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## Field Planning and Data Collection Practices for Conducting Detailed Natural Hazard Vulnerability Assessments of Campus Structures

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FIELD PLANNING & DATA COLLECTION PRACTICES  
FOR CONDUCTING  
DETAILED NATURAL HAZARD VULNERABILITY ASSESSMENTS  
OF CAMPUS STRUCTURES

**Shandy Ogea Heil & Carol Friedland**

**Department of Construction Management  
Louisiana State University**

2013 DISASTER RESISTANT UNIVERSITY (DRU) WORKSHOP  
UNIVERSITY OF NEW ORLEANS, MARCH 20-22

# TOPICS OF DISCUSSION

- Project Overview
- Main Objectives
- Project Goal
- Pre-Assessment Phase
- Assessment Phase
- Post-Assessment Phase



# PROJECT OVERVIEW

- LSU-Systems DRU Project



- Vulnerability assessments of over 300 campus structures
  - Hurricane/ High-Wind
  - Flood
  - Hail

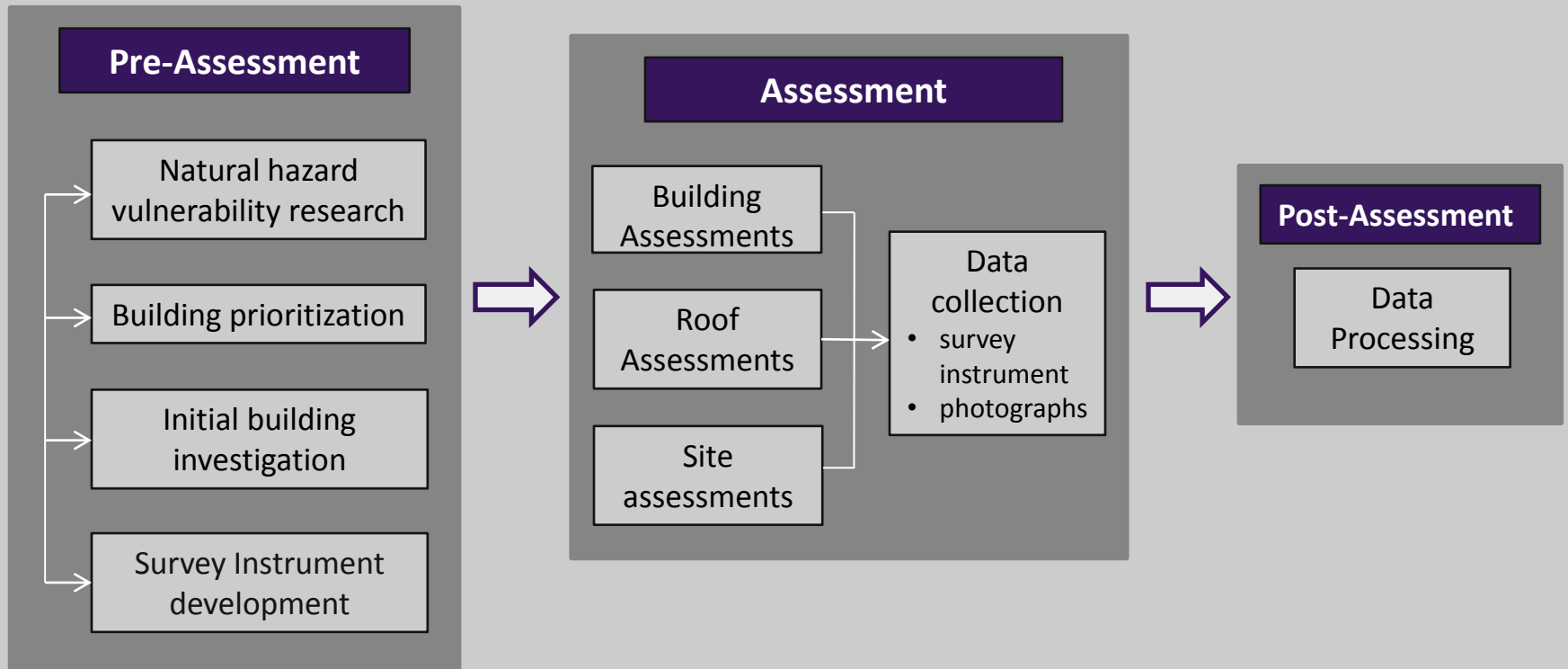
# MAIN OBJECTIVES

1. **Collect *detailed building* and **vulnerability data**** for designated *Critical Buildings*
2. **Process *assessment data***
  - i. Integrate data with **vulnerability assessment tools** (i.e. HAZUS/CDMS)
    - *Overall losses of each campus as a whole*
  - ii. Provide **per building** assessment results
    - **customized building reports**
    - Vulnerability queries
      - Summary of assessment findings
      - Potential mitigation strategies for vulnerabilities

•

# PROJECT GOAL

Develop systematic methodology for field planning and data collection practices



# PRE-ASSESSMENT PHASE

- Natural Hazard Vulnerability Research -
- Building Prioritization -
- Initial Building Investigation -
- Survey Instrument Development -

# NATURAL HAZARD VULNERABILITY RESEARCH

1. *Identify* **types of natural hazards** indicative of each area
2. Determine *magnitude* and *types* of **damage** caused during past events
  - Insurance claims
  - Maintenance reports
3. Establish **vulnerability assessment categories** for *survey instrument*
4. Develop **mitigation recommendations**
  - FEMA Assessment Team Reports case studies



# BUILDING PRIORITIZATION

- **Critical Buildings:** role *before, during, and after* a natural hazard are *crucial to the proper functioning of university operations*

<b>Critical Operations</b> (Continuous Operation)	<b>Primary Operations</b> (Resume Operation within 24 hrs.)
<ul style="list-style-type: none"> <li>➤ Power facilities</li> <li>➤ Public evacuation centers</li> <li>➤ Police headquarters</li> <li>➤ Computing services/ communication hubs</li> </ul>	<ul style="list-style-type: none"> <li>➤ Facilities housing live animals or temperature sensitive research specimen (<b>require electricity</b>)</li> <li>➤ Student health centers</li> <li>➤ Primary food facilities</li> <li>➤ Administration/operations buildings</li> </ul>
<b>Secondary Operations</b> (Resume Operation within 1 week)	<b>General Operations</b> (Resume operation within 30 days)
<ul style="list-style-type: none"> <li>➤ Facilities vital for the normal operation               <ul style="list-style-type: none"> <li>• Heavily used classroom</li> <li>• Technology centers</li> <li>• Facilities that generate income</li> </ul> </li> <li>➤ Secondary food facilities</li> </ul>	<ul style="list-style-type: none"> <li>➤ Facilities not vital to university operation               <ul style="list-style-type: none"> <li>• Classrooms used only by a small population of students</li> <li>• Miscellaneous, low priority buildings</li> </ul> </li> </ul>

# INITIAL BUILDING INVESTIGATION

## 1. Obtain **construction documents** and **building records**

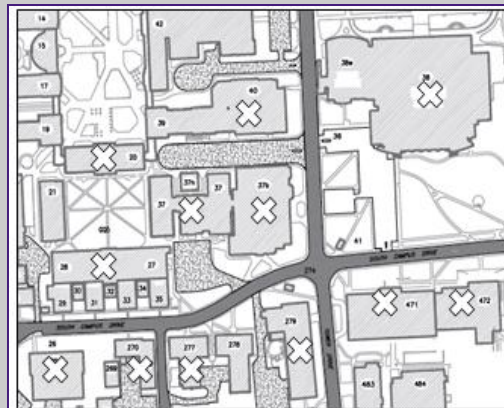
- Building attributes that cannot be observed visually
  - Structure, Roof, & Foundation Types

## 2. Conduct **interview** with **person(s)** knowledgeable about each building

- Confirm current vulnerabilities or recurrent problem areas
- Determine points of entry (door & roof access)

## 3. **Locate Critical Buildings** on **campus map** and through **aerial imagery**

- Building location
- Roof types



# SURVEY INSTRUMENT DEVELOPMENT



## Survey Instruments

ENGINEERED BUILDINGS		<input type="checkbox"/> Commercial	<input type="checkbox"/> Residential	
1. How Many Stories?		<input type="checkbox"/> 1-4 stories	<input type="checkbox"/> 5-9 stories	<input type="checkbox"/> 10 or more stories
<b>Building Assessment Form</b>		<b>Assessor:</b>	<b>Date:</b>	
Location - City/State - Zip/County/Parish		<b>Building ID:</b>	<b>Other Building ID:</b>	
Photo #1 (if any)		Comments/Notes		
Name last of Assessor		Location (Floor/Elevation (ft))		
Building Type		<input type="checkbox"/> Unknown	<input type="checkbox"/> Warehouse	<input type="checkbox"/> Store
Building Condition		<input type="checkbox"/> Unknown	<input type="checkbox"/> Excellent	<input type="checkbox"/> Fair
Construction Date		<input type="checkbox"/> Unknown	<input type="checkbox"/> Concrete	<input type="checkbox"/> Steel
Is it a Flood Hazard?		<input type="checkbox"/> Unknown	<input type="checkbox"/> No	<input type="checkbox"/> Yes
Elevation		<input type="checkbox"/> Unknown	<input type="checkbox"/> 1st	<input type="checkbox"/> 2nd
Mechanical Equipment Height (ft)		<input type="checkbox"/> Unknown	<input type="checkbox"/> 1st	<input type="checkbox"/> 2nd
Number of Assessment Levels		Current Value in Assessment (ft of Surface Building)		
Transparency		<input type="checkbox"/> Unknown	<input type="checkbox"/> High	<input type="checkbox"/> Low
Material Exposure		<input type="checkbox"/> Unknown	<input type="checkbox"/> Steel Frame	<input type="checkbox"/> Concrete
Wind Up Rating		<input type="checkbox"/> Unknown	<input type="checkbox"/> None	<input type="checkbox"/> Low
Roofing Height		<input type="checkbox"/> Unknown	<input type="checkbox"/> Tall	<input type="checkbox"/> Short
Windborne Debris Source		<input type="checkbox"/> Unknown	<input type="checkbox"/> None	<input type="checkbox"/> Low
Windborne Debris		<input type="checkbox"/> Unknown	<input type="checkbox"/> None	<input type="checkbox"/> Low
Windborne Debris		<input type="checkbox"/> Unknown	<input type="checkbox"/> None	<input type="checkbox"/> Low

- Custom/Campus-specific
- Standardized Format

# SURVEY INSTRUMENT DEVELOPMENT

## Two Data Categories:

### GENERAL BUILDING AND SITE ATTRIBUTES

- Building & Roof *structure types* (i.e. steel, masonry, wood)
- Building envelope *material types* (wall cladding, roof membrane)
- *Foundation type*
- *Number of stories*
- *Site topography*

### VULNERABILITY ASSESSMENT CRITERIA

- *Overall condition* of building & roof
- *Lowest floor elevation* to determine the BFE
- *Holes in the building envelope* (wind pressurization & rain infiltration)
- *Glass construction type* (i.e. singled pane annealed, shatter-resistant)
- *Quantity and types of openings* (windows, exterior doors, garage doors)
- *Roof drainage* performance
- *Attachment of:* rooftop equipment, awnings, & architectural features
- *Wind-borne debris* sources
- *Overhanging* trees

# SURVEY INSTRUMENT DEVELOPMENT

## Engineered

ENGINEERED BUILDINGS		<input type="checkbox"/> Commercial	<input type="checkbox"/> Residential	1
<input type="checkbox"/> High Rise (7-5 stories)		<input type="checkbox"/> Medium-Rise (3-6 stories)		2
<input type="checkbox"/> Low Rise (1-2 stories)				3
<b>Building Assessment Form</b> (Adapted from Dr. Carol Penland/res. 3)		Surveyor:	Date:	4
Location: <input type="checkbox"/> Mid-Rise <input type="checkbox"/> Mid-South Campus <input type="checkbox"/> Mid-Rise <input type="checkbox"/> Mid-Rise <input type="checkbox"/> Mid-Rise		Building ID:	Other Building ID info:	5
Photo #1's (left range): _____ to _____		Camera(s) Used:		6
Number of Stories:		Lowest Floor Elevation (ft):		7
Building Type: <input type="checkbox"/> Unknown <input type="checkbox"/> Warehouse <input type="checkbox"/> Retail <input type="checkbox"/> Concrete				8
Building Condition: <input type="checkbox"/> Unknown <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor				9
Construction Class: <input type="checkbox"/> Unknown <input type="checkbox"/> Concrete <input type="checkbox"/> Masonry <input type="checkbox"/> Steel <input type="checkbox"/> Wood <input type="checkbox"/> Other				10
Significant Features: <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No				11
Substructure: <input type="checkbox"/> Unknown <input type="checkbox"/> Pile <input type="checkbox"/> Pier (per post or beam)				12
Foundation: <input type="checkbox"/> Unknown <input type="checkbox"/> Concrete <input type="checkbox"/> Masonry <input type="checkbox"/> Pile <input type="checkbox"/> Other				13
Mechanical Equipment Height (ft):		Number of Basement Levels:		14
Parties at Assessment (Name):		Contract Value in Assessment (Name of Entire Building):		15
Topography: <input type="checkbox"/> Unknown <input type="checkbox"/> Flat <input type="checkbox"/> Valley <input type="checkbox"/> Ridge <input type="checkbox"/> Slope				16
Wind Exposure: <input type="checkbox"/> Unknown <input type="checkbox"/> Open Field <input type="checkbox"/> Open Land <input type="checkbox"/> Forested <input type="checkbox"/> Suburban				17
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				18
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				19
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				20
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				21
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				22
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				23
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				24
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				25
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				26
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				27
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				28
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				29
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides				30

## Pre-Engineered

PRE-ENGINEERED BUILDINGS		<input type="checkbox"/> Large	<input type="checkbox"/> Medium	<input type="checkbox"/> Small	1
<input type="checkbox"/> High Rise (7-5 stories)		<input type="checkbox"/> Medium-Rise (3-6 stories)			2
<input type="checkbox"/> Low Rise (1-2 stories)					3
<b>Building Assessment Form</b> (Adapted from Dr. Carol Penland/res. 3)		Surveyor:	Date:		4
Location: <input type="checkbox"/> Mid-Rise <input type="checkbox"/> Mid-South Campus <input type="checkbox"/> Mid-Rise <input type="checkbox"/> Mid-Rise <input type="checkbox"/> Mid-Rise		Building ID:	Other Building ID info:		5
Photo #1's (left range): _____ to _____		Camera(s) Used:			6
Number of Stories:		Lowest Floor Elevation (ft):			7
Building Type: <input type="checkbox"/> Unknown <input type="checkbox"/> Warehouse <input type="checkbox"/> Retail <input type="checkbox"/> Concrete					8
Building Condition: <input type="checkbox"/> Unknown <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor					9
Construction Class: <input type="checkbox"/> Unknown <input type="checkbox"/> Concrete <input type="checkbox"/> Masonry <input type="checkbox"/> Steel <input type="checkbox"/> Wood <input type="checkbox"/> Other					10
Significant Features: <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No					11
Substructure: <input type="checkbox"/> Unknown <input type="checkbox"/> Pile <input type="checkbox"/> Pier (per post or beam)					12
Foundation: <input type="checkbox"/> Unknown <input type="checkbox"/> Concrete <input type="checkbox"/> Masonry <input type="checkbox"/> Pile <input type="checkbox"/> Other					13
Mechanical Equipment Height (ft):		Number of Basement Levels:			14
Parties at Assessment (Name):		Contract Value in Assessment (Name of Entire Building):			15
Topography: <input type="checkbox"/> Unknown <input type="checkbox"/> Flat <input type="checkbox"/> Valley <input type="checkbox"/> Ridge <input type="checkbox"/> Slope					16
Wind Exposure: <input type="checkbox"/> Unknown <input type="checkbox"/> Open Field <input type="checkbox"/> Open Land <input type="checkbox"/> Forested <input type="checkbox"/> Suburban					17
Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides					18
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Wind Obstacles: <input type="checkbox"/> Unknown <input type="checkbox"/> None <input type="checkbox"/> One Side <input type="checkbox"/> Two Sides					30

## Roof

ROOF (STAPLE TO OTHER FORM)		1
<b>Building Assessment Form</b> (Adapted from Dr. Carol Penland/res. 3)		2
Surveyor:		3
Date:		4
Roof Geometry: <input type="checkbox"/> Other <input type="checkbox"/> Gable <input type="checkbox"/> Hip <input type="checkbox"/> Complex <input type="checkbox"/> Dome		5
Roof Slope: <input type="checkbox"/> 0° <input type="checkbox"/> 15° <input type="checkbox"/> 30° <input type="checkbox"/> 45° <input type="checkbox"/> 60°		6
Roof Length: <input type="checkbox"/> Unknown <input type="checkbox"/> 0-2 feet <input type="checkbox"/> 2-4 feet		7
Roof Width: <input type="checkbox"/> 0-2 feet <input type="checkbox"/> 2-4 feet <input type="checkbox"/> 4-6 feet <input type="checkbox"/> 6-8 feet		8
Roof Height: <input type="checkbox"/> 0-2 feet <input type="checkbox"/> 2-4 feet <input type="checkbox"/> 4-6 feet <input type="checkbox"/> 6-8 feet <input type="checkbox"/> 8-10 feet <input type="checkbox"/> 10-12 feet		9
Roof Material: <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10		10
Roof Coating Condition: <input type="checkbox"/> Unknown <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor		11
Type of Roof Covering: <input type="checkbox"/> Unknown <input type="checkbox"/> Asphalt Shingle <input type="checkbox"/> Clay Tile <input type="checkbox"/> Metal <input type="checkbox"/> Membrane with Ballast <input type="checkbox"/> Membrane without Ballast <input type="checkbox"/> Other		12
Type of Roof Deck: <input type="checkbox"/> Unknown <input type="checkbox"/> Wood <input type="checkbox"/> Metal <input type="checkbox"/> Cast-in-Place Concrete <input type="checkbox"/> Steel <input type="checkbox"/> Precast Concrete <input type="checkbox"/> Other		13
Approximate Roof Area:		14
Specialty Attachments: <input type="checkbox"/> Unknown <input type="checkbox"/> Hurricane Clips <input type="checkbox"/> Wind Ties <input type="checkbox"/> Other		15
Evidence of Water Damage: <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No		16
Evidence of Water Penetration: <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No		17
Roof Drains, Blocks, Chuggins: <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No		18
Number of Roof Drains: <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10		19
Roof Condition: <input type="checkbox"/> Unknown <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Partial		20
Other Comments:		21

# ASSESSMENT PHASE

- Building Assessments -
- Site Assessments -
- Roof Assessments -

# FIELD ASSESSMENTS

Collect ***General Building*** and ***Site Attributes & Vulnerability Assessment Criteria***

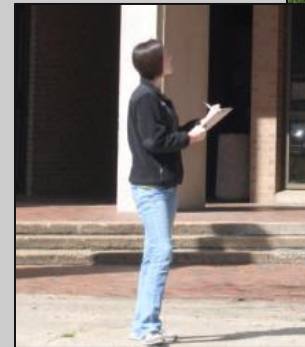
- Building
- Site
- Roof

**Assessment data collected through:**

- Documentation of survey instrument criteria
- Photographs



Engineered



Pre- Engineered

# ASSESSMENT TECHNIQUES

## Building Assessments

- Walking inspection from ground
- Around building parameter
- Foundation – Wall – Roof Connection
- Basement



## Site Assessments

- Walking inspection of site
- Attention to neighboring structures/conditions



# ASSESSMENT TECHNIQUES

## Roof Assessments

- Flat roofs
- Sloped roofs



Physical Assessment



Remote Assessment



Ground-based



Aerial Imagery via UAV

# VULNERABILITY ASSESSMENT CRITERIA OVERVIEW

# BUILDING CONDITION

- Subjective determination
- Dependent on overall condition of the **exterior envelope** and **foundation**
- Generally coincides with the **age** and **maintenance** of the building
  - Fair to Poor Condition = Greater Vulnerability

## Excellent



- Built < 5 years, recently remodeled, or well-maintained buildings with no deficiencies
- Exterior building envelope free of deficiencies
- Small ancillary items sufficiently attached and in good condition (gutters and decorative features)



# BUILDING CONDITION

**Good**



- Built >5 years & <20 years, or well-maintained buildings with minor deficiencies
- Minor exterior envelope and attachment deficiencies

**Note: 1930's building classified in "good condition" due to maintenance level**



Loose fascia board



Missing gutter hardware attachments



# BUILDING CONDITION

**Fair**



- Built >15 years, <50 years, or moderately maintained buildings with repairable deficiencies
- Moderate exterior envelope and attachment deficiencies



Building envelope largely comprised of Non-shatter resistant windows in poor condition

# BUILDING CONDITION

## Poor



- Buildings that have not been maintained and pose a threat to neighboring buildings in a high-wind or flood event.
- Minor exterior envelope and attachment deficiencies



Roof deck deterioration at building connection



Missing/broken clay tiles



Windows in very poor condition



Insufficiently attached gutter

# ROOF CONDITION

**Excellent**



- No deficiencies
- New construction or newly re-roofed buildings

**Good**



- No missing tiles, shingles, or other roof membrane type
- No visible water damage
- Predominate condition category for campus buildings



# ROOF CONDITION

**Fair**



- Minor flaws (evidence of water ponding, isolated repairs, membrane attachment issues)
- Flaws that could potentially affect the structural integrity of the roof system

**Poor**



- Missing tiles, shingles, or membrane cover that expose roof deck
- Heavy corrosion of metal roof systems and attachments
- Original roof systems that have not been maintained



# LOWEST FLOOR ELEVATION & HEIGHT OF MECHANICAL EQUIPMENT

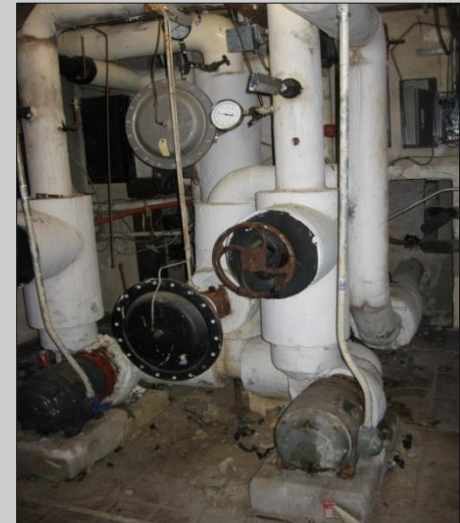
- Determines if building and equipment are *above the BFE*



Measurement of foundation thickness



Above grade mechanical equipment atop cement foundation



Below grade mechanical equipment located in a basement room

# HOLES IN BUILDING ENVELOPE

- ***Wind Pressurization*** during **high-wind events**
- ***Rain infiltration*** into **interior**



Deterioration of Soffits



Missing vent covers



Windows with flashing,  
sealant or gasket failures of  
the sash and frame

# GLASS CONSTRUCTION & OPENINGS

- **Wind Pressurization and Rain Infiltration**
- **Hail!**



Non-Impact Resistant  
vs.  
Impact Resistant



Building envelopes with high amount  
of Non-Resistant windows



Roll-up Garage Doors

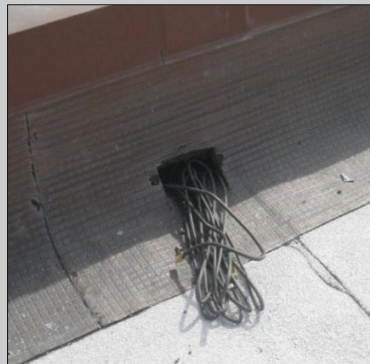


# ROOF DRAINAGE PERFORMANCE

## Detection of *Rooftop Ponding*

### Drainage Inspection

- *Drains*
- *Scuppers*
- *Gutters*
  - Source of Clogs
  - Quantity & Placement



# ATTACHMENT

## ROOFTOP EQUIPMENT & COMPONENTS

### HVAC Equipment

- Fans, Vents, Condensers

### Lightening Protection

### Communication Equip.

### Flashing & Skylights



# ATTACHMENT

## BUILDING ACCESSORIES



Light-Frame Carports



Awning-to-Building Attachment



# WIND-BORNE DEBRIS SOURCES

## Debris from Buildings

- Roofing Materials
- Rooftop Equipment
- Awnings/Carports
- Gutters
- Flashing



## Non-Building Related Debris

- Outdoor furniture
- Lightweight, Unanchored containers
- Appurtenant Structures/Sheds
- Fencing



# OVERHANGING TREES



Branches over Structures



Tree related Drainage Issues



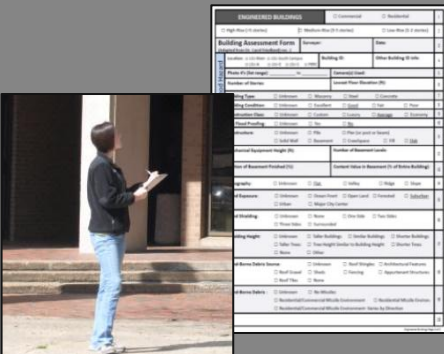
# POST-ASSESSMENT PHASE

- Data Processing -

# PROJECT SEQUENCE

## Data Collection

Field assessments using detailed **data survey instrument**



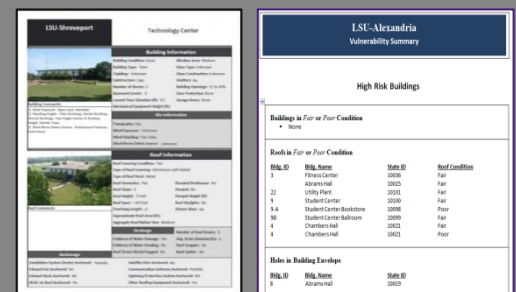
## Data Entry

Input of assessment data into **customized database**



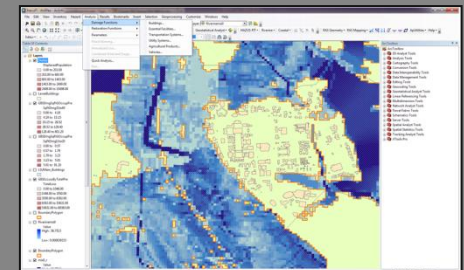
## Data Processing

Detailed, individual building **reports & vulnerability queries**



## Data Processing

Integration with **Vulnerability Assessment Tools** to determine potential losses caused by regional natural disasters

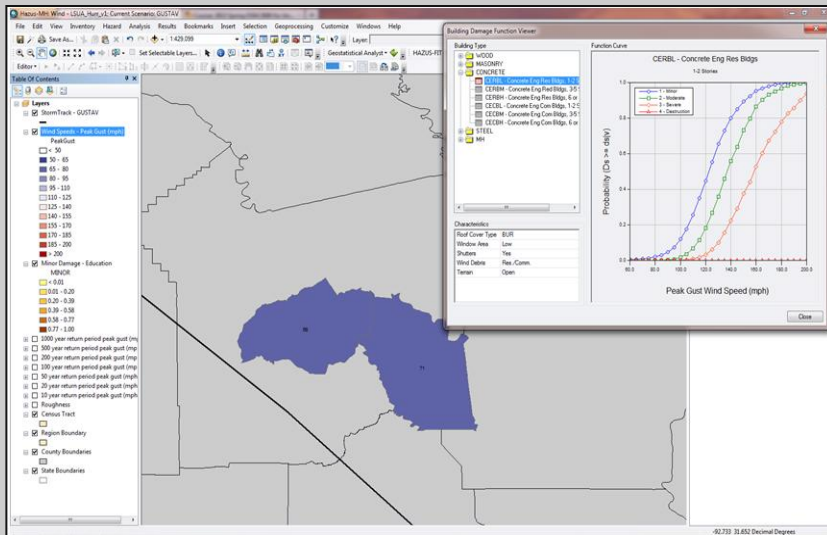


# DATA PROCESSING RESULTS

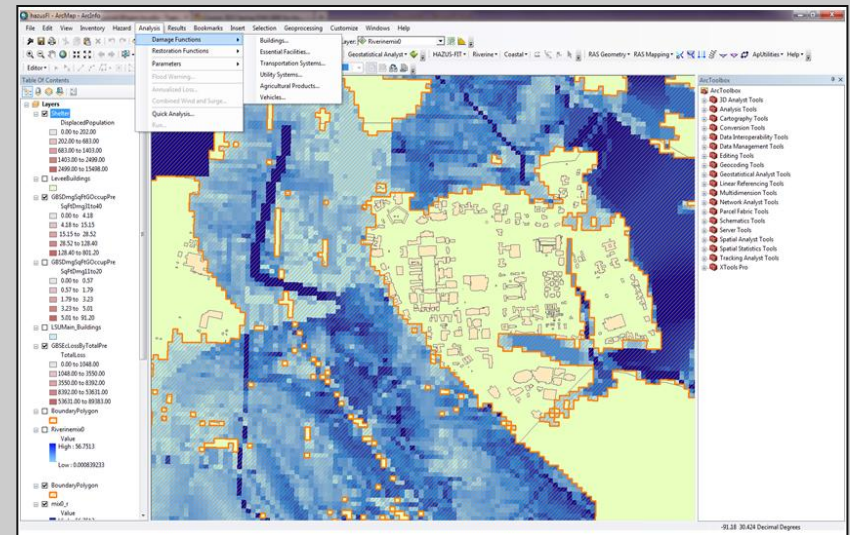
## HAZUS Analysis

- Campus-wide Scale

### Hurricane/High-Wind Losses





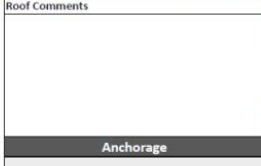
### Flood Losses










# DATA PROCESSING RESULTS

## Customized building reports

- Per Building Scale

LSU-A&M		Thomas Boyd Hall Building ID: 4	
 <p><b>Building Comments:</b> 1) Wind-Borne Debris: Roof gravel &amp; clay tiles from surrounding bldgs. Photo 5: loose gutter</p>		Building Information	
		Building Condition: Good Building Type: Steel Substructure: Unknown Cladding: Stucco Number of Stories: 4 Basement Levels: 0 Lowest Floor Elevation (ft): 0 Mechanical Equip. Height (ft): 0	Building Openings: 31 to 40% Door Protection: None Garage Doors: None Window Area: Medium Glass Type: Unknown Glass Construction: Unknown Shutters: No
 <p><b>Roof Comments</b></p>		Site Information	
		Topography: Flat Wind Exposure: Suburban Wind Shielding: Three Sides Wind-Borne Debris Source: Unknown	
 <p><b>Roof Comments</b></p>		Roof Information	
		Roof Covering Condition: Good Roof Covering Type: Asphalt Section, Clay Tile Roof Deck Type: Cast-in Place Concrete, Wood Roof Geometry: Flat Roof Slope: 30 Roof Height: 0 Feet, 15 Feet Roof Span: Unknown Overhang Length: 0-2 feet Approximate Roof Area (SF): Aggregate Roof Ballast Size: None	Elevated Penthouse: Yes Parapet: No Parapet Height (ft): Roof Skylights: No Atrium Glass: No
<p><b>Drainage</b></p>		Evidence of Water Damage: No Evidence of Water Ponding: Yes Roof Drain Blocked/Clogged: No	
		Number of Roof Drains: 2 Avg. Drain Diameter(in): 4 Roof Scupper: No Roof Gutter: Yes	
<p><b>Anchorage</b></p>		Ventilation System (Vents) Anchored: Unknown Exhaust Fan Anchored: Partially Exhaust Stack Anchored: NA HVAC on Roof Anchored: Partially	
		Satellite Dish Anchored: NA Communication Antenna Anchored: NA Lightning Protection System Anchored: NA Other Rooftop Equipment Anchored: NA	

Current Problems & Vulnerabilities		
 <p>Drainage Issue: Evidence of water ponding on rooftop</p>	 <p>Fan Cowling Attachment: Fan cowlings should be attached to the curb with steel cables. Wind Speed Conditions and Cable Sizes can be determined from FEMA guidelines in (Ref. 1)</p>	 <p>Securing Small Rooftop Equipment to Curbs: Attach stacks, exhaust fans and air intakes to the curb with corrosion resistant fasteners not exceeding 6in. on centers between the equipment, transition pieces, and the roof curb. (Ref. 1)</p>
 <p>Air Conditioning Condensers and Similar Equipment: Condensers and similar equipment should be secured with straps fastened to the stand, curb, or roof deck. (Ref. 1)</p>	 <p>Wind-Borne Debris: Wind-Borne debris can cause significant damage to windows and other components of the building envelope. Debris sources for each building are listed under Building Information or Building Comments of the report. (Ref. 3)</p>	 <p>Wind-Borne Debris: Wind-Borne debris can cause significant damage to windows and other components of the building envelope. Debris sources for each building are listed under Building Information or Building Comments of the report. (Ref. 3)</p>
 <p>Overhanging Trees: Tree located near or above structures should be trimmed periodically to prevent damage to the structure and reduce the amount of organic debris on rooftops which pose drainage issues and potential fire hazards.</p>		

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LSU System Disaster Resistant University

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# DATA PROCESSING RESULTS

## Vulnerability queries

### LSU-Alexandria Vulnerability Summary

#### High Risk Buildings

##### Buildings in *Fair* or *Poor* Condition

- None

##### Roofs in *Fair* or *Poor* Condition

<u>Bldg. ID</u>	<u>Bldg. Name</u>	<u>State ID</u>	<u>Roof Condition</u>
3	Fitness Center	10036	Fair
	Abrams Hall	10015	Fair
22	Utility Plant	10101	Fair
9	Student Center	10100	Fair
9-A	Student Center Bookstore	10098	Poor
9B	Student Center Ballroom	10099	Fair
4	Chambers Hall	10021	Fair
4	Chambers Hall	10021	Poor

##### Holes in Building Envelope

<u>Bldg. ID</u>	<u>Bldg. Name</u>	<u>State ID</u>
8	Abrams Hall	10019

### Vulnerable Building Envelope Components

#### Buildings with Single Pane Windows

<u>Bldg. ID</u>	<u>Bldg. Name</u>	<u>State ID</u>
2	Avoyelles Hall	10016
20	Human Resources	10085
23	Child Care Center	12811
22	Utility Plant	10101
6	Bolton Library	10018

#### Buildings with Skylights

<u>Bldg. ID</u>	<u>Bldg. Name</u>	<u>State ID</u>
1	Science	10088
3	Fitness Center	10036

#### Buildings with Garage Doors

<u>Bldg. ID</u>	<u>Bldg. Name</u>	<u>State ID</u>	<u>No. of Doors</u>
6	Bolton Library	10018	1 Door
	Facility Service	10081	4 Doors

### Drainage Issues

#### Evidence of Ponding

<u>Bldg. ID</u>	<u>Bldg. Name</u>	<u>State ID</u>
1	Science	10088
3	Fitness Center	10036
5	Coughlin Hall	10053
7	Oakland	10080
	Abrams Hall	10015
22	Utility Plant	10101
9	Student Center	10100
9-A	Student Center Bookstore	10098
9B	Student Center Ballroom	10099
4	Chambers Hall	10021

# CONCLUSIONS

- **Hazus assessments** *reflected actual building conditions*
- **Queries** for each major vulnerability were *utilized for the LSU-Systems DRU report*
- *University personnel* found **building reports** extremely *useful* for vulnerability detection and mitigation actions

FIELD PLANNING & DATA COLLECTION PRACTICES  
FOR CONDUCTING  
DETAILED NATURAL HAZARD VULNERABILITY ASSESSMENTS  
OF CAMPUS STRUCTURES

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