City of Poquoson
Fire and Rescue

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SPECIAL OPERATIONS

SOP#: SO 4.00

Title: Structural Collapse Search and Rescue

Effective Date: 01/01/2009

Revised Date: 01/01/2009

Fire Chief's Signature

City Manager's Signature

STRUCTURAL COLLAPSE SEARCH AND RESCUE

I. PURPOSE

The purpose of this SOP is to provide Fire Department personnel with the basic information needed to effectively manage search and rescue operations at the site of a structural collapse and provide awareness of technical rescue operations that may occur at a structural collapse involving injured or trapped victims.

This SOP is not all-inclusive and cannot encompass all situations that may be encountered.

II. APPLICABILITY

All career and volunteer personnel

III. PROCEDURES

Scene Preparation

- Upon arrival at a "structural collapse incident" the first arriving unit shall establish command utilizing the Incident Command System.

- Assure the response of the York County or Newport News Technical Rescue Team if person(s) may be injured or trapped.

- Assess the need for additional resources e.g., Police, EMS, Hazmat, Codes Compliance, Dominion Power, VNG, Public Works, and Public Utilities.

General Assessment

- Assure all utilities and fires are controlled.

- Assess structural stability of structures from outside.

- Recon the structure and identify types of structures, use, and possible number of victims.

- Remove surface victims first.

- Await arrival of the Technical Rescue Team.

- For a single structure secure the area within 500', allow only needed personnel in hot zone.

- For a damaged area secure area at natural landmarks allow only needed personnel inside hot zone.

The IC or the officer assigned to the Operations Section should determine the following:

1. Is the building:

    - Unframed: structure in which the weight of the floor and roof are supported by bearing walls

    - Framed: structures that are erected by constructing structural steel or reinforced

concrete skeleton made of horizontal beams and vertical columns

2. Potential for secondary collapse

   - Walls out of plumb: walls that have large bows in the middle are leaning or separated from the floor.

   - Smoke or water movement through bricks: at the scene of fire ground collapse.

   - Buckled steel beams: after heavy fire loads, look for beams that sag or are distorted.

   - Large cracks, plaster falling: large cracks that appear in walls, roofs, floors, or other structural components.

   - No water run off or sagging floors: as a result of firefighting operations or as a result of weather.

   - Overloading or age: look for sagging roofs, floors, or spans that (creep).

   - Noise: listen for buildings that creak, moan, groan, snap, crackle or pop.

3. 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:
    - 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.
    - 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.**
    - 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.**
    - 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 that supports the floors.

III. SEARCH AND RESCUE STAGES

A systematic approach to dealing with building collapse will enable the incident commander 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:
    - Building's use
    - Number of occupants
    - Number of victims trapped and the probable location
    - Status of rescue operations underway
    - Presence of hazards
        - Gas and utilities
        - Flammables
        - Electrical
        - Flooding from burst mains
        - Plumbing and sewer distribution
    - Structural stability of adjoining buildings

Immediate Rescue of Surface Casualties

- Victims found on top of the debris or lightly buried should be removed first.
- All rescue efforts should be directed to the victims who can be seen or heard.
- Rescue efforts should also be directed to reach those victims whose location is known even if you cannot see or hear them.

Scene Organization and Management

- Working within the Incident Command System is essential to a successful operation.

- The following checklist may assist:

    - Turn off all utilities.
    - Structural integrity assured or evaluated.
    - Request a structural engineer or architect.
    - Rescue operation being directed.
    - Designate team leaders for rescue team.
    - Divide the collapse area into manageable areas.
    - Develop a contingency plan.

STAGE II

Exploration and Rescue from Likely Survival Places

- Once victim location has been identified by:

    - Rescuers
    - Search dogs
    - Victims
    - Listening devices
    - Fiber-optic video
    - Infrared detectors

- Seek out casualties by looking in places that could have afforded a reasonable chance for survival.

- Typical areas that should be searched are:

    - Spaces under stairways
    - Basement and cellar locations
    - Locations near chimneys or fireplaces

- Voids under floors which are not entirely collapsed
- Un-demolished rooms where egress is barred
- Voids created by furniture or heavy machinery

Locating Casualties Using the "Hailing System"

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

Breaching and Shoring

- In some instances victims may be reached by breaching and shoring.
  - Initially try to avoid the breaching of walls. This may undermine the structural integrity of the rest of the building.
  - It is safer to cut holes in floors and use the shaft approach.
  - 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.

- Shoring may be used to support weakening walls or floors.
    - Shores should not be used to restore the structural elements to their original positions.
    - An attempt to force beams or walls into place may cause collapse.
    - If you decide to shore, keep the following in mind.
    - Keep timber shores as short as possible.
    - The maximum length of a shore should be no more than 50 times its width.
    - 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.
    - **Shoring should be attempted only by qualified personnel or under the supervision of a practical shoring engineer (technical rescue personnel).**
    - Air-shoring may be used in the place of timbers and will provide a stronger shoring system.
    - Shoring should **never** be removed once placed.

STAGE III

Selected Debris Removal

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

STAGE IV

General Debris Removal

- This should be employed after all other methods have been used.
- This should be used only after the decision has been made by the Incident Commander that no other victims may be found alive.
- This basically amounts to the demolition phase.

General

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

BUILDING COLLAPSE TACTICAL CHECKLIST

- Assure all water, gas and utilities are secured.
- Provide for sufficient scene illumination.
- Provide for ventilation at site of extrication.
- 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 wear proper personal protective equipment.
- Rescuers 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 are fallen or supporting debris.
- Do not cut timbers that 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:**

    - Accept the fact that you will have little control of bystanders and personnel working on the pile for a period of time.
    - Request a police response. Consider that this may well be a Terrorism Event and FBI, DEM, ME's office and other state and agencies may need to be notified.
    - Request a fencing company or the military to fence the entire perimeter of the building with chain link fence, concertina wire or other type fence to control access, and protect evidence.
    - Request the power company and have them string temporary poles and lights around the entire perimeter.
    - Once there is adequate police presence, clear the entire rubble pile and collapse site and start from scratch by assigning teams to specific areas.
    - Prepare for extended operations