

COMPARATIVE STATISTICAL ANALYSES OF SOLID WASTE QUANTITIES AND STRUCTURAL DAMAGE BY HURRICANE ANDREW

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Abstract

The hurricane Andrew has generated approximately 2.4 million tons of demolition debris. An additional 0.5 million ton is estimated to be generated during rebuilding and repair of the buildings. The total of 2.9 million tons of structural debris is approximately equivalent to five years of landfill space. Extensive structural damage has been caused by the hurricane to roof coverings (tiles and shingles), mobile homes, wood framed walls and roof structures, large metal buildings, boats in marinas and trees. This paper presents the statistical analyses performed on the structural damage and structural waste quantities generated due to hurricane damage. The quantities of structural debris were analyzed for five areas with the most severe hurricane damage to the homes in Dade County, Florida, in relation to extent damage to buildings and amount of

structural waste generated. The structural waste quantities were estimated based on the Hurricane Andrew Damage Assessment records compiled by the Metro-Dade County Building and Zoning Department.

1. Introduction

The hurricane Andrew has caused significant damages for roof coverings (tiles and shingles), mobile homes, wood framed walls and roof structures, large metal buildings, boats in marinas and trees. After the hurricane, approximately 135,000 residences needed either roof repairs or a complete overhaul. About 28,000 residences were declared uninhabitable. The damage to the buildings has created significant quantities of structural waste to be disposed of. The collection and disposal of solid waste after the hurricane incorporated limited separation of different types of materials

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such as wood, metals, household debris (rugs, furniture, electrical appliances, clothing), and construction and demolition debris. Most of the structural waste is unburnable and difficult to recycle due to contamination with different types of waste materials. During the cleanup activities after the hurricane Andrew, the solid waste collected contained over 50 percent structural waste (by volume). After the waste from trees were burned or chipped for recycling, structural waste fraction was over 80 percent of the total solid waste deposited in landfills.

2. Analyses of Damaged Areas

The damage data that was used in the analyses were compiled by Metro-Dade County Building and Zoning Department. Five zones with significant structural damage were selected in areas ranging in distance to the ocean and the hurricane eye landfall site. Figure 1 presents the locations of these areas.

Zone 1 is a recently developed area near the eastern Everglades, approximately 8 miles from the Atlantic coast. Concrete construction is the typical method with clay tile or shingle as the roofing material.

Zone 2 is the landfall site of the northern eye wall of the hurricane. The area is highly developed residential area with concrete construction and a wide variety of roof structures. There was also a slight storm surge of less than four feet in this area.

Zone 3 is also the coastal area containing Saga Bay and Gables by the Bay. The eye of the hurricane made landfall in this zone. There was a significant storm surge of less than 10 feet in this area. This zone is a new developed area with mostly wood frame construction with shingle roofs.

Zone 4 is approximately three

miles inland from Biscayne Bay. It includes Homestead Air Force Base and part of the Homestead business district. This area is mostly agricultural with recently built small residential units. The structures are mostly wood frame with shingles and mobile homes.

Zone 5 is about 7 miles inland from Biscayne Bay. This area is mostly agricultural with a small business district. The structures are mostly wood frame with shingle roofs. This zone includes the Florida City and Redlands and borders the Everglades National Park.

Table I presents the characteristics of residences in each zone analyzed. Table II presents the number of residences and the number of homes damaged in each zone. Table III presents the corresponding quantity of structural waste requiring disposal in each Zone. The amount of structural waste for each zone was calculated based on the number of homes damaged and the composition of an average house in South Florida area. The average house was selected as a two bedroom house.

3. Conclusions

The amount of structural debris generated by the hurricane Andrew is significantly dependent on the land use. The quantitative and qualitative analyses and evaluation of the structural debris provide a good tool for future land use and development, emergency management planning, choice of building materials, planning of sequential clean-up and disposal activities and emergency solid waste management planning for coastal areas which could be hit by a hurricane such as hurricane Andrew.

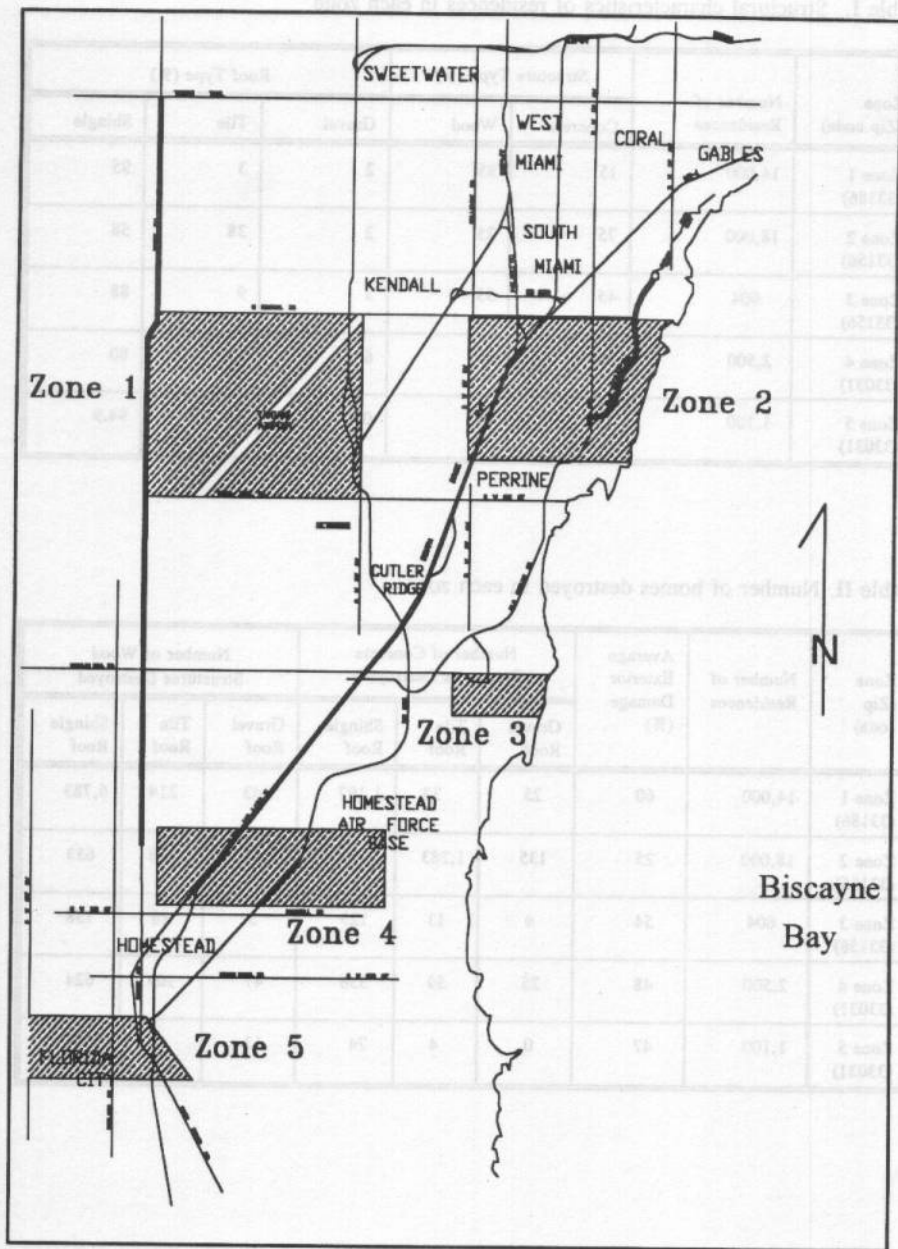


Figure 1. Locations of the five zones analyzed for structural waste generation.

Table I. Structural characteristics of residences in each zone

Zone (Zip code)	Number of Residences	Structure Type (%)		Roof Type (%)		
		Concrete	Wood	Gravel	Tile	Shingle
Zone 1 (33186)	14,000	15	85	2	3	95
Zone 2 (33156)	18,000	75	25	2	38	58
Zone 3 (33156)	604	45	55	3	9	88
Zone 4 (33031)	2,500	35	65	6	14	80
Zone 5 (33031)	1,100	15	85	0.1	5	94.9

Table II. Number of homes destroyed in each zone

Zone (Zip code)	Number of Residences	Average Exterior Damage (%)	Number of Concrete Structures Destroyed			Number of Wood Structures Destroyed		
			Gravel Roof	Tile Roof	Shingle Roof	Gravel Roof	Tile Roof	Shingle Roof
Zone 1 (33186)	14,000	60	25	38	1,197	143	214	6,783
Zone 2 (33156)	18,000	25	135	1,283	1,958	45	428	653
Zone 3 (33156)	604	54	4	13	129	5	16	158
Zone 4 (33031)	2,500	48	25	59	336	47	109	624
Zone 5 (33031)	1,100	47	0	4	74	13	40	387

Table III. Quantity of solid waste produced in each zone

Zone (Zip code)	Total Solid Waste Produced (Tons)	Solid Waste from Concrete Structures (Tons)			Solid Waste from Wood Structures (Tons)		
		Gravel Roof	Tile Roof	Shingle Roof	Gravel Roof	Tile Roof	Shingle Roof
Zone 1 (33186)	271,778	1,398	2,222	63,615	4,448	7,295	192,800
Zone 2 (33156)	221,417	7,492	75,385	104,031	1,402	14,560	18,547
Zone 3 (33156)	13,090	244	776	6,864	168	550	4,487
Zone 4 (33031)	45,625	1,398	3,456	17,857	1,458	3,719	17,737
Zone 5 (33031)	16,893	4	228	3,911	411	1,347	10,992