Sample Design Solutions to reduce the impact of weather-related hazards

Lightning Rods for houses and buildings to prevent damage from lightning strikes.

Example of Lightning Protection System
Helmets for protection from earthquakes and tornadoes

Earthquake Safety Helmets

When assembled
- Height: 175 mm
- Width: 315 mm
- Depth: 35 mm

When flat
- Height: 210 mm
- Width: 345 mm
- Depth: 35 mm

Easy Way to Reduce Tornado Injuries: Helmets
Jan 13, 2012 4:50 PM CST
Reinforcing core columns, foundations, and beams in buildings to reduce damage from earthquakes
Will protect against:

- Earthquakes
- Hurricanes
- Tornadoes
- Fire Storms

- Build verandahs and patios as separate structures rather than extensions of the main building.

- If they blow off, the rest of the house will not be damaged.
Underground houses also protect against tornadoes
The original tornado-proof structure (seen here) had an irregular shape. The new design is a perfect square and sits flat on the ground. The house is lowered into the ground by a hydraulic arm.
Designs to reduce the impact of floods

Figure 2: Wet proofing — measures to make the building more resilient to flooding

- Elevate all activities which are not compatible with water above flood elevation.
- Properly anchor all foundations to prevent flood water washing them out and also to avoid flotation of the structure if the flood water gets too high.
- Provide openings or break-away wall sections to allow free passage of water.

Figure 3: Dry proofing — measures to keep water out of building

- Improved resistance of walls and floors to prevent water ingress.
- Valves to prevent backflow.
- Flood barriers for doorways.
- Covers for external and internal wall vents.
- Raised electrical sockets above flood level.
- Improved resistance of internal walls, floors, and fittings to improve the ability of materials to withstand the effects of internal flooding.

How to protect your home from flooding

- Flood resilient
- Flood resistant

- No fitted carpets
- Air brick cover
- Drain and pipes
- Flood guard and raised threshold
- Waterproof coating
- Shelving
- Tiled floor
- Well-mounted TV
- Power socket

Source: Environment Agency
Using sand bags to prevent flooding
Fire-proofing by building with concrete and steel and innovative house designs

Insulated concrete forms combined with flame-resistant roofing and siding

Fire Ratings

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
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<td>Wood frame walls</td>
<td>1</td>
</tr>
<tr>
<td>ICF walls</td>
<td>4</td>
</tr>
</tbody>
</table>

(low) (high)
Important spaces elevated, to protect against flooding.

Windows imported from Germany are designed to resist 150-mile-per-hour winds.

Hurricane Proof HOMES
**Anatomy of a High Wind & Hurricane Resistant Home**

All aspects of a Deltec home are ingeniously designed to work as a system, making it the smartest home you can build for high wind areas.

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**A. DESIGN**
- Architectural design building envelope works with interior air pressure
  - Wind can't build up enough pressure to cause structural failure
  - Reinforced 10-inch poured concrete walls and floors
  - Structural design incorporates air movement pressure relief vents
  - Air pressure relief vents release air pressure during critical events

**B. ENGINEERING**
- Dome is building envelope to resist high wind and pressure
  - Building envelope is shaped to keep wind out
  - Roof design works with interior air pressure
  - Roof surface is designed to accept hurricane wind pressures

**C. MATERIAL EXCELLENCE**
- High-quality materials with a superior structural integrity
  - Metal skin panels with a high degree of wind resistance
  - Metal skin panels are attached with high-strength fasteners

**D. SUSTAINABILITY**
- Retained soil on foundation provides superior ground pressure
  - Enhanced insulation maintains a more balanced temperature inside the home
  - High wind pressure relief and design features help reduce high wind gains in the home

**E. CONNECTIONS**
- Baffles and reinforcing cudough stress points and strong connections between the roof interior wet and dry walls
  - Connection systems keep roof systems anchored to walls
  - Multiple connection systems to the floor system for structural stability and to distribute shear forces

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**Hurricane Resistant Homes that withstood Hurricane Ike at its worst**

**Gilchrist Texas**

*Underground Support Columns*
- Concrete and steel 18-inch support columns are 10 ft into the ground

*Concrete and Steel Columns*
- Reinforced concrete columns more than a foot square lift the house more than 25 ft above the ground

*Grade Beam*
- Reinforced concrete beams, 2 ft thick and a 4-inch concrete slab link the underground support columns to distribute the weight of the house equally

*House Frame*
- Every piece of the wood is secured using metal straps. The entire structure is bolted to the concrete columns below

*Roof*
- Secure to the house frame with metal straps and shingles are attached with six inch nails
1. Hollow concrete brick designed to cause minimal damage
2. Reinforced cement concrete roof
3. Stone foundations made from rubble from destroyed houses
4. Reinforced steel corner pillars provide strength and flexibility
HOW TO BUILD A CONCRETE DOME HOUSE
how to build the strongest, fireproof, tornado and earthquake resistant concrete dome house by Jan Hornas

12-inch-thick walls are made of reinforced concrete.

Windows were tested to withstand a two-by-four travelling at 60 miles per hour.