

	<b>Structural Collapse Search &amp; Rescue 2700</b>		<b>TFCA Best Practices: 4.04</b>	
	Effective: 03/2010	Revision: 12/2014	Fire Chief: Eric Thompson 	

# STRUCTURAL COLLAPSE SEARCH AND RESCUE PROCEDURES

## PURPOSE

- To provide guidelines for search and rescue operations at structural collapse incidents

**Red Oak Fire Rescue shall assume command and control of any incident involving structural collapse or structural damage within the City of Red Oak until the emergency has been mitigated. (TFCA BP 4.04)**

## **Structural Collapse Guidelines: (TFCA BP 4.04)**

1. Scene safety will be secured by ensuring natural gas, water and electricity are controlled and accounted for.
2. A charged and manned hoseline will be deployed if natural gas is not controlled.
3. Constant atmospheric monitoring will be required.
4. Personnel making initial entry into the structure must be in full PPE. Special Ops PPE wear is approved once safe to do so.
5. Stabilization of the structure should be made from the exterior moving toward the interior.
6. Areas not capable of being stabilized will be cleared visually, thermally and by sound without entering the area.
7. Void spaces should be cleared visually, thermally and by sound.
8. Approved USAR markings will be placed outside of the structure once it has been cleared.

## ASSESSMENT

The officer assigned to the operations section should determine the following.

### 1. **Is the Building:**

A. **UNFRAMED:** Structures in which the weight of the floor and roof are supported by bearing walls.

B. **FRAMED:** Structures that are erected by constructing structural steel or reinforced concrete skeleton made of horizontal beams and vertical columns.

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## 2. Potential for Secondary Collapse:

- A. **WALLS OUT OF PLUMB:** Walls that have large bows in the middle are leaning or separated from the floor.
- B. **SMOKE OR WATER MOVEMENT THROUGH BRICKS:** At the scene of fire ground collapses.
- C. **BEAMS PULLING AWAY:** Be alert for the separation of support beams from the walls to which they are attached.
- D. **BUCKLED STEEL BEAMS:** After heavy fire loads, look for beams that sag or are distorted.
- E. **LARGE CRACKS, PLASTER FALLING:** Large cracks that appear in walls, roofs, floors or other structural components.
- F. **NO RUN OFF OR SOGGY FLOORS:** As a result of fire fighting operations or as a result of weather.
- G. **OVERLOADING OR AGE:** Look for sagging roofs, floors, or spans that creep.
- H. **NOISE:** Listen for buildings that creak, moan, groan, snap, crackle or pop.

## 3. Control All Utilities to ensure safety for all members. Ensure that the following have been secured.

- A. Gas
- B. Water
- C. Electrical
- D. Sewer

## VOID DETECTION

Voids may be formed for a variety of reasons and in a variety of forms. During the search phase, survivors are most likely going to be found inside of voids. These voids may be of different sizes and shapes and are affected by the nature in which the building collapses.

Be able to spot certain types of collapses and identify the following types of voids:

1. **Lean-to-Floor Collapse:** Occurs when one of the supporting walls fails or when floor joists break at one end. This type of collapse usually creates a large void.
2. **Lean-to-Cantilever:** This form occurs when one end of the floor or roof section is still attached to portions of the wall. The other end will hang unsupported. **THIS TYPE OF COLLAPSE IS EXTREMELY DANGEROUS.**
3. **V-Shape Void:** This occurs when heavy loads cause the floor to collapse at the center.

**OCCUPANTS ABOVE THE TRAPPED FLOOR WILL USUALLY BE FOUND IN THE BOTTOM END OF THE COLLAPSE. VICTIMS BELOW THE COLLAPSE FLOOR WILL BE FOUND IN VOIDS.**

4. **Pancake Collapse:** Is the result of the total bearing wall or column failure of an upper floor causing the upper floors to pancake down on the floors below. Victims may be found between floors or in voids created by household or office furniture which supports the floors.

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## **SEARCH AND RESCUE STAGES**

A systematic approach to dealing with building collapse will enable the incident manager or rescue operations officer to increase efficiency and reduce injury to both rescue personnel and civilians.

### **STAGE I**

#### **RECONNAISSANCE**

Provide for a general survey of the area and size up of the damage. Find out the following information:

1. Building's use
2. Number of occupants
3. Number of victims trapped and the probable location
4. Are rescue operations currently underway
5. Presence of hazards
  - A. Gas and utilities
  - B. Flammables
  - C. Electrical
  - D. Flooding from burst mains
  - E. Plumbing and sewer disruption
6. Structural stability of adjoining buildings

#### **IMMEDIATE RESCUE OF SURFACE CASUALTIES**

1. Victims found on top of the debris or lightly buried should be removed first.
2. All rescue efforts should be directed to the victims who can be SEEN or HEARD!
3. Rescue efforts should also be directed to reach those victims WHOSE LOCATION IS KNOWN even if you cannot see or hear them.
4. The *Ahailing* system (yelling into voids) and *visual* (looking) may be used to determine victim locations.

#### **SCENE ORGANIZATION AND MANAGEMENT**

1. Begin Tactical Worksheet
2. The following checklist may assist.
  - A. Are all utilities shut down
  - B. Is structural integrity assured or evaluated and a safety officer and observer on site
  - C. Has an engineer or architect been requested
  - D. Are rescue operations being directed
  - E. Are team leaders for each rescue team designated
  - F. Is the collapse area divided into manageable areas
  - G. Is a contingency plan on standby

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## STAGE II

### EXPLORATION AND RESCUE FROM LIKELY SURVIVAL PLACES

1. Once victim location has been identified by:
  - A. Rescuers
  - B. Search dogs
  - C. Victims
  - D. Listening devices
  - E. Fiber-optic video
  - F. TIC
2. Seek out casualties by looking in places, which could have afforded a reasonable chance for survival.
3. Typical areas that should be searched are:
  - A. Spaces under stairways
  - B. Basement and cellar locations
  - C. Locations near chimneys or fireplaces
  - D. Voids under floors which are not entirely collapsed
  - E. Voids created by furniture or heavy machinery

### LOCATING CASUALTIES USING THE "HAILING SYSTEM"

Use this method to determine victim locations.

1. Place rescuers in "call" and "listen" positions.
2. Have the operations officer call for silence.
3. Going "around the clock" each rescuer calls out or taps on something. A period of silence should follow each call.
4. All members should attempt to determine a "fix" on any return sound by pointing.
5. After a sound has been picked up, at least one additional "fix" should be attempted from another angle.
6. Once communications with the victim have been established, it should be constantly maintained.

### BREACHING AND SHORING

1. In some instances, victims may be reached by breaching and shoring.
  - A. Initially try to avoid the breaching of walls. This may undermine the structural integrity of the rest of the building.
  - B. It is safer to cut holes in floors and use the shaft approach.
  - C. If you must breach a wall or cut a floor, cut a small hole first to assure that you are not entering a hazardous area.
2. Shoring may be used to support weakening walls or floors.
  - A. Shores should not be used to restore the structural elements to their original positions.

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- B. An attempt to force beams or walls into place may cause collapse.
- C. If you decide to shore, keep the following in mind.
  - 1) Keep timber shores as short as possible.
  - 2) The maximum length of a shore should be no more than 50 times its width.
  - 3) The strength of a shore is dependent on where it is anchored. If anchored to a floor, it will be dependent on the strength of the floor.
  - 4) SHORING SHOULD BE ATTEMPTED ONLY BY QUALIFIED PERSONNEL.
  - 5) Air-shore may be used in the place of timbers and will provide a stronger shoring system.
  - 6) Shoring should **NEVER** be removed once placed.

### STAGE III

#### SELECTED DEBRIS REMOVAL

1. This stage of the rescue process will consist of reducing the size of the rubble.
2. This must be accomplished based on a pre-determined plan.
3. Cranes and heavy equipment may be needed to accomplish this portion of the rescue.
4. Remove debris from the top down.
5. Remove debris from selected areas where information suggests that victims might be.

### STAGE IV

#### GENERAL DEBRIS REMOVAL

1. This should be employed after all other methods have been used.
2. This should be used only after the decision has been made by the incident manager that no other victims may be found alive.
3. This basically amounts to the demolition phase.

#### GENERAL

1. It is safer to reach entrapped victims from above.
2. Diagram the building on command board.
3. Assure control of all accesses to the site.
4. Beware of "at will" response by volunteers or citizens.

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## BUILDING COLLAPSE SAFETY CHECKLIST

- Assure all water, gas and utilities are secured.
- Provide for sufficient illumination.
- Provide for sufficient ventilation.
- Clear the area of personnel not directly involved in the search and rescue operation.
- Station a safety officer in a position to observe for unsafe conditions and the potential for secondary collapse.
- Keep apparatus and equipment away from the structure.
- Stop all traffic for 200 yards in all directions to avoid vibrations.
- Control spread of fire caused by cutting torches.
- Assure all rescue personnel are properly protected.
- Rescuers should work in pairs, assigned to a team and frequent relief should be planned.
- Coordinate activity when there is more than one operation.
- Check for and control hazardous gases, chemicals, sewage, etc.
- Provide for atmospheric monitoring in all confined spaces.
- Prohibit smoking on site and in the hot zone.
- Watch for overzealous rescuers.
- Avoid unnecessary disturbance of loose debris.
- Do not remove natural shores and supports such as doors and beams which have fallen or are supporting debris.
- Do not cut timbers which support debris.
- Work around heavy obstructions, when possible, instead of cutting through them.
- When working around a victim, remove debris by hand to avoid further injury.

If this is a large concrete reinforced structure that has collapsed, consider the following:

1. Accept the fact that you will have little control of bystanders and personnel working on the pile for a period of time.

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2. Request a heavy police response to control the area.
3. Request a fencing company or the military to fence the entire perimeter of the building with chain link fence, consartina wire or other type fence to control access.
4. Request the power company and have them string temporary poles and lights around the entire perimeter.
5. Once there is adequate police presence, clear the entire rubble pile and collapse site and start from scratch by assigning teams to specific sectors.

## COMMAND TACTICAL WORKSHEET STRUCTURAL COLLAPSE OPERATIONS

### Primary Assessment

- Secure witness or RP
- Determine location, number and condition of victim(s)
- Determine location and number of buildings involved
- Rescue/recovery mode

### Secondary Assessment

- Occupancy type (business, mercantile, assembly)
- Building construction type
- Assess hazards (secondary, collapse, gas, electric) - control hazards
- Assess need for additional personnel (search dogs, Red Cross, structural engineer)
- Assess need for additional equipment (100 ton crane, heavy equipment)
- Assess traffic conditions (establish transportation corridor)

### Groups

- Safety
- Building triage
- Search (technical) - begin marking system
- Access
- Extrication (technical)
- EMS (treatment, transport)
- Staging
- PIO
- Police Liaison
- Haz Mat
- Operations (technical)

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### Rescue Operations

- Make general area safe (traffic control)
- Remove surface victims
- Make rescue area safe (secure utilities)
- Establish perimeter (access)
- Establish transportation corridor
- Establish victim staging area (accountability)
- Remove all non-essential personnel from rescue area
- Establish building triage team(s)
- Establish action plan for building search team(s)
- Establish action plan for rescue team(s)
- Personal protective equipment
- Transfer victims to MICU
- Selective debris removal

### Termination

- PAR (personnel accountability)
- General debris removal
- Remove equipment
- CISD