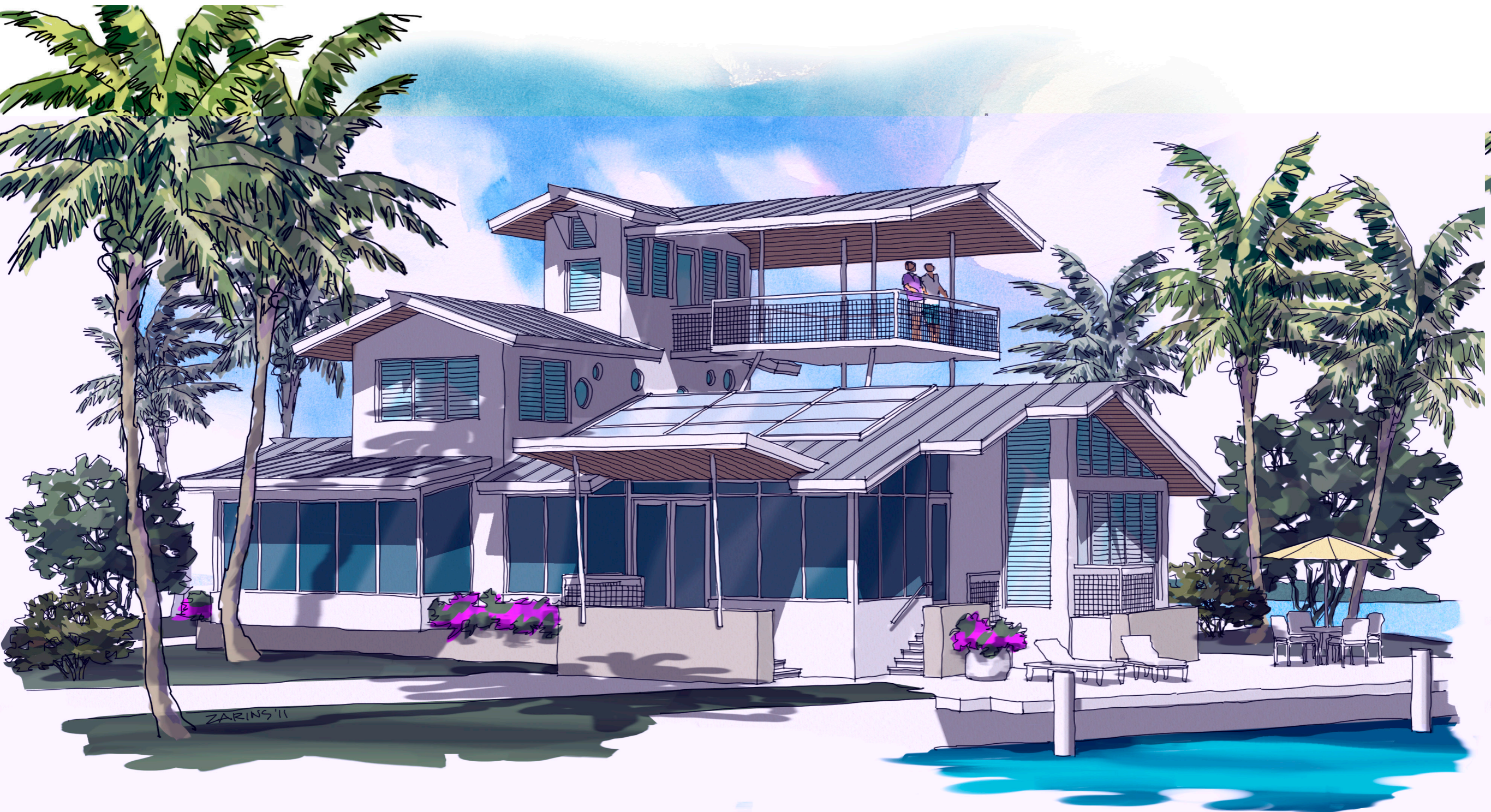


Energy Efficient Sustainable Tropical House

A Design that Uses Passive Cooling to Stay Comfortable Naturally



The Florida Keys, an archipelago of 1,700 islands in the southeastern United States, are known for their world class sport fishing, scuba diving and snorkeling. The area is abundant with numerous varieties of fish, animal and plant life; it also has its fair share of insects with "No-See-Ums" and mosquitoes leading the list. They make their presence known, especially after Florida's post card, picture perfect, sunsets.

The Keys begin at the southeastern tip of the Florida peninsula, about 15 miles south of Miami, and extend in a gentle arc south-southwest and then westward to Key West. The islands lie along the Florida Straits, dividing the Atlantic Ocean to the east from the Gulf of Mexico to the west, defining one edge of Florida Bay. The Florida Keys are geographically in the subtropics; however the climate of the Keys is considered to be tropical with the Gulf Stream just a few miles off shore which has a significant effect on the region's climate. These unique characteristics embrace a design strategy for a passively cooled, tropical house.

The prototypical passively cooled, tropical house design works toward one basic overriding goal: staying comfortable without relying on air conditioning. This is accomplished by the moderation of three variables: temperature, humidity and air circulation. Victor Olgay in his book, *Design with Climate*, developed guide lines for climate responsive architecture in four distinct climate regions; one is a hot humid tropical environment. Designing a passively cooled house starts with the site and includes every aspect of the house right down to the color.

Historically characteristics of these distinct tropical house types are seen in the Florida Seminole Indian chickee huts which are elevated platform, open sided structures with palmetto frond thatched roofs. The open sides offer free air movement through and around the structure and the thatched roof offers protection from the sun and rain. Prior to the use of air conditioning in South Florida, homes responded to the needs of the environment with the wide use of attic venting and later, jalousie windows to promote air movement. Excellent examples can also be seen in "Florida Cracker Houses" and the modernist work of Paul Rudolph in the Sarasota, Florida area.

In a hot, humid environment wind and shade are your friends; they help to lower the air temperature, moderate humidity and promote air circulation. Passive cooling techniques rely on increased air movement; therefore prevailing breezes are primary considerations in site selection. An individual, somewhat elevated, freely elongated house, on an east-west axis is preferred. With the long south or north façade situated to capture the prevailing breeze. The shorter east and walls minimize the sun's strong radiation effects from the rising eastern sun and intense setting sun in the west. Ideally the prevailing breeze will first pass over a water body then under high branching trees to reduce the temperature before passing through the house's interior spaces. Appropriately sized roof overhangs allow exterior walls to remain in shade and allow windows to remain open during wind driven tropical rain storms.

The Keys House site is oriented to the southeast overlooking an expansive wetlands conservation area with native trees and vegetation.

The prevailing breeze is out of the southeast over the Atlantic Ocean allowing for optimal air flow through the long south wall of the house. The air is tempered first as it comes off the Atlantic Ocean. The air temperature is further reduced as the air passes through the trees located in the conservation area. Finally the air passes through another layer of shade, the roofed screened room, at the southeast portion of the house. The now tempered air enters the interior through a southeast facing wall of pocketed sliding glass doors opening the full length of the mosquito free, screen room collecting the prevailing passively cooled breeze from the southeast.

Increasing air flow across the skin stimulates vaporization and with it a cooling effect. Open wall solutions are preferable, walls being less important here than in other regions. Customary distinctions between walls and openings disappear as ventilation is needed the great majority of the year. With the exterior walls as open as possible allowing for maximum air flow, screen protection is required from insects and small animals. Creating the covered screen entry space at the front of the house provides sun, rain, insect and animal protection while allowing the wall to be open to collect as much breeze as possible.

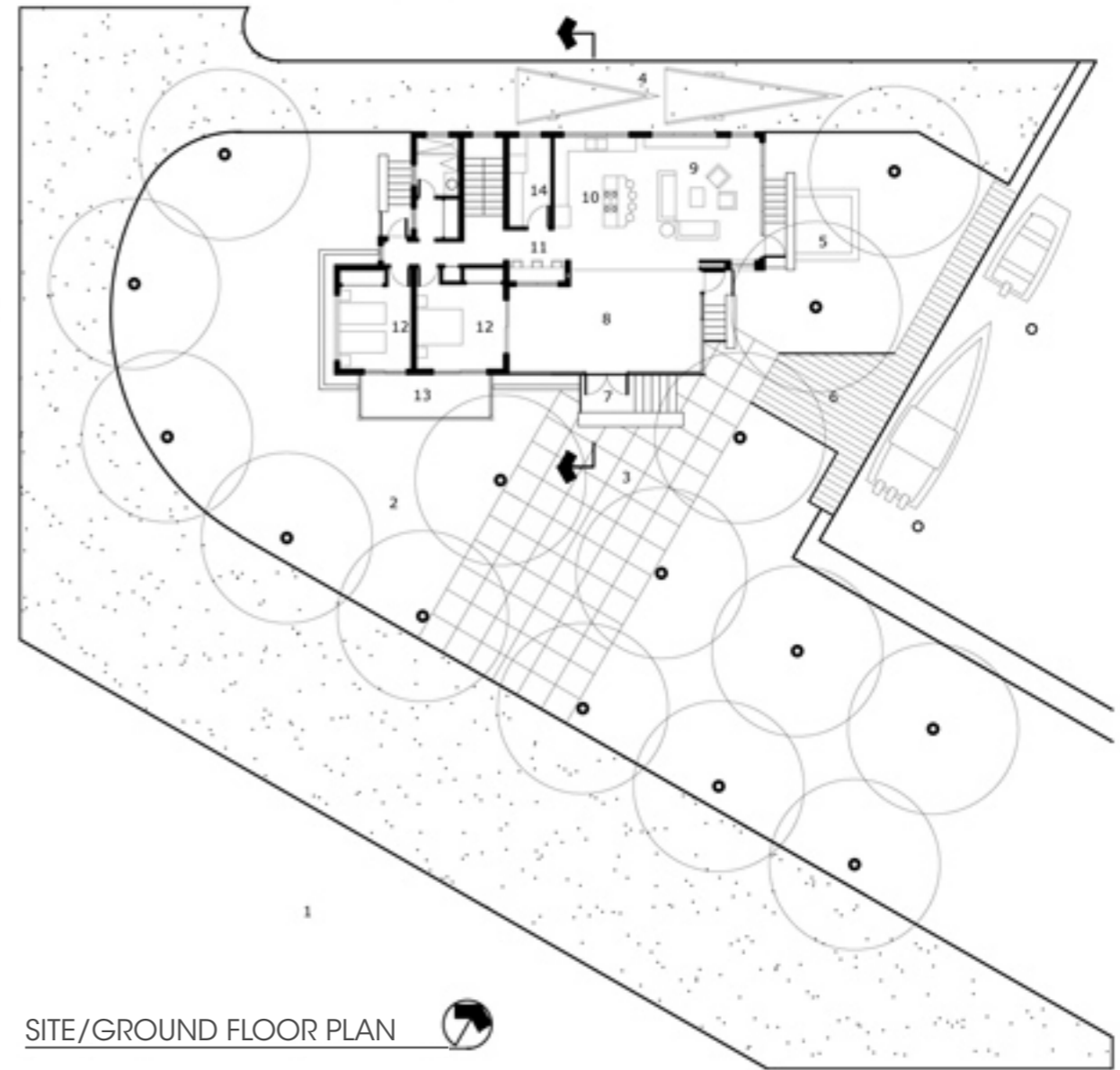
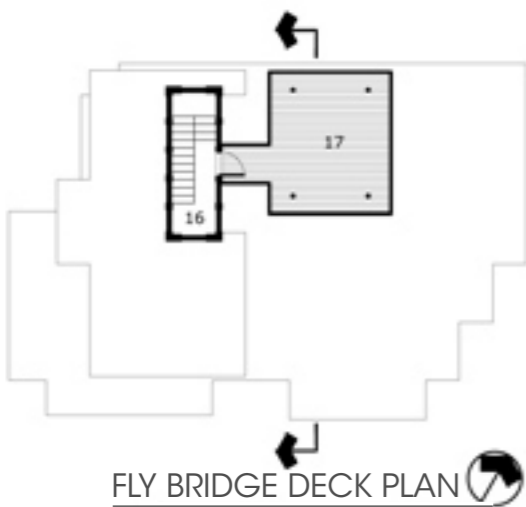
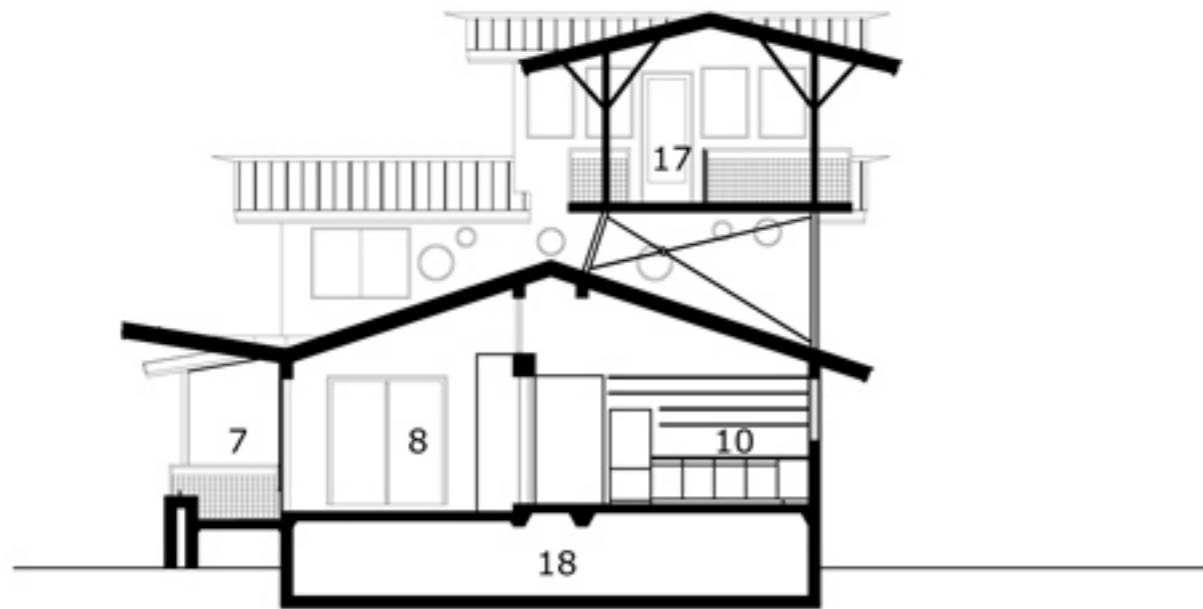
To induce air flow, especially on those "dead air" days, above the stairwell leading to the roof deck, is an operable windowed copula, which creates a "stack" effect to thermally induce air flow, with additional help from a whole house fan when required. Any form of heat storage should be avoided with interior walls opened to induce cross ventilation. In response, louvered interior doors and transoms are used to promote air movement through the house. To additionally promote free air movement and to visually lighten the form, the house is elevated off the ground.

The roof takes on the strongest thermal impacts; here the design emphasis changes from walls to roof. It must be water tight, insulated and reflective. The roof of the Keys Houses is vaulted on the interior, with an insulated roof above, radiant barrier and a reflective "5V crimp" galvalume roof to the exterior.

Intangibles such as state of mind and clothing play an important part of staying comfortable. Not letting the heat of the day, enter into your psyche, wearing breathable cotton clothing and a broad brimmed, ventilated hat is helpful.

Other sustainable practices are incorporated in the Tavernier House Including:

- Rain water harvesting
- Basement water storage cistern
- Photovoltaic and hot water solar panels on the roof
- Drip irrigation
- Planting native drought tolerant vegetation
- High efficiency plumbing fixtures
- FSC certified and reclaimed lumber
- Environmentally preferable products



- 1. WETLAND
- 2. PALM TREES
- 3. PARKING COURT
- 4. BOAT TRAILER PARKING
- 5. DIPPING POOL
- 6. DOCK
- 7. MAIN ENTRY
- 8. SCREEN ROOM
- 9. FAMILY ROOM

- 10. KITCHEN
- 11. MINI DEN
- 12. BEDROOM
- 13. SCREEN ROOM
- 14. LAUNDRY ROOM
- 15. MASTER BEDROOM
- 16. CUPOLA
- 17. FLY BRIDGE DECK
- 18. CISTERN

SITE/GROUND FLOOR PLAN

SQ FT CALCULATIONS
 1742 TOTAL FLOOR INTERIOR
 816 SCREEN ROOM & ROOF DECK



The cupola draws hot air up and out of the house, while cooler air is drawn in through the ground level screened rooms and louvered windows. On "dead air days" when warm air needs some help, a whole house fan located in the cupola is turned on to help move air through the house.

Broad leaf palm trees help cool the outside air before it enters the house and shade the exterior walls from the sun. Coconut palms, indigenous to the tropics were selected for their ability to live in a high salt and low water environment.

The prevailing breeze comes from the southeast off of the Atlantic Ocean. Before it reaches the house it passes through a wetland reserve and under the fronds of coconut palms. Both the wetland and palms moderate air temperature before it enters the southeast facing screened rooms and louvered windows

Tropical regions are ideal to capture the sun's energy and put it to good use. Solar panels located on the south facing roof collect energy providing the house's electrical and hot water requirements.



Staying comfortable in a passively cooled house requires that the interior spaces are shaded and well ventilated. The house is designed to promote air circulation. Southeast facing screened rooms keep mosquitoes out and act as a wind scoop capturing the prevailing breeze coming off the Atlantic Ocean. An open wall of pocketed sliding glass doors at the family room, kitchen and ground level bedrooms allows the breeze to continue into the house's interior.

The roof receives the strongest thermal impact. A ventilated double roof is desirable with the upper surface acting as sun protection. It must reflect solar radiation and be insulated. A wide overhang is necessary for rain protection and reducing solar glare. The 5V crimp galvalume roof reflects the sun's radiant heat; a metalized radiant barrier film below ventilates the hot air out of the ridge helping to keep the interior of the house cool.

Walls are finished with white stucco to reflect any heat radiation that is not blocked by landscape and exterior shading devices. Windows are manufactured with aluminum jalousie louvers. The louvers provide sun, hurricane and security protection.

The house is sited to promote air circulation with minimum impact from the sun's radiant heat. Siting the house is the first and most important step to passively cool a home. Along with capturing the prevailing breeze, shade, light colors, and reflective materials help keep the house cool inside.

About the Author:

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