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# Natural Hazard Mitigation Plan Update for the University of Mississippi

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# Outline

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# Background

- The Disaster Resistant University (DRU) Project was initiated on August 24, 2004, with a grant of $75,000 provided by the Federal Emergency Management Agency (FEMA) and administered by the Mitigation Bureau of the Mississippi Emergency Management Agency (MEMA).

- The goal of the DRU project was to create a natural multi-hazard mitigation plan for the University of Mississippi with emphasis on those hazards considered most likely to cause major damage.

- The Center For Community Earthquake Preparedness (CCEP) at the University of Mississippi prepared the original mitigation plan with input of the DRU Advisory Committee formed at the beginning of the project.

# 2006 DRU Mitigation Plan

The completed DRU plan was submitted to MEMA and approved by FEMA in July of 2006. A total of eight hazardous natural disasters were identified that could potentially harm the campus of The University of Mississippi. A HAZUS-MH based risk analysis was performed and the following losses were estimated:

| | |
|---|---|
| **1) Tornado** | **- $129,222,000;** |
| **2) Earthquake** | **- $112,907,344;** |
| **3) Straight-line Wind** | **- $30,077,000**; |
| 4) Severe Winter Weather | - $705,000; |
| 5) Lightning | - $9,754,112; |
| 6) Hail | - $5,443,938; |
| 7) Wildfire | - insignificant losses |
| 8) Flood | - insignificant losses |

# 2011 Five Year DRU Update

- A three year research program
- ~$84,000 MEMA Hazard Mitigation Grant
- Natural hazard assessment update
- Risk analysis update
- DRU Advisory committee review
- Public meetings to obtain stakeholder input on hazards, risk analysis, mitigation actions, priorities

# Necessities for DRU Study Upgrade

- Construction and/or extensive remodeling or re-purposing of buildings on the campus property
- Change in costs of buildings and contents (inflation, change in building utilization, change in interior inventory, etc.)
- Revision of loss estimation methodologies
- Changes in natural hazard intensities, per the recommendations of the previous DRU committee and new building code (per IBC 2012).

# Major Changes in Data Used for Natural Hazard Considerations

| HAZARD | 2005 | 2013 | MOTIVATION |
|---|---|---|---|
| **Tornado** | F3 | EF4 | Recent Tornadic Activity (2009 Oxford, MS; 2011 Tuscaloosa, AL; 2011 Smithville, MS; 2011 Joplin, MO) |
| **Earthquake** | 14% g | 25% g | 2009 MAEC Catastrophic NMSZ Event (M7.7 Scenario-Segment Release) |
| **Wind Storm** | 100 mph | 115 mph | Memphis Wind Event and updates to building code (IBC 2012 Peak 3s Gust Maps) |

# Recent Tornado Hazards


Tuscaloosa, AL

Joplin, MO

Smithville, MS

# University of Mississippi-0xford Campus

(Source: Google Maps)

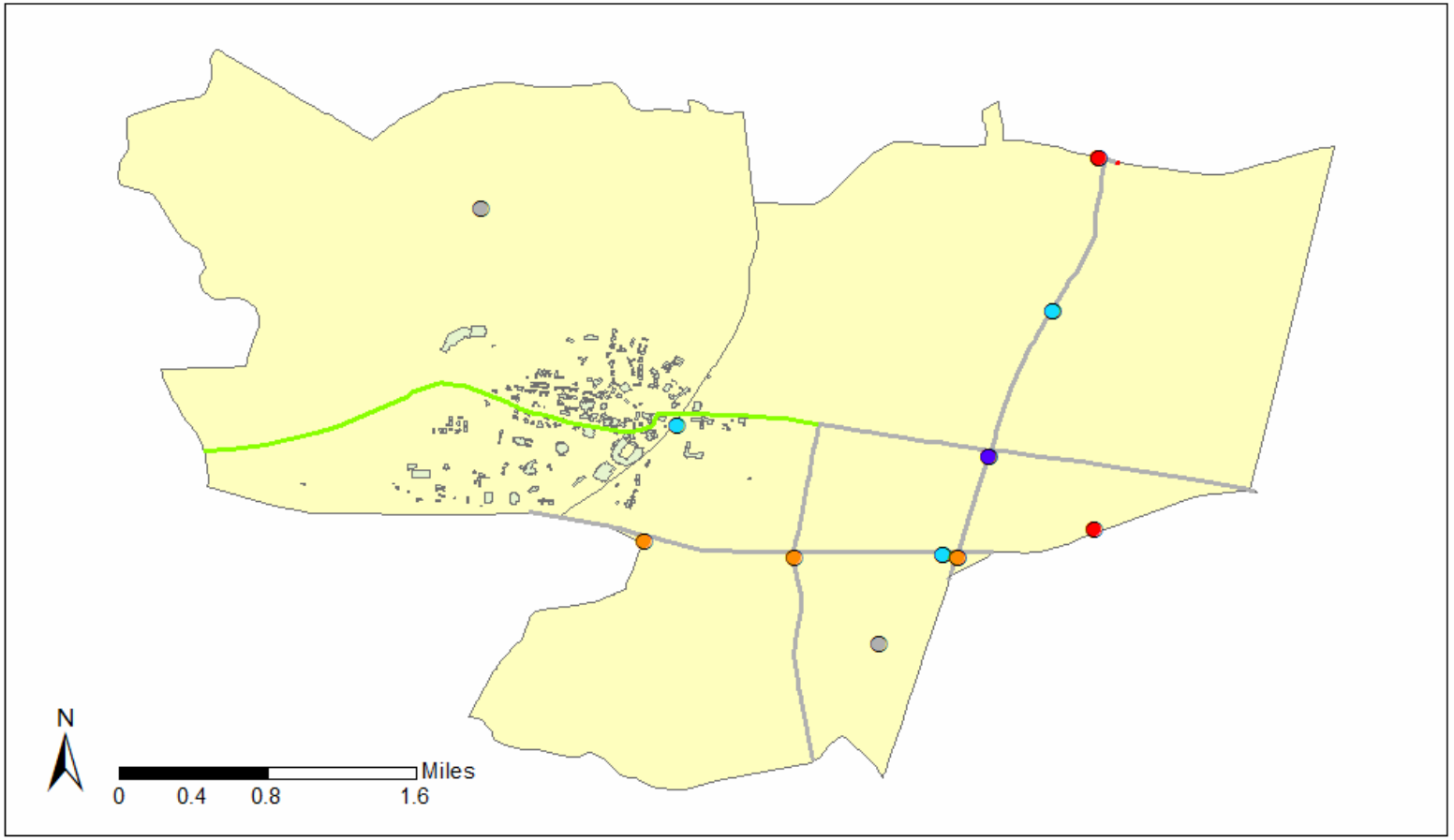
# Major Changes in Inventory

## New Buildings (RC>$10M)

| FACILITY | 2013 RC $M | 2013 CV $M |
|---|---|---|
| Robert C. Khayat Law Center | 50.0 | 68.9 |
| Campus Walk | 33.1 | ? |
| Indoor Practice Facility | 31.7 | ? |
| Jackson Avenue Center | 23.1 | ? |
| Center for Manufacturing Excellence | 11.0 | 1.6 |

# HAZUS-MH Updated DRU Study Region
## (Campus Building Inventories)

Study Region : DRU Tracts



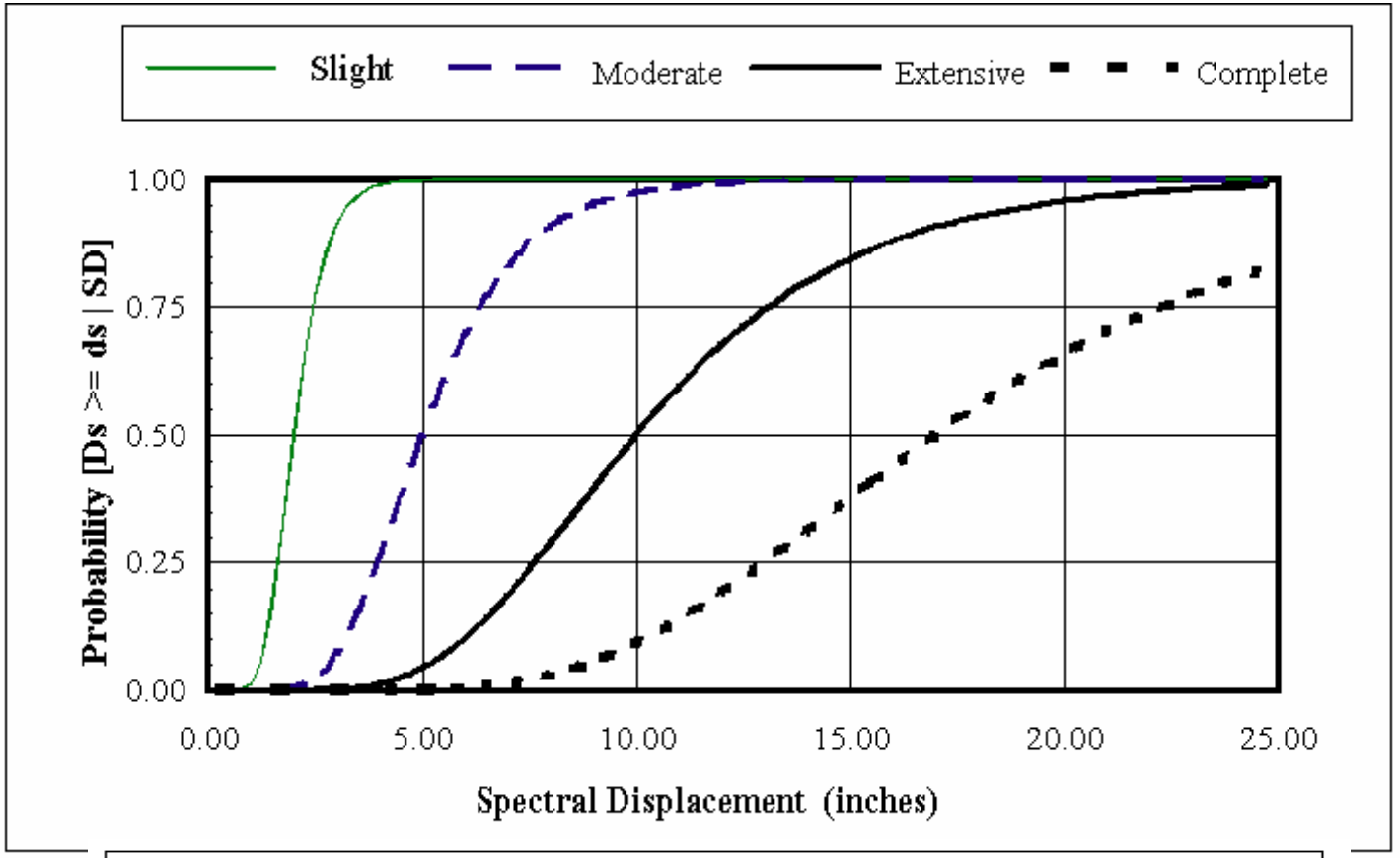
# Update Study Methodology

- In the DRU update study, the newest version of HAZUS-MH (MR5) has been used to estimate the losses for earthquake and wind hazards.

- Building damage models for earthquake, flood, and hurricane have been modified by FEMA in the newer version since their first release of HAZUS-MH.

- HAZUS contains GIS based methodology used for mitigation and recovery as well as preparedness and response.

# Fragility Curves for Earthquake Damage





Source: HAZUS technical manual

# Earthquake Loss Estimation Methodology

$$CS_{ds,i} = BRC_i * \sum_{i=1}^{33} PMBTSTR_{ds,i} * RCS_{ds,i}$$

$$CS_i = BRC_i * \sum_{ds=2}^{5} CS_{ds,i}$$

$CS_{ds,i}$ = cost of structural damage (repair and replacement costs) for damage state ds and occupancy "i"

$BRC_j$ = building replacement cost of occupancy "j"

$PMBTSTR_{ds,i}$ = probability of occupancy "i" being in structural damage state ds

$RCS_{ds,i}$ = structural repair and replacement ratio for occupancy "i" in damage state ds

# Tornado Loss Estimation

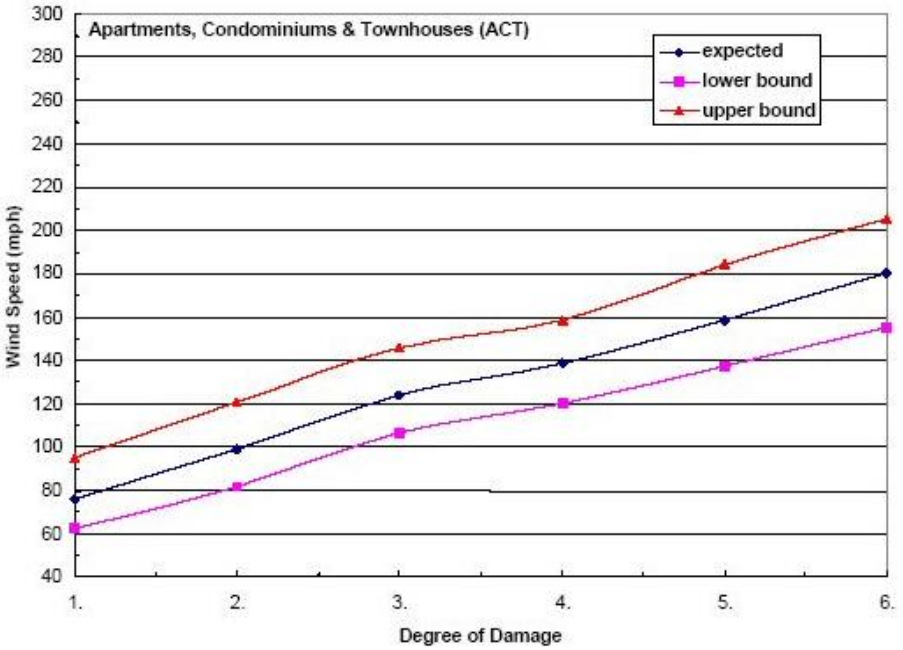
- Since there are not any standardized loss estimation models for tornadoes, preliminary loss estimation due to tornado hazards have been made based on our engineering judgment from EF4 degree of damages
- Estimated functional downtime and displacement time following a tornado was also considered in estimating loss ratio
- A statistical assessment methodology is being studied for more precise estimation
- Estimated contents loss was based on the amount of damage to the structures.

# Tornado Loss Estimation (EF4=168-199mph)

5. APARTMENTS, CONDOMINIUMS AND TOWNHOUSE
(Three stories or less)

Typical Construction

- Flat, gable, hip, or mansard roof
- Asphalt shingles, tile, metal, or BUR roof covering
- Plywood/OSB roof decking
- Light-framed wood or metal roof trusses
- Wood, metal, or vinyl panels, stucco brick veneer or El combinations of wall coverings
- Wood or metal stud walls
- Wood floor diaphragms
- Sliding patio doors; balconies



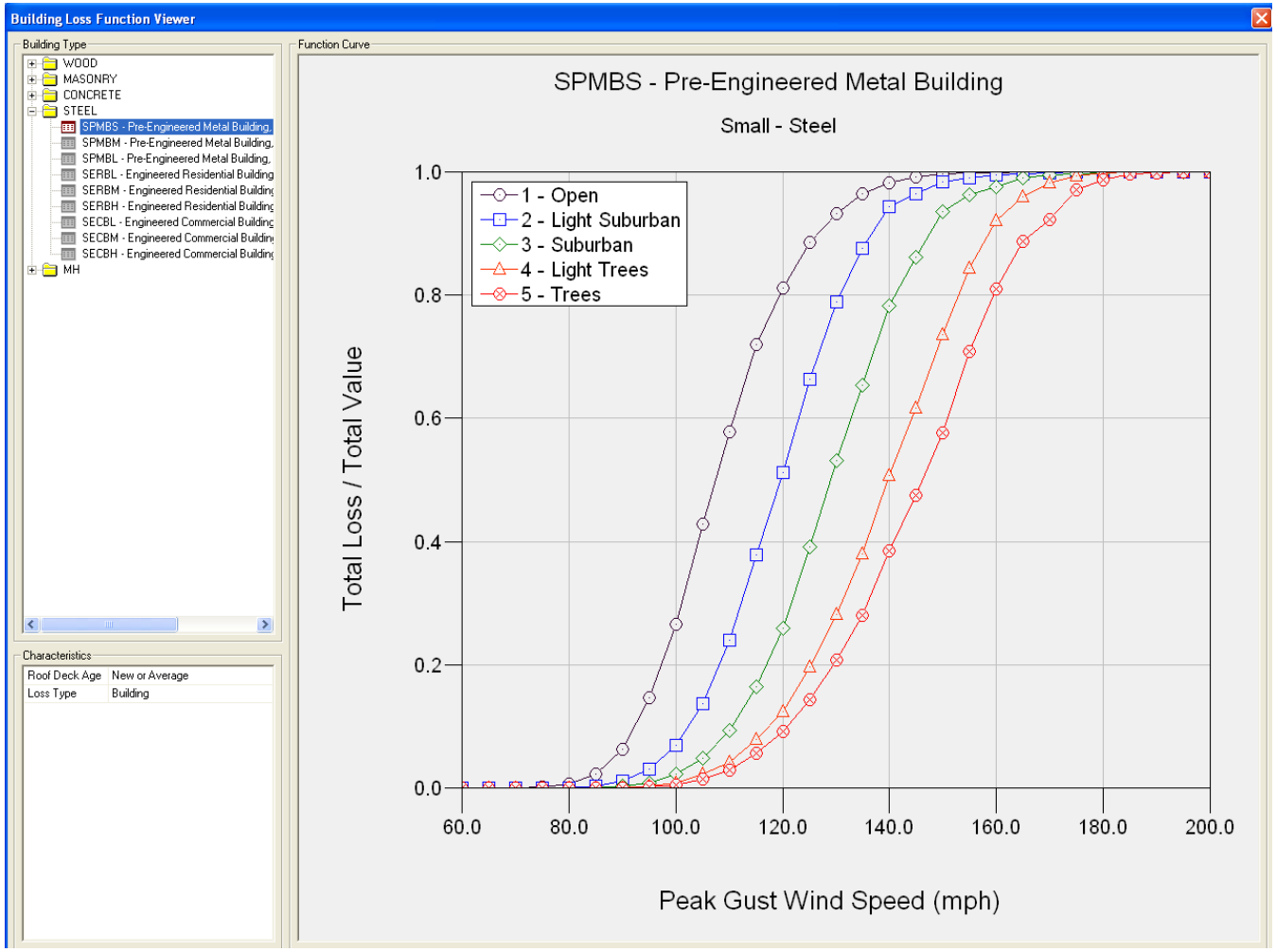

| DOD* | Damage description | EXP | LB | UB |
|---|---|---|---|---|
| 1 | Threshold of visible damage | 76 | 63 | 95 |
| 2 | Loss of roof covering (<20%) | 99 | 82 | 121 |
| 3 | Uplift of roof decking; significant loss of roof covering (>20%) | 124 | 107 | 146 |
| 4 | Uplift or collapse of roof structure leaving most walls standing | 138 | 120 | 158 |
| 5 | Most top story walls collapsed | 158 | 138 | 184 |
| 6 | Almost total destruction of top two stories | 180 | 155 | 205 |
| 7 | Total destruction of entire building | | | |

* Degree of Damage

Source: http://www.spc.noaa.gov/faq/tornado/ef-scale.html

# Straight-line Wind Loss Estimation

- Loss estimation due to straight-line wind was based on the building loss functions used in the hurricane module of HAZUS-MH MR5.



# Major Changes in Losses
## (Preliminary Risk Assessment)

| HAZARD | 2005 | | 2013 | |
|---|---|---|---|---|
| | Bldg $M | Total $M | Bldg $M | Total $M |
| Tornado | 115 | 129 | 350 | 396 |
| Earthquake | 95 | 113 | 567 | 594 |
| Wind Storm | 54 | 60 | 142 | 171 |

# Mitigation Strategies

- In the 2006 DRU study, mitigation strategies were made and presented to the committee in terms of goals, objectives, and action items.

- A total of 6 goals associated with their action measures were recommended to reduce the campus vulnerability due to natural hazards.

- Mitigations strategies for the 2011 update study are yet to be made since the update loss estimation has not been finalized.

# Summary

- 2011 earthquake hazard loss estimate has seen a significant rise from the original 2005 study. In fact, it has surpassed the tornado loss estimate which was the first priority natural hazard identified at that time.

- Tornado damage and loss estimates have also gone up due to the increased wind speed (from F3 to EF4).

- Other tornado loss estimation methodologies are still being studied to further refine the estimate

- Straight-line wind storm has also increased the dollars losses due to the higher wind speed (from 100 mph to 115 mph).

# Concluding Remarks

- As a result of general engineering judgment, other factors were under consideration during this project. Among these other factors were building type and the building codes utilized for each building. These factors impact the loss estimation to a significant extent.

- Additionally, a few buildings exist for which the researchers could not obtain the exact replacement costs. Therefore, reasonable costs for these structures are being estimated based on existing engineering knowledge and visual inspection.

- Buildings like The Lyceum are irreplaceable; meaning we cannot put a specific monetary price tag on it due to its historical significance.

# References


- Natural hazard mitigation plan of the University of Mississippi, Lafayette County, MS, CCEP, DRU advisory committee, July 2006

- HAZUS-MH Loss Estimation, HAZUS Technical Manual, FEMA

- Enhanced F Scale for Tornado Damage. National Oceanic and Atmospheric Administration. http://www.spc.noaa.gov/faq/tornado/ef-scale.html

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