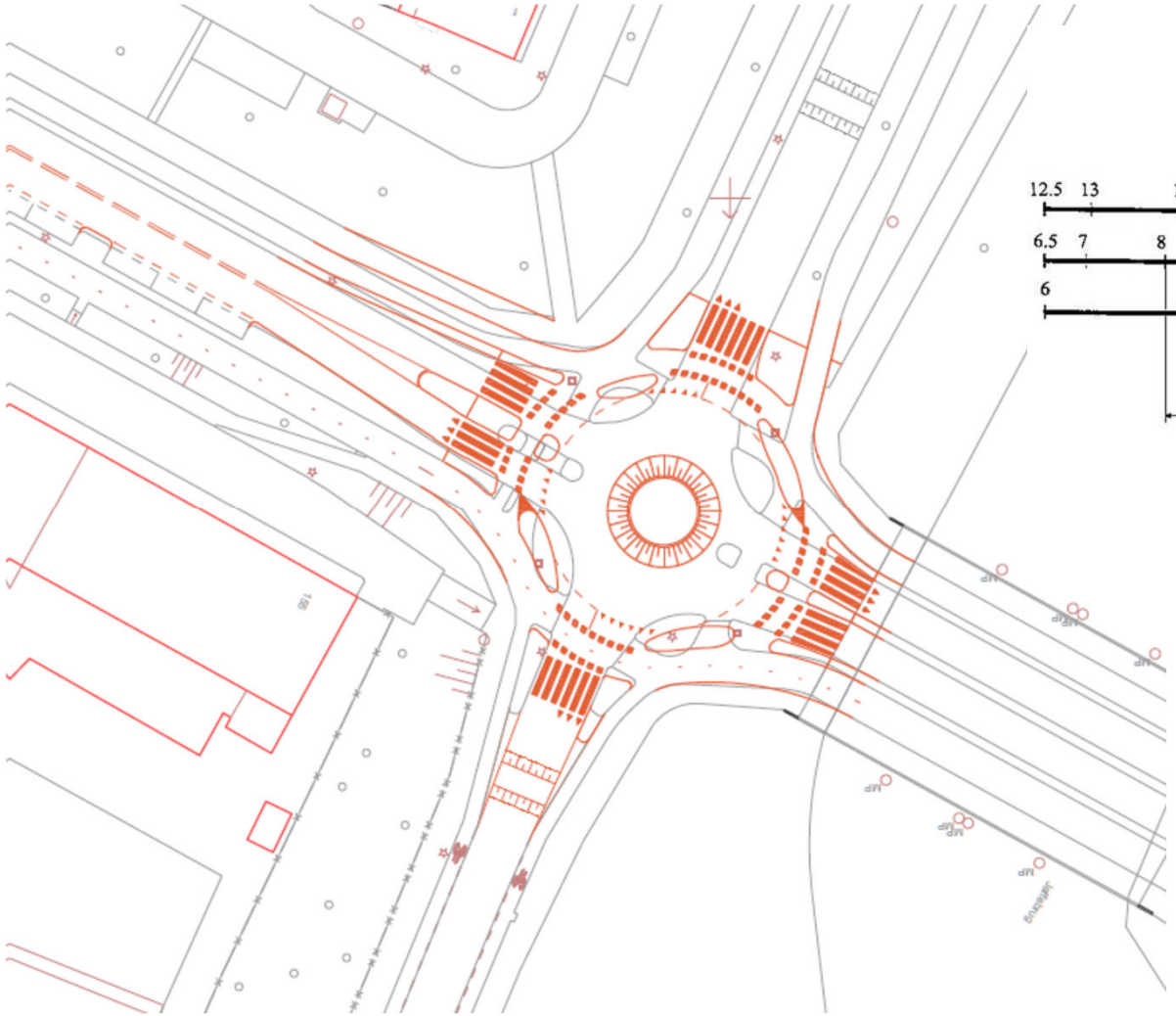
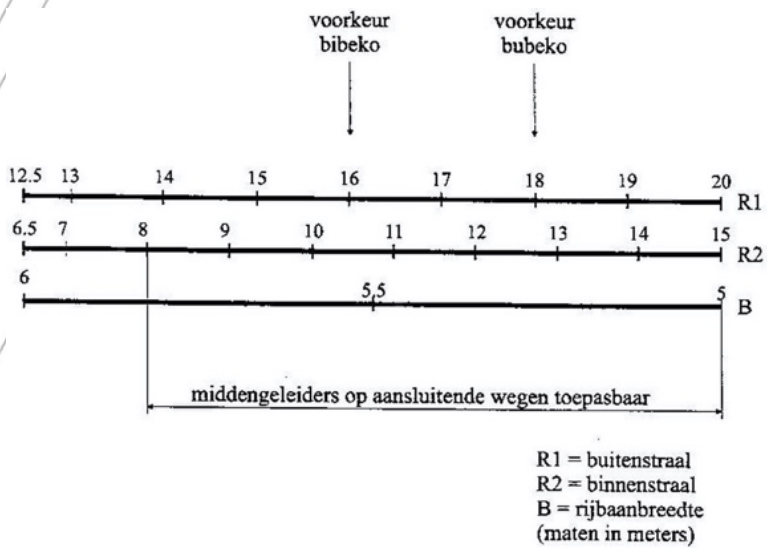


Protected Roundabouts





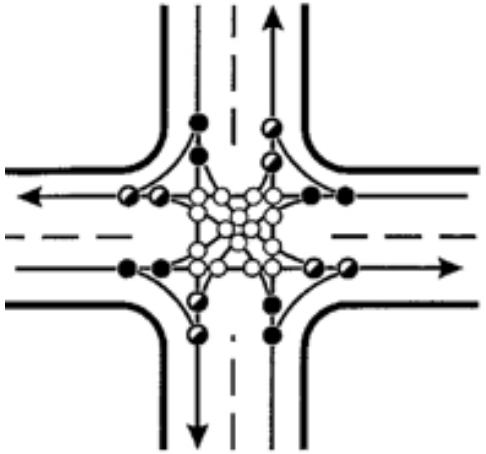
Outer radius 41 ft – 65 ft

Inner radius 21 ft – 50 ft

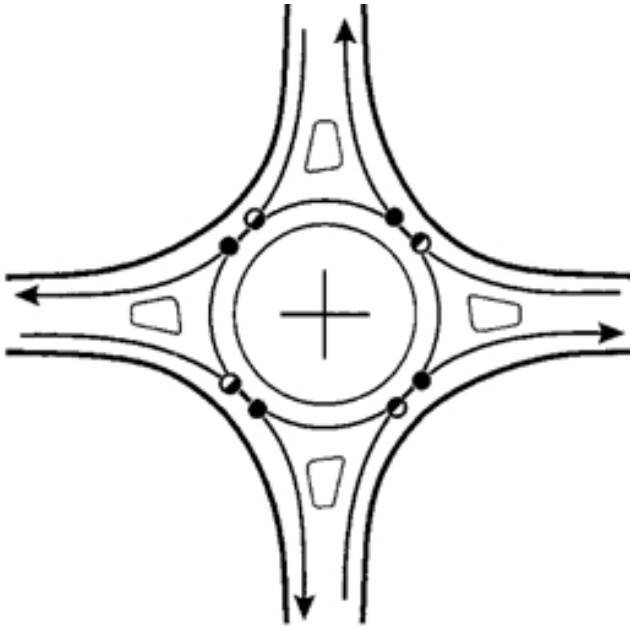
Lane width 18 ft

Protected Roundabouts

24 conflict areas are eliminated with a roundabout



Diverging	8
Merging	8
Crossing	16
	32



Diverging	4
Merging	4
Crossing	0
	8

Turbo roundabouts

’Dutch left’ intersection.

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THE A-B-C OF THE ‘DUTCH LEFT’

DIVIDED HIGHWAY INTERSECTION WITH LEFT TURN LOOP

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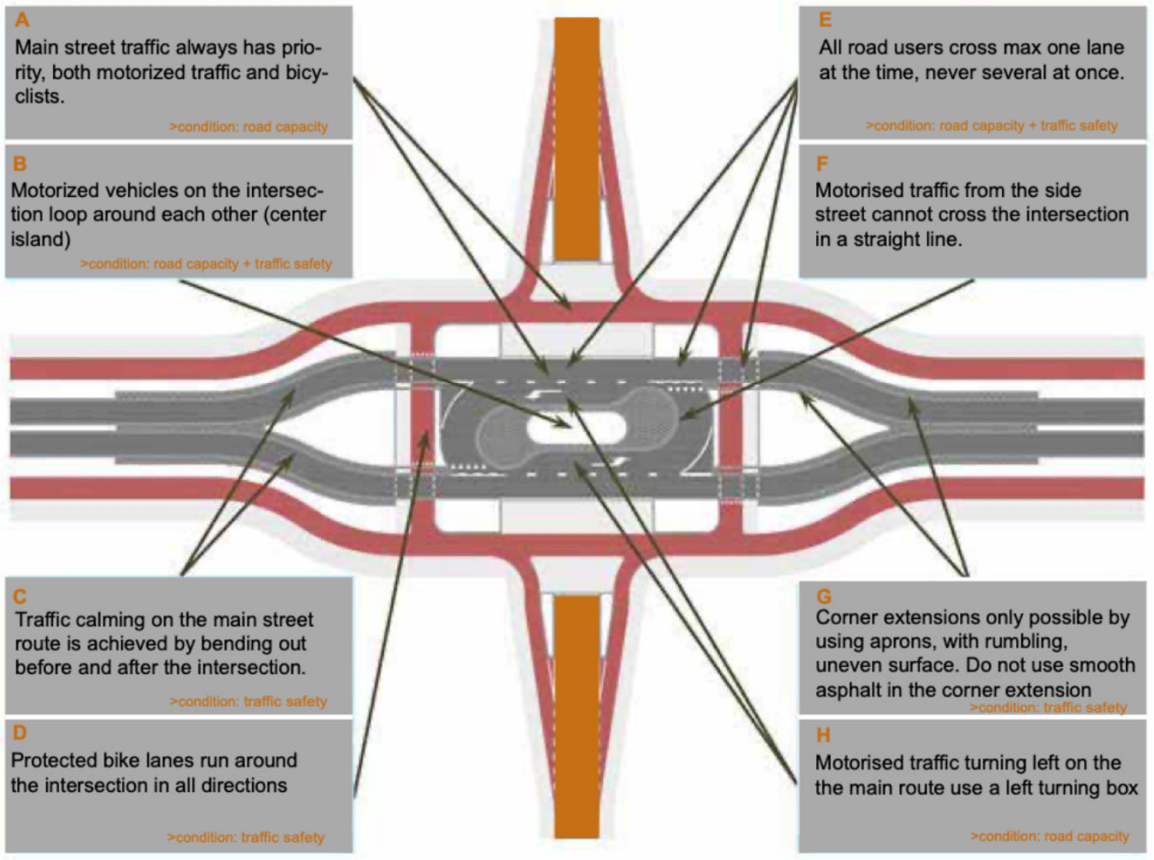

source: Bout J, Olijve M J, Het Voorrangsplein, een nieuw kruispuntstype, Windesheim/CROW, 2015

Transformations

Roundabout design

Roundabout design

Roundabout design

Roundabout design

Workshop

Design the street

and the intersection

Exercise: Case study design.

- **High over concept design (full case study area)**

Corridor design: look at the road classification and the AADT. Are all lanes necessary? If reduced, where and when?

What is the role of the corridor in the bike network? What bicycle and pedestrian quality are we striving for? For whom?

+/- 10 min.

- **Design the corridor (full case study area)**

Design the street, draw on the aerial map.

Focus on the road segments first, with a rough idea of intersection types.

Think about safety, zones, dimensions. But not too detailed. (its not CAD).

+/- 20 min

- **Design the intersection (zoom in on different part of the study area)**

Design a major and minor intersection in more detail

Top down drawing. Think about right of way,, signalization and buffering space, maybe even signal phasing.

Materialization really matters to ensure self explanantory design.

+/- 30

- **Presentation**

Bundle the previous step in a 5 min presentation