Designing a Landscape

When designing a landscape the four main climatic factors, in order of importance, are:

1. Sun
2. Wind
3. Temperature
4. Humidity

Thus, a landscape architect should first try to address sun issues, then wind issues, etc. It is possible that a landscaping technique that will positively affect one factor will negatively affect another. In this case, priority should be given as noted above.

The landscape architect should also take note of existing features, such as:

1. Prevailing winds
2. Areas that need shading
3. Noise pollution you wish to block
4. Areas that suffer from poor drainage and standing water (some plants may not grow well)

A well designed landscape will cut summer and winter energy costs substantially, protect the building from wind and summer sun, reduce noise and air pollution, and reduce the amount of water, fuel, and pesticides required for lawn maintenance.

One aspect of landscaping commonly overlooked is food production. Most food today is grown using chemical fertilizers and biocides, freighted over long distances and sold in supermarkets. The reintroduction of food production into local landscapes can help to alleviate the environmental burdens associated with pesticides, herbicides, and transportation fuels. In every green building project, one should try to include:

- A garden, or
- Orchard, or
- Cropland, or
- Any other form of edible landscaping

- Widespread tree planting and climate-appropriate landscaping offer countless environmental benefits. Trees and vegetation control erosion, provide food, create a natural habitat for wildlife, and clean the air
- Planning a landscape before you build is extremely important. This should not be an after thought, once you have cleared the land
- Plan open spaces as carefully as you do inside spaces
- Make an attempt to preserve as much vegetation as possible. Transplanting trees and bushes is a good practice and becomes especially important in climates (arid, harsh) where it is difficult to establish new growth
- Planting new vegetation in conjunction with existing vegetation can create a desirable micro-climate around a structure
- Carefully positioning trees can save up to 25% of a household's energy consumption for heating and cooling [1]
- Computer models devised by the U.S. DOE predict that the proper placement of only 3 trees will save and average household between $100 and $250 in energy costs annually [2]

Climate Regions

Depending on the climatic region in which the proposed building is located, different strategies should be used to maximize the energy efficiency of a building. This may mean an attempt to minimize the winter heating loads for cooler climates or an attempt to minimize summer cooling loads in warm climates. Listed below are four general climatic regions and the suggested climatic design strategies. The suggestions are general. To optimize your building, contact your local, regional, or federal government to obtain site specific climatic information. This will allow you to make a more informed decision about designing the landscape.

The information on temperate, hot-arid, hot-humid, and cool climates was taken directly from the following website:

Energy Efficiency and Renewable Energy Network (EREN): Landscaping for Energy Efficiency
http://www.eren.doe.gov/erec/factsheets/landscape.html

Temperate

- Maximize warming effects of the sun in winter
- Maximize shade during summer
- Deflect winter winds away from the building
- Funnel summer breezes toward the home

Hot-Arid

- Provide shade to cool roofs, walls, and windows

- Allow summer winds to access naturally cooled homes
- Block or deflect winds away from air-conditioned homes

Hot-Humid

- Channel summer breeze toward the home
- Maximize summer shade
- Avoid locating planting beds close to the home if they require frequent watering

Cool

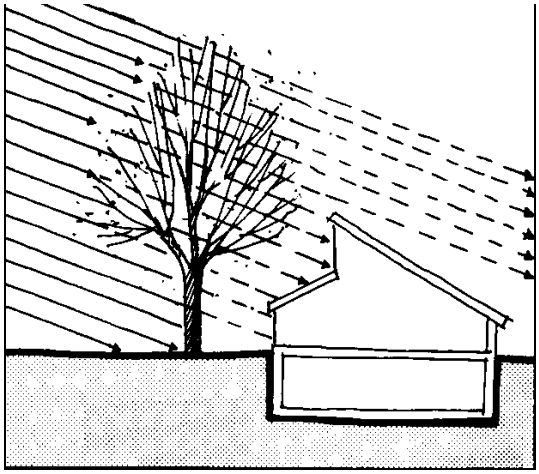
- Use dense windbreaks to protect the home
- Allow winter sun to reach south facing windows
- Shade south and west windows and walls from direct summer sun (if summer overheating is an issue)

Climatic Factors

Listed below are the four most important climatic factors that landscape architects must deal with. They are presented in order of importance.

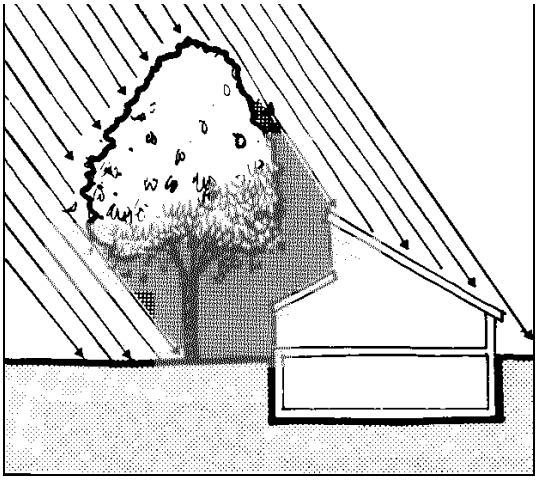
Sun

- Shading the building and nearby paved surfaces from the summer sun can lower the temperature of the air by as much as 15°F. This, in turn, reduces the amount of energy consumed by cooling systems [3]
- Deciduous trees that provide maximum sun passage during the winter are Honeylocust, Ginkgo, and Mullbery, due to thin branches and trunks



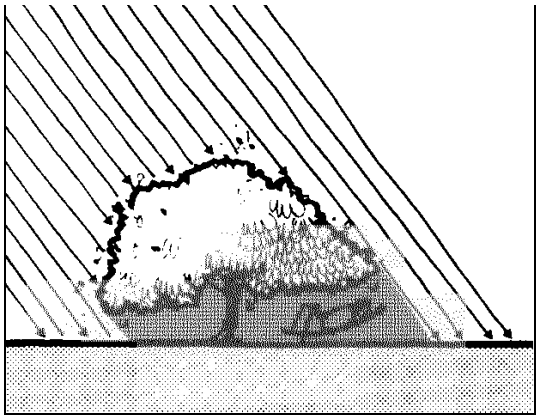
Branches and trunks prevent solar gains in the winter [4]

- Plant deciduous trees on the SE and SW corners to block morning and afternoon sun in the summer
- Plant a hedge along a sidewalk to create shading and reduce the heat radiation from the sun
- Use a large bush or row of shrubs to shade a patio or driveway
- Deciduous forests can absorb and reflect up to 90 % of incoming solar radiation [5]
- Trees, ground cover plants, and shrubs shade the pavement and ground around a structure. This cools the air before it reaches the walls and windows of a building.
- Shading and evapotranspiration from trees can reduce the surrounding air temperature significantly (approx. 4-5°C)
- Trees to shade buildings should be large with arching crowns (Silver Maple, Siberian Elm)



Trees with tall crowns should be used for shading buildings [6]

- Deciduous trees with high spreading crowns can be planted to the south of a structure to provide maximum shading in the summer time and sun penetration in the winter. *Note: don't plant evergreens too close to the south side of a structure if you wish to make use of the warm winter sun*
- Trees to shade lawn should have broad crowns (American Beech, Crabapple)



Trees with wide crowns should be used for shading lawn areas [7]

- To block out low-angled afternoon sun, trees to the west of a structure should have crowns that are lower to the ground
- A 6 to 8ft deciduous tree planted near a building will begin to shade windows within the first year [8]
- For shading walls and windows, plant shrubs close to a structure. Shrubs grow quickly, are relatively easy to maintain, and begin shading within a few years
- A window box with trailing vines is good for shading a portion of a wall
- A trellis, placed near a porch or patio, is an excellent way to shade an area from summer sun
- Roof planting helps to absorb summer sun and stabilize interior temperatures
- Shade east and west facades from low-angled sun
- Use a strategy of quick growing trees (Poplars and Willows) in conjunction with slower growing, but longer lasting trees
- Consider the density of the canopy
- Consider the dates that leaves appear and fall
- Honeylocust and many Ashes bloom late and drop their leaves early, allowing for fall warming
- Oaks often retain dead leaves in the winter, blocking sun

Wind

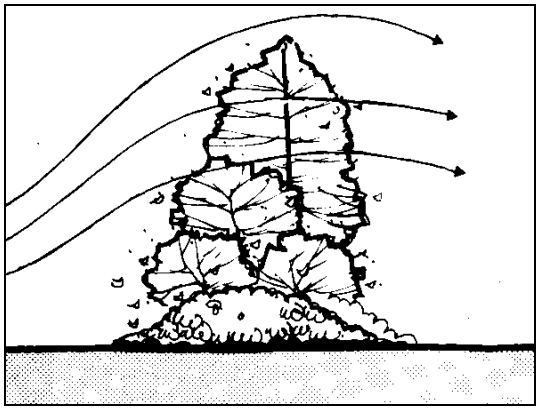
- Trees, fences, hills, along with various geographic features, can be used as windbreaks to shield a structure from the wind
- A study completed in South Dakota concluded that windbreaks to the north, west, and east of houses cut fuel consumption by approximately 40%. Windbreaks located solely on the windward side cut fuel consumption by about 25% [9]
- A very dense shelterbelt shows the most reduction in wind speed, but this recovers very quickly
- A medium density shelterbelt provides the best overall wind protection
- The optimal wind protection will depend on the building distance from the windbreak
- Wind speeds should be kept below 5m/s, since above this causes human discomfort

Effects of wind on people [10]

Wind Speed (m/s)	Effect
0-1.5	No noticeable wind
1.6-3.3	Wind felt on face
3.4-5.4	Hair is disturbed, clothing flaps
5.5-7.9	Raises dust, dry soil and loose paper, hair disarranged
8.0-10.7	Force of wind felt on body, limit of agreeable wind on land
10.8-13.8	Umbrellas used with difficulty, difficult to walk steadily
13.9-17.1	Inconvenience felt when walking
17.2-20.7	Generally impedes progress
20.8-24.4	People blown over by gusts

- The best windbreaks are those which block wind close to the ground through the use of trees and shrubs that have low crowns
- Evergreen trees and shrubs are common types of windbreak. They are quite effective at blocking winds if planted to the north and northwest of a structure
- A windbreak can reduce wind speed for a distance as large as 30 times the height of the windbreak
- To obtain maximum protection of your home, plant the windbreak at a distance of several times (approx.2-5) the mature height of the vegetation
- If snow tends to drift in your area, plant evergreen shrubs with relatively low crowns on the windward side of your windbreak
- Planting shrubs, bushes, and vines next to your house creates dead air space that insulates your home in both winter and summer. Make sure that you allow a space of approximately 1ft between the wall of the structure and the full grown plant

- A wall, fence, tree, earth berm, etc. can deflect and carry the wind over an entire structure
- Factors for wind break vegetation selection: form, density, seasonal variation, growth characteristics, and hardiness
- Use plants with different growth rates to form a windbreak
- To lift wind up and over, density should be greatest at ground level

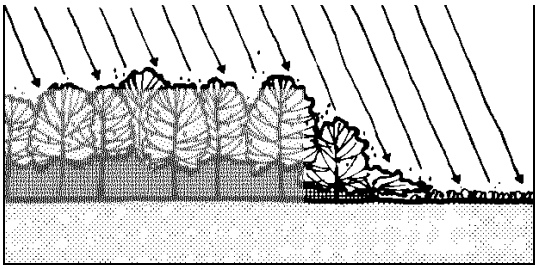


In order to lift wind up and over, the density of the windbreak should be greatest near the ground [11]

- Two or three rows of trees is sufficient
- Spruce and pine generally provide the best wind protection
- Deciduous trees aren't as effective, but less turbulent and large influence
- Wind breaks should be at least 10 times as wide as they are high
- Use different species: evergreens low to the ground and deciduous toward the top
- Where space is limited, use dense conifers (i.e. Cedar, Juniper) adjacent to building
- Somewhat permeable vegetation helps to slow wind speed and reduce turbulence
- If the summer winds are turbulent or ill-defined in terms of direction, deciduous trees help to ensure air flow close to the ground
- Snow accumulates whenever and wherever the wind speed falls

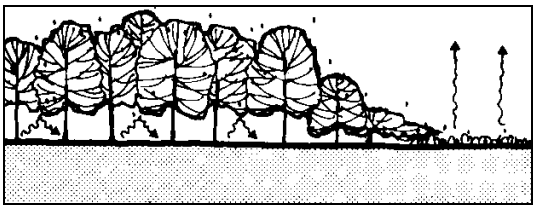
Temperature

- Cool air settles near the ground and as such, air temperatures directly under trees can be as much as 14°C cooler than the nearby air [12]



Heat blocked by forest canopy [13]

- At night , trees can act as a blanket, trapping heat



Heat retained under canopy [14]

- Temperature differences between forests and adjacent lands of 5-13°F have been recorded [15]
- General agreement that isolated trees have no measurable effect on temperature

Humidity

- Humidity can be increased by adding surface water and restricting air flow
- In areas where humidity and wetness are ongoing problems, do not allow dense vegetation to grow immediately next to a structure

Landscaping with Native Plants

- Landscaping with native plants, regardless of the project, conserves water, energy, and restores character within a region
- Once established, native plants can survive on the average rainfall and are able to adapt to the temperature changes within a region
- Xeriscaping is a technique that uses drought resistant vegetation. Once established, the vegetation can survive solely on rainfall and groundwater.
- Native landscaping provides much more than the technique known as xeriscaping. A native landscape, regardless of location and size, provides habitats for wildlife and joins larger natural areas together
- Native landscaping eliminates the need for chemical fertilizers, pesticides, etc. because

natural vegetation creates a habitat for insects and microorganisms that benefit and keep plants healthy
- If you are unsure of where to begin, go outside and observe the natural beauty within your region. Designing a naturalistic landscape can be accomplished by simply imitating what you find within your region.
- It is important to observe native plants in their natural environments to become familiar with their maintenance requirements, growth rates, mature size, etc.
- The commercial availability of native plants will determine what you will incorporate in your landscape. Ask stores and nurseries if they sell native vegetation and if they do, ask if they would show you the items that they have for sale. This creates a demand and it is likely that stores will begin to stock a variety of native plants, if they do not already.
- When landscaping, try to decrease impervious surfaces as much as possible to allow for infiltration and restoration of underground aquifers (i.e. use grass for low use areas, sand and gravel for driveways and walkways, etc.)
- Certain grasses such as Buffalo grass and Fescue reach a mature height of approximately 5-6in. and require little water to survive
- Comparing these alternatives to conventional grass (i.e. Kentucky Blue Grass), reduces water, fuel, and time required for maintenance
- If located on poor soil, use compost (from grass clippings and organic waste) to improve the quality of the soil. Compost material is a free and natural alternative to chemical fertilizers.

Storm Water Management

- Conventional practice is to carry the storm water off the site as quickly as possible through storm sewers or to collect it in retention ponds. This prevents the replenishment of underground aquifers.
- To control runoff from rain:
  1. Reduce amount of impervious material to permit storm water seepage
  2. Vegetation can be increased to maximize the amount of storm water consumed and stored
  3. Storm water may be held in temporary storage areas or permanent lakes and ponds from which water is slowly released
- More environmentally friendly options, such as infiltration (to recharge aquifers) and detention, can save money on infrastructure costs
- Using native landscaping helps water to infiltrate into the soil whereas conventional lawns promote water runoff
- The use of storage ponds, check dams, and swales help to slow the flow of the water over the ground, allowing for more of the water to infiltrate into the soil
- These techniques will also help to prevent soil erosion caused by heavy rain periods
- These techniques imitate nature, reduce off-site water flow, create natural and 'alive' landscapes, and cost less to build and maintain than a conventional storm drainage system

Traffic Areas

- Effort should be made to avoid the use of impermeable surfaces such as pavement and concrete
- The Prince George Native Friendship Centre in British Columbia, uses crushed gravel combined with crushed concrete for its parking lot, finished with concrete curbs

References

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