SITING & FORM

Most of the location, orientation and massing decisions made in the early stages of design have a profound effect on the energy and environmental impacts of buildings. This is particularly the case for solar-responsive, daylighting and natural cooling design, where early decisions establish the potential for passive renewable energy use. Other environmental strategies, such as stormwater management, are also greatly influenced by site planning.

Solar-Responsive Design

There are many direct and indirect benefits of designing buildings that respond to the sun. However, approaches to shape and orientation differ depending on the purpose: Is the goal to minimize cooling loads, or to collect solar energy now or in the future? The challenge is to ensure that different portions of the building respond appropriately to these two very different goals, while integrating them into a functional and elegant whole.

Careful orientation and massing can minimize solar energy entering the building and greatly reduce cooling loads, especially for commercial and retail buildings with high internal loads. This translates into lower energy costs over the life of the building and less air pollution from electricity generation. Careful solar control can also reduce costs for mechanical cooling equipment often to the point of lower overall construction cost. Solar control to reduce cooling loads helps provide year-round comfort, more independence from energy price increases and less vulnerability to brownouts.

Many Santa Monica buildings require heating — especially building with low internal electrical loads, such as multi-unit residential.

Unlike solar control for cooling, using solar energy for service hot water (SHW) heating or electricity generation requires maximizing the exposure of collectors to the sun. This reduces the capital cost of these systems, which in the past has been relatively high. Those parts of the building that carry these systems should be shaped to collect solar energy efficiently.

In Santa Monica, solar hot water systems are cost-effective for many uses now. Photovoltaic electricity generation is currently expensive, but costs are dropping rapidly. "Building-integrated" photovoltaic (BIPV) systems, which incorporate collectors into the roof, walls and other building elements, are now entering the market, replacing conventional exterior finishes and reducing construction cost. Another trend is to use solar collectors as window shades — gaining two functions from the same elements. Ensuring that the building will be able to take advantage of free, renewable solar energy in the future, when capital costs will be lower, is a prudent strategy.

Daylighting Design

Building occupants place a premium on natural light and a view to the exterior. If carefully admitted and controlled, daylight enhances the visual quality of interior spaces, and offers many psychological benefits that are difficult and expensive to replicate with electrical lighting. Natural light has inherent variability and unique spectral qualities that reveal and highlight interiors. Providing naturally lit interiors has been shown to increase occupant satisfaction, lower absenteeism, and improve worker productivity and retail sales.

Daylighting design has a major impact on the form and orientation of buildings. First, the building and its openings — windows, skylights and roof monitors — must be oriented to allow light to enter interior spaces, without causing glare or visual discomfort. As well, design for daylighting can constrain the depth of buildings, to allow natural light in most occupied spaces. This limitation can be

greatly eased by the use of light distribution strategies, such as lightshelves and ceiling slopes, that extend the depth of daylit space.

A view to the outdoors is important for occupants' sense of well-being, since it provides cues on orientation, time of day and weather. Providing visual contact with the exterior from most interior areas attracts and retains tenants and staff — but also places limitations on building depth and interior partitions.

Natural Ventilation and Cooling

Natural, or passive, ventilation and cooling uses wind and the buoyancy of warm air to provide comfortable conditions within buildings during hot periods. When carefully combined with daylighting and thermal mass, natural ventilation can greatly reduce the cooling load in buildings, and minimize or eliminate the need for mechanical cooling in most circumstances in Santa Monica.

Natural ventilation and cooling offers many advantages over artificial air-conditioning. First, although all major manufacturers are introducing equipment that uses less damaging refrigerants, often with equal or better energy efficiencies than existing chlorofluorocarbon (CFC) equipment, many still use refrigerants that damage the ozone layer and are slated to be banned in the near future. Natural cooling eliminates this concern. Second, regardless of the refrigerant, mechanical cooling equipment consumes fossil fuels during use, with their associated operating and environmental costs. Third, there is growing market evidence that building occupants prefer natural ventilation over that provided by mechanical air-conditioning systems — providing an advantage when selling or leasing a building or attracting and retaining employees.

Santa Monica has ideal conditions for natural ventilation and cooling. The prevailing breezes are consistently on-shore from Santa Monica Bay, from the west-southwest and west throughout the year. These winds are most consistent when cooling requirements are high, when air temperatures are higher and the sun is most intense. As well, Santa Monica's street grid and lot orientation are at right angles to the prevailing on-shore winds, allowing the use of natural ventilation for most locations.

However, building form and orientation must be shaped to take advantage of natural cooling opportunities. First, the building must be located and shaped considering the prevailing wind. Air inlets are best placed in upwind exposures, where the pressure is highest. Air outlets are best placed in downwind, low-pressure exposures. Spaces with single-sided natural cooling must be narrow; cross-ventilation requires paths for air to move through one or more rooms in the building. Interior walls are best placed where they don't block airflow. As well, natural cooling is enhanced by tall spaces, that allow heated air to rise out of the occupied zone and out of the building. Finally, thermally massive floors and walls store the cold from night air in effective night ventilation strategies — which affects structural design.

Integrating Design Strategies

Many of these features — openings to the outdoors, high and narrow spaces, and interior wall placement — are the same as those of daylighting design. Combining these two strategies can reduce the cooling loads of Santa Monica buildings to the point where artificial air-conditioning is not necessary, and artificial light is required only as it gets dark. The result: much lower air pollution and consumption of non-renewable energy.

Most of the Recommended Practices in this chapter are aimed primarily at reducing energy consumption, but they also offer indoor environmental quality benefits. However, they only establish the potential for energy savings and its environmental benefits; these strategies must be coordinated with envelope, mechanical and electrical systems design and control strategies to ensure these savings are realized.

Solar-responsive, daylighting and natural cooling design offer significant environmental benefits, and they work best when combined. The most effective design strategy is a narrow floor plan, allowing most interior spaces a direct connection to the outdoors. Narrow spaces provide the opportunity for increased daylight, better views to the exterior and more potential for natural ventilation.

Stormwater Management

Pollution of Santa Monica Bay by stormwater runoff is one of the most pressing and difficult environmental problems in the Los Angeles basin. Building sites have a role to play in reducing the amount and contamination of stormwater runoff. The Santa Monica Municipal Code ordinance 7.10.060 requires that building developers submit an Urban Runoff Mitigation Plan, showing how the site will address this issue. The most effective approach is to limit the amount of impermeable surfaces on the site, since permeable surfaces both reduce peak stormwater runoff, and treat stormwater pollutants.

Runoff from parking areas and vehicle lanes in particular contain a wide variety of contaminants, including lead, asbestos, oil, grease and gasoline. Biological and mechanical methods of treating these contaminants, and reducing the amount of stormwater carrying them to the Bay, are summarized in

- SFa: SMMC 7.10.060: Submit an Urban Runoff Mitigation Plan to the Engineering Division
- TRa: SMMC 5.20.080: Install Clarifiers or Oil/Water Separators on Drains from Service Bays and Parking Areas
- LAa: SMMC 7.10.060: Minimize Stormwater Runoff to Impermeable Areas