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Defining Streets

With 75% of the world's population expected to be living in cities by the year 2050, urban streets will need to balance demands for increasing personal mobility and access to the city economy. Where the low-density, auto-centric development patterns of the 20th century have failed, dense cities with robust multimodal transportation networks are best suited to provide sustainable growth, equal economic opportunity, and a high quality of life. Walkable, cyclable, and transit-oriented neighborhoods are what today's urban dwellers need and demand.

The capacity of urban streets must be increased in ways that support the urban context and ensure a high-quality public realm. This can be achieved by prioritizing sustainable modes of transportation through dedicated space, allowing high-efficiency modes like transit to leave more room for other street activities that support urban life.

As cities grow upward, inward, and outward to serve changing populations, it is critical to consider the many players and processes that shape streets. Our streets are integrally tied to other urban systems, and designing them well offers multiple benefits to cities and their residents.

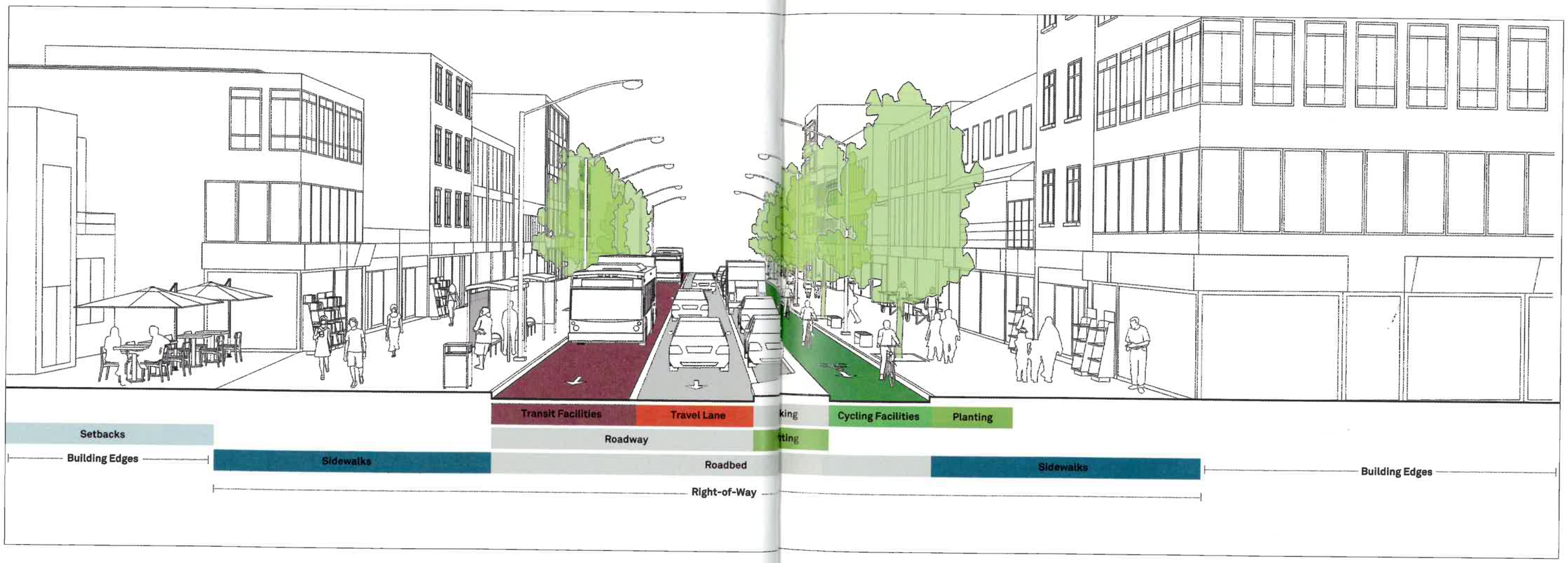
Hong Kong, China

1.1 | What is a Street

A street is the basic unit of urban space through which people experience a city. It is often misconceived as the two-dimensional surface that vehicles drive on when moving from one place to another. Streets are, in fact, multidimensional spaces consisting of many surfaces and structures. They stretch from one property line to another, including the building edges, land uses, and setbacks that define each side. They offer space for movement and access and facilitate a variety of uses and activities. Streets are dynamic spaces that adapt over time to support environmental sustainability, public health, economic activity, and cultural significance.

Streets are like outdoor rooms shaped by multiple planes: the ground plane at the bottom, the buildings and the roadbed edges as the side planes, and the canopy plane like the ceiling of the room. Each plane is constructed of many individual elements that are often regulated or created by a range of different policies, codes, guidelines, and building practices.

Understanding the various portions of a street as either continuous or interchangeable offers a flexible approach to street design. While sidewalk clear paths, bike lanes, and travel lanes must be continuous and connected in order to function effectively, interchangeable elements such as parking spaces, trees, parklets, and transit stops allow a street to be adapted to serve its context. The terms below broaden the definition of *street*.



Right-of-Way

The entire distance from building edge to building edge.

Sidewalk

Dedicated space with clear walking paths and universal access used for a variety of activities and functions. *See 6.3.4: Sidewalks.*

Roadbed

The space between the two sidewalks that can be designed to carry various modes of transportation and their ancillary facilities.

Transit Facilities

Dedicated space within the roadbed for different types of transit to travel on. *See 6.5.4: Transit Facilities.*

Service Infrastructure

The utilities and services provided within the space of the right-of-way.

Street Activity

Social interactions, neighborhood activities, and citywide events that take place within the street.

Street Furniture

The objects, elements, and structures placed within the street.

Building Edges

The collection of building facades, windows, setbacks, signs, and awnings that define each side of the street.

Travel Lanes

The dedicated space within the roadbed for motorized vehicles to move on. *See 6.6.4: Travel Lanes.*

Ancillary Lanes

Dedicated spaces for stationery cars, cycles, transit vehicles, loading and unloading zones.

Cycle Facilities

Dedicated space for cyclists to travel. This can be within or separate from the roadbed. *See 6.4.4: Cycle Facilities.*

Planting

Trees, planting beds, and green infrastructure within the sidewalk, between parking spaces, or in medians. *See 7.2: Green Infrastructure.*

1.2 | Shifting the Measure of Success

After decades of designing streets to move large numbers of vehicles as efficiently as possible, cities are finally rediscovering the benefits of designing safe and livable streets that balance the needs of all users. It is time to change practices and redefine what constitutes successful streets. Streets should not be evaluated in isolation or as transportation projects alone. Instead, each design presents an opportunity to ask what overall benefits can be gained.

Public Health and Safety

Every year, millions of people die unnecessarily from preventable causes, such as traffic violence or chronic diseases related to poor air quality and lack of physical activity. Street design must promote safe environments for all users and offer healthy choices that facilitate active transportation, such as walking, cycling, and using public transit. Streets should improve access to healthy food options, mitigate noise levels, and provide landscaping and trees that improve air and water quality.

Quality of Life

Cities around the world are competing for the title of 'most livable city'—a recent measure of success—acknowledging the value of quality-of-life measures in attracting and retaining residents and businesses. As people experience a city through its public spaces, the livability of a city is highly dependent on its streets. Shaping how safe, comfortable, efficient, and vibrant a city's streets are will affect how livable it is and how connected its citizens feel. Streets can encourage social interaction, and designs that offer natural surveillance and help build stronger, safer communities.[1]

Environmental Sustainability

In the face of unprecedented climate challenges, street projects provide an opportunity for local actions to improve the environmental sustainability and resilience of a city. Promoting sustainable transportation modes through well-designed streets can lower carbon emissions and improve overall air quality. Incorporating trees and landscaping can improve water management, foster biodiversity, and increase access to the natural environment.

Economic Sustainability

Great streets attract people and business. Street projects that increase safety, improve public realm quality, and welcome multimodal use have positive economic effects such as higher retail sales and increased property values. Investment in streets has long-term economic benefits.[2]

Social Equity

In an era of increasing inequality, cities must ensure that their most valuable public spaces offer safe and equitable use to all, regardless of ability, age, or income, empowering the most vulnerable users with safe and reliable mobility choices.

A city serves its citizens better through street design that increases access to jobs and schools, benefits individual health, improves sanitation, and encourages strong communities.

1.3 | The Economy of Streets

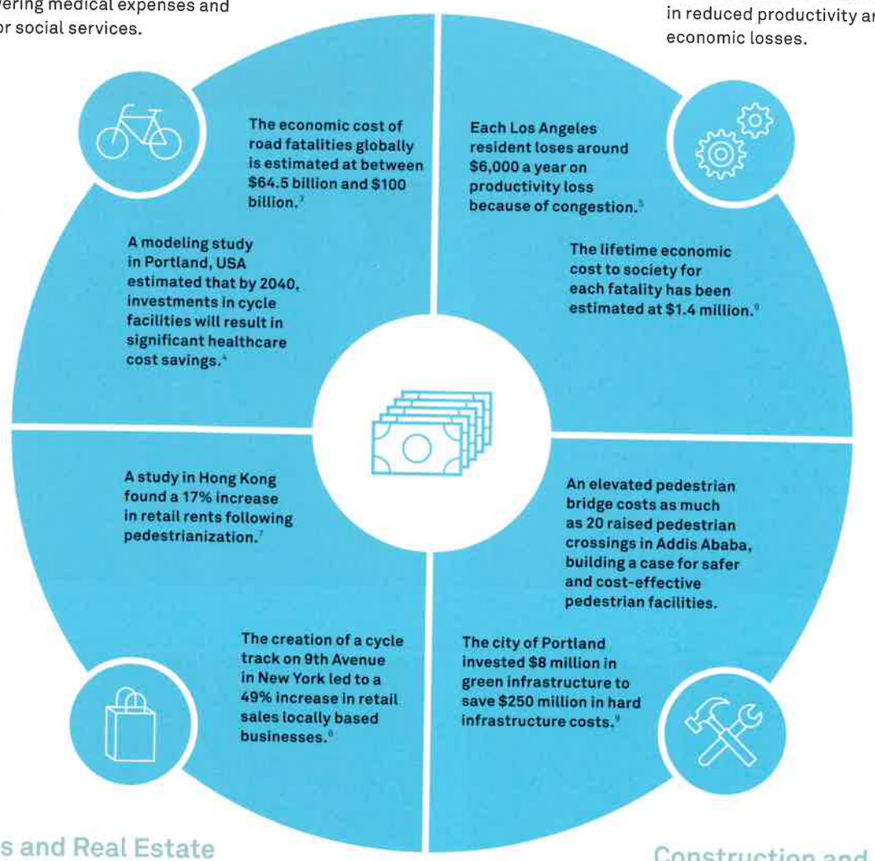
A safe, vibrant, efficient street network is essential to the economic health of a city or region. Street design also plays a major role in facilitating access to formal and informal commerce, jobs, or the wholesale movement of goods. The up-front costs of constructing a street should be considered with regard to the benefits its design will confer throughout its lifespan. Cost impacts of street design should be considered for individuals through value of travel time, public transportation access, fuel costs, and individual health, while the larger externalized cost to society can be examined through expenses such as those related to traffic crashes, hospital costs, negative environmental impacts, and congestion.

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.



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.

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]

1.4 | Streets for Environmental Sustainability

Designing streets that respond to their environment can help cities meet the challenges of a warming planet. Various international organizations and agendas, such as the UN Sustainable Development Goals, have increased the focus on environmental sustainability, greenhouse gas emissions, and global warming. It is the time to promote the environmental benefits of great streets. Investment in sustainable streets can be attracted by highlighting improved environmental impacts and increased contribution toward achieving a city's environmental goals.

Microclimate

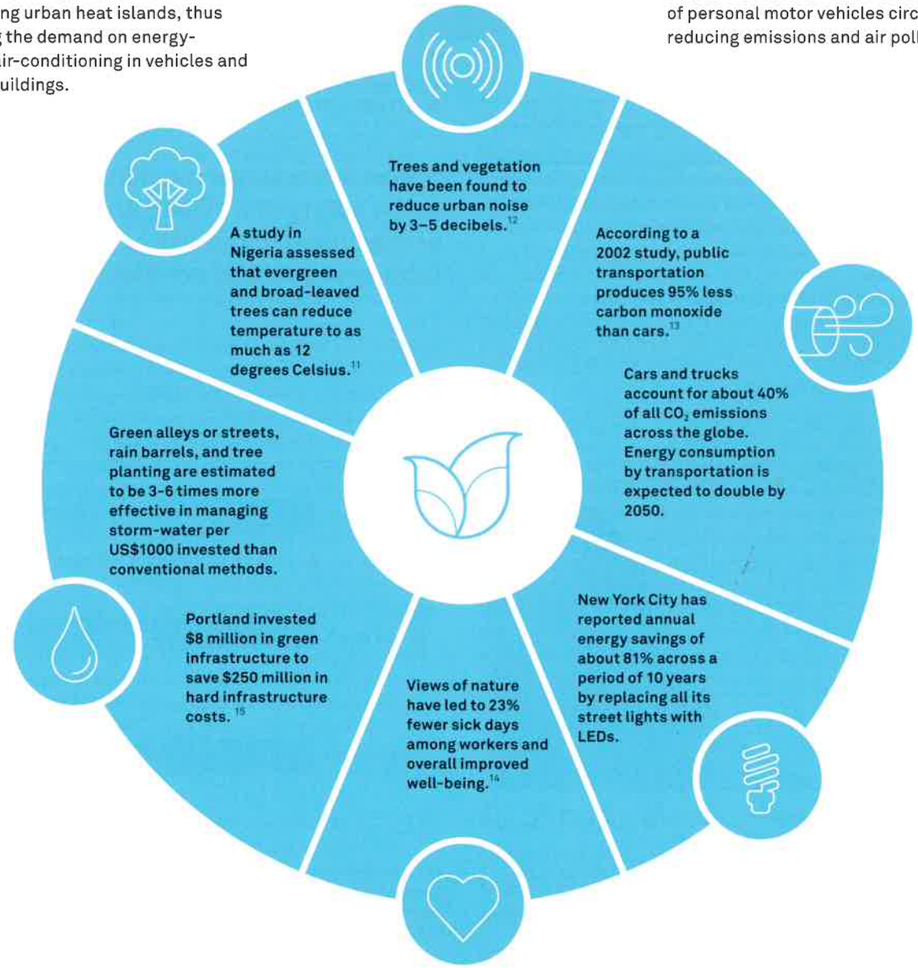
Street trees and landscaping can assist in improving the local climate and reducing urban heat islands, thus minimizing the demand on energy-intensive air-conditioning in vehicles and adjacent buildings.

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[16] and have been linked to crime reduction.[17]

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.

1.5 | Safe Streets Save Lives

More than 1.2 million people die on roads around the world every year. That is equivalent to roughly one person dying every 30 seconds, or over 3,400 people dying every single day of the year.[18] Many of these deaths occur on urban roads and are preventable crashes caused by behavior induced by street design.

Creating safe streets is a critical responsibility shared by designers, engineers, regulators, and civic leaders. Even in the cities with the best safety records, the threat of traffic violence makes movement around the city a potentially dangerous daily activity. Highway-like street designs that prioritize automobiles over vulnerable users and encourage high speeds fail to provide safe environments.

A New Paradigm for Safety

The new paradigm for safety is built on human limits. The human body is fragile and can only survive certain forces. This means:

- Reducing exposure to the risk of conflict
- Reduce crash numbers and the severity of impact by
- Reducing speed
- Shaping streets that are safe for vulnerable users

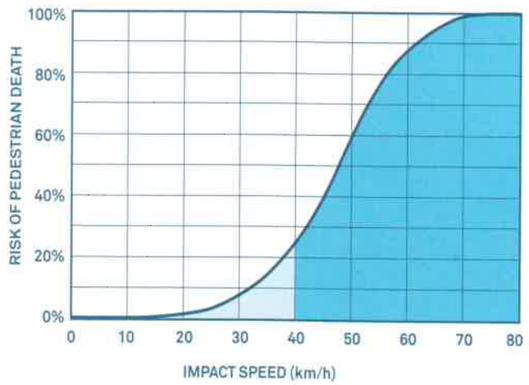
When vehicles move at or below 40 km/h, potential conflicts take place at lower speeds, dramatically increasing the chances of survival in the case of a crash.

Studies from around the globe have shown that most traffic deaths, especially the easily preventable pedestrian deaths, occur on a small percentage of arterial streets.[19] These streets are rendered dangerous by design. They contain the following characteristics:

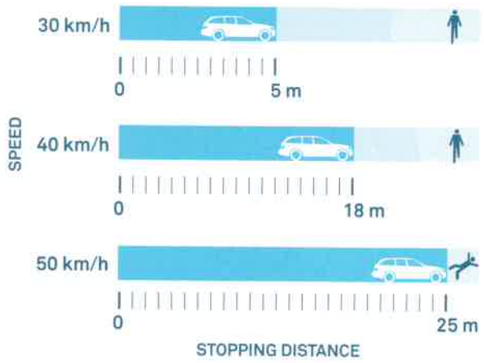
- Wide streets that invite speeding and lack safe crossings.
- Streets that act as front yards but allow aggressive behavior by those passing through.
- Highway-like surface streets where motorcyclists and public transport passengers are at risk from large speed differentials, and where sidewalks are missing or substandard.

The combination of high traffic speeds and volumes, long crossings, and large distances between marked crossings make them fatal corridors for vulnerable users.

Speed is the single most important factor in the safety of a street, and is directly proportional to the risk of pedestrian fatality in cases of conflict.



The relationship between impact speed and risk of pedestrian death. Several recent studies (Pasanen 1993, DETR 1998, Rosen and Sanders 2009, and Tefft 2011) show the existence of a clear relationship between vehicular speeds and pedestrian casualties, supporting the idea that speeds over 40 km/h should not be permitted in urban streets. However, most of these studies were conducted in high-income countries and there are reasons to believe this relationship might be even more extreme in low- and middle-income countries.[20]



The relationship between speed and stopping distance. The graphic above depicts minimum stopping distances, including perception, reaction, and braking times. They are based on dry conditions and assume perfect visibility.[21]

Common Causes of Traffic Fatalities

Many traffic injuries are directly related to design. Conditions become more dangerous with the addition of speed. Common causes for traffic fatalities include the following:

- **Lack of Sidewalks:** When the sidewalk is blocked, narrow, or nonexistent, pedestrians are forced into the roadbed. This presents a particular threat when the street is designed for fast-moving vehicles, and not designed to accommodate all users safely.
- **Lack of Accessible Crossings:** Pedestrians are at risk of being struck when accessible crossings are not provided or are inaccessible. Mid-block pedestrian crashes are very common on large streets, where vehicle volumes and speeds are prioritized over sufficient opportunities for safe crossing.
- **Lack of Protection:** Wide, multi-lane streets without refuge spaces expose pedestrians to moving vehicles for longer distances as they cross the street. This is particularly unsafe for the elderly or those who move at a slower pace.
- **Lack of Predictability:** When signals and countdown clocks are not provided, or when signal cycle lengths result in a long wait time, pedestrians are unable to safely judge the time they have and are more likely to cross unsafely.
- **Lack of Cycle Facilities:** Cyclists are at risk of rear-end and overtaking crashes when mixing with motor vehicles at moderately high speeds, especially on multi-lane streets.
- **Poor Intersection Design:** Large intersections are often designed for dangerous, high-speed turning. Lack of visibility results in poor navigation and assessment of different users' movements.
- **Unsafe Boarding Areas:** Transit riders are at risk when boarding and alighting vehicles in traffic, especially if no safe facilities are provided. Higher-speed streets and poor intersection design near boarding areas increase chances for severe crashes and put vulnerable users at risk.
- **Surface Hazards:** Obstacles and surface degradation, including potholes, can present hazards to pedestrians and cyclists.

Safe Design Supports Education and Enforcement

Regulations and education are critical to creating a culture of safety. However, a street cannot be made safe if it has been designed to prevent people from making safe decisions. Most road safety agendas focus on reducing probability of human error through education and enforcement, without emphasizing the design of safe streets. Design can ensure that a crash or conflict caused by human error will be limited in its severity. The design of a street is often far outside the scope of a safety project, but it can have direct and indirect impact on the safety of street users.

Vision Zero and Sustainable Safety Programs

The Vision Zero (initiated in Sweden) and Sustainable Safety (initiated in the Netherlands) programs are proactive safety programs being adopted by an increasing number of cities around the world. The premise of such programs is that loss of life is unacceptable, and their goal is preventing all serious road crashes. These initiatives place the burden of safety on the system design, not the road user. Innovative street designs that reduce speed, strict enforcement against traffic violations, legislative ordinances that lower speed limits, and public awareness campaigns have proven to be impactful strategies adopted by these programs.

According to the World Health Organization, over 3,400 people die on the world's roads every day and tens of millions of people are injured or disabled every year. Children, pedestrians, cyclists, and older people are among the most vulnerable of road users.

1.6 | Streets Shape People

Human Health

The World Health Organization defines health as a state of complete physical, mental, and social well-being (and not merely the absence of disease). Urban streets provide the platform for everyday experiences and must, therefore, be designed to support human health and well-being for all people.

Traffic Fatality and Injury

In addition to the 1.2 million people who die, another 20–50 million people are seriously injured each year as a result of road traffic crashes. Young adults aged between 15 and 44 years account for 59% of global road traffic deaths.[22]

Air Quality

Outdoor air pollutants are a major public health concern, causing respiratory and other diseases. An estimated 3.7 million deaths worldwide in 2012 were caused by air pollution and 88% of these deaths were in low- and middle-income countries.[23] Policies and investments in streets that support cleaner, low-emission transportation choices such as collective transit, walking, and cycling can assist in reducing outdoor air pollution.

Physical Activity

Insufficient physical activity is one of the ten leading risk factors for death across all income scales worldwide and a key risk factor in non-communicable diseases. With more than 80% of the world's adolescent population insufficiently physically active,[24] streets must offer safe and accessible sidewalks and cycle facilities to promote physically active modes of transportation.

Water Stagnation

Water stagnation exposes people to water-borne and vector-borne diseases. Streets designed for easy maintenance and proper water flow management reduce the chances for water stagnation, thereby reducing the risk of water-borne diseases.

Access to Nature

Streets are public spaces that people use on a daily basis. Providing access to nature with street trees and landscaping can reduce blood pressure and improve emotional and psychological health.[25]

Noise Pollution

Street noise is one of the primary sources of noise pollution, contributing to a number of health problems, such as sleep disturbance, cardiovascular issues, poor work and school performance, and hearing impairment. Allowing large vehicles and heavy traffic on residential streets may cause sleep disturbances. Street design can reduce speed while policies can reduce horn use, minimizing noise pollution, and reducing discomfort for other street users.

Human Experience

Human experience of neighborhoods and cities is shaped by streets. The ease at which people move from one place to another, access services, enjoy their surroundings, and feel safe impacts their mental health and comfort.

Human Senses

The most intimate experience of a street comes from walking on the sidewalk, suggesting that the success of the street should be measured at human eye level, and at walking speed. Pedestrians experience the street with all their senses. Smells, sounds, textures, and visual interest shape the comfort of the space. Young children, whose senses are not yet fully developed, will use and experience a street differently. As people age, their hearing, vision, and mobility may become impaired, changing the way they receive signals from their environment and their ability to use the street. Consider how textures, materials, sounds, and visual clues can create a safe and enticing environment for people of all abilities.

Safety and Access

People feel more comfortable using safe streets. Urban streets must be designed for slower traffic speeds and include sidewalks, lighting, furniture, and shade to support a safe experience. Streets provide links to critical services such as health care and education and require safe, secure, and accessible routes. Street design should provide spaces that enhance urban safety and support crime prevention.

Social Interaction

Well-designed streets connect people with their communities, providing opportunities to meet people, see friends, and feel socially connected. Streets with reduced traffic volumes and speeds extend the territory of the private spaces that line the street, increasing the opportunity for social interaction.

Empowerment and Social Inclusion

Streets should be spaces of empowerment for the vulnerable. For people burdened with poverty or living in cultures that face social inclusion challenges, streets should provide an inclusive place for diverse users.[26]

Expression

As the central network of public space in a city, streets are often places for political or cultural expression, demonstrated through parades, marches, and celebrations. Streets should be designed as neutral ground to support such events.

Spiritual and Personal Meaning

As sites for daily activities and rituals, streets hold memories of places and events. Streets can represent the character of a specific place and have personal meaning to people. Street design should support safe, positive, and enjoyable experiences.

1.7 | Multimodal Streets Serve More People

Great street designs move, hold, and serve more people within the same space.

Streets must be designed to serve different modes and provide multiple mobility options for its users.

Multimodal streets offer people options for safe, attractive, and convenient travel by foot, by cycle, on transit, as well as in motorized vehicles.

Multimodal streets help to make cities more efficient. A reduction of private cars on streets has a direct link to reduced production of greenhouse gases, related to climate change. This shift also helps in increasing space for commerce and public use, and contributes to a better quality of life and economic growth.

Multimodal Streets Move More People

Multimodal streets move more people. Repurposing street space for more efficient travel modes increases the total street capacity while reducing personal motorized vehicles.

This reduces time spent commuting, thereby increasing productive time that contributes to economic growth.

Multimodal Streets Support Local Businesses

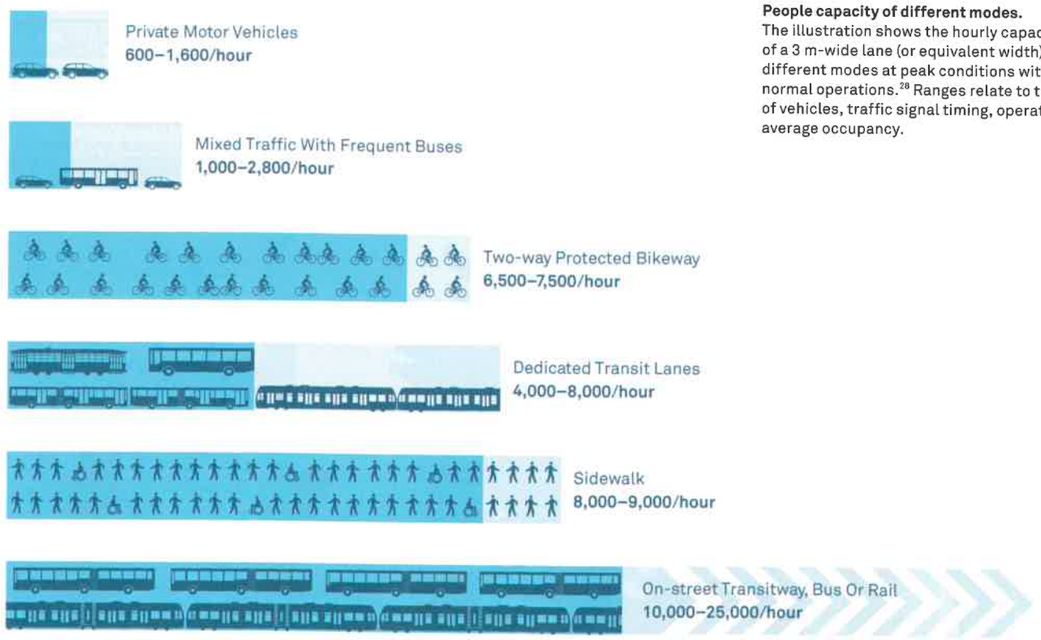
Street projects that improve safety and encourage multimodal use have positive economic effects, such as higher retail sales and improved property values.[27] Moreover, people who walk or cycle often spend more at local retail businesses than people who come to an area by car, underscoring the economic importance of offering attractive, safe spaces for transit riders, pedestrians, and cyclists.

Multimodal Streets are Accessible to More People

A multimodal street network allows people to tailor their trip by their preferred mode of travel. Multimodal streets provide better accessibility to locations within the citywide transit and cycling networks, which can enhance the adjoining neighborhoods and improve property values. This can help invite new businesses and services to improve the overall quality of life.

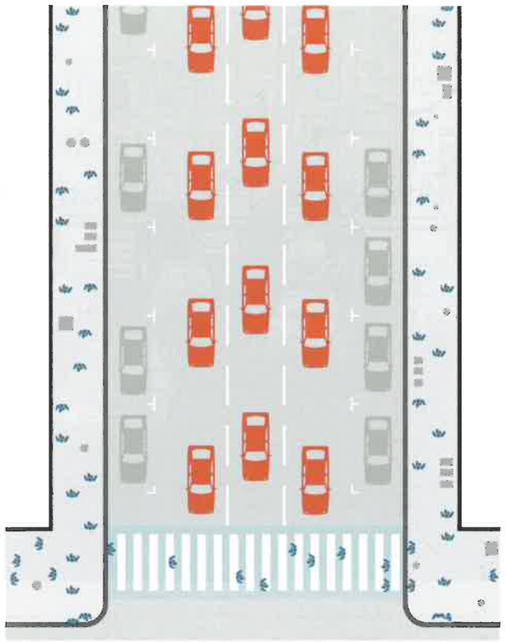
Multimodal Streets are More Environmentally Sustainable

Multimodal streets provide infrastructure for sustainable modes like walking and cycling, which can help lower carbon emissions by reducing vehicular exhaust, thereby improving overall air quality and reducing a city's contribution to climate change.

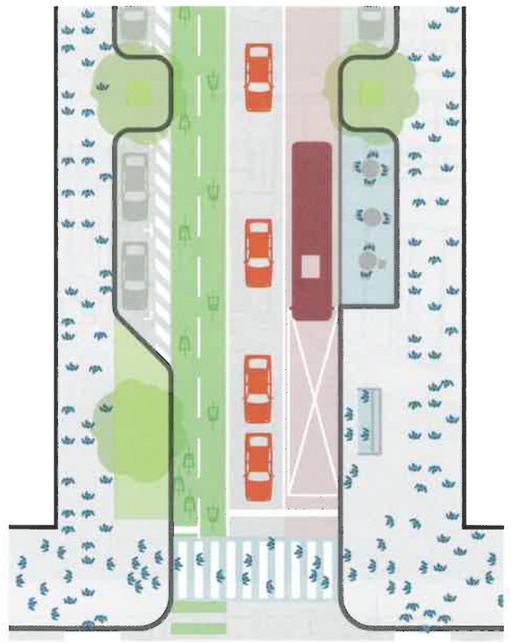


People capacity of different modes.
The illustration shows the hourly capacity of a 3 m-wide lane (or equivalent width) by different modes at peak conditions with normal operations.[28] Ranges relate to the type of vehicles, traffic signal timing, operation, and average occupancy.

Car-Oriented Street



Multimodal Street



The capacity of car-oriented streets and multimodal streets.
These two diagrams illustrate the potential capacity of the same street space when designed in two different ways. In the first example, the majority of the space is allocated to personal motor vehicles, either moving or parked. Sidewalks accommodate utility poles, street light poles and street furniture narrowing the clear path to less than 3 m, which reduces its capacity.

In the multimodal street, the capacity of the street is increased by a more balanced allocation of space between the modes. This redistribution of space allows for a variety of non-mobility activities such as seating and resting areas, bus stops, as well as trees, planting and other green infrastructure strategies. The illustrations show the capacity for a 3-m wide lane (or equivalent width) by different mode at peak conditions with normal operations.

Hourly Capacity of a Car-Oriented Street

4,500/h	x2	**9,000 people/h**
1,100/h	x3	**3,300 people/h**
0	x2	**0 people/h**

Total capacity: 12,300 people/h

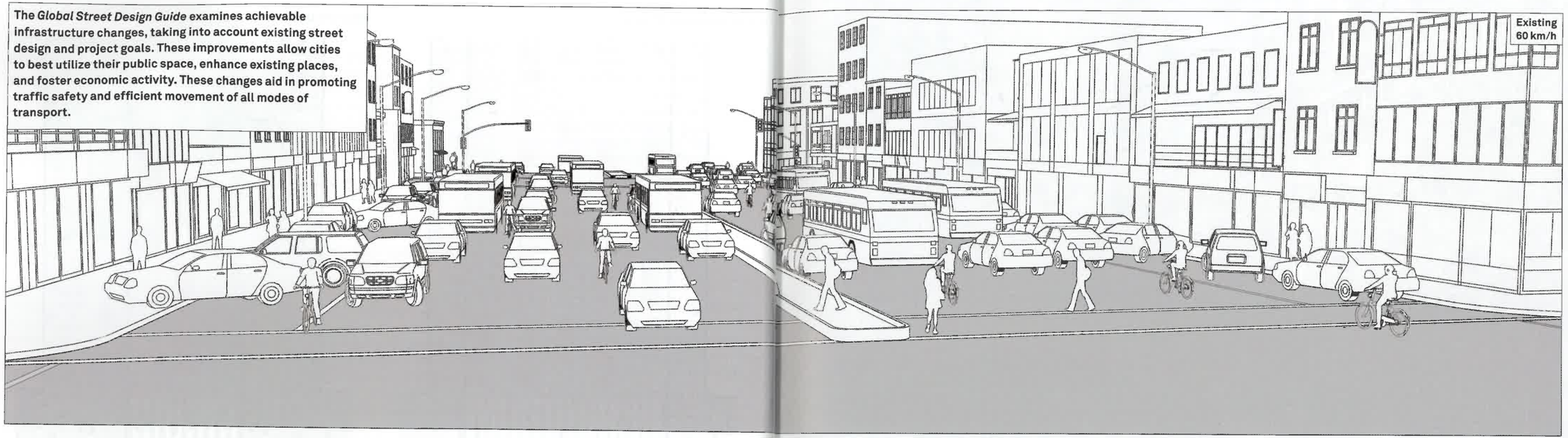
Hourly Capacity of a Multimodal Street

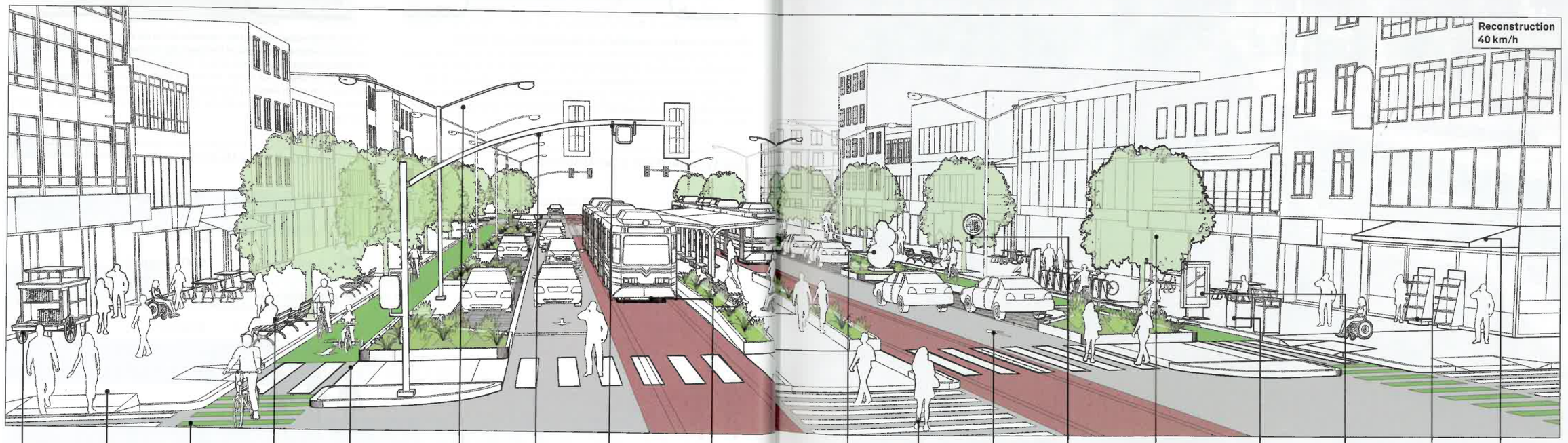
8,000/h	x2	**16,000 people/h**
7,000/h	x1	**7,000 people/h**
6,000/h	x1	**6,000 people/h**
1,100/h	x1	**1,100 people/h**
0	x1	**0 people**

Total capacity: 30,100 people/h[29]

1.8 | What is Possible

The *Global Street Design Guide* examines achievable infrastructure changes, taking into account existing street design and project goals. These improvements allow cities to best utilize their public space, enhance existing places, and foster economic activity. These changes aid in promoting traffic safety and efficient movement of all modes of transport.





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