Support Urban Development UEQ-1

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: Support development in existing urban areas and fully utilize and support existing infrastructure.

Action: Channel development to urban areas. Provide development that supports and maximizes the use of existing infrastructure and exceeds a minimum development density of 60,000 SF/acre.

Related Guidelines: UEQ-2, UEQ-3, UEQ-4

Potential LEED™ 2.1 Credits: 1 possible with SSc2 (see Submittal Template)

Introduction/Context

With over 12 million square feet of development planned for the 16 acre WTC site this project clearly meets the urban development goals of the 60,000 SF/acre LEED™ criteria described above. The full WTC redevelopment will, in fact, be 10 times this density.

As one of the densest urban centers in the United States, New York City is a model of the efficiencies gained through compact development. According to the 2000 census there are 66,940 people living on each square mile in Manhattan, compared to a national average of 80 people per square mile. This density allows 82% of Manhattan's residents to travel to work by public transit, bicycle or on foot. While good comparative energy use data for NYC is difficult to isolate, New York State's per capita energy use is the lowest in the continental United States. This is largely attributable to the fact that more than 40% of the state's population lives in New York City.

(Note: This LEED™ 2.1 Credit is automatically achieved, however the sustainable context has been described as it impacts other Guidelines and identifies inherent qualitative potentials.)

Relevant Issues

Ecological

The World Trade Center site offers a unique opportunity to build a sustainable city within a city: a new urban center that is designed with ecological considerations informing the planning process from the beginning. As a result of the great tragedy of 9/11, most of the physical history of the original World Trade Center site has been destroyed. It is therefore the responsibility of those of us who come after to make exceptional efforts to plan and develop the site in a manner that is respectful of the immediate past, while looking to the needs and well-being of the millions of people who will use it in the future. The World Trade Center site is planned to be a vital and exciting hub in Lower Manhattan. Developing it in step with the natural environment, and fully optimizing the natural assets offered by its unique location, provides a powerful opportunity to make this site an ecological exemplar of environmental quality. Such a singular approach to large-scale infrastructure and construction demonstrates that the built environment can work in harmony with the natural environment and need not pollute or degrade the atmosphere, waterways and surrounding land.

Many of the concepts that inform sustainable site planning have been incorporated in the Master Plan. The redevelopment of the World Trade Center site is planned to offer green infrastructure, parks and plazas, as well as greenways leading to and from its center, and connecting to other city parks. It will be important for each project within the complex to continue this mission, and to sustain the effort to make the entire site a paradigm of environmental/sustainable and human-centered design.

Economic

The redevelopment of the World Trade Center site is of enormous importance to the economy of the city and the state. Centered on the confluence of public transit systems where services arrive from upstate New York, Manhattan and New Jersey and the more industrial south, this site brings together the business and financial interests of the nation. The recent losses in revenue from businesses and real estate, as well as many thousands of individual jobs, have had a significant impact on the economy of New York. The repair, completion and addition of new transportation services, the rise of compact, high density, new structures at the site and the return of the work force and many businesses will have a large economic impact.

The site is ideally located to draw upon a large, well educated work force from the city, the surrounding counties and nearby states. With the new transit systems in place, attractive buildings, planned services and good paying jobs, the pre-conditions for the viability of the project are in place.

Neighborhood

Although the actual site under consideration in these Guidelines represents an area of approximately 16-acres in size, some 36-acres of land were deeply affected by the terrorist attacks of 9/11. Much of this area has, of necessity, been off-limits to the public, including nearby residents, for the last three years. As infrastructure and

utilities are rebuilt and access to public transit improves, access to this site will increase.

The World Trade Center Master Plan establishes a high density mix of commercial, retail, memorial, transportation, civic and cultural uses for the site. This mix of facilities provides a dynamic program for rebuilding, which will bring a great deal of activity and commerce to Lower Manhattan and the immediate neighborhood. Despite the high density program a large amount of green space has been incorporated. This park-like mix of green and open plazas and squares, along with tree-lined streets and linking greenways, will increase connections to natural systems, provide a canvas for the changing seasons and support a more diverse community of city flora and fauna.

Methodology

Design Strategies

While the WTC Master Plan and existing built environment relationships have largely addressed the requirements of this Guideline, it is important for design teams to be aware that these project parameters include a significant sustainable design strategy.

These high density goals can be accomplished and still provide significant opportunities for public plazas and green spaces, view corridors to the neighborhood, adjacent green areas and the River and connections to the underlying transportation infrastructure. By providing a continuum – a sense of connection to other areas -- the site will become a tightly integrated destination within the context of the greater city. The sustainable strategies throughout the remainder of the Guidelines are essential to the humanization of this highly efficient density.

Means and Methods

While design teams have already addressed the density issue, planning for a successful high density development at the World Trade Center site will need to include flexibility and the ability to adapt buildings as conditions change. According to Staley and Scarlett in '*Market Oriented Planning',* future "…planning will have to incorporate the evolutionary and dynamic aspect of communities to be successful". The objective is to create conditions where communities are allowed to evolve with time, responding to both economics and consumer preferences.

For specific, primary occupancies, this suggests that a 'loose fit, long life' approach to designing office space would be appropriate. The ability to convert a typical, corporate office building to an alternative occupancy, such as multi-family housing or education facilities, with minimal demolition or teardown, encompasses smart planning and sound economics. To achieve this goal, buildings will need to be flexible, and consideration should be paid to design and structural issues, such as depth of floor plates, slab-to-slab clearances, egress capacity, etc. For the mix of corporate, financial and state and city governmental offices that might be expected to represent a profile of the initial occupancy of the site, flexible options will help to guarantee the continuing viability of the buildings. Their potential to change with demand and community needs will provide a substantial return on investment.

Care should be exercised to ensure that all buildings designed for the site are responsive to their role in the greater community and seek to enrich the mix of occupancies. Other considerations might include ground floor retail/shopping spaces, restaurants or spaces that provide services with an inherent extended "street life" and enhancement of safety/security. An auditorium, designed for a specific building client, might also be designed to accommodate community uses. The design of each project can be seen as a vital piece of the jigsaw puzzle, which will be enhanced if each contributes to improving the quality of the urban setting, street life, the community and ecological systems.

Reference

Definitions

Definitions have not been included for this Guideline.

Standards

Standards have not been included for this Guideline.

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Support Urban Development UEQ-1-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: _____

Phase:
SD ☐ DD ☐ CD ☐ FINAL ☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	●	●	●	●	●

☐ **Required Component:** *(Note: this will satisfy LEED™ 2.1 Sustainable Sites Credit 2: Development Density)*
This certifies that this development is in an urban area, supports and maximizes the use of existing infrastructure and exceeds a minimum development density of 60,000 square feet per acre, as defined by the USGBC in the LEED™ 2.1 Reference Guide.

Name _____ Signature _____

Company _____ Role in Project _____

Date _____

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Expanded Public Transit and Bicycle Access UEQ-2

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: Encourage the development of public transportation, address opportunities to connect/cross-connect systems and support and increase bicycle access.

Action: Integrate and encourage utilization of public transportation. Follow the recommendations of the NYC Department of City Planning (DCP) 1999 Bicycle Parking Needs Study and the 1997 NYC Bicycle Master Plan. Reduce parking from pre 9/11 levels and implement a Parking Management Plan to reduce future parking demands. Site parking for commercial uses is not to exceed 1300 cars. For Towers: Support bicycle use by providing bicycle racks or secure and convenient storage. For Site: Support bicycle use by providing bicycle racks near transportation, retail and cultural centers.

Related Guidelines: UEQ-1, UEQ-4, UEQ-7, UEQ-8

Potential LEED™ 2.1 Credits: 2 possible with SS cr. 4.1, and SS cr. 4.2. (see Submittal Template)

Introduction/Context

The World Trade Center site has always been a focal point for mass transportation in lower Manhattan, bringing together regional rail, the PATH train and bus routes from New Jersey and Staten Island, and providing a network of subway and bus connections North into Manhattan and to the extended five-borough region. Good connections to Penn Station, Grand Central Station and the Port Authority Bus Terminal have allowed for easy access beyond the city limits and suburban areas to national transportation services. With the rebuilding of the World Trade Center infrastructure, these services are again becoming available, expanded and enhanced to meet the needs of a growing, ever more mobile public.

Plans call for a central 'World Trade Center Transportation Hub' which will be at the very core of the complex. A cross-linking Connector Corridor will provide easy, underground access to a new Ferry Terminal currently under construction. A new link to the Long Island Railroad is also under consideration.

All of these public transit amenities help to diminish reliance on vehicles, which are predominantly cars driven by single individuals working in or near the confines of the World Trade Center. The bicycle path infrastructure can link to an expanded network of bike paths extending completely around Manhattan. Secure storage for bikes will need to be a priority within the World Trade Center redevelopment area, in order to further encourage the use of non-vehicular transportation.

Relevant Issues

Ecological

The combination of convenient, low-cost public transportation and bicycle access provides viable alternatives to 'driving to work' and reduces the number of vehicles in the city. Reductions in vehicular traffic translate directly to reductions in exhaust and air pollution. By offering convenient, viable public transportation options to the many people who frequent the site, less fuel is consumed by private or single-occupancy vehicles. Fewer cars will also reduce the need for impervious parking areas, decreasing storm water runoff and lessening heat island effects.

Bicycles are, of course a preferred sustainable means of individual transportation where appropriate. Therefore, the provision of amenities necessary to make cycling in the city safe, convenient, and comfortable for anyone who wishes to do so, is an important sustainable goal under this credit.

Economic

By providing convenient, comfortable public transportation, individual automobile use becomes a less attractive option for many commuters. As gasoline and parking expenses rise, this has become more evident, particularly in Manhattan. The potential for storm water surge and resulting sewage overflow can be lessened by reducing the typical urban center parking ratios.

The World Trade Center's proximity to mass-transit access points is an attraction for many business people and contributes to tenant job satisfaction, retention and productivity. Fundamentally, the economic viability of the entire complex flows from its integrated multi-mode transit system. People who live reasonably close to the site may choose to bicycle to work, given that appropriate amenities are made available. Bicycling reduces impacts to infrastructure, has no deleterious impact on air quality and, as a healthy human activity, may help to ward off health care costs.

Neighborhood

Easy access to mass-transit and well-placed interconnections via bicycle and foot paths translate to better connectivity for the residents who live and work around the World Trade Center site. They also facilitate an enhanced exchange of ideas and cultural activities between the local community and those who live in the greater metropolitan region. By providing alternatives to automobile access at the site, vehicle exhaust emissions are also reduced, providing cleaner air and a healthier environment. As an additional benefit, with less vehicle exhaust fumes and particulate clouding the air, building exteriors will require less maintenance and less frequent cleaning.

Methodology

Design Strategies

The design of an enhanced mass transit infrastructure on multiple levels, with multiple modes of transport, is now well defined at the World Trade Center site. Access points at strategic street locations have been designed into the Master Planning documents. Additional access points may be located within or near new structures planned for the redevelopment, and are an important consideration in capturing the full potential of this credit.

One way to provide optimum opportunities to encourage bicycle use is through the provision of convenient facilities for secure bicycle storage. These facilities may be of a temporary nature, such as free-standing, outdoor racks, or more permanent, and secure, such as a bicycle room within each building. These strategies may be further enhanced by the provision of showers and changing rooms for use by cyclists, located near the bicycle storage area.

Site circulation routes and bike paths running between buildings, amenities such as shopping areas and restaurants, mass-transit access points, and bicycle lock-up facilities can also be designed to maximize the potential for cycling within the complex, and to avoid additional vehicular congestion. Programs such as 'Public Use Bicycles' (PUB) and 'Bike-in-Transit', which are designed for temporary use of bicycles, can be employed to great advantage on the 16-acre World Trade Center site, perhaps in conjunction with Battery Park City. To tie this sustainable initiative closely to the overall goals for easy site access and neighborhood pedestrian flow patterns, the location of such bicycle facilities would ideally also be located near mass transit access points.

Although bicycles generally require little day-to-day maintenance, the notion of cycling to work would be well-supported by the existence of a bicycle maintenance facility within a short distance of the main site structures.

Means and Methods

Restrict vehicle access, movement and parking on the site.

Secure bicycle racks for general outdoor use are readily available in the marketplace, or can be designed for the site. PUB programs provide their own locking kiosks, with bicycles being accessed via the use of pre-purchased cards or codes. Early planning might incorporate a bike storage room with secure facilities, and an option for showers and changing facilities in each major structure. These programs support both private ownership and use of bikes and public programs such as PUB.

Public Use Bicycle (PUB) programs have been in existence for 35 years in Europe, and are generally well-used and successful in diminishing the need for private transportation within a city or compound. The installation of a PUB, or public-private program such as ClearChannel Adshel's 'Smartbike' or Deutsche Bahn's 'CALL A BIKE', will provide an innovative and attractive means of non-vehicular, on-demand transportation within the 16-acre World Trade Center site. Some of these systems

are provided free of charge by their sponsors, depending on advertising as the sole means of revenue. Advertising on the locking kiosks and bikes helps to reduce bike theft. Kiosks located both near the entrances and exits of commuter rail and subway stations, and near large office complexes and entertainment centers, will increase access and encourage use of these short term rental bicycles. Bicycles can help reduce the need for non-pervious infrastructure as well as automobile use. However any such program will depend on the inclusion of dedicated bike paths, which will enhance safety factors and contribute to efficiency of movement and speed.

Case Studies

ClearChannel Adshel 'SmartBike' Program

This system provides a network of public use bicycles distributed through locking kiosks placed throughout a city. The SmartBike system helps mitigate traffic congestion and air pollution because it makes cycling a convenient alternative to driving. This program has been adopted in cities including Rennes, France, Bukit Batok, Singapore, and Drammen, Norway. Annapolis, Maryland is in the process of implementing an Adshel system and other US cities are considering implementation of the program as well. A city wishing to implement this system contracts with Adshel for its initial setup. Adshel does not sell the necessary equipment to the cities, rather they retain ownership of system components and are responsible for their maintenance. Adshel uses the bicycles and their racks to generate revenue through advertising. This is the sole source of funding for the system. Locally manufactured bicycles are typically employed. The basic function of the program remains the same no matter where it is instituted. People unlock a bicycle from one of many docking stations placed in convenient locations around the city using a Smart Card. The Smart Card tracks an individual bicycle and keeps a record of user identity. On-line monitoring deters theft and vandalism and can pinpoint a specific Adshel bike anywhere in the city. The advertising on the bicycles also reduces vandalism, making an Adshel bike easily identifiable to the casual observer. When a person is finished using a bike, they return it to the nearest docking station and lock it in place with their Smart Card. The embedded tracking technology supports overall system management and updates the central controller with the number of bicycles available at each docking station. Using this information, system attendants can be dispatched to transfer bikes from overloaded stations to nearly empty ones. (Community Bike 2002)

The Plaza at PPL Center, Allentown, Pennsylvania

The PPL Energy Company chose to erect this facility on a previously developed, urban site rather than consolidating all of the company's operations into a single suburban campus. This put their new building in a location where it could exploit existing urban infrastructure, including structured parking and a public transportation hub adjacent to the site. The designers of the new plaza incorporated elements that support pedestrian commutation. The site is equipped with enough covered, secure bicycle storage for 5% of the building's occupants, as well as shower and changing facilities for use by all employees. No new parking was constructed as part of this project and the existing lot which serves the building's occupants was retrofitted with 24 electric vehicle recharge stations. All lines of a regional bus system stop within one block of the building, with most of the buses stopping directly beside the facility. (USGBC 2003)

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Definitions

Definitions have not been included for this guideline.

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Expanded Public Transit and Bicycle Access UEQ-2-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: _____

Phase: SD ☐ DD ☐ CD ☐ FINAL ☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	●	●	●	●	●

☐ **Required Component:**
A Bicycle Access diagram is attached and indicates

- Location of secure bicycle storage areas
- Access points to mass transit and pedestrian paths
- Existing and proposed new bicycle paths

☐ **Required Component:** *(Note: this will satisfy LEED™ 2.1 Sustainable Sites Credit 4.1: Alternative Transportation - Public Transportation Access)*
This certifies that the project is located within ½ mile of a rail station or ¼ mile of two or more public bus lines usable by building occupants.

☐ **Optional Component:** *(To satisfy LEED™ 2.1 Sustainable Sites Credit 4.2: Alternative Transportation - Bicycle Storage and Changing Facilities requirements)*
Secure bicycle storage with convenient changing/shower facilities (within 200 yards of the building) will be provided for at least 5% of the regular building occupants as follows:

Number of regular building occupants:	
Number of bicycle storage slots provided within 200 yards of building:	
Number of showers and changing facilities provided:	
Percentage of occupants served	

Name _____ Signature _____

Company _____ Role in Project _____

Date _____

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Regional Mass Transit UEQ-3

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To promote regional mass transit systems.

Action: Provide inter-modal connection facilities for regional transportation system, ferries, subways and buses with clear connections between the various transportation systems. Allow for future integration of other regional transportation systems.

Related Guidelines: UEQ-1, UEQ-2, UEQ-4

Introduction/Context

The first observation one might make about the WTC Redevelopment is that the entire development is shaped by a "movement infrastructure" of mass transit, roadways, rail, footpaths, escalators and elevators. This transportation infrastructure transports tens of thousands of people arriving by ferry, rail, subway, bus, van pools and private vehicles, as well as by bicycle and on foot, to and through this unique community of spaces in the heart of the nation's densest urban center. This infrastructure, in turn, enables very high levels of development density and supporting services.

This measure is intended to ensure that the full site development is coordinated with, and linked to this infrastructure, to maximize mass transit potentials, connect the downtown Manhattan area with the surrounding region and make both commuting and traveling easier. The new PATH station is a centerpiece of this project, but the overall character and the experience of the average user on the site will be greatly enhanced by supporting the full network of mass transportation. This should include the new ferry terminal located to the north of the World Financial Center, regional buses which serve both commuters and visitors to the memorial, possible future connection to the LIRR, as well as the subway system.

All future projects, including ones of smaller scale, can respond with planning strategies that facilitate (physically and visually), the efficiency and clarity of the overall system. This can be clearly demonstrated in pedestrian circulation pathways, the location of entry/exits, view corridors and the inclusion of wayfinding/graphics. Another useful strategy is the provision of a way for people to monitor the current operational status of mass-transportation systems. For example, if people can see that a particular subway line is experiencing delays before they actually board that train’s platform, congestion can be curtailed as they choose alternate routes before entering the system and avoid backtracking.

Relevant Issues

Ecological

Ecological benefits from improved regional transit systems linked to Lower Manhattan include increased transportation energy efficiencies, reduced pollution and reduced regional and local land development pressures. An efficient and improved regional transportation system includes high speed linkages between high density urban areas, allowing the creation of green belts and open space to preserve important ecological functions from groundwater recharge, habitat preservation and the support of increased biodiversity to local agriculture and heat island effect mitigation.

Economic

Economic growth is significantly tied to a transportation infrastructure that can grow, change form and become more efficient to meet its users' needs. The North East region saw two major building expansions in the last century. The first was brought about by the growth of rail transportation in the latter part of the 19th century and the first part of the 20th century. The second expansion was the direct result of highway building following WWII. These two initiatives created the necessary conditions for development to spread outward from city centers and rail corridors.

Today the Regional Plan Association (RPA) and others are calling for what might best be described as an optimization of New York's vast existing transportation network to significantly increase its potential to move people and goods in an efficient manner. The Third Regional Plan outlines 16 targeted transportation objectives, a number of which are focused on improving regional mass transit connections. The ultimate goal of this ambitious plan is an expansion in growth equivalent to the first two building expansions, without a loss of environmental quality.

Neighborhood

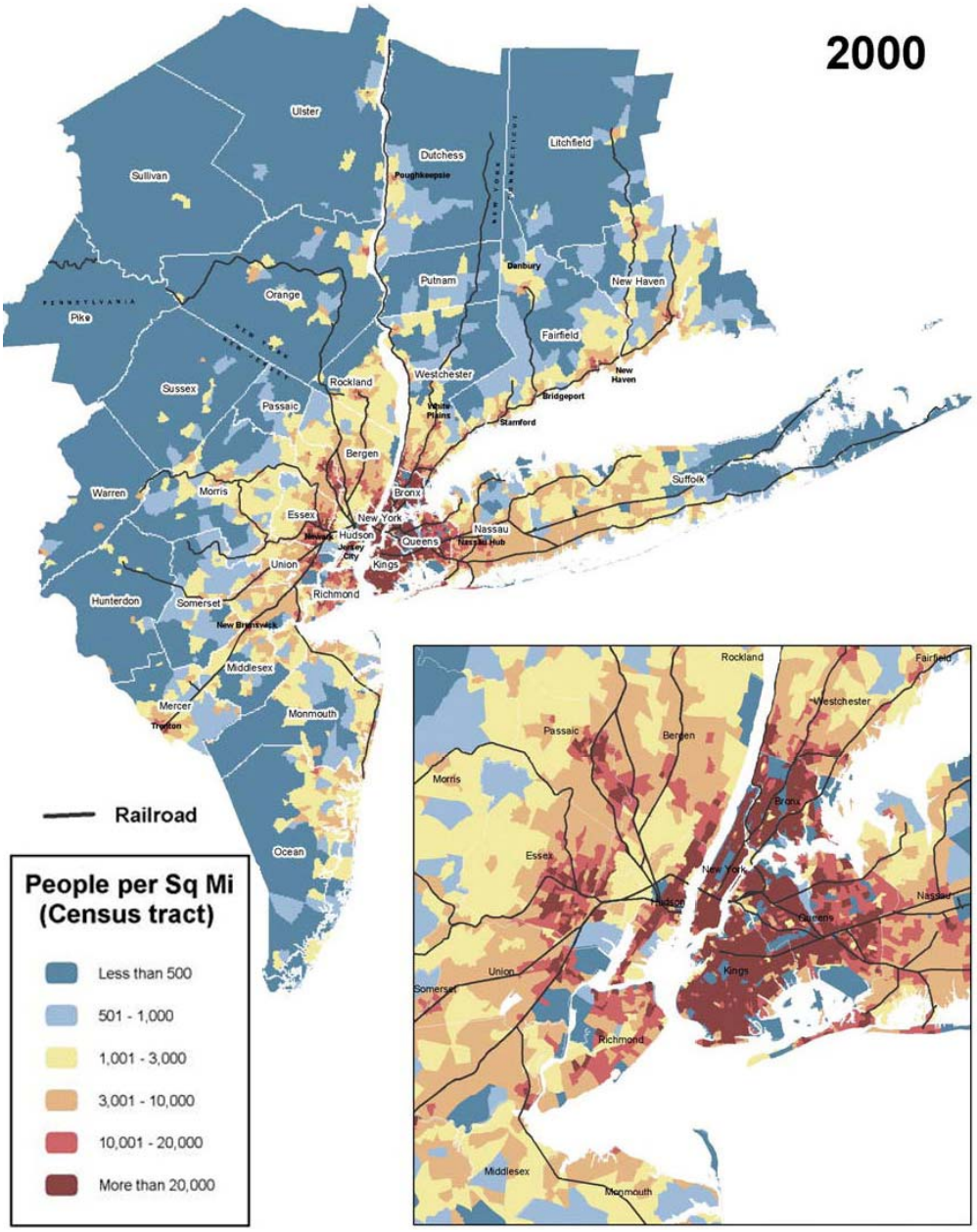
Access to a comprehensive network of interconnected transit systems offers commuters and visitors to the World Trade Center a choice of transportation means and more efficient travel options. Planning that looks to enhanced accessibility encourages people to make full use of available public transportation, especially those who travel to and from the site daily. Conveniently located connections to mass transit systems promote increased use as people realize that they can arrive either inside or close to their building, avoiding the hassle of congested city streets and tough parking conditions. The associated reduction in pollution from personal vehicles provides cleaner air, more livable neighborhoods and improved flow of goods and services. Good transportation links will also provide access to retail and cultural events, supporting diversity at the site and creating a 'destination' for many who come for reasons other than work.

Methodology

Design Strategies

Major access locations have been determined as part of the site master plan. The intent of this guideline is to acknowledge the importance of good access to regional transit systems and provide strategies to support and supplement connections.

Supplemental access points may be provided in coordination with security requirements and changing numbers of commuters and/or visitors. Architects, landscape architects and planners who receive commissions to design buildings, parks and other projects at the WTC site need to be aware of the overall planning accessibility objectives. Consideration of existing and planned access points close to each project site can identify those areas which are well served, as well as those that are underserved by access to mass transit. Where appropriate additional entrances at building lobbies or close to exits can link commuters directly to the greater Transportation Hub. Links can be stairs or escalators to subway entrances or the underground corridors that lead to other inter-modal transit connections.



New York-New Jersey-Connecticut Metropolitan Region (RPA 2004)

Means and Methods

Review existing and projected pedestrian traffic and mass transportation access patterns, in conjunction with project planning. Determine potential impacts of new linkages on increasing system efficiency, promoting greater use (see RPA's Third Regional Plan) and creating flexible, responsive designs.

Provide legible signs with interactive video or LED displays to provide updated transportation information. These are ideally located in public plazas and lower level mass-transit lobbies of each building, where they are immediately visible to commuters, indicate if transportation systems are running on schedule. Visually attractive and easily available to all site occupants and visitors, these display panels can provide real-time traffic reporting, offering re-routing information when necessary, thereby encouraging the use of mass transportation in lieu of automobiles.

Case Studies

Transbay Terminal, San Francisco

The city of San Francisco is planning a new central terminal in the downtown area to better connect the city with two existing local commuter rail lines, existing Amtrak and new high-speed rail lines that will connect San Francisco and Los Angeles. In addition, the station will be a new hub for express and local buses and provide retail and dining facilities. The station is designed with many sustainable goals including maximization of natural daylight and ventilation and the capture of rainwater for maintenance and irrigation. It is also intended to revitalize the downtown area, encourage growth and is part of a larger plan to bring a higher density of residential, retail and commercial building to the area. (Metropolitan Transportation 2001)

Reference

Definitions

Definitions have not been included for this Guideline.

Standards

Standards have not been included for this Guideline.

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Regional Mass Transit

UEQ-3-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: _____

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	●	○	○		○

☐ **Required Component:**
The attached narrative describes how this project enhances connections to existing and potential future regional mass transit systems.

Name _____ Signature _____

Company _____ Role in Project _____

Date _____

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Pedestrian Movement UEQ-4

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: Support neighborhood, community, visitor and commuter pedestrian pathways and facilitate pedestrian access to and through the site.

Action: Diagram anticipated pedestrian pathways that are coordinated with plans for WTC Redevelopment Projects. Enhance pedestrian pathways, both above and below ground, to facilitate and support pedestrian traffic. Describe and illustrate enhancements including connections to buildings, additional pathways and transportation nodes, path size, adjacent area uses, public art, vegetation, access to daylight and direct sun, furnishings, wayfinding, paving materials and patterns and view corridors.

Related Guidelines: UEQ-1, UEQ-2, UEQ-5, UEQ-6, UEQ-7

Introduction/Context

Pedestrian traffic is integrated throughout New York City streets to a greater extent than in any other North American city, yet the city does not always provide pedestrians with the amenities they need for their safety and comfort. In this great metropolis, multiple sidewalk vendors, artists, musicians, store displays, street theater and drama, constantly play to and attract the attention of pedestrians, to a greater extent than any other city in the western hemisphere. Yet these same pedestrians are exposed to confusing traffic crossings, a toxic brew of vehicle exhaust and ground level ozone, mounds of sidewalk trash, and a lack of public restrooms. Moreover, sunlight available at street level often consists of mere slivers, even on days when the city is not experiencing heavy rain or winds, from which there is little shelter. Street grids reflect Cartesian precision which expedites real estate transactions and the location of one's coordinates, but frequently does little to improve the pedestrian experience.

Designing amenities for pedestrians includes the provision of basic accommodations that encompass all typical activities -- going to work, going home, looking for a meal, going to school, shopping, sight-seeing, or just plain walking. It requires a plan which addresses physical comfort, allows for reasonable safety, and supports environmental well-being, including a connection to natural systems (time of day, seasonal changes) and way-finding.

Relevant Issues

Ecological
Walking is healthy: not only is it good exercise, but for each person who walks, a car may be removed from the street or a seat on a bus vacated. Remove enough cars and empty enough bus seats and soon an asphalt lane can be replaced with a planted median. This scenario invites more pedestrians to the sidewalk, and as the noise and fumes from traffic diminish, the cycle will continue with extended ecological and health benefits for all. Europe has embraced this concept successfully and created pedestrian thoroughfares through key, central shopping areas in many of its major cities, from Lille in France to Copenhagen in Denmark.

Economic
Increasing pedestrian access to and through the site will inevitably mean more business for commercial, retail and service establishments positioned near or alongside pedestrian pathways. Coordinating these pathways with transportation access points, outdoor open spaces and other places of interest will further increase pedestrian traffic, bringing people to the site for business, shopping and relaxing in a pleasant, safe environment.

Neighborhood
In a neighborhood setting, pedestrian activity increases social interaction and can help to build a sense of community. This activity can both create and extend these same qualities from the surrounding community. Lots of people attract street artists and vendors, and increased population on the street is a recognized way to minimize street crime. The provision of some minimum shelter from the weather at outdoor bus stops, parks and open plazas, for example, will further enhance the quality of the area and contribute to a sense of human well-being.

Methodology

Design Strategies
Analyze and study existing pedestrian movement in the larger neighborhood surrounding the site. Diagram existing pedestrian pathways which are coordinated with the WTC Site redevelopment plans, and enhance pedestrian access through additional walkways at new structures. Develop an understanding of the spatial / programmatic needs of the inhabitants in and around the site and provide pedestrian infrastructure to meet those needs.

Commercial, retail and cultural venues need to be well served by sidewalks and other means of access. Consider including provisions for safe, out-of-the-traffic stream, drop-off/pick up locations for pedestrians near all major buildings. Develop a system of pathways (pervious, if possible) for pedestrians through any large green spaces, and locate shady and/or sheltered places for people to walk and sit, protected from traffic. Provide adequate outdoor lighting at sidewalks and pathways, with light output focused down to brighten the pedestrian area while avoiding night-sky pollution. Include minimal weather-related shelters, street furniture at sidewalks, and appropriate trash disposal containers to keep streets and sidewalks clean and free of rubbish and vermin.

Means and Methods

Enhance pedestrian pathways below, on, and above ground. Provide new pedestrian connections in strategic locations to ease congestion, improve circulation at the site, connect buildings where appropriate, and support access to mass-transit systems. Study provision of pedestrian amenities such as public art, adjacent open spaces for non-circulation uses, street furnishings, wayfinding, view corridors, access to parks, and access to natural light and direct sunlight, and incorporate these where appropriate. Design pedestrian infrastructure in an aesthetically pleasing and functionally comfortable manner. Consider textures, patterns, colors, materials, and the shapes and dimensions of pathways, appropriate to locale and function.

When possible, design pedestrian infrastructure to help provide relief from harsh natural elements such as wind, rain and snow. Minimal, open structures with roofs can be appropriate. Structures that offer greater protection should be considered in windy locations.

Implement traffic control features to define clear pedestrian zones and provide protection for pedestrians in areas that they must share with vehicles. In association with authorities such as the traffic police, establish speed limits within the WTC complex and pedestrian 'right of way' at crossings to further safeguard those on foot.

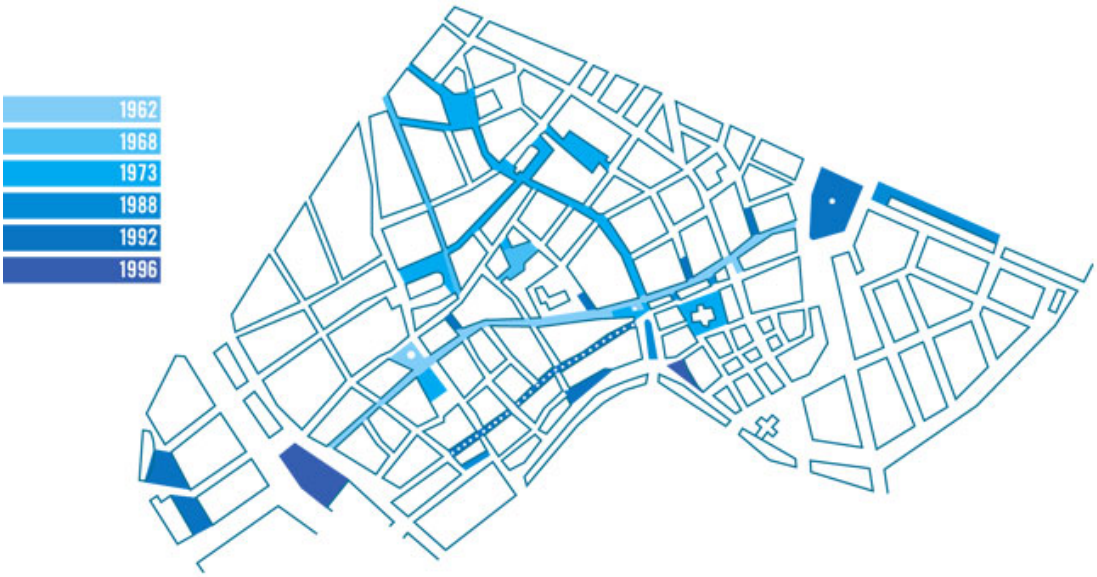
At underground concourses, introduce maximum daylight to provide a connection to the natural world above. The use of daylight creates an optimum interaction between built and natural systems, contributing to an easier and more enjoyable experience of wayfinding. Architectural wayfinding elements that utilize daylight and floor patterning, balanced with structure, interior volumes, and placement of circulation elements, can be incorporated to articulate the major spaces and connections, and to reduce the dependence on signage.

Case Studies

Copenhagen, Denmark

Copenhagen is a leading city in the campaign to support both increased pedestrian traffic and greater use of public spaces for personal enjoyment, health and wellbeing. The historical development of Copenhagen, being organized with a narrow medieval street grid, provided the city with an easier starting point from which to develop enhanced pedestrian infrastructure. Making the most of this innate characteristic, city leaders have made a concerted effort to continually enhance the quality of the pedestrian experience. Informed by rigorous research into human behavior in urban spaces, city planners have instituted a series of strategies designed to create a more pedestrian-friendly city. Jan Gehl, a Danish architect involved in these efforts, reported on research showing that four times more public activity occurs in Copenhagen's city center than in comparable cities with fewer pedestrian amenities. In 1962, the city converted its main street, Stroget, into a pedestrian thoroughfare. In the following years more streets were slowly converted to pedestrian traffic only. Pedestrian-priority streets were also created, where walkers and cyclists have right-of-way while vehicular traffic is allowed only at limited speeds. The city stabilized the level of vehicular traffic by gradually reducing the available number of parking spaces by 2-3 percent per year. (Makovsky 2002)

In the decade between 1986 and 1996, 600 parking spaces were phased-out. The parking lots left empty by these design moves were given new life as public squares. Smaller scale pedestrian enhancements, such as places to sit, and support of general comfort and security on city streets, continues to enhance Copenhagen's efforts. The development of pedestrian zones over time are indicated in shades of blue on the diagram below. (Makovsky 2002)



Copenhagen City Center (from MetropolisMag.com August/September 2002)

Reference

Definitions

Definitions have not been included for this Guideline

Standards

Standards have not been included for this Guideline.

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Pedestrian Movement

UEQ-4-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: _____

Phase:
SD ☐ DD ☐ CD ☐ FINAL ☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	●	●	●	●	●

☐ **Required Component:**
The attached diagram indicates enhanced site pedestrian pathways, connections to adjacent existing and proposed pedestrian patterns, pathways and transit hubs.

☐ **Required Component:**
The attached narrative description explains how proposed new pathways and nodes will improve pedestrian circulation to and through the site. Path size, adjacent area uses, public art, vegetation, access to daylight and direct sun, furnishings, wayfinding, paving materials and patterns, and view corridors are included in the description.

Name _____ Signature _____

Company _____ Role in Project _____

Date _____

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Green Infrastructure UEQ-5

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: Support the development of green infrastructure by developing and linking vegetated site areas with existing neighborhood green spaces.

Action: Diagram "green" infrastructure within 1000' of site boundary. Create site vegetated areas to enhance site contributions to natural ecological processes, sustain air and water resources, promote biodiversity and reduce heat island effects. Facilitate creation of green infrastructure linkages in conjunction with adjacent neighborhood green spaces.

Related Guidelines: UEQ-4, UEQ-6, UEQ-7, SEQ-3, SEQ-8, SEQ-13

Introduction/Context

The allocation, placement and specification of site vegetation offers significant opportunities, which extend beyond planted areas to enhance Urban Environmental Quality. In dense urban areas ecological systems are under severe stress. Physical or visual linkages to adjacent green areas offer extended value in supporting ecological systems by providing important green 'corridors', which allow for movement and greater biodiversity for insects and wildlife (songbirds, butterflies, etc.). In addition, adjacent or nearby parks and green spaces, which may not be physically linked, but are visually connected, constitute a patchwork or mosaic of green locales which also constitutes a recognized sustainable initiative. The dynamics of these types of urban "patch" habitats are just beginning to be understood and offer designers both an opportunity and a valuable tool to contribute to the quality of the ecology of this specific urban site.

In the steel, glass and concrete canyons of lower Manhattan, parks and plazas serve to provide the human population with an important reminder of the natural processes which sustain all planetary life. Plants and trees represent a key connection to seasonal changes in the natural world. In these two respects, plants serve as important environmental indicators in dense urban areas. They remind us that human beings are but a small part of a much larger eco-system and the visible state of health of these living organisms serves as a sensitive barometer of environmental wellbeing.

As living landscapes, green areas require separate design considerations, which differ significantly from a sustainable approach to designing buildings. Thought must be given to how the landscape will change over time as maturation will affect its form, ability to function and provision of shelter and shade. The landscape's potential to add visual pleasure and provide food and wildlife habitat in five, ten and even fifty years must also be considered.

Relevant Issues

Ecological

The ecology of plants in a dense urban environment is very different from the naturally propagated systems that occur in deep woodlands or natural meadows. These plants, which occupy small, isolated patches in city parks and gardens, present enormous challenges to insects and all forms of wildlife. Birds and insects are involved in the dispersion of seeds, and are responsible for natural pollination. Planning for maximum green spaces, preferably with physical and/or visual connecting green corridors, helps to support biodiversity and to alleviate potential ecological interruptions.

In urban environments, plants are subjected to stresses which are heightened by the built structures and human activities around them. At the same time, they are helpful in moderating some of the worst conditions associated with microclimates, such as 'heat island effect', which is created by heat build-up in the impervious built environment. Trees and vegetated areas mitigate heat island effect by providing natural shading and enhanced opportunities for evaporative cooling, while reducing areas of heat absorbing materials. In addition, plants and trees offer a natural air quality enhancement by absorbing significant quantities of carbon dioxide (CO_2) generated by building and automobile exhausts, reducing particulate loads and producing oxygen.

Trees, shrubs, vines and flowers contribute to people's sense of well being, health and pleasure. Urban gardens and green spaces tend to moderate temperature, cooling the ambient air significantly. In hot summer months, shade trees with their characteristic broadleaf structure provide pools of cooler air, bringing welcome respite from the heat. Many parks and plazas include fountains and water displays, and these too contribute to wildlife habitat, while providing a cooling effect on local temperatures.

Economic

Real estate values in Manhattan are always higher for property in close proximity to parkland and green spaces. Green corridors, at best, provide tangible links to other neighborhood parks and, at least, offer the perception of extended greenspace. Mosaic or patchwork areas of green enhance the perception of open space. In either case, these win-win, environmental/sustainable strategies serve to increase the physical and visual quality of the entire locality, increasing real estate values, as well as providing community amenities and enhanced ecological benefit.

Neighborhood

Green spaces are important to the well-being of people and neighborhoods. They improve air quality, mitigate heat-island effect and enhance human well-being through the increasingly well-documented and accepted restorative effects resulting from reinforcing connections to nature. Trees planted in close proximity serve as 'buffer zones', reducing noise pollution and protecting pedestrians from wind. Parks and plazas, linked loosely together by green corridors -- tree-lined streets, sidewalk planters, planted roadway medians, etc. -- serve to support pathways for wildlife. Insects, butterflies and birds, particularly the small indigenous songbirds common to this North East region, are able to thrive, finding in these multiple islands of green,

sufficient diversity, food and habitat to maintain the strength of their species and to support their natural habits. People enjoy these connections to nature and find natural sights and sounds to be fundamental qualities of enrichment in urban spaces.

Methodology

Design Strategies

Diagram 'green' spaces within 1,000 feet of the site boundary and identify important existing or planned neighborhood green spaces for linkage to site green spaces. Consider the design of *physical* green corridors in the planning of the site, via streets and thoroughfares leading from the center to regional neighborhoods. Green corridors need not be elaborate or demanding of dedicated space. Tree-lined streets provide one traditional means of linking green spaces. Large planters can also be designed to maintain a ribbon of plant-life from site green spaces to neighborhood parks or plazas. Wherever feasible, include vegetated areas, at roofs, terraces, ground level plazas and parks, and in open wells and areaways. These will serve to enhance the site, mitigate heat island effect and provide habitat for wildlife. Built-up site development will be measurably enhanced by maximizing this program.

Means and Methods

Employ strategies for strengthening the ecological functions of green space patches as outlined in Landscape Ecology Principles in Landscape Architecture and Land-Use Planning. (Dramstad 1996) This handbook of ecological planning principles analyzes structural patterns in landscapes through three types of elements: patches, corridors and matrices. Clear diagrams are provided of how patterns of these three universal elements can be structured to improve ecological function in the landscape. The dynamics within these universal elements are further developed and explained through the qualities of their sub-elements which include edges, boundaries, barriers, stepping stones, networks and meshes. Applications of these strategies are schematically demonstrated in different scales and settings.

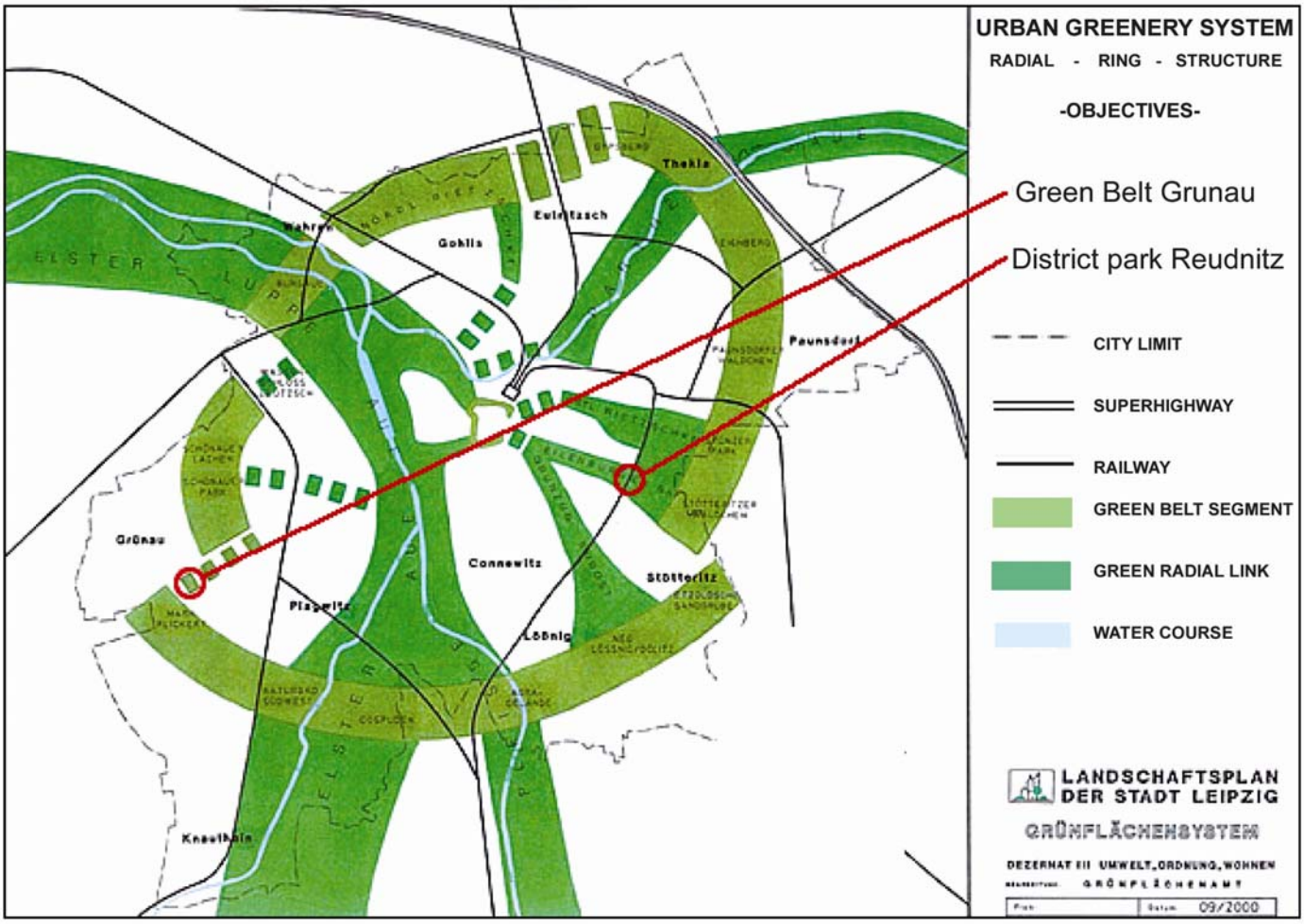
Include buildings in this analysis and consider the use of green walls and roofs when possible to extend green space potentials.

Case Studies

Urban Green Environmental Project, URGE, European Commission
Leipzig, Germany

Modern Leipzig was developed with belts of housing tracts around the historic city center. Many of these houses are now derelict and others have been left vacant by a mass exodus to the suburbs. As these structures are demolished, the city is making an effort to replace them with sustainable green spaces. Some of these efforts have coalesced into smaller campaigns within particular neighborhoods. One example is the Green Belt of Grunau in Western Leipzig. The area where this green tract was created had been set aside for a new road and tram tracks before the Berlin Wall was taken down. Afterward, those plans were abandoned and the land lay unused for several years. The local government, with the help of neighborhood residents, developed a project to turn this land into public open space with playgrounds, walking paths, and other recreational areas. In Eastern Leipzig, a plan was devised to create a 'green finger' to replace former railway infrastructure within

this densely populated part of the city. The district park, Reudnitz, was created to develop open public space of ecological significance, improve the quality of life, provide recreation areas for local residents, and support the development of an advanced network of cycle tracks and footpaths. These projects are merely two examples of city-sponsored efforts to building new green infrastructure in Leipzig. The map below shows the overall scope of these projects as of the year 2000. (URGE 2004)

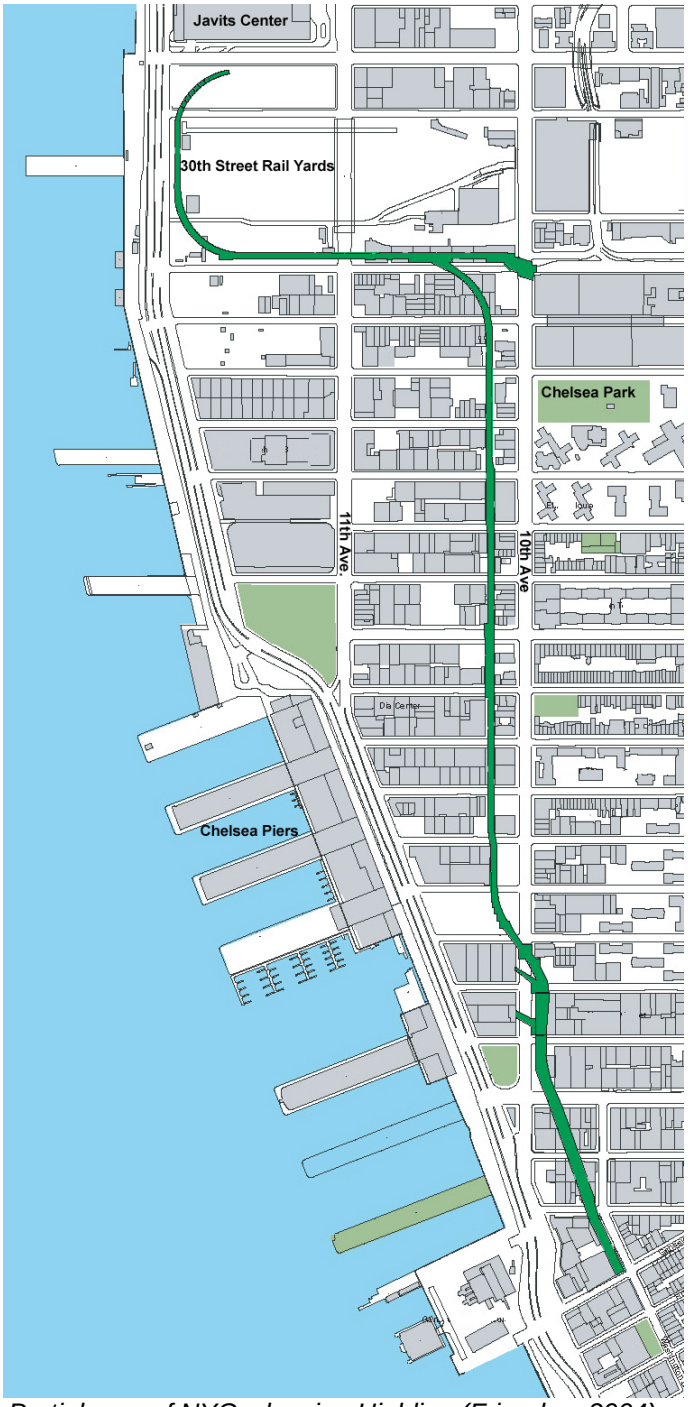


Map of green infrastructure in Leipzig in the year 2000 (URGE 2004)

<u>New York City, Highline project</u>

Friends of The High Line was formed as a non-profit group to promote the conversion of a 22 block long, abandoned elevated railroad running from 34th Street to Gansevoort Street into a public green corridor. They feel it offers an opportunity to create a unique recreational amenity for New York City. As a result of their efforts, New York City has pledged capital support to help push this venture forward. If the vision of this project is realized, it will create a tranquil, elevated public green space that offers views of the Manhattan skyline, the

Hudson River, and gardens that are currently "hidden" inside various city blocks. This public promenade will also offer various recreation programs. Some potential ideas proposed have been a public urban beach, music venues, and botanical gardens. (Friends of The High Line 2004)



Partial map of NYC, showing Highline (Friends... 2004)

Views from up on the Highline (Friends…2004)

Reference

Definitions

Green Infrastructure is an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations (Benedict 2002)

Standards

Standards have not been provided for this Guideline.

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Green Infrastructure

UEQ-5-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: _____

Phase:
SD ☐ DD ☐ CD ☐ FINAL ☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
	●	●	●	●	●

☐ **Required Component:**
The attached plan diagrams existing and proposed green spaces within a 1,000 foot radius of the project site, highlighting proposed new green spaces.

☐ **Required Component:**
A supporting narrative is attached and confirms how proposed new green spaces on the site will strengthen the overall system of green infrastructure. It includes details on ecological patch dynamics, habitat creation and how these specific strategies are being supported over time.

Name _____ Signature _____

Company _____ Role in Project _____

Date _____

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Outdoor Environmental Comfort UEQ-6

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To facilitate site development that supports outdoor environmental comfort.

Action: Design site structures, materials and landscape to enhance comfort and functionality of outdoor spaces and mitigate the effects of heat islands. Extend outdoor comfort levels further into the Spring and Fall seasons with passive strategies that maximize natural assets. Design structures with consideration for site environmental wind conditions where pedestrians would be affected and seek to moderate any such effects.

Related Guidelines: UEQ-4, UEQ-5, SEQ-3, SEQ-8, SEQ-9, SEQ-10

Introduction/Context

Shaping the environment to increase comfort predates the building of early settlements more than 10,000 years ago. This strategy is instinctive, and was first reflected in the choices of early nomadic peoples, when they selected a south-facing cliff to warm themselves on a wintry day or a shady glen to cool themselves on a hot summer day. Throughout the last 10,000 years there have been many excellent examples of environments that were specifically shaped to optimize human comfort. In 1963, Victor Olgyay was one of the first to mine this wealth of environmental comfort knowledge when he published his now classic book, Design With Climate. Olgyay examined traditional and indigenous shelters from around the world to develop a checklist for designers on how to moderate the effects of climate. These traditional architectural forms were fully integrated into their environments and shaped by the need to maximize thermal comfort and minimize the amount of construction material required. This economy of means has created a wealth of information on the creation of comfortable outdoor environments.

Calculating outdoor environmental comfort is not an easy task. The sun moves through the sky, changing position and the intensity of solar radiation it delivers to the Earth. “Sensible Temperature”, or the temperature one perceives, is determined by changing air temperatures, humidity levels and temperatures of nearby surfaces. Winds shift in both intensity and position throughout the day and also impact thermal comfort. People wear different weight clothing, engage in different levels of activity and have different personal comfort levels. In indoor spaces we constrain many of these variables. In outdoor spaces these controls are not possible or desirable. We can, however, move about more in the outdoors, and people do. Given a sunny or shaded bench on a brisk November day, people will nearly always choose the sunny bench. On a summer afternoon, in all likelihood the other bench will be more popular.

This variety is essential to good outdoor environmental comfort design. By creating areas that will provide comfort at different times of the day and season, we can increase the potential for people to use these spaces throughout the year.

Relevant Issues

Ecological

Bringing people outdoors reduces demands on indoor spaces and provides increased opportunities for connection to the natural world. Reduced demand on indoor spaces reduces indoor light and air conditioning energy requirements.

The act of bringing people outdoors for longer periods of time improves their health. People tend to move about more, opportunities for exercise are increased and fresh air and daylight are especially important to city dwellers who spend a large portion of their time indoors. Increasing people's connection to the natural world has also been demonstrated to reduce stress and provide opportunities for rest and relaxation.

Bringing people outdoors and into connection with natural systems also increases awareness of those systems and their role in sustaining us.

Economic

Increasing and extending the amount of time that outdoor spaces are comfortable provides increased and extended opportunities for outdoor retailing, dining and performances. Improvements to health from bringing people outdoors and increasing opportunities for exercise have direct economic benefits in both increased productivity and reduced medical costs.

Neighborhood

Outdoor spaces that are welcoming can enhance the level of social interaction that occurs in a neighborhood as more people linger outside. A comfortable outdoor space is likely to be used more frequently and the increased presence of people outside works to deter crime.

Methodology

Design Strategies

Analyze the local microclimate to illustrate site environmental conditions including proposed and existing building locations, wind patterns, solar access, and shading patterns, vegetated areas and water features. The analysis should include local climate data for temperature, humidity, wind speed and direction, solar radiation, rainfall and cloud cover.

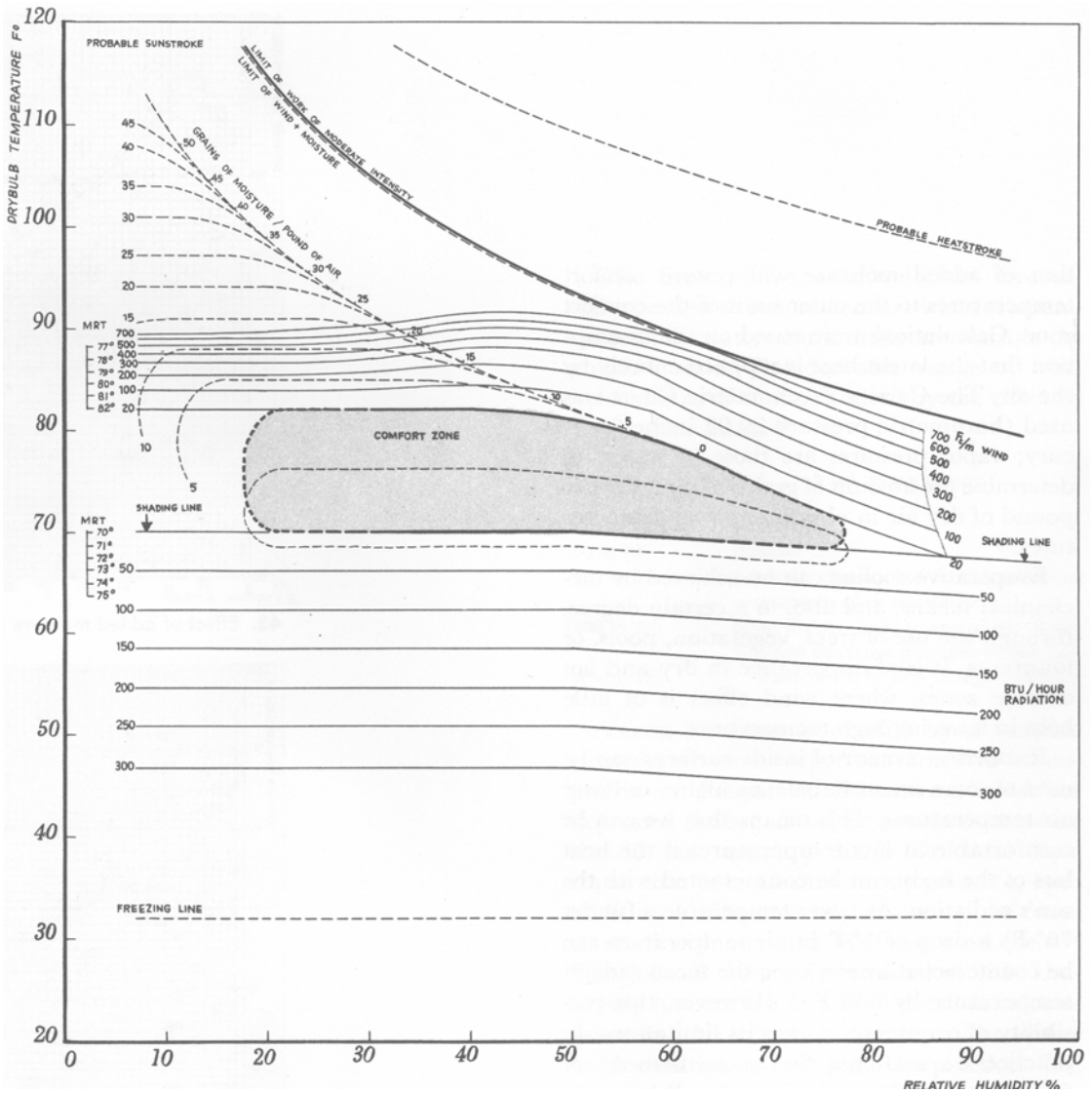
Outdoor Thermal Comfort strategies should provide a variety of comfort levels to ensure there are areas for different times of day and season. Include consideration of activities, ages, and clothing levels.

Researchers at the Center for the Built Environment, University of California, Berkeley have developed an Advanced Thermal Comfort Model based in part on Dr. Zhang Hui's PhD dissertation, "Local Thermal Comfort in Asymmetrical and

Transient Environments". The model distinguishes itself from previous environmental comfort models in its ability to model human comfort and sensation in non-uniform and changing thermal environments. While still in development, the model does have potential as useable tool for better understanding outdoor environmental comfort.

Means and Methods

The Bioclimatic chart shown below was developed by Victor Olgyay in the early 1960's to illustrate how different climatic conditions affect environmental comfort. The chart maps out an average environmental comfort zone and demonstrates how this comfort zone shifts as environmental conditions change. It includes solar radiation (btu's per hour), dry bulb temperature (degrees Fahrenheit), relative moisture content (actual density over saturation density), actual moisture content (grains of moisture per lb of air) and wind (feet per minute).



Psychometric (Bioclimatic) Chart for US moderate zone inhabitants (Olgyay 1963)

Solar radiation strategies:

Locate and orient outdoor areas and furnishings to take advantage of solar exposure, when desired, while providing areas of shade for times when the sun is too intense. Shade provided by deciduous trees during the warmer months will open up to sunshine during winter months, increasing opportunities for outdoor environmental comfort. Consider thermal mass, use of vegetation and light and dark colored materials to optimize material properties in thermal comfort design and reduce heat island effects. Consider night-covering or phase-change material potentials to retain heat in certain cases.

Wind strategies:

Locate and orient outdoor areas and design site features and plantings to moderate pedestrian level wind effects in areas where people walk or congregate. Consider seasonal shifts in winds. An increase of wind by 1 mph is equivalent to a 2 degree drop in temperature (a breeze moving at 100 ft/min is equivalent to 1 mph). This suggests that outdoor environments which will be used on summer afternoons should be placed to maximize cooling breezes and that even a gentle breeze can have a very significant effect on thermal comfort.

Provide ledges or breaks along tall building faces to reduce wind effects at the pedestrian level on the windward side of buildings.

These issues are ideally studied in wind tunnel tests that quantify environmental wind conditions during the design phase. It is very difficult to predict wind effects of tall buildings at ground level. Much can be done with dense plantings, walls, canopies and other methods, but rules of thumb become difficult to apply in dense urban settings.

Acoustic Strategies:

Enhance acoustic comfort through passive strategies such as flowing water features and landscaped areas that absorb urban noises or provide more pleasing noise masks.

Moisture strategies:

During certain times of the year the potential may exist to use site water features to improve environmental comfort levels. When relative humidity levels are low and air temperatures are high, adding moisture to the air will reduce sensible temperature because heat energy is required to evaporate water.

Temperature:

Sensible temperature is determined by both air temperature and nearby surface temperatures. Include radiant surface heating considerations to increase thermal comfort opportunities. Avoid using reflective materials and surfaces that may create uncomfortable glare for outdoor users.

The avoidance of local heat island effects is paramount for outdoor comfort in summer months. Limit large expanses of unbroken paving and use light-colored paving when possible. Planted areas and water features can both aid in reducing heat island effects.

For winter comfort, mitigating wind and capitalizing on sun are most important. While deciduous trees give good solar access in winter, their effectiveness as windbreaks is reduced when the leaves fall, so windbreaks should use lower evergreen plantings.

Bodies produce heat from food energy; 20% of food energy is converted to work, while 80% is converted to heat. This heat leaves our bodies through convection (40%), radiation (40%) and evaporation (20%). Heat production is also very dependent on activity level, as illustrated in the following chart.

290 btu/hr	At Rest	1400 btu/hr	4 mph
400 btu/hr	Sitting	3-4,000 btu/hr	Sustained exertion
760 btu/hr	2 mph	8,000 btu/hr	Olympic Athlete

Case Studies

Urban Form and Climate Study, Toronto, Ontario

This joint Urban Design Study was conducted by the Berkeley Environmental Simulation Laboratory and the Centre for Landscape Research at the University of Toronto, to examine the effect that new development in downtown Toronto might have on pedestrian comfort in urban spaces. The study sought to investigate the shadows and wind patterns that would be produced by new buildings. These investigations focused on sidewalk level. Combined effects of sun and wind conditions were of special interest for evaluating potential pedestrian comfort. The study was divided into three areas, coordinated with three specific zones of proposed urban development in Toronto. These areas were studied in detail through physical models and computational techniques. Physical models were subjected to wind tunnel testing and shadow analysis and computer simulation predicted how both existing and future buildings might effect human comfort.

This analysis resulted in the following recommendations:

Proposed building heights were adjusted to produce 3, 5 and 7 hours of daily sunlight at street level from March to October. Three hours was deemed adequate for commercial streets in the central business district. The five hour window was recommended for other downtown areas, including pedestrian connectors, shopping, historic and tourist areas. Seven hours was proposed for residential streets on the edge of downtown.

Building height recommendations were also made as part of the wind study. To reduce high winds at building bases, a series of gradual setbacks and height rises were recommended and abrupt changes in height were discouraged.

The methods employed by this study can also be applied to other cities as part of their urban planning methodologies. (Wright 1995)

Reference

Definitions

Definitions have not been included for this Guideline.

Standards

Standards have not been included for this Guideline.

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Outdoor Environmental Comfort UEQ-6-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: _____

Phase:
SD ☐ DD ☐ CD ☐ FINAL ☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
	●	●	●	●	●

☐ **Required Component:**
A microclimate analysis study is attached that illustrates site environmental conditions, including proposed and existing building locations, wind patterns, solar access and shading patterns, vegetated areas and water features. The analysis includes local climate data for temperature, humidity, wind speed and direction, solar radiation, rainfall and cloud cover.

☐ **Required Component:**
Plan(s) and supporting description(s) of the site's preferred "outdoor room(s)" are attached, illustrating strategies which will be used to support human environmental comfort at specific outdoor spaces on the site. This description addresses the four diverse seasonal periods of the year, the influence of the environmental condition factors noted above, anticipated activity levels of people using the space, and adjacent material treatments.

☐ **Optional Component:**
For major high-rise components, an environmental wind condition analysis is attached and addresses cumulative wind effects at pedestrian level on the site.

Name _____ Signature _____

Company _____ Role in Project _____

Date _____

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Wayfinding UEQ-7

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To facilitate both neighborhood and site-user orientation and site readability.

Action: Integrate wayfinding as an integral design quality when developing green corridors, visual corridors and memorable place markers in conjunction with surrounding neighborhoods.

Related Guidelines: UEQ-2, UEQ-3, UEQ-4, UEQ-5, SEQ-9, SEQ-13

Introduction/Context
Clarity of direction may not normally be associated with sustainable design, yet site orientation and understanding is essential to basic environmental stewardship. Well designed way-finding strategies, integrated with landscape and built forms, can do more than provide a guide through the site. They can also be engaged to inform site users about the unique features and systems that characterize different localities within the site.

Universal diagrams and multilingual signs are essential components of any campus or building neighborhood plan or map; however, there are any number of 'memorable' sensory experiences that are more powerful and more intuitive. The attractive power of a large, strongly day-lit space, for instance, perceived from a less brightly lit corridor, "This way out." In a similar way, views between buildings provide memorable prospects or spatial sequences for people navigating a site, and are immediately recognized on repeat visits, reminding people of where they are within the complex. Changes in paving materials can act as subtle reminders far more powerful a signs. A strong integration of built form and wayfinding goals are essential at the WTC Site.

Urban designers might consider taking cues from some prescient healthcare designers who have been exploring ways to improve wayfinding for disabled and elderly patients. To-date, these strategies have focused on *shaping* the environment, providing natural light at key locations and using water and plants to distinguish one particular setting from another. This reduces the disorienting effect of uniformity in contemporary hospital interiors. Similarly, at the World Trade Center site, specific scenes, angled views of landmark features, and reinforced natural and supplemental light at critical underground junctures, will inform and remind site users of their location and orientation.

Relevant Issues

Ecological

A clear wayfinding strategy integrated into the landscape and built environment assists users in site orientation. It also helps them become familiar with the icons and orderly features, as well as distinguishing landmarks, that characterize the community and the visible neighborhoods beyond. A well-integrated system of pathways tells a story about the site. As site users first find their way, they begin to learn about inherent site systems and rhythms. A 'sense of place', which develops as an understanding of the site and how it should be through all its seasonal changes, provides a level of comfort for most people.

Economic

Retailers are keenly aware of the importance of a clear and easily understood wayfinding techniques. Easily found and/or memorized pathways, often realized through visual, or even subliminal, sensory responses are essential to attracting and maintaining customers.

Neighborhood

Legible and understandable pathways through sites and neighborhoods assist visitors, service and emergency personnel in reaching their destinations efficiently. Such systems not only provide clarity, welcoming those unfamiliar with the site, but may also save lives in an emergency. Clear pathways, separation of vehicular, bicycle and pedestrian traffic, and attractive venues will all contribute to maintaining a lively, interactive bustle at the redeveloped World Trade Center site. This will ensure the success of its commercial, retail, restaurant, cultural and entertainment venues.

Methodology

Design/ Means and Methods Strategies

Provide outdoor light-wells between underground spaces and covered atria to provide opportunities for views to the outdoors and daylight penetration at lower levels. Place day-lit apertures to reinforce important crossings or nodes and to draw people to key locations, such as escalators to other levels, or amenities, such as shopping areas, restaurants or underground building entrances.

Develop a plan which defines the site according to a visual language similar to that of Kevin Lynch's in The Image of the City, to include:

Paths – predominant elements, streets and walkways, characterized by special use, continuity and directionality.

Edges – linear boundary elements, strongest edges are impenetrable, e.g. building edges or waterfront edges.

Districts – Relatively large areas which can be mentally "entered and understood" to have a common character relating to texture, form, detail, symbol, building type, use, activity, inhabitants, degree of maintenance, topography.

Nodes – foci which can be entered, junctions of paths or concentrations of small characteristic points, may be large squares or extended linear shapes.

Landmarks – external prominent point reference visible from many locations.

Use a consistent language of wayfinding cues throughout the entire site to avoid confusion.

Means and Methods

Use line-of-sight connections as cues between locations where appropriate. Wherever possible, introduce natural light to help direct people. Incorporate memorable place markers to function as orientation points. Use materials, patterns, and textures to demarcate spatial zones. When connecting multiple buildings, coordinate floor numbers. Clearly distinguish between public and non-public spaces and identify arrival points. Locate public information stations in logical and highly visible locations. When needed, augment architectural wayfinding cues with clear and concise graphic indicators, such as signage.

Case Studies

Bristol Legible City Project, Bristol, United Kingdom

This project was conceived by the Bristol City Council in 1996 to make the city more easily navigable by both residents and visitors. The keystone of this plan was a system of wayfinding implemented by a core development team lead by the city council and comprised of urban planners, product designers, information designers, traffic engineers, and public art consultants. This team delivered over 40 individual projects throughout the city that were coordinated to create an overall system of legibility. The first step of this program involved the redesign of signage throughout Bristol, although the scope of the urban intervention was much greater. The projects developed as part of this program linked together diverse parts of the city through consistently designed information in order to make attractions and destinations easier to locate. Other goals were to promote a clear, positive identity for the city of Bristol, to reinforce the character of distinct neighborhoods, and to encourage a shift toward the use of public transportation. The infrastructure of the system includes clear, succinct directional signs with simple to understand 3D maps, on-street information panels, printed walking maps, and art projects. A visual language was developed to include easily understood symbols, a unified color palate, and legible text. Another key aspect of this project was to rectify traffic problems. A new signing hierarchy was proposed to discourage through traffic at the city's center, improve access to city attractions, and promote various modes of public transportation.

Reference

Definitions

Wayfinding is a term that was coined by an architect named Kevin Lynch in the Sixties to describe devices and techniques used to increase the legibility and ease of navigation of a space or site.

Standards

Standards have not been included for this Guideline.

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Wayfinding

UEQ-7-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: _____

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
	●	●	●	●	●

☐ **Required Component:**
A wayfinding plan is attached that highlights proposed wayfinding elements. The plan addresses how buildings, their elements and the landscape are employed to enhance site legibility and ease of navigation. The plan includes a clear description of the visual language which has been developed and how these wayfinding elements work to orient site users in simple and consistent ways.

Name _____ Signature _____

Company _____ Role in Project _____

Date _____

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Vehicular Emissions UEQ-8

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: Reduce back-up of traffic into neighboring streets in order to minimize vehicle emissions and improve neighborhood air quality from pre a 9/11 base. To minimize potential idling time for all vehicles.

Action: Optimize traffic flow of all vehicles coming to the site to reduce the amount of time that vehicles must idle. Seek to reduce traffic backups through scheduling and onsite accommodation. Design bus stops to minimize traffic backups and potential vehicle idling times.

To the extent that there is a NY State Agency and/or other governmental presence on site, at least 50% of light duty fleet vehicles will be alternative fuel or hybrid vehicles by 2005 and 100% by 2010.

Related Guidelines: UEQ-1, UEQ-2, SEQ-1, SEQ-3, SEQ-5, SEQ-6, EEQ-1, EEQ-5, MEQ-1, MEQ-5, IEQ-5, IEQ-7

Introduction/Context

The size and density of the World Trade Center Redevelopment will require a large number of service and delivery vehicles. Many of these will be heavy duty trucks, buses and vans. A unique opportunity exists to reduce the environmental and acoustical impact of these vehicles by requiring the use of cleaner fuels, scheduling deliveries at night, limiting the permissible idling time for engines, and minimizing required trips. Neighborhood air quality is directly affected by these vehicles, therefore strategies to restrict their emissions will have extended benefits, including a reduced potential for smog (ground-level ozone) carbon monoxide and particulate releases.

Air Quality in Lower Manhattan is monitored by both the New York State Department of Environmental Conservation (DEC) and the US Environmental Protection Agency (EPA). Carbon monoxide, sulfur dioxide, nitrogen dioxide, sulfates and nitrates, particulates, ozone and lead concentrations are all currently sampled on Canal Street as representative of Lower Manhattan. At this time New York County does not meet federal standards on ozone, carbon monoxide and particulate matter, all generated to a large extent by vehicular traffic emissions. Non-attainment, as defined by the Clean Air Act and Amendments of 1990, defines a locality where air pollution levels persistently exceed the National Ambient Air Quality Standards for pollutants that are harmful to public health. 'Non-attainment' is an official designation, which is applied only after an area's air quality has exceeded these standards for several consecutive years. According to a 2001 European study, over 50% of air pollution in cities is generated by vehicle emissions, which now also account for more deaths than road accidents. The Third Ministerial Conference on Environment

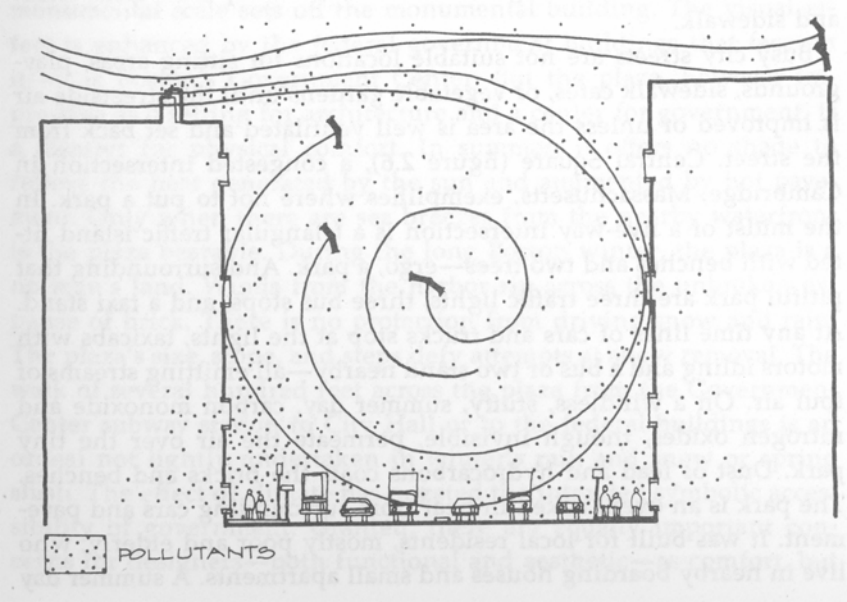
and Health, organized by the World Health Organization (WHO), also noted that road traffic was the most rapidly growing source of pollution in Europe, and “car exhaust is causing a rise in respiratory conditions, heart disease, bronchitis and asthma”.

Local weather plays a significant role in the manner in which vehicle pollutants affect air quality, and variations in climate and temperature cause different impacts. Heavy traffic during the hot, sunny summer months causes ozone levels to spike: nitrogen oxides and hydrocarbons, the chief "precursors" of ozone, react in the presence of sunlight to produce ground-level ozone, or smog. Smog is recognized as a significant contributor to asthma and other serious respiratory illnesses. In cold weather, higher levels of carbon monoxide are released because fuels do not burn as efficiently. Historically, the worst air quality months in New York City are June, July and August.

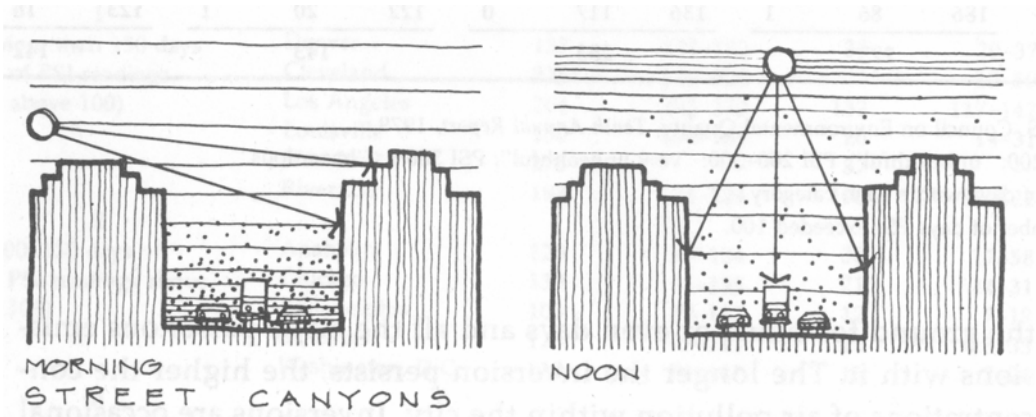
Relevant Issues

Ecological

Vehicle emissions have been shown to have direct and detrimental effects to human health and the health of ecological systems. Pollutants emitted by trucks and cars become trapped in city canyons and collect at street level. Additional pollutants can be blown from rooftops to the streets below when the temperature at the bottom of the ‘canyon’ is lower than the temperatures above. This occurs when a warm air mass moves over cooler air or when air near the ground is cooled from below at night. The cooler air becomes trapped, retaining a concentrated soup of pollutants in the narrow canyon at street level.



Pollutant trapping in Street Canyons (Spirn 1984)



Effect of air temperatures in pollutant trapping in Street Canyons (Spirn 1984)

These conditions are dangerous to human health. According to David Gee of the EU-funded European Environment Agency: "We've known about lead and its ability to damage the IQ of children at quite low levels, like lead in petrol (gasoline) getting into the ordinary atmosphere, onto vegetation, onto soil and then into children. . . There is increasing evidence about low levels of contamination being part of a causal chain, in things like attention disorders and hyperactivity, and those sort of neurological symptoms which seem to be associated with low-level toxic pollution." Vehicle emissions also contribute to a major increase in premature death from heart and respiratory illnesses.

Economic

Poor air quality resulting from traffic congestion and idling engines reduces the visual quality of the site, making it less attractive to visitors. These factors increase the amount and severity of respiratory, heart and cognitive related health problems, which in turn incur significant medical costs. In addition, heavy diesel traffic and idling/revving engines create noise pollution in the streets, which also has a negative impact on the acoustical quality in nearby buildings. A lesser known impact is the soiling and erosion of building facades and materials that result from the acidic nature of hydro-carbon emissions from vehicles. Dirty, unkempt building facades are unattractive and costly to clean and/or repair.

Traffic back-ups create delays and cause loss of time and efficiency in the exchange of goods and services, producing negative affects for local commerce.

Neighborhood

Clearly, the detrimental nature of vehicle emissions extends to the entire neighborhood and beyond. The objective is to minimize impacts to human health and building fabric by establishing pre-approved, enforceable guidelines. Only essential service and delivery vehicles should be allowed on the site during working hours; they should perform their services at times when there is less opportunity for traffic back-ups – i.e. late evening, night-time, early morning. Both the type of fuel(s) permitted, and the manner in which each vehicle is operated, should be controlled to minimize the potential for deleterious emissions.

Methodology

Design Strategies

Consider including auxiliary building service lanes and delivery zones dedicated to these activities to keep service vehicles out of the mainstream traffic and to minimize loading/unloading time. Coordinate site strategies with city traffic management.

Accommodate needs of alternative fuel vehicles based on EO-111, Section 8, Alternative-Fuel Vehicles requirements.

Study wind effects and design buildings and street intersections to reduce the potential trapping of airborne pollutants at ground level. Allow for better air circulation while carefully avoiding wind tunnel effects.

Means and Methods

A key strategy to better ambient air quality is to simply minimize the need for vehicular traffic within the site. Maximize opportunities for building occupants and regular visitors to have easy access to public transportation systems. Schedule large volume public events at "off-peak" times. Schedule major service deliveries and moving/relocation at "off peak" times as well. Locate street level bus stops in a manner that prevents negative impact on traffic flow, and does not contribute to traffic back-ups and idling time.

Where building programs include accommodations for state government vehicles, provide facilities to ensure that alternative fuel and/or hybrid vehicles can be serviced at the site, in accordance with EO-111, which notes: '*State agencies and other affected entities that operate medium- and heavy-duty vehicles shall implement strategies to reduce petroleum consumption and emissions by using alternative fuels and improving vehicle fleet fuel efficiency*'.

In addition, it is recommended that the requirements of the Battery Park City Authority be considered for adoption by construction teams at the World Trade Center Site. They require that all construction vehicles over 5 tons use ultra-low sulfur diesel fuel or compressed natural gas (CNG), and diesel fuel vehicles over 5 tons must be equipped with high performance engines and catalyzed diesel particulate filters. These requirements also affect generators at the site.

Site planners are encouraged to coordinate their work with that of the City's Traffic Planners. Instigate requirements which employ 'Urban Traffic Management Control' systems to help keep traffic moving smoothly. Use of 'Traffic Calming' techniques helps to reduce vehicle emissions (frequent acceleration and deceleration generate much greater levels of emissions). Coordinate with city efforts to design traffic routes through the complex and greater neighborhood that help prevent back-ups, and develop a plan that keeps heavy vehicular and service traffic out of the site during daylight hours.

Case Studies

The Vauban District, Freiburg im Breisgau, Germany

This model district was one of the first residential developments in Germany to institute a low car traffic concept. The goal of this endeavor was to curtail the amount of private, vehicular traffic throughout the entire district to reduce pollution and support pedestrian programs. Large sections of the residential areas have policies prohibiting the construction of parking spaces on private property. Instead, communal parking lots are provided at the edges of the residential zones and financed by a system of taxation. Car-less residents may sign a declaration that they do not own a vehicle and become exempted from that tax burden. One of the projects conducted according to these policies was the "Optimization of the Traffic Concept of the District Freiburg-Vauban during Implementation" which was sponsored by the German Federal Foundation for Environment. As part of this they funded a study by the Institute of Transportation Research to evaluate the success of the traffic-reducing policies in the district. One significant conclusion from this study was that it fostered a high amount of car-sharing. Although merely 0.1% of drivers in Germany, as a whole, share a car, the percentage of people sharing cars in Vauban is a much greater 33%. (Nobis 2004)

Reference

Definitions

Traffic Calming refers to the act of slowing traffic to create more humane urban environments better suited to non-vehicular transportation modes such as walking and bicycling.

Urban Traffic Management Control (UTMC) describes a system that tracks traffic patterns and dynamically adjusts traffic light patterns to keep traffic moving smoothly.

Standards

Standards have not been included for this Guideline.

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Vehicular Emissions

UEQ-8-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: _____

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	●	● Ⓔ	● Ⓔ		●

☐ **Required Component:**
A description (with plan diagrams where appropriate) is attached that illustrates specific measures that will be taken to reduce vehicular traffic (from pre 9/11 norms) on and around the site. The description includes anticipated vehicular service requirements for the project and scheduling design strategies which have been employed to reduce these requirements.

Name _____ Signature _____

Company _____ Role in Project _____

Date _____

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