HOMESITE CHARACTERISTICS AND THE SELECTION OF ADJUSTMENTS TO HURRICANE HAZARD IN THE LOWER FLORIDA KEYS

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The Lower Florida Keys, including Big Pine through Saddlebunch Keys, are among the most vulnerable locales with respect to the hurricane hazard within the United States. Hurricanes have struck these islands, whose highest elevation is eight feet, an average of one out of seven years, though the area has gone unscathed by a direct hit since Hurricane Inez (1966). Since then thousands of newcomers, most lacking hurricane experience, have taken up residence on these islands.

The potential for calamity resulting from the settlement within the Florida Keys has prompted the Florida Coastal Coordinating Council to caution:

Disaster preparedness experts feel that we are well on the way in the Keys to producing one of the greatest man made natural disasters in history.1

Official concern in 1974 prompted a county resolution and subsequently an ordinance regulating new construction within the flood hazard districts. Essentially the ordinance requires that the ground floor of all new buildings be elevated above the level of the 100-year flood.2 Within the Lower Florida Keys, where 96 percent of the land is below five feet in elevation, new dwellings must be elevated at least eight feet above sea level.

Elevated houses, usually constructed upon stilts but occasionally upon mounded fill, had been constructed even before the enactment of the county ordinance. Large-scale speculative building was uncommon. Most of the houses were custom built for (and often by) their occupants, so the dwellings directly reflect the attitudes of the builders toward various considerations, including hurricane hazard. This study of 361 homes attempts to determine the nature of the hazard-related structural adaptations evident in the dwellings of the Lower Keys.3 It differs from other studies on human response to natural hazards in that it examines the behavior of inhabitants (as shown by their selection of adjustments) rather than their perceptions of the environmental hazard, a research paradigm suggested by Guelke.4

The role of the immediate local environment upon hazard perception and adjustment behavior has not been thoroughly examined in previous research. Geographic variations in the perception of the hurricane hazard and attitudes toward damage prevention between widely separated sites were considered by Baker5 and Fuller.6 Burton, Kates, and Snead7, in their study of the coastal flood hazard, considered general variations in the vulnerability of coastal communities because of elevation. The only evaluation of differences in the perception of hurricane hazard by residents of nearby communities (South Miami Beach and Key Biscayne) was made by Bartnick8 who related the differences to the socio-economic characteristics of the populations. In the analysis of hurricane evacuation behavior, most post-event evacuation studies9 have only considered the general area of residence (i.e. beach, bay, or inland), although Wilkinson and Ross10 found that evacuation was related to perceived homesite elevation.

Homesite Location and the Selection of Adjustments

Residents of the Lower Florida Keys may make several major long-term adjustments to minimize hurricane loss, such as selecting a permanent house rather than a mobile home, choosing an elevated house instead of a ground level...
house, and purchasing flood insurance. If the spatial patterns of the adjustments accurately represent actions taken primarily to reduce potential hurricane losses, a close relationship between the selection of these adjustments and the physical homesite characteristics would be expected, since the vulnerability of the homesites to hurricane destruction varies locally.

A variety of physical parameters may be expected to affect the potential for hurricane flood damage to a dwelling. They include whether or not the homesite is adjacent to a canal or the shore, as well as the distances from the nearest canal and shore; the distance from the southern coasts of the keys (which would be exposed to storm surges from the open waters of the Straits of Florida); whether or not the homesite is on filled land; the ground elevation; and the types of vegetation about the homesite.

Environment of Elevated Versus Ground Level Houses

The selection of the elevated versus ground level house adjustment is statistically related to many of the physical characteristics of the homesite. Two statistical tests were run, chi-square and Automatic Interaction Detector (AID3).

Results from Chi-Square Analysis

A chi-square analysis was run on the data set with the following null hypothesis: there is no significant difference between the elevated houses and the ground level houses with respect to the sites examined. The results are given below and in Table 1.

<table>
<thead>
<tr>
<th>Physical Variables</th>
<th>Elevated/Ground Level House Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filled/unfilled land</td>
<td>*</td>
</tr>
<tr>
<td>Adjacency to canal</td>
<td>*</td>
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<tr>
<td>Adjacency to shore</td>
<td></td>
</tr>
<tr>
<td>Distance to canal</td>
<td>*</td>
</tr>
<tr>
<td>Distance to shore</td>
<td>*</td>
</tr>
<tr>
<td>Distance to southern coast</td>
<td>*</td>
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<tr>
<td>Ground elevation</td>
<td></td>
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<tr>
<td>Flood hazard zone</td>
<td></td>
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<tr>
<td>Natural vegetation</td>
<td>*</td>
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<tr>
<td>Vegetation height</td>
<td>*</td>
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</tbody>
</table>

* Indicated chi-square significant at .05 level.
Distance to Shore. Elevated houses are disproportionately located on homesites within 500 feet of the shore. In fact, some two-thirds of all the elevated houses studied are so located, compared with only 44 percent of the ground level houses. Nevertheless, even within this area ground level houses are more numerous than elevated houses. While the relationship between the distance to the nearest shore and the elevated/ground level house selection is significant, that between these house types and the adjacency of the homesite to the shore is not significant.

Location Vis-a-vis Canals. Canals run alongside the majority of homesites occupied by both elevated and ground level houses. Elevated houses, however, are over-represented on such homesites—they comprise 41 percent of all houses located along canals but only 21 percent of the houses located away from canals. This relationship is shown more strongly when distance of the house to the nearest canal is considered. Only 4 percent of the elevated houses surveyed are located over 300 feet from a canal, contrasting with 26 percent of the ground level houses.

Filled Land and Natural Vegetation. Ground level houses are under-represented upon filled land homesites, but the elevation of the homesite is not statistically associated with the elevated/ground level house adjustment. The type of natural vegetation about the homesite is statistically associated with the house type upon the site, illustrating the fact that the vegetation patterns covary with many of the other physical characteristics. For example, while 9 percent of all houses are upon landfill areas (usually mangrove swamps) where little or no revegetation has occurred, this is much more characteristic for stilt houses (17 percent) than for ground level houses (5 percent). On the other hand, only 6 percent of the stilt houses are located within areas where the Caribbean slash pines are found, whereas 15 percent of the ground level houses are located amid these pines. There is no significant relationship, however, between the choice of ground level or elevated houses and the height of the vegetation.

Results from AID2 Analysis

Certain combinations of physical homesite characteristics are more frequently associated with the siting of elevated houses than others. The use of the Automatic Interaction Detector (AID2) program illustrates how the various physical variables interact to explain the sitings of elevated and ground level houses (Fig. 1). It is possible to characterize the physical environments of those homesites most and least likely to be occupied by elevated and ground level houses.

Certain physical variables, which do not significantly discriminate between homesites with elevated and ground level houses when considering the entire sample, are significant with smaller segments of the population. A case in point is elevation. While elevated houses comprise 33 percent of all houses occupying homesites upon filled land situated over 7,000 feet from the southern coast, this figure drops to 14 percent on those homesites over five feet in elevation and rises to 36 percent for those homesites under five feet in elevation.
Fig. 1. Physical characteristics of homesites occupied by elevated houses. Percentage figures indicate the proportions of all houses within various environments which are elevated. Example: Of the 56 residents sampled who lived over 300 feet from a canal and upon unfilled land, only 4 percent occupy elevated houses. AID3 Analysis, explained variation equals 21 percent.

Conclusion

The chi-square tests and the AID3 analysis both demonstrate that significantly greater proportions of elevated houses are located upon the homesites most vulnerable to hurricane flood damage. Homesites upon filled land, near the shore or canals, and at low elevations are all particularly vulnerable for ground level houses. The acceptance of elevated houses as an adjustment to these hazardous circumstances is indicated by their distribution—primarily within areas which may receive the most severe wave action, with relatively few elevated houses within other areas. On the other hand, elevated houses are over-represented within neighborhoods with scant vegetation cover. They may also be more vulnerable to wind damage, an aspect of the hurricane hazard from which elevated houses may not be adequately protected.

While these findings provide valuable insights into the environmental factors associated with the adoption of the elevated house adjustment, the AID3 analysis explains only 21 percent of the variation between elevated and ground level houses, leaving much of the spatial pattern unexplained.

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2. Monroe County, Florida, *An Ordinance Regulating Development within Flood Hazard Districts within the County of Monroe* (Ordinance No. 3-1975), Section 4 (a).
3. The population used in this study was drawn from a larger sample which also included mobile home residents. Characteristics of the mobile homes are described in John A. Cross, "Residential Adjustments to the Hurricane Hazard in the Lower Florida Keys" (Ph.D. diss., University of Illinois, 1979).


