



1. Broken window glass (boarded windows) downwind of Marriott Hotel in Coral Gables. View looking south-west along Highway 1.



2. Minor roof damage to residences in Coral Gables.



3. Partial loss of roof and metal decking in shopping center along Highway 1 near Perrine. View looking northwest.



4. Loss of metal roof deck above department store entrance and northeast corner along Highway 1. View looking west.



5. Metal building damage along Highway 1.
View looking west.



6. Loss of metal roof cladding above
loading bay doors. View looking northwest.



7. Loss of cladding and several collapsed
bays in metal buildings along Highway 1.



8. Collapsed north and west walls of
concrete masonry building housing Budweiser
Distributing.



9. Roof covering lost in opposite directions on Florida City apartment building (looking southeast).



10. Roof damage on concrete masonry building in Homestead. View looking southwest.



11. Destroyed mobile home part in Homestead adjacent to undamaged metal water tower.



12. Close-up view of mobile home park in Homestead. View looking west.



13. Close-up view of mobile home park in Florida City, looking west.

14. Damage to residences (from F0 to F2) in Florida City. Wood-framed roofs were supported on concrete masonry walls.



15. Loss of residence roof among undamaged homes. View looking southeast.



16. Removal of roof deck exposed wooden trusses on concrete masonry homes in Florida City.



17. Residence damage (F0 to F2) which likely initiated in carport area. View looking south in Florida City.



18. Flat roof damage (to F2) on multi-family dwellings in Florida City. View looking southeast.



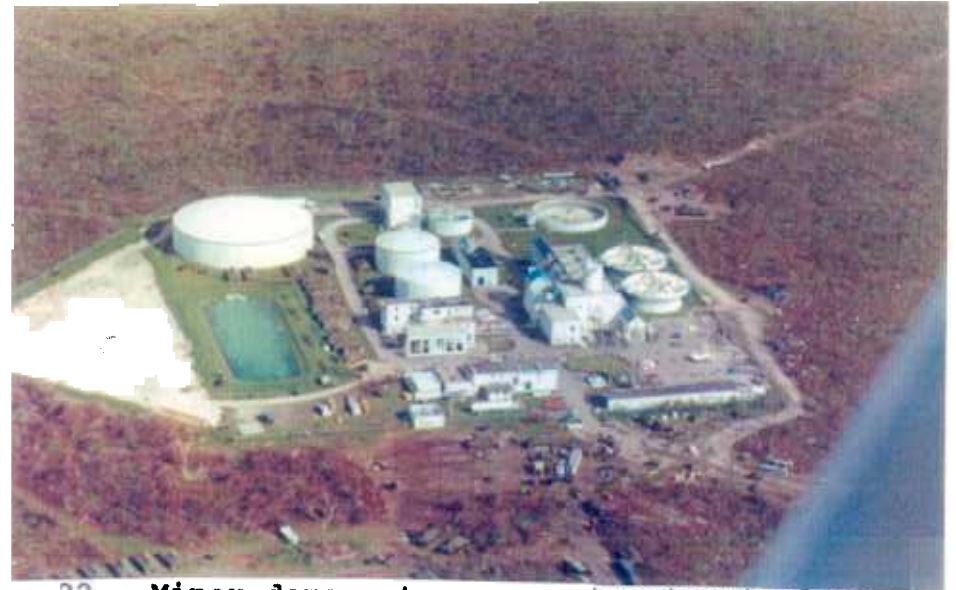
19. Damage to steel and concrete warehouse building in Florida City looking southeast.



20. Steel tower collapsed to the north near Florida City.



21. Tree falls in various directions just south of Florida City. View looking southwest.



22. Minor damage to sewage treatment plant in rural Redlands. Concrete tanks remained undamaged.



23. Damage to nursery and adjacent housing.



24. Minor roof damage to homes in Ocean Reef community on Key Largo.



25. Beach sand displacement inland along shoreline of Key Biscayne.



26. Bay front homes along Key Biscayne remained intact. Only minor roof and surge damage was noted.



27. Flattened forest at southern end of Key Biscayne. Few trees were left standing.



28. Close-up view of flattened forest at south end of Key Biscayne. Downed trees pointed due west.



29. Damage to concrete tiles that were secured with mud (mortar). Failure occurred between the mud and the tile.



ICC

31. Tiles that bonded well to the mud failed along the roll roofing underlayment (Homestead).

30. Tiles which did not bond well to mud. Note the offset between mud placement and the tile on the leftmost tile (Homestead).



32. Tiles nailed to wood battens performed just as poorly as tiles that were mudded to roll roofing (Saga Bay area).



33. Almost complete absence of composition shingles on each house in subdivision just west of Homestead Air Force Base.



34. Roof shingles were stapled on house to the right and nailed on the house to the left (Country Walk).



35. Close-up roof view showing staples secured in plywood deck. Many staples are crooked and oriented incorrectly.



36. Staples oriented incorrectly on roof in Country Walk.



37. Failure of built-up roof covering on warehouse occurred where insulation board was lightly adhered to roof deck.



38. Insulation board had little to no bond to roof deck (near Tamiami Airport).



39. Missing full and half sheets of plywood decking on residence (Country Walk).



40. Full sheet of chipboard decking with shingles left intact (Homestead).



41. Pre-manufactured trusses fell like a stack of dominoes as they were laterally braced only by roof decking.



42. Lack of blocking between rafters in Homestead residence.



43. Gable end scabbed on to roof in Country Walk subdivision.



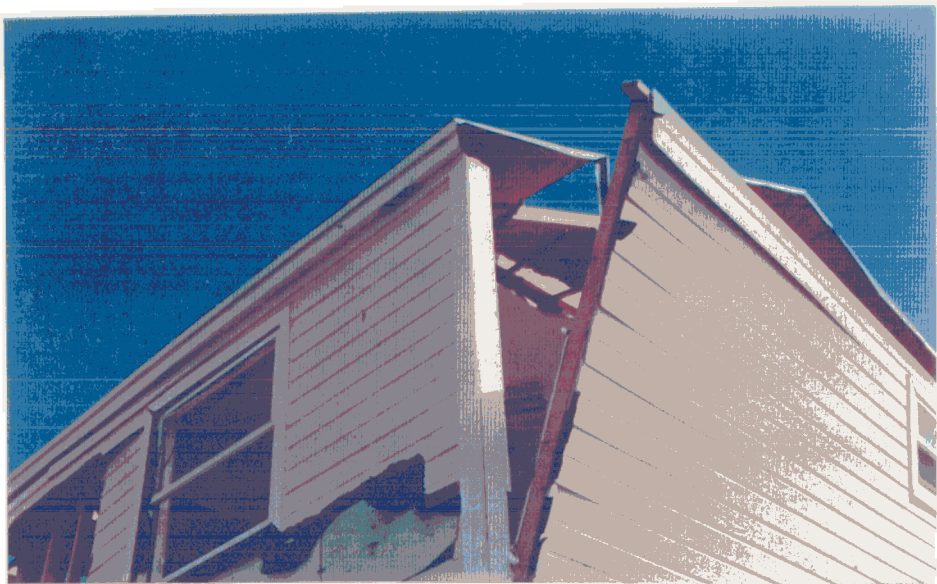
44. Gable end failures were common in several subdivisions in Homestead.



45. Rotation of metal straps along ends of roof trusses in residence.



46. Metal clips secured wall studs to bottom plate. The bottom plates were nailed into the foundation.



47. Only four nails connected the wall to the northwest corner on a two-story home in Saga Bay.



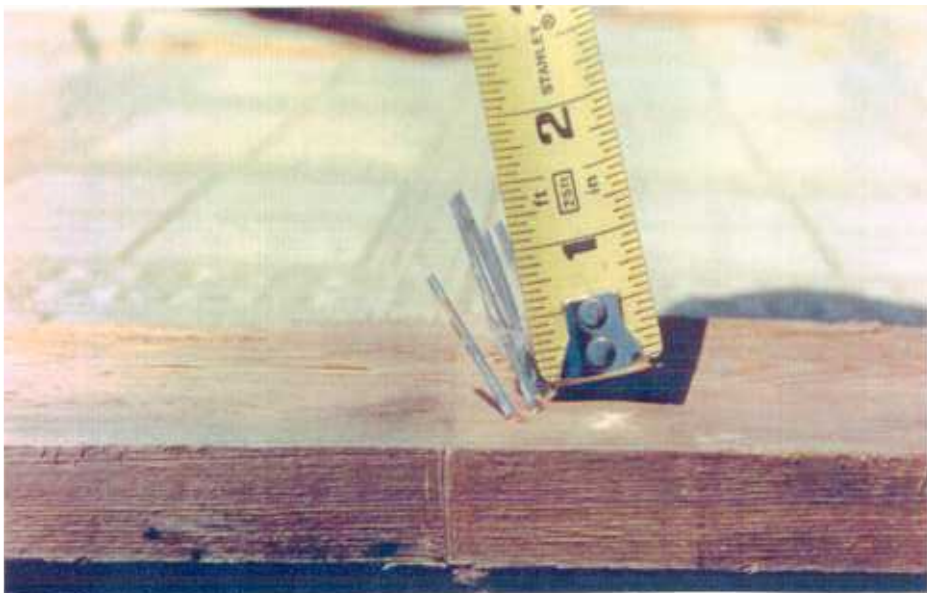
48. Garage door failure likely led to side wall collapse in Country Walk home. The door faced east; few nails secured the wall.



49. One of several destroyed mobile home parks in Homestead.



50. Mobile home steel frame and flooring are all that remained intact.



51. Stapled connection where wall stud met bottom plate in mobile home.



52. Roof trusses fell intact as they were lightly attached to the walls.



53. Hangar door and end wall failure in metal building at Tamiami Airport. Door faced east.



54. Rotation of steel frame occurred when center of hanger collapsed. View looking north at Tamiami Airport.



55. Rotation of column base caused steel bolts to pull loose from concrete footing. Note the base plate remained intact.



56. Torn base plate on airport hanger column (Tamiami Airport).



57. Cleveland Indians stadium in Homestead Florida. Light standards remained upright.



58. Two of six light standards had buckled slightly at base (Homestead).



59. Nuts were loose on light standards base plate (Homestead).



60. Fence along playing field downed to the east (Homestead)



61. Northeast wall corner failure in concrete masonry warehouse near Tamiami Airport.



62. Wall cladding failure on suction side of condominium building along Saga Bay.



63. Large span double tee building collapse in Cutler Ridge. View looking southwest.



64. Tilt-up concrete wall failures on large warehouse. View looking southwest.

65. Double-tee concrete roof beam failed at center of 55 ft span and fell on top of car which owner hid from storm.



66. Unique failure of double-tee roof beam as it was uplifted in high winds on strip shopping center (Cutler Ridge).



67. Wall cladding failure at Cutler Ridge office building.



68. Cladding was composed of stucco type finish over a fabric mesh that was bonded to styrofoam insulation.



69. High storm surge occurred along the Cutler Canal where a large boat was washed ashore.



70. Water mark in residence along Old Cutler Road south of Coral Gables.



71. Water mark along restroom wall in Black Point Marina.



72. Debris line along fence at Coconut Grove Marina.



73. Two story steel boathouse collapsed crushing boats at Black Point Marina.



74. Boats moored at dock were strewn about in 12-13 foot surge at Black Point Marina.



75. Loss of roof and exterior walls on residence at Cypremort Point, LA.



76. Roof thrown 100 yards to the south of residence depicted in previous photograph.



77. Windward wall buckled on this northward facing residence at Cypremort Point.



78. Collapse of old wood timber roof on main street in Jeanerette, LA.



79. Timber roof collapsed in downtown Jeanerette, LA building.



80. LaPlace, LA tornado path was two houses wide. Homes already had been demolished.



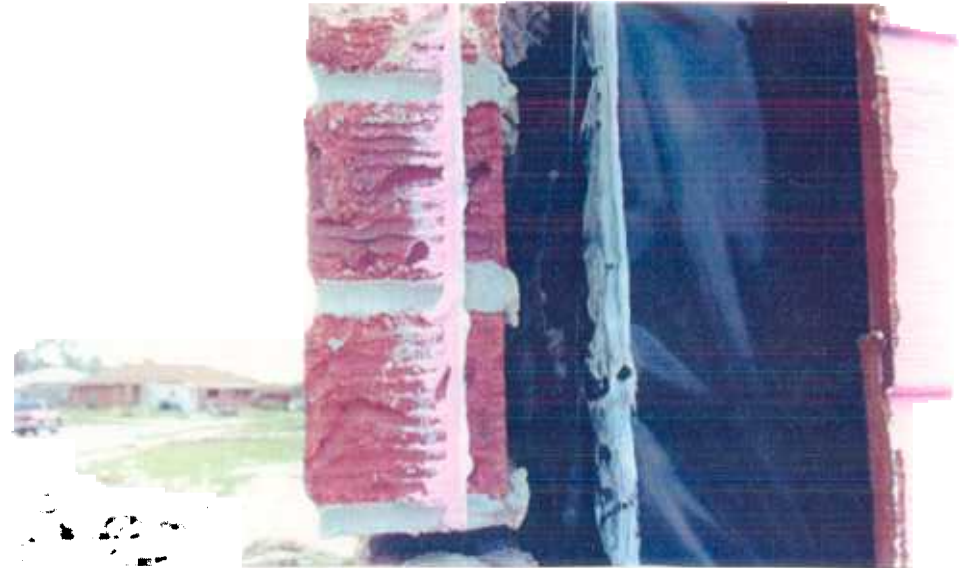
81. Home with F3 damage in LaPlace, LA tornado.



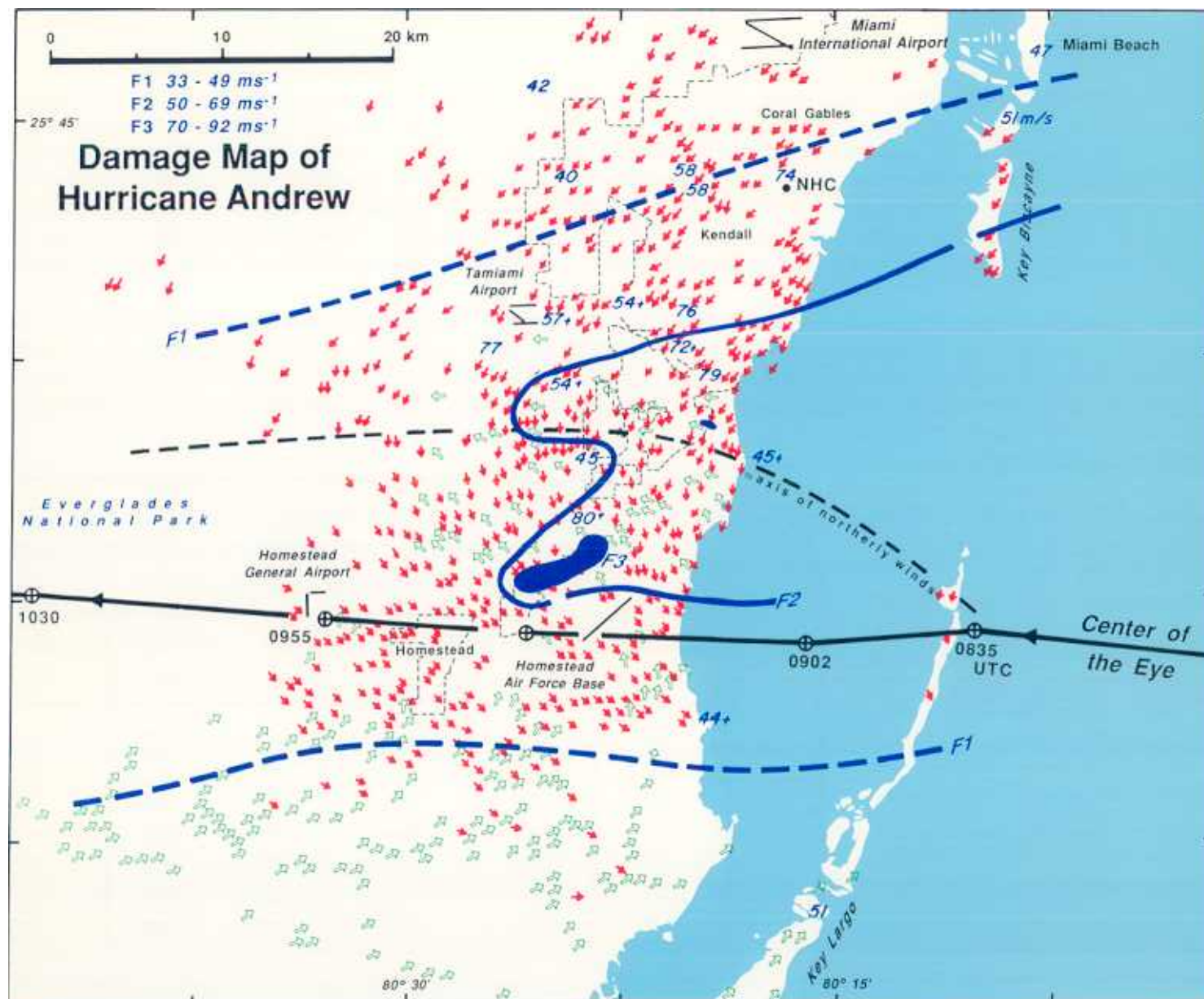
82. Exterior brick wall and framing rotated northward. Failure occurred where wall studs were nailed to anchored bottom plate.



83. Wall studs were end nailed and were easily pulled from the bottom plate.



84. Corrugated metal brick ties were nailed into framing, however, they were not bent in to the mortar joints of brickwork.





Damage Map of Hurricane Andrew. The map, with scale in upper left (1 km equals 0.62 statute miles or 0.54 nautical miles), indicates the direction of peak damaging wind from direction of tree fall and orientation of debris from damaged buildings. The red arrows indicate the direction of the "first wind", the peak damaging wind at the leading, or front, edge of the "eyewall", which is the ring of intense rainfall and highest wind surrounding the clear "eye". The open green arrows indicate the direction of the "second wind", the peak damaging wind at the trailing, or rear, edge of the eyewall. The thick, black line is the track of the geometric center of the eye as seen on Miami and Key West WSR-57 National Weather Service radars. Dots with crosses indicate center positions at approximate half-hourly intervals for indicated times in universal time, UTC (subtract 4 hours for Eastern Daylight Time). The heavy dashed line shows the axis of northerly flow and that it recedes further from the storm track when the center crosses the coast. This is probably due to the increased friction over land relative to over-water causing the wind to angle more strongly inward toward lowest pressure. Numerical values labelled throughout the map are wind speed

estimates from surface anemometers, of variable quality and exposure, in ms^{-1} (1 ms^{-1} equals 2.24 mph). Letters labelled throughout the map indicate key damage survey sites described in Wakimoto and Black ("Damage Survey of Hurricane Andrew and its Relationship to the Eyewall", Bull. Amer. Meteorol. Soc., Feb, 1994).

The f-scale contours are indicated by the blue lines. The lower-case f-scale, as described in Fujita (Mystery of Severe Storms, 1992, p31, NTIS PB92-182021) refers to the degree of damage to any structure types (in this case, CBS), i.e. f0- little damage, f1- minor damage, f2- considerable damage, f3- walls collapse, f4-structure blown down, etc. The dashed line indicates f1, the solid line indicates f2 and the solid shading indicates the f3 region. These contours correspond to the degree of damage to the majority of CBS buildings in the area. The upper-case F-scale, as developed by Fujita ("Proposed Characterization of Tornadoes and Hurricanes by Area and Intensity", U. of Chicago, SMRP Paper 91, 1971) is a scale of 12 wind speed categories ranging from gale force winds (F0=40 mph, Beaufort 8) to the speed of sound (F12=738 mph, Mach 1). The scale, with wind equivalents, is shown on the map and was developed for wood-frame houses, where the f-scale and F-scale numbers are equal. For other types of construction, the f-scale and F-scale must be properly matched. The table to the right is such a matching for CBS construction typical of South Dade County, Florida. The northernmost lobe of the f2 contour (gusts of 176 mph), located between 184th and 152nd Streets, is probably associated with the first wind (from the northeast and east) and the southernmost lobe, over Naranja Lakes and surroundings, including the f3 contour (gusts of 202 mph), is probably associated with the second wind (from the southeast). (Copies available from NOAA/NWS, Forecast and Warnings Branch, 1325 East-West Hwy, Silver Spring, MD 20910) Map produced for the NOAA-Hurricane Research Division (HRD) by Roger Wakimoto (UCLA), caption by P. Black (HRD), based on joint flights by R. Wakimoto and N. Atkins (UCLA) and G. Forbes (Penn State). Survey and printing cost supported by Office of the Federal Coordinator for Meteorology, NOAA/Office of Oceanic and Atmospheric Research and NOAA/National Weather Service.

**FUJITA-SCALE WIND SPEED EQUIVALENTS AND PRELIMINARY
ADJUSTMENTS FOR CONCRETE-BLOCK-STUCCO (CBS)
CONSTRUCTION (1 April, 1993)**

F-SCALE	Fastest-Quarter-Mile		Peak 2-sec Gust*		f-scale: CBS
	mph	ms^{-1}	mph	ms^{-1}	
1.0	73	33	86	38	0
1.5	88	40	102	46	0.5
2.0	113	50	129	58	1.0
2.5	138	62	155	69	1.5
3.0	158	70	176	79	2.0
3.3	176	79	194	87	2.5
3.5	186	83	202	90	3.0

*Calculated using Krayner and Marshall (Gust Factors Applied to Hurricane Winds, Bull. Amer. Meteorol. Soc., 1992) conversion factors for over-land exposures