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# TORNADO PROTECTION

IDENTIFYING THE SAFEST SPACES IN BUILDINGS



photo: NOAA

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This procedure is designed to assist in a systematic review of a building to find best available spaces against severe winds. It is not intended to imply that these spaces guarantee safety during a storm, but that they are the *safest available* in the building.

There are some facilities such as *lightweight modular houses, offices, and classrooms which must be presumed to be death traps, even if tied down. THEY SHOULD BE EVACUATED! There is no guarantee that the ties will hold.*

## ADVANCE PREPARATION

Obtain the following equipment: Compass, flashlight and tape measure. Obtain plans for each floor of the building. Ideal plans are small, to scale, with sufficient detail. If the drawings are not available, have someone prepare a simple, accurate drawing of each floor. Check drawings against the actual building. Don't presume accuracy.

## SPACE REQUIREMENTS

The space per person depends on the size of the people and their degree of mobility. Small children may require less than 3 sq.ft./person. Usually 5-6 sq.ft/person is adequate for adults. However, nursing home or hospital patients will require much more space.

## TEST AND RECORD

A plan is almost worthless if it is not tested and understood by the people it is intended to protect. A good plan has the following features:

- a. It identifies one or more spotters who are responsible for prompt and accurate visual identification of an approaching storm. The National Weather Service will provide training.
- b. It provides for a prompt, clear warning that will be readily understood by all.

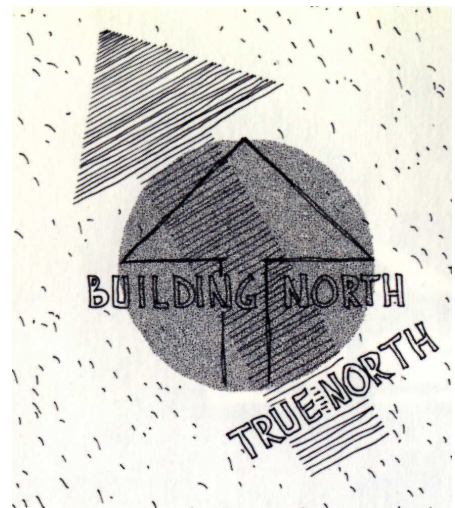
The plan should be recorded and made known – so all will know where to go and what to do in an emergency.

## EXTERIOR SURVEY

Establish true north. Use a compass or compare the building to an accurate map of the locality. Place a north arrow on the floor plans of the building. Do not confuse true north with *BUILDING NORTH*, a direction sometimes used to simplify drawings.

Check completely around the building, look for and record the location of the following:

- a. Potential missiles, such as site equipment, nearby buildings, automobiles, and other debris, especially on the south and west sides.
- b. Ground embankment against the buildings
- c. Changes in grade level
- d. Mechanical equipment on the roof.
- e. Electrical service entrance.
- f. High building elements such as chimneys and high portions of the building.
- g. Changes in roof level.



Drive or walk around the building. Look for changes in roof heights. Take a look from each direction, particularly from the south and west, noting building entrances, windows, and construction features.

## AVOID!

Carefully identify the following spaces as the most hazardous locations, *the spaces to avoid!* Avoid locations where roofs are likely to be blown off. They may fall in on the occupants. Missiles also have direct access to the interior.

Portions of roofs most likely to be blown off are:

- Windward edges (usually south and west).
- Long spans.
- Portions with loadbearing wall supports.
- Portions with overhangs on the windward sides.

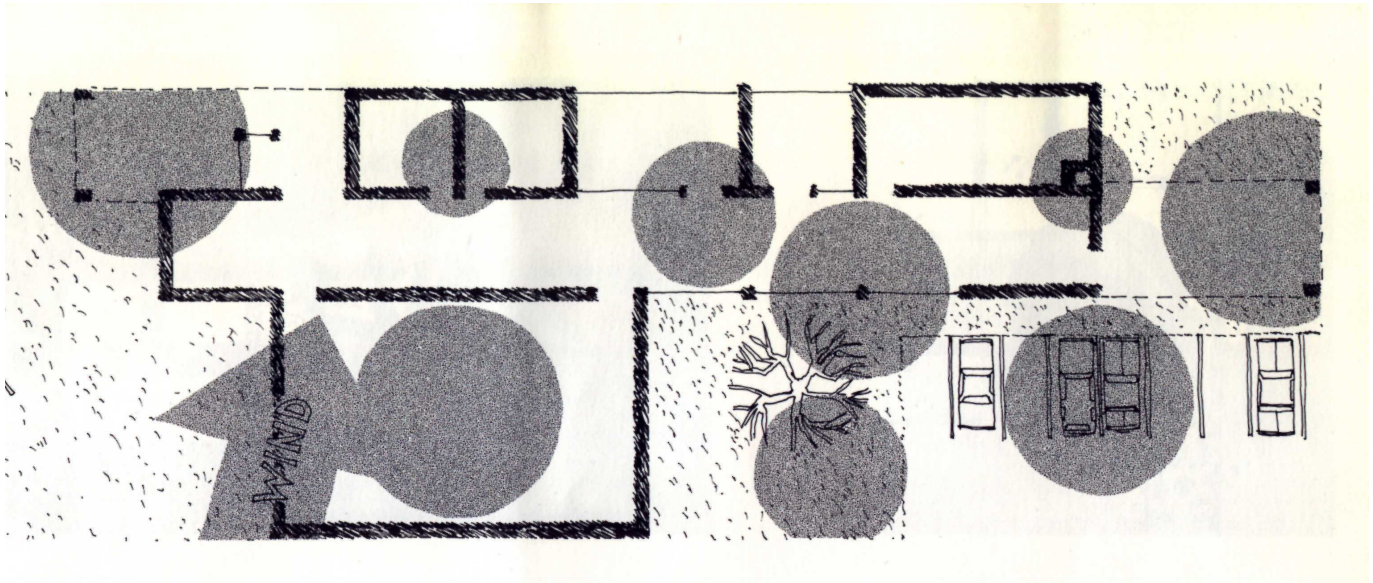
Avoid exterior walls that are most likely to be partially or completely destroyed. The most likely damage will probably occur, in the following order, to these walls:

- South
- West
- East
- North

Check for corridors that may become *WIND TUNNELS*. Examination of corridors after tornados revealed much debris, and evidence of very high speed winds. This was found in corridors with exterior doors allowing direct exit (no turns) to the following directions, *in order of severity of wind tunnel effects*:

- South
- West
- East
- North

However, buildings constructed or remodeled since the late 1970's have safer corridors. Many entrances have vestibules. The door windows are now safety glazing, much more resistant to impact.



Avoid locations with *WINDOWS facing the likely storm direction*. Assume that the windows will blow IN on the south and west sides of the building, and occasionally on the east and north.

Avoid, whenever possible, portions of buildings that contain loadbearing walls. If such a wall collapses, the roof or floor will fall in.

Examination of building failures after high winds reveals a pattern of remaining spaces. These should be considered for occupancy during a tornado.



## **CONSIDER – but do not necessarily select....**

... the *LOWEST FLOOR*. If a building has a basement, or a partial basement, it is probably the safest space in the structure. However, multistory buildings usually have identified spaces on upper levels. The top floor may contain excellent spaces if the roof structure is concrete.

... *INTERIOR SPACES*. These are spaces that have no walls on the exterior of the building. However, avoid interior spaces with large spans.

... *SHORT SPANS*. It is difficult to find one space, with the exception of the basement, that will offer a high degree of protection to all of the building occupants. Therefore, seek out a number of smaller spaces.

... portions of the buildings supported by *RIGID STRUCTURAL FRAMES*, such as steel, concrete, or wood, rather than those that have unreinforced loadbearing walls.

## **REFINE**

It is essential that spaces selected be the very best available. Often poor (relatively hazardous) spaces exist within generally safe areas. These poor spaces must be avoided or occupied as a last resort.

Avoid spaces opposite doorways or openings into rooms that have windows in the exterior walls, particularly those facing south or west.

Avoid interior locations that contain windows such as display cases, transoms above doors, and door sidelights.

Avoid interior location under skylights or clerestories.

Avoid locations where interior doors swing. When the storm hits, the doors are likely to swing violently.

Avoid spaces within the falling radius of higher building elements, such as chimneys or upper walls enclosing higher roof areas. Assume that the falling radius is approximately equal to the height of the higher building element above the roof. Remember ... a high wall can fall in either direction.

## **OTHER CONSIDERATIONS**

Often the best available shelter spaces in a building *CANNOT* be occupied during emergencies for various reasons. Consideration of the following will help determine if the spaces can be occupied:

*What portion of the space is usable?* Permanent equipment and furniture reduce the usable space.

*Which good spaces are often inaccessible in emergency?* Many fine spaces normally are locked, with few people having keys. However, advanced planning could make these spaces available.

*Which good spaces are unsuitable for occupancy due to operational reasons?* Many secure spaces offer excellent protection, but operationally may *not be used* (for security or personal reasons).

*Where is the building first aid kit?* It should be in one of the safest spaces.

*Would protection levels increase significantly and movement time-to-shelter decrease significantly if people were jammed in at a lower square-foot per-person ratios?* This is a valid alternative in lieu of using lower quality protection, with more space per person.