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BUILDING DAMAGE ASSESSMENT

RESIDENCE OF MICHAEL KODRIN
177 HOLIDAY DRIVE
PORT SULPHUR, LOUISIANA

DATE OF LOSS:

AUGUST 29, 2005
(HURRICANE KATRINA)

PREPARED BY:
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REPORT NUMBER 60630

DATE OF INSPECTION:
JULY 2, 2007

DATE OF REPORT:
JULY 12, 2007

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INVESTIGATIVE METHODOLOGY

The purpose of this report is to reconstruct events at landfall in order to determine the extent of damage caused by wind and flood. The phrase *most likely scenario* as used in this report refers to events believed to have occurred to a reasonable degree of certainty based on the professional opinion of the Lead Investigator. The opinion is based on available evidence including analysis of weather conditions, physical data collected at the site location and the investigator's knowledge, training and experience. Mr. Kodrin was interviewed at the building site on July 2, 2007. The final report was peer reviewed for consistency of data and use of a systematic approach desirable and necessary in the analysis of building failure. Aerial photographs, maps and other data referenced but not included in this report remain on file in the project folder.

SYNOPSIS OF WEATHER CONDITIONS

Hurricane Katrina made its second landfall near New Orleans the morning of August 29, 2005. Wind data from Automatic Surface Observation System (ASOS) instrumentation is incomplete due to power interruption prior to maximum wind and minimum pressure occurrence. The National Weather Service (NWS) WSR-88D single-Doppler radar in Mobile measured outer band winds as high as 132 mph between 3000 and 4000 feet above ground level during the morning hours (between 0700-0800 CDT) with estimates that 80-90 percent (106-119 mph) of the maximum wind speed value reaching the ground. The Corps of Engineers IPET report references H*Wind sustained wind speeds at 100 knots (115 mph) at Buras (13 miles southeast of Port Sulphur) at 0600 CDT as surge rose first against the east bank of the Mississippi levees and then continuing until 1000 CDT as surge pushed north (most likely from Adams Bay south of Port Sulphur). As shown by the NOAA Wind Map in Attachment C, peak (three-second) wind gusts reached 149 mph in Port Sulphur. Storm surge height in Port Sulphur was approximately 12 feet above sea level.

BUILDING DESCRIPTION

The Kodrin residence was a one-story, wood-framed manufactured home constructed on masonry pier and masonry stem walls. The original structure was blocked on the site about 1967. The superstructure was strapped to the ground. The house was located on the west side of the Mississippi River levee and faced north. A separately built wood-framed garage was located at the southwest corner of the property lot on a poured-in-place concrete slab. The overall dimensions of the superstructure were 25' x 65' with a 6'3" x 32'3" front stairs and 4'2" x 13'6" rear stairs. A two car garage measuring 30' x 30' was located at the southwest corner of the house with a concrete driveway at the southeast corner and a shell driveway along the east side of the property lot from the street to the concrete driveway. The finished floor was about 4 feet above grade level. Adjacent grade level is assumed at about mean sea level, placing the finished floor 4 feet above mean sea level.

Kitchen cabinets were newly installed 6 months before Katrina. Hardwood floors, new garage doors and door openers, washer, dryer and freezer were about 2 years

old. Interior walls were paneled; rooms included a living area, kitchen, 4 bedrooms and 2 bathrooms. The roof was covered with asphalt shingles.

DESCRIPTION OF DAMAGE

Lettered photos were taken shortly after Katrina and were provided by Mr. Kodrin. Numbered photos in Attachment B were taken during the site inspection of July 2, 2007. Based on a floor level 4 feet above mean sea level, it is assumed that 8 feet of water would have covered the finished floor assuming the floor was intact at that point of time.

Photos A, B, D and E show the south side of the residence. Photos J, K, L and M show the north side of the residence. Photo C shows metal fencing on the south side of the property lot. Photos F, G, H, and I show local damage which in general depicts damage caused by flood – however without further investigation it is unclear if the metal roofs shown in Photos G and I detached due to wind or collapsed due to flood. Photos N and O show clear examples of wind damage due to nearby building structures. The asphalt shingled roof for the Kodrin residence is seen in the background of Photo P (rear left of the individual standing in the street). The roof clearly is wind damage; such damage would have occurred prior to the rise of flood water. It is clear from the photograph that the roof was damaged by wind; it is not clear from the photograph if the entire roof was removed by force of wind.

Photos 1-3, 9 show the juxtaposition of the front porch, crawl space under the house (now covered with grass) and the rear concrete slab (which supported the garage). Photos 4 and 5 show the grade beams under the building footprint. Photos 6 and 7 show the rear stairs. Photo 8 shows the driveway looking towards the west end of the slab which supported the garage. Photo 10 looks east towards the levee. Photos 11 and 12 look south on the levee. Photo 13 shows the Mississippi River. Photo 14 looks west from the levee to the property lot (behind the first row of trees). Photos 15-17 show a slab-on-grade foundation of a building located between the Kodrin property lot and the levee.

REVIEW OF REPORT PREPARED BY DENSON ENGINEERS, INC.

A report prepared by Denson Engineers, Inc. and dated December 2, 2005 was reviewed. Denson concluded that the structure "was completely destroyed by moving waters" leaving only the foundation slabs and brick step serving the front and rear entries. Denson described the storm surge in the area as "significant" but does not provide surge height information. There is no discussion of wind direction or wind speed in the report. Denson notes that there were structures in the area that received wind damage, "but there is no evidence available to indicate that the insured's residence was damaged by wind prior to being destroyed by the storm surge and moving waters". Denson found homes in the general area which were wind damaged and also found homes "heavily damaged" or destroyed by moving waters". Since about 12 feet of storm surge covered the area, it can be assumed that most every home in the area was damaged by flood. Not all homes

were destroyed by moving waters. Many of the homes that weren't destroyed by moving water in fact sustained wind damage. Severe wind preceded the rise of storm surge in this area. Based on this information, it cannot be concluded that flood destroyed all missing homes and it cannot be concluded that wind did not damage the missing homes before the rise of storm surge.

ANALYSIS USING THE ENHANCED FUJITA SCALE

Useful in assessing wind damage to buildings is the Enhanced Fujita (EF) Scale which is used by the National Weather Service to estimate surface wind speeds based on ground indicators such as damaged buildings and structures. Although specifically developed to evaluate tornado damage, the EF Scale is applicable to hurricane damage with the understanding that damage caused by fast-moving storms (like tornados) will occur at lower wind speeds during slow-moving storms (like hurricanes) because of the longer exposure time to debilitating wind.

ENHANCED FUJITA SCALE
ONE- AND TWO-STORY RESIDENTIAL DWELLINGS
Table 1

DOD*	Damage description	EXP	LB	UB
1	Threshold of visible damage	65	53	80
2	Loss of roof covering material (<20%), gutters and/or awning; loss of vinyl or metal siding	79	63	97
3	Broken glass in doors and windows	96	79	114
4	Uplift of roof deck and loss of significant roof covering material (>20%); collapse of chimney; garage doors collapse inward; failure of porch or carport	97	81	116
5	Entire house shifts off foundation	121	103	141
6	Large sections of roof structure removed; most walls remain standing	122	104	142
7	Top floor exterior walls collapsed	132	113	153
8	Most interior walls of top story collapsed	148	128	173
9	Most walls collapsed in bottom floor, except small interior rooms	152	127	178
10	Total destruction of entire building	170	142	198

* DOD is degree of damage

Based on the NOAA wind gust map enclosed with Attachment A, three-second wind gusts as high as 149 mph may have crossed the area. The LB column of Table 1 is for "lower bound" buildings that may not meet current code requirements. Assuming the building was properly strapped (as per Mr. Kodrin); for the purpose of this analysis it is assumed that the building would meet the current requirements of hurricane resistant construction. This analysis is based on the "EXP" column for "normally constructed buildings" that meet current requirements of hurricane resistant construction. Table 1 indicates that at 121 mph an "entire house shifts off foundation" – however this house was well-strapped and most likely that did not occur. At 122 mph "large sections of roof structure [are] removed" and at 132 mph "top floor exterior walls collapse".

Working inductively from Photo P, it is clear that the roof sustained the "loss of significant roof covering" (which occurs at 97 mph) before the rise of storm surge. (This does not preclude higher wind speeds before the rise of flood water, but shows based on physical evidence alone that wind reached 97 mph before the rise of flood water). At the same wind speed "garage doors collapse inward" and porch areas fail. At slightly lower wind speed (96 mph) window glass in doors and windows breaks. From the physical evidence, it can be concluded that more likely than not (a) the roof was damaged to the point of replacement; (be) window glass in doors and windows broke (c) the interior of the residence was damaged by wind and water penetrating through wind caused openings; (d) the garage roof was damaged to the point of replacement; (e) the garage doors, door openers and interior of the garage were damaged by wind and water penetrating through wind caused openings; (f) the front and rear porches were damaged.

Using a 149 mph wind gust and working deductively from Table 1, it can be determined that the roof sheathing was breached and exterior walls collapsed before the rise of flood water. It remains unclear if the roof was transported several hundred feet northwest by force of wind or (after the building collapsed) it floated to its final location as seen in the photograph.

It is clear that flood would not have removed the roof from the site unless the building collapsed, because the roof was strapped through the building walls to the foundation. Water overtopping (as opposed to breaching) the levee would not have a strong current velocity; hence there was insufficient hydrodynamic force to collapse the exterior walls of the building. Since flood could not collapse the walls, flood could not remove the roof. The only way for the roof to travel down the street would be if wind lofted and blew the roof down the street or (more likely) if wind collapsed the building, allowing flood to float the roof after which time wind pushed the roof on top of the water. There was very little wave activity; water overtopping the levee presented no opportunity for wind stress to birth waves because of the shortness of fetch and generation time.

CONCLUSION

Wind attacked and destroyed the Kodrin residence before the rise of storm surge. Storm surge eventually rose to a height about 12 feet above mean sea level (higher than the Kodrin roof) but without a strong current velocity or wave load there is no reason to believe that height of water alone would collapse a building strapped to the foundation and capable of resisting hydrostatic loads. Some parts of the building and its contents may have remained on the property lot until the rise of storm surge. However, the building and garage were economically totaled by wind before the rise of storm surge.

ATTACHMENTS

1) Attachment A provides maps and aerial photographs used in the report.
2) Attachment B provides photographs of Katrina damage.
3) Attachment C provides additional information on wind and storm surge.

4) Attachment D provides biographical sketches as recommended by the ASCE Technical Council on Forensic Engineering.

END OF REPORT 60630

Respectfully submitted,

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