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3.3 Building Placement and Orientation on a Site

Where buildings are situated on a site and how they are oriented provide significant opportunities to reduce overall environmental impacts—including both direct site impacts and indirect impacts relating to energy consumption by the building(s). A well-planned and optimally oriented building relates well to its site and the climate. This maximizes opportunities for (1) passive solar heating when heating is needed, (2) solar heat gain avoidance during cooling times, (3) natural ventilation as needed, and (4) high-quality daylighting throughout the year.

Opportunities

Carefully planned building placement should minimize stormwater runoff, minimize habitat disturbance, protect open space, reduce the risk of erosion, and save energy by providing for solar energy utilization, natural ventilation, and daylighting. These opportunities should be acted on as early as possible in the site selection and site planning process—even before pre-design so that site issues can inform the process. Some opportunities continue through design and, to a limited extent, through construction and landscaping.

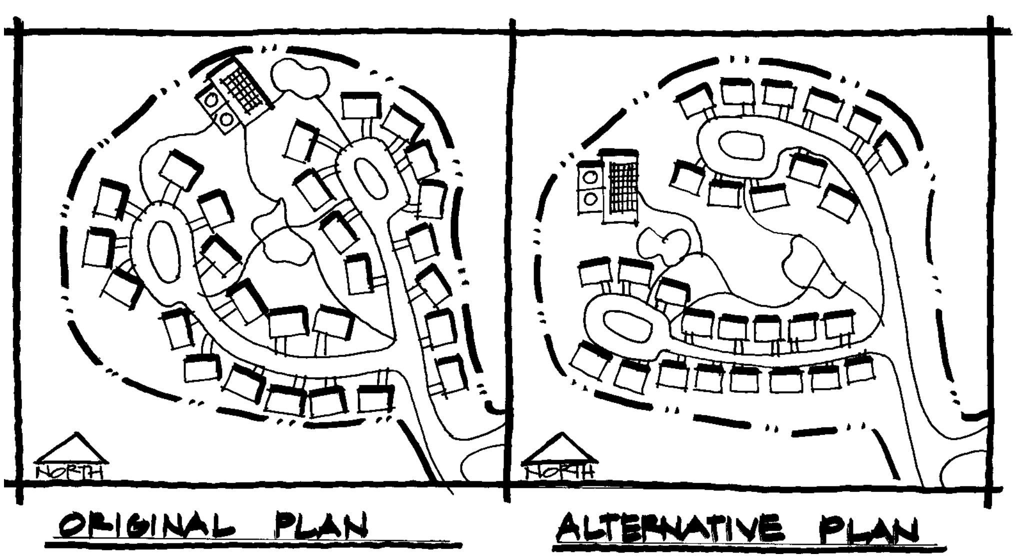
Technical Information

Where buildings are situated on a site can have a huge impact on the overall *greenness* of a facility. Try to *concentrate* development impacts while retaining as much undeveloped open space as possible. Locate buildings and roadways to minimize site disturbance, particularly where significant wetlands and wildlife habitat (including wildlife corridors) are present. Keeping buildings and infrastructure on an area of the site close to public highways and with easy access to utilities will reduce material use, minimize new impervious surfaces, and permit as much open space as possible to be retained.

Slope and soils considerations are very important in building and infrastructure placement. Consider both long-term stormwater management issues and short-term erosion impacts during construction. Avoid very steep slopes and those with unstable soils.

Site plans that consider orientation in the placement of buildings provide abundant opportunities to benefit from natural systems—bioclimatic design. The options illustrated below compare the layout for a conventional military base and one planned with solar orientation in mind. These site plans are for the same property. Site topography needs to be considered too. Slopes to the south allow for plenty of solar access, while north-facing slopes will provide good shading opportunities.

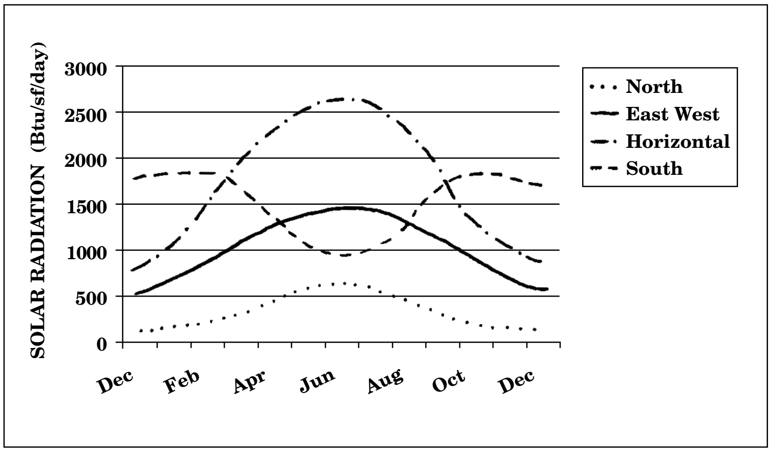
Rectangular buildings should be oriented with the long axis running east-west. In this configuration, east and west walls receive less direct sun in summer, so unwanted heat gain is reduced. This same configuration works well for buildings in cold climates where passive solar heat gain on the south side during the winter is desired. A long, narrow building plan also facilitates daylighting and natural ventilation.



This site plan illustrates two variations of the same military housing project. The alternative plan has excellent orientation on all buildings, the original plan doesn't.

Source: ENSAR Group

Solar energy at various orientations at 40° latitude.



Source: ENSAR Group

Solar energy is both a friend and a foe of low-energy building design. The diagram above illustrates the amount of daily solar energy availability relative to orientation for each month of the year at 40° latitude. As can be seen, south-facing walls achieve the most solar gain during the winter, while the least in the summer. East and west vertical orientations and horizontal orientation (skylights) all result in more heat in the summer than winter. The optimal orientation depends upon what the application is. For example, when trying to use solar energy during the winter for passive solar heating, south-facing glazing is desired. South-facing glass is relative easy to shade with an overhang or awning during the summer to minimize solar heat gain. North-facing glass receives good daylight but relatively little direct insolation, so heat gain is less of a concern. East- and west-facing glazing is the most difficult to control (because of low sun angles) and the greatest contributors to unwanted heat gain. Daylighting can be achieved with almost any orientation, but control of natural light is critical and will depend on the glazing area, the types of glazing used, daylighting design strategies, and other key issues.

Proximity of trees to buildings should take into account growth rate, life span, and ultimate canopy shape. Planting decisions and decisions about which trees to leave require a careful balance between the desirable qualities of shade with the loss of future solar access. Evergreen trees may provide shade and block cold winter winds, but on the south side deciduous trees are preferred because they lose their leaves and admit more sun in the winter. When existing tree plantings are too dense, selective thinning and lifting the canopy may improve air movement, enhance ground-level vistas, and allow remaining trees better growth potential. Special care should be used in construction near trees. Important plant areas and trees to be retained should be effectively barricaded to prevent damage (at a minimum, fence off the area around trees to the outer perimeter of branches—the "drip line"). Tunnel for utility lines instead of trenching near trees. When cutting roots and limbs, cut cleanly. Water well before major cutting to invigorate the tree. When major roots are cut, light canopy pruning will reduce transpiration stresses.

Driveways and parking lots should be located on the east or north side of buildings in southern climates. This reduces heat buildup during hot afternoons. Existing or newly planted shade trees can cool these surfaces. In cold climates, driveways and parking lots work better on the south and west sides of buildings to melt snow. In relatively populated (town) locations, it is generally preferable to hide parking behind buildings to present a *pedestrian-friendly* face to the community.

Account for prevailing winds. A *wind rose* is a diagram of annual wind directions and velocity for a particular region. It is useful for plotting information on wind in order to provide natural shielding from adverse winds in cold weather and to benefit from favorable winds for passive cooling measures. Wind rose information is usually available from airports, larger libraries, Internet sources, and county agricultural extension offices.

References

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