A TRAC-Oxfam-SIGUS/ MIT collaboration toward ***'Sustainable Housing on the Bayous'***. This project is a part of an initiative to rebuild homes destroyed by Hurricanes Rita and Katrina on the bayous of southern Louisiana, and to protect against future hurricane challenges. A broad range of interventions are considered: rebuilding and repair, outreach and training, and regulatory processes, for the formal and informal construction sectors.

Occasional Working Papers

Design-Build Research: HURRICANE SHUTTERS

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8 April 2007

A report from the SIGUS design-build workshop 'Sweat! Design! Build! in January 2007 led by Zachary Lamb, focused on practical shutters that resist hurricanes while affordable to the bayou communities.

Design-Build Team:
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An initiative of TRAC, OXFAM AMERICA, and SIGUS-MIT made possible with the generous support of donors throughout the United States. To contribute funds or volunteer for the construction of the Lift Houses, go to: http://www.trac4la.com/ . *For more information:* TRAC - www.trac4la.com - *pegcase@trac4la.com* | SIGUS-MIT - web.mit.edu/sigus - *sigus@mit.edu* | OXFAM AMERICA - www.oxfamamerica.org/gulfcoast - *info@oxfamamerica.org*

HURRICANE SHUTTERS

In the bayous few people have functional shutters: most are decorative. In hurricanes, protection is needed to prevent flying debris and to prevent high winds from entering the house, possibly lifting the roof.

The shutter designs explored in this report target the following criteria:

- Provides a tight seal for windows
- Resists flying debris
- Quick and easy to close and lock
- Affordable, made from off-the-shelf elements
- Provides shading, and operable from the inside

Exterior

Interior

Opened

Design-Build Team: Salome Francpourmoi; Anna Konotchick; Charles Mathis

A project of the SIGUS design-build workshop 'Sweat! Design! Build! in January 2007 focused on practical shutters that resist hurricanes while affordable to the bayou communities.

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HURRICANE SHUTTERS

THE CURRENT SITUATION

In the bayou region few people have functional shutters.
Many houses either have decorative shutters that are nailed to the wall, or don't have shutters at all.
When hurricanes come, protection is needed to prevent flying debris from breaking into windows at great speed, and also prevent high force winds from entering the inside of the house and possibly lifting up the roof.
One of the main window protections so far was the resort to plywood sheets nailed in front of the windows in the last moments preceding the hurricane. Although somehow efficient, this method requires some technical skills, fast work and probably adds up to anxiety when one needs to think about personal protection as well.

This study explores ways of building shutters that would meet the following requirements:

- provide tight sealing of windows against wind
- resist projection of flying debris
- provide security against burglary
- be quick and easy to close and lock
- be more affordable than ready-to-install shutters on the market
- consist of off-the-shelf elements available in local hardware stores

And, as much as possible:

- provide some kind of shading
- be workable from the inside of the house

Three full-scale prototype shutters were developed and built to test their feasibility and to assess costs.
• Prototype 1 - Cedar Tongue & Grove
• Prototype 2 - 'HardiPlank' & Pine
• Prototype 3 - HardiPlank & Metal; with 3 Shading Panels and Workable from Inside

For each, a full-scale working model was built, a price estimation was made, and the strengths and weaknesses were assessed.

Note: This is intended as a preliminary study and not a definitive report. It offers thoughts on design, market studies, and strategies for manufacturing, but only as an initial exploration.

RECOMMENDATIONS

Cedar seems to be the most appropriate base material to use, as it proves to be:

- easy & quick to cut and assemble by house owners, even with little technical skills
- strong
- safe for the manufacturer and the user (no risks linked to breathing particles)
- resistant to mould, which makes it particularly adapted to the humidity of the Louisiana climate
- cost-effective in the long-term (initial cost may be higher than other materials, but the absence of maintenance allows for savings and peace of mind on the long-term)

Therefore further study is suggested for Prototype #1, which seems to combine simplicity, resistance and sustainability in the most efficient way.
Prices of hardware could be negotiated with local manufacturers in order to obtain hinges and locking systems from the same source, which could allow for volume discounts.

SUGGESTIONS TOWARDS A FINAL DESIGN

The definitive solution for our hurricane shutters should:

- be lockable from the inside (maybe by putting the strap hinge on the other side?)
- have an optimized way of supporting windload
    - o decide whether the shutter should be larger than the window frame and support itself on the walls (decreases the risk of windows imploding if debris pushes on shutter, but shutter is on top of house surface – potential grip for winds)
    - o OR be inserted into the window frame (more risk of pushing onto the window under the pressure of debris, but house surface is completely flat, which gives less grip to winds)
- work with the shape of the window itself (solve the issue of inside screens that prevent from reaching out)
- be aesthetic in open and closed position (issues of symmetry)

PRODUCTION AND DISSEMINATION STRATEGIES

The final design of hurricane shutters should be easily used on any kind of house.
Its simplicity should allow any homeowner with basic skills to manufacture them by him- or herself.

However, it is an interesting idea to try to set up small shutter manufacturing units where these shutters are needed, in order to make them available in a faster and easier way to anyone.

Materials

Each of these units should have in store large quantities of:
- wood
- hardware

The only variable in the manufacturing of shutters is window size.
Dimensions of base materials remain the same.
Adjustments are made only in
  - number of hardware pieces used (for example, 2 pairs of strap hinges for a very tall window instead of 1 pair)
  - length of wood used (tongue & grove allows to adjust width very easily, and any extra may be sawed off)

Tools
- chop saw
- drill
- tape measure
- drawing pencil
- (calculator)

Manufacturing team

Person 1
Does measurements and cuts wood accordingly

Person 2
Assembles wood pieces and installs hardware

Installing team

Person 1
Makes measurements so that shutters are centered.
Attaches shutters to wall.

Person 2
Helps holding shutters while assembling

SCENARIO 1 - Volunteer Builders

Who?
Any group of volunteers present for any amount of time.

Where?
In volunteer camps that have the proper tools and enough space to set-up a shutter workshop

When?
Whenever a house is located that needs shutters and the owner is willing to have them installed.

Example:
House in need of shutters identified by NGO TRAC
manufacturing at PDA Village by volunteers
Transportation and installed on-site by volunteers

SCENARIO 2 - Local Builders

Who?
Local people, trained and employed for this purpose (opportunity to create 2-3 part-time jobs)

Where?
In a shutter manufacturing workshop set-up especially for this purpose
Located strategically so as to minimize transportation

When?
Permanently, as long as there is demand

Example:
House in need of shutters identified by NGO TRAC
Or
Homeowner in need of shutters contacts workshop (telephone, email, visit)
Manufactured at shutter workshop by team
Transportation and installation on-site by team
Or
Transportation and installation on-site by homeowner

KNOWLEDGE AND BEST PRACTICE DISSEMINATION

Three ways are suggested to make information available:

1) Giving a 'name' to this specific design of shutter will help spread awareness, as it makes it easier to refer to and suggests a precise image.
(Ideas for a name that would recall the genesis of the shutters and link them to Louisiana are best: *Houma Shutters, Terrebonne Shutters, Bayou Hurricane Shutters, Houma Style Shutters* …)

2) Make a handbook that describes manufacturing processes.: *'How to build Bayou Hurricane Shutter H*andbook should be:

- user-friendly (clear drawings and diagrams rather than text)
- short
- opened to updates by manufacturers (e.g. blank pages at the end can be filled with best practices discovered while making, etc. + advice)
- provide a list of contacts (stores for materials, existing manufacturers, etc.

3) Have experienced manufacturers train other people

BRINGING DOWN COSTS

Three suggestions for controlling costs:

Volume discounts
Having the manufacturing of shutters be concentrated in dedicated workshops may allow the purchase of materials at a cheaper price because in larger quantities (economies of scale).

Sourcing
If custom hardware for this specific shutter design can come from a local source (e.g. in Terrebonne parish from hardware manufacturers like Hardware Solutions), then it might be interesting to compare such prices with the prices of chain hardware stores such as Lowe's or Home Depot.

Donation systems
One may want to examine how money could be donated to help families acquire shutters.
If part of the cost (ideally the entirety) is supported through donations, then more families may be encouraged to protect their houses.
Organize a *'Buy'em Shutters'* campaign?

DISTRIBUTION ISSUES

Manufacturing Technique

The design of the shutter isn't copyrighted, but is intended to be distributed freely to any person wishing to use it.
The handbook (as well as pictures from finished / installed shutters) should be downloadable from the web.
A printed version should be easily available (perhaps place piles of handbooks in places where people gather – supermarkets, churches, etc.)

Transportation of shutters

Manufacturing units should be set up according to local needs, so as to minimize transportation to homeowners.
A regular van should be large enough as a transportation vehicle for an entire house's set of shutters.
Such considerations should be based on a study of demand, that can be made through a website as well.

Awareness

Learning about this easy way to make hurricane shutters should be made through a variety of communication channels:

- Word of mouth within communities (churches, neighborhoods, disaster relief organizations)
- Internet (set up a clear and easy website)
- Local radios + newspapers
- TV?

Here are some ideas for the content of a dedicated website:

- Description of the shutters
- Explanation of advantages / price comparison
- Downloadable handbook
- Pictures of already installed shutters
- Section for people to get on a waiting list for shutters and indicating their geographical location
- Contact list of manufacturers
- Contact list of stores for material

It should be kept into mind that people in the bayou often do not have access to the Internet and resort to other communication channels to get information.

Prototype #1 - CEDAR TONGUE & GROVE

Exterior

Interior

Opened

Exterior Closing System

Interior Closing System

Costs

Around $130 for a pair of shutters (material for 1 window).
($160 for a larger window with 2 pairs of strap hinges instead of 1)

January 2007 Prices

	Unit Price	Quantity	TOTAL
strap hinge	$11.99	2	$23.98
galvanized carriage bolt	$0.33	6	$1.98
galvanized nut	$0.13	6	$0.78
pin (hex bolt)	$1.70	1	$1.70
nut	$0.33	1	$0.33
hinge	$29.82	1	$29.82
big hook	$0.39	1	$0.39
small hook	$0.39	2	$0.78
turnbuckle eye	$0.99	2	$1.98
cedar board tongue & grove 1x6x8	$9.49	5	$47.45
cedar board 1x4x8	$4.50	3	$13.50
		sub-total	$122.69
		tax 4%	$4.91
		TOTAL	$127.60

Strengths
Strong (braced by wood and metal fasteners)
Cedar resistant to mould
Low maintenance (savings)
Windproof (tongue & grove)
Drains water outwards, dries up
Easy to build
Quick to build

Weaknesses
Cost

Prototype #2 - HARDIPLANK & PINE

Exterior

Interior

Open Exterior

Exterior Closing (center)

Exterior Closing (side)

Costs

Around $70 for a pair of shutters (material for 1 window)

January 2007 Prices

	Unit Price	Quantity	TOTAL
hinges	$29.82	1	$29.82
cedar 1x2x8	$2.84	3	$8.52
lock	$10.78	1	$10.78
Hardiplank (re-use from wall)	$0.00		$0.00
screws	$0.05	30	$1.50
woodglue	$8.00	0.1	$0.80
paint (quart)	$10.00	1	$10.00
		sub-total	$61.42
		tax 4%	$2.46
		TOTAL	**$63.88**

Strengths

Strong (Hardipanel)
If cedar frame, will not rot
Possibility of reusing Hardiplank from wall covering? (but different according to the use of sheet or plank)
Potentially cheap

Weaknesses

Takes time to build
Hardiplank is not as easy to cut as wood
Silica dust when cutting hardiplank (avoid breathing)
Hardiplank must be painted
Frame drains water inwards
Closing system not as strong as Prototype #1

Prototype #3 - HARDIPLANK & METAL - 3 SHADING PANELS - WORKABLE FROM INSIDE

Exterior

Interior

Hardiplank (inside)

Corrugated Metal Sheet Panel (outside)

Shutters in Open Position

Interior Closures

Rope Connections

Costs

About $100 for a pair of shutters (material for 1 window)

January 2007 Prices

	Unit Price	Quantity	TOTAL
tin (re-use)	$0.00		$0.00
pine 1x2x8	$2.84	5	$14.20
hold-down clamp	$13.95	1	$13.95
cleat	$1.34	1	$1.34
rope (re-use)	$0.00		$0.00
eye	$0.99	2	$1.98
hinges top	$16.34	1	$16.34
hinges sides	$29.82	1	$29.82
screws	$0.05	50	$2.50
paint (quart)	$10.00	1	$10.00
			$90.13
		tax 4%	$3.61
		TOTAL	**$93.74**

Strengths

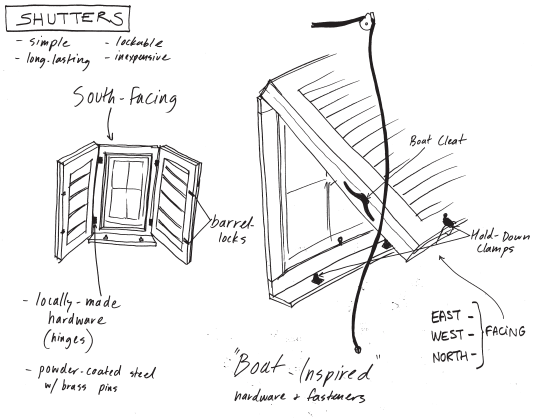
Gives shade in a flexible way (3 panels)
Possibility of reusing material (tin, boat hardware/rope)
Strong
Easily closed from the inside (latch)

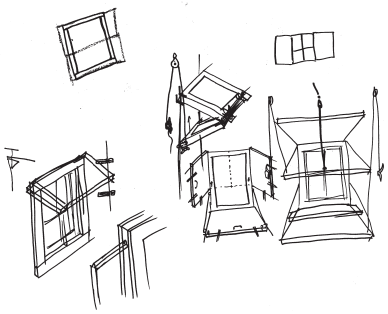
Weaknesses

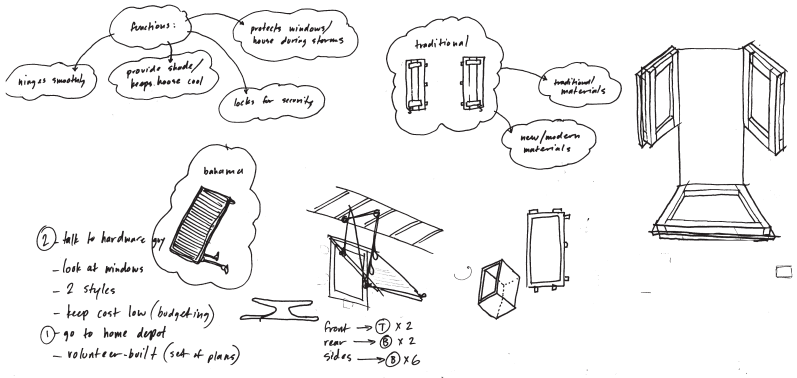
Tin is hard to cut cleanly
Heavy
Many different panels may be complicated to handle
Frame drains water inward
Hardiplank must be painted
Hardiplank is not as easy to cut as wood
Silica dust when cutting Hardiplank (avoid breathing)

Charles Mathis Salome Francpourmoi Anna Konotchick

Initial design sketches



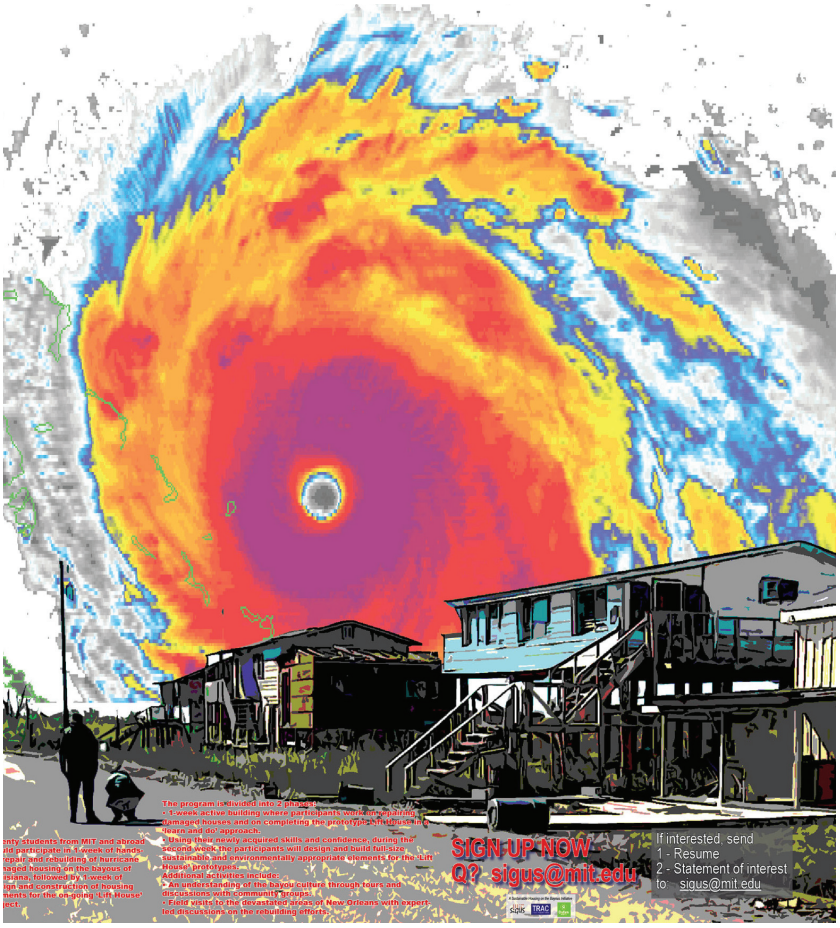




SWEAT! DESIGN! BUILD!

A Challenge to the Hurricane Twins Katrina and Rita

An International Two-Week Workshop
In Louisiana – January 6-20, 2007



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