

Oak Alley: The Heavy Mass Plantation House

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ABSTRACT

Oak Alley, a southern Louisiana plantation house was constructed in the 1830's. The climate responsive strategies employed in the house and site design have been identified and documented through field tests, model analysis and occupant interviews by Brian Andrews and Brian Spencer, working with Dr. Eugene Cizek and Professor Susan Ubbelohde. This paper discusses the background of "bioclimatic design" strategies developed for the Gulf Coast climate of the U.S. Three major factors in the success of Oak Alley's response to climate are examined: the dynamic heavy-mass envelope, the migration of the occupants, and the contributions of ritual, contrast, and synesthesia to thermal comfort. Conclusions address the value of studying historic examples and the complexity of a truly responsive and comfortable design.

1. INTRODUCTION

In comparison to the rest of the continental U.S., the Southeast, and especially the swamps and bayous of Louisiana have epitomized the relative tropics. A world of palm trees and Spanish moss, dripping with humidity and crawling with insects, the South is home to the passions of William Faulkner and Tennessee Williams.

Understanding the South's nearly mythic role as our representative hot humid climate clarifies the ease with which we have assumed that tropical architectural strategies might be appropriate. Thus the "low heat capacity walls and roof, maximum shade, maximum ventilation" described by Fitch and Branch for the tropical rain forest in their seminal article¹ have crept into our general consciousness as somehow applicable design strategies in the Deep South.

2. BIOCLIMATIC DESIGN GUIDELINES

As we became better at both describing the climate and understanding implications for architectural response,² we also began to look at 19th century architectural prece-

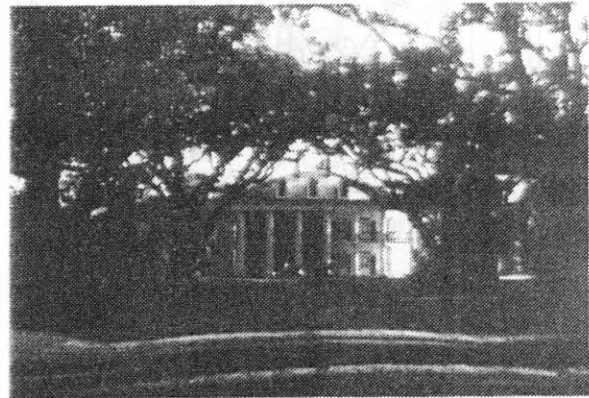


Fig. 1. Oak Alley Plantation, Vacherie, Louisiana.

dents. This search was ostensibly for clues, but functioned primarily as confirmation of the newly developed guidelines.³ For the northern U.S. and the Southwest, passive designs could provide comfort for most of the year. The basic architectural strategies suggested for orientation, aperture, and envelope and mass characteristics tended, in general, to work through the annual patterns of seasonal change. However, in the Southeast, our sophisticated analysis brought us to a difficult position; a set of conflicting guidelines.

In Regional Guidelines for Building Passive Energy Conserving Homes (1980), the potential of passive strategies for providing thermal comfort was addressed. Chapter 11 for the Gulf Coast distinguished the "primary design condition" as "too hot for comfort" (52% of the year). The recommendations were: 1. Allow wind to ventilate and cool; 2. Protect from the sun; 3. Flatten day-to-night temperature swings; 4. Avoid creating additional humidity. The "secondary design condition", "too cool for comfort", occurs a substantial 36% of the year. However, the recommendations of 1. Letting the sun in and 2. Avoiding infiltration are, along with #3 and 4 above, "less important and should only be considered if greater detail and operational control is possible".⁴ This relieves the

designer of resolving the more difficult of the contradictory guidelines. For example, should the architect design with high ceilings or minimize the volume to be heated or refrigerated? Is it better to provide many large operable windows, or do you minimize glazing to reduce infiltration, winter heat loss and summer solar gain? The difficult question of the appropriate use of thermal mass versus a lightweight insulated frame is not clearly answered.

Watson's analysis and guidelines (1981)⁵ assume people will use air conditioning when conditions are unrelieved by passive means. However, he also looks at percentages of occurrence to determine design strategies for this climate:

minimize infiltration	71%
minimize conductive heat flow	56%
passive solar gain	42%
minimize external air flow	42%
minimize solar gain	43%
promote ventilation	19%
promote radiant cooling	5%
promote evaporate cooling	4%

Examining Watson's recommendations in relation to the AIA guidelines is even more perplexing: the statistics tell you clearly that if you want to have the option of air conditioning, you must build a thermos bottle which can admit and block solar gain on an equal basis.

What becomes clear is that choosing bioclimate design strategies via percentage of occurrence is akin to designing for an average daily temperature of 50 degrees F. It is possible that the climate described consists of 90 degree days and 10 degree nights. Being comfortable part of the time, even if it is more than 50%, is not a satisfactory solution. It is important to find new ways to define the problem.

In the Gulf Coast, one needs to design a building that can be both an open parasol and a protective enclave, recognizing the differences between winter and summer, spring and fall and the accompanying sun position and wind shifts. In effect, a truly climate-responsive house would need to be a complex integrated set of passive systems; a chameleon of many talents. Herein lies the value of examining historical precedents. Many of these houses, including Oak Alley, respond in a sophisticated fashion to the complex demands of the Gulf Coast climate.

3. OAK ALLEY PLANTATION HOUSE

Oak Alley was built in the 1830's facing the Mississippi River to the north at the end of an existing allée of twenty-eight oak trees. The house was placed on the site of a previous cottage and constructed with

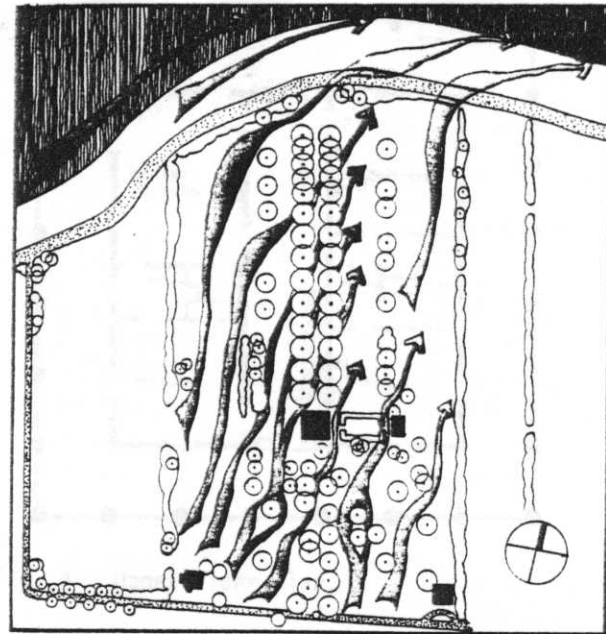


Fig. 2. Site plan showing typical summer winds.

bricks of Mississippi River mud, molded and fired on site. Completed in 1839, the house has two floors of living areas, each with an eleven foot central hall running north and south. Square in plan, the house is surrounded with an eleven foot deep gallery and a total of twenty-eight brick columns, corresponding to the twenty-eight oak trees which form the allée. The 16" walls are of masonry, finished with painted stucco on the exterior and painted plaster on the interior. Originally there were four dormers, one on each side of the hipped roof. The full complement of out-buildings typically associated with a working plantation (kitchen, garconnières, shed, stables, slave quarters, etc.) are also on the grounds to the east and south of the house.

The house was altered by the architects Koch and Armstrong during restoration in the 1920's after fifty years of abandonment. The original kitchen building still stands opposite the formal garden to the east; however, the kitchen was brought into the house in the southeast corner of the ground floor. The dormers were increased to three on each side of the house for a total of nine. The stairway has also been moved from the southwest corner to the center hall, explaining the absence of fireplaces in the southwest rooms. Finally, the original black and white marble floors were replaced with wooden floors.

4. THE DYNAMIC ENVELOPE

Oak Alley recognizes the demands of the exterior climate by providing an envelope which can function as either an open parasol

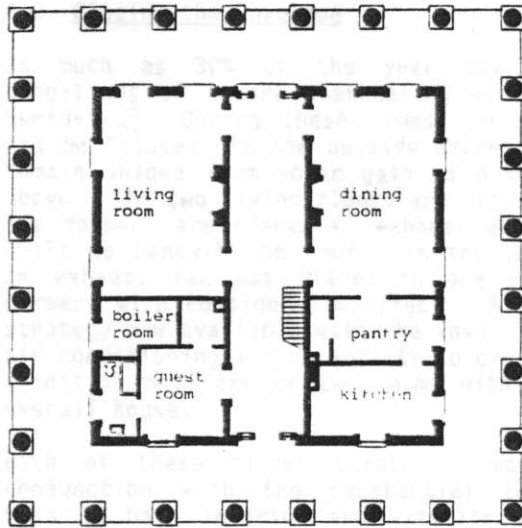


Fig. 3. Ground floor plan.

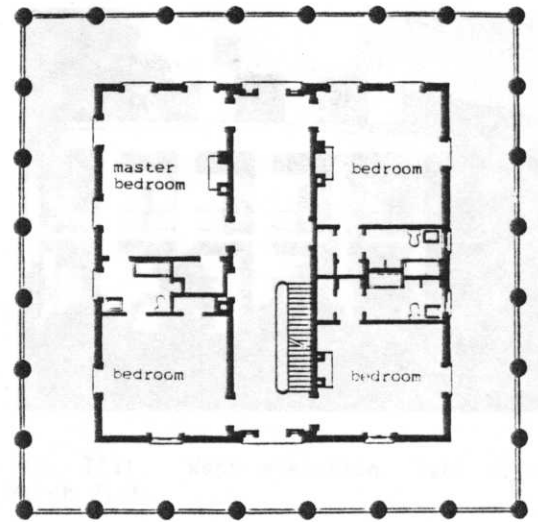


Fig. 4. Upper floor plan.

or a thermal enclave. Each living area, including the central hall which functioned as a second parlor, has French doors giving onto two orientations. These can open the rooms dramatically to the outside breeze and temperature. The interior doors to the hall and through the service rooms support additional cross ventilation, while the fifteen foot ceilings allow hot air to rise above head height.

Coupling the hatch door on the roof's belvedere and the operable dormers with the vertical opening created by the move of the stair, the house has an effective stack ventilating system. This supplements the potential for cross ventilation during those periods of minimal and uncertain wind speed and direction, generally the months of July and August.⁶ (Fig.6)

4.1 Shade

In conjunction with ventilation, shade is still required for comfort during those overheated periods not yet severe enough to require an enclave (March, April, May, and October).⁷ This is provided on the north or front galleries nearly all year. The east walls and glazing are shaded after 10 a.m. in March and September and from 9:00 a.m. on June 21st. The southern walls are shaded throughout the day from early March to early October. The west wall is the mirror of the east, lacking shade in the afternoons from March to September (Fig.7) A second layer of operable sun controls, the wooden shutters on each French door, can be used during those periods when the overhangs do not provide the necessary shade.

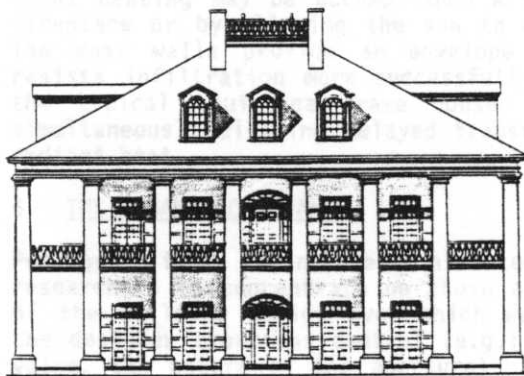


Fig. 5. North elevation.

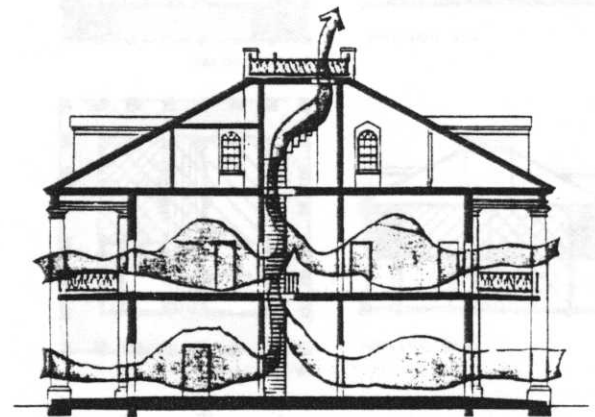


Fig. 6. Section showing stack ventilation.

4.2 Closing the Envelope

As much as 30% of the year may bring conditions of severe overheating with high humidity.⁸ During these times, the house can be "closed" to the outside extremes and remain shaded from solar gain as described above. The two living floors are closed and the dormers are opened to exhaust any heat built up beneath the roof. In the 1930's, an exhaust fan was placed in one of the dormers with considerable effect. A second strategy now available with the invention of air conditioning is the ability to close and condition only one or two rooms within the overall house.

Both of these closed strategies work in conjunction with the substantial thermal mass in both interior and exterior walls. The masonry walls are coupled to a continually available sink; the 65 degree F. groundwater. Oak Alley's brick walls, like the masonry walls in the French Quarter of New Orleans, have their foundations let into the high water table. This causes a condition in which the water is wicked up into the wall. Thus the walls are kept cooler than summer air temperatures, although they suffer from peeling paint. The interior relative humidity is, unfortunately, increased. When the room is closed, the discomfort must be balanced by the cooler mean radiant temperature of the room or the dehumidifying action of the air conditioner. Due to the presence of a heat sink independent of daily cycling, the occupants can utilize both ventilation and the cool mass without compromising the effectiveness of either. It is this combination which allowed the central hall to be a favorite room in hot periods.

4.3 The Winter Enclave

The need for a winter enclave is a critical fact of life in Louisiana, where heating bills often run as high as cooling due to lack of insulation and infiltration control. Each of Oak Alley's rooms may be closed to infiltration using the doors and shutters. Local heating may be accomplished with the fireplace or by allowing the sun to enter. The mass walls provide an envelope which resists infiltration more successfully than the typical Louisiana frame house, while simultaneously allowing delayed transfer of radiant heat.

5. THE DYNAMIC OCCUPANTS

Perhaps it is in our nature as architects or researchers to concentrate on those aspects of the building design over which we know the designer exercises control (e.g.: the U value, the nature of the aperture). There may be a mention of a "sun space" or a "shaded porch which accepts breezes" in the

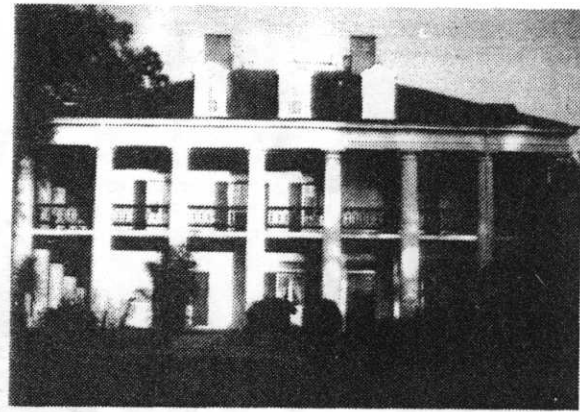


Fig. 7(a). West elevation, late afternoon March 21st.

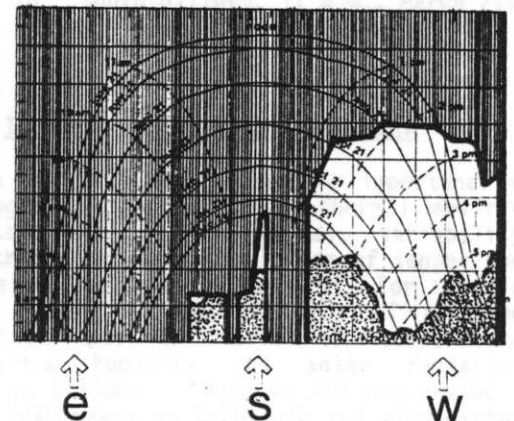


Fig. 7(b). Solar transit plot from west gallery.

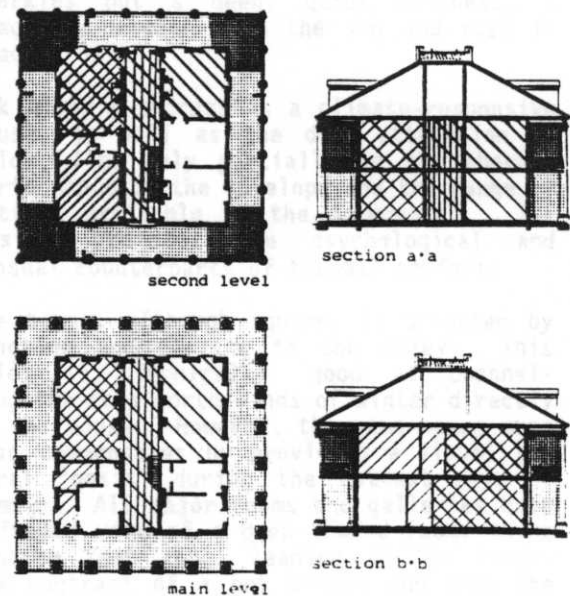


Fig. 8. Thermal zones in (a) plan (b) section.

published guidelines, but on the whole we have left unrecognized and unexploited the most powerful ally of the dynamic envelope, the redundant living space. The ability of those living in the house to move up and down, in and out, and around the house on the galleries makes this house truly responsive to the climate.

Oak Alley's galleries, ground floor paved arcades and center halls are areas which may be occupied at any point when they offer improved thermal comfort. Because they were initially conceived as living spaces, rather than as "hallways" and "overhangs", their eleven foot widths accommodate a variety of activities with ease. The northeast corner of the second floor gallery has shade and breeze on a hot afternoon. The dark center hall offers cool walls on an August day. The mid-day sun of the southern gallery warms a space blocked from northeast November winds.

In fact, migration through these "redundant living spaces" provides the most immediate response to the range of diurnal patterns typical of this climate. Previous research has identified three daily comfort patterns which together account for 97% of the year: (1) days which begin cold, move into the modified comfort zone, and then turn cold again "C-MCZ-C"; (2) days which are within the modified comfort zone all day "MCZ"; and (3) days which begin in the modified comfort zone, become hot, and then return to the modified comfort zone "MCZ-H-McZ". Conditions coded both C and H require a closed building and either cooling or heating. Conditions coded MCZ can be comfortable with an open building if the right amount of wind or sun is provided.⁹ In Oak Alley, one can move in and out of a "closed" space onto a gallery, and then seek the sun and wind conditions appropriate by moving around the galleries until comfortable.

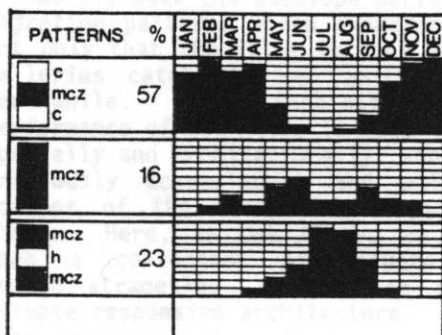


Fig 9. Typical annual distribution of diurnal comfort patterns, Lake Charles, Louisiana.



Fig. 10. South gallery, 11 a.m., March 21st.

6. THE OASIS AND THE ROCKING CHAIR

Lisa Heschong has argued the importance of recognizing and designing thermal environments which include ritual, variability, contrast, and the stimulation of senses such as sight, sound and touch.¹⁰ For example, she describes the necessity of a summer enclave not in terms of temperature, relative humidity and solar radiation, but as follows: "When we are overheated... the heat makes us lethargic and slow-witted. Any action requires too much effort... A hot day... can also be stressful because it overstimulates. The sun can be too bright, glinting off of every surface. The antidote then is not something that moves and sparkles but a deep, quiet coolness, a place to retreat from the sun and rest in peace."¹¹

Oak Alley's success as a climate-responsive house, as well as the deep attraction it holds, lies only partially in the thermal performance of the envelope and the range of actions available to the occupants. The design provides the psychological and sensual counterparts of thermal comfort.

The house, although square, is oriented by function and glazing to the alley. This alley is, ironically, good at channeling the cold north winds of winter directly to the house. However, the same space more than compensates by providing a visual and aural "oasis" during the hottest days of summer. All major rooms and galleries have a framed view of a deep shaded room, three hundred feet long, leading to the river. The contrast of a hot bright sun with the green of the alley only emphasizes the pleasures of the coolness provided. This alley was historically the formal entrance for those coming from the river or along

River Road, framing the house and establishing a powerful spatial and thermal experience as preamble to the house itself. The interior hallway, a formal extension of the alley, also extends the coolness offered on a hot day. The dimmer shade and cool masonry walls protect you while the visual connection to river, green grass and breezes is maintained.

The French doors, the shutters and the mosquito netting hung on the galleries not only provide thermal comfort, but do so in a visible and variable manner. Their visibility and obvious connection with comfort allows them to become objects of "affection", which broadens our appreciation and care for the place.¹² Similarly the twenty-eight round columns act as sun-dials, casting shadows which move daily and seasonally, placing the house in time. On overcast days, the curves of the column shaft model the soft light, always distinguishing the protected zone of the galleries from the outside environment through light and shade.

7. CONCLUSION

Heschong reminds us that "the association of comfort with people and place are reinforced by the ritualized use of a place. It establishes, in time and behavior, a definition of the place as strong as any architectural spatial definition."¹³ Oak Alley provides a magnificent architectural set upon which these rituals can develop. The northwest corner of the upper gallery was used each summer evening for sitting after dinner in a rocking chair, feeling the breeze pick up around the corner of the house, watching the coolness come as the sun set. The seasonal ritual of taking up the rugs to bare the marble floors and hanging the mosquito netting on the galleries defines the summer house in time as well as place.

These "psychological" aspects of thermal comfort, which cannot be "measured" on site or modelled in the lab are those which ultimately make the envelope performance and migration patterns worth examining. It is not only that the alley is cool or that the galleries catch the sun which makes them worthwhile. The sophisticated thermal performance of Oak Alley is made significant spatially and architecturally, and the house graciously acknowledges and welcomes the actions of the occupants as part of the whole. Here, in Oak Alley, we have more than a collection of climate response design strategies, we have an example of climate responsive architecture.

8. ACKNOWLEDGEMENTS

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