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Chapter 23

Street Furniture and Amenities: Designing the User-Oriented Urban Landscape

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Additional information is available at the end of the chapter

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1. Introduction

It is often difficult to understand fully how site design integrates the elements of furniture that are used for various designated purposes and create a sense of place. Such an understanding can open up creative possibilities for designers of outdoor areas and enable them to shape spaces that can succeed in achieving their aims over the long term [1].

If street furniture is properly integrated in the design of a public space, it creates an identity and develops a sense of place around it [2]. Items of street furniture comprising, for example, objects used to facilitate transportation or the use of land adjacent to a street, are commonly used in urban areas with the aim of making the street more aesthetically appealing; however, these objects, if placed near intersections, may obstruct the view of drivers, especially if crowds develop around them; and if they are close to the roadway, they should also not obstruct the sight distance of pedestrians [3].

The furniture should be selected and set up based on an analysis of the site's current and desired patterns of use, so it can serve its purpose effectively; quality furniture is costly, so it should be used only where it is really needed. There are various approaches to selecting or designing street furniture: for example, there could be a coordinated selection which gives a consistent tone to streets and walkways; or various parts of the streetscape could be designed to serve as artworks in themselves [4].

Generally speaking, there are five basic criteria involved in selecting and placing items of street furniture: *function* (i.e. seeing how necessary an item is and how it can serve its purpose), *siting and layout* (i.e. deciding where each item should be places), *form and appearance* (i.e. making sure there a continuity or at least a linkage between the designs of different items), *durability* (given expected usage), and *cost* [5].

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1.1. The significance of street furniture

Street furnishings create the settings for resting, sitting and eating, and social encounters with others. Such settings may be of great importance to the elderly, those with limited mobility, and adults who have small children; but in addition to their functional aspect, items of urban furniture such as benches and tables in parks and squares can also be socially significant [6], as they give these sites a comforting and appealing air and draw people in together.

Appropriately selected and placed furniture can draw people to outdoor spaces and add to the pleasure of using these spaces; the main challenge is getting them outdoors, with the aim of making them feel welcome, relaxed, and involved [1]. The quality of urban spaces is indicated by their character and how well they create a sense of identity, as well as by the quality and placement of their street furniture, as can be seen in various cities: London's red telephone booths and Paris' metro entrances, for example, have become iconic and essential to these cities' identities [7]. In addition to their functional and symbolic roles, items of street furniture may also set standards and expectations of quality for the development of the areas where they are found [8] and can serve as talking points for planning [9].

2. Furniture planning

In order to plan the design of street furniture, one must first plan establish and define the type of space under consideration – whether it is a park, a street, a plaza, a waterfront, a recreational area, or a mall, for example. The initial defining questions are: who are the potential users of the space, for what purpose and at what times will it be used, and how will it serve users when they arrive there? [1].

Typically, installations where the furnishings have been planned and coordinated as part of a broader design concept are more successful than those where they have been selected piecemeal without taking account of users' needs, or the architectural character or weather conditions at the site.

As regards what furniture should be consistent across various sites and which unique to a particular site, this depends on the situation, but in general there can be some consistent elements, such as signage, or streetlighting (for quality of illumination, aesthetics, and to facilitate maintenance by standardizing the types of bulbs used) [10]. In brief, the goal is to create convenient, easily maintained and publicly accessible amenities that do not hinder pedestrians or traffic [11].

2.1. Placement of street furniture

The location of the furnishings should be based on their functions [4], and coherent with the patterns and designs of the hard surfaces at the site**.** The items of furniture should not give the appearance of being cluttered, so that, for example, signs are attached to a single post or column rather than being distributed in several places; group amenities such as seating

areas or telephone booths are set up where they will be used, such as at pedestrian junctions; and features like bollards are used minimally [12].

In addition, the furniture should not be hazardous for pedestrians; if it is used along a walking area it should be aligned to make passage easier, rather than staggered like an obstacle course [13, 14]. Varying the texture of the walking surface at key points can also help the visually impaired to find public amenities more easily [11].

3. Street furniture design

The furnishings of urban outdoor spaces should be designed with the needs of the disabled, children, and the elderly in mind, and also to enable triangulation – i.e. they should be linked together to stimulate social encounters and encourage people to talk to strangers.

In public spaces this stimulus can be created by the selection and arrangement of the street furniture; for instance, if benches, rubbish bins and telephones are far apart, they may have the effect of drawing people apart, whereas if they are arranged closely linked with other amenities such as a coffee cart, they tend to bring people together quite naturally.

Safety and Security

Furniture items designed for outdoor spaces must be constructed of safe materials and designed to prevent injury, without sharp edges or exposed fasteners. They are usually either attached to the ground with anchor bolts (for example, using surface mounting, i.e. attaching a bench to a concrete slab), or embedded in the ground. Naturally, the technique used for mounting should be decided on in advance, so the furniture can be made accordingly [15].

The type of furniture and its arrangement should also take into account visibility and sightlines, lighting, and accessibility issues that may be faced by women, children, the elderly and the disabled. Areas which are unsafe or pose risks should be designed taking these factors into consideration [16].

Materials Used in Street Furniture

Furniture selection and design should take into account weather effects such as sunlight, expansion and contraction, wind stress, moisture, and in some cases, salt spray, frost, or ice. The best designs usually incorporate strong, simple shapes, native materials, and natural finishes, generally in black, grays, and earth tones, accented with bright colors [17].

The most popular materials used are steel and wood; other possibilities are stone, concrete, recycled plastic and various other materials. The choice of materials depends on the context and limitations of the design; for example, whether the furniture should be resistant to vandalism, whether ventilation is needed for drying it during wet weather spells, what the weather conditions may be, how frequently the furniture is likely to be used and by whom, what the initial costs are, including mounting, the costs and ease of maintenance, and whether there is a possibility of using eco-friendly materials [15]. Site furniture should be

made of nonflammable materials such as metal, brick, or stone, and wooden structures should be avoided in areas where there is a risk of fire [18].

Steel

Stainless steel is a popular choice of material, because it is versatile, has a high strength/weight ratio and can be shaped to fit almost any design aesthetic. It is durable, resistant to corrosion and impact, and requires no maintenance; it is also cheap compared to all the other materials in terms of life-cycle cost, and is fully recyclable.

Wood

Wood is another popular choice of material for street furniture, because it is a natural material that feels warmer in cold weather and cooler in hot weather, unlike metals. Its disadvantages are that it dries more slowly than metals after rain, needs more maintenance, and is easier to burn, break, carve graffiti into, or otherwise vandalize. Wood may be inexpensive, but the type of wood selected should depend on the location and frequency of use of the furniture. For example *Pinus spp.* is inexpensive and quite durable, but loses its color and longevity if it is not treated and maintained; the cost of maintaining or replacing it may outweigh the initial cost of purchasing it. *Cedrus spp.* weathers naturally, is non-toxic and has a pleasant odour, but it is not a hardwood, and can easily be carved into or chipped; it is therefore unsuitable for areas where there is frequent use of the furniture.

Concrete

Concrete furniture may not need to be mounted, as it is heavy; it is also difficult to vandalize (except with spray paint). Concrete has a long durability and may be aesthetically attractive if it is designed to be consistent with neighboring architecture; however, it does not drain or ventilate well after rain. Much of the concrete street furniture that exists today seems outmoded and appears to lack innovation.

Stone

Like concrete, stone is very durable, does not need to be mounted because it is heavy, and is resistant to vandalism except when spray paint is used. However, it has many of the same disadvantages: it does not ventilate or dry well after rain, and is limited in its aesthetic possibilities where design is concerned [15].

Plastic

Recycled furniture is generally made from plastics, which give it a smooth texture and appearance. The resulting furniture is highly durable, often lasting considerably longer than wood; low-maintenance; and therefore more cost-effective in the long term.

Colour

Items of street furniture should contrast significantly in color with the background where they are situated, and have a luminance contrast of at least 0.3 (30%) to increase their visibility to pedestrians. This can be supplemented by colored borders in the pavement,

which mark the edges of the street furniture and guide pedestrians around it to clear and unobstructed walking areas [19].

Sustainability

Paint or other finishing materials of furniture should be non-toxic and non-staining [14]. The use of recycled materials in street furniture enables manufacturers to conserve natural resources and reduce their carbon footprints; it also educates the users of the furniture, the public, on the importance and mental and physical benefits of recycling. In addition, such furniture items can be recycled again when they need to be replaced, further reducing damage to the environment.

Local city administrations have been increasing initiatives to ensure the sustainability of their street furniture, including raising civic awareness, in order to reduce costs and fulfil legal requirements for emissions and energy efficiency. Most of these initiatives are demonstrably effective; replacing filament light bulbs with new LED bulbs, for example, can cut the energy consumption of street lighting by 40-70%.

With new, renewable energy sources other possibilities are emerging, such as, for example, converting street lamps into photovoltaic power sources which supply light, and at the same time supply energy to a city's power grid. Photovoltaic devices differ from solar panels, in that the power they generate can either be stored in batteries or added to the mains power grid [20]. In addition to this variation on solar energy generation, there are items of street furniture available that are wind-powered, or designed as photovoltaic-windpower hybrids; these items, according to their designers, optimize the use of renewable energy sources and also guarantee a power supply through two different sources of energy. Another new power source that is being explored for street furniture is geothermal energy, which arises from the subsoil; heat-controlled benches, for example, can be connected through bore holes in the earth to a geothermal system which produces a comfortable seating temperature [21].

3.1. Seating

Seating facilities, such as benches, should be integrated within the outdoor spaces of the city wherever people wait, meet, or socialize; in public squares, for instance, they should be coherent with other elements, so that when seats are not in use they do not create a sense of isolation or emptiness. Being able to sit within a city landscape provides an opportunity to pause, and also a tactile and more intimate contact with a place than one has when standing or walking [22].

Location

The best locations for benches are places where there is heavy pedestrian use: retail shopping corridors, transit stops, plazas, spaces outside cultural institutions, etc; poor locations are areas where there is little activity, such as in front of offices that close early or buildings without windows, and in spaces hidden from view or far away from active areas [23]. In high-activity areas there should be access to seating every 60m (or every 50m if there

is intense activity) [24]; there should also be rest facilities at regular intervals of 100-200m, with the needs of the disabled kept in mind [11].

Benches should be set up near other amenities such as bus shelters, kiosks, news stands, waste receptacles, telephones, etc., and arranged where there is protection from the wind and to allow a choice of sitting in the sun or shade. Moveable chairs or lightweight benches allow the widest range of choices. They should be separated from the walking path by a space of 30-60cm, and with the seats level and having a maximum lengthwise slope of 4%; if the slope is greater, the ground should be built up to create a level surface [25].

Benches set at right angles to each other create situations conducive to socialization [26], whereas if they are lined up in a row they prevent group conversation (they could be lined up in areas with an exceptional view, or where there are many people passing by). In addition, they should not be set up directly facing each other (unless they are being used to play games), because people are reluctant to make direct eye contact with strangers and will turn or sit sideways to avoid it. If pairs of benches are set up at a 90-120° angle, the space they create facilitates both socialization and sitting alone. There should also be appropriate space left beside and in front of benches to accommodate wheelchairs and walkers for the disabled without hindering pedestrians [27].

Design

In designing benches, considerations of comfort are important, but the level of comfort provided depends on how they will be used: on a shopping street, for example, people may stop briefly to rest, so comfort is less important than it is, say, in a park, where people may spend half a day in seating areas. There may also be other things to consider: for example, large slats in benches might be less comfortable than small slats, but may be more appropriate in areas where teenagers tend to sit on the back rests of the benches. In general, the selection or design of benches should take into acount all relevant conditions of use.

Appearance is another important consideration: benches should be designed to fit in with their surroundings, because a bench functions like an extension of the property it adjoins, and gives a street a sense of ownership. As a result, it is more likely that business owners will take responsibility for the care of the bench and the street, and this, on a more general level, will contribute positively to the area's safety and security [27].

Armrests and back support are normal features of seating; these provide assistance to the elderly. Back supports, contoured seats and arm rests provide comfort when sitting and support when getting up and down; these are important design elements, especially in areas where people sit for longer periods of time. Adding armrests in the center of a bench should be considered in cases where it is desirable to prevent people from sleeping on benches. When space is available, steel seating is occasionally used in circular or curved forms to give an organic feel to an area [28].

The design options for a site can be increased if the types and heights of seating (stairs, benches, seat walls, etc.) are varied [18]. The length of seating elements should be 60cm per person. For benches, the recommended height of the seating surface is 42.5cm, with a width

of 35-40cm and the back rest extending for 50cm. Benches with arm and back rests provide support to users' bodies; to provide appropriate back support for users, the back rests should be 32.5-37.5cm in height. Between the seating surface and the back rest there should be a 95°-100° angle, and the seating surface should slope back at an angle of 10°. Walls to be used as seat walls should be 37.5-60cm in height (42.5cm is recommended); and the depth of a seat wall should be at least 37.5cm if access is only available from one side, or 75cm (90cm is recommended) if it is available from both sides [25].

Moveable chairs to be used in open spaces are an alternative to benches and other seating elements; while these may not be ideal in every situation, they can be quite useful, as they are more comfortable than benches. While their cost varies, they are also less expensive: approximately ten moveable chairs can be purchased for the cost of one bench. In addition, users can arrange moveable furniture that they find at a site in any way they wish in order to sit closer together or further apart, in the sun or under shade.

Disabilities

For users with disabilities, some seating should be located near public toilets and telephones. In general, rest areas with benches should allow at least 1m of adjoining space to accommodate wheelchairs [14]; for the same reason, table surface heights should be within the range 0.75-0.90m, and the minimum height under the table should be 0.6m [11].

3.2. Waste receptacles

Location

The most common error in placing waste receptacles is putting them wherever there is an empty space, instead of in places where people will use them. If they are not placed appropriately they will remain empty while the surrounding space becomes dirtied: people will not change their habitual walking path to find a trash can, so the proper placement of these items of furniture is crucial.

Waste receptacles should be highly visible and accessible in order to minimize littering. They should be located where they are most likely to be used, in crowded areas like busy intersections, close to crosswalks, beside take-out food shops or vendors, at bus stops, in plazas, outside building entrances such as offices, department stores and homes, and near other items of street furniture like benches, seats, shelters, walls, fences and telephones [27]. Receptacles should be situated far enough away from seating areas to minimize the unpleasant effects of trash odors and insects on users; and their fronts should be set back at least 30cm from walkways [25].

The number of waste receptacles to be provided depends on how many people use an area, how much litter is produced in the area, and on how efficient maintenance and sanitation programs are. On streets in the city center, 2-4 waste receptacles per block are usually sufficient: one should be at each end of the block next to the crosswalk, and one or two more in the middle of the block if there are benches or food stalls along it [13]. Trash cans are

usually spaced at 30m intervals, unless there is an increased need in a particular area; they are usually single units rather than groups of receptacles [24]. On commercial streets there should be at most one trash can every 60.96m; in areas where there is a lot of pedestrian traffic, the distance between receptacles can be decreased, but additional receptacles should be provided only if maintenance is provided by a private sponsor [29].

In some isolated natural areas trash cans may not be necessary, or if they are, they should be selected from a determined range; their location should not detract from the view and they should not have unnecessary decorations that clash with other items of street furniture. In these areas, discreet cigarette stubbers should be provided instead of ashtrays [28].

It should also be taken into consideration that waste receptacles will also be used at night in parks and squares; for this reason, they are most appropriately placed along lit-up pedestrian walkways or other lighted areas.

Design

Waste receptacles come in numerous forms, and may be designed with open, half-open, or closed tops, and mounted on colums (lighting, signs etc.), walls or vertical surfaces, free standing, fixed to the ground surface, moveable (generally for temporary use), built-in bins (benches, seats, walls etc.) [30,31]; however, appropriate receptacles should have certain qualities, of which the most important is that they should clearly look like places for discarding litter; if they blend in with the environment too well they will become unrecognizable. While they should certainly be compatible with other street furniture and with the local architecture, their function and purpose must be clearly recognizable.

Another important quality of a good waste receptacle is ease of use; the following characteristics are the most desirable. First, people should be able to dispose of waste without having to touch the receptacle or open a door to use it. Trash cans are most easily accessible when they are about 100cm in height with the receptacle at most 40cm from the outer edge [19]. The opening of the receptacle should be large enough for litter to be put in, but the size depends on the context; in parks, for example, people may dispose of larger items, so the opening should be bigger. In general, it should be at least 25cm wide, so a folded newspaper or take-out food container can be put into it; if the opening is too small, items can get stuck in it and litter will be strewn in the vicinity of the receptacle. The opening should also be at most 90cm above the ground to facilitate use by the disabled.

The size of the receptacle should be determined by its expected use and how often it will be emptied. Well-organized public spaces have several smaller receptacles that are emptied often, rather than one large receptacle that is only emptied at long intervals. In most areas, containers with a volume of 114-190 litres are sufficient. Wheelie bins are suitable for areas where there is a high volume of trash, if they can be emptied easily by collection equipment. In shopping centers, 120-litre wheelie bins with a framed cover over the top are required; while in town and district parks, 240-litre or 120-litre wheelie bins should be provided, depending on user needs [24].

Waste receptacles should be sturdy; to bear the forces of activities such as sitting, leaning, etc., that may occur beside or on top of them [13]. They should especially be able to contain all kinds of chemical and flammable materials, and should also be robust enough to withstand the impact of children climbing on them or bicycles and other motor vehicles striking them [31]. If they are attached to streetlights they should not obstruct the flow of pedestrians, and should be painted in contrasting colors to assist those with low vision [32].

It is important to know how often waste receptacles will be emptied. In areas where the receptacles are being inspected regularly, they can be lined with plastic bags. If it is expected that the receptacles will be emptied daily, they may be lidless; otherwise there may be a need for them to have a hinged lid resistant to outdoor weather conditions. Lids are also important for receptacles outdoors, to prevent the garbage from getting wet. In addition to having the waste from them collected, the receptacles themselves should also be cleaned from time to time.

The materials used for waste receptacles should be durable and resistant to vandalism, fire, rust, and stains. Among the choices of materials available are: enamels, which are graffiti- and stain-resistant, but may chip easily; wood and rough-textured or porous surfaces, which are rust- and stain-resistant but easily vandalized and hard to clean; aluminum, which generally serves its purpose but may be vandalized to be used as scrap metal in some areas; and plastics, which may be problematic if they are solvent-sensitive, especially in parks, where discarded barbecue lighter fluids can erode them. Galvanized steel is a very durable material that can be used for receptacles in aeas where they may be heavily abused [27].

In view of landfill costs and the currently growing acceptance and understanding of recycling, it seems likely that the need for receptacles for recycling will increase in the future.

3.3. Signage

Signage systems play a number of important roles: they provide information and directions for people to find their way around a site, help maintain the site's image and coherence, and encourage learning.

Location

The location of signs significantly reinforces their message. Besides conventional signboards, maps, kiosks, and other elements may also function as signs; and placing signs at other site amenities like benches, cafes, restrooms and intersections can help create mini-destinations in larger open spaces [33].

Signage can be used for various purposes: for example, directional signs can help people keep their bearings and give them a sense of security; and in parks where there are large natural areas or no specific destinations, micro-spaces can be created with a sign, a picnic table, a telephone, or other amenities, facilitating social encounters and enabling

communication in the event of an emergency. If the areas where signage is used incorporate other activities, these areas can enable visitors to fulfil various needs in one place, and also create a relaxing social environment in which to spend time.

Design

When people know where they are in a space and know how to get to where they want to go, they feel safer. Instead of using restrictive signs warning that something "is prohibited," a more constructive approach should be used: signage should be positive and informative, and give people the confidence to act on their own. Signage can also be used to educate people on safety issues and to encourage them to report on any dubious activities they may see.

There are four basic kinds of sign: regulatory, warning, informational and educational [34].

Regulatory signs are used for traffic control, and include stop and yield, right-of-way, speed limit and exclusion signs. Directional signs, occasionally posted in natural areas in particular, help people keep their bearings and feel located and secure; they make use of landmarks and other places of interest and are required to indicate changes in direction [19].

Warning signs indicate existing or potentially dangerous conditions; they are usually found near intersections, bridges and crossings, and can also indicate changes in the gradient or surface conditions [34]. Warning signs should make use of all the languages in areas where more than one language is commonly spoken, and should be posted at all entrances to limited, controlled, and exclusion areas. The wording should clearly indicate restricted areas, and the signs (which should not be mounted on fences with intrusion-detection equipment) should be posted at intervals of less than 30.48m [35].

Informational signs inform visitors about a site; in this way they serve as outreach tools. *Maps* at entrances, within the site and at points along pathways can help increase users' knowledge, curiosity and interest about the area. They help visitors guide themselves, and also highlight places of interest. Maps should not be cluttered with too much or unnecessary information; they should clearly define important points.

Educational signs are a pleasurable way to get people interested in unique features of a site. Educational signage should be created with the types of audiences, their interests, and their reasons for visiting the site in mind.

Poor signage can be confusing rather than illuminating; signs should be posted off-site and at entrances, grouped on one support for clarity and ease of maintenance [24] and should include on-site directional, parking, and cautionary signs for visitors, employees, service vehicles, and pedestrians [35].

Signage should be clearly visible. Directional signs should be visible from a distance of at least 20m: for clear visibility, the sign should not be further away than 47m or closer than 6m. The design and placement of signs for pedestrian use must take into account such matters as their visibility, the size and proportions of the writing, and the relation between the writing and its background. The writing on signs should be complemented by standard

graphic symbols to help people; directional arrows should be clearly marked. International symbols should particularly be utilized in outdoor areas used by foreign visitors.

Different materials can be used for signage: carved wooden signs are attractive in natural environments, but they are not resistant to theft and damage; metals can become bent and rusted; plastics can be broken or burned. The most damage-resistant materials are concrete and stone.

All signage should be accessible, and durable in the long term (at least 7-10 years). In areas where there is a risk of vandalism, signs on two supports should be used rather than on single supports. Signs should be easily replaceable in case of damage; and the care of signage should not be neglected.

Shape

The octagon is used only for stop signs [34]; information signboards should be rectangular, warning signboards triangular, and interdictory signboards circular [11].

Colour

There should be a strong color contrast between the text and its background, and between the sign and the surface or background against which it is seen; black text on a white background, for example, provides a good color contrast. Clashing colors, such as green text on a red background, should be avoided. The surface behind the sign should contrast with the sign to make it stand out; or if this is not feasible, the background within the sign should be increased in size [19].

Lettering

The size of the letters used on signs should be proportional to the reading distance: The character width-to-height ratio should be between 3:5 and 1:1, and the character stroke width-to-height ratio should be between 1:5 and 1:10. The letters and graphic symbols should be raised at least 1mm from the background, so the visually impaired can read them by touching them. The smallest letter type should at least 15 mm, and there should be normal spacing between words and letters.

Disabilities

The symbol for amenities for the disabled is composed of a wheelchair figure with a square background or border; the figure is distinguished from the background by contrasting colors, most commonly white for the figure and blue for the background, and the wheelchair figure should always be seen as facing right.

Signs should be accessible to wheelchair users; permanently fixed street furniture will also clearly provide more wayfinding cues for the visually impaired than landmarks [36]. Signs should not be placed behind glass because reflection may hinder visibility. Signs placed on the pedestrian path of travel are obstructive; so they should be detectable.

There is no need for large numbers of directional signs; these should be placed at main entrances and doors and where there are changes in direction or level. Fixed signs indicating

street names should be placed at a maximum height of 2.50m. Maps and information panels at building entrances, along roads, and on public buildings should be set at a height of 0.9-1.8m; wall-mounted signs should be installed with the centre line 1.4-1.60m from the finished floor level; and overhanging signs should allow a minimum clearance of 2m. Orientation signs and push buttons in lifts should have a text in Braille or in relief for the visually impaired [11].

Signals at crossings may be supplemented with audible or tactile messages to facilitate crossing for all users, including the visually impaired; however, audible pedestrian signals should be used judiciously, because they can create a noise problem [37].

3.4. Lighting

Site lighting design focuses on illuminating the environment to anticipate and respond to the needs of users of the site. The lighting elements involved in a site may have diverse functions such as wayfinding, creating social spaces, interacting with the natural and built environments, and meeting security requirements; the overall design must enable all these functions to coexist experience for users [38].

Because of security concerns, there is often a tendency to over-light parks, plazas, streets, and other public spaces; a good design plan should relate lighting to the functions of a particular space in the evening or at night. Site lighting, beyond its practical functions, should be considered in terms of how the types of lights used, their location and their intensity, affect the way a street is perceived and used [39].

Aesthetically speaking, site lighting can add colour and vibrance to an area at night; however, its primary purpose is to provide safety and security after dark. Lighting is especially important at building entrances, intersections, stairs, sudden changes in grade, dead ends, and remote walkways. Areas with high crime rates should be well lit to provide some security for those using facilities in the evenings or at night; but while it may increase people's feeling of safety, lighting may not have an effect on reducing actual crime rates.

Location

Light poles should be coordinated with other streetscape elements, and utility equipment such as pull boxes and underground trenches, both above and below ground, should be coordinated when placing lighting fixtures. Fixtures should not be placed near tree foliage that may block their light; the anticipated height and diameter of the tree canopy should be considered in relation to the height and spacing of lighting fixtures, the need for a certain level of light, and the need for uniformity. The most suitable distance between a tree and a light fixture depends upon the type of tree and on the type of light fixture; if the light from a fixture is blocked because of the existing locations of the fixture and trees, other light fixtures may be added to achieve the required level of illumination [29].

Design

The lighting of outdoor spaces should be designed carefully, taking into account placement, intensity, timing, duration, and color [18]; lighting can be provided by bollards, street lights,

faced lights, shop windows, and other elements of the cityscape. In lighting, as in signage there is a hierarchical order of priority: at the highest priority level, activity areas and primary walkways should be lit to become the focus of pedestrian activity after dark; at the lowest level of priority one may find, for example, the decision not to light some areas at all because using them at night would be unsafe or inappropriate.

Site illumination enhances the safety of traffic and pedestrians crossing; it is used to provide warnings about hazards, and helps increase security and reduce vandalism. Within the plan of the site, it gives emphasis to focal and meeting points, and building entrances. Accent lighting can highlight fine architecture or areas of unusual significance or beauty [17].

Lighting fixtures can also be used to highlight trees and give accents to shrubbery; they can also be mounted in trees to light pathways below. When deciding on such usages, planning should take account of which trees are deciduous and which trees retain their foliage [38].

Steps or stairway lighting should provide sufficient light for people to see the stairs and differentiate between risers and treads: their visibility depends on the materials used for the steps, as well as the physical form of the stairs; dark materials require a higher level of light, and a change in color between risers and treads will increase visibility [40].

Quality and quantity of light

Appropriate light sources should be chosen, and fixtures should be designed to direct light precisely, with shielding used to prevent light trespass and glare. The intensity and color of the light should complement the elements to be illuminated. High-pressure sodium lighting, typically used in city street-light fixtures, casts a yellowish-orange glow that distorts colors, diminishes visual clarity and undermines the quality of the night-time urban environment; it should therefore be avoided. Metal halide lighting, in contrast, produces a soft, white glow that renders color accurately, provides better visual clarity, and requires less wattage for the same level of visibility. The quality of light is also influenced by the relationship between the brightness of a light source and one's distance from it: light becomes more diffuse further away from the source, so to produce the desired quality of light, the light source should be located within the range of heights specified for a given brightness.

Height of luminaires

The illumination standard set for pedestrian walkways by the Canadian Standards Association, is 0.4 footcandles, at which level a person's face can be identified from a distance of 12-15 metres [41]. Street and road lights are usually installed on 9-15m high poles, spaced 45-75m apart. Fixed light poles should have durable marking strips in contrasting colors, at least 0.3m long, attached along the centre line at a height of 1.4-1.6m to warn visually impaired pedestrians [32]. Lamps supply an average illumination of one-half a footcandle on local roads and in all parking areas, and one footcandle on major roads and in large parking areas. Pedestrian paths require intensities varying from less than one-half footcandle for walkways to five footcandles for building entrances, steps, and intersections. Mall and walkway light poles are 3-4.5m in height. Although the mounting heights of luminaires have increased in recent decades with lamp technology allowing for higher and

brighter road lights, this is not particularly beneficial for pedestrians. If the heights of luminaires are reduced and adjusted to a pedestrian scale, more fixtures will be needed, which means the luminaires and poles and their placement can have a more positive effect on the streetscape [39].

Lamp Types and Wattages

Lamps are usually incandescent or based on mercury vapor. Fixtures where the light source is below eye level may be used to illuminate landscaping and pedestrian walks; if these are the main light sources, there should also be peripheral lighting to illuminate the immediate surroundings and create a feeling of security for passing pedestrians [42]. Excessively bright lights and frontal floodlighting should be avoided; lower-wattage light sources should be used instead. The lighting of hardscape elements from a distance can negatively affect night-time vision, and should also be avoided. Up-lighting should only be used where it will not interfere with the pedestrians' vision [15]: when a luminaire's height is lowered, the lamp's brightness must be adjusted so as not to cause excessive glare for pedestrians, but at the same time, the wattage must also be sufficient to adequately illuminate the road [39].

Reducing light pollution

Light pollution occurs when outdoor lighting is misdirected, misplaced, unshielded, excessive, or unnecessary [18]. Light pollution, or the over-illumination of the night sky by electric lights, can be a significant problem in urban areas; it can negatively impact the normal functioning of humans and many animal species. Light pollution can be decreased if designers minimize light trespass off the site, thus reducing night-time sky glow, increasing night-time visibility, and alleviating the negative effects of light pollution on nocturnal environments. Today newer outdoor lighting products have been designed to minimize light pollution; these types of products, located strategically within the landscape, can provide adequate illumination without emitting excess light [43].

3.5. Fountains

Location

In open outdoor spaces, water fountains or drinking fountains provide a focal point. Flowing water has a visual and auditory appeal that creates ambience, and the sound of a water fountain can help screen out traffic sounds in seating areas [44]; drinking fountains should be available for functional reasons as well in regions where there are hot summers [45]. Care should be taken in designing water fountains for high-rise office districts, as the buildings can cause air turbulence that blows around the spray from fountains.

Design

Drinking fountains should be designed on a scale appropriate to their setting. These fountains should be accessible to children and people in wheelchairs, as well as standing adults, including those on crutches or using walkers, and the water control should be simple, with little strength required. A well-designed fountain may have a water spigot on the side for filling containers, or washing hands.

Stone, concrete, brick and metals such as copper, bronze, cast iron and steel are suitable materials for fountains [40]. Taps may also be designed with the disabled in mind, at the usual height of 85-95cm. This allows sufficient space for them to be approached by users of wheelchairs, which are usually 85cm in height; the approach should be on a hard surface. The basin should be cantilevered 20-30cm outwards from the wall or support stand, with the drinking spigot or bubbler mounted on the outer edge of the basin. To operate the fountain, a lever-type handle should be located on the side or rim of the basin; foot pedals should only be used together with a lever for controlling the flow [46].

As wind rises, fountain height should be reduced by 10 percent for each 5mph of wind speed above 10mph. For critical situations a wind sensor should switch off the fountain [47].

Types of fountains

Fountains fall into three categories: rising jets, downward falls, and a combination of the two.

Rising jets are often used in public displays, and because they can rapidly change form, they can be interactive, coordinated with music or easily accessible to people; indeed, the water itself may be the spectacle, if it flows in large quantities or if advanced technologies are used. Rising jets can be seen from a distance, and coordinated lighting can change their appearance into what has been described as "never ending fireworks" [48].

Downward fall or "cascade" fountains are found in nature in the form of rivers, streams, waterfalls and rising springs. Throughout history, human beings have contained, diverted, decorated and reduced or enhanced them, and eventually used them as models, supplemented by artificial pumping systems.

An example of a *combination fountain* is the "splash fountain," in which people cool themselves; even if they were not designed with this in mind, fountains are often used by children for this purpose. Some fountains may be fenced in or built with raised edges to prevent access; others are designed specifically for easy access, and with nonslip surfaces so they can be used safely. In recent years, purpose-designed splash fountains have been created in open spaces in conjunction with public pools, parks, or public playgrounds. These "splash pads" have no standing water, so there is no risk of drowning in them and no supervision is needed.

3.6. Bollards

These are vertical barriers and are one of the most unobstrusive ways of preventing access by vehicles enroaching on to pedestrian areas.

Location

The use of bollards should be limited to areas where sidewalk structures, furniture, private property and vegetation are being damaged by vehicles trying to park; this is particularly problematic on narrow streets. Aesthetically appealing bollards may be used in locations to

indicate special spaces like shared public paths or streets limited to pedestrians. Lighted bollards can provide additional illumination for pedestrians in median refuges.

The usual lateral distance of a bollard is about 3m from the center of the street. They should be positioned alongside the the walking path so as not to obstruct pedestrians. Bollards should be installed 45cm from the back edge of the curb [28].

Design

The design of bollards should be contextualized within a 'family' of streetscape elements [29]. Their size range is usually 10-25cm in diameter, but decorative bollards may be larger and may differ in shape. In general, design details appear on the sides and tops of bollards, which should be articulated for this purpose; bollards should also be painted in colors that enhance other elements of the streetscape (except for gray) and to assist the visually impaired. Signs and directions may be affixed to bollards so additional signposts are unnecessary, and the bollards may be painted with white bands where appropriate [28].

The spacing between bollards is usually about 90cm, wide enough to allow luggage and wheelchairs to pass between them. The spacing should also be varied to follow the rhythm of the other elements that make up the streetscape – i.e. lighting fixtures, landscaping, etc. In some contexts, an area may be defined or an entryway blocked by a series of bollards. Bollard forms vary from the simple and modern to the decorative and traditional, depending on the surroundings. The simplest bollards are wooden or painted steel posts embedded in the ground; in their most practical form they demarcate parking areas, alleyways, or entrances to significant public spaces. More complex, detailed forms and refined materials are used when the intention is to blend in with the local architecture and other elements of the city and inform local identity; such forms comprise part of the public street furniture and amenities. The materials and finishes used for bollards are determined by their relation to other elements in the space under consideration [1].

Bollards comprise a wide variety of fixed or flexible elements that are used to demarcate spaces, prevent the entry of vehicles, or otherwise protect a space; they can be designed to give way to or hold up against any force. They can be removable but locked by means of locking pins or by sheer weight [14]. They should be used sparingly, and their style should be determined by their location. Thus distinctive old bollards should be kept and renovated, and new ones created in the same style, if it is still appropriate, using moulds; plastic bollards should only be used for temporary purposes. The design concept for an area should be re-thought in order to minimize the use of bollards: to reduce the need for them, reinforced slabs or stronger paved areas, as well as the use of other street furniture items or planting trees should be considered.

Permanent Bollards

Fixed bollards are also known as "static," "architectural" or "permanent" bollards. These are usually concrete, wood or metal, and cannot be moved as they are surface-mounted or embedded in the ground. They should be set 300-450mm in the ground on a concrete or consolidated hardcore base and surrounded by concrete [49].

Rising (retractable) bollards rise up and go back down into the ground again automatically, by means of an electronic, hydraulic or pneumatic mechanism when they are activated by a hand-held remote, swipe card, or other remote device.

Security bollards are designed to withstand heavy impacts. They may be fixed or retractable, and are used to prevent terrorist or criminal attacks.

Removable bollards have a base permanently fixed to the ground, but can be unlocked with a key and lifted out when necessary.

Telescopic bollards collapse concentrically and retract to street level when they are unlocked with a key.

Lay-flat bollards, also known as "fold-down" or "collapsible" bollards, can be unlocked with a key and laid flat on the ground when required.

Bell bollards are short and bell-shaped; these are used in areas with frequent U-turns or tight turning circles, as the slope of the bell enables the wheel of a vehicle to strike it and roll around it.

Temporary & Flexible Bollards

Qwick Kurb is the brand name of a temporary plastic curb, which is comprised of several plastic bollards or paddles strung together.

Planters can serve as environmentally friendly bollards, physically delimiting streets, widening sidewalks and restricting access for motor vehicles. If they are properly funded, managed and maintained, they can enhance the aesthetics of a public space and facilitate a community's acceptance of a new curb or median [50].

Lighted bollards provide illumination in the form of area or marker lighting. "Area lighting" illuminates the ground plane around the bollard, while "marker lighting" provides a glow indicating a bollard's location. Marker bollards are solar powered, so they do not need to be connected to the electrical grid. In cases where a light is required at a low height for visibility, a simple path light on a post may be more useful and user-friendly than a strong, lighted bollard [1].

3.7. Public Art

The term "public art" refers to sculptures and other artworks which are situated in public spaces outdoors and are freely and physically accessible by the public. Public art may belong to the community as a whole, but it can also be displayed in private places and serve a smaller community of interested people [51].

Public art complements and enhances the environment and brings public spaces to life; it can range from disparate objects to an entire streetscape [52]. Large-scale works can bring thematic unity to a district or demarcate a gateway to a neighborhood, while works on a human scale can provide points of visual interest for pedestrians passing by. Well-designed

public artworks that recognize the local culture as well as broader influences can define a community, serving as landmarks that uniquely express the spirit of a place or highlight some of its functional aspects, draw people towards it, and so contribute to its growth and dynamism [15]. Public art that fits into its surroundings can thus also create a setting for breaking down barriers, generating diverse forms of social encounters and interactions, and inspiring creative expression [53].

Location

Public works of art can serve as focal points on streets and in public areas, especially at key points or intersections where there is pedestrian movement or where people tend to gather, and they can give these spaces a unique character; however, they may not be appropriate for high-traffic walking areas such as pedestrian thoroughfares, unless they function as street furniture. In addition, they can create a special sense of place in less frequented locations.

Design

Works of public art may be permanent, static or based on objects; they can also be temporary, dynamic, or evanescent; however, they should serve as pedestrian amenities [51], and the aim in the design and planning phases should be to integrate them with other elements of the streetscape such as light poles, benches, trash receptacles and utility boxes. Artworks can be centers of focus in parks or plazas, or visual "surprises" that appears as one follows a pedestrian pathway.

The materials used, whether for a modern or a more traditional sculpture will vary depending on what the sculpture expresses, their appropriateness for its composition, and the cost factors involved. In any case, public artworks should be of a reasonable quality as regards their construction, and particularly their surface finish; they should be structurally sound and designed for minimal maintenance and to resist vandalism [24]. They should also be accessible to the disabled and not hinder pathways; some may need visible warning strips around the base for this purpose.

4. Maintenance

If the types of street furniture and manufacturers involved at a site are consistent, maintaining or replacing worn or damaged furnishings will be less costly [54]; proper installation of items will ensure their durability, and damaged materials should be replaced with more sustainable products wherever possible [43]. The furniture should be easy to repair, and one way to facilitate this is to design it as replaceable modular parts, so that it does remain unusable for long periods pending repairs [16].

Street furniture is often vandalized by burning, slashing, carving, and spray painting, so this should be taken into account in the planning phase; some materials and styles are more resistant to vandalism. The furnishings must be durable and secure, with finishes and coatings that resist stickers, graffiti and bacteria. Thus while wood may be a cheap and aesthetically appealing choice, it is easy to carve, burn, and spray-paint, so it is not particularly resistant to vandalism compared to other alternatives. Recycled plastic is a

popular material for street furniture, but it can be burned, carved and painted; wear due to ultraviolet radiation may be another problem (although some recycled plastic products are marketed as UV-stable), so this material may be more appropriate indoors. Steel is the material most resistant to vandalism, but it is usually the most costly: steel meshes and steel bars cannot be spray-painted, burned or slashed easily, and they also have the advantage of good ventilation so they dry rapidly after rain [15].

5. Conclusion

Street furniture should be available in proportion to the intensity of activity in a particular area, and carefully placed to create unobstructed paths for pedestrians without creating hazards. Furnishings include benches, waste receptacle, signs, lighting, fountain and other elements that make people feel comfortable. These elements should be coordinated and integrated so that they are both attractive and functional. However, beyond comfort, the aim of these furnishings is to provide a place with character and identity, and to encourage people to enjoy outdoor spaces. Street furniture also addresses specific needs, such as seating and shelter when one is waiting for transportation. If well planned and designed, it can also enhance the visual aspects, image and identity of a site. The quality, organisation and distribution of street furniture reflects the quality of an urban space and can also set standards and expectations for future development [8], as the aim of these furnishings is to combine and coordinate form, scale, materials and placement to create visual appeal, accessibility and safety through understanding the needs of users [55].

Besides its functional aspects, high quality in the designing of street furniture has recently become a focus of attention in urban landscape design, with emphasis placed on the integration of function and aesthetics with new materials and technologies, creative concepts and artistic application in the user-friendly cityscape. Street furniture enables a city to become closer knit as a community, a space where people can gather, share and experience life together. Visually unattractive or poorly planned street furniture defines a city through chaos, a lack of order and harmony, and the absence of community. In recent years, cities have also become very concerned about waste disposal and the stability of the environment, as can be seen in the growing tendency of using recycled street furniture; well designed street furniture enables cities to continually update outdoor spaces sustainably while being environmentally conscious at the same time.

Author details

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