Chapter 1

Site Planning

When anticipating the construction of a new home, selecting the site is one of the largest influences on the success of that endeavor. There is far more to good site planning than a choice of which lot seems best at first glance. There are the obvious decisions such as, matching the family's needs to the quality of the neighborhood, perhaps school districts, or commuting distance to work, shopping, and recreation.

The things that can go wrong, the complexity of the research and decisions to be made may seem intimidating, but the success of the whole project depends on it. Below are some questions and points to help think through the process of site planning.

Changing Times – Professional Advice

Many years ago, residences were normally designed by professionals who considered the above decisions a part of the process. Additionally, air conditioning brought with it the need to make buildings energy efficient. Now, when these and other systems are more important to energy efficiency, design professionals are usually commissioned only for the "jewel" projects. Every structure, from the modest to the award winning must go through the same question and answer process if it is to perform to its highest potential. Generally missing from the process today is the architect to assist and guide one through the design process from site evaluation, structures design, construction observation and the quality of work reporting.

In today's "do it yourself" (DIY) world, architects are often bypassed. At the very least, seek out an architect to consult on a limited hourly basis to get past the hurdles where expertise is lacking to decide, or to effectively monitor the builder's work. Below are some issues that should investigated as the site selection and planning process progresses.

Surveys

The following surveys would be strongly advised for any new house:

- Property lines survey including metes and bounds (angle and distance dimensions) of all property lines. The legal description should be shown. It should indicate any easements or servitudes.
- An existing utility survey is important to locate and describe all connections to electricity, gas, water, sewer, storm drainage, telephone, cable junction/distribution box if any. This information can be combined with the property lines or topographic survey if the contract calls for that.
- A topographic survey is critical to design proper drainage and setting the optimum elevation of a slab, or wood framed first floor. The datum flood elevation measurement should be performed, certified by a registered land surveyor.
- Geotechnical investigation and analysis. This consists of taking one or more soil borings to 25' or more below grade. From several tests, the properties of the soil are determined, providing bearing pressure, shrink/swell potential and other data. The analysis is performed by a registered engineer and provides several recommended foundation types.

Location and Size

Although some of these questions may not affect energy efficiency of the house directly, they are among many fundamental questions that can affect whether or not to build on this site.

- Will the site be large enough to accommodate the size house desired, once the easements and zoning setbacks are deducted from the area of the land?
- Are school districts important?
- Will the property hold its value over time?
- Will this site be conducive to building an energy efficient structure?

Drainage

Is the topography flat, making it difficult to drain the site well or is it hilly or sloped creating the potential for erosion, interesting landscaping and perhaps difficult mowing?
Does the site have the potential for draining water away from the proposed house without diverting the runoff onto the neighbor's property?
Will separate improvements or permits be required to discharge storm runoff to a bayou, canal, etc?
Has a registered land surveyor to determine the minimum slab elevation above mean sea level that must be certified to meet the flood plane requirements been commissioned?
Will the above requirements necessitate bringing in a substantial volume of fill-grade earth?
Has the cost of fill and of compacting it under the structure, walks and drives been investigated?
Does the budget allow for this contingency?

Earthwork

"Dirt cheap" is an expression which has little meaning if remedial earthwork becomes necessary. Most potential homeowners or builders do not realize the high value a relatively small investment in a geotechnical investigation and analysis by a professional engineer. Select fill, compacted properly under a slab on grade will go a long way for stability through the years. Some sites/houses may require drilled concrete shafts, a post tensioned slab, or other foundation type. The foundation appropriate for a house may not be the same as the one on either side of it.

The geotechnical report may indicate and describe a high bearing pressure soil with no indication of expansive soil which can shrink and swell under a structure as the moisture content varies. It can cause cracks and misalignment of the slab, footings or grade beam. This can wreak havoc with the remainder of the structure bearing on that foundation/slab. Remember that a geotechnical report is inexpensive if it produces a proper foundation/slab design under one's investment.

If the need arises to remove poor soils such as quick sand, organic deposits or expansive clay and replace them with select, compacted fill, the budget can be hit hard. Ignore the problem and the costs may be many times larger. It is possible to obtain an option to purchase the property and commission the geotechnical investigation. Losing one's option money and paying for the geotechnical reports may be far less expensive than making a blind property purchase only to discover much additional expensive earthwork and foundation enhancements are required. Even worse is not discovering those issues above before construction.

Geotechnical investigation is standard practice in commercial construction. Those structures are no different from residential structures in terms of placing pressure (pounds per square foot) on the soil

at the foundation. Either structure can settle differentially on soil with inadequate bearing capacity, or which contains decaying organic matter such as stumps or limbs of previously cleared timber. The primary difference in foundation failure rates is related to the awareness of the owner. What can not be seen beneath the surface on the site can ruin the investment made.

From an energy efficiency standpoint, sinking or heaving of the soil causes cracks in slabs, walls, miss-fitting doors and windows which can allow excessive infiltration into a house which may have been constructed as nearly air tight. The best insurance against this outcome is to procure the soil borings and analysis. Then, the bearing surfaces of all foundation members must be of adequate size to distribute their loads at less than the allowable soil bearing pressure.

Views and Access

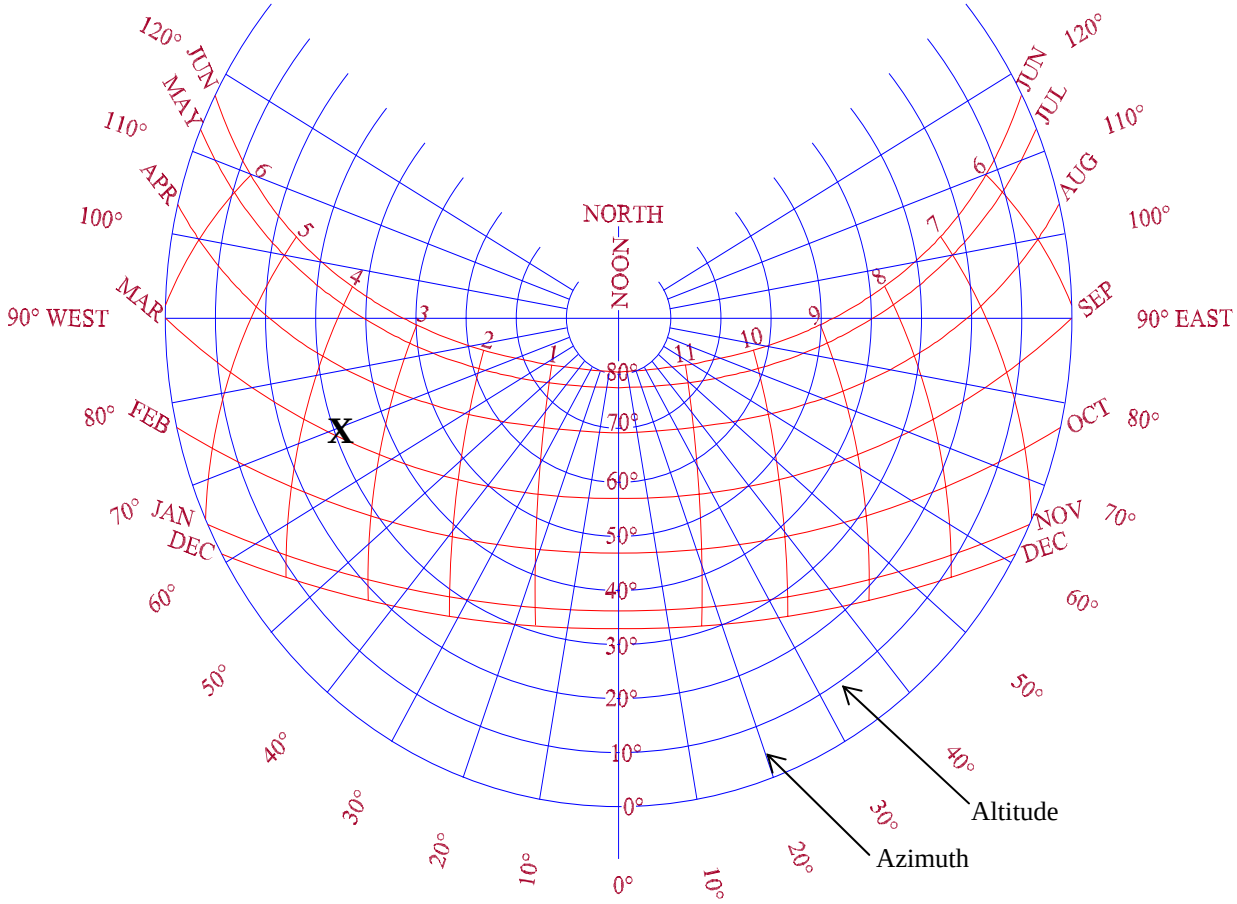
Are there vistas from the site which should be appreciated and enjoyed from within the house? Conversely, are there unsightly views which should be screened? Will the site easily accommodate pedestrian and vehicular access? What about fire trucks? Where are nearby fire hydrants? How will these vistas and means of ingress affect where expanses of glass will be placed in the exterior wall of the structure? How will that be coordinated with the path of the sun throughout the day and with the changing altitude and bearing during the changing of the seasons? How will that affect the quantity of solar energy intake (heat gain)? For example, the north side of a building receives very little sunlight which can penetrate windows. Only in late June, very early or very late in the day does the sun come from the northeast or northwest. However, everyday, the early morning or late afternoon sun is very low in the east and west. It is not possible to block it with an overhang. Will vistas to the west become a problem with excessive solar heat gain or glare?

The proper placement of roof overhangs admits the low winter sun into the house, and excludes the higher summer sun. The design of the overhang is dependent on the height of the wall, the depth of the soffit, the vertical distance from the soffit to the head (top) and sill (bottom) of the window, or glass door (collectively called fenestration; meaning openings in an opaque wall). A uniform two foot overhang may, or may not be appropriate. See Chapter 6 for how to determine the best overhang for the location.

Understanding Solar Position

Figure 1-1 below is a Solar Chart used to determine the position of the sun at any time in the year. The curved horizontal arcs represent the 21st day of each month. Solar altitude is shown by concentric circles in 10 degree increments. Curved lines indicating the time of day are labeled as 6 a.m. to 6 p.m. Azimuth lines (similar to bearing) are radial lines in 10 degree increments from South. Interpolation is permissible.

Figure 1-1
Solar Path Chart



In the example indicated by the "**X**":

- *Month/Day: March 23 (or August 30)*
- *Time: 3:35 p.m.; Azimuth: 70° west of South*
- *Altitude: 30.5° above the horizon.*

The chart in Figure 1-1 above is for 32 degrees North Latitude (North of Alexandria). A chart can be calculated mathematically for a specific latitude, but this one is representative of most of Louisiana. It is based on "sun time" for the particular location. Using the chart as an overlay on a site plan provides an understanding of how the sun's path each day of year will affect window locations, admitting daylight and heat gain when and where desired and excluding them when they would be detrimental. This information can also be expressed in a table as shown in Chapter 6, Figure 6-10.

Natural Cooling

Louisiana's hot, humid summers drive most people indoors to seek air conditioned comfort — comfort that is paid for by high monthly cooling bills. Natural cooling design measures can further reduce the air conditioning needs of any house. Natural cooling guidelines are especially important for passive solar homes because their large expanses of south-facing glass can cause overheating if

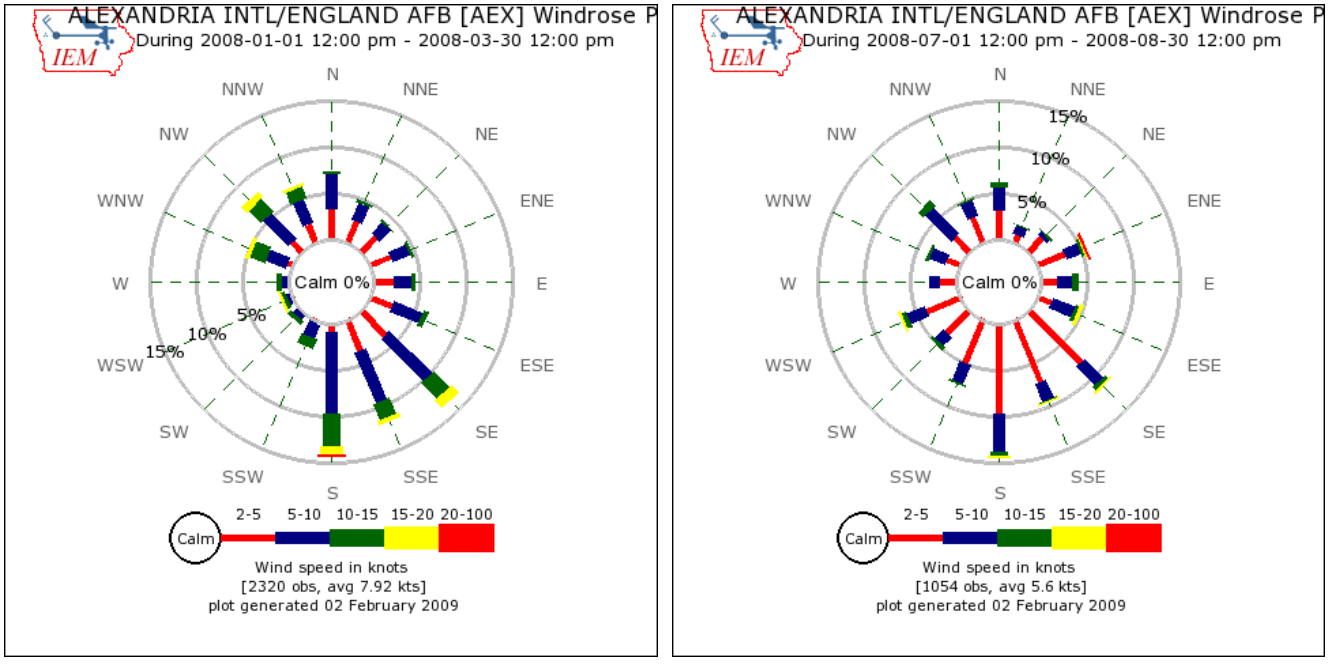
unprotected in summer. In Louisiana, summer discomfort is caused by humidity as much as by heat. Natural cooling techniques and new approaches designed to reduce humidity levels can promote comfort on moderately warm days. Natural cooling techniques and proper insulation and air sealing will continue to save money and energy. Remember that shading from trees can greatly reduce the ambient temperature, saving air conditioning. Capturing the natural breezes on the site can reduce the need for air conditioning during spring and fall.

Prevailing Breezes - Wind Rose

A consideration is wind direction and speed. This interesting Wind Rose diagram (see Fig. 1-2 below) is available from: http://mesonet.agron.iastate.edu/sites/locate.php?network=LA_ASOS

It is very useful in determining the predominant strength and direction of wind for the area of the site. This allows design for natural ventilation and shielding from cold winter winds. The web site will construct a wind rose for the most populated areas of the state. Thirty-eight stations on land are available in Louisiana plus Vicksburg and Natchez in Mississippi. Be sure to try several years as these plots are for one year of data and will vary somewhat, year to year. By using January 1 to March 1 and July 1 to September 1, the most significant prevailing winds can be seen for the more extreme seasons. April to June and October to December will show the temperate seasons when many people like to be out-of-doors. Be careful to avoid hurricanes as they will distort the average results.

Figure 1-2
Wind Roses Winter and Summer



1 knot = 1.1508 miles per hour, 5 knots = 5.75 mph, 15 knots = 17.26 mph, etc.

The length of the ray indicates the fraction of the time that the wind blew from a particular direction while the different sized/colored sections indicate the proportion of that time within a particular speed range. The center shows the percentage of the time period that was calm and the average wind speed for the period is shown below the speed legend.

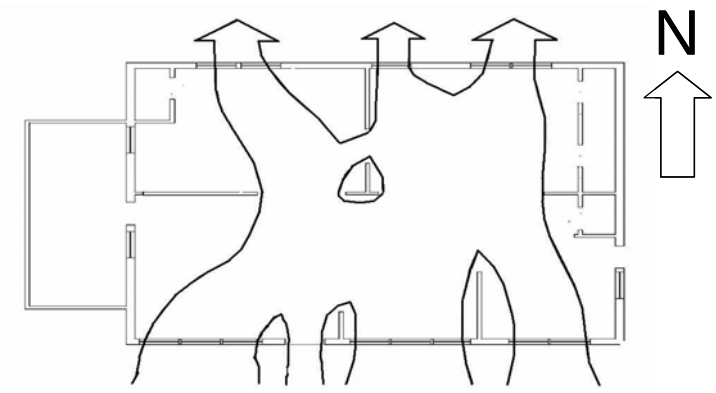
The USDA also has a Wind Rose program that illustrates the yearly average since 1961 of wind direction and speed for four cities around the state:
ftp://ftp.wcc.nrcs.usda.gov/downloads/climate/windrose/louisiana/

Natural Ventilation

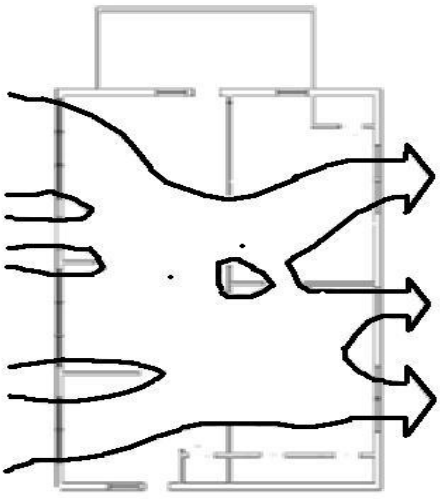
Even in the land of hot and humid, there are those times when we would prefer natural ventilation to heating or cooling. The fresh air is great for removing odors or pollutants from our environs. The saving for not using the heating and cooling is another plus. Use the Wind Rose information combined with site specific information. A forest or high hill on one side of the site will change wind directions. Large man made structures will also, but are not usually found in residential areas. Locating on the side of a hill or on the edge of a lake or other large cleared area will affect wind patterns. For example if the site is on a man made lake, it is probably sloping; that is, a hill on the side away from the lake. How will the same winds affect similar sites on north and south shores of the lake? The north shore site will have some of the winter winds blocked and receive direct breezes in the summer, while the south shore site will be just the opposite. The degree of affect will depend on the magnitude of the obstacles being considered.

It may be desired to present the bedroom side of the house with few windows to predominantly north winter winds. The west side may be "shaded" by a garage and storage area. But the south or south east breezes of the spring and fall present a good time to welcome the breezes by opening various windows on opposite sides of the house. Careful planning is required to combine the many beneficial features into an efficient house.

Figure 1-3
Natural Ventilation Design Strategies

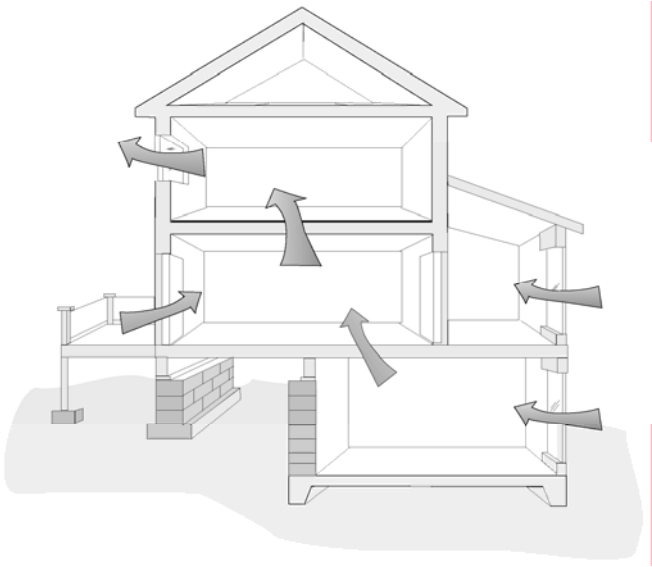


Note: North-South vs East-West Axis.
Window orientation needs adjusting
for different locations/sites.



East or West Wind

Figure 1-4
Stack Effect

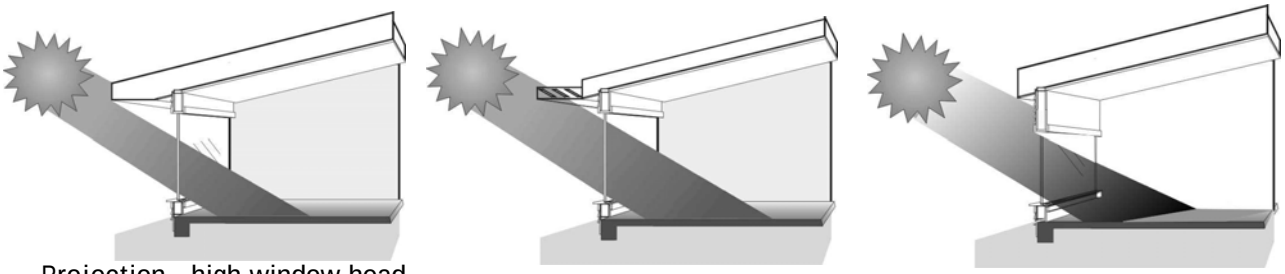


As the interior air heats up it rises to the higher parts of the structure and escapes creating suction. The suction pulls in cooler (lower) air from outside. The structure behaves like a chimney cooling and aerating the house. The taller the structure, the stronger the force. This effect is why most old plantation homes have such high ceilings and double hung windows.

Orientation of Building and Components

1. Major glazed areas are oriented within 20 degrees of north and south which have overhangs for summer shading.
2. Placing the garage on the west blocks summer sun.

Figure 1-5
Overhang Types



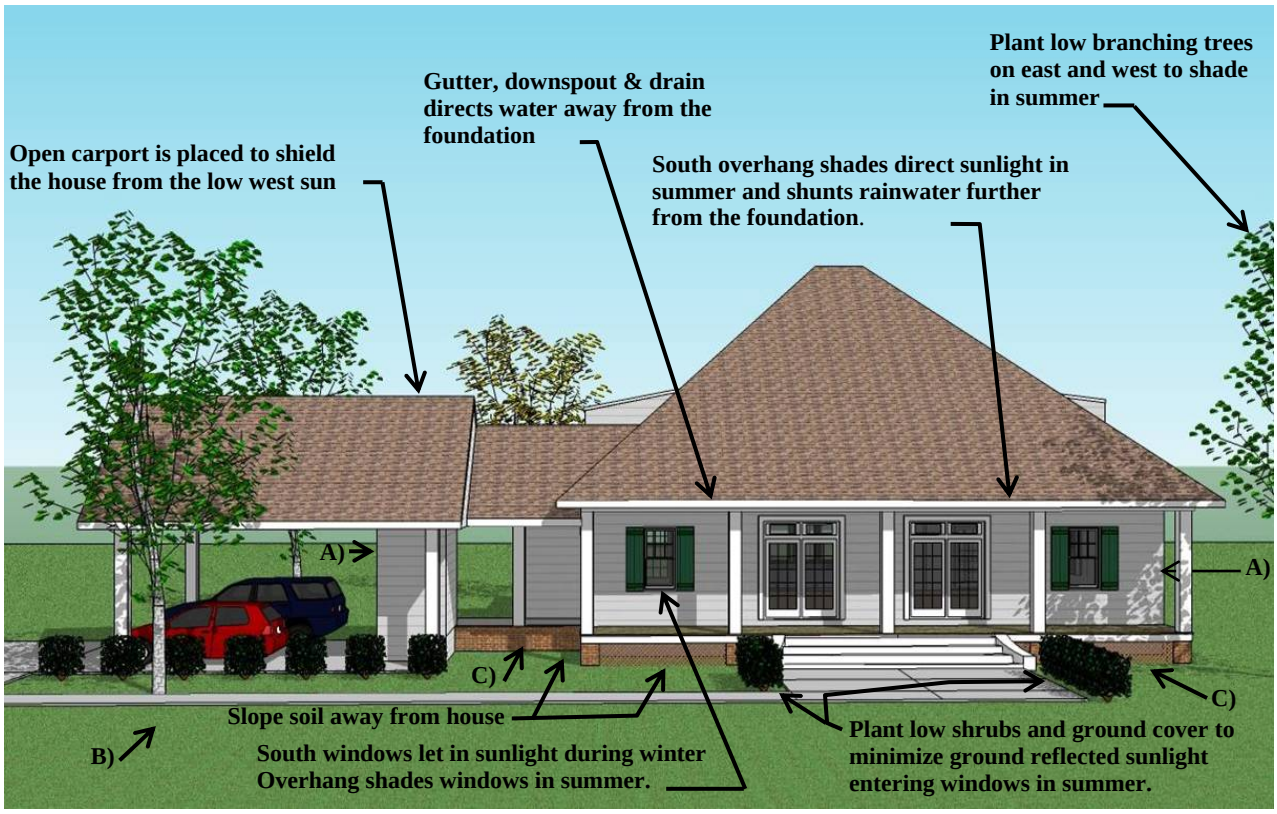
Projection – high window head. Excludes summer sun; admits winter sun.

Louver – high window head. Excludes summer sun; admits winter sun

Low window head. Excludes summer sun; admits winter sun

For more specific information concerning overhangs and window shading options see Chapter 6.

Figure 1-6
Site Planning



LEGEND FOR FIGURE 1-6 ABOVE

A) Minimize east and west windows; use north windows for daylighting and ventilation.

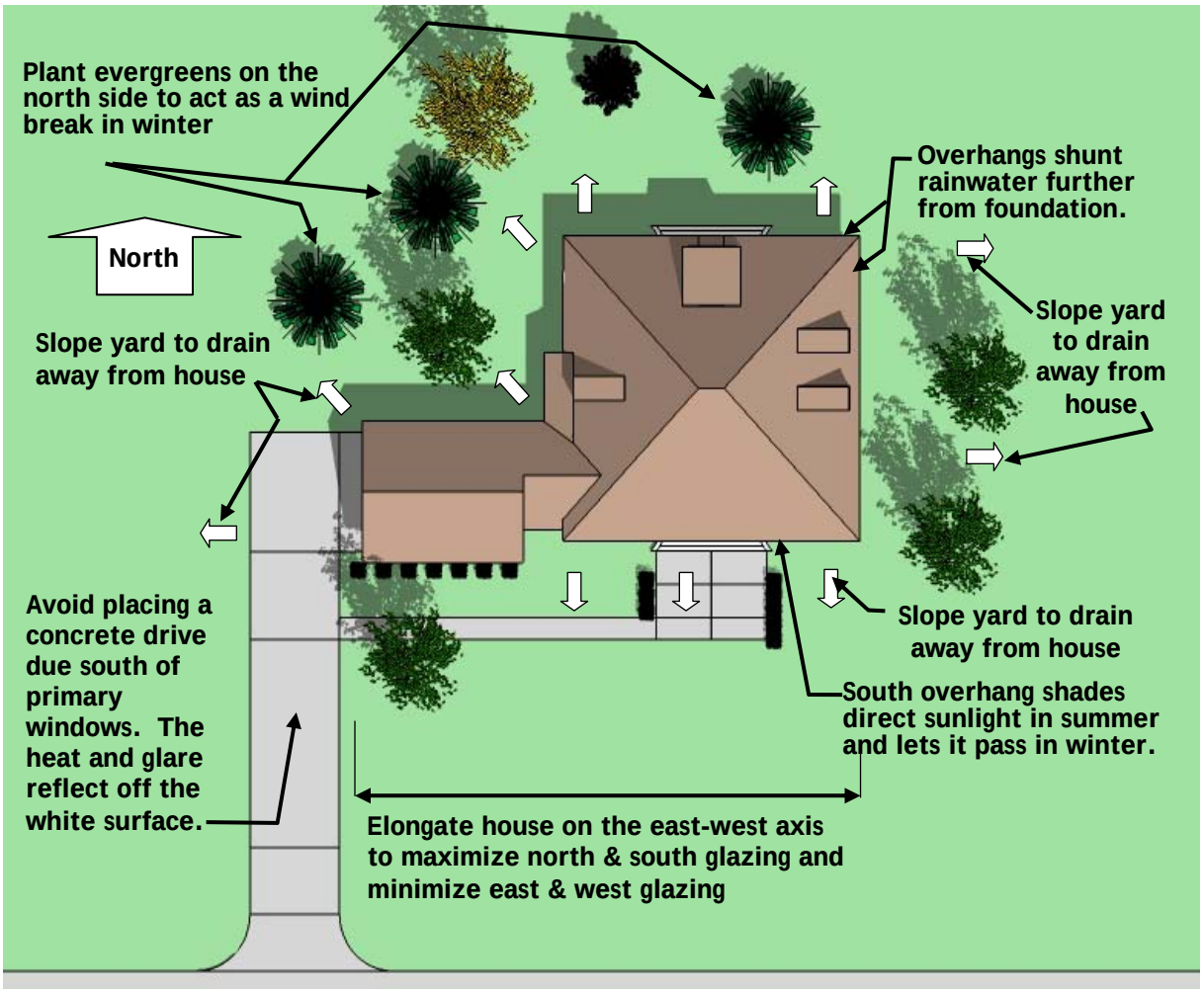
B) Water-saving landscaping practices known as xeriscaping: substitute mulched shrubbery and ground cover for turf grass. Where used, choose turf grasses that require less water, use drip rather than spray irrigation on plants; shade lawn to reduce evaporation.

C) Continuous perforated foundation drain connected to subsurface closed drain carrying moisture away from foundation. Embed perforated drain in gravel and cover with durable filter fabric, to prevent silt intrusion into gravel bed and reduction of intake holes in perforated pipe drain.

D) Termite prevention measures: remove construction lumber and other wood from soil before backfilling; obtain termite treatment and long-term renewable contract from reliable, established company; consider use of "termite traps," both to eliminate pests and to determine if they are present; if using slab insulation, make sure pests control company will guarantee home against infestation. For slabs on grade, always have the termiticide applied.

Figure 1-7 shows a typical site plan for a new residential project. It is advisable to elongate house on the east-west axis (even more than in this illustration) to maximize north & south glazing and minimize east & west glazing. Ensure that finished grading does not leave low areas (ponding) and that the site generally slopes away from the structure to drain. Puddles are not just a nuisance, but can be a fertile breeding place for disease bearing mosquitoes.

Figure 1-7
Site Planning



Plant low-limb, deciduous trees to the east and west of the living spaces. This helps to permit the passage of some sun into the space in winter, but the heavy summer foliage blocks the sunlight when the heat gain is least wanted inside the space. South facing overhangs can be designed to permit the passage of low altitude winter sunlight into the space, while excluding the high altitude summer sun. Low shrubbery can help prevent ground bounce glare from reflecting off the ground or paved areas and penetrating the south windows.

Landscaping and Trees

According to the U.S. Department of Energy report, "Landscaping for Energy Efficiency", careful landscaping can save up to 25% of a household's energy consumption for heating and cooling. Trees and vines on trellis or arbor are very effective means of shading in the summer months. In addition to contributing shade, landscape features combined with a lawn or other ground cover can reduce air temperatures as much as 9^{o}F in the surrounding area when water evaporates from vegetation and

cools the surrounding air. Louisiana's abundant trees are wonderful for natural shading and cooling. However, they must be located so as to provide shade in summer and permit sun light in the winter coming from the south. Even deciduous trees that lose their leaves during cold weather block some winter sunlight – bare trees can block over 50 percent of the available solar energy if they have a lot of limbs.

Landscaping Guidelines

1. Ground cover reduces reflected sunlight.
2. Deciduous trees shade east, west, southeast, and southwest sides in summer.
3. Trellis with deciduous vine can shade east and west walls.
4. Windbreak of evergreen trees and shrubs to the north buffers winter winds.

Table 1-1
Shading Design Strategies

Window Direction	Landscaping	Overhangs	Shade Screens	Interior Shades Can eliminate over 40% of solar gains.	Recommended Strategies
South	Deciduous trees shade some in winter. Provide a few high branching trees. Use shrubs and ground cover to reduce sunlight reflected into windows from the ground.	Provide good control if sized correctly. They do not shade diffuse sunlight on hazy days and ground-reflected sunlight.	Block up to 70% of sunlight before it gets through window. Can be very effective.	Should be used on all windows without exterior shade screens. Roller blinds are more effective than Venetian blinds.	Shrubs & ground cover. Overhang that does not block winter sunlight. Use shade screens or interior shades.
Southeast & Southwest	High branching trees are appropriate near southeast and southwest corners of house.	Less effective than on south windows.	Effective.	Effective.	High branching trees, shrubs and ground cover. Use shade screens or interior shades.
West	High branching trees are appropriate. Low branching trees block low afternoon sun. Shrubs next to the house are less effective, but block diffuse, ground-reflected sunlight.	Must be as long as the window is tall (e.g. porches and carports). Not effective for low sun angles.	Effective.	Effective.	High branching trees, shrubs and ground cover. Use shade screens or interior shades.
East , Northeast & Northwest	Low branching trees block low morning and afternoon sun. Shrubs next to the house are less effective, but block ground-reflected sunlight.	Must be as long as the window is tall (e.g. porches and carports) or use awnings that extend over windows.	Effective.	Effective.	Low branching trees and ground cover. Use shade screens or interior shades.
North	Evergreen Trees provide diffuse summer shading and serve as a wind break.	Ineffective.	Effective if incoming light is a problem.	Can control the small amount of incoming sunlight.	Evergreen trees and interior shades.

Conclusion

Proper consideration of each of the unique criteria found with each site and planning a resolution to conflicts is key to successful and more productive site planning. The design decisions will change the site for a long time. The following questions should be asked before making a final decision:

- Is weather data on hand for predominant wind direction and strength?
- Are there obstructions that will alter wind patterns?
- How much rain falls annually by month?
- How does the land drain on its surface?
- Where to drain water without infringing on the neighbor's right not to have it on his property?
- Is there a crest which would make an ideal high building platform?
- Does the earth have sufficient strength of bearing pressure for what is to be built?
- Does it drain well internally?
- Is it sandy or does it contain expansive clay with its volumetric changes?
- Are there rock outcrops or other unusual features?
- Where will the automobile traffic be?
- How will groceries get into the kitchen in the rain?
- Where are the best views from the site? The worst?
- Where will the path of the sun be in July; in January?
- How will windows and doors be affected by:
    - Area?
    - Orientation?
    - Shading?
    - Solar Heat Gain Coefficient (SHGC) and U factor?
- Will the yard be oriented well for future photovoltaic panels or solar water heaters?

Armed with knowledge about these characteristics of the site, various plans can be tested by the questions above. A final site plan from these scenarios can provide lower utility bills and a more pleasant environment for many years. The remainder of construction decisions will be easier to address when the plan addresses all the questions and others that are aesthetic. The energy efficiency of the home will be greater if the precepts of good site planning are followed.

Notes: