

ROADS TO RESPECT 2010
European Transport Safety Council ETSC
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**Road Safety Criteria in Road
Planning and Design.**
Road safety audit RSA

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Up Road ChanaePb 4 rto

Basic criteria in road geometric design

1. Road traffic safety
2. Protection of environment
3. Economy: investment, operation and maintenance costs
4. High traffic performance: capacity and level of service (LOS); (based on MOEs: delay, stops, queues, etc.)
5. Technical and construction requirements
6. Needs of disabled and vulnerable road users (pedestrian, cyclists)
7. Social constraints

- General requirements are supplemented in design guidelines by detailed design recommendations
- **In design we always assume certain design standard**

Implementation of new technologies



Road safety criteria



Road safety criteria

Related to:

- a) Road users: psychological, psychophysical – taking into account; sight, perception, time for decision, memory (RAM), reaction to monotony, impact of speed,
- b) Vehicles: vehicles' body, width, turning radius, acceleration, deceleration,
- c) Road; its geometry, cross section, pavement, drainage, roadside

In other words:

Roads should be

- **Recongnizable** – user should be able to recognize alignment, road should be „**self-explaining**”
- **Readable** - geometry and signing should be easy to understand, and the amount of information should be limited
- **Drivable** – paths for all, specially turning movements at intersections should be provided, as vehicles when turning occupy wider corridors,
- Having **minimum number of collision** points with other traffic movements, with other traffic users
- **Providing visibility** of road users, road and traffic control devices

Form of these criteria depends on stage of planning/design

- Planning stage; road network, hierarchical system
- Conceptual design
- Detailed technical design
- Design of signing and marking
- Monitoring existing traffic

In all these stages designs should be **audited**

Road safety audit

What should be taken into account in planning stage?

Links of transportation/road planning with land-use planning

- Land use planning; location of traffic generators; housing estates, working places, education, shopping areas, supermarkets, culture, churches, etc.
- Transportation corridors – major roads, streets, public transport lines,

RS aims:

- a) Building of the hierarchical network with roads of various functions and technical classes

Planning stage

Each network should consist of roads playing:

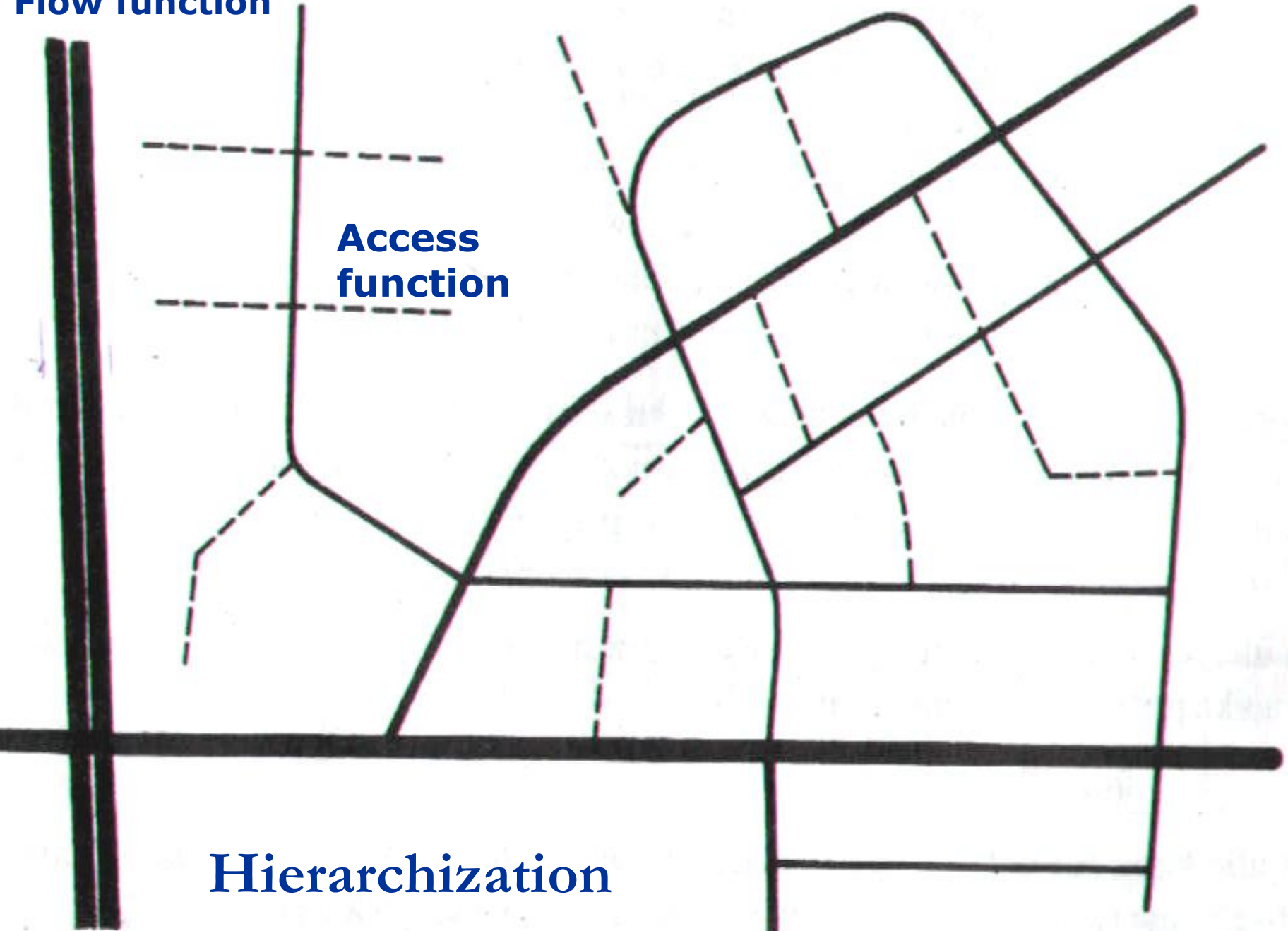
- Flow functions,
 - Area distributor functions
 - Access functions
-
- a) roads/streets should not cross links between traffic generators and destinations i.e. school – houses etc
 - b) minimisation of conflict points; vehicular/vehicular flows, vehicular/ pedestrian (cycle) flows
 - c) Access control/access management should be taken into account – depending on function of road/street – limitation of number and density of intersections and driveways

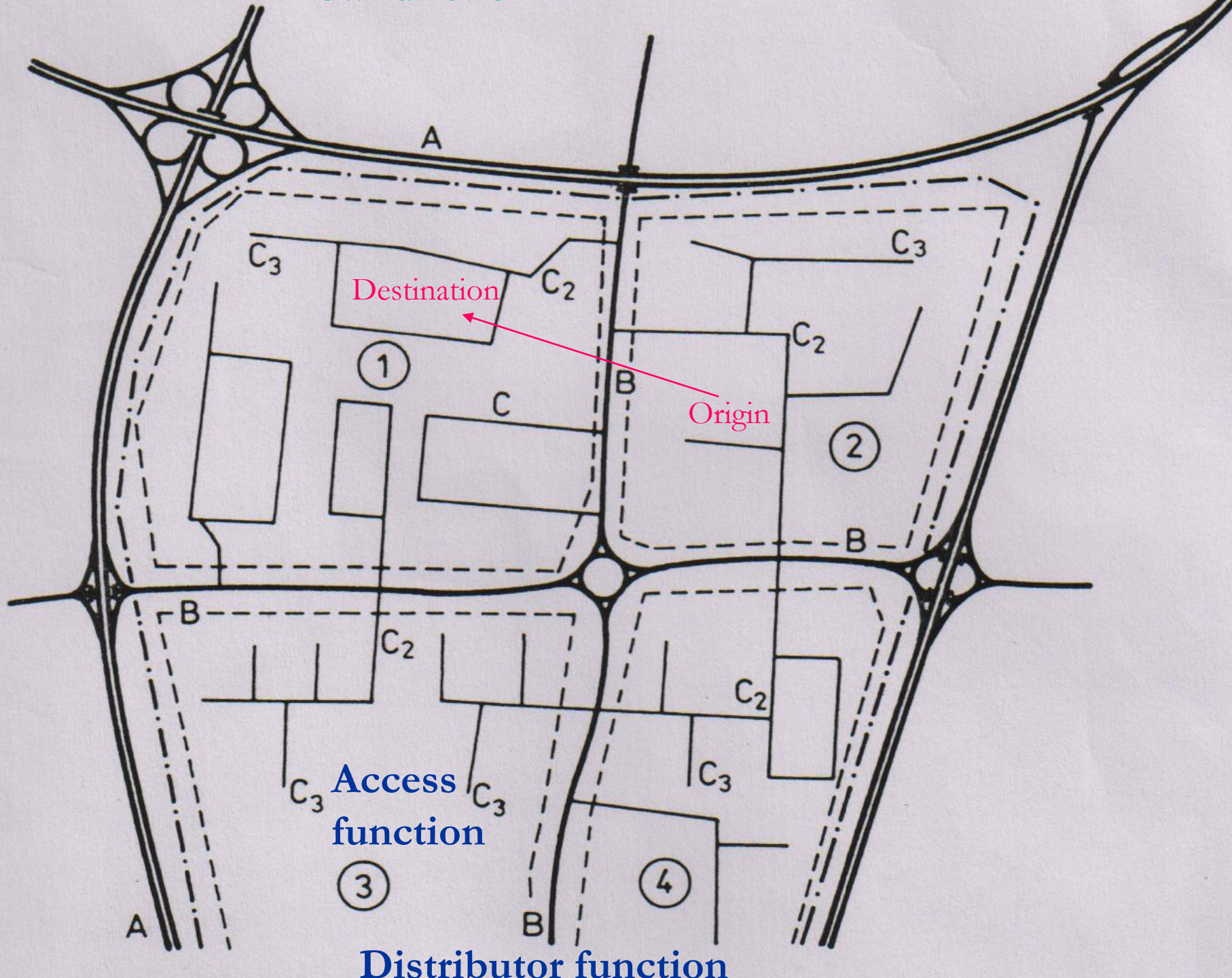
Distributor function

Flow function

**Access
function**

Hierarchization











Access management

- Access management: distances between intersections and interchanges, access points to and from properties and density of driveways
- It is important in planning stage, land use planning, in conceptual design and also for noise protection

Conceptual project stage

Ideas of: „**Self explaining roads**“, „**Forgiving roads**“ The Swedish concept of “safe speed”no time no time for details

- The concept of **self-explaining** roads on which the driver is encouraged to adopt its behaviour naturally, in consistency with design and function. Different classes of roads should be distinctive, within each class features such as width of carriageway, road markings, signing, and use of street lighting should be consistent throughout the route.
- Drivers would perceive the type of road and “instinctively” know how to behave.

„Forgiving roads“: Errors of drivers do not lead to accidents, if so accident severity is limited

- Safety barriers on both sides of the road on high embankments, bridges culverts etc avoiding „roofing“
- Safety barriers at trees,
- Gentle slopes of embankments in high risk locations (intersections, horizontal curves, instead of 1:1,5; or 1:2 better and safer 1:3–1:5
- Waking marking – lines waking sleepy drivers on edges of carriageway





Conceptual project stage

Road safety criteria:

- a) Psychological – users' behaviour
- b) Traffic dynamics
- c) Homogeneity
- d) Visibility
- e) Other (drainage,....)

Most of these criteria are taken into account
in design guidelines

a. Features of road users – users' behaviour; knowledge of traffic rules, travelling speed, accepted risk, using seatbelts & running lights, reaction time, reception of information, etc. **No time to present**

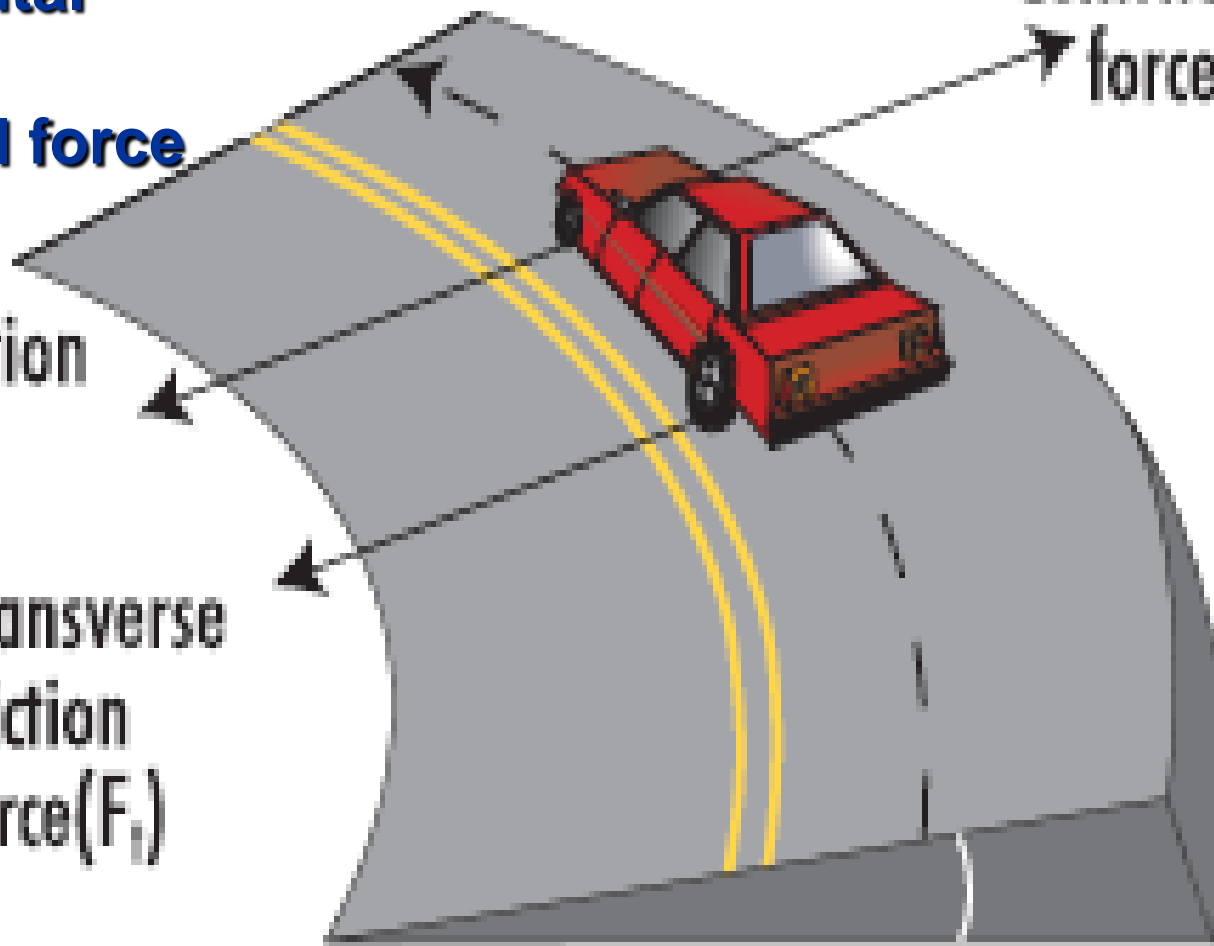
Vehicle stability on horizontal curves – centrifugal force

**Vehicle stability
on horizontal
curves –
centrifugal force**

Superelevation
force(F_e)

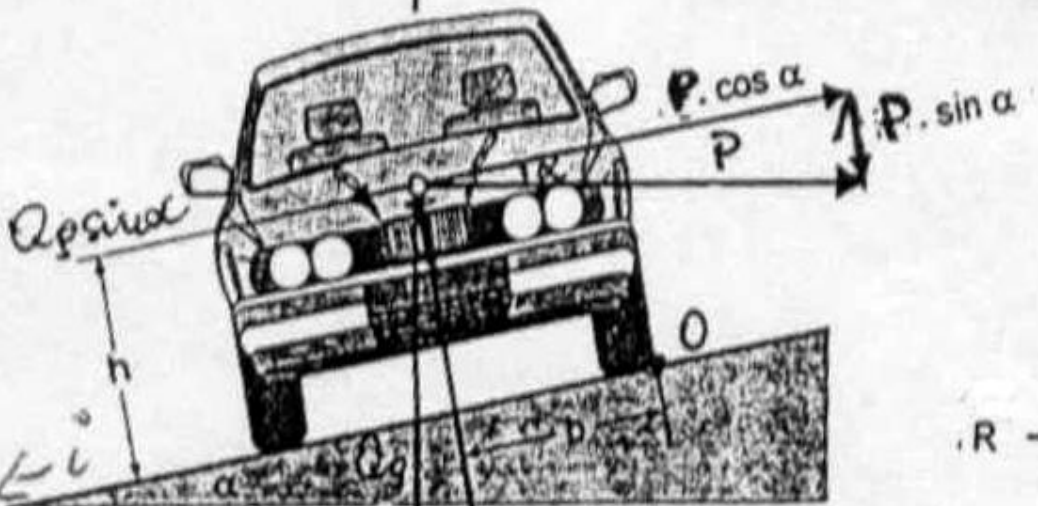
Transverse
friction
force(F_f)

Centrifugal
force(F_c)



Superelevation

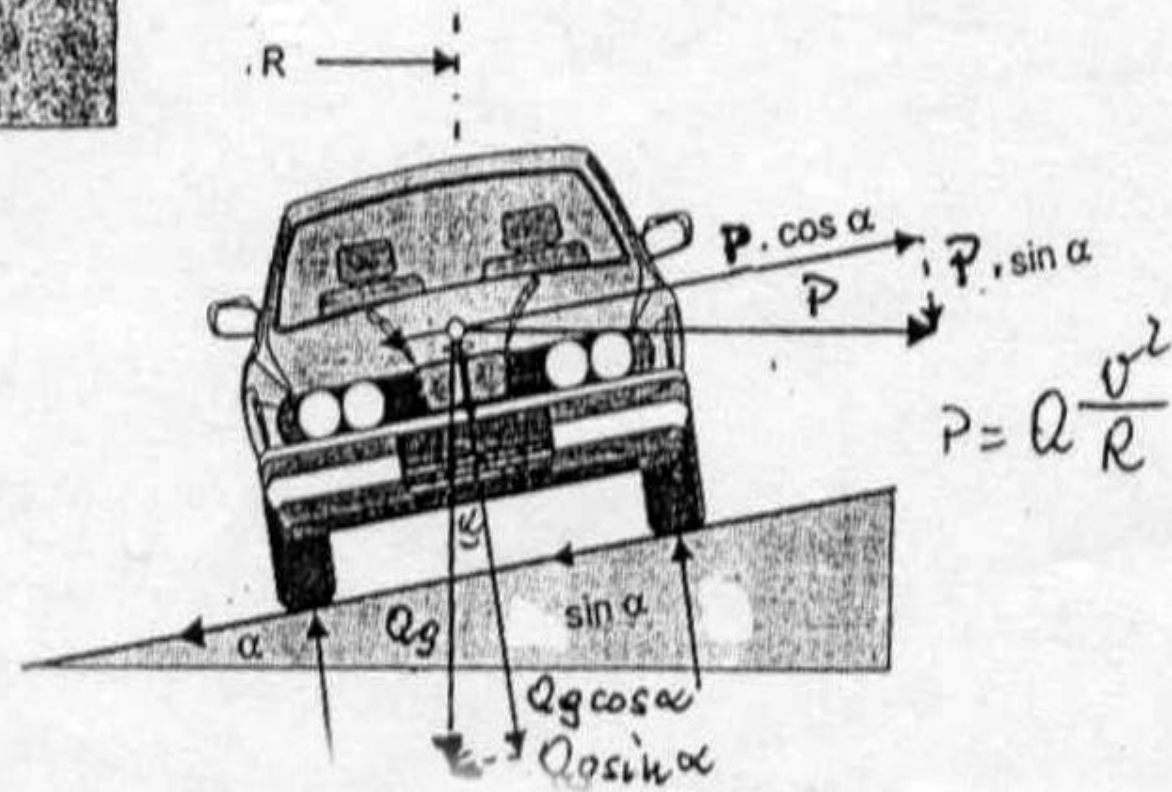
PROMĚN . R →



Dynamics:
Vehicle stability on horizontal curves – centrifugal force

Q_g - síta tížkosci

masa



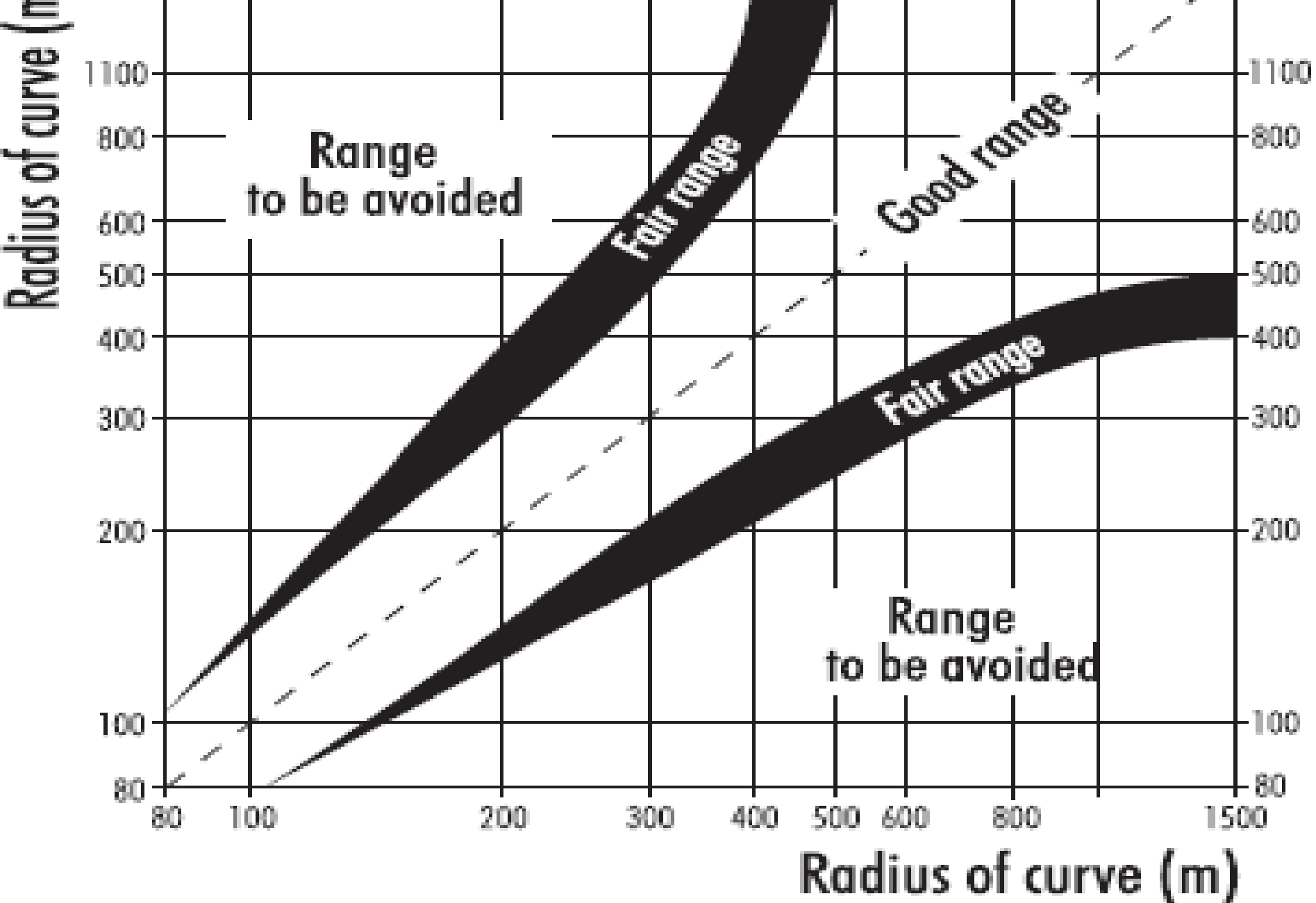
Design factors

Centrifugal force depends on speed V and radius R (horizontal and vertical curves). Important for road safety on horizontal curves are:

- Superelevation e 2-7%
- Side friction coefficient f_s
- Radius R
- Length of tangent (perception of curve)

Design values are given in standards

Problems of losing stability control i.e. understeering, oversteering, were presented yesterday by Toyota



Homogeneity of neighbouring curves and road sections R1:R2

Transition curves

Curves between straight section and circular curve giving smooth change of centrifugal force

No time to present and discuss

Visibility

Required sight distances on horizontal and vertical curves based on real speed V_{85} :

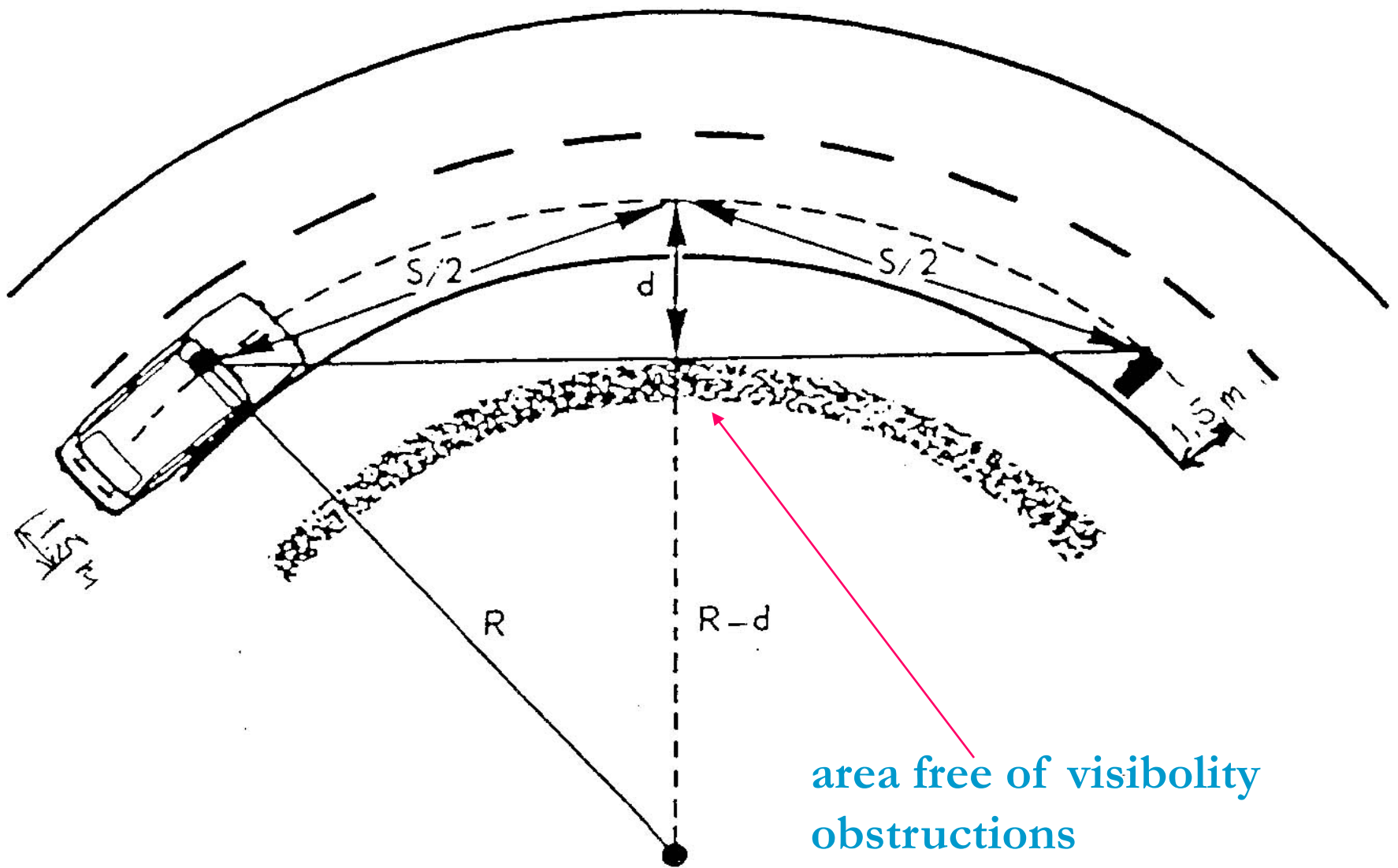
- a. **stopping sight distance** - if not provided speed reduction, improve skid resistance
- b. **passing (overtaking) sight distance**, should be provided on recommended percentage of a road length in order to allow overtaking on straight sections to avoid creation long platoons

Problems with that criterion; overtaking lanes, slow traffic lanes or 2+1 sections can be considered

Visibility

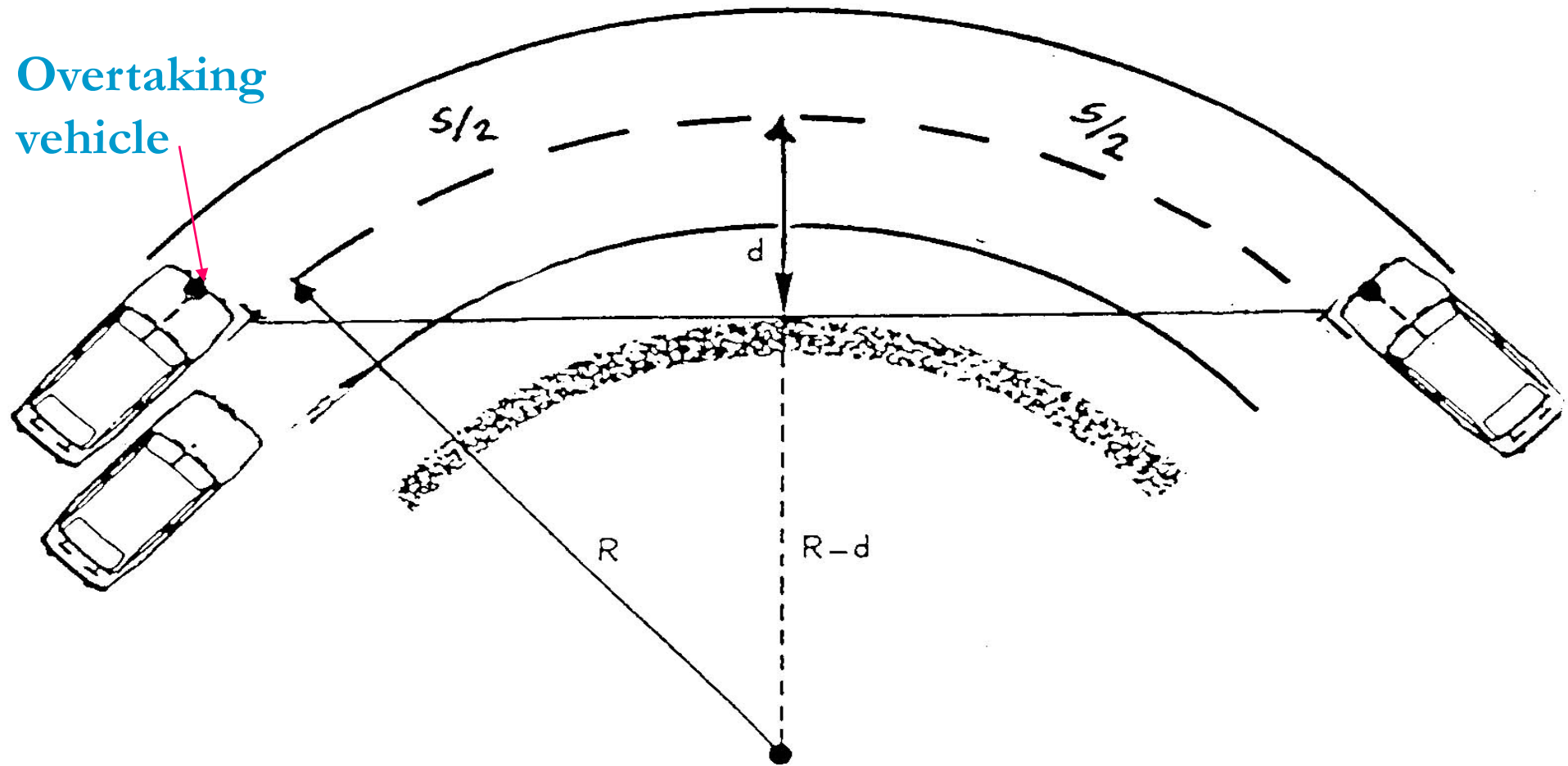
- **Stopping distance: grade, skid resistance of pavement** **no time to discuss**
- **Overtaking requirements** **No time to present and discuss**
- **Percentage of road with allowed overtaking** – some sections should give possibility of overtaking - % of section must give such possibilities

Visibility	Visibility	
	horizontal alignment	vertical alignment
stopping sight distance	<p>driver obstracle visibility radius</p>	<p>h_1 h_2 LZ R</p>
passing sight distance	<p>driver obstracle driver visibility radius</p>	<p>h_3 $h_1 = 2.5m$ LW R</p>



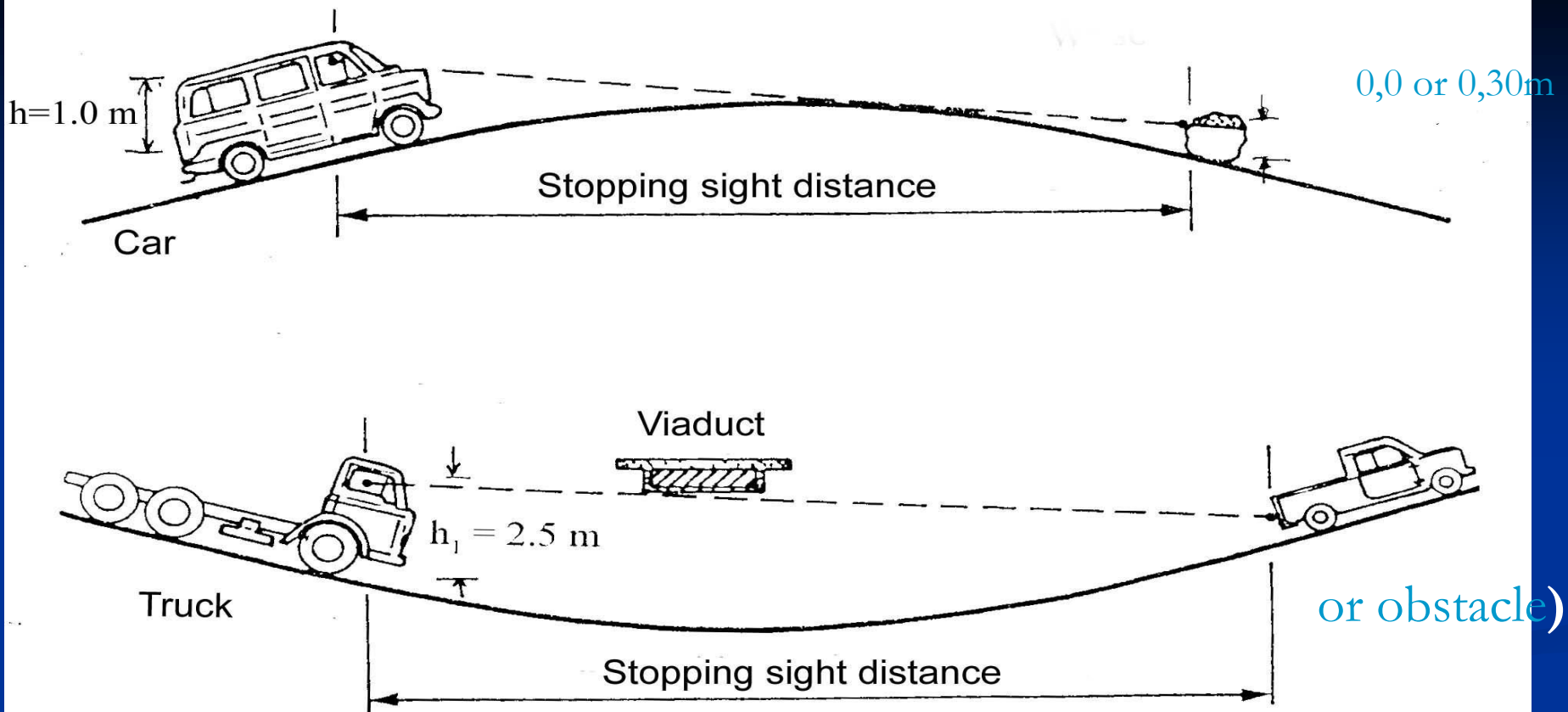
Horizontal curve radius R should provide stopping visibility (and visibility allowing overtaking - recommended). Area on internal side of a roadside should be free of visibility obstructions

Overtaking
vehicle



Checking possibility of passing depending on the
distance d – depending on and V_{85} speed

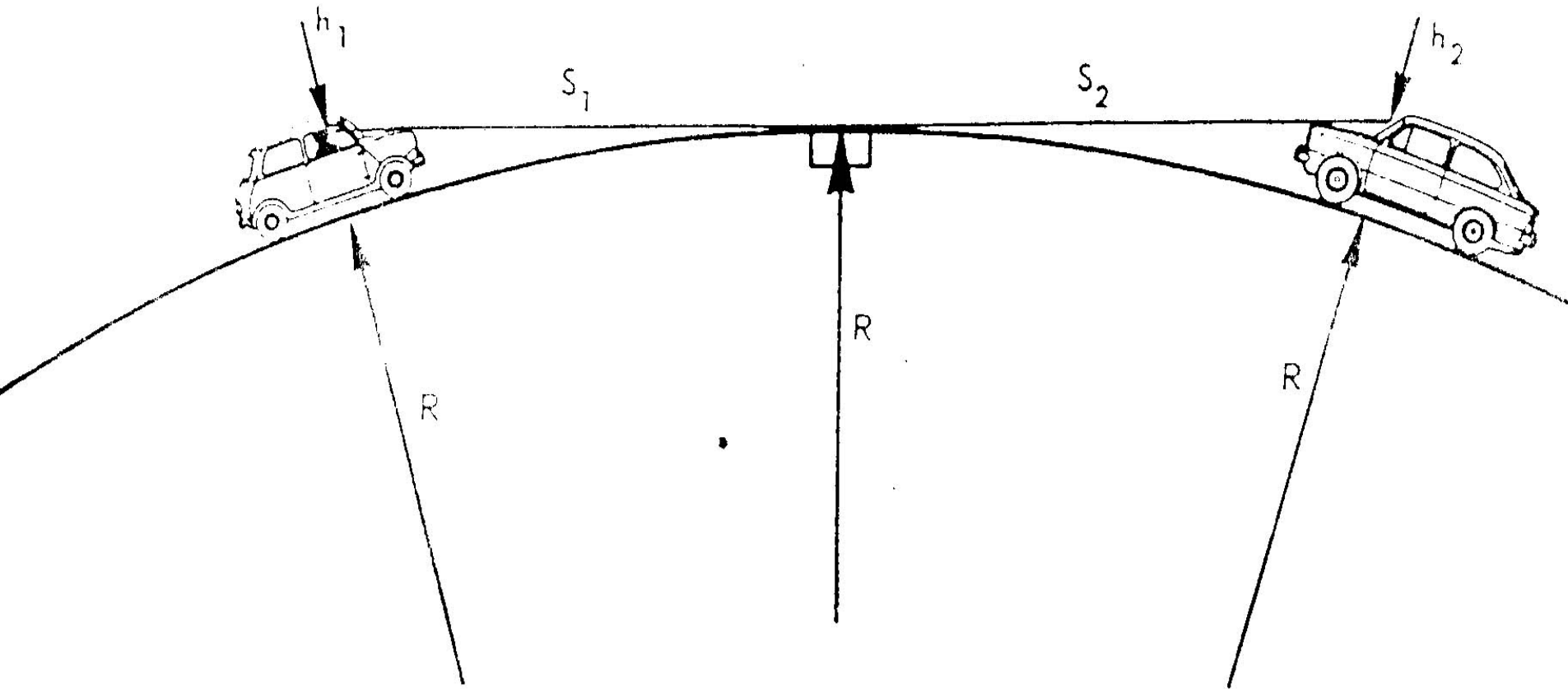




b) Vertical alignment (vertical curve radius R should provide stopping visibility (and visibility allowing overtaking - recommended)

Checked are: crest and sag vertical curves

Overtaking min. distance (s_1+s_2)





hotel business

KOFFINA
MEBLE
do Banków, Biur, Hoteli



Road safety criteria in choice and design of intersections. They should be:

- **Recongnizable** – user should recognize that he is approaching intersection,
- **Readable** - geometry and signing should be easy to understand
- **Drivable** – paths for all, specially turning movements should be provided, as vehicles when turning occupy wider corridors,
- **Reducing speed**
- Having **minimum number of collision points**
- **Providing visibility** of road users, road and traffic control devices

Recongnizable

- User should recognize that he is approaching intersection,
- Besides of good location, there are some measures to make intersection location recognizable to drivers (including signing and marking)





ПРАВИЛНИК
ДВБ
КАДА
МАШИНИ
КАРАНИ

Улица
Рова

10

7



Intersection should be recognizable
Combination of crest curve with intersection

Readable – geometry, signing and marking should be easy to understand

- typical layouts
- avoiding unexpected designs
- avoiding too much information



A large blue directional sign with white road layout. It features a central vertical line with a horizontal crossbar at the top and a horizontal crossbar at the bottom. A curved line branches off to the right from the bottom horizontal bar. Five red-bordered boxes with white text are placed around the sign: '631' at the top, '61' on the left, '633' on the right, '3,5^t' in the center below the top horizontal bar, and '632' at the bottom. A circular prohibition sign with a red border and a white background, containing a black silhouette of a truck, is positioned in the center of the sign, overlapping the top horizontal bar and the '3,5^t' box.

A vertical information sign with a white 'i' symbol on a blue background. Below it is a blue arrow pointing left with the number '350'. At the bottom is a blue arrow pointing up with the word 'OPEL' written below it.

A green directional sign with the word 'Niepa' written in white. Below the text are three blue arrows: one pointing up, one pointing down, and one pointing right.



13355

STOP

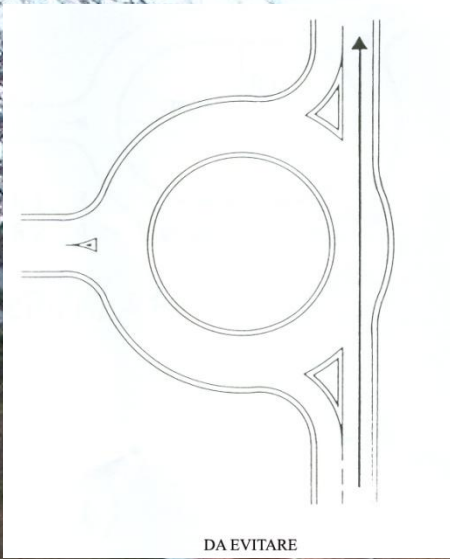
STOP

30
41
754
30
28
38
65



STOP





Trentino special; where is a central island?
Path deflection . Nice view instead!

Is it self-explaining roundabout? USA





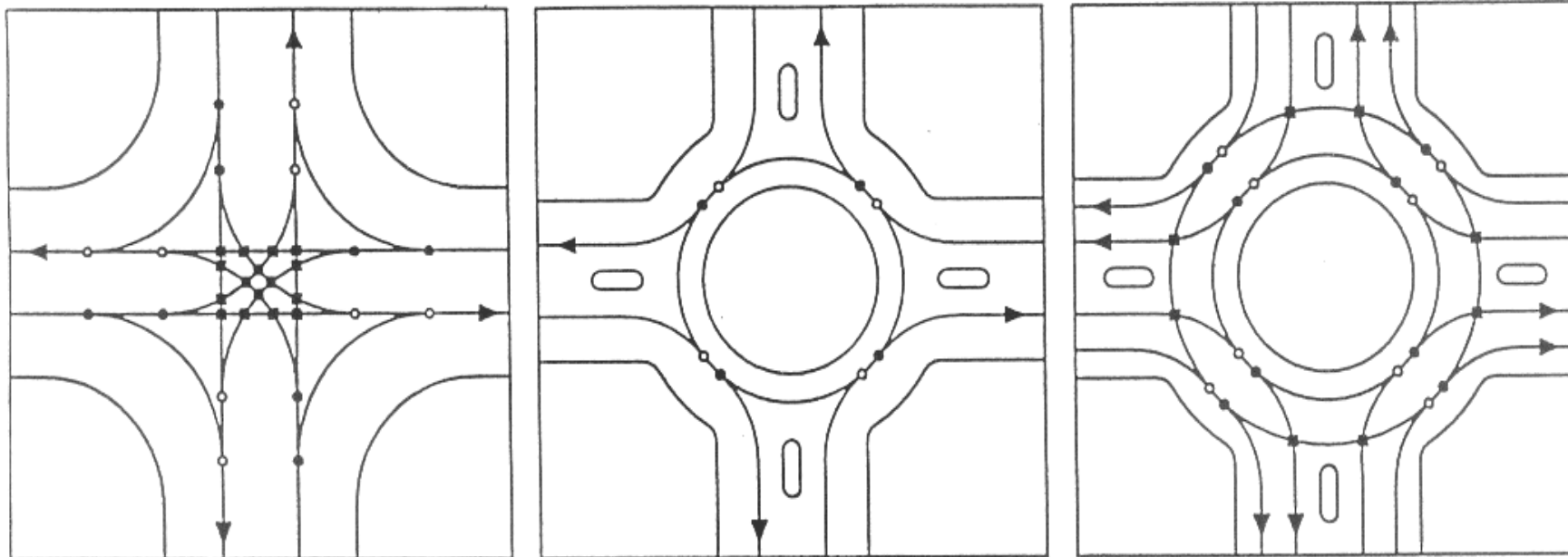
Is it self-explaining roundabout? (Closer to an island)



Minimum number of collision points

- Reduction by use:
 - traffic signals, two-phase or multiphase
 - roundabouts, particularly one lane roundabouts

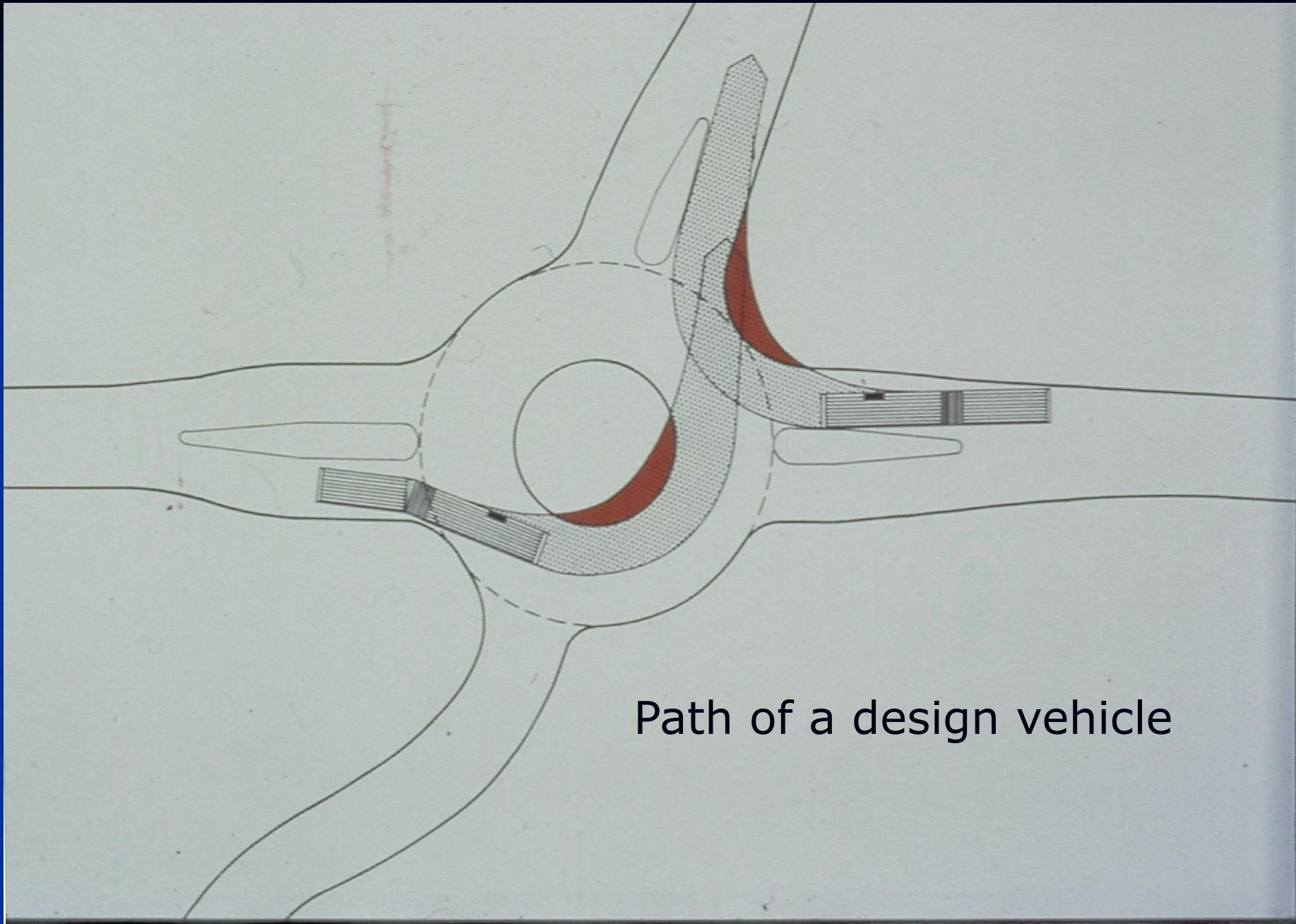
Reduction of the number of collision points



Legenda: ■ - krzyżowanie
● - wyłączenie
○ - włączanie

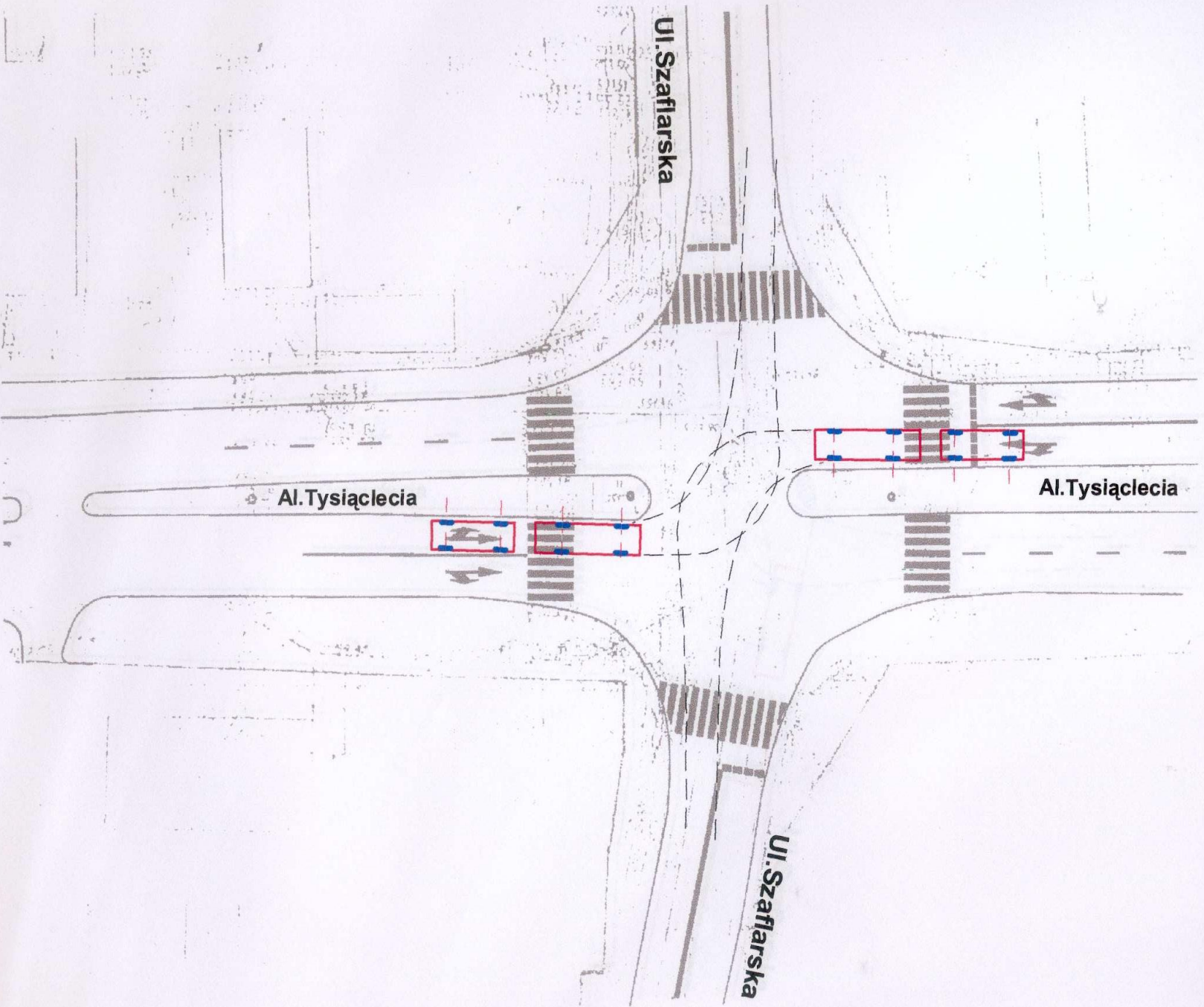
diverging

- **Drivable** – vehicles when turning occupy wider corridors,
- paths with proper width specially widened for turning movements, at small roundabouts should be provided
- **An intersection should be drivable in all weather conditions for each vehicle admitted to traffic**



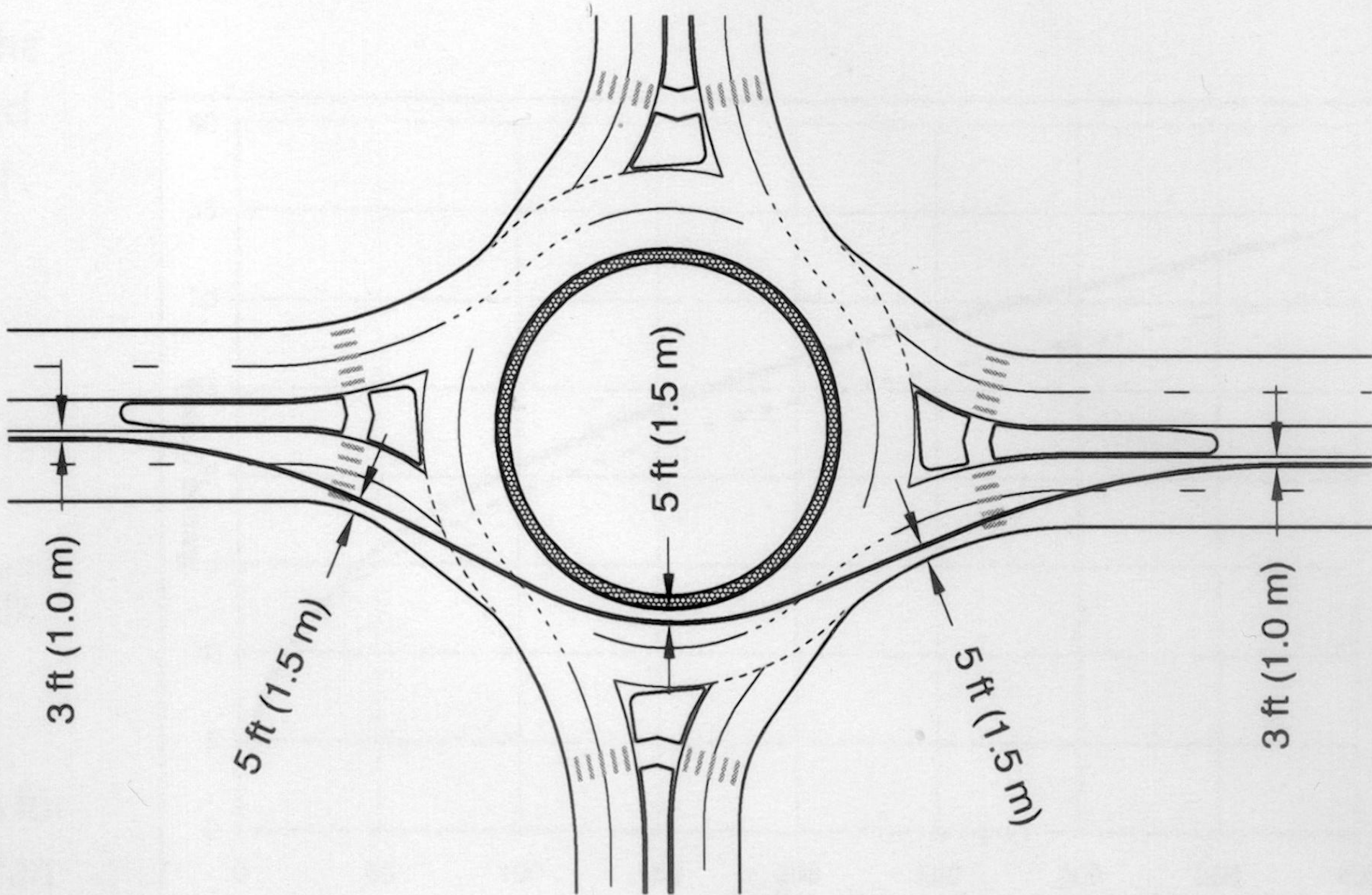
Path of a design vehicle

**SPRAWDZENIE PRZEJEZDNOŚCI SKRZYŻOWANIA
NA KIERUNKU AL. TYŚIĄCLECIA
sam. ciężarowy z przyczepą**



**Dochodzi do nakładania się korytarzy ruchu pojazdów relacji,
które nie są ze sobą kolizyjne.**

Drivable, but also to decrease speed



Provide **visibility** of road users, road and traffic control devices

- on horizontal and vertical curves,
- at intersections (including roundabouts) and pedestrian crossings,
- when locating various road and traffic control devices, etc.



LONGVIEW COLLEGE
←

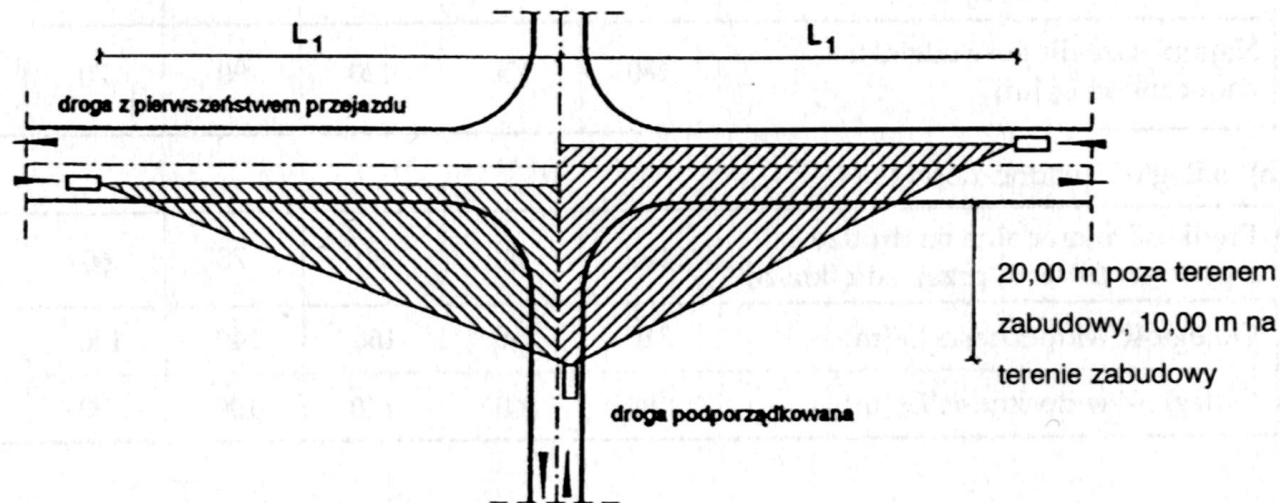
SHARE THE ROAD
BICYCLE

SHARE THE ROAD
BICYCLE

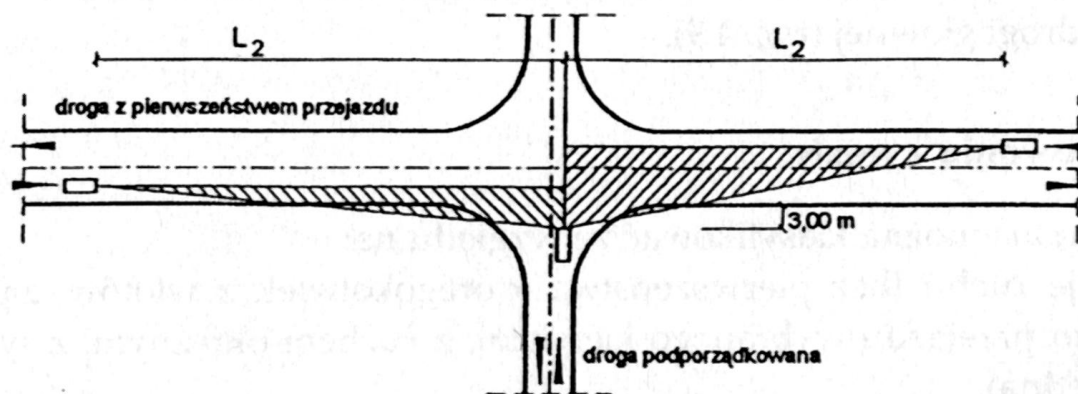
SHARE THE ROAD
BICYCLE

CHEVROLET

Intersections. Visibility from minor entry



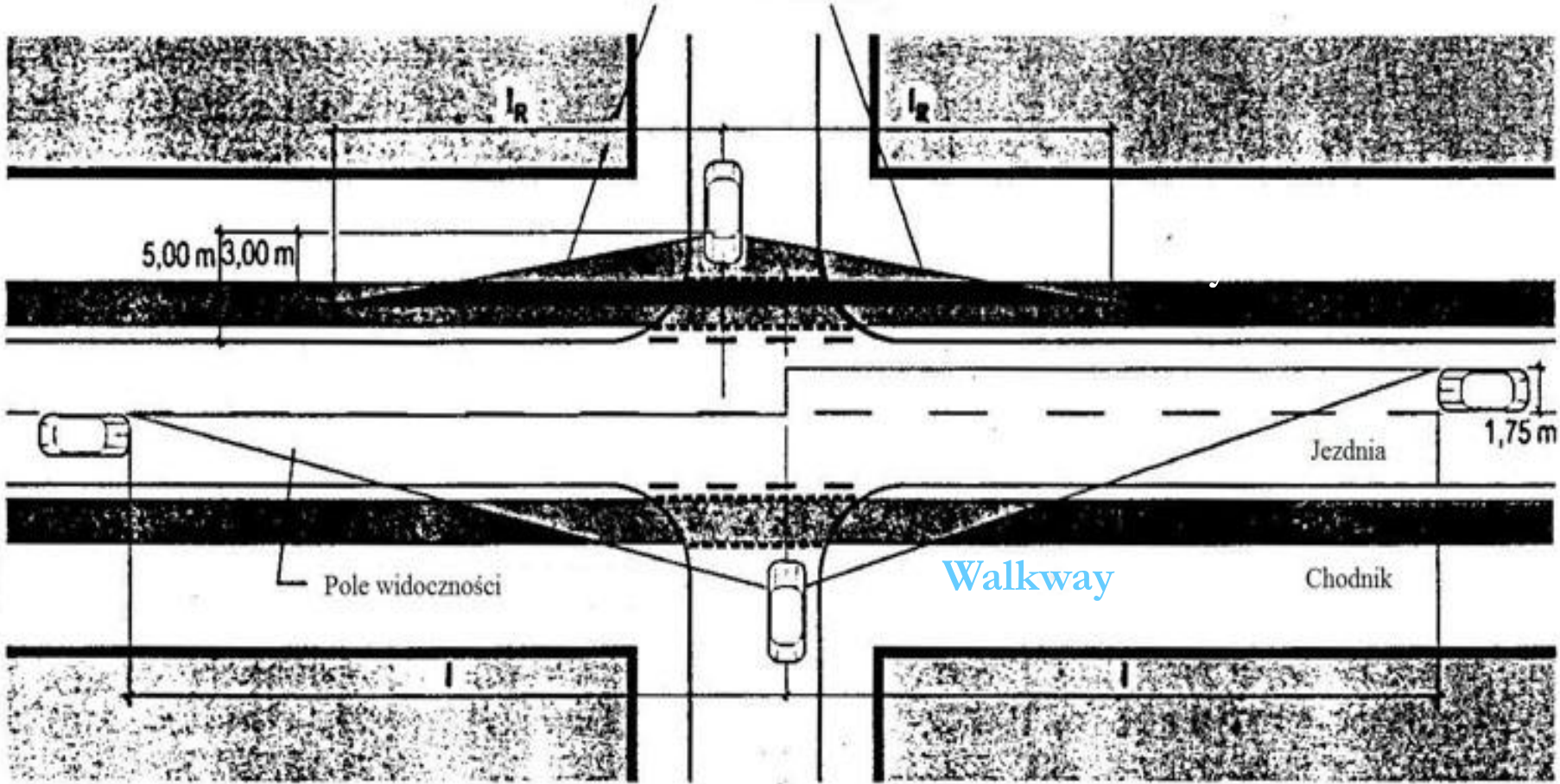
Widoczność przy dojeździe do skrzyżowania

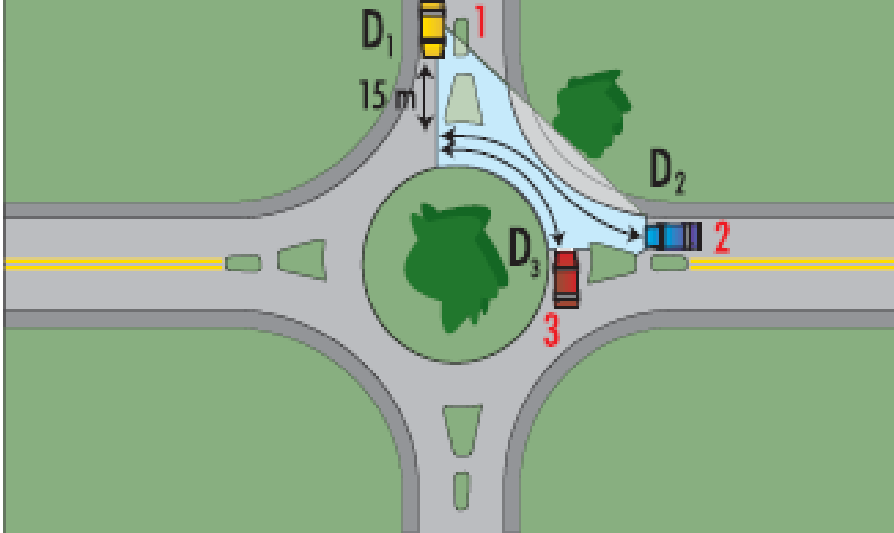
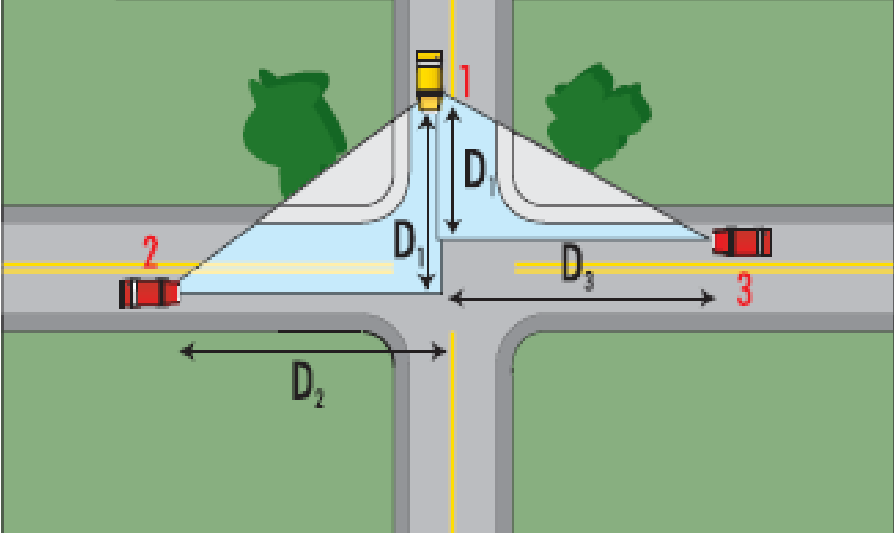


Widoczność przy ruszaniu z miejsca zatrzymania

Pole widoczności
na ścieżkę rowerową

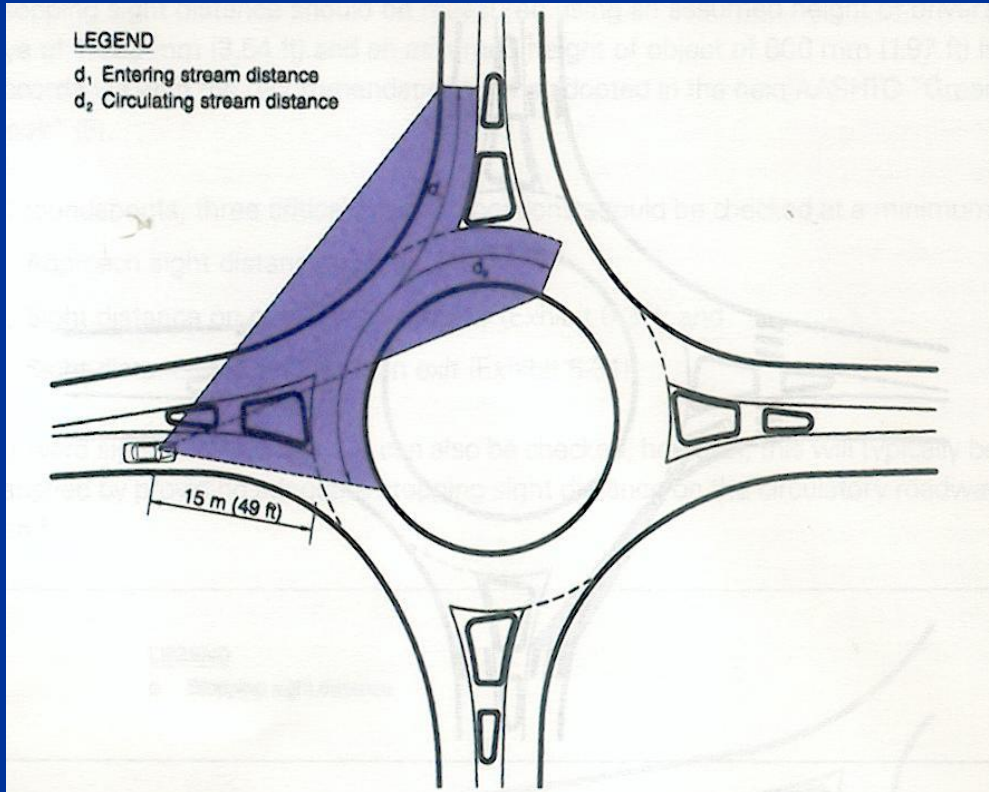
Visibility area



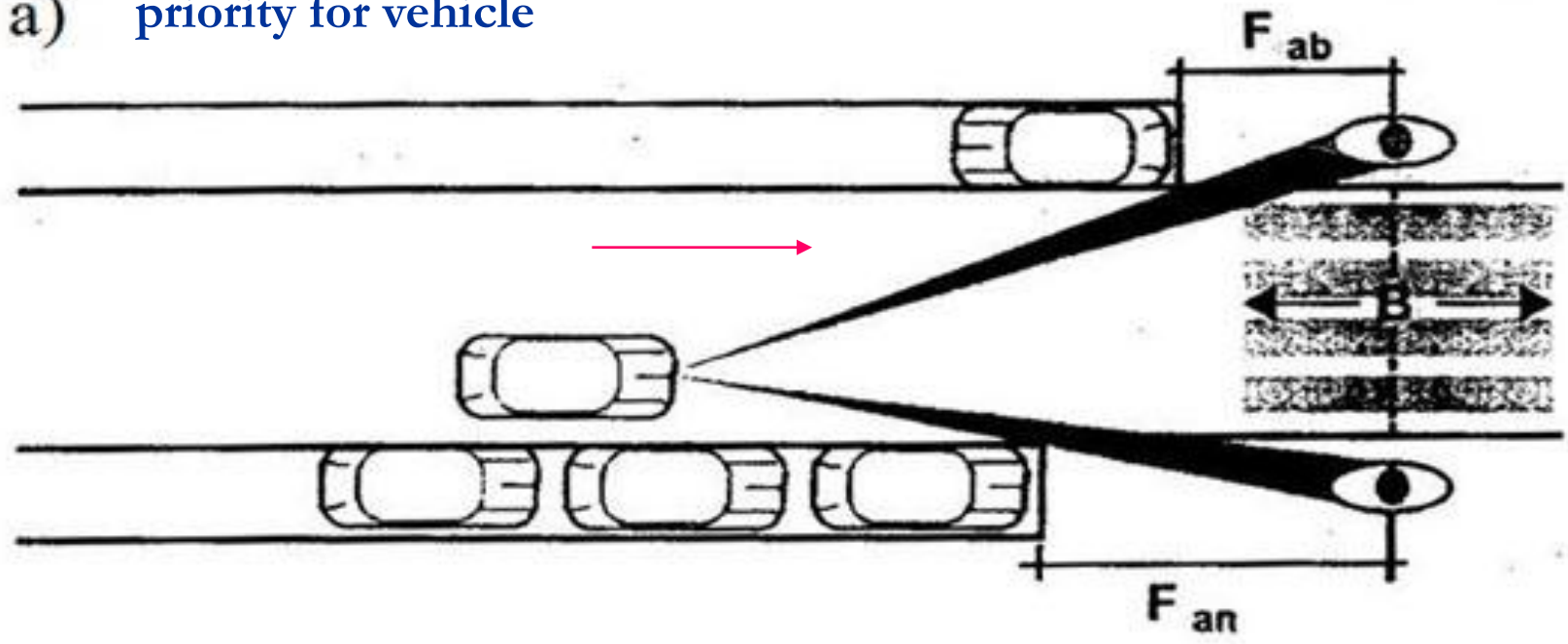


Conventional intersection:

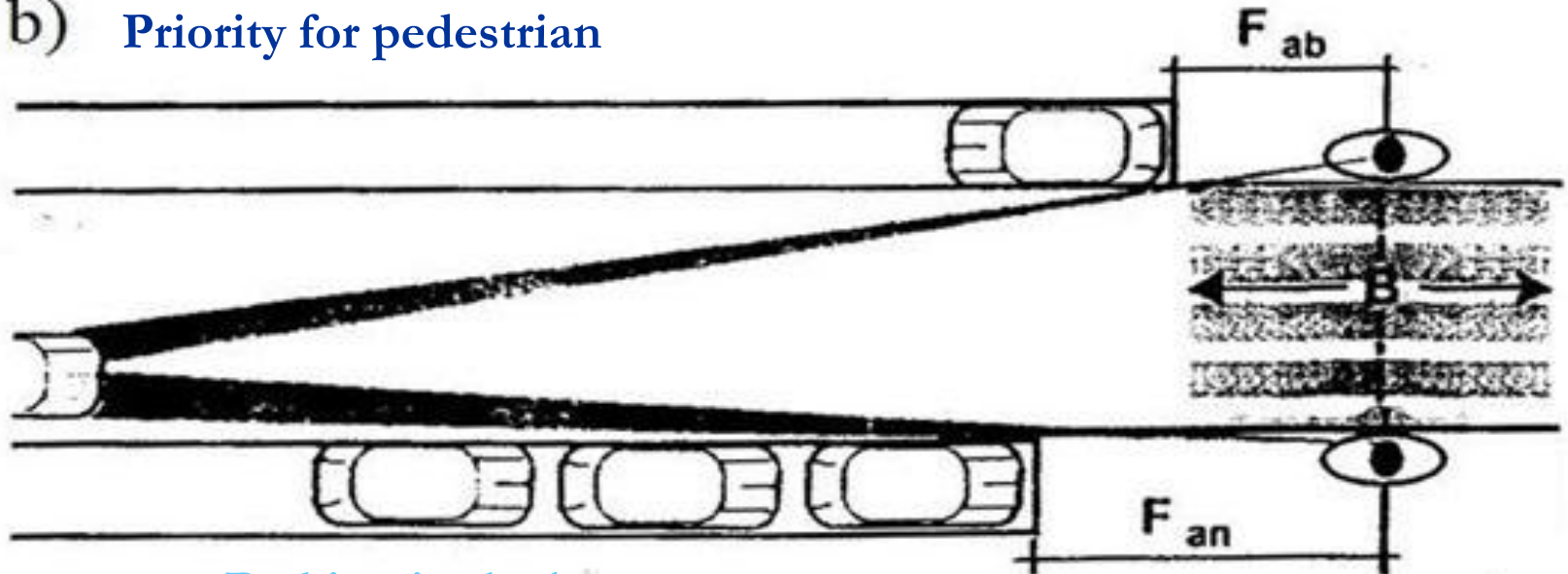
Roundabout:



a) priority for vehicle



b) Priority for pedestrian



Parking in the bay



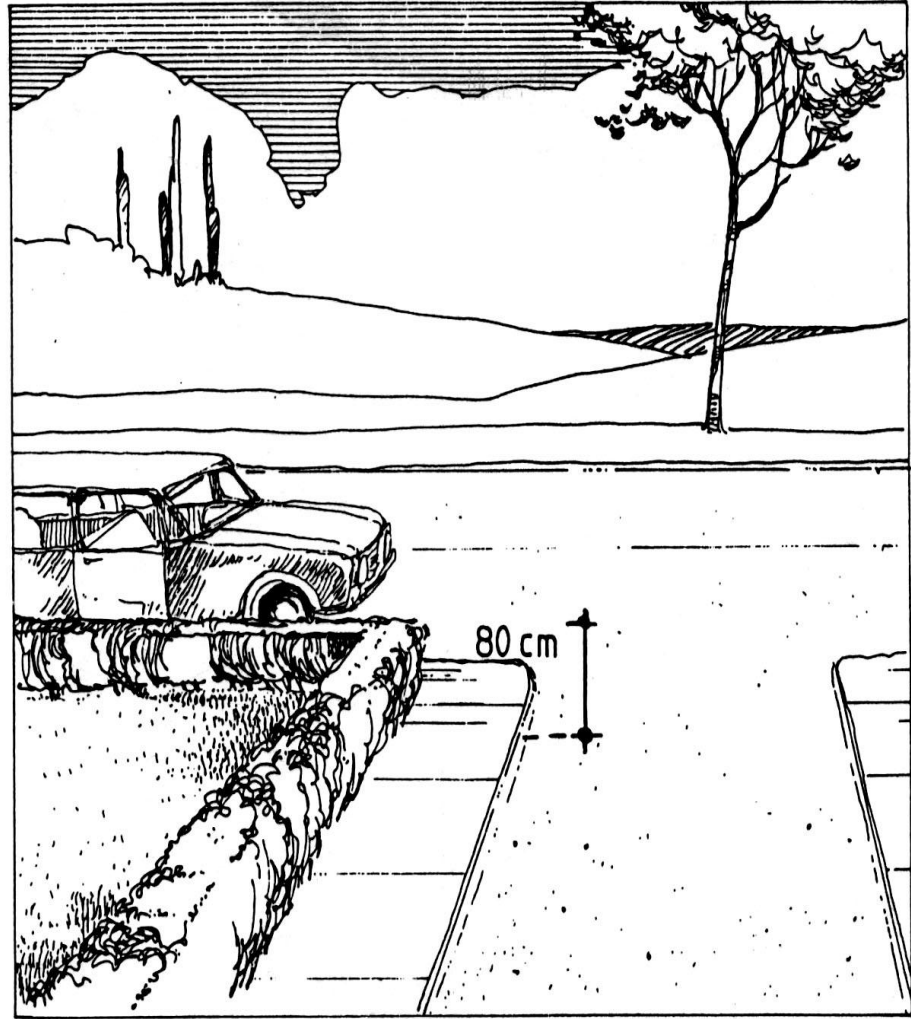
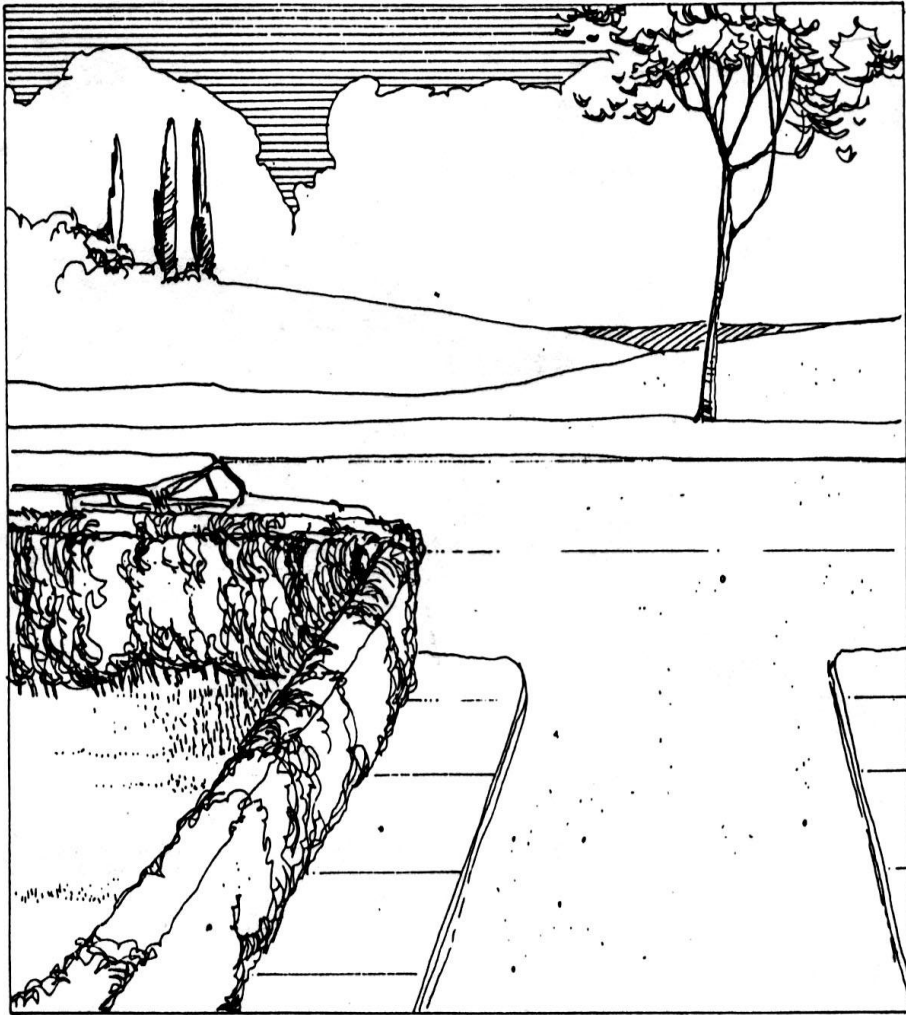
NOZ 8642



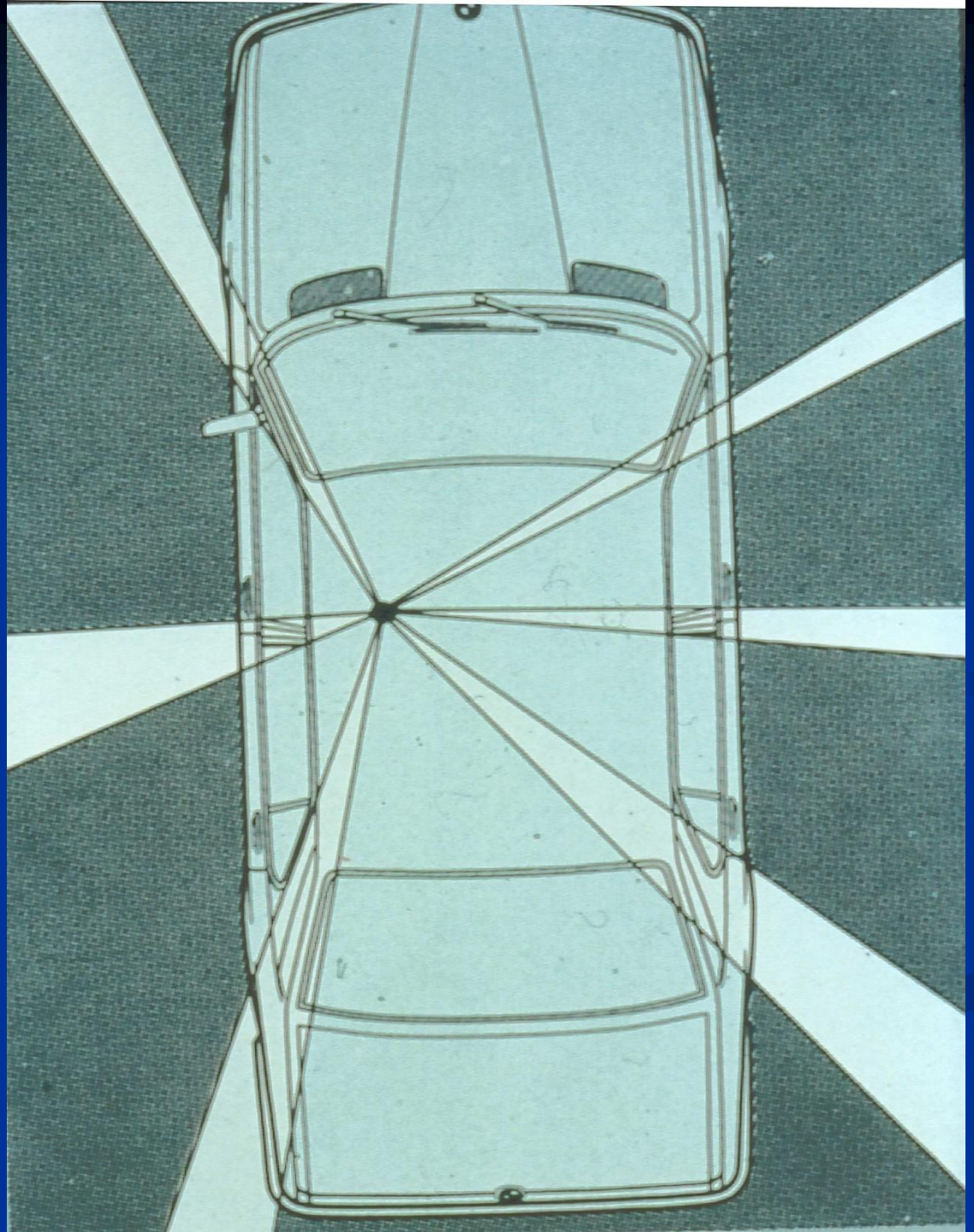




KR 5026W



Ergonomics of visibility





WYKONANIE PRAC

10

ELIAT

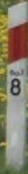
Zalicy David Sobonary
ADRESOWANIE W SPRAWIE

COMPUTERY
MAMY PRZEKAZAĆ
INFORMACJE
WYKONANIE PRAC

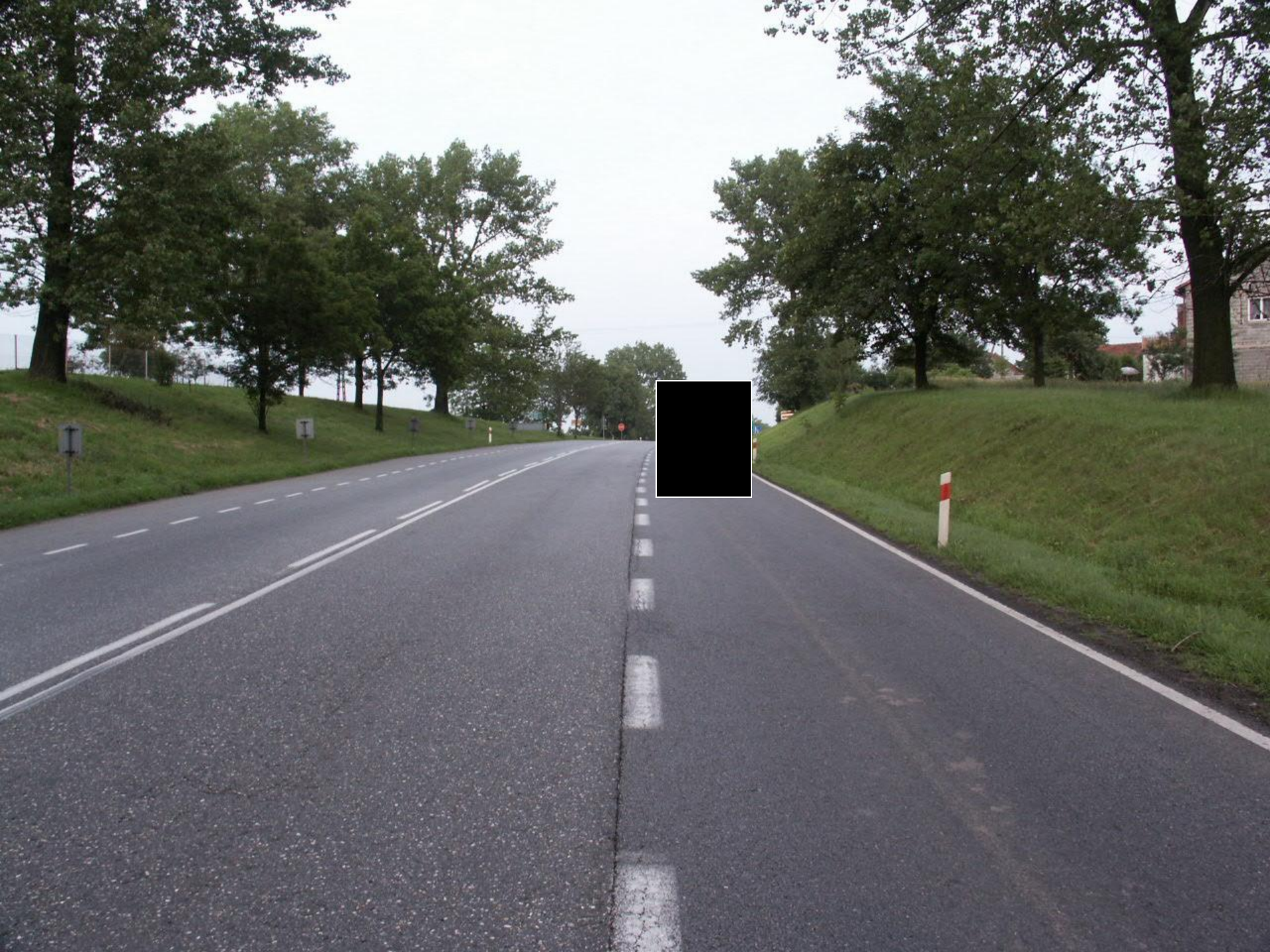
Chyline
Zorkowice

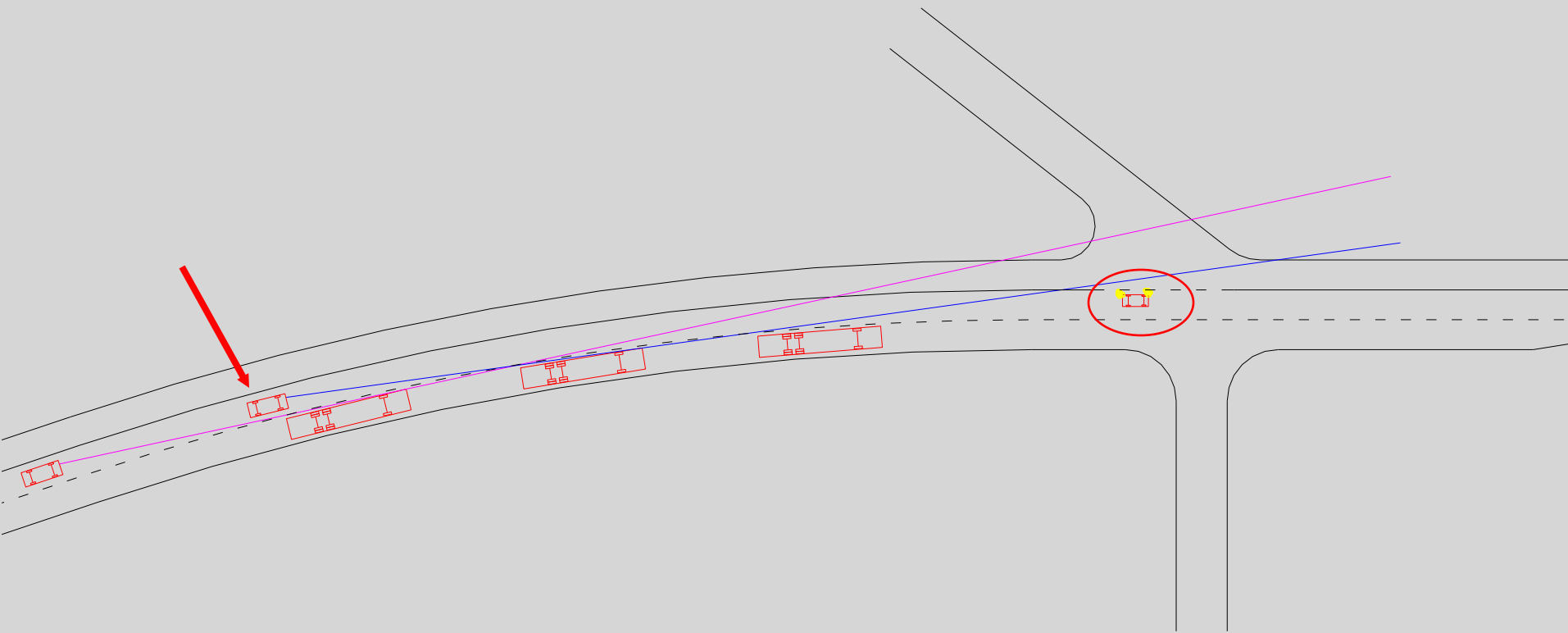
ITKOWICE

8







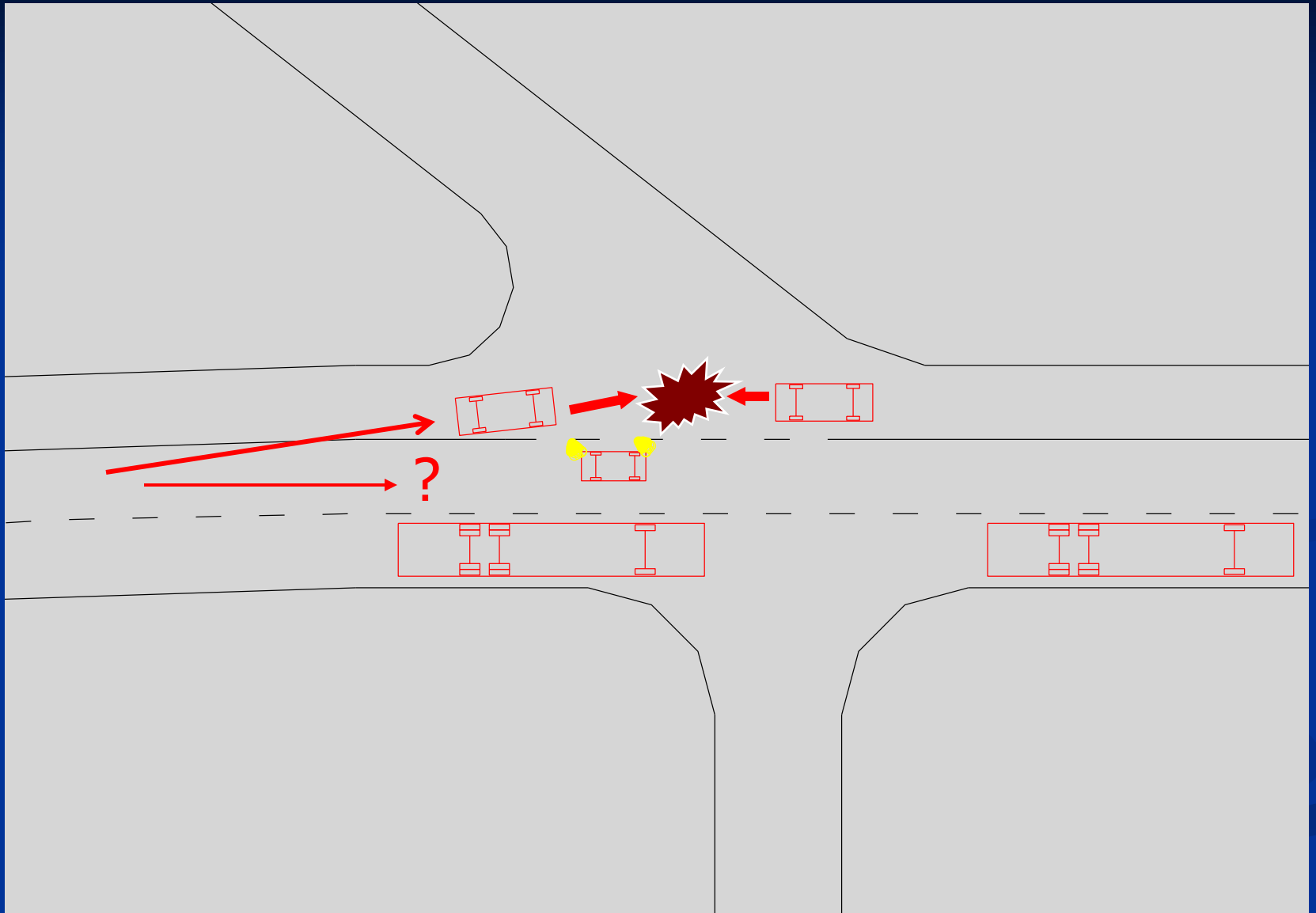


$$L_{ZMIN} = t_r \cdot V + L_h$$

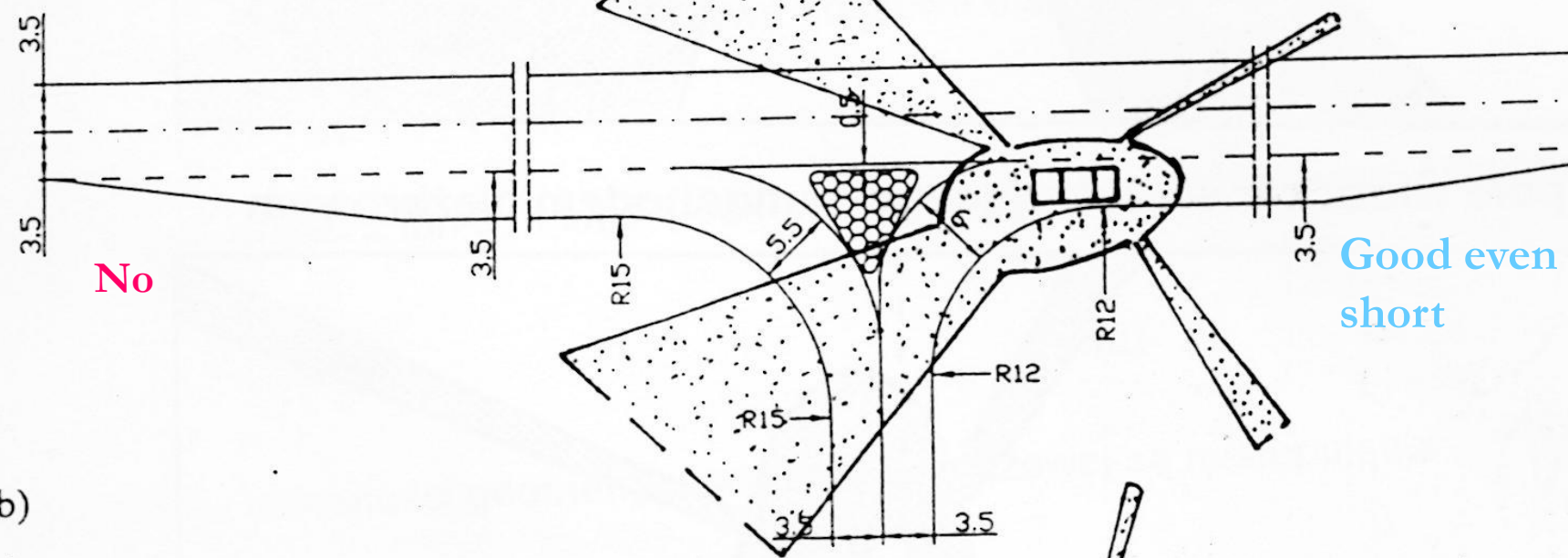
$V = 90 \text{ km/h} - L_{ZMIN} = 80.6 \text{ m (117,2)}$

$V = 110 \text{ km/h} - L_{ZMIN} = 110,2 \text{ m (164,9)}$





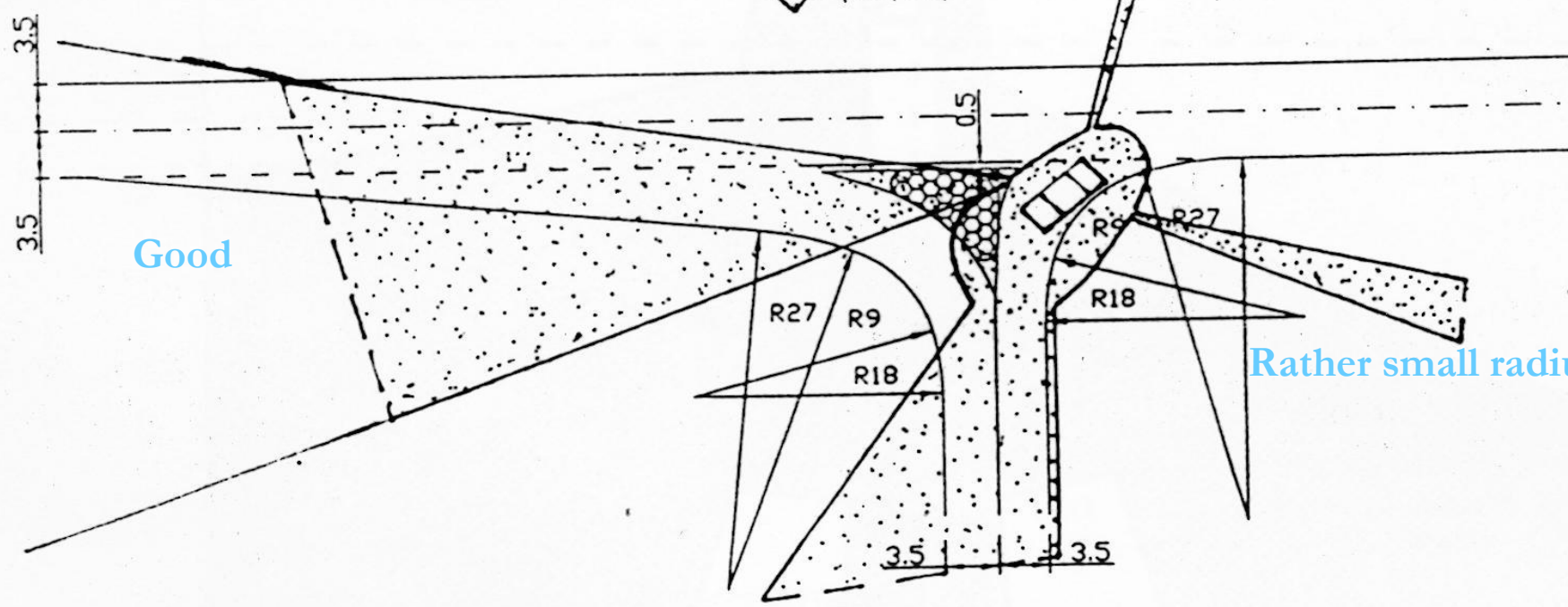
a)



No

Good even short

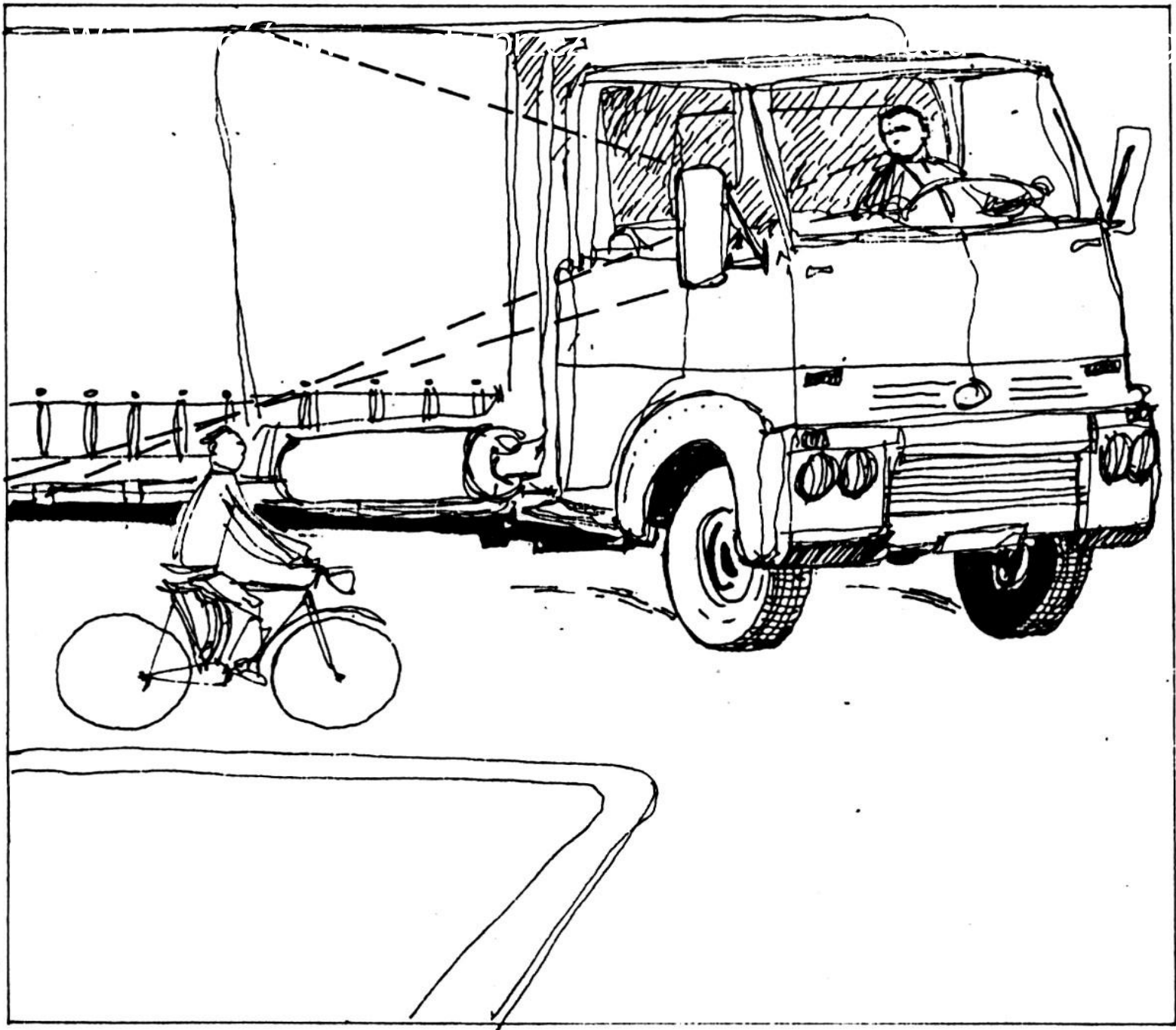
b)



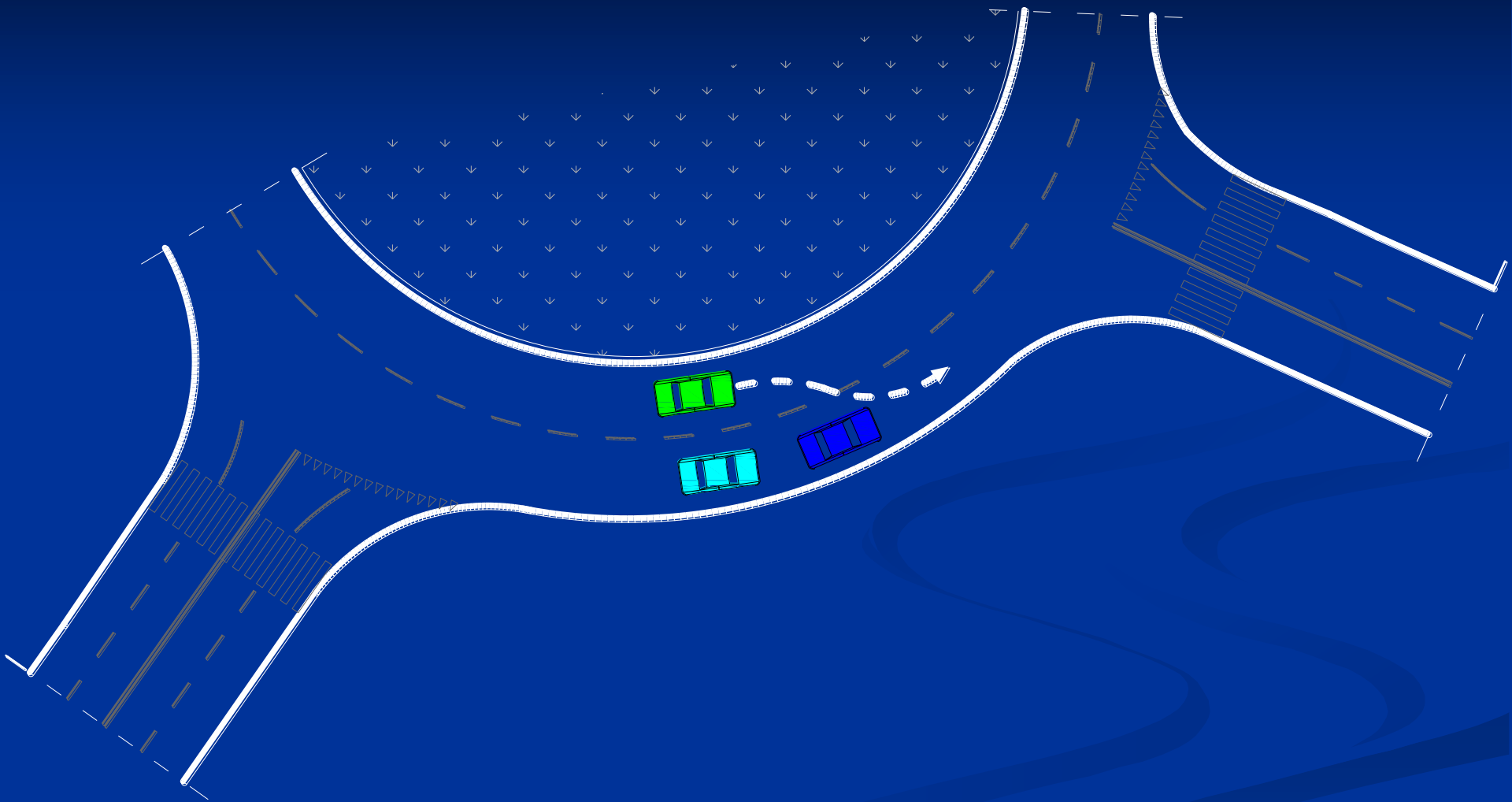
Good

Rather small radii









Road safety audit

- The European Parliament and the Council of the European Union have adopted the Directive on Road Infrastructure Safety Management (19 Nov. 2008) in order to guarantee high level of road safety.
- These EU institutions came to conclusion that setting –up of appropriate procedures is an essential tool for improving a safety of road infrastructure.
- **Two procedures:** road safety impact assessment **RSIA** and road safety audit **RSA**

- Road safety impact assessment **RSIA** – means a strategic comparative analysis of an impact of a new road (or substantial modification of the existing network) on safety performance of the network
- **Road safety audit RSA means an independent detailed systematic and technical safety check relating to the design characteristics of road infrastructure project and covering all stages from planning to early operation**
- The directive shall apply to roads which are part of the trans-European road network (usually national roads)

Why do people involved in the design and construction process make errors resulting in accidents as they should follow design guides?

- a. Road accident is a result of errors made by road users in circumstances „helping” to make these errors.
- b. These „helping circumstances” are created by road factors, traffic control factors and varying traffic-road-weather conditions
- c. Good design and construction make a road „forgiving”; for example sharp braking on slip or skid resistance surface.

- Designing of road consists of a set of decisions related to vertical and horizontal alignment etc. . These decisions have an impact on accident risk, on frequency and severity of accidents. These decisions are usually made without knowledge on their impact on safety.
- For example how students select a radius for their horizontal curve in student's projects?
- Applying rules from guidelines in automatic way, being convinced that taking values from tables one produces safe project
- Short time used for real design as most of its time designer spends on environmental, economical, implementation and coordination issues.



Arriving to pedestrian crossing „in the shadow”



Vehicle can come in the shadow of other vehicle – not visible to pedestrian





Pedestrian crossing sign is not well seen, some signs are too small



Technical inspection issue



Santander
Alfonso
AGA
903 34910





PIESI



