

Building Siting, Orientation and Layout

Siting

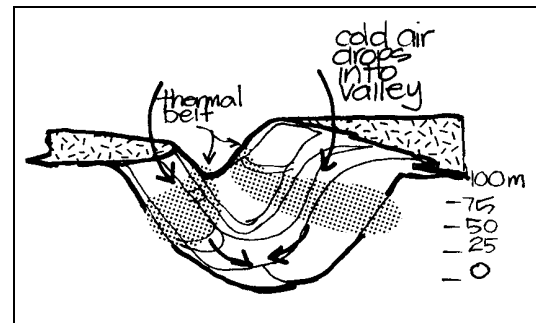
Questions to ask:

1. Is the land suitable for development?
 2. Are there better uses for the site?
 3. Does the land have cultural, historical, or archeological significance?
 4. Is redevelopment possible?
 5. Are clean air, water and soil present?
 6. Does the site have solar access?
 7. Are mass transit, roads, highways, and other transportation options nearby?
 8. What are the sites natural values (i.e. wildlife present)?
 9. What about topography, geology, hydrology?
 10. Are strong electromagnetic fields (EMF) present? *Note: Avoid building within 100 yards of power transmission lines*
 11. Can existing structures be reused?
 12. How much will future development on adjacent lands affect your project in the future?
- Conscientiously renovating existing buildings whenever possible is more sustainable than constructing new buildings altogether
 - Early in the siting process, carry out a careful site evaluation for solar access, soil types, vegetation, important natural areas, etc.
 - Preserve open space and wildlife habitats and try to avoid altering sensitive areas such as wetlands, forests, etc.
 - Construct the building to provide access to public transportation, bicycle paths, and walking access to basic services

Orientation

- Buildings should be placed on an east-west axis with the longest wall facing south or south-east to maximize light penetration and passive solar heating
- The north and west facing walls should contain fewer windows because these walls generally face winter winds

- A well oriented building admits low-angle winter sun, rejects overhead summer sun, and minimizes the cooling effect caused by winter winds
- In deciding how to orient the building, take note of:
 1. Exposure to sun, wind, and water
 2. Proximity of nearby buildings, fences, bodies of water, trees, and pavement and their possible climatic effects
 - Buildings provide shade and windbreak
 - Fences and walls block or channel the wind
 - Bodies of water help to moderate temperature, but increase humidity
 - Trees provide shade, windbreaks, or wind channels
 - Pavement reflects or absorbs heat, depending on whether it is light or dark in colour
- Orient the building so that you take advantage of existing shadow patterns created from vegetation and nearby structures
- Design homes to nest within the habitat, while taking advantage of natural lighting
- Take advantage of natural cliffs to help block cold, northerly winds
- Buildings that are built on mid to upper slopes are warmer than those on hilltops or in valleys
- Try to locate structure in a “thermal belt” if built on a slope



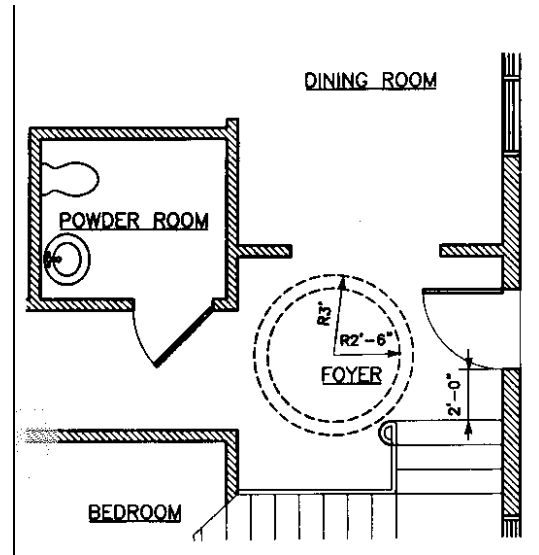
Location of a thermal belt on a slope [1]

- Designing for the sun is the most important climatic feature to consider in design
- A sun shadow analysis should be done for the site
- For low residential and industrial buildings, the orientation is not as significant as for downtown areas

Room Layout

The design of room layouts should consider many factors. A designer should be aware of passive heat gain potentials from sunlight, the potential for natural light penetration into the building, natural heating and cooling provided by the ground, and accessibility issues for the handicapped, elderly, and children.

- Rooms used during the day should be located on the south side to benefit from natural day lighting:
 - Living room
 - Dining room
 - Family room
 - Offices, etc.
- Place lesser used rooms on the cooler north side
- Usually, kitchens are best placed on the north and east sides of a home for two reasons:
 1. Kitchen appliances will contribute to heating the space
 2. Eastern morning sun is pleasant in the kitchen and breakfast areas
- Bedrooms can benefit from natural circulation of heat into them during the day. They can be located on the south side and allowed to overheat somewhat during the day so that they remain pleasant at night
- Entryways should be sheltered from winter winds to minimize heat loss when coming and going from the structure
- Windows should be oriented in a room to allow for cross ventilation wherever possible, as this is a natural and energy efficient way to ventilate a building
- If the building includes a basement, place rooms in the basement, instead of mechanical rooms or storage rooms, since basements are naturally cool in the summer and naturally warm in the winter
- Hallways should be 48" wide for greater accessibility
- A 60" diameter circle should be able to be inscribed in the floor to promote maneuverability in a front foyer
- It is a good idea to locate all necessary facilities for sleeping, eating, and going to the bathroom on one floor for greater accessibility. This means that a residential unit should have at least one bedroom and bathroom on the same floor as the kitchen.



Case Study 1: Rocky Mountain Institute Main Office, Colorado

AIA "Building to Save the Earth"
Lecture Series – 96 minutes
Energy and Resource Flows
Talk by: Amory Lovins

- The building is oriented in such a way that they receive 99% of their heat passively
- This was made possible by using straight forward superinsulation techniques:
 - R40 walls
 - R60 roofs
 - Six air to air heat exchangers
 - Super windows (9 year old version, argon filled)
- The windows let in 3/4 of visible light and block most of the infrared radiation
- The building contains an atrium at the center, where there is an indoor garden and some tropical plants
- The capital costs were lower because they did not require a furnace or the corresponding duct work
- The building is equipped with 2 wood stoves
- The building saves 99% of water heating energy through the use of passive and active systems
- They save half the amount of water and 90% of household electricity
- The monthly electricity bill for this structure is typically \$5, for a 4000ft² building

- The extra cost for construction, using these techniques was approximately \$1.50 per square foot, which paid back in 10 months
- The building is more comfortable, healthier, happier, and creates a more productive atmosphere
- It is estimated that you can save 2/3 of energy costs by choosing office equipment carefully
- You can knock \$5 per square foot off the capital costs of a new office building by down sizing the mechanical systems
- By designing systems such as these, you can save enough money on operating costs over the life of the building to pay for the entire building

Case Study 2: Dewees Island Project

The Post & Courier: "Dewees Doing the Environment Right" By: Dave Munday. May 8, 1996

- All buildings on the island are made to conserve energy and minimize the impact on nature
- This case study focuses on a two story structure, 2300ft²
- The building is nestled among live oak trees, overlooking miles of marshlands
- The cost to build was \$201, 750
- Using materials to conserve energy cost \$6500 extra
- Homes are required to use water conservation fixtures (reduces water consumption by 60%)
- Energy independence is possible because homes utilize passive heating and cooling techniques. As a result, homeowners use 50-60% less electricity than normal
- The projected savings per year in energy and heating costs would be \$1450
- This amounts to \$37, 000 over 30 years, recouping all costs in 4 ½ years
- On Dewees Island, an architectural Resource Board guides homeowners through all sustainable development practices

To discover more about the development on Dewees Island, please visit:

<http://www.deweesisland.com/>

References

1. Climatic Information for Energy Conscious Planning. Ontario Ministry of Energy, 1982. pg. 2-22.
2. Bynum, Richard T. Jr. and Daniel L Rubino. Handbook of Alternative Building Materials in Residential Construction. McGraw-Hill, Toronto, ON, 1999. pg. 1-11.