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**FRAMEWORK FOR BETTER STREET DESIGN IN CROATIA:  
COMPARATIVE RESEARCH ABOUT GERMAN AND CROATIAN  
STREET DESIGN**

s: Univ.-Prof. Dr.-Ing. Stefanie Bremer

h: Integrated transport planning / Mobility development, UniKassel

f: DBU MOE Fellowship

## **01 context of street design**

# elements of a street



Global Street Design Guide, NACTO, 2016.

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# street utilities

Design streets in coordination with basic utilities such as water, storm, and sanitary sewers, electricity, communication, gas, and lighting. Consider adopting energy-saving and efficient utilities and green infrastructure such as bioswales, pervious strips and porous pavements, reclaimed water systems, district cooling and heating, and automated waste collection systems.



Global Street Design Guide, NACTO, 2016.

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## street design in Croatia



Lessons for Students in Architecture, Herman Hertzberger, 1991.

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## environmentally sustainable streets

*Over 70% of EU citizens live in urban areas (cities, towns and suburbs) that generate 23% of all transport greenhouse gas emissions.*

The New EU Urban Mobility Framework, 2021.

# environmentally sustainable streets

## Microclimate

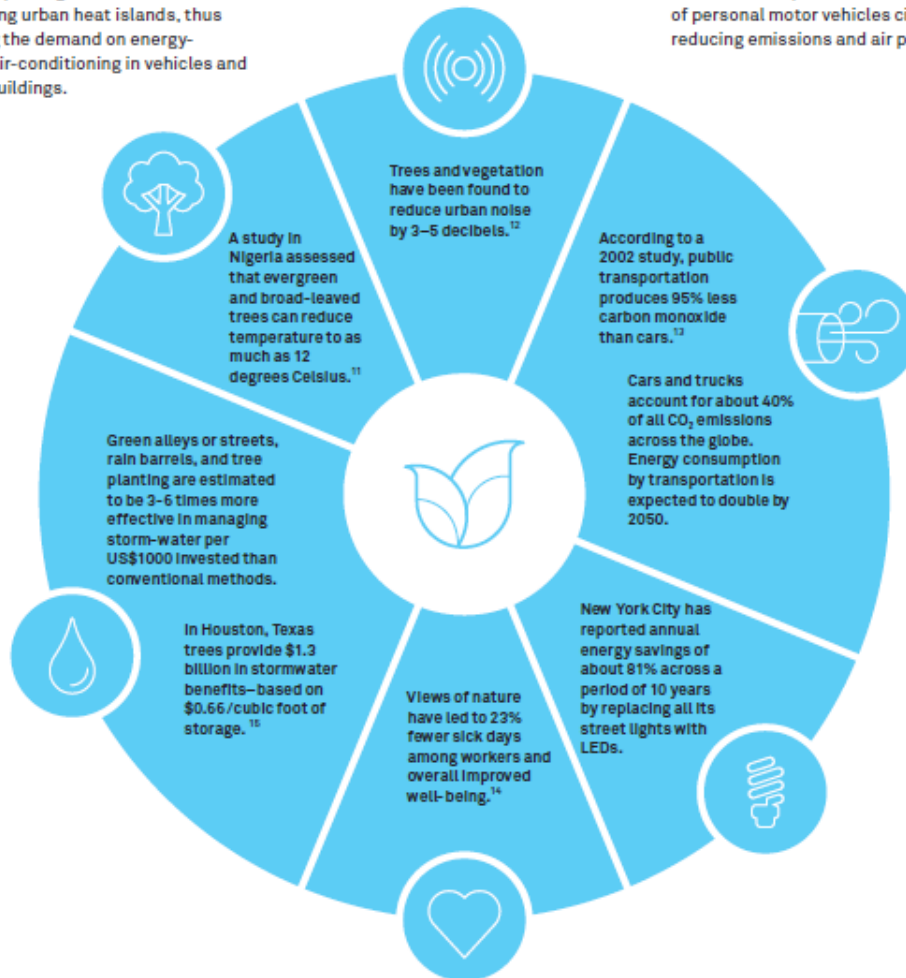
Street trees and landscaping can assist in improving the local climate and reducing urban heat islands, thus minimizing the demand on energy-intensive air-conditioning in vehicles and adjacent buildings.

## Noise

Urban trees can reduce noise pollution.

## Air Quality

Streets prioritizing pedestrians, cyclists, and transit help to reduce the number of personal motor vehicles circulating, reducing emissions and air pollution.



## Water Management

Incorporating green infrastructure strategies and local plant species within streets helps manage stormwater and reduces irrigation needs. See 7: *Utilities and Infrastructure*.

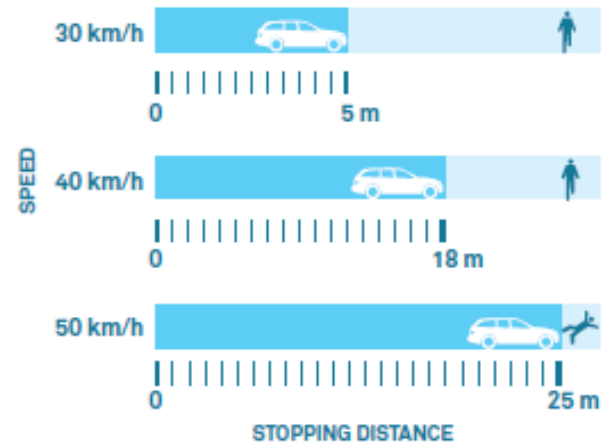
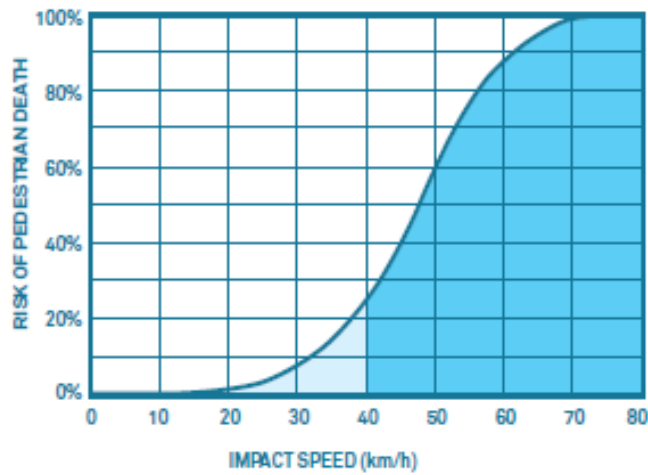
## Health and Safety

Urban trees and vegetation help decrease stress and aggressive behavior in cities<sup>16</sup> and have been linked to crime reduction.<sup>17</sup>

## Energy Efficiency

Street projects can contribute to improving a city's energy and resource efficiency by using recycled and low-impact materials and technologies as well as renewable energies.

# safe streets



Global Street Design Guide, NACTO, 2016.

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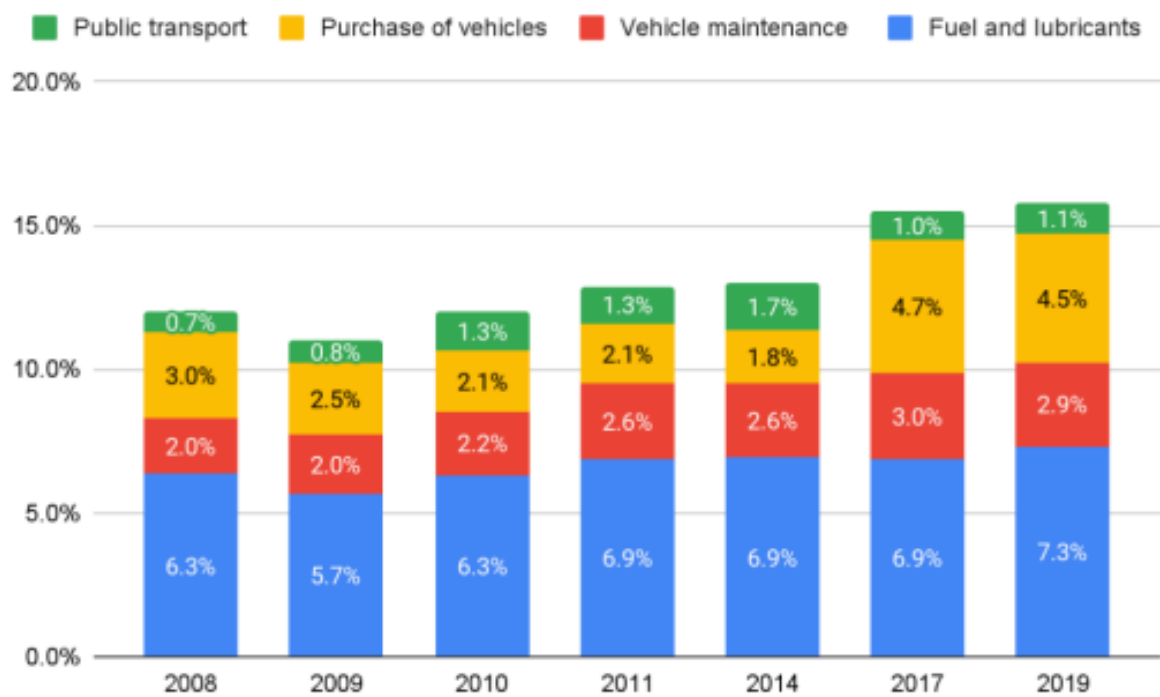
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proposals



mobility poverty



social aspect of the streets

	Quality of the physical environment	
	Poor	Good
Necessary activities		
Optional activities		
“Resultant” activities (Social activities)		

Life between buildings, Jan Gehl, 1971.

context

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# economy of a street

## Health and Human Lives

The cost of lives lost and serious injuries caused by road crashes have a significant impact on the economy. Better-designed streets relieve mental and physical stress, lowering medical expenses and the need for social services.



The economic cost of road fatalities globally is estimated at between \$64.5 billion and \$100 billion.<sup>2</sup>

A modeling study in Portland, USA estimated that by 2040, investments in cycle facilities will result in significant healthcare cost savings.<sup>4</sup>

A study in Hong Kong found a 17% increase in retail rents following pedestrianization.<sup>7</sup>

The creation of a cycle track on 9th Avenue in New York led to a 49% increase in retail sales locally based businesses.<sup>8</sup>



## Business and Real Estate

Pedestrians, cyclists, and transit riders generally spend more money at local retail businesses than people who drive cars, underscoring the importance of offering attractive, safe spaces for transit riders, pedestrians, and cyclists. Great streets have also been shown to add value to neighborhoods.

## Work and Productivity

Significant numbers of human working hours are lost as a result of time spent in congestion or injuries incurred in road crashes. These lost hours result in reduced productivity and, therefore, economic losses.



Each Los Angeles resident loses around \$6,000 a year on productivity loss because of congestion.<sup>5</sup>

The lifetime economic cost to society for each fatality has been estimated at \$1.4 million.<sup>6</sup>

An elevated pedestrian bridge costs as much as 20 raised pedestrian crossings in Addis Ababa, building a case for safer and cost-effective pedestrian facilities.

The city of Portland invested \$8 million in green infrastructure to save \$250 million in hard infrastructure costs.<sup>9</sup>



## Construction and Maintenance

Narrow streets cost less to build and maintain. Using good-quality, durable materials can significantly reduce maintenance costs. Green alleys or streets and tree planting are estimated to be 3-6 times more effective in managing stormwater and reduce hard infrastructure cost.<sup>10</sup>



shifting the objectives

**public health and safety**

**quality of life**

**environmental sustainability**

**economic sustainability**

**social equity**

*context*

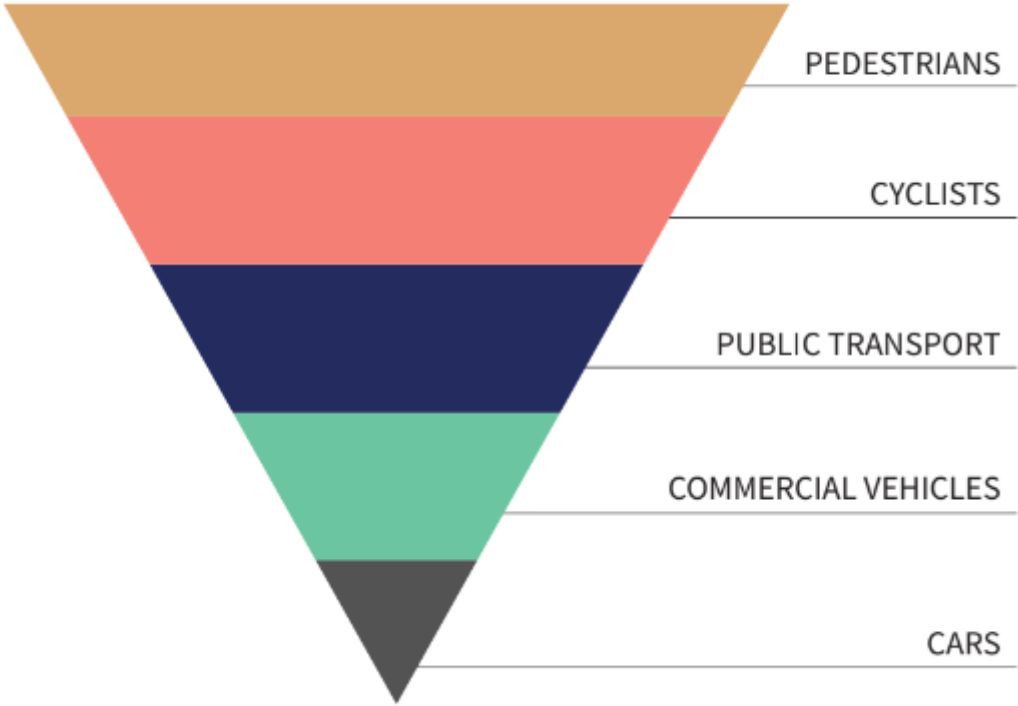
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green mobility pyramid



Street Design Manual for Oslo, Agency for urban environment, 2020.

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# street transformations



Marienhilfer Straße, Bureau B+B, 2015.

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## **02 legal and institutional framework**

## global and eu policies

UN: Sustainable Development Goals, 2015.

UN: The New Urban Agenda, 2016.

EU: Urban Agenda for the EU, 2016.

EU: The European Green Deal, 2020.

EU: The New European Bauhaus, 2020.

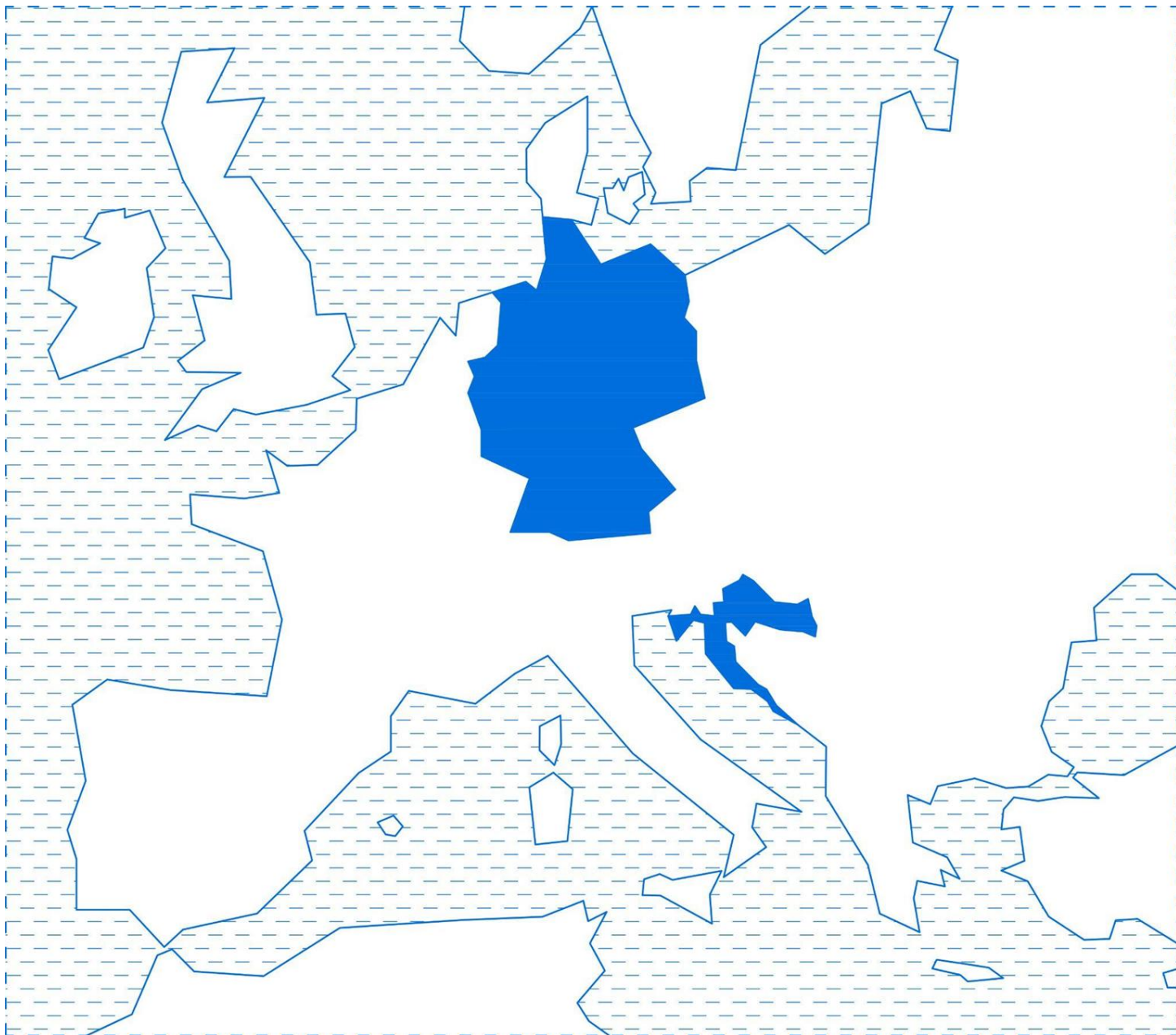
EU: The Sustainable and Smart Mobility Strategy, 2021.

EU: The New EU Urban Mobility Framework, 2021.

EU: Recommendation on Support Programmes for SUMP, 2023.



## Germany - Croatia



context

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proposals

## streets in Croatia - Zagreb - city center



context

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proposals



## streets in Germany - Osnabrück - city center



context

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*framework*

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proposals

## streets in Germany - Osnabrück - city center



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proposals



## streets in Croatia - Zagreb - old town



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proposals

## streets in Germany - Hann. Münden - old town



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proposals



## streets in Croatia - Zagreb - residential street



context

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proposals

## streets in Germany - Osnabrück - residential street



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proposals



# streets in Germany - Osnabrück - residential street



context

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proposals

## streets in Germany - Osnabrück - Fahrradstraße



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proposals



## streets in Germany - Münster - Fahrradstraße 2.0



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Croatia - strategies, laws, guidelines - Germany

+	transport development strategy	+
+	cycling development strategy	+
-	pedestrian traffic strategy	+
+	disability equality and accessibility	+
+/-	cycling infrastructure standards	+
+	road traffic safety law	+
-	public participation	+
-	network design standards	+
-	street design standards	+

context - *framework* - proposals

# FGSV publications classification

Art	Typ	Titel/ Bezeichnung	Formulierungen (Beispiele)	Charakter der Regelungen	Abstimmung intern (FGSV)	Abstimmung extern	Verfasser	Art der Bekanntgabe
Regelwerk	R1	Technische Vertrags- bedingungen (ZTV, TL, TP)	muss / darf nicht	Anforderungen	mit den betroffenen Ausschüssen aller Arbeits- gruppen	mit den Straßenbau- verwaltungen und Industrie- verbänden, ggf. mit den Straßen- behörden	FGSV	regelmäßig Bekanntgabe zur Einführung durch BMVI
		Richtlinien	soll / soll nicht sollte / sollte nicht	Regelfälle, Empfehlungen				
	R2	Merkblatt / Empfehlungen	sollte / sollte nicht	Empfehlungen	mit den betroffenen Ausschüssen aller Arbeits- gruppen	mit den Straßenbau- verwaltun- gen, falls Bekanntgabe durch BMVI	FGSV	Veröffentli- chung, fallweise Bekanntgabe durch BMVI
Wissensdokument	W1	Hinweise	kann / kann nicht ist zweckmäßig / nicht zweckmäßig	Möglichkeiten	mit den betroffenen Ausschüssen aller Arbeits- gruppen	-	FGSV	Veröffentlichung
	W2	Arbeitspapier	ist zweckmäßig / nicht zweckmäßig	Möglichkeiten	im zuständigen AA plus Freigabe durch AG-Leitung	-	zuständiger AA in der FGSV	Veröffentlichung

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road categories

Category group		Motorways	Inter-urban roads	Open main roads	Built-up main roads	Access roads
		AS	LS	VS	HS	ES
Continental	0	AS 0		-	-	-
Large scale	I	AS I	LS I		-	-
National	II	AS II	LS II	VS II		-
Regional	III	-	LS III	VS III	HS III	
Local connectors	IV	-	LS IV	-	HS IV	ES IV
Small-scale	V	-	LS V	-	-	ES V

AS I

-

Occurring, designation of category problematic  
Not occurring or not justifiable

RASt

Directives for the Design of Urban Roads, FGSV, 2006.

# FGSV directive

Road and Transportation Research Association

Working Group Highway Design



**Directives  
for the Design of Urban Roads**

**R 1**

**RASt 06**

**Edition 2006  
Translation 2012**



context

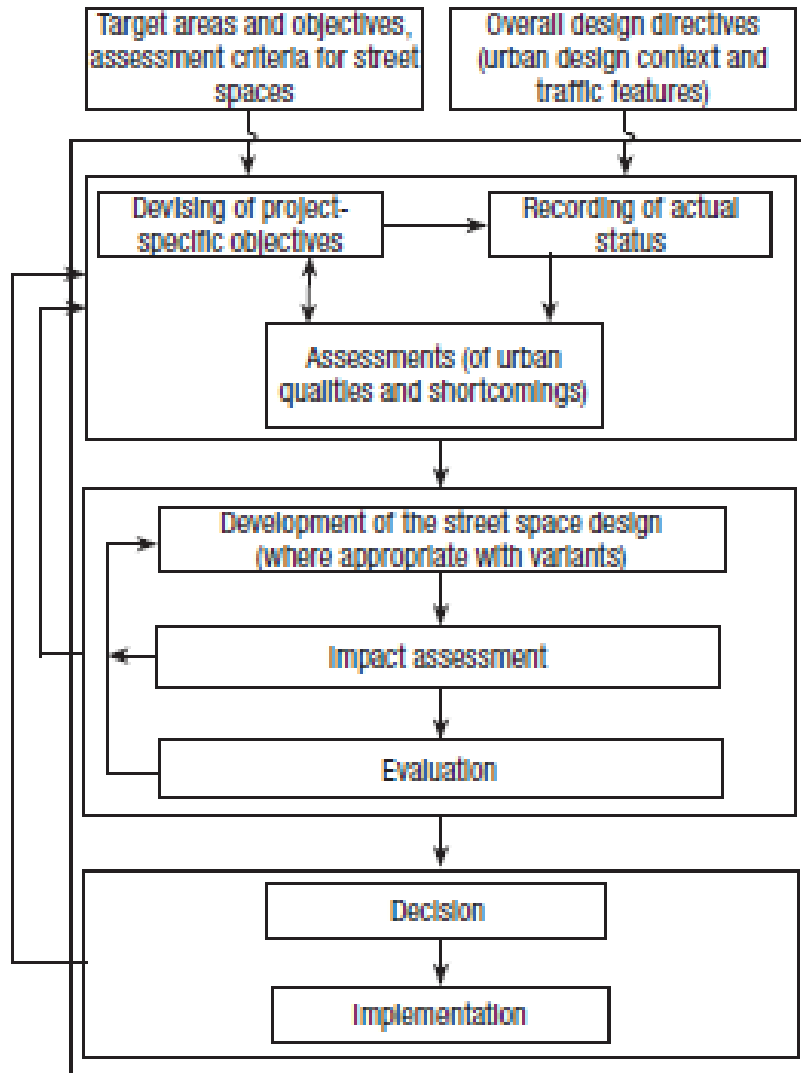
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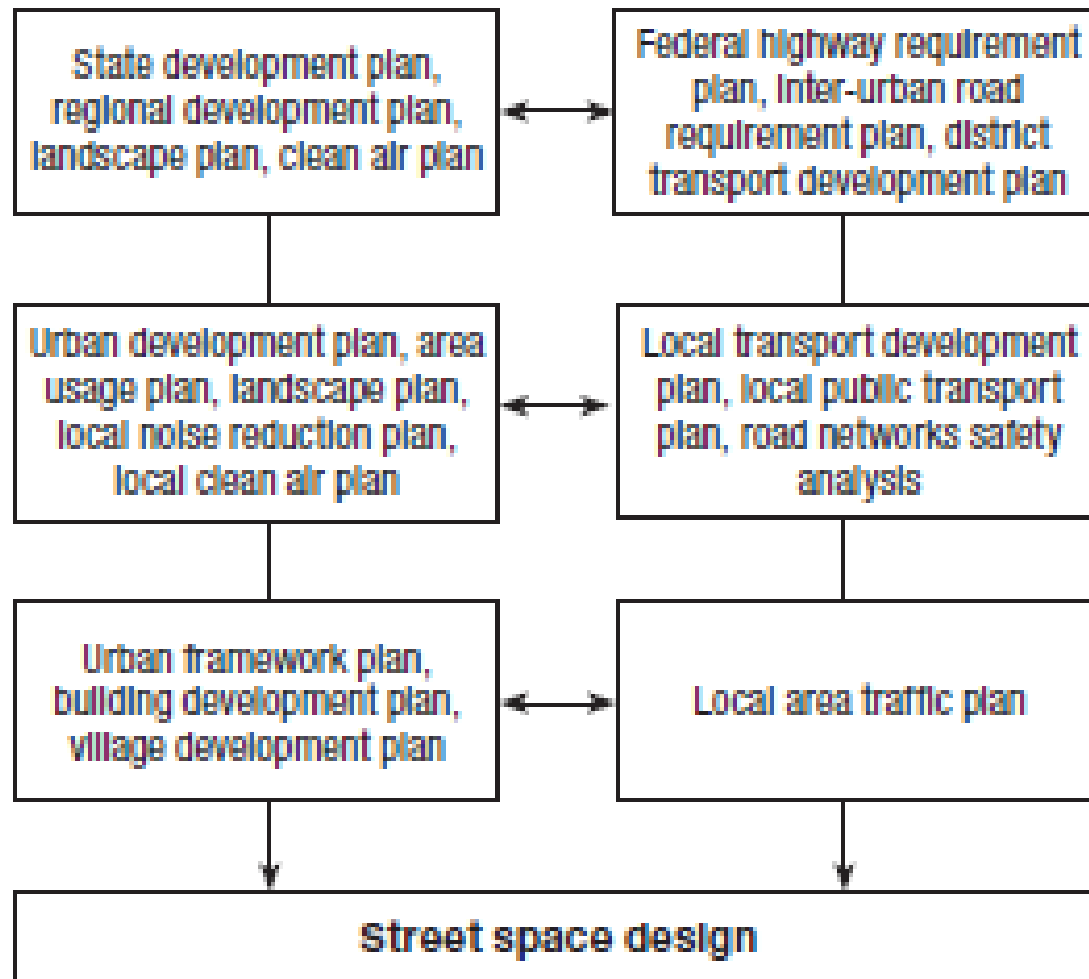
proposals

# a street space design procedure

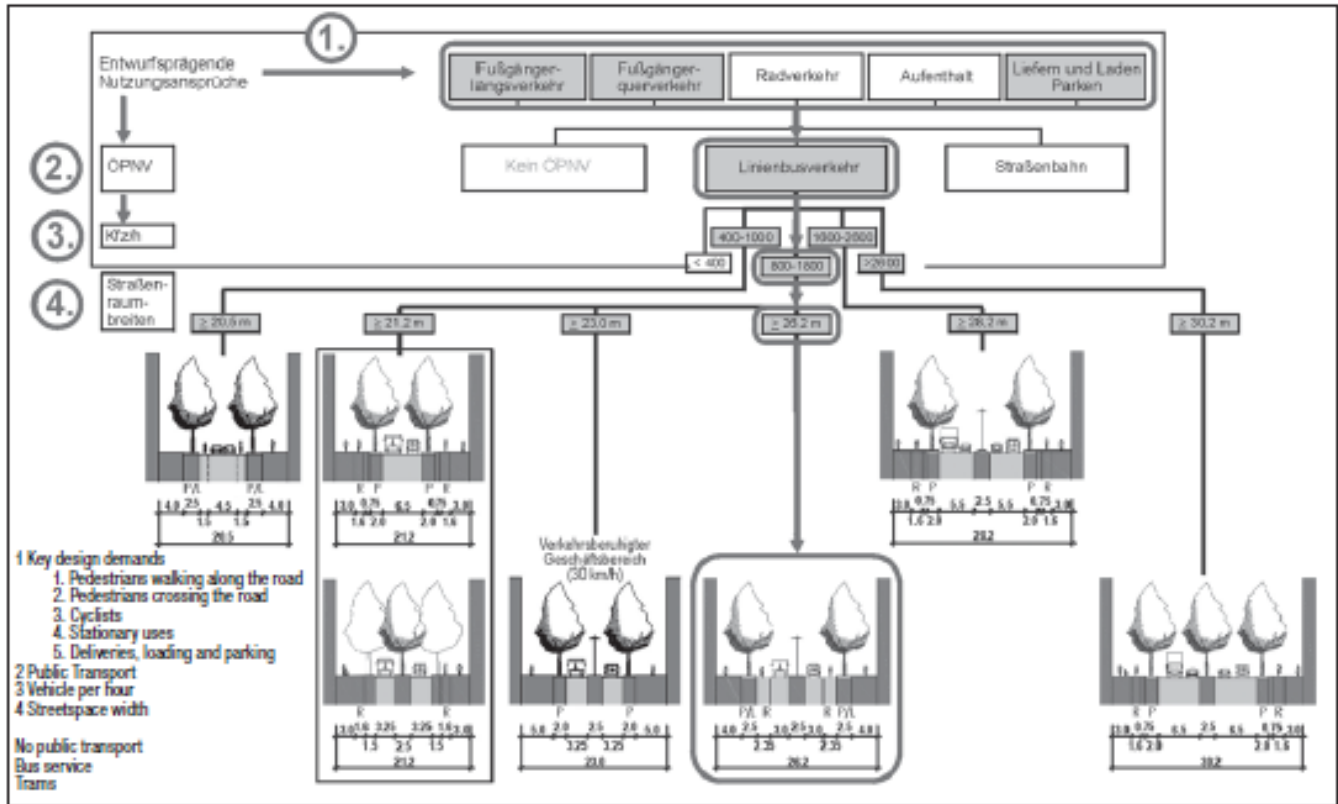




## local bases for design directives



# selection of a recommended cross-section



# residential street guidelines

## 5.2.2 Residential street

### Characteristics

- Access road (ES V)
- Different forms of building: rows, terraced and detached houses
- Residential only
- Short length: up to approx. 300 m
- Access function only
- Traffic volume below 400 veh/h
- Usage: Residential, parking.

### Typical constraints and requirements

- Carriageway widths should allow oncoming cars to pass.
- Passing points should be laid out as necessary for cars and refuse collection vehicles to pass.
- Bicycle facilities are not required.
- No special requirements are imposed with regard to pavement widths.

### Special points of note

- In most cases residential streets are located in 30 kph zones.
- In special cases, depending on their location within the road network, residential streets may also be part of a cycle route. If so, the following points should be taken into consideration:
  - Cycle routes form part of local cycle networks; they serve existing or expected cycle traffic, providing key links away from main arterial roads.
  - To ensure efficient cycle journeys, right of way over other access roads may be provided, with appropriate engineering, such as speed humps and be clearly marked.
  - In some isolated cases, bus services may be routed along cycle routes.



Residential street in an urban neighbourhood with environmental traffic calming elements



Village-style residential street with 'soft separation' and offset parking bays



Cycle route with bus lane

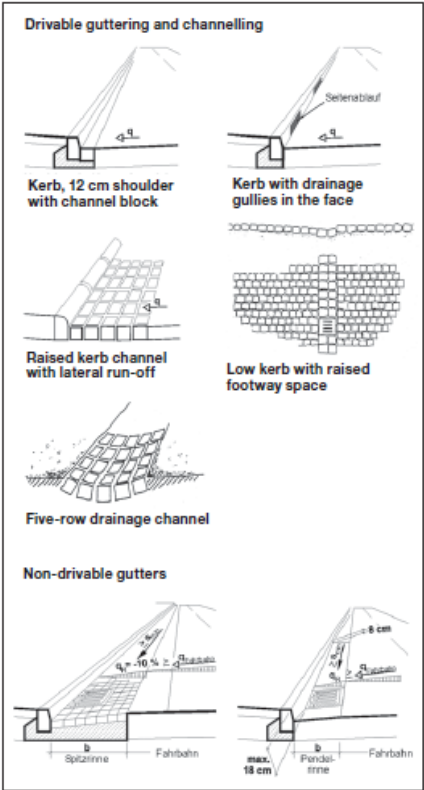


Figure 63: Examples of drivable and non-drivable gutters/channels

incoming roads. Channel widths of more than 0.50 m may be useful for in design, as they narrow carriageways visually (figure 63). With a narrow asphalt surface, however, noise must be expected due to them being driven-over.

The channel depth should be at least 3 cm, and owing to the necessity of being driven over must not exceed 1/15th of the width. The minimum longitudinal slope is 0.5 % when using smooth materials. When using natural stone paving, this should be increased to 1.0 %.

Open dished channels are suitable means for separating the carriageway from the footway areas on urban streets and lightly-loaded two-lane main roads.

6.1.4 Horizontal and vertical alignments

6.1.4.1 Basic considerations

Decisions on horizontal and vertical alignments vary between main roads in urban and non-urban locations.

On local streets and main roads in built-up areas, it is not necessary to calculate horizontal and vertical alignment elements in terms of driving behaviour because speeds are usually

- determined by the driver's response to the street environment and
- are limited by law to 50 km/h and less, or
- impossible, because the necessary changes in the surrounding environment or built structure could not be justified.

For non-built-up main roads, with large intervals between junctions and which are of major link importance for motor traffic, the threshold values for the geometric designs are differentiated by speed.  $V_{limit} = 50$  km/h where frontages are facing away from the road and  $V_{limit} = 70$  km/h where frontages are distant from the road.

On roads with trams the BOSTrab directives<sup>38)</sup> must also be followed.

Table 19: Limit values of the design elements for carriageways on built-on urban roads

	Design elements	Limit values
Horizontal alignment	Curves: minimum radius, min R [m]	10
Vertical curvature	Maximum longitudinal gradient, max s [%]	8,0 (12,0)
	Peak minimum radius, min $H_k$ [m]	250*)
	Trough minimum radius, min $H_w$ [m]	150*)
cross-section	Maximum lateral slope on curves, max $q_K$ [%]	2,5
	Minimum ramp slope, min $\Delta s$ [%]	0.10 · a where a[m] = distance of carriageway edge from centre of rotation
Visibility	Minimum visibility for s = 0 %	20 (with $v_{limit} = 30$ km/h)
	min $S_h$ [m]	43 (with $v_{limit} = 50$ km/h)

\*) On residential estate roads with predominantly car traffic, smaller radii can be selected, though the radii should not fall below the min  $H_k = 50$  m and min  $H_w = 20$  m

6.1.4.2 Overview of horizontal and vertical alignment elements

Table 19 sets out the limit values of the main design elements for carriageways on access roads and built-on main arterial roads. The design parameters for autonomous cycle traffic installations are contained in the ERA.

<sup>38)</sup> "Directives for the routing of rail tracks in accordance with the Regulation governing the construction and operation of trams" (BOSTrab routing directives), in: Verkehrsblatt (1993), volume 15, p. 571–576.

Croatia - institutional interdisciplinarity - Germany

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# FGSV (Road and Transportation Research Association)



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# E-studio, University of Kassel



introduction

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*institutional framework*

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case studies

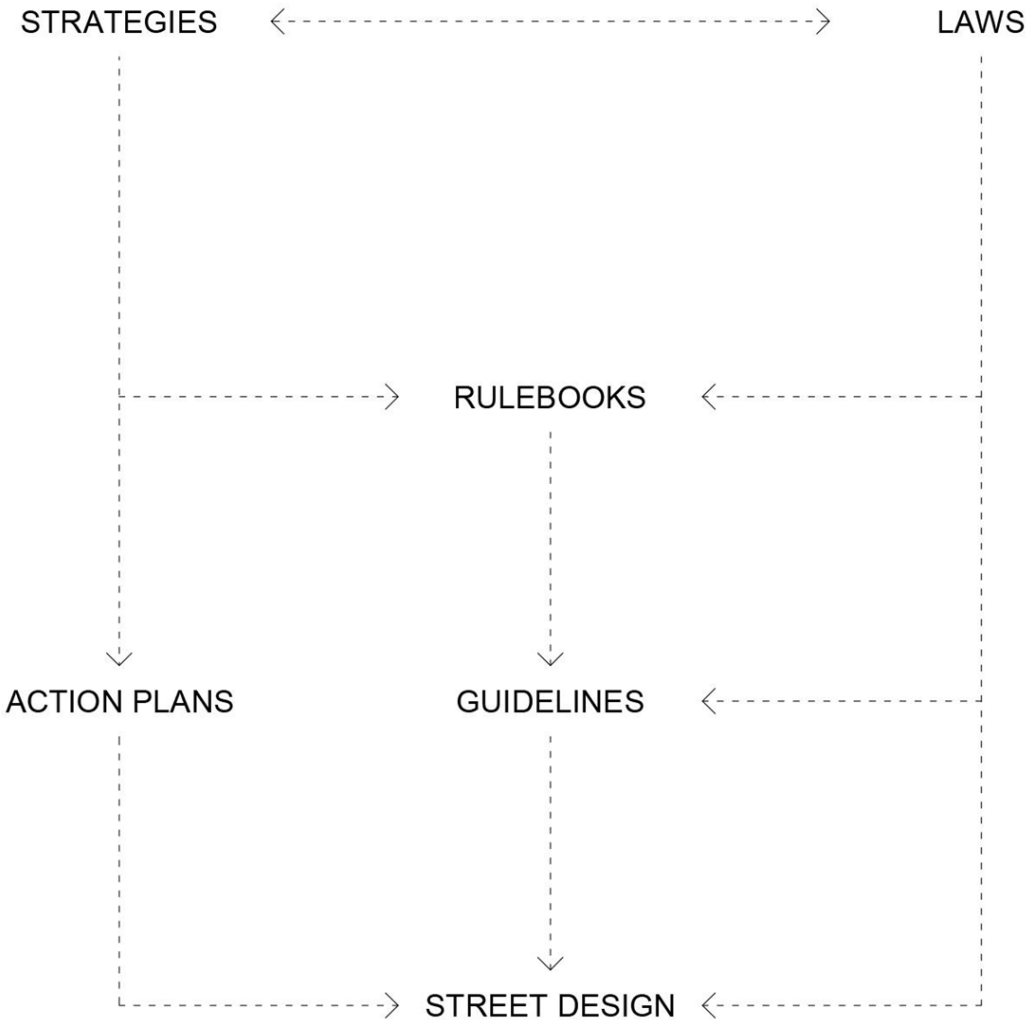
**03 proposals for legal and institutional changes in Croatia**



state level

1. QUANTIFYING GOALS IN STRATEGIES
2. CONNECTING STRATEGIC PLANS WITH PRAXIS
3. DATA AND EVALUATION
4. INTERDISCIPLINARITY IN STREET DESIGN
5. NEW ROAD AND STREET CLASSIFICATION
6. CROATIAN STREET DESIGN GUIDELINES
7. UPDATING ROAD TRAFFIC SAFETY LAW
8. EXPANDING CYCLING INFRASTRUCTURE RULEBOOK
9. PARTICIPATION IN TRAFFIC PLANNING
10. MORE FINANCING FOR BETTER RESULTS

horizontal and vertical connections



context

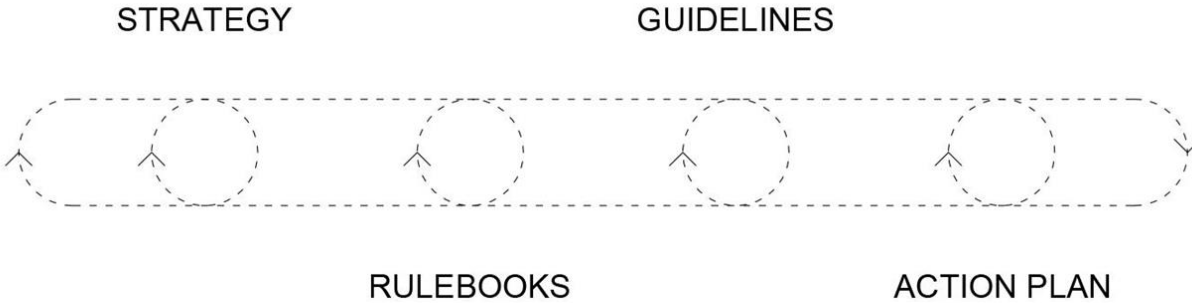
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evaluate and update



context - framework - *proposals*

## city level

1. DATA AND EVALUATION
2. SUSTAINABLE URBAN MOBILITY PLAN (SUMP)
3. CYCLING NETWORK DEVELOPMENT PLAN
4. INTERDISCIPLINARITY IN STREET DESIGN
5. NEW ROAD CLASSIFICATION
6. CITY STREET DESIGN MANUAL
7. PARTICIPATION IN TRAFFIC PLANNING
8. STREET TRANSFORMATIONS
9. STREET TRANSFORMATIONS AS A TOOL FOR URBAN REHABILITATION
10. EMPLOYEE TRAINING
11. MORE FINANCING FOR BETTER RESULTS

new road classification

Fig. 1.1. a



Fig. 1.1. b

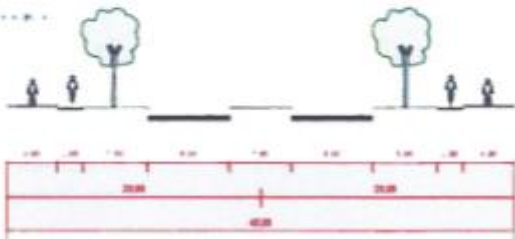


Fig. 1.1. c

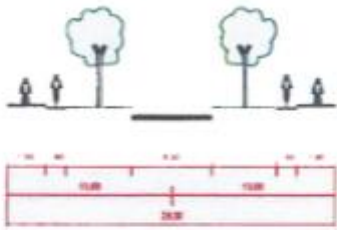
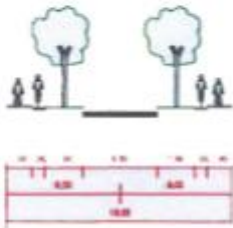


Fig. 1.1. d



context

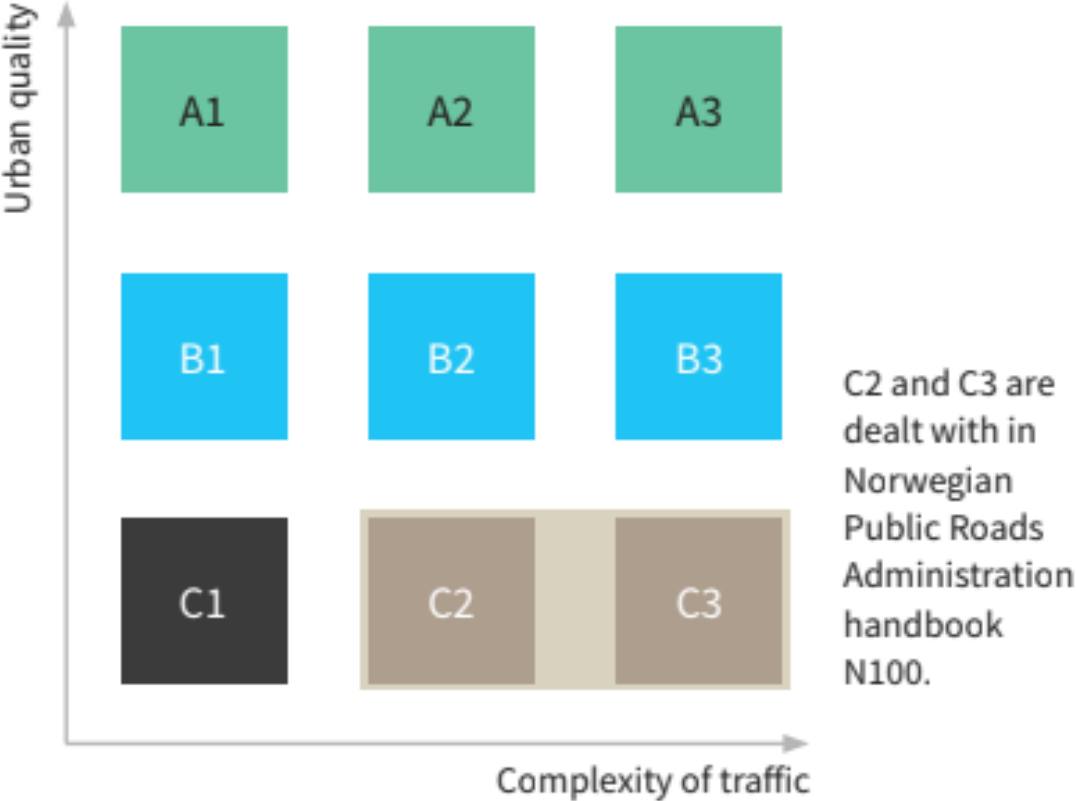
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new road classification



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*proposals*

## city level

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importance of standardization

unclassified roads (streets) in Zagreb = 2.450 km

context

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## city level

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10. EMPLOYEE TRAINING
11. MORE FINANCING FOR BETTER RESULTS

# *illegal* development areas



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# street transformations as a tool for urban rehabilitation



context

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## city level

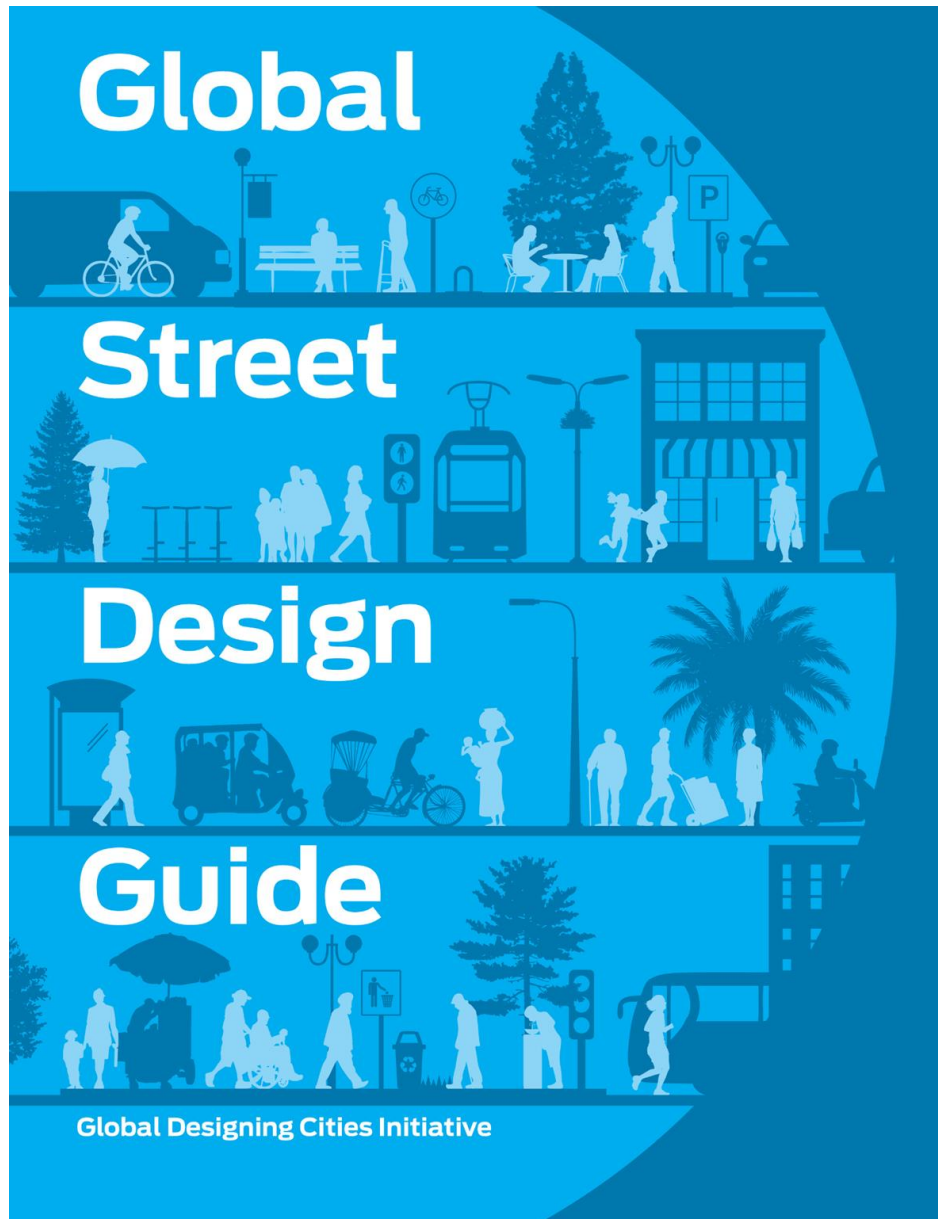
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## University level

1. INTERDISCIPLINARY UNIVERSITY COURSES
2. INTEGRATED TRAFFIC PLANNING
3. PROFESSIONAL TRAINING



Global Street Design Guide, NACTO, 2016.



context

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framework

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