TORNADO INFORMATION FOR SCHOOLS

A tornado is a cell of violent high velocity winds that has developed in a massive storm front usually containing severe thunder storms. A tornado will usually have a maximum wind velocity between 125 and 200 miles per hour, progress across the countryside at 40 to 60 mph, 90% of the time have a general directional path from the southwest to the northeast, and in the northern hemisphere rotate in a counter clockwise direction. The tornado usually develops from the confrontation of warm moisture laden winds from the south with the strong cold front winds from the north. These fronts are sometimes aided by a hot dry air mass from the southwest. From this turbulent meeting of strong fronts, one or many tornadoes may be spawned. These areas of turbulence are first noticed on weather radar and referred to as "hooks". The disturbances may dissipate or develop sufficient strength to touch down and start their destructive path as a tornado. A tornado will usually be found in the interior of, or on the trailing edge of a severe thunderstorm. The usual classic long funnel shape that is common out in the mid-west is seldom seen in the southeastern states. The tornado is normally preceded by heavy rains and is not visible because of trees, buildings, and landscape blocking the view. Normally, you will hear it prior to seeing it.

Some of the principle effects of peak tornado winds are:

a. The disintegrating pressure of winds against walls, windows, and doors.
b. The devastating effect of missiles propelled by the wind.
c. The collapse of high portions of buildings, such as chimneys, into lower parts which would otherwise suffer little damage.
d. The explosive pressure differential when air pressure inside a building is momentarily higher than outside.

Previously, it had been thought that a possible greater effect than the wind was the explosion of air trapped inside a building when the low-pressure eye passes overhead causing all walls and roof to blow outward. Investigations indicate that this phenomenon does not occur. Indeed there are pressure differentials, but certainly no vacuum type area associated with a tornado as many people think. All buildings investigated that appear to explode always had one wall blown inward. Lets look at the various pressures associated with a tornado. As high velocity winds strike a building, the side facing the wind receives a tremendous buildup of pressure. As the winds pass along the sides and over the top of the building, a pulling or outward pressure is exerted. On the leeward side a pulling or outward pressure also exists. Lets assume that the buildup of pressure on the windward side causes the windows, doors, or walls to blow inward. The built-up pressure is released into the room or building and instantly exerted on the remaining three walls and roof. This pressure is outward and coupled with the exterior pulling pressure can cause the remaining parts of the building to be blown outward. A person watching would usually think it exploded.

In the past, much misinformation has been distributed and this is a cause for concern, especially in regard to exterior doors and windows. The recommendations now is that these windows and doors be kept closed. If you follow the open window concept, you would have to open windows for every storm that might produce a tornado. Even minor winds could, and would, blow rain into classrooms. Consider the water damage that would be caused from the dozens of storms that did not bring a tornado. When you realize the low probability of any one particular school being hit by a tornado, opening windows probably wouldn't be worth the effort. The thinking behind this theory was to equalize pressure so your building would not explode. In the section of your building that's hit by the maximum winds of a tornado, it won't make any difference if the windows are open or closed. It is far more important to have the doors and vents between classrooms and corridors open. In this way when windows are broken from the buildup of pressure and flying debris, the potential pressure buildup in a room is lessened because it can dissipate throughout the building.

The treatment of interior and exterior doors depended upon the construction of the building. Exterior door glazing that is made of non-shattering material should be kept closed. If they have glass panels that would shatter, it is suggested they be propped open so they do not add to the storms debris. Interior doors between classrooms and corridors should be secured open if other pressure releasing ventilation (transoms, vents, etc.) are not available. It would be best if all opened doors are wedged securely to prevent flapping around. A wall latch or wooden wedge is ideal for this. If the doors can not be securely held in an open position, then they should be closed to keep them from flapping.

There have been some disturbing publications that indicate a corridor as unsafe if it runs in the direction of the storm, since it can act as a wind tunnel. Since tornadoes are generally expected out of the southwest, it would indicate that all corridors with exits either to the south or west are unsafe. You will find that virtually all corridors have an exit either south or west; yet, we find in most facilities that those corridors are the only areas with any degree of protection available. It is a shame that these publications fail to explain their reasoning. We are in a percentages game and we must select the **best available** areas that afford the greatest protection. As an example, if you had a school with a long south to north corridor with no other protective area, would you suggest the principal leave the students in the classrooms and leave the corridor vacant? Certainly not, you would use the corridor, because the chances of your being in the right location of the storm to have this severe tunneling effect would be minimal. Even the tunneling effect would be preferable to that of falling walls and roofs that might be expected in the classrooms.

Do not believe that only southwest winds are present in a tornado approaching from that direction. The direction and velocity of the wind is determined by your location or position in the tornado path. Assume that the tornado cell has maximum rotational wind velocities of 150 mph and is progressing across the countryside at 50 mph. If your building is on the right edge of the tornado, the 150 mph wind velocity is augmented by the 50 mph progression producing the equivalent of 200 mph wind force on your building. If your position happens to be on the

left edge then the 150 mph wind velocity is retarded by the 50 mph progression producing the equivalent of 100 mph wind force on your building. The wind force is in the opposite direction form the first example. If you are near the center of the storm path, the leading edge of the tornado would have right to left wind direction; the trailing edge would have left to right wind direction. Although 90% of the tornadoes are reported to have a general path from the southwest to the northeast, the direction of the tornado within that path may be very erratic. As an example, an investigation of a storm path in northeast Birmingham, indicated several near 90 degree directional changes within a 500 a yard distance.

The following suggestions are for school principals:

1. Have an adequate source of weather information so that you can keep abreast of weather conditions. At least two (2) NOAA SAME Tone Alert radios should be in each school building.

2. Formulate a plan of action and pass instructions to all teachers and other employees.

3. Have enough drills until you are satisfied with the response. It is suggested that a drill be held shortly after school begins in the fall to acquaint new students and teachers with the plan. Another drill should be conducted soon after to assure the principal that the plan is adequate. It would be helpful to have a drill in early spring as a refresher prior to the tornado season (peak season is usually March, April, and May).

4. Select the best protective area available in which to house the students in the event of a tornado. Basements are usually considered the best area, with corridors and small interior rooms being the best area on the first floor of a structure. Refrain if at all possible from areas on the second floor or above because the wind velocity can be much greater than at ground level. If relocation action has not been taken early enough to remove students to lower levels, the corridor area would still be the best protection at upper levels.

5. Never house students in areas or rooms where there is an outside wall and the ceiling or roof is wide span. Sometimes this area must be used if no better protective area is available, but remember there is danger of both wall and roof collapse in cafeterias, gymnasiums, and most large classrooms.

6. Realize that in most new construction where the roof has been constructed of a light weight insulating material (celetex or some similar trade name) that the tornado type winds will greatly disturb it. If much of the roof is blown away, some of it will fall into the structure. Panels falling normally would not cause injuries but during a tornado this light weight material may become very dangerous as a result of the high wind velocities involved.

7. Instruct the students and teachers to sit facing the wall, with their heads between their knees and cover their heads with a hood or jacket. If there is a danger area near, such as a glass entrance, students should deviate slightly from the above by sitting with their backs toward the danger. The sitting position provides the smallest target from flying debris and provides the greatest protection to the body's vital areas. Do not position the students on their knees because they cannot remain in that position for any length of time.

8. Understand why exterior doors and windows should be kept closed, while interior doors (classrooms to corridors) should be kept securely open. It is quite desirable to keep as much rain and flying debris out as possible, but there may be greater importance in positioning the interior doors to the building can absorb any excessive pressures generated in parts of a structure damaged by a tornado.

9. Post "storm watchers" during any severe storm and especially during the "tornado warning" period. Do not rely solely upon an outside source for information regarding a possible tornado. A tornado might form and touch down a short distance from your school. A few seconds warning prior to being hit could save many lives.

10. Be aware of the conditions that are usually associated with a tornado:

    a. Very dark ominous clouds
    b. High winds and hail
    c. Frequent almost continuous lighting and thunder
    d. A continuous low roar or rumble

11. Know that a **"tornado watch"** defines an area approximately 250 miles long and 120 miles wide that has a high probability of receiving at least one tornado. There is no cause for alarm unless the sky becomes threatening or a tornado warning is issued. During this time, one should review the tornado plan and notify all the teachers of impending weather conditions. One should consider relocating students from portable classrooms to safer areas before weather conditions deteriorate.

12. Know that a **"tornado warning"** technically means that a tornado has been spotted on the ground in your county or moving toward your county; or that weather radar indicates a high probability of a tornado existing. This is the time to relocate students to areas offering greatest tornado resistance.

13. Keep the students at the school if a tornado warning is in effect at school dismissal time. They should be retained until conditions permit their release.

14. Work with the bus drivers and have them become aware of substantial buildings (churches, other schools, public buildings, etc.) along their route to which the students may be relocated if a tornado threatens. **Do not stay in the bus,** a ditch offers more

protection.

15. Advise parents not to drive to the school to pick up their children when storm conditions are severe. Driving conditions become very hazardous because of heavy rain, hail, strong winds, and normal congestion near the school. Even if they are able to pick up their children, they may be taking them from a generally better protected area to the dangers of being in a vehicle, a home that has less protection, or to a mobile home.

16. Know that large trailers will start to lift when hit broadside by 50-55 mph winds. This means that trailers and portable classrooms can be badly damaged during severe thunderstorms and do not have to be hit by the direct force of a tornado to be destroyed. Relocate children from portable classrooms when any severe storm is forecast or eminent.

For more information, programs, or for a member of our staff to help with a shelter survey please call our office at 513-785-5810 or check out our internet website at http://butlercountyohio.org/ema/.