ROYAL HASKONING

Bicycle Traffic Planning and Design

April 1, 2011, Prilep, Macedonia

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Bicycle Traffic Planning and Design

Content:

- Policy
- Basic principles
- Network
- Routes
- Sections
- Junctions / crossings
- Bicycle parking
- Additional subjects

Policy

Why design and realize facilities for bicycles?

Benefits of cycling

Mr. Roelof Wittink, Director I-CE, Interface for Cycling Expertise

Benefits: the local economy

- **Shops better accessible when people come by bike**
- **Drivers spend 2 times more, cyclists come 3 times more often**
- **Houten shopping centre has 2,5 timer higher turn over**

Benefits: road safety

- **Considering cyclists and pedestrians main factor for road safety**
- **32% more km by car and on the bike, 1980-2001; 48% less fatalities in cars and 54% less fatal cyclists**

Benefits: attractive cities

- **You remember cities from urban space, monuments, not from cars**
- **Cars need 20-30 times more space than bicycles**

Combination public transport

Combi public transport and cycling is car alternative

- **Public transport competes on longer trips, bike on short trips and is door-to-door;**
- **Bicycle is excellent feeder: 40% train passengers come by bike, 15% leave by bike**

Costs and benefits

- **Costs roads for car 10 times higher,**
  for parking 15 times higher

- **Cost benefit ratio: 1 : 5 – 15**

Conclusion:

- **Less congestion, more safety, better fitness, better air quality, zero emission, less stress, affordable, more independence, it’s a pleasure**

What to learn

- **Potential is high: 50% all trips within cycling distance**
- **Investments are needed**
- **Listen to what people have to say**
- **Plan and design for a *coherent* network of *safe*, *attractive*, *comfortable* and *direct* routes: 5 quality requirements, everywhere applicable**

Social indifferent

Cycling has always been done by all people,
no matter income and lifestyle,
including royal family

Essential policy elements

Stimulate use of bicycles (7,5 km)

Bicycle route networks → Meet quality requirements

Appropriate parking facilities → Location & quality

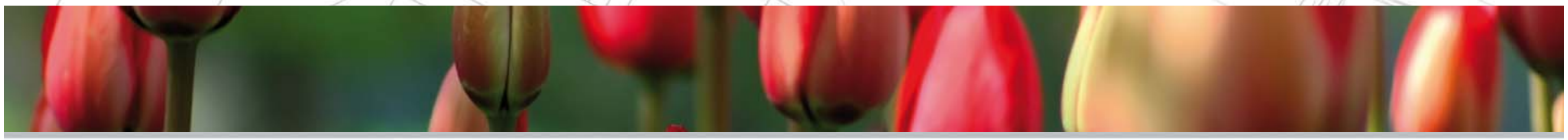
New developments well connected

Reduction of bicycle theft

Be alert for new barriers

New: High Speed Bicycle Routes!

Basic principles



Human being as measure of things →
→ design from cyclists' point of view

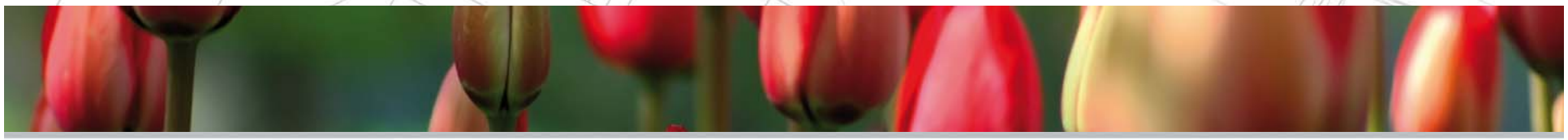
Characteristics

Integral design

Function, form and use

5 main requirements

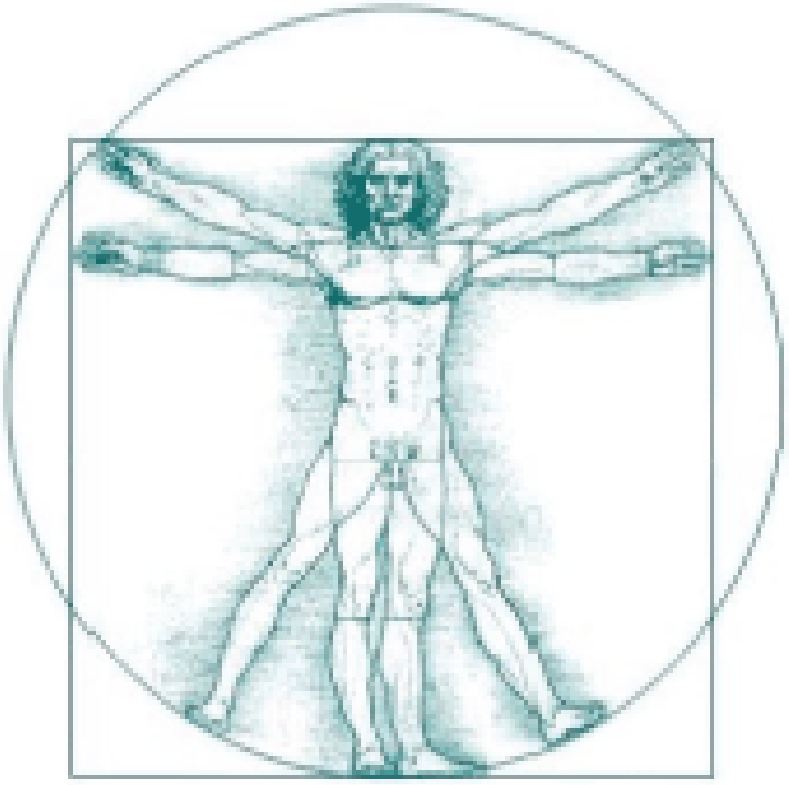
Basic principles



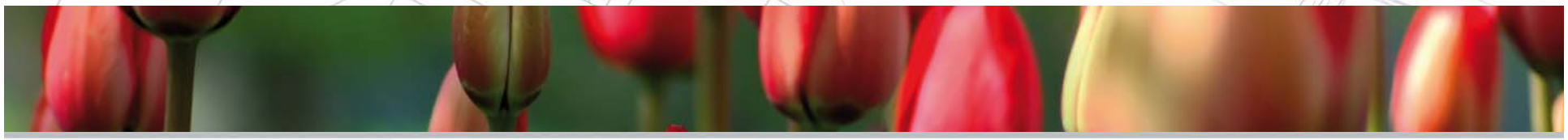
Human being as measure of things →
→ design from cyclists' point of view

Differences:

- **age**
- **gender**
- **physical capacities**
- **reason for cycling**



Basic principles



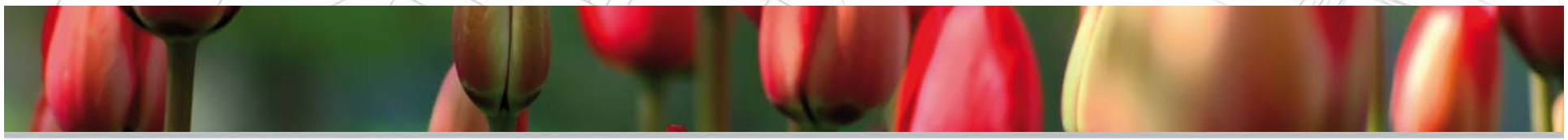
Human being as measure of things →
→ design from cyclists' point of view

Design speed:
commuter cyclist

Crossing time, gradient:
elderly

Eye level, red light discipline:
youth

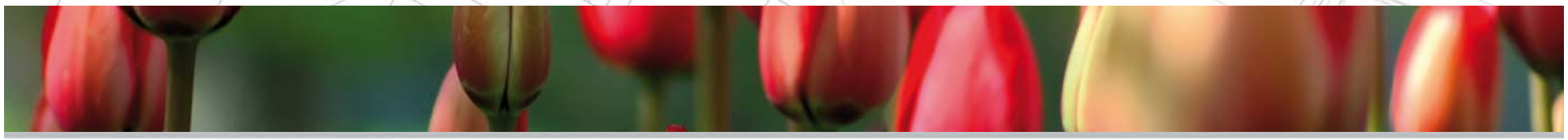
Basic principles



Characteristics:

1. **Muscle power** minimum energy loss
2. **Unstable** wind, bumps, low speed
3. **No crumple zone** vulnerable, space
4. **Hardly suspension** smooth surface
5. **Open air** shelter, attractive surroundings
6. **Social activity** side by side, escort
7. **Key factor: people** physical limitations

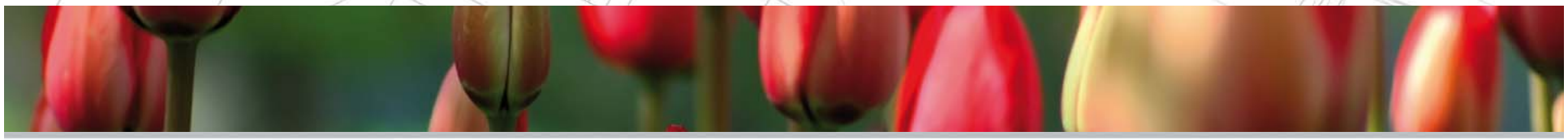
Basic principles



Characteristics:

Different types of bicycles

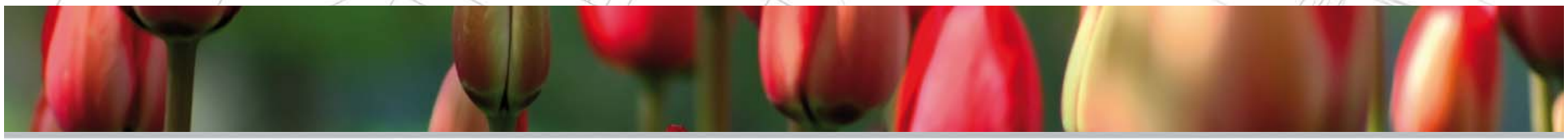
Basic principles



Characteristics:

Different bicycles
Different cyclists

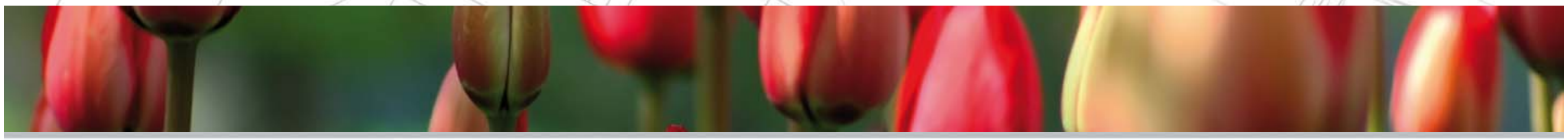
Basic principles



Characteristics:

Different bicycles
Different cyclists
Different use of bicycle

Basic principles



Characteristics: main dimensions

Length: 150 – 220 cm
Height: 40 – 120 cm
Handle bar width: 45 – 70 cm
Wheel size: 51 – 72 cm
Tyre thickness: 2.5 – 5.0 cm

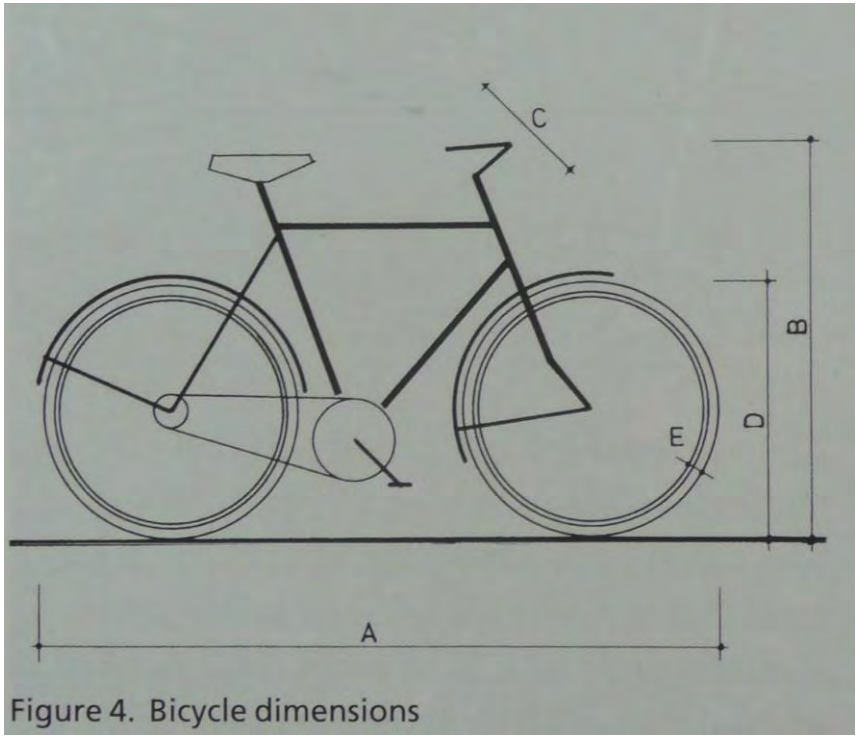
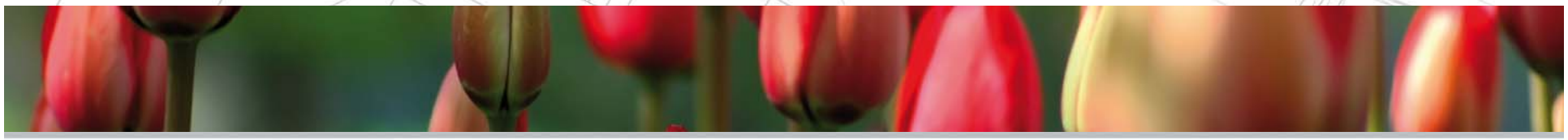
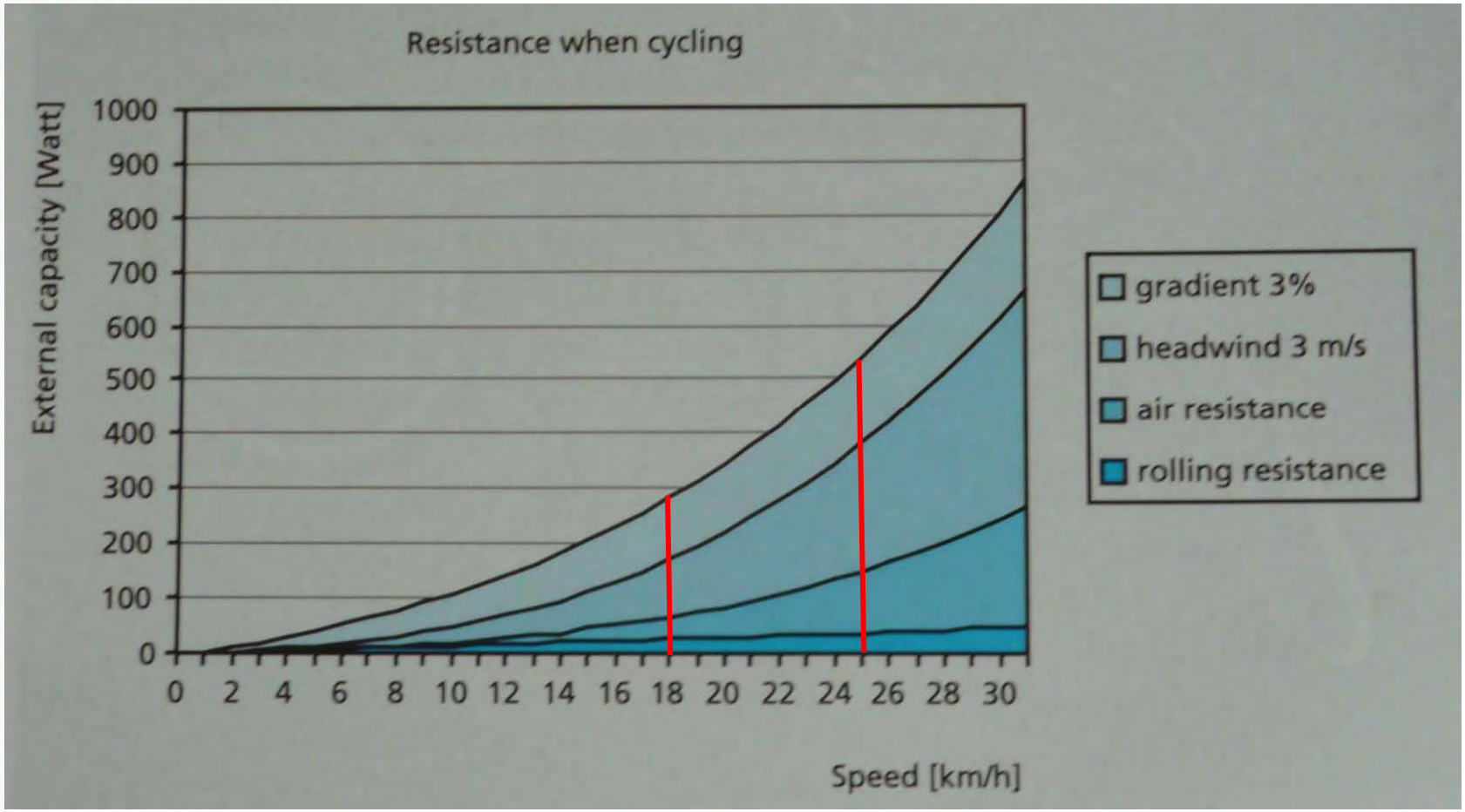


Figure 4. Bicycle dimensions

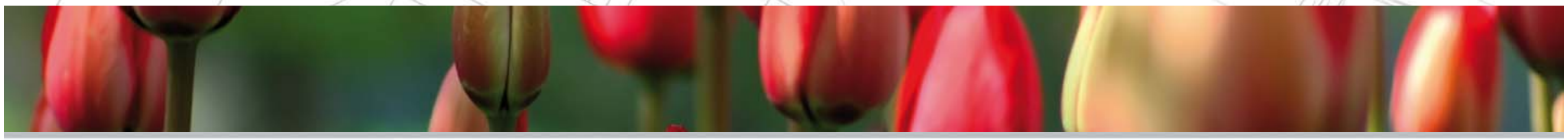
Basic principles



Characteristics: muscle power → resistance

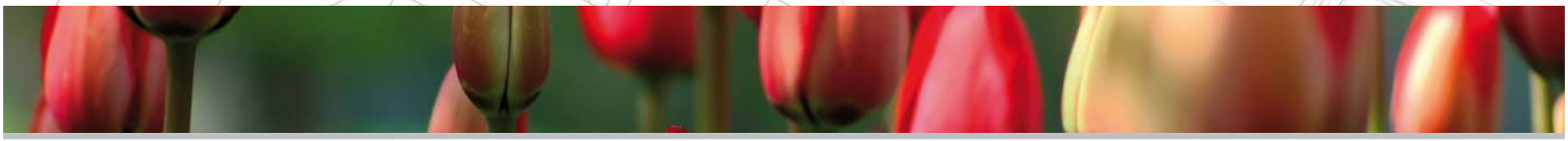


Basic principles



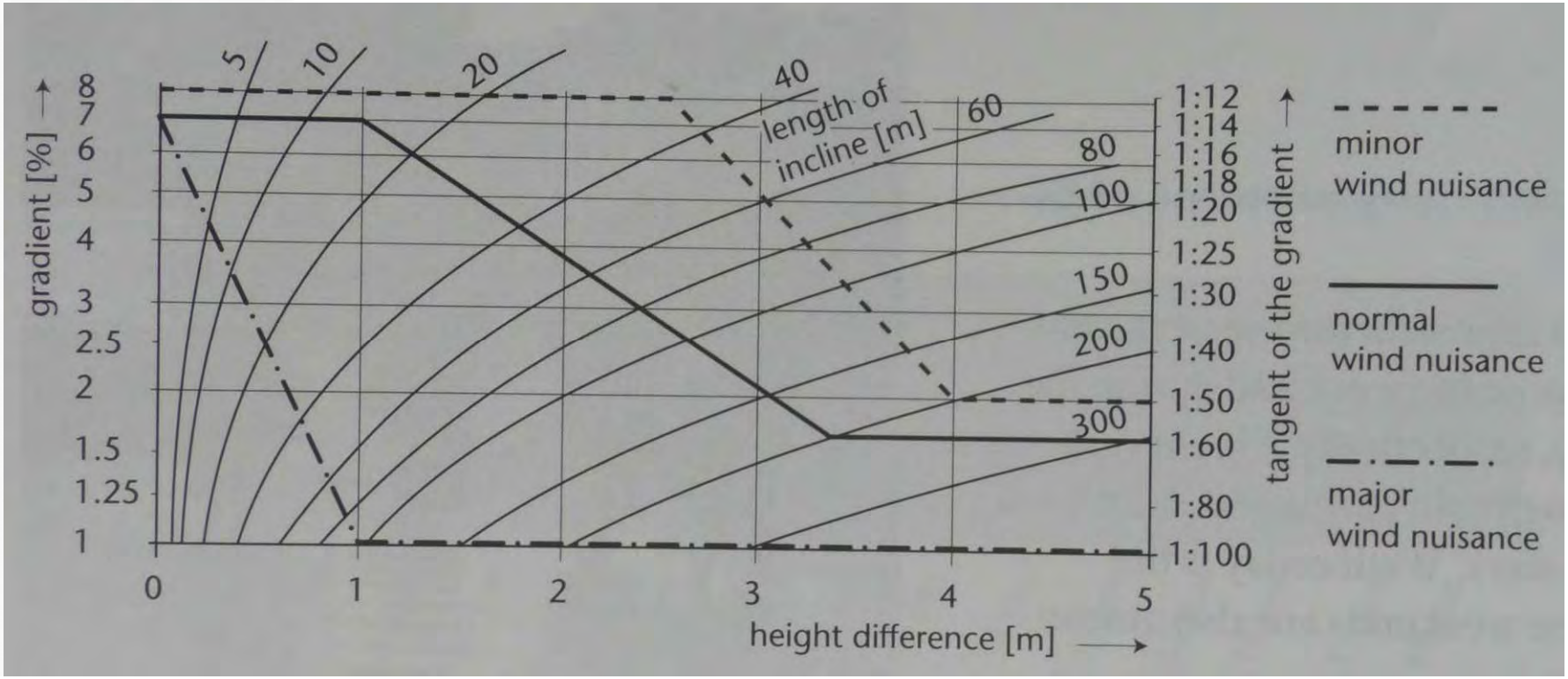
Characteristics: muscle power → resistance

Basic principles

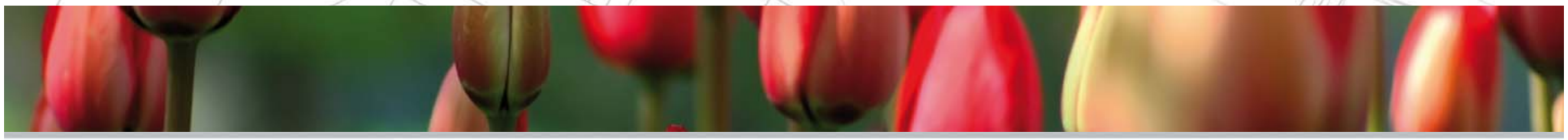


Characteristics: muscle power

gradient



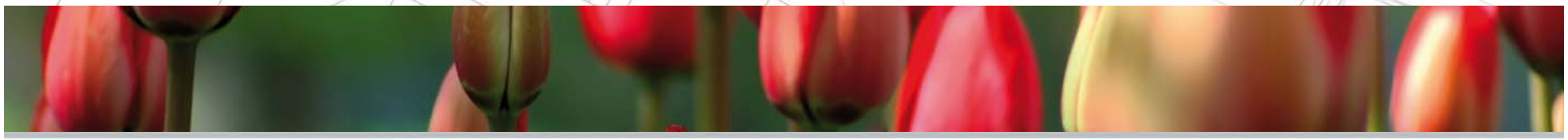
Basic principles



Characteristics: muscle power

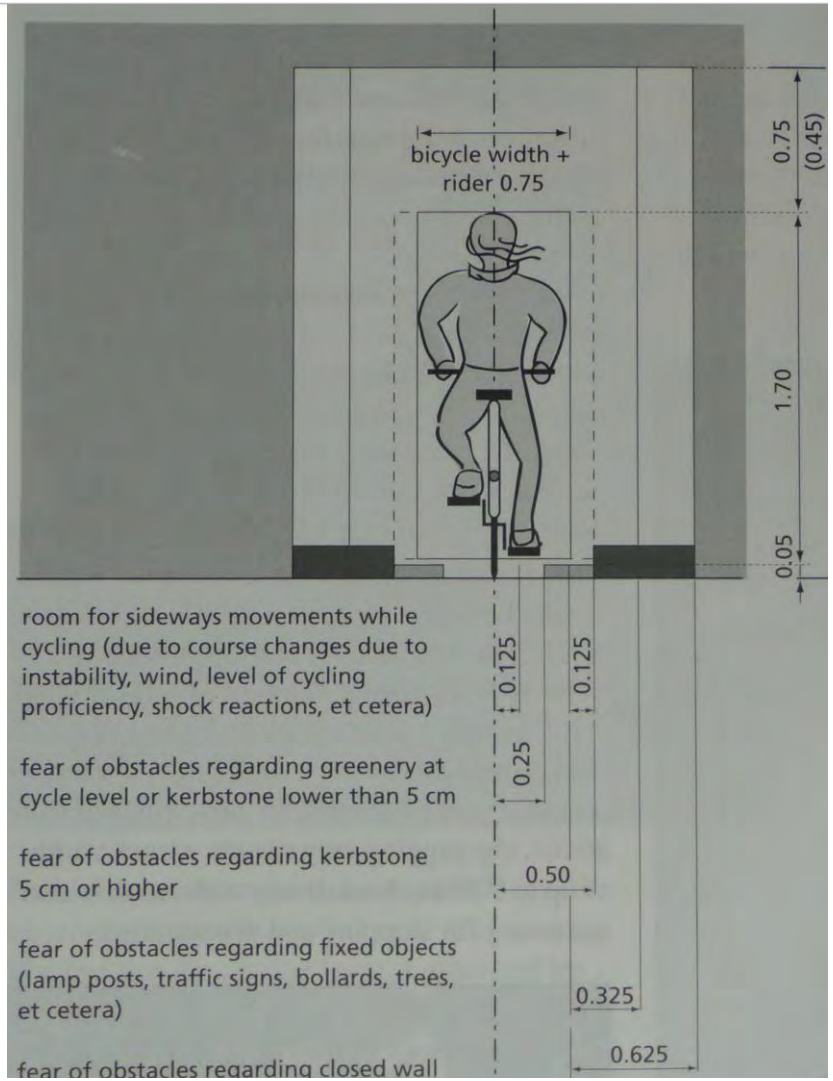
gradient

Basic principles

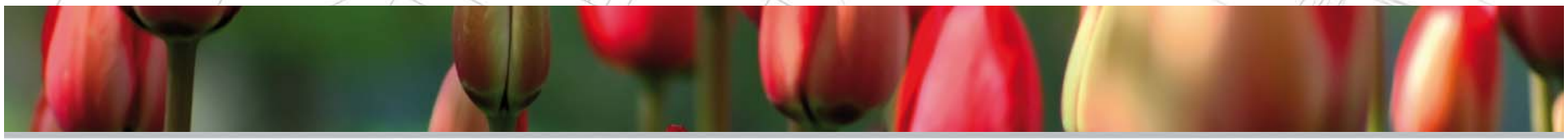


Characteristics: balance

zigzagging, free space

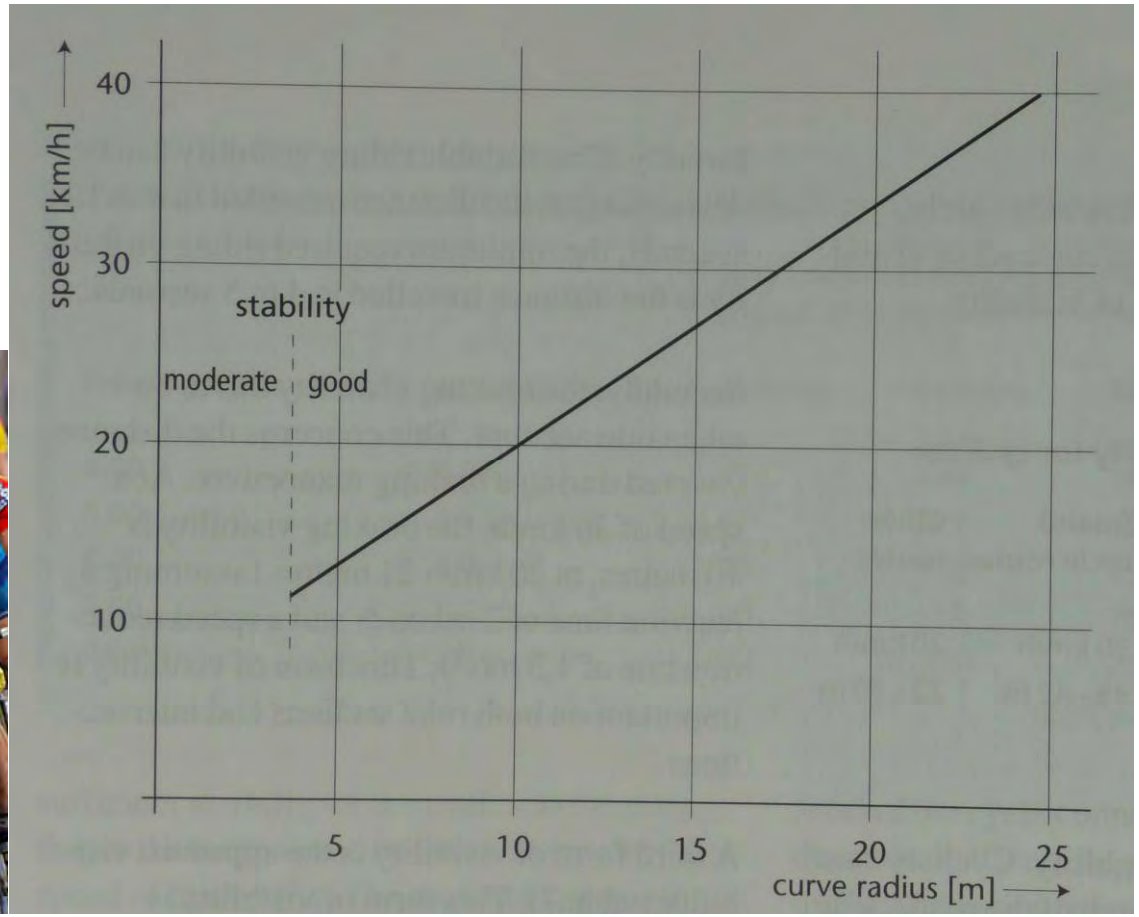


Basic principles



Characteristics: stability

curves and speed



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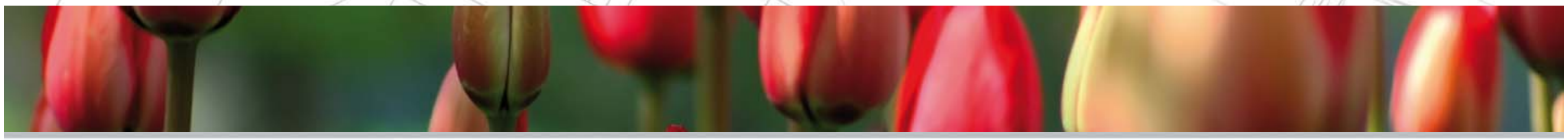


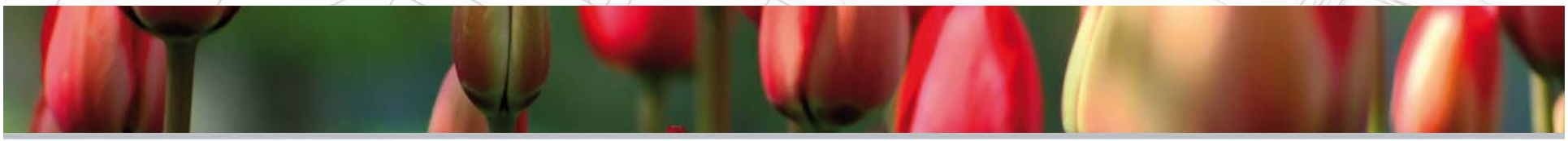
Characteristics: stability

visibility

Table 7. Approach visibility required for various road widths and riding speeds

		approach visibility required (m) for various closing speeds of motorised traffic (V_{85})			
crossing distance (m)	crossing time (s)	30 km/h	50 km/h	70 km/h	80 km/h
4.00	4.2	45	100	180	205
5.00	4.5	45	105	185	210
6.00	4.9	50	110	190	220
7.00	5.1	50	115	200	225
8.00	5.5	55	120	205	235

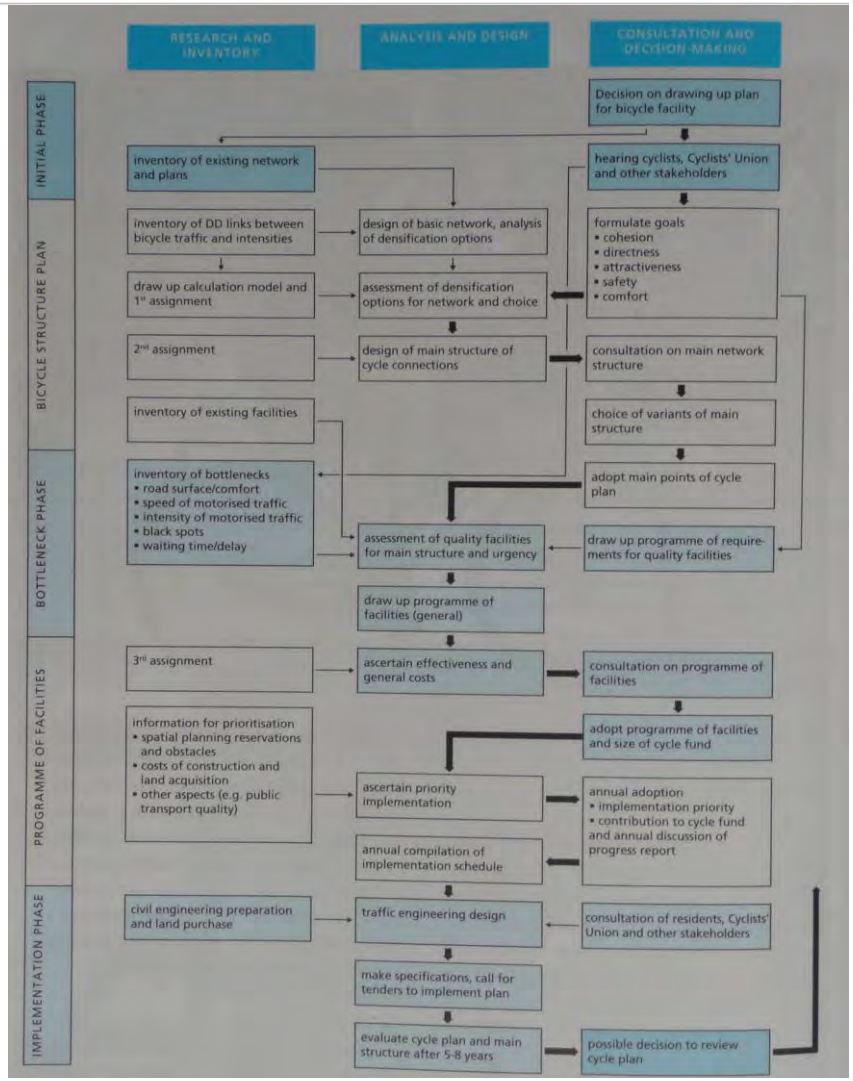
Basic principles



Integral design

- **Research and inventory**
- **Analysis and design**
- **Consultation and decisions**

- **Initial phase**
- **Bicycle structure plan**
- **Bottle neck phase**
- **Programme of facilities**
- **Implementation phase**



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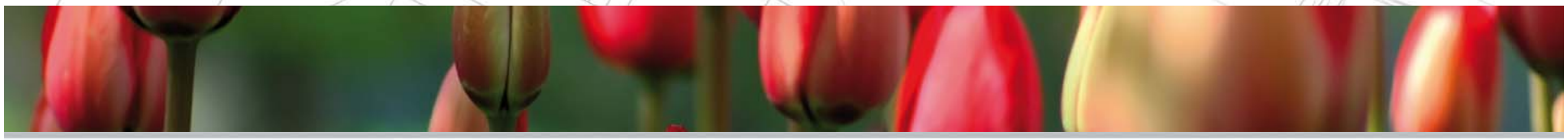
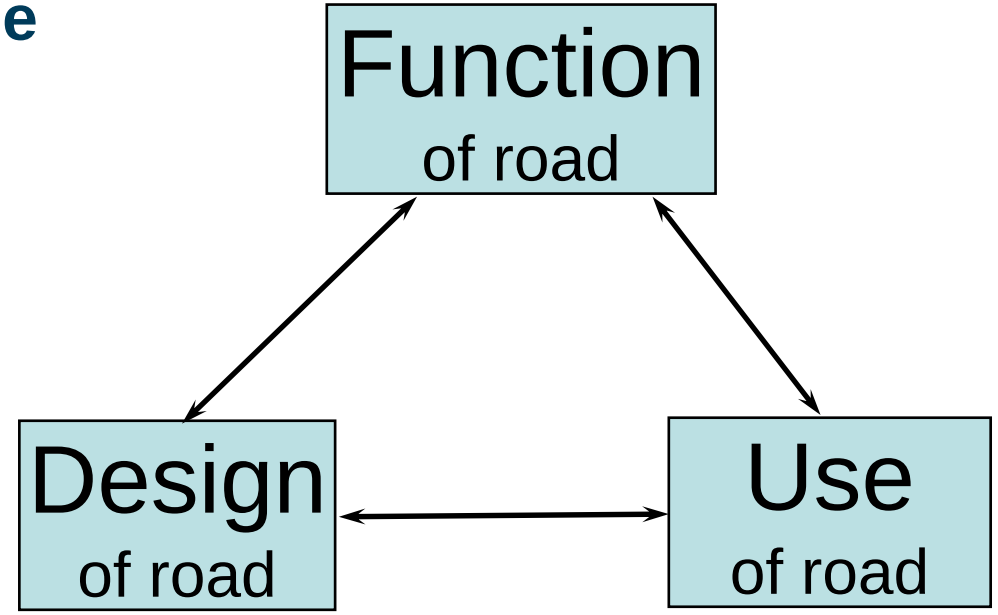
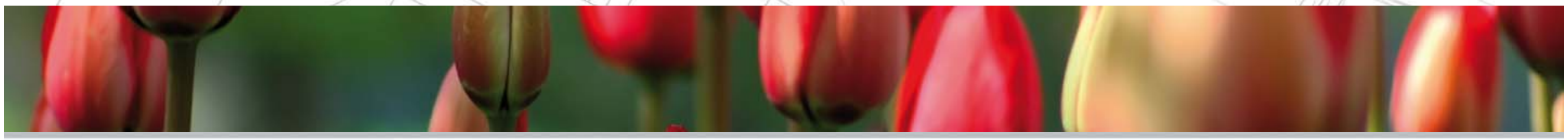


Function, form and use



function:	use of the road as intended by the road authority
design:	the physical design and layout properties of the infrastructure
use:	actual use of the infrastructure and behaviour of the road user

Basic principles



Safety

Cohesion

Directness

5 main requirements

Comfort

Attractiveness

Basic principles

Cohesion

Cohesive whole
(network / route)

From origin to destination

- **availability**
- **ease**
- **quality**
- **freedom**

Basic principles

Directness

As direct as possible (route)

From origin to destination
Minimum travel time

- **traffic flow speed**
- **delays (number and length)**
- **detours (distance)**

Basic principles

Attractiveness

Cycling has to be pleasant (journey)

Varies per person;
Psychological: perception

e.g.:
- **quiet**
- **smooth**
- **safe**
- **beauty (nature / buildings)**

Also: social safety

Basic principles

Safety

Vulnerability
(mass / speed / no technical provisions)

Save conditions:
Separation in time or space

- **big residential areas**
- **avoid dangerous routes**
- **short journeys**
- **shortest = safest**
- **ease**
- **avoid conflicts**
- **reduce speed**

Basic principles

Comfort

Minimum nuisance and delay (journey)

Avoid additional physical effort

- **smoothness of pavement**
- **hilliness**
- **chance of stopping**
- **weather**
- **traffic**

Network

Essential basis for bicycle friendly climate

- **Provides opportunity to use bicycle for various purposes**
- **Distinguishes functions of routes**
- **Allows design related to function**

Network based on expected use:

- **Define main origins and destinations**
- **Link origins and destinations**
- **(Multi modal) traffic modelling**

Routes

Providing physical link between origin and destination

Level of quality related to function and (expected) use

Sections

Design choices and decisions

Function, form and use:

- **Bicycle volume**
- **Motor vehicle speed**
- **Motor vehicle volume**

Design requirements:

- **Cohesion not applicable**

Sections

Directness

Distance:
minimum bending and winding

Time:
minimal delay (forced speed reduction): < 15%

design speed:
- **high speed routes: 30 km/h**
- **main routes: 25 km/h**
- **other routes: 20 km/h**

Sections

Attractiveness

Social safety:

visibility (surroundings)
public lighting
maintenance

Traffic nuisance:

separation with busy traffic (motor vehicles) related to surroundings

Sections

Safety

Risk of accidents:

minimize number of meetings between bicycles and motor vehicles

separation if major speed differences

speed reduction if major differences in mass and / or direction

sufficient visibility (day and night)

Sections

Comfort

Flow:
minimize probability of speed reduction (width of surface, wide curves, car parking)

Smoothness:
smooth surface, preferably asphalt or concrete

Gradient

Weather nuisance

Sections

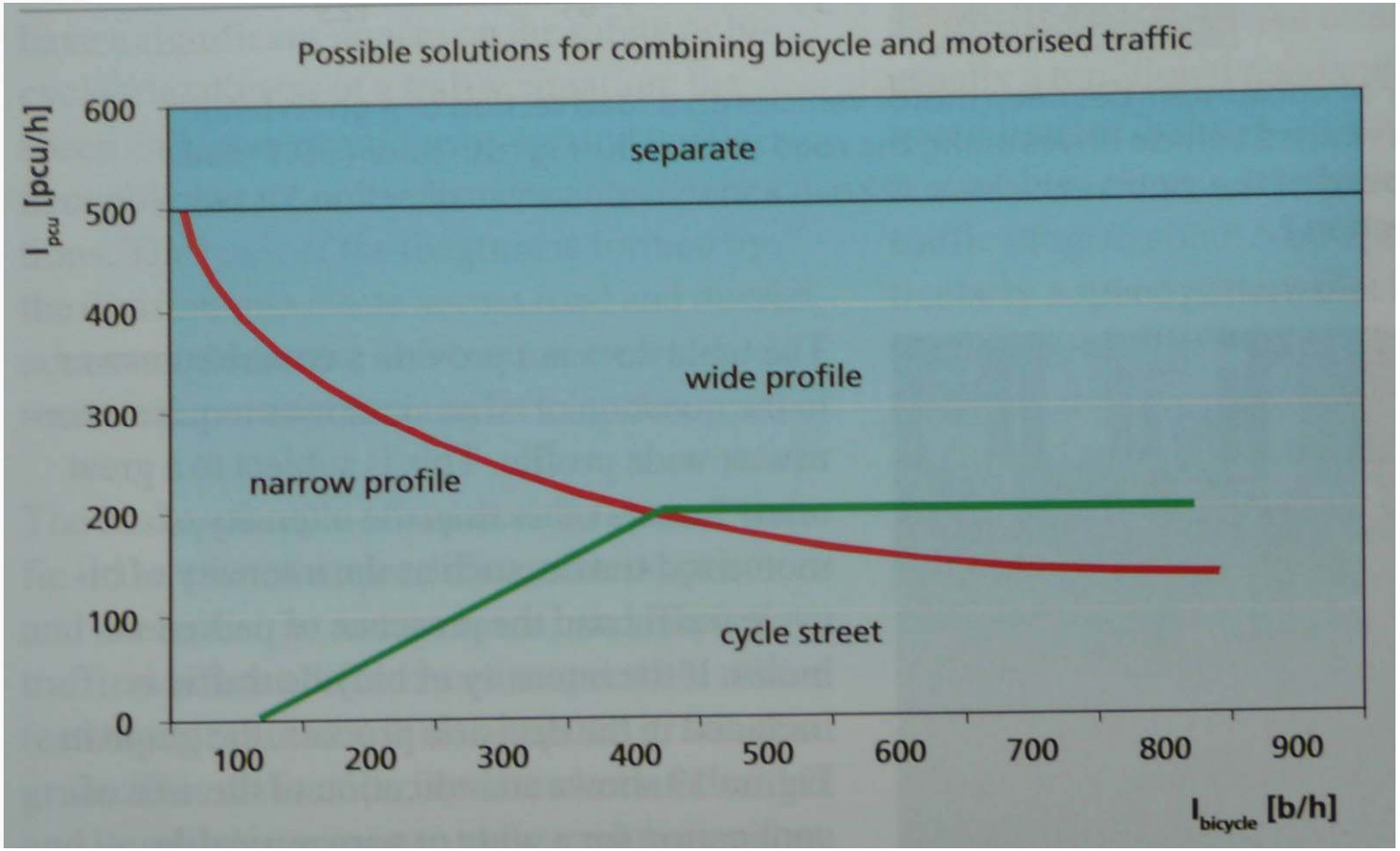
Separation

Table 14. Option diagram for road sections inside the built-up area

Road category	Max. speed of motorised traffic (km/h)		Motorised traffic intensity (pcu/day)	Cycle network category: basic network ($I_{bicycle}$ > work 750/day)	cycle route ($I_{bicycle}$ 500-2500/day)	main cycle route ($I_{bicycle}$ > 2000/day)
	n/a		0	solitary track		
Estate acces roead	walking pace or 30 km/h		1 - 2.500	combined traffic		cycle street or cycle lane (with right of way)
			2.000 - 5.000			
			> 4.000	cycle lane or cycle track		
District acces road	50 km/h	2x1 lanes	irrelevant	cycle track or parallel road		
		2x2 lanes				
	70 km/h			cycle track,moped/cycle track or parallel road		

Sections

Separation / combined use



Sections

Combined use, dimensions

Dimensional segment	Required width profile (m)
cyclist[2)]	0.75
car[2)]	1.75
lorry[2+3)]	2.60
cyclist/edge (kerb)[1)]	0.25
cyclist/parked vehicle[1+4)]	0.50
cyclist/cyclist (both riding)	0.50
cyclist/driving vehicle[1+4)]	0.85
vehicle/vehicle (both driving)[2+4)]	0.30
driving vehicle/kerb[2+4)]	0.25

1) value determined on the basis of research
2) source: Recommendations for Traffic Provisions in Built-up Areas (ASVV)
3) in this context, buses are counted as lorries
4) a vehicle refers to: all motor vehicles with at least three wheels

Sections

Combined use,
Bicycle and pedestrian traffic

Table 20. Possibilities for combining bicycle and pedestrian traffic

Number of pedestrians per hour per metre of profile width[1)]	Recommended solution [33]
< 100	Full combination
100 - 160	Separation; traffic path with continuous profile (no differences in height)
160 - 200	Separation; traffic path with sectional profile
> 200	No combination possible

1) the number of pedestrians that pass an imaginary line straight across a street in an hour, divided by the total profile width in metres

Sections

Examples: Combined

Sections

Examples: Bicycle lanes

Sections

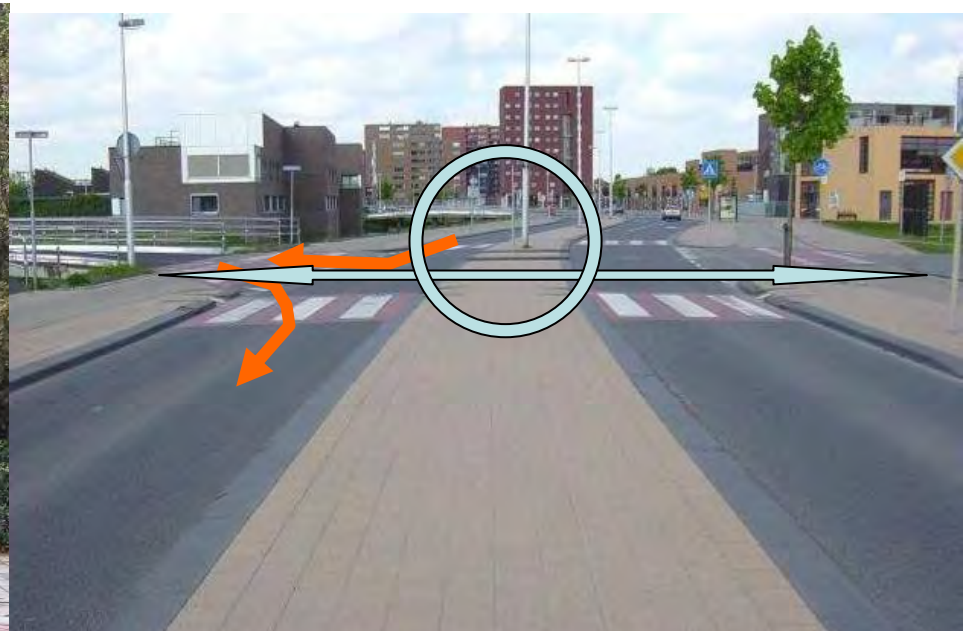
Examples: Bicycle street

Sections

Examples: Separate bicycle path

Sections

Examples: Short cut



Junctions / crossings

Design choices and decisions

Function, form and use:

- **Comprehensible**
- **Minimum number of conflict points**
- **Low traffic speed**

Design requirements:

- **Cohesion not applicable**

Junctions / crossings

Directness

Distance:
illogical movements or diversions avoided

Time:
minimal delay (forced speed reduction)

right of way
refuge islands
traffic lights
bridge or tunnel

Junctions / crossings

Attractiveness

Social safety:

visibility (surroundings)
public lighting
maintenance

Junctions / crossings

Safety

Risk of conflicts:

minimize number of meetings between bicycles and motor vehicles

separation if major differences in speed and / or mass

speed reduction at level crossings

bundled conflicts

sufficient visibility (day and night)
visibility cyclists by car drivers

Junctions / crossings

Comfort

Flow:
minimize probability of waiting

minimize delay due to sharp curves, stationary traffic

Smoothness:
smooth surface, smooth transition

Traffic nuisance:
pollution, noise, bad smell

Weather nuisance

Junctions / crossings

Type of junction

Table 24. Option table: district access road – estate access road intersection solutions

Section 1: district access road, with or without (main) cycle route	Section 2: estate access road or solitary path			
	I_{pcu} < 500 pcu/h			I_{pcu} > 450 pcu/h
hourly intensity	no cycle route	cycle route	main cycle route	all situations
1-1,000 pcu/h	right of way intersection		right of way intersection + supplementary measures or roundabout	roundabout
800 - 1,500 pcu/h	right of way intersection + supplementary measures			
1,200 - 1,750 pcu/h	right of way intersection + supplementary measures, roundabout, intersection with TCS or grade-separated intersection (only for main cycle route where appropriate)			
> 1,500 pcu/h	intersection with TCS or grade-separated (only for main cycle route where appropriate)			roundabout, intersection with TCS or grade-separated solution

Junctions / crossings

Type of junction

Table 25. Option table: district access road – district access road intersection solutions

Section 1: district access road, with or without (main) cycle route	Section 2: district access road, with or without cycle route ($I_2 \leq I_1$)			
	$I_2 < 1{,}200$ pcu/day			$I_2 > 1{,}000$ pcu/day
	hourly intensity (I_1) pcu/h	no cycle route	cycle route	main cycle route	all situations
	500 - 1,500		single lane roundabout		roundabout (if necessary with bypass or two-lane) or TCS
	1.200 - 1,750		roundabout (if necessary with bypass or two-lane) or TCS		(multi-lane) roundabout with cycle tunnel in busiest lateral direction (or TCS)
	> 1,500		(multi-lane) roundabout or TCS	(multi-lane) roundabout with cycle tunnel in busiest lateral direction (or TCS)	TCS or grade-separated

Junctions / crossings

Examples: Crossing

Junctions / crossings

Examples: Right of way

Junctions / crossings

Examples: Roundabout

Junctions / crossings

Examples: Roundabout

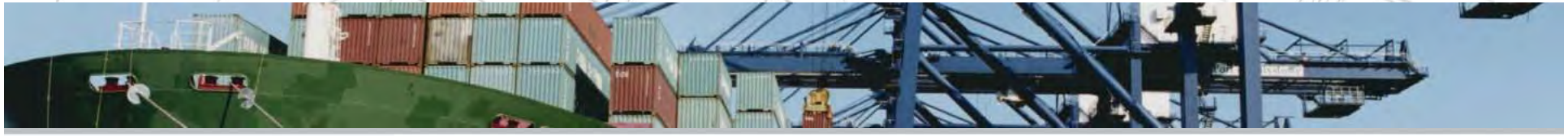
Junctions / crossings

Examples: Traffic lights

Junctions / crossings

Examples: Bridge / tunnel

Bicycle parking

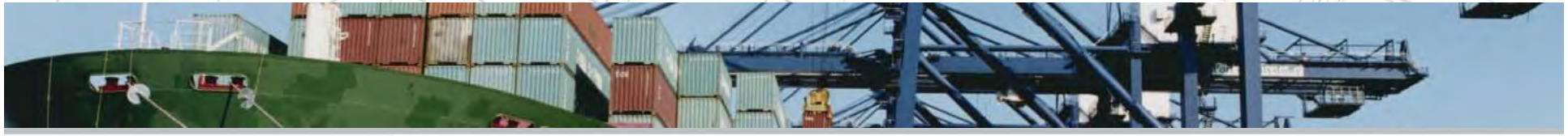


Essential for stimulating use of bicycle

Cyclists' point of view:
- **Theft prevention**
- **Damage prevention**
- **Clean and dry storage**

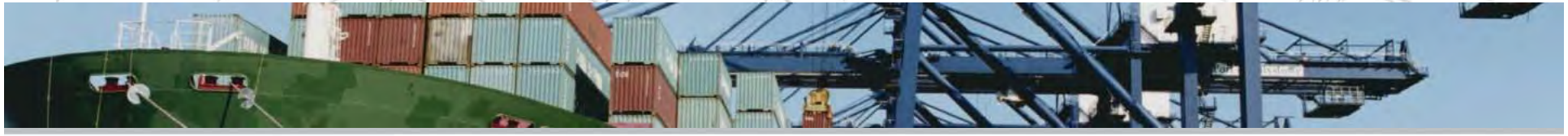
Road authority point of view:
- **Preventing blockage / nuisance for pedestrians**
- **Appearance public area**

Bicycle parking



Examples

Bicycle parking



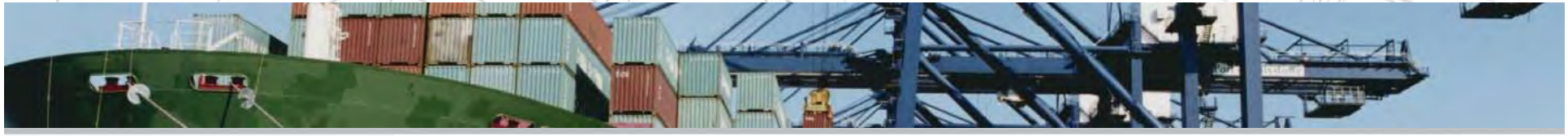
Origin: Individual dwelling

- **Lockable storeroom**
- **Neighbourhood storage**
- **Balcony**

Destination:

- **Private storage / parking**
- **Public parking**
  - **Free or paid**
  - **Supervised or unattended**

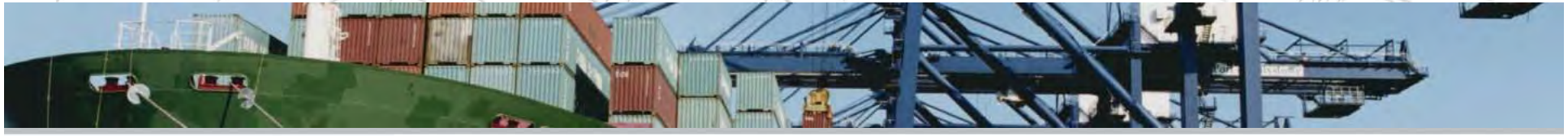
Bicycle parking



Examples origin:

- **Balcony**
- **Lockable storeroom**
- **Neighbourhood storage**

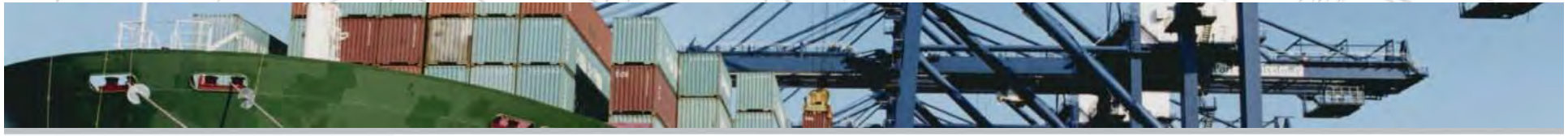
Bicycle parking



Examples destination:

- **Private storage / parking**
- **Public parking**

Bicycle parking



Examples:

- **Public parking**
  - **Free or paid**

Additional subjects

Additional facilities:

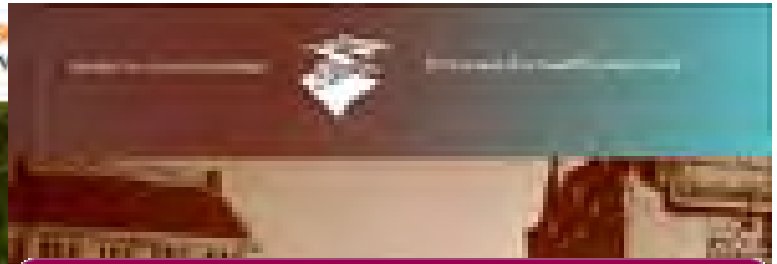
- Signage
- Resting points
- Shelter
- Service
- Bicycle rental

Additional subjects

Stimulating bicycle usage by:

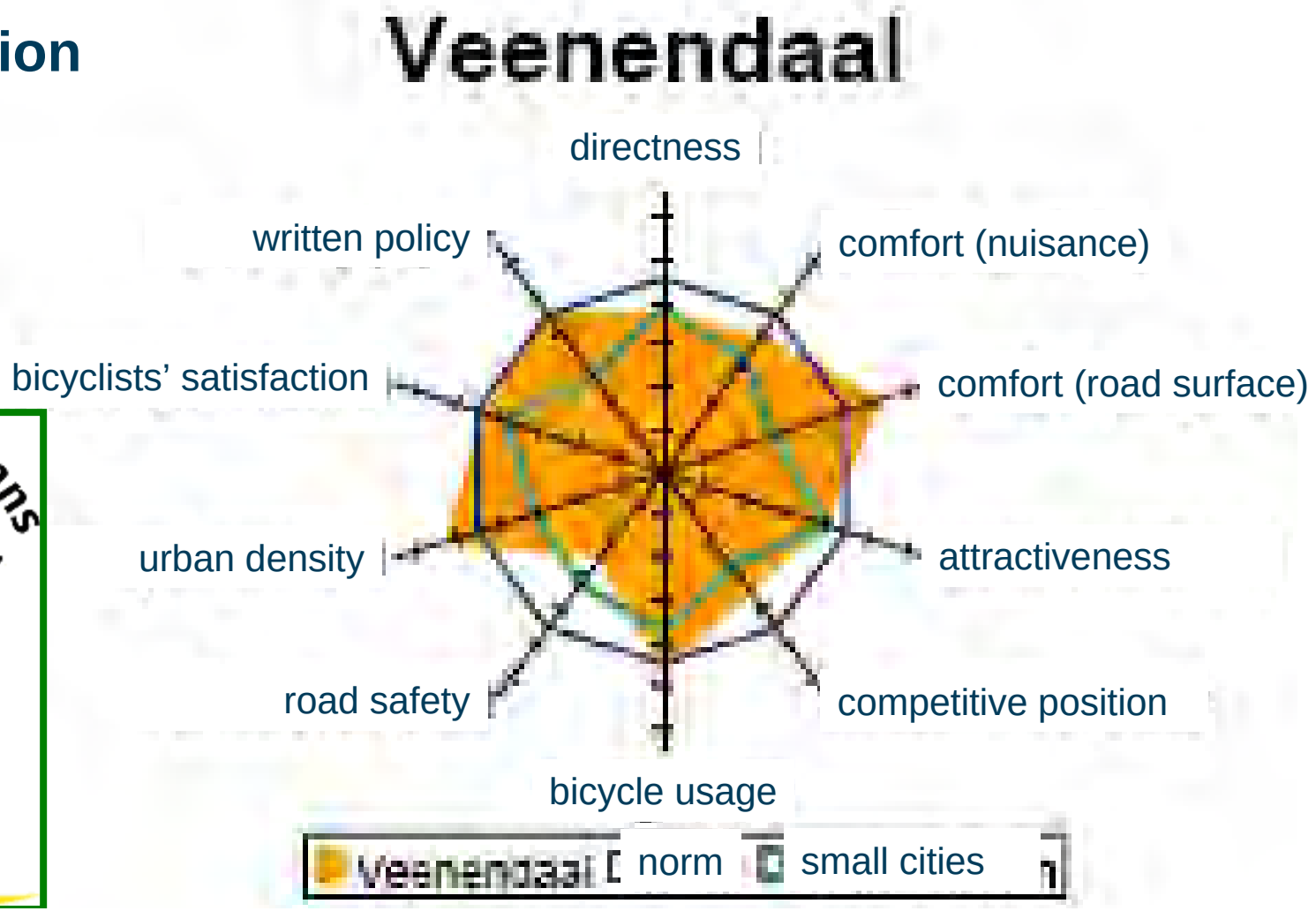
- **Promotion**
- **Dissemination**

- **Brochure**
- **Article**
- **Event**
- **Logo**



Additional subjects

Evaluation



Source: 'De Fietsbalans cd-rom 2002-2003', Fietsersbond

Bicycle Traffic Design

How to design:

- **Bicycle path / lanes?**
- **Junction / crossing?**
- **Bicycle parking ?**

Always think of:

- **Function**
  (main route / secondary / school / recreational)
- **Also for other road users (cars / pedestrian)**
- **Volumes**

Bicycle Traffic Design

Thank you for your attention

ROYAL HASKONING

Thanks to:
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www.cycling.nl