GOOGLE BOOKS - http://books.google.com/books?id=yZQhTvvVD7sC&pg=PA36&lpg=PA36&dq=Arup+STRI+panama&source=bl&ots=Wo9PRc42Wu&sig=flrE3m7z-I_L7qlYSbCLXJIsMEY&hl=en&sa=X&ei=5WZmT73dBoHKsQKR5Mm2Dw&ved=0CDAQ6AEwAg#v=onepage&q=Arup%20STRI%20panama&f=false

Excerpt from the book, "**Sustainable Design of Research Laboratories**" by Kling Stubbins

View at entry of Smithsonian Tropical Research Institute Field Station Laboratory in Bocas del Toro, Panama, completed October 2003. *Image courtesy of Kiss + Cathcart, Architects.*

vidual team members depends absolutely on the success of the entire team. In essence, everybody wins, or nobody wins.

The following case study shows a successful example of design integration. Corresponding color images are shown in Figures C-6 through C-10. Only through a careful iterative process was the project able to incorporate significant sustainable strategies into a laboratory in a sensitive environment with significant climate challenges and aggressive energy targets.

Smithsonian Tropical Research Institute Field Station

A Field Station Laboratory in Bocas del Toro, Panama
Kiss + Cathcart, Architects
Arup, Engineers

The Smithsonian Tropical Research Institute (STRI) is a bureau of the Smithsonian Institution, and one of the world's leading centers for basic research on the ecology, behavior, and the evolution of tropical organisms. STRI retained Kiss + Cathcart with Arup Consulting Engineers USA to design the main laboratory building at its new marine research facility on land on Isla Colon, an island in the province of Bocas del Toro, Panama. The province of Bocas del Toro has coasts only on the Caribbean shoreline, and Isla Colon is one of more than 50 barrier islands which form the archipelago of Bocas del Toro. Bocas del Toro has a unique fauna and flora cover and contains the most complete record of the marine environment in the southernmost end of the Caribbean.

The site location of the Smithsonian Tropical Research Institute (STRI) Field Station Laboratory in Bocas del Toro, Panama. *Image courtesy of Smithsonian Institution.*

View of STRI Field Station Laboratory site from north, at the narrowest part of Bocas del Toro island, Panama. An existing sawmill building is visible onsite; the Caribbean Sea is on the left, Matambal Bay is on the right. *Image courtesy of Kiss + Cathcart, Architects.*

Site

The project site is a narrow strip of low-lying land between a mangrove swamp on Matambal Bay and the beach of the Caribbean Sea. Since STRI's mission is the study of marine biology and environmental science onsite, it was imperative to minimize the new building's impact while providing an exemplary scientific facility. Research performed at STRI helped prevent the building of an electricity-generating station less than a mile along the coast, because concerns arose about warming and pollution of the marine environment.

Kiss + Cathcart Architects, with Arup Engineers, designed the main laboratory building to be as close to "net zero" environmental impact as possible. The building collects all of its own water, treats all of its own waste, and generates all of its own energy, the PV roof generating 75 percent of the building's energy needs.

Density and Community Connection

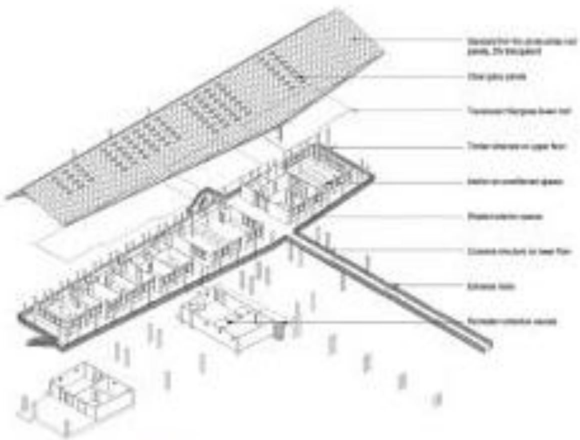
Lot size: 26,000 square miles

Building footprint: 30,800 square feet (2,860 square meters)

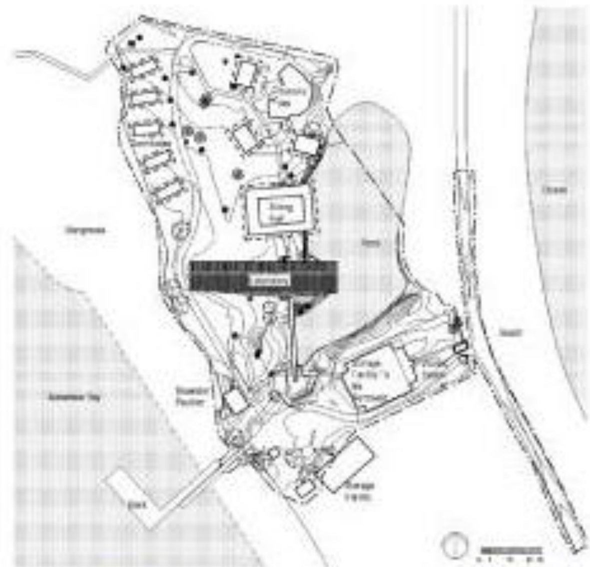
The building design takes cues from the local vernacular in its raised wood frame, siding, and large overhanging roofs. Its combination of high-tech and low-tech solutions suits its location as a remote research station with sophisticated scientific equipment.

The majority of the building's users are visiting scientists who stay either onsite in the dormitories or in the village of Bocas del Toro. Many of these offsite visitors use a bicycle, taxi, or local bus to get to the site. The amount of parking provided onsite is minimal, accommodating approximately eight cars.

continued



Raising the entire STRI Field Station Laboratory on concrete piers helps to catch prevailing breezes for passive cooling, and also provides a measure of flood protection and minimizes the lab's impact on the site. Air conditioning is zoned so that individual rooms can be cooled separately. *Image courtesy of Kiss + Cathcart, Architects.*



Site plan for STRI Field Station Laboratory in Bocas del Toro, Panama. Lot size: 26,000 square meters; building footprint: 30,800 square feet (2,860 square meters). *Image courtesy of Smithsonian Institution.*

Ecological Issues

The site is a former sawmill with landfill from the sawmill's waste. Adjacent land is lightly inhabited with a radio antenna on municipal land to the north, and small, inhabited shacks on the land to the south. Master planning of the site included protecting the mangrove swamp to the west and allowing views to both the bay and ocean sides of the site. Impervious area was minimized with gravel roads and paths. This was especially important, since the site is already often waterlogged. The concrete floor slab of the former sawmill building was reused for visitor parking. The location of the laboratory was influenced by large tree locations, the conditions of the fill, and the relationship of the building to the pond, the dock, and the seawater tank pavilion. The former pond, which had been filled with sawmill waste, was restored to provide habitat for local species. Six crocodiles now reside there. A future phase will add a constructed wetland system adjacent to the pond to treat waste from the building.

Climate and Bioclimatic Design

The basic strategy was to maximize airflow and minimize solar heat gain. The form of the building developed out of passive solar concerns. The double roof, which has an overhang large enough to prevent the sun from hitting the exterior walls, shades the enclosed, conditioned spaces. This substantially lowers solar heat gain, and ventilation of the large space between the two roofs (with louvers at the apex of the roof) prevents the build-up of hot air. The translucent lower roof, together with the partially transparent photovoltaic roof, allows an optimum 5 percent of daylight into the interior rooms for daylighting.

The building-integrated photovoltaic (BIPV) roof faces south with a shallow 17-degree pitch, designed for an optimal combination of energy generation and water capture at this latitude. The photovoltaic system provides up to 30 kilowatts (kW) of

Materials

Materials were chosen for environmental reasons, and, where possible, were left without additional finish. Sustainably harvested local hardwood was used for the upper structure and siding of the building.

Extensive research was done to find the most suitable type of wood for the upper frame and siding. The wood chosen, canafistula, is naturally very resistant to termites and fungi. FSC-certified wood is not produced in Panama, but the Panamanian environmental agency, ANAM, has its own sustainable forestry regulations, and the wood used was locally harvested and certified by ANAM.

The foundation had to be a reinforced concrete mat, because the bearing capacity of the soil was extremely low. The site is also often waterlogged, and the concrete lower level helps minimize termite and fungi damage to the upper wood structure. The same hardwood was also used for windows, doors, exterior siding, and siding in the lobby.

Wherever possible, the structure became the finish, and there are minimal other finishes; interior walls are water-resistant gypsum wallboard, and the lower roof is translucent fiberglass. Specified paints are low-VOC, and the interior floor finish is ceramic tile.

The double-roof construction of the STRI Field Station Laboratory allows light to filter through the PV and the inner roof of translucent panels, providing an even daylighting effect through the majority of spaces in the facility. *Image courtesy of Kiss + Cathcart, Architects.*

By maximizing the open-air spaces used for circulation, the STRI Field Station Laboratory in Bocas del Toro, Panama, could minimize the areas that require mechanical conditioning, which reduces the overall energy demand of the project. Shelter is required to accommodate the significant rainfall in this region. *Image courtesy of Kiss + Cathcart, Architects.*

Design for Adaptability to Future Uses

Within this structure, the interior volumes are not structural and, therefore, can be easily reconfigured for adaptive reuse. Space can be enclosed on the ground floor for additional storage and service use. The wood frame is bolted together for possible disassembly. However, as it stands right now, the building could be easily reused to serve as a hotel or school.

Indoor Environment

The building's main functions—labs for resident and visiting scientists, teaching labs, a conference room, and support spaces—occupy a string of volumes on a raised platform shaded by an overhanging pitched roof. Interior volumes are shaded by the large photovoltaic roof, which minimizes direct heat gains. The narrow plan, together with the space between the two roofs,

continued

allows cross-ventilation to keep the building cool while providing daylight and views. The translucent lower roof, along with the partially transparent photovoltaic roof, admits an optimum 5 percent of daylight into the interior rooms for daylighting. Since the exterior areas are shaded, users' eyes will have time to adjust to the lower interior light levels, and they will not immediately turn the lights on before their eyes have time to adjust.

All working spaces have translucent, daylit ceilings and are within 5 meters of a window, affording good views and daylighting. Individual occupants in all spaces have the choice of air conditioning, ceiling fans, or natural ventilation from operable windows.

Low-VOC paints were used throughout, and wood that did not need to be treated was chosen. Detailing of water runoff, along with good ventilation of all spaces, was designed to avoid conditions favorable to mildew growth.

Conclusion

Like lab design itself, the process of architectural and engineering design is undergoing profound changes, both in terms of process (integrated design) and technology (BIM). In today's complex world, it is simply not possible to create state-of-the-art facilities for research without using the most sophisticated tools and methods for design. The result will be better buildings: facilities that are more flexible, more adaptable, more cost-efficient, and better able to support the evolving needs of the research community.

Key Concepts

- Integrated design means simultaneous decision-making, broad groups of architects, engineers, construction groups, and owner groups. This is in contrast to a conventional "sequential" process where the architect makes some decisions, then passes it to an engineer who makes other modifications, and then passes it to a construction group who builds it.
- In an integrated process, tradeoffs are possible to get the most sustainable building possible.
- The integrated process includes the following tasks.
  - Research/Evaluation—Studying what is possible; what the site and climate afford
  - Criteria/Load-setting—Taking a close look at what is needed to serve the building spaces and occupants. External loads can be mitigated through design, internal loads are developed from the criteria and program. Challenging these setpoints and criteria can have a very large impact
  - Design—Including massing, orientation, envelope optimization, shading, and system design
- Building information modeling is a methodology that allows for much of the coordination that used to take place in the field to be simulated and tested in computer model form.
- Key components of BIM include :
  - 3D Modeling
  - Design Optimization
  - Construction Logistics
  - Building Operation and ongoing Performance Modeling