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

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h: Integrated transport planning / Mobility development, UniKassel
f: DBU MOE Fellowship
01 context of street design
elements of a street
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.
Street design in Croatia
Over 70% of EU citizens live in urban areas (cities, towns and suburbs) that generate 23% of all transport greenhouse gas emissions.

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.

Trees and vegetation have been found to reduce urban noise by 3–5 decibels. A study in Nigeria assessed that evergreen and broad-leaved trees can reduce temperature to as much as 12 degrees Celsius.

According to a 2002 study, public transportation produces 95% less carbon monoxide than cars.

Cars and trucks account for about 40% of all CO₂ emissions across the globe. Energy consumption by transportation is expected to double by 2050.

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 and have been linked to crime reduction.

New York City has reported annual energy savings of about 81% across a period of 10 years by replacing all its street lights with LEDs.

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.
Mobility poverty overview in Central and Eastern Europe: Croatia, Vladimir Halgota, Zvonimir Lozić, 2023.
### Social Aspect of the Streets

**Quality of the Physical Environment**

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**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.

**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.

- The economic cost of road fatalities globally is estimated at between $64.5 billion and $100 billion.¹
- Each Los Angeles resident loses around $6,000 a year on productivity loss because of congestion.³
- The lifetime economic cost to society for each fatality has been estimated at $1.4 million.⁵

- A modeling study in Portland, USA estimated that by 2040, investments in cycle facilities will result in significant healthcare cost savings.⁴
- A study in Hong Kong found a 17% increase in retail rents following pedestrianization.⁷
- 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.

**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.

- The creation of a cycle track on 9th Avenue in New York led to a 49% increase in retail sales locally based businesses.⁸
- The city of Portland invested $8 million in green infrastructure to save $250 million in hard infrastructure costs.⁹

**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.¹⁰
shifting the objectives

context - framework - proposals

public health and safety

quality of life

environmental sustainability

economic sustainability

social equity
street transformations
02 legal and institutional framework

EU: Urban Agenda for the EU, 2016.
EU: The Sustainable and Smart Mobility Strategy, 2021.
streets in Croatia - Zagreb - city center
streets in Germany - Osnabrück - city center
streets in Germany - Osnabrück - city center

case study - framework - proposals

- context

- framework

- proposals
streets in Croatia - Zagreb - old town
streets in Germany - Hann. Münden - old town
streets in Croatia - Zagreb - residential street

context - framework - proposals
streets in Germany - Osnabrück - residential street
streets in Germany - Osnabrück - residential street
streets in Germany - Osnabrück - Fahrradstraße
streets in Germany - Münster - Fahrradstraße 2.0

context - framework - proposals
Croatia: strategies, laws, guidelines

- 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

Germany:

+ context
- framework
- proposals
### FGSV publications classification

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AS I: Occurring, designation of category problematic
- Not occurring or not justifiable
FGSV directive

Directives for the Design of Urban Roads

RAS 06

Edition 2006
Translation 2012
a street space design procedure

directives for the design of urban roads, FGSV, 2006.

context - framework - proposals
local bases for design directives

context - framework - proposals

State development plan, regional development plan, landscape plan, clean air plan

Federal highway requirement plan, inter-urban road requirement plan, district transport development plan

Urban development plan, area usage plan, landscape plan, local noise reduction plan, local clean air plan

Local transport development plan, local public transport plan, road networks safety analysis

Urban framework plan, building development plan, village development plan

Local area traffic plan

Street space design
selection of a recommended cross-section
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.
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. \( V_{\text{lim}} = 50 \, \text{km/h} \) where frontages are facing away from the road and \( V_{\text{lim}} = 70 \, \text{km/h} \) where frontages are distant from the road.

On roads with trams the BOSStrab directives\(^{38}\) must also be followed.

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

<table>
<thead>
<tr>
<th>Design elements</th>
<th>Limit values</th>
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<td>Horizontal alignment</td>
<td>Curves: minimum radius, ( \min R , [\text{m}] )</td>
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<tr>
<td>Vertical curvature</td>
<td>Maximum longitudinal gradient, ( \max s , [%] )</td>
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<tr>
<td></td>
<td>Peak minimum radius, ( \min H_k , [\text{m}] )</td>
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<td></td>
<td>Trough minimum radius, ( \min H_k , [\text{m}] )</td>
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<tr>
<td>Cross-section</td>
<td>Maximum lateral slope on curves, ( \max q_{\text{max}} , [%] )</td>
</tr>
<tr>
<td></td>
<td>Minimum ramp slope, ( \min \Delta s , [%] )</td>
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<tr>
<td>Visibility</td>
<td>Minimum visibility for ( s = 0 % )</td>
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<tr>
<td></td>
<td>( \min S_{\text{vis}} , [\text{m}] )</td>
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</table>

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

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.

\(^{38}\) “Directives for the routing of rail tracks in accordance with the Regulation governing the construction and operation of trams” (BOSStrab routing directives), in: Verkehrsbane (1993), volume 15, p. 571–576.
FGSV (Road and Transportation Research Association)

classification - framework - proposals
E-studio, University of Kassel

introduction - institutional framework - case studies
03 proposals for legal and institutional changes in Croatia
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

STRATEGIES ←→ RULEBOOKS ←→ LAWS

ACTION PLANS ←→ GUIDELINES ←→ STREET DESIGN

context - framework - proposals
evaluate and update
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

context - framework - proposals
new road classification

C2 and C3 are dealt with in Norwegian Public Roads Administration handbook N100.
1. DATA AND EVALUATION
2. SUSTAINABLE URBAN MOBILITY PLAN (SUMP)
3. CYCLING NETWORK DEVELOPMENT PLAN
4. INTERDISCIPLINARITY IN STREET DESIGN
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9. STREET TRANSFORMATIONS AS A TOOL FOR URBAN REHABILITATION
10. EMPLOYEE TRAINING
11. MORE FINANCING FOR BETTER RESULTS
importance of standardization

unclassified roads (streets) in Zagreb = 2.450 km
1. DATA AND EVALUATION
2. SUSTAINABLE URBAN MOBILITY PLAN (SUMP)
3. CYCLING NETWORK DEVELOPMENT PLAN
4. INTERDISCIPLINARITY IN STREET DESIGN
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9. STREET TRANSFORMATIONS AS A TOOL FOR URBAN REHABILITATION
10. EMPLOYEE TRAINING
11. MORE FINANCING FOR BETTER RESULTS
illegal development areas
street transformations as a tool for urban rehabilitation

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
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10. EMPLOYEE TRAINING
11. MORE FINANCING FOR BETTER RESULTS

context - framework - proposals
University level

1. INTERDISCIPLINARY UNIVERSITY COURSES

2. INTEGRATED TRAFFIC PLANNING

3. PROFESSIONAL TRAINING
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