



Mitigation Case Studies

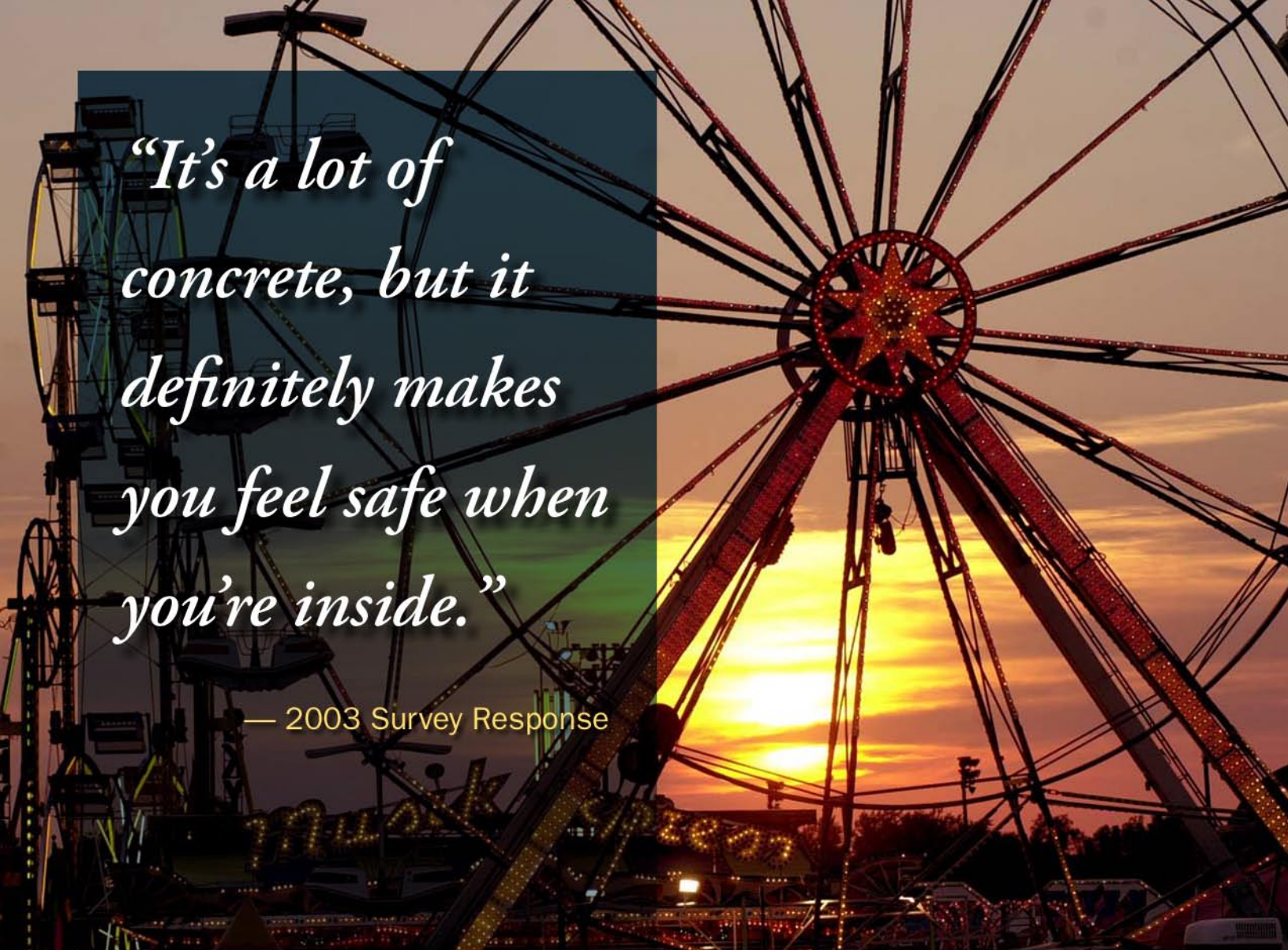
A Safe Haven for Campers

Iowa State Fair Campground Shelter
Des Moines, Iowa

September 2004



FEMA



*“It’s a lot of
concrete, but it
definitely makes
you feel safe when
you’re inside.”*

— 2003 Survey Response

The Iowa State Fair campground is part of the Iowa State Fair complex, which is located outside Iowa’s capital, Des Moines, an area vulnerable to tornadoes and high-wind events. In June 1998, a storm with winds in excess of 100 miles per hour (mph) caused over \$465,000 in damage to the State Fair complex, severely impacting the campground with fallen trees and limbs. Fortunately, no one was hurt during this event, but the potential for disaster and loss of human life was obvious. As a result, the State Fair Board made a decision to construct a shelter at the campground, which is used from April to October. The fear of damage to the State Fair complex and injuries to fairgoers during Iowa State Fair week in August are separate concerns the State Fair Board is dealing with in other ways. The construction of the campground shelter has demonstrated the importance the State Fair Board has placed on the safety of campers at the Iowa State Fair complex.

IOWA STATE FAIR PHOTO BY STEVE POPE

COVER PHOTOS BY TOM HURD,
SPATIAL DESIGNS ARCHITECTS AND CONSULTANTS

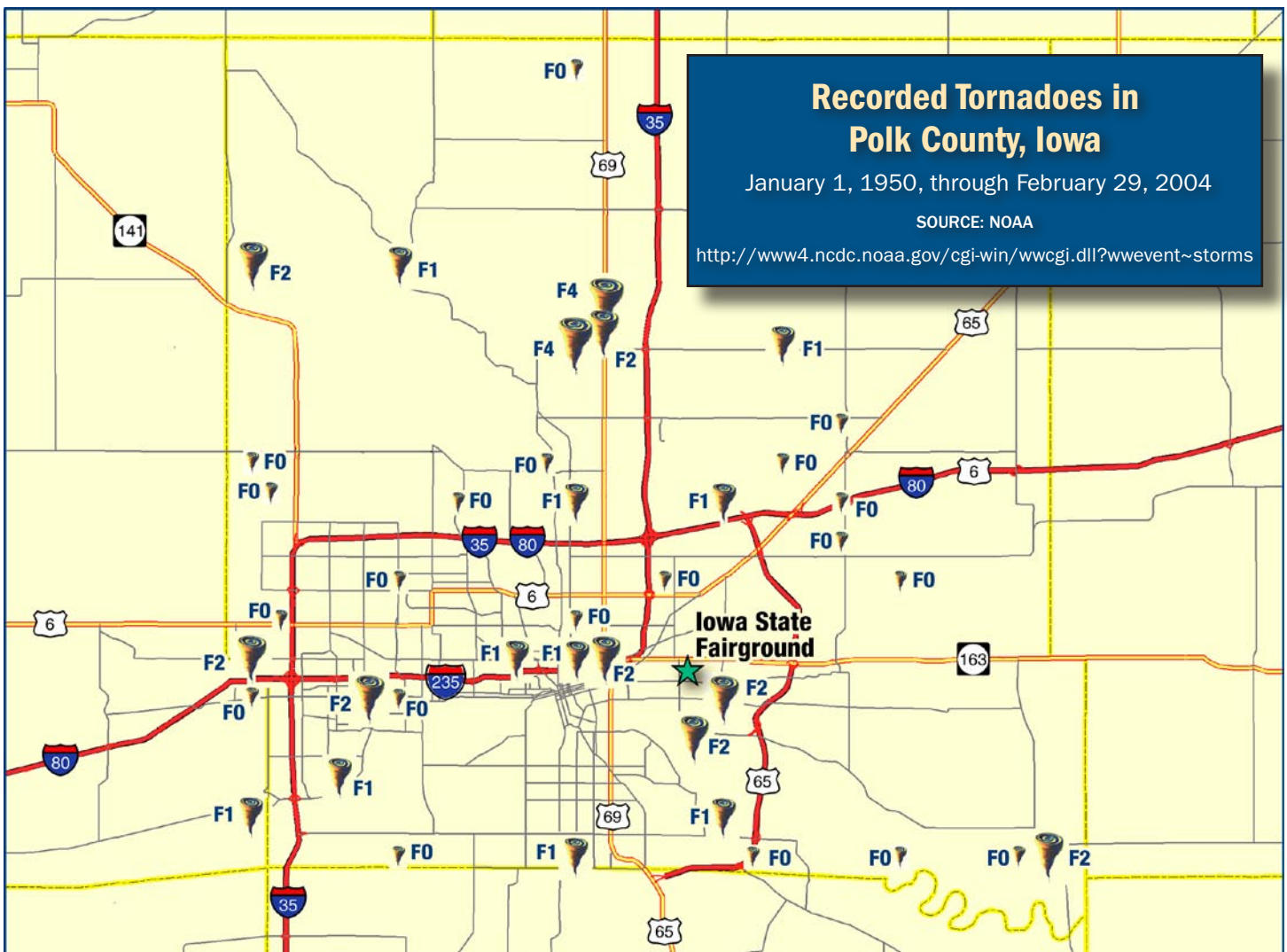
Case Studies

DES MOINES, IOWA

The Iowa State Fair, typically held during the second week of August, falls within the March-to-November tornado “season.” Fortunately, the State Fair complex has not been hit by a tornado during the State Fair, but it was hit by a record high-wind event in June 1998 that caused extensive damage. According to the National Climatic Data Center, the State of Iowa ranked sixth in the number of tornadoes across the nation with 1,974 events between 1950 and February 2004. In Polk County alone (home to the Iowa State Fair and the capital city of Des Moines), 49 tornadoes have been confirmed since 1950.

Vulnerable Campers

Campers are particularly susceptible to harm during high-wind and tornado events because of their physical vulnerability. In April 2001, high winds flipped over a recreational vehicle in Winnebago County, Iowa, and two campers were injured. In May 2003, a camper was killed when a tree fell on her tent during a high-wind event near Oskaloosa, Iowa. Fortunately, two members of her family who were also in the tent escaped uninjured.



Key (based on the Fujita Scale)



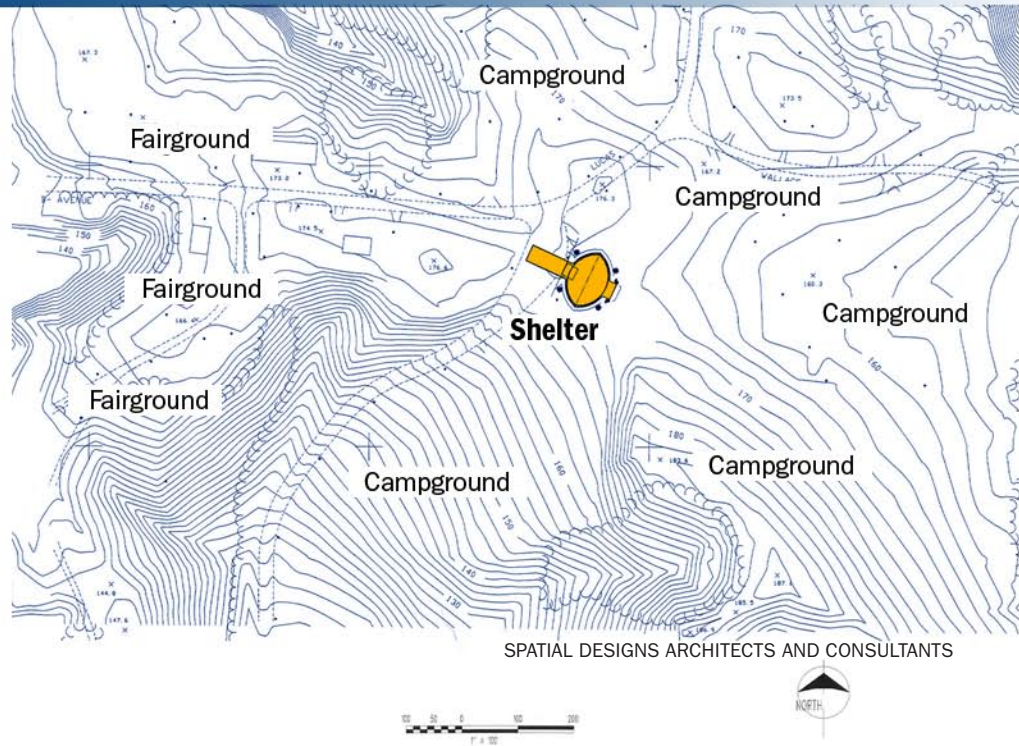
Note: There were no reported F5 or F3 tornadoes in Polk County, Iowa, between January 1, 1950, and February 29, 2004

Seeking Refuge

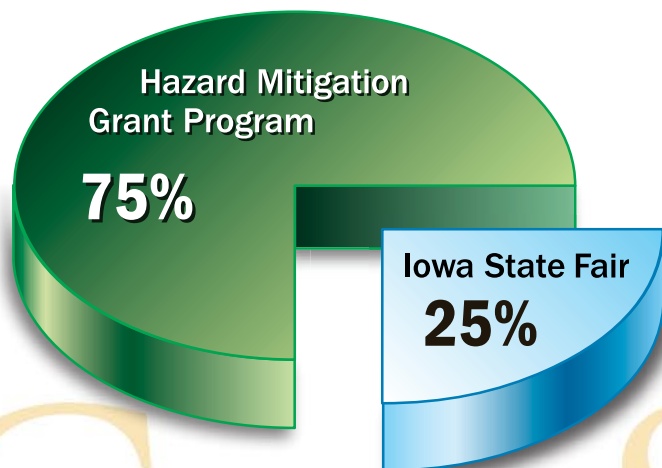
The Iowa State Fair complex includes the fairground and the 160-acre campground, which is located approximately 600 feet from the outskirts of the fairground. Prior to the construction of the shelter, the campground offered little protection for campers during a tornado or high-wind event. In fact, the only places of refuge were three restroom structures. Given the inherently temporary nature of camping equipment (e.g., trailers, tents, and motor homes), there is a high potential for casualties at a campground during a tornado event.

In the event of a tornado watch, campers at the State Fair complex may find that, without reservations, they cannot readily move to a safer location, such as a hotel or motel, especially when the State Fair complex is being used for a well-attended event such as the State Fair. As a result, campers may disregard an emergency warning in the hope that the danger would soon pass without incident. With the construction of the new shelter, campers have a place to seek refuge during a tornado or high-wind event.

The warning signal for an approaching tornado or high-wind event is a pole-mounted siren adjacent to the State Fair complex. Iowa State Fair employees report from past experience that the siren is “plenty loud.” The State Fair monitors National Weather Service broadcasts continuously during the week of the State Fair for news of impending storms. Also present in the shelter and around the State Fair complex are National Oceanic and Atmospheric Administration (NOAA) weather radios for monitoring weather conditions. The State of Iowa received a grant to provide NOAA weather radio transmitters throughout Iowa for use as a warning system.



Iowa State Fair Campground Plan



From a Good Idea to Groundbreaking

The Iowa State Fair and the Iowa Homeland Security and Emergency Management Division (HLSEM) collaborated on the shelter construction project. The funding source was the Hazard Mitigation Grant Program (HMGP); funds for the project were split between Federal (75 percent) and local (25 percent)

Campground Multi-Use Shelter

monies. The Federal portion consisted of a \$600,000 grant from the Federal Emergency Management Agency (FEMA). The State Fair itself funded the remaining 25 percent.

The project began in the fall of 2002, when Linda Roose, Iowa HLSEM Safe Room Project Coordinator, contacted the College of Design at Iowa State University in Ames, Iowa, requesting assistance with the design for a storm shelter. Professor Bruce Bassler and two of his students, Eric Requist and Maren Tomblin, agreed to research designs for the shelter. The students worked on the project during the fall semester and submitted their designs to the State Fair Board. The Board selected their unique preliminary shelter design, which resembles a football when viewed from above. Ms. Roose then contacted the

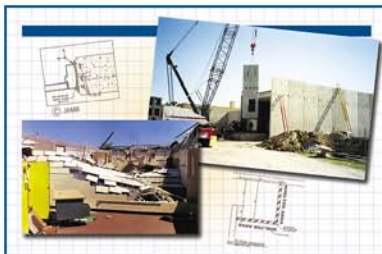


IOWA STATE UNIVERSITY

Students at the Iowa State University College of Design researched and provided the preliminary shelter designs.

American Institute of Architects (AIA) to find an architect. Tom Hurd, of Spatial Designs Architects and Consultants, came on board and developed the concept into the final design, completing the plans as prescribed by the standards set in FEMA publication 361, *Design and Construction Guidance for Community Shelters* (<http://www.fema.gov/fima/fema361.shtm>). Groundbreaking for the shelter construction occurred approximately 2 years from the inception of the idea.

Concept drawing (below) developed by Tom Hurd of Spatial Designs Architects and Consultants.

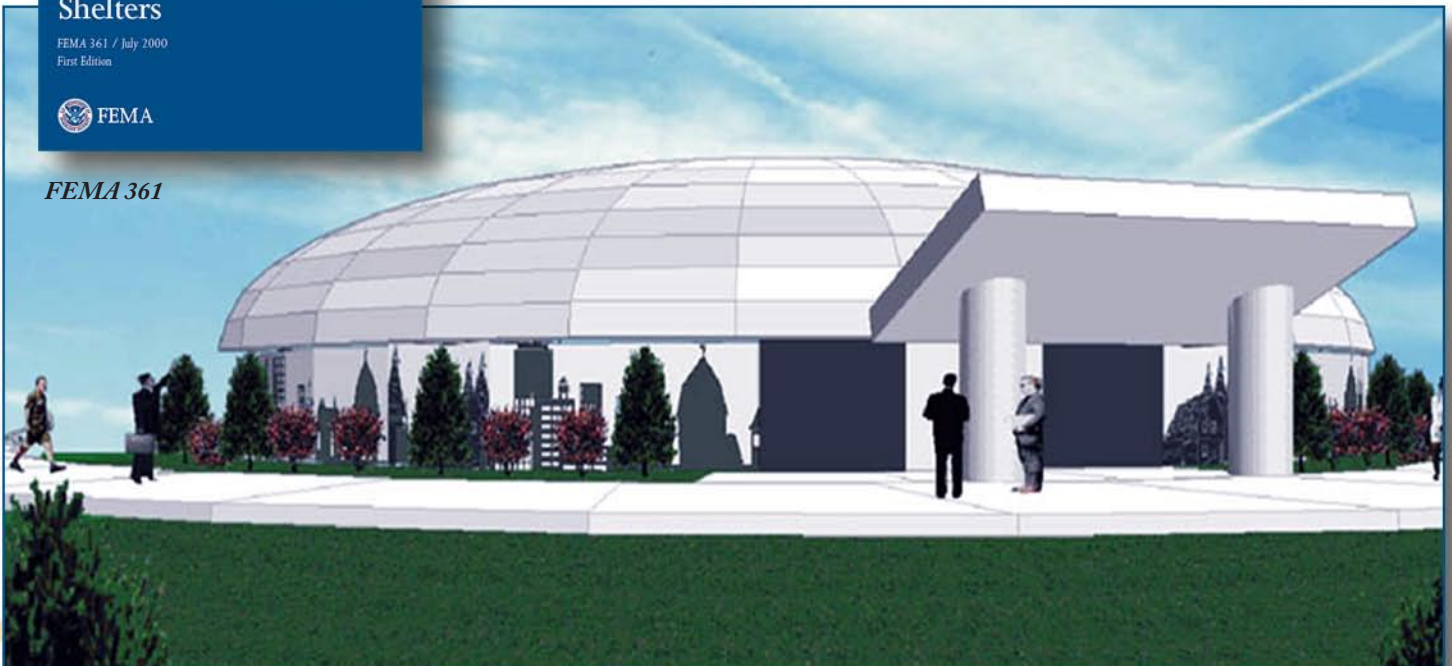


Design and Construction Guidance for Community Shelters

FEMA 361 / July 2000
First Edition

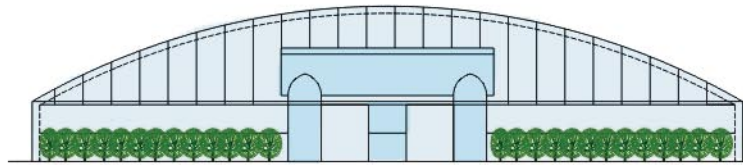


FEMA 361

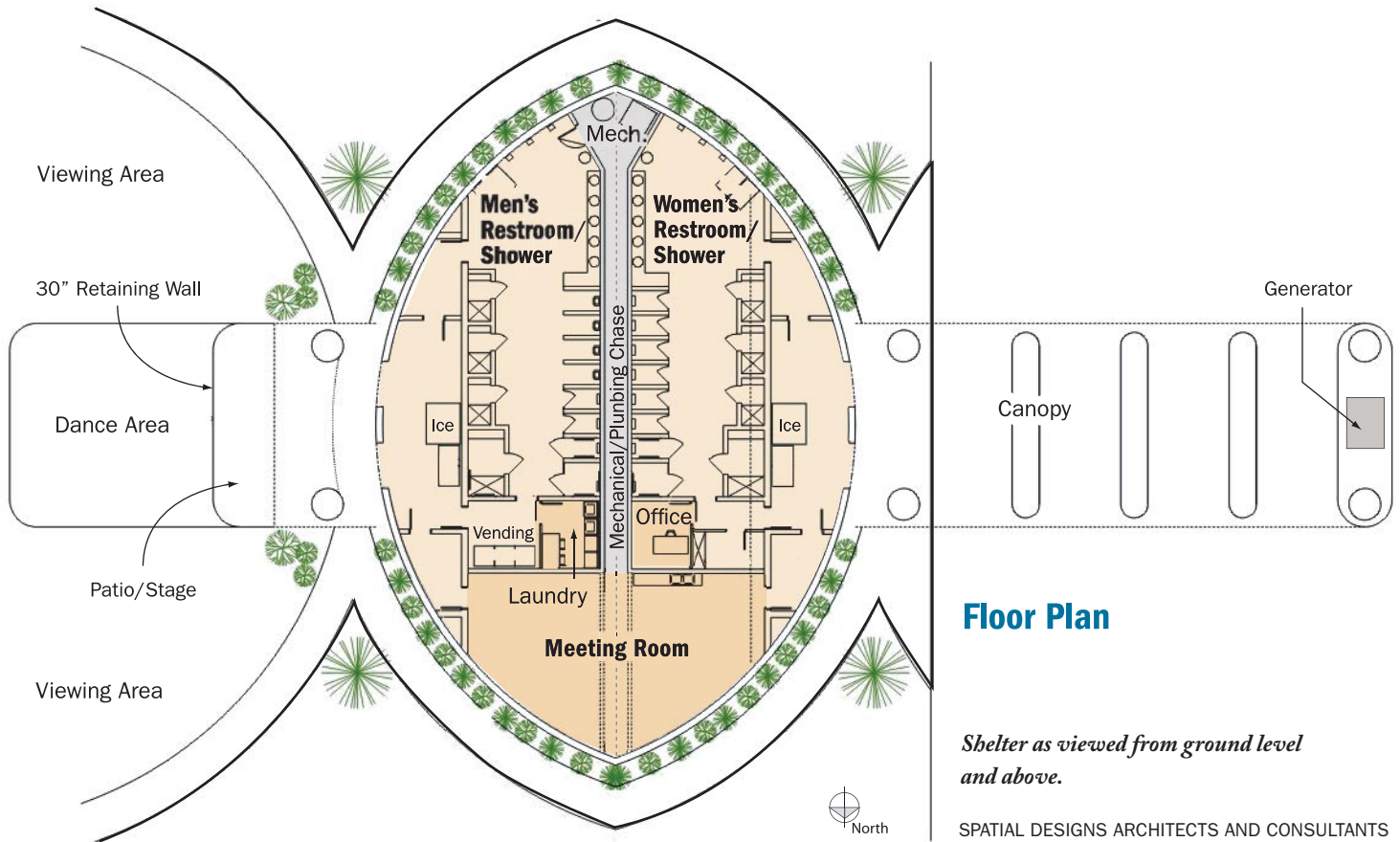


SPATIAL DESIGNS ARCHITECTS AND CONSULTANTS

Campground Multi-Use Shelter



East Elevation



Floor Plan

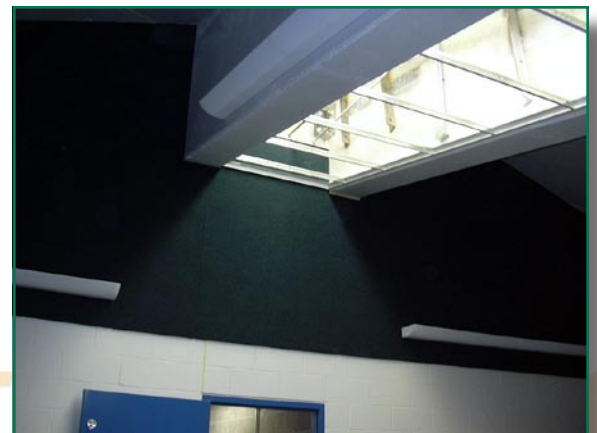
Shelter as viewed from ground level and above.

SPATIAL DESIGNS ARCHITECTS AND CONSULTANTS

The Campground Sports a New Shelter

The shelter encompasses 5,200 square feet in area and is 100 feet long by 71 feet wide. It is centrally located in the campground area, sited on the side of a hill between the campground and the fairground to serve as the fourth shower/restroom facility. The floor plan of the shelter is a mirror image of the two halves of the elliptical structure. The men's and women's restrooms and showers are located on opposite sides of the building. A floor-to-ceiling mechanical/plumbing chase divides the two restrooms. A meeting room is at the north end, covering both halves of the shelter, and is illuminated with an overhead light fixture designed to mimic a skylight. When not in use as an emergency shelter, the large multi-purpose building is used by both the fairground staff and campers for restrooms, showers, a laundry area, offices, and meeting room facilities.

An overhead light fixture designed to mimic a skylight illuminates the meeting room.



IOWA EMD

The shelter was constructed to hold approximately 400 people. According to Bill Hare, Plant Operations Director for the Iowa State Fair, this is the highest number of campers expected at the campground at any time other than the week of the State Fair. The number of campers during the week of the State Fair is very high, estimated roughly at 4,000 people. Building a shelter large enough to accommodate the maximum number of campers for that one week would not be economically feasible. A shelter for 400 people was economically feasible and considered to be the best protection that could be offered to campers.

Signs are posted around the campground to show the shelter's location. When checking into the campground, campers will receive fliers that describe the shelter and offer safety tips in the event of a tornado or high winds.

This campground shelter is a prototype for other shelters across the State of Iowa. The Iowa HLSEM and FEMA worked with the Cities of Ventura and Duncombe to design community shelters that will double as multi-purpose structures for the local residents. The Ventura shelter was completed in May 2004. The shelter at Duncombe is now under construction. It will be partially solar powered, making it even more environmentally conscious.

Building the Shelter

The unique design of the shelter offers excellent wind resistance, and created interest from a design standpoint because it did not look or feel like a typical bunker. The curved surfaces force the wind around the shelter on all sides, thus alleviating wind pressure at specific points. The shelter was constructed in accordance with the criteria presented in FEMA publication 361, *Design and Construction Guidance for Community Shelters*. Representatives of FEMA's Regional Office in Kansas City, Missouri, and Linda Roose worked closely with the architects and contractors during the design and construction of the shelter.



The unique shape of the shelter's curved surfaces force the wind around the shelter on all sides.

SPATIAL DESIGNS ARCHITECTS AND CONSULTANTS



Campground Multi-Use Shelter

The roof and the unique curved walls of the structure are constructed of 12-inch-thick, precast concrete panels. The concrete uses a special formwork that retains the overall curved shape. The pie-shaped panels enable the roof to be the required width without exceeding a maximum span of 32 feet. The roof and wall panels are connected with welded steel plates.



IOWA HLSEM

Twelve-inch-thick, precast concrete panels (shown above) were used to create a unique shape.



IOWA HLSEM

The pie-shaped roof panels are lowered into place with a crane.



IOWA HLSEM

Case Studies

DES MOINES, IOWA

The interior partition walls are constructed of fully reinforced concrete masonry units (CMUs). The central mechanical chase vents through to the roof. Surrounding the mechanical chase are reinforced walls designed to protect occupants from debris that may enter the chase, with “missile” strength, from the roof vent. To reduce the likelihood of debris entering the chase, the roof-mounted venting system is equipped with drainable stationary louvers that have been tested and approved by Miami-Dade County, Florida, for hurricane resistance (Miami-Dade County, Florida, Notice of Acceptance number: 01-0328.04).

The doors, manufactured by Curries, meet the door design and performance criteria specified by FEMA 361 and have been tested by Texas Tech University’s Wind Science and Engineering Research Center (<http://www.wind.ttu.edu/>).

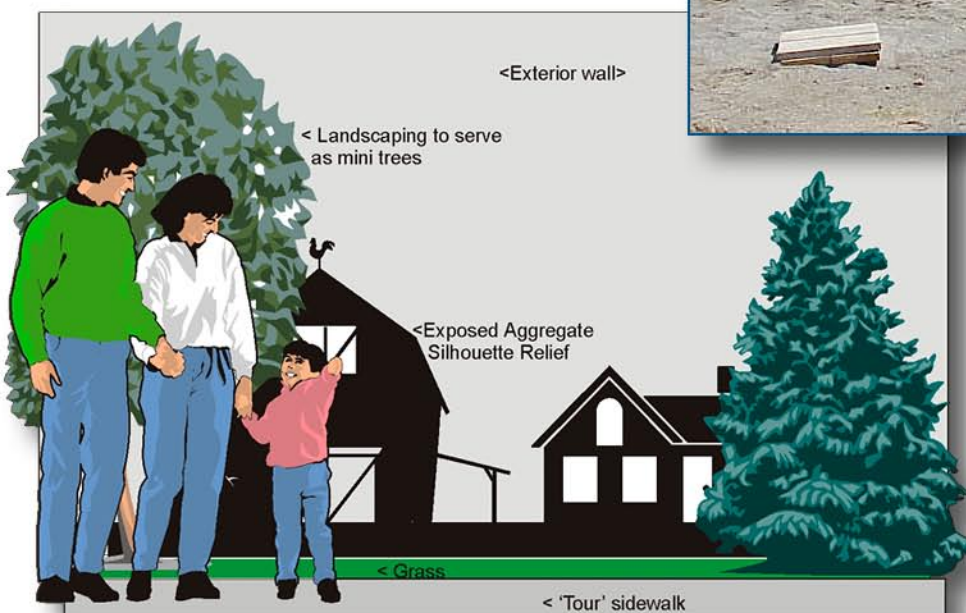


IOWA HLSEM



IOWA HLSEM

Construction of fully reinforced CMU interior partition walls.



Relief of Iowa scenes proposed by Spatial Designs Architects and Consultants for exterior walls.

Because the large structure is curved and windowless, the designers wanted to break up the repetitive massing to generate user interest. The architects at Spatial Designs Architects and Consultants recommended a silhouette relief composed of “Iowa Tour” scenes sandblasted around the perimeter. Bill Hare reports that they would like to obtain sponsors for the creation and design of the relief murals.

On the east side of the structure, a concrete canopy mounted on concrete piers provides weather protection. The canopy has been designed to withstand 250-mph winds and to prevent them from becoming a debris hazard themselves during a high-wind event. A future canopy on the west side is planned to cover the entry to the shelter from the road. The canopy on the east side of the shelter provides cover for gatherings at the campground such as small musical groups and social events; descending steps radiating from beneath the canopy promote its use as a stage.

Inside the structure, many of the interior walls are 8 inches thick. Lighting is provided by an overhead light beam in the large meeting room. The light beam is projected from a long, narrow shaft with a 12-inch concrete cap, installed at the peak of the vaulted ceiling between two large concrete beams. The setting of the light gives it a skylight appearance. The meeting room is expected to hold approximately one-third of the shelter capacity of 400 occupants.



SPATIAL DESIGNS ARCHITECTS AND CONSULTANTS

Canopies mounted on concrete piers designed to withstand 250-mph winds provide weather protection.



IOWA HLSEM

The People Feel Safe

The summer of 2003 was the first season that the campground shelter was open to the public. No severe storms were reported during that time, and the campers enjoyed having the extra restroom, shower, and laundry facilities included in the shelter. The campers and the State Fair Board also have a certain peace of mind knowing that there is a safe place to go during a tornado warning or high-wind event in the camping season.

Upon arrival at the campground, campers will be given printed information that outlines what actions should be taken in the event of a storm warning. Because many campers do not carry telephones, their first contact will be the campground host, who is on duty 24 hours a day. Security personnel and the campground hosts are responsible for contacting each camper during a storm warning.

In a survey of last year's campers during the construction of the shelter, Deanna Truman-Cook, of *The Des Moines Register*, and Linda Roose received positive reviews of the new shelter.

"It was a relief for us, it is quite a place!"

– Fred Brown, 65, camper

Need for Future Campground Shelters

The campground shelter at the Iowa State Fair complex, built to meet FEMA 361 criteria, was planned as a prototype for other shelters across the State of Iowa. It can also serve as an example of how to address the safety of campers at other state fair campgrounds in the United States. Based on the size of state fairs across the United States and the time of year they are typically held, it is surprising that more shelters are not in place for campers.

Nearly all U.S. state fairs are held in either July or August, which is not only during tornado season in the Midwest, but is also during the thunderstorm and hurricane season in the East, Southeast, and Gulf Coast region. Tragedy struck at the New York State Fair in September 1998, when thunderstorms and high winds came through the fairground's campground, killing two men asleep in their

Shelter Operations Plan for Campground Safe Shelter

Information to be included in the Shelter Operations Plan

- **Call List**
 - Names and responsibilities of all associated personnel
- **Hours of Operation**
 - As long as the campground is open (spring to fall), the restroom/safe shelter will remain unlocked.
- **Community Management Team Responsibilities**
 - Site Coordinator
 - Assistant Site Coordinator
 - Signage Manager
 - Campgrounds Manager
 - Notification Manager
 - Shelter Manager
 - Shelter Maintenance Plan
 - Equipment List
- **Facility Training**
 - Site Coordinator
- **Emergency Assignment**
 - Iowa State Fairground (ISF) Maintenance
 - ISF Public Safety
 - Campgrounds Host

tents, and injuring seven others. In an interview with *The Des Moines Register*, Jim Tucker, CEO of the International Association of Fairs and Expositions, reported that many fairs have been hit by tornadoes and high-wind events in the past.

Whether to design and construct shelters that can provide protection for all attendees at a state fair or, as in the approach taken by the Iowa State Fair, for a selected group with the greatest need, is a decision that will need to be based on a state's priorities and resources. Although the campground shelter at the Iowa State Fair complex cannot hold the thousands of fairgoers who typically attend the fair, constructing the shelter is a big step toward providing for the safety of campers who would otherwise have nowhere to turn.



Completed shelter.
SPATIAL DESIGNS ARCHITECTS AND CONSULTANTS

Useful References for Designing Shelters

Department of Homeland Security/FEMA

FEMA 361, *Design and Construction Guidance for Community Shelters*, Washington, DC
<http://www.fema.gov/fima/fema361.shtm>

FEMA 431, *Tornado Protection: Selecting Refuge Areas in Buildings*, Washington, DC
<http://www.fema.gov/fima/fema431.shtm>

FEMA 320, *Taking Shelter From the Storm: Building a Safe Room Inside Your House*, Washington, DC
<http://www.fema.gov/fima/tsfs02.shtm>

Case Studies

DES MOINES, IOWA

Hazard Mitigation Grant Program (HMGP)

<http://www.fema.gov/fima/hmgp/>

<http://www.dem.dcc.state.nc.us/mitigation/hmgp.htm>

International Association of Fairs and Expositions (IAFE)

<http://www.fairsandexpos.com/>

National Storm Shelter Association

<http://www.nssa.cc/>

Texas Tech - Wind Sciences and Engineering Research Center

<http://www.wind.ttu.edu/>

American Institute of Architects (AIA)

<http://www.aia.org>

American Society of Civil Engineers (ASCE)

Minimum *Design Loads for Buildings and Other Structures*, ASCE 7-02, 2002, American Society of Civil Engineers, ISBN: 0-7844-0624-3 <http://www.pubs.asce.org/ASCE7.html?99913>

Acknowledgments

FEMA would like to acknowledge the contributions made to this case study by Linda Roose, of the Iowa Emergency Management Division, and Tom Hurd, of Spatial Designs Architects and Consultants, Mason City, Iowa. Ms. Roose and Mr. Hurd provided information about the design, construction, and funding of the campground shelter, including photographs of the shelter construction process and the completed shelter.