

Attachment - Concepts of the Street and their Contribution to Multifunctional and Sustainable Streets

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Impressum

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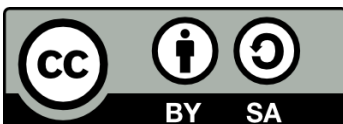
21073 Hamburg

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Online-Publication

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Preliminary Remarks

The following table originated in the context of the LILAS-project (10/2020-12/2023), which has been founded by the Landesforschungsförderung Hamburg, Germany.

The table provides an overview of the measures identified in the literature review and their objectives and characteristics. The respective measures are assigned to superordinate target categories, which were derived inductively from the measures identified and can be attributed to a variety of disciplinary perspectives.

Forms and types of greenery in street spaces	Comments
Trees (climate resilient, domestic)	Aesthetics, cooling
Greened planters	Aesthetics
Accompanying green and water retention spaces	Integration of green spaces
Greened water spaces	Cooling
Hedges, shrubs	Noise reduction, air cleaning, demarcation, aesthetics, cooling
Rain garden	Integration of greening and water retention
Bioswale	Integration of greening, water retention and infiltration
Greened parking spaces (grass pavers)	Unsealing
Greened rails	Unsealing
Greened trenches	Water retention
Irregularly-arranged green structures	Street design, integration of green spaces
Tree plantings in rain gardens/bioswales	Integration of green, water retention and infiltration
Vertical greening (trellises, poles)	Cooling
Greened median	Unsealing
Plant bed/community garden/raised bed/fruit-tree	Urban gardening
Flower bed/flowers	Decoration
Wildflowers	Habitat for insects
Multi-level greening from herbs to trees	Ensuring high(er) wind speeds for air exchange
Greened patches around trees	Integration of greening, inclusion of residents who care for greened areas
Vegetation barriers	Reduction of air pollution and noise exposure, aesthetics
Suspended pavements/tree trenches/street tree systems	Creation of substratum filled root spaces
Water management and water-related measures in street spaces	Comments
ecological and waterpermeable pavements	Water infiltration
water-misted areas/fog	Albedo, cooling
(Subsurface) storage basin/cistern	Water retention
Water permeable parking spaces	Unsealing
Water channel/gutter	Water drainage
Water retention basin/storage basin	Flood prevention
Temporary water retention (e.g. lowered parking space, sports areas, green areas)	Flood prevention
sensor-based irrigation system with storage basin/cistern	Adjusted irrigation
Restructured/newly-built drainage system	Adjusted drainage
Omitting curbs	Improved drainage/water flow
Curb cutouts for water runoff	Improved drainage/water flow
Emergency overflow (flattened curbs)	channelling of water flow during flood events
Water reservoir (gravel trenches under water permeable pavement)	Water retention and infiltration
Soil filter	Water purification
Emergency waterways on the streets (V-profile)	Flood prevention

Decentralised water runoff in greened areas (e.g rain garden)	Improved drainage/water flow, adjusted irrigation
Storage trenches, impounded streets (raised curbs in the cases of streets with a V-profile)	Steering of water flows during flood events
Storage channels	channelling water flows
Climate tile (combination of water-permeable pavement, piping system, swale)	Improved drainage/water flow, water retention
(Street accompanying) water retention areas	Water purification, water retention
Greened rain gardens	Integration of greening and water retention
Bioswales	Integration of greening, water retention and infiltration
Swales	Water retention and infiltration
Greened parking spaces (grass pavers)	Water infiltration
Greened trenches	Integration of greening and water retention
Tree plantings in rain gardens/bioswales	Integration of greening and water infiltration
Streets for pedestrian and bicycle traffic	Comments
Sidewalks/pedestrian areas ((minimum) width, good condition, clear demarcation)	High quality pedestrian infrastructure
Uniform street surface	Street surface quality
Sidewalk surfaces (skidproof)	Safe walkways
More, and safe, bicycle parking facilities, bicycle stations (establishment, expansion)	Safe and more bicycle parking facilities
Safe street crossing facilities (barrier-free, marked, equipped with signals, different colours)	Safe street crossings
Target-group-specific traffic signals at street crossings (acoustics, LED on street)	Target-group-specific traffic signals
Shorter waiting times/green waves for pedestrian and bicycle traffic	Acceleration of pedestrian and bicycle traffic
Earlier green at traffic lights (pedestrians)	Increased visibility
Widened, curb-limited sidewalk areas	Faster street crossing, more space for pedestrian traffic, change of cross-section
Plane-free track crossings (90° for bicycle traffic)	Safe, barrier-free crossing options
Coloured and spatially-highlighted marking elements (3D)	Increased visibility
Additional street crossings	Pedestrian comfort
Create sidewalks	Consistent pedestrian network
Create bike lanes/protected bike lanes	Consistent cycling network
Create bike lanes (wider lanes)/cycle streets	Quality of cycling infrastructure
Lowered curbs/ramps	Barrier-free, bicycle-friendly development
Omitting curbs/curb stones	Area integration, accessibility
Speed limits/traffic calming (regulative)	Improved perceptibility and responsiveness of street users
Street overpasses/underpasses (pedestrian and bicycle traffic)	Creating possibilities for conflict-free street crossing
Create linear medians	Street crossing
Create multi-purpose medians (vehicle/bicycle turning, street crossing)	Street crossing, turning procedures
Punctual traffic islands	Street crossing

Traffic prioritisation (pedestrian and bicycle traffic)	Prioritisation of other street users
Equal rights of street users	Mixed use of traffic areas
Bike sharing systems/areas	Integration of new mobility offerings
Allowing bicycle traffic in pedestrian zones	Mixed use of traffic areas
Handicapped accessible access	Accessibility
Elevators	Accessibility, comfort
Safety lanes/dooring zones	Cycling safety
Bike boxes (spaces for bicycle traffic at traffic lights)	Visibility of cycling traffic, perception of safety, turning possibility
Non-genuine one-way streets (bicycle traffic is allowed to enter from both directions)	Consistent cycling network, cycling acceleration
Temporary markings and street signs	Situational adaptation measures
Prioritisation of bicycle lanes	Cycling safety, cycling acceleration
Push-measures for the limitation of motorised vehicle traffic in street spaces	Comments
One-way streets (regulation, installation)	Traffic regulation, area reclamation
Traffic aspects of pavement (driving characteristics, noise, repair)	Pavement properties
Street entry restrictions, with specific exceptions (residents, authorised persons, emission standards)	Traffic regulation
Street entry prohibitions for private cars/vehicles (temporary, permanent)	Traffic regulation
Partial closures for motorised vehicle traffic (temporary, permanent)	Traffic regulation
Reduction or narrowing of lanes	Space reclamation, reuse of space
Narrowed lanes (linear)	Speed reduction
Visually narrowed lanes (pavement gutters)	Speed reduction
Narrowed lanes (punctual)	Speed reduction
Swiveled lanes (S-guidance, structural elements)	Speed reduction
Speed bumps (Berlin cushions, elevated paved areas)	Speed reduction
Reduction and conversion of parking facilities (temporary, permanent)	Space reclamation, reuse of space
Speed reduction through design/elements (curve radii, historic pavements)	Speed reduction, structuring
Cul-de-sacs/drive-through barriers	Access restrictions
Bollards	Access restrictions
Chicanes	Speed reduction
Drive-through bans	Access restrictions
Restructuring of parking areas (sufficient space for pedestrians between parked cars)	Clarity
Slowed left turn	Traffic safety
Underground parking	Relocation of street parking
Removal of right turns	Traffic safety
Clearly marked/demarcated parking areas	Clarity
Parking bans	Clarity, space reclamation
Stopping restrictions	Clarity
Temporary street space reuse/flexi-zones	Temporary change of street use

Speed limit/traffic calming (regulative)	Speed limitation
Traffic islands/narrowing of the street space (punctual - street crossing)	Street crossing, speed reduction
Traffic prioritisation (pedestrian and bicycle traffic)	Prioritisation of other street users
Equal rights of street users	Mixed use of traffic areas
Need-related environmental requirements of street spaces	Comments
Street furniture (seating, information facilities, rubbish bins)	Stay
Seating areas/seat walls	Stay
Shaded seating (covered, green)	Stay
Public sanitary facilities	Need satisfaction
Improvised seating (own chairs, structural elements)	Stay
Street lighting (installation, upgrading)	Stay
Adequate sidewalk widths (not too wide, otherwise they can appear cold and empty)	Stay
Cycling ban	Stay
Shading (awnings, sun sails, trees, canopies, (movable) umbrellas, building stock)	Stay
Roofing/shelters/leaf roof (protective function e.g., sun, rain)	Stay
Covered walkways/arcades/pedestrian areas (protective function: e.g., sun, rain)	Stay
Noise barriers (noise protection walls)	Stay
Air-conditioned areas (street overpasses, shopping areas)	Stay
Drinking water dispensers/fountains	Need satisfaction
Climate-sensitive surface materials (high albedo, low heating)	Environment design, stay
Building entrances with steps to sit on/porches	Stay
Misting showers (cooling arches)	Satisfaction of needs
Hedges, bushes, shrubs (noise reduction, air purification, delineation, aesthetics, cooling)	Stay, aesthetics, environment design
Temporary change in land use/flexi zones	Temporary conversion
(Open) water features (install)	Stay, aesthetics
Reduction/removal of obstructive elements (billboards, signs)	Aesthetics, stay, environment design
Rubbish collection areas (prevention of litter pollution)	Aesthetics, environment design
Vegetation barriers	Reduction of air pollution and noise
Offerings and incentives to visit and use street spaces	Comments
Landmarks	Aesthetics
Play and sports equipment/play elements	Stay
Diverse, distinguishable street surfaces (noisy, structural, colourful)	Aesthetics, Structuring
Sails/awnings/canopies	Aesthetics

Temporary pocket parks, parklets	Stay, Conversion
Permanent pocket parks and places	Stay, Conversion
Monuments	Aesthetics
(Street) art (sculptures, structures, installations, exhibitions)	Aesthetics
Street artists	Stay
Food trucks/(direct sales) markets/street vending/kiosks (windows, counters, stalls)	Stay
Vending machines	Stay
Fish ponds/fish basins	Stay, aesthetics
Water features (fountains, cascades)	Stay, aesthetics
Installation and expansion of internet access (5G)	Stay, Communication infrastructure
Display areas for offerings (displays, shop windows)	Stay
Restriction of street advertising (signs, light installations)	Aesthetics
Take down poles and bury wires, remove dumpsters, (advertising) boards, stalls	Aesthetics
Remove street vendors	Stay
Highlight street entrances (ornamented gates, flags, signage)	Aesthetics
Ornaments	Aesthetics
Public telephone boxes	Stay
Temporary land use/flexi zones	Stay, Conversion
Flower beds/flowers	Aesthetics
Wildflowers	Aesthetics
Vegetation barriers	Aesthetics
Smartification and mechanisation of street spaces	Comments
More efficient street lighting (motion sensors, LED)	Energy Efficiency
Self-illuminating, dynamic street markings (adapts to environment and traffic conditions, LED)	Reactive infrastructure
Illuminated street surface (lighting intended to improve visibility)	Safety
CCTV/camera-based traffic monitoring/video detection (traffic conditions, speeds)	Traffic monitoring
(Magnetic) sensor-based monitoring of traffic and environmental data (humidity, temperature, movement)	Traffic and environmental monitoring
E-charging station/charging facilities/smart poles	Energy supply, charging facilities
Pumping systems	Prevention of damage due to heavy rainfall
Piezoelectric films/coverings	Energy production
Rubber sheets as linear inductive generators for power generation	Energy production
Solar cell pavement (bike lanes, paving)	Energy production
Photovoltaic pavement (LED displays, heating, drainage)	Energy production
Photocatalytic pavements (reduction of nitrogen oxides by titanium oxide)	Emission reduction
Smart grids (temporary, self-sufficient energy supply and storage in a street context)	Energy supply and storage

Inductive charging and energy transfer systems (for electric vehicles)	Energy supply and storage
Overhead power lines	Energy supply
Conductor rails (integrated into streetspace)	Energy supply
Micro wind turbines	Energy production
Street lamps with solar panels	Energy production
Batteries/accumulators as electricity storage in street space (in the future also heat and hydrogen)	Energy storage
(Low-temperature) storage - (gravel-water storage, geothermal probe storage, aquifer heat storage)	Energy storage
(360°) camera surveillance/CCTV	Street space monitoring
Energy supply/connections in the street space (temporary use)	Energy supply
Communicating infrastructure (digital twins of infrastructure with collection of environmental data)	Communicating information system
Heated bridge structures (geothermal energy)	Self-regulating infrastructure
Underground empty pipes/underground cables (electricity transport, inductive charging of e-cars)	Energy infrastructure, energy supply
Geothermal probes (double U-tube probes, storage probes, surface collectors, pipe registers)	Energy production
Fluid-flow interlayer (between asphalt surface course and asphalt binder course)	Self-regulating infrastructure
Magnetisable (heavy) concrete (better transmission of electrical energy)	Energy infrastructure
Establishment and expansion of Internet access (5G)	Communication infrastructure, stay
Measures to accommodate special user groups in street spaces	Comments
Loading and unloading zones	Supply and disposal
Signposted/marked paths or streets/route signs (play street signs/traffic-calmed area)	Safety, structuring
Entry and exit areas (persons with disabilities, taxi passengers, other private individuals)	Special needs, structuring
Play areas/zones	Activity possibilities, stay
Visual/perceptible separation (tactile stripes, guide stripes for the blind, flat curbs, sloped curbs, gutters)	Special requirements, structuring
Safety zone for vulnerable groups	Safety
Parking in exceptional cases (disabled persons)	Special demands
Play and sports equipment/play elements	Activity possibilities, stay
Entry restrictions with exceptions (residents, authorised persons, emission standards)	Traffic regulation
Handicapped accessible driveways	Accessibility
Lowered curbs/ramps	Barrier-free, bicycle-friendly implementation
Safe street crossing options (barrier-free, marked, street signs, different colours)	Safe street crossing
Target group specific street signs and signals at street crossings (acoustics, LED on street)	Target group specific street signs and signals

Reduction/removal of obstructive elements (billboards, signs)	Aesthetics, stay, environment design
Handicapped accessible sidewalks/pedestrian areas (central lines, tactile dividing strips, height adjustment)	Accessibility
Improving and expanding public transportation and alternative mobility options	Comments
Establishment of special vehicle lanes/bus lanes/public transport axes (rail)	Traffic infrastructure
(Temporarily) modified streetscapes (fencing, surface adaptation)	Traffic test
Bicycle and pedestrian bans	Traffic test
Conversion of footpaths into traffic lanes	Traffic test
Sheltered public transport stops	Traffic-related infrastructure
Public transport stops	Traffic infrastructure
(E-)car-sharing	Mobility offering
E-scooter rental systems	Mobility offering
Reserved car-sharing parking spaces/areas	Mobility-related service offering
Public transport stops within walking distance (bus, train, suburban train, underground rail)	User comfort
Traffic-related measures and elements for streetscape structuring	Comments
Structural traffic delimitation elements (railings, high curbs, curb and trough gutters, chains, bollards, grids, fences)	Structuring, safety
Widened sidewalk areas/curbs (distance between traffic lanes and pedestrians)	Structuring, safety
Signposted/marked paths or street/route signs (play street signs/traffic-calmed area)	Structuring, safety
(Temporary) markings and street signs/signals	Structuring
Omission/reduction of street signs/signals, signage and markings	Personal responsibility due to reduced/absent structuring
Removal of (visual) obstacles in the streetspace (bollards, parking strips)	Structuring, clarity
Visual/perceptible separation (tactile strips, guide strips for the blind, flat curbs, sloping curbs, gutters)	Structuring, special requirements
Traffic circles	Structuring
Parking lanes as spacers/safety lanes between pedestrian and vehicle traffic	Structuring, safety
Spacers/safety strips between pedestrian/bicycle and motorised vehicle traffic (trees, planters, green strips)	Structuring, safety
Reserved areas designated by colour or elements (food truck areas, booth areas)	Structuring
Turning facilities (cul-de-sacs)	Structuring
Low fences	Clarity, structuring

Leveling (between street and building entrances, street elements)	Structuring
Different types of distinguishable street surfaces (noise, structure, colour)	Structuring, aesthetics
Punctual traffic islands	Street crossing
Clearly marked/designated car parking spaces	Structuring
Restructuring of parking areas (sufficient space for pedestrians between parked cars)	Structuring, clarity
Speed reduction through design/elements (curve radii, historic street surfaces)	Structuring, speed reduction
Narrowed lanes (punctual)	Structuring, speed reduction
Swiveled lanes (S-guidance, structural elements)	Structuring, speed reduction
Narrowed lanes (linear)	Structuring, speed reduction
Central median (pedestrian crossing - linear)	Structuring
Creating multi-purpose median strips (motorised vehicles/bicycle turning, street crossing)	Structuring, street crossing, turning operations
Traffic islands/narrowing of street space (street crossing - punctual)	Structuring, street crossing, speed reduction
Omission of curbs/curb stones	Structuring, area integration, accessibility
Speed bumps (Berlin cushions, elevated paved areas)	Structuring, speed reduction
Greened central medians	Structuring, greening

Identified measures and overarching objectives. Own presentation 2024.