STRUCTURAL COLLAPSE SEARCH AND RESCUE PROCEDURES

A. GENERAL

This guideline provides operational guidance for the safe and effective use of personnel and equipment at incidents that involve structural collapse operations. This guideline is used in conjunction with NFPA 1670 and 1006 and the FEMA Urban Search and Rescue Field Operations Guide.

All rescue efforts should be directed to the victims who can be seen or heard. Rescue efforts should be directed to reach those victims whose location is known.

The Incident Commander shall assign a qualified rescue technician to serve as the Rescue Group Leader. The Rescue Group Leader will make position assignments in accordance with the Thurston County SORT Team Mobilization and Operations Plan as required by the needs of the incident.

In large incidents Squads may be assigned by the Rescue Group Leader. A Squad will consist of one leader who is a qualified Rescue Systems II Technician or a Structural Collapse Specialist, two rescue technicians and two operations level personnel at a minimum.

**Rescue Group Supervisor:** Coordinates rescue operations and the sectors associated with all activity in the “rescue area”. Reports to the Incident Commander.

**Technical Rescue Safety Officer:** Responsible for monitoring safety within the hazard zone at the structural collapse site. Reports to the Rescue Group Supervisor and coordinates with the Incident Safety Officer.

**Entry Team Leader:** Directs disentanglement and removal operations. Controls access into the collapsed structure. Reports to the Rescue Group Supervisor.

**Shore Team Leader:** Supervises the installation of shoring systems including wood, pneumatic, hydraulic or mechanical as required by the incident. This operation may be assisted by operations level personnel. Reports to the Rescue Group Supervisor.

**Search Team Leader:** Supervises reconnaissance and victim search including the operation of search cameras and listening devices. Reports to the Rescue Group Supervisor.
**Equipment Officer:** Supervises the organization and deployment of Technical Rescue equipment. This operation may be assisted by operations level personnel. Reports to Rescue Group Supervisor.

**Hazard Control:** Oversees atmospheric monitoring, ventilation and control of the utilities. Reports to the Rescue Group Supervisor.

**Extrication:** Responsible for any complicated or long duration rescue extrication that needs to be done to extricate the patient. Reports to the Entry Team Leader.

**Cutting Team:** Responsible for set-up and operation of the cutting table in preparing shoring materials. Reports to the Entry Team Leader.

**Incident Safety Officer:** Responsible for monitoring overall safety at the incident site. Reports to the Incident Commander and coordinates actions with the TR Safety Officer.

Personal protective equipment is required at all structural collapse incidents. Minimum equipment includes:

- Helmet
- Eye Protection
- *USAR Gear or Coveralls (FR or Nomex) or Turnout Gear
- Gloves
- Steel toe above the ankle boots or turnout boots
- Respiratory protection as required by the RGS or TR Safety
- **Knee / Elbow pads

* The Rescue Group Supervisor may reduce minimum PPE to heavy duty cotton work clothing if there is no fire hazard.

**Optional but advised.
Typical locations in which viable victims may be located include void spaces in various types of structural collapse. Examples of void spaces are shown in the illustrations below:

**Lean-to**
A lean-to is formed when one or more of the supporting walls or floor joists breaks or separates at one end, causing one end of the floor(s) to rest upon the lower floors(s) or collapse debris.

**“V”**
A “V” is formed when heavy loads cause the floor(s) to collapse near the center.
**Pancake**
A pancake is formed when the bearing wall(s) or column(s) fails completely and an upper floor(s) drops on to lower floor(s) causing it to collapse in a similar manner.

**Cantilever**
A cantilever is formed when one end of the floor(s) hangs free because one or more walls have failed and the other end of the floor(s) is still attached to the wall(s).
A-Frame
An A-Frame collapse occurs when flooring separates from the exterior bearing walls but is still supported by one or more interior bearing walls or nonbearing partitions.

Secondary Collapse
Indications of potential secondary collapse include the following:

- Leaning walls
- Smoke or water seeping through joints
- Creaking or groaning sounds
- Recurring aftershocks
- Sagging floor or roof assembly
- Missing, strained or damaged points of connection of structural elements
- Excessive loading of structural elements
- Sliding plaster and airborne dust
- Separating walls
- Lack of water runoff
- Racked or twisted structure
- Building vibration

A four stage 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 1 – Reconnaissance / Size-up
- Stage 2 – Exploration and rescue from likely survival locations
- Stage 3 – Selected debris removal
- Stage 4 – General debris removal
B. OPERATIONAL GUIDELINES

Stage 1

First Arriving Units- Operations Level Personnel

1. Establish Command

2. Size Up

First arriving units will attempt to gather the following incident information and report to the Incident Commander.

- General description of the incident and cause (i.e. earthquake, explosion, terrorism, general failure etc.)
- Remove non-essential personnel.
- Assess incident scene hazards including: Disrupted or exposed utilities, flowing water, mechanical or equipment, hazardous materials
- Determine if the building is a framed or unframed structure. A framed structure is one in which the weight of the floor and roof are supported by bearing walls. An unframed structure is erected by a structural steel or reinforced concrete skeleton with horizontal beams and vertical columns.
- Structural stability of adjacent buildings.
- Determine the number and location of victims.
- Determine if victims are injured.
- Determine if victims can self rescue.

3. Establish a safety zone at least 1 ½ times as wide as the height of the remaining damaged structure.

4. Request SORT response as appropriate.

5. Request Law Enforcement for incident scene control, evidence management etc.

6. Immediate rescue of surface casualties includes, victims found on top of the debris or lightly buried. These victims should be removed first.
Stage 2

Technician Level Personnel

1. Conduct size up if not already done. To include the use of the following Marking systems:
   - Hazard Marking System
   - Search Marking System
   - Victim Marking System

2. Once surface casualties have been rescued begin exploration and rescue from the most likely survival places including:
   - Under stairways
   - Basements
   - Near chimneys and fireplaces
   - Void spaces in partial collapse locations
   - Void spaces near furniture or equipment

3. Technician Level Personnel will conduct exploration activities using one or more of the following methods:
   - Rescuers
   - Search dogs
   - Fiber optic video
   - Listening devices
   - Victim tapping / yelling
   - Infrared detectors

4. Breaching may be required to reach victims trapped by structural materials and other debris. Breaching may compromise the remaining structural integrity of the structure. Using the shaft approach from above to reach victims should be considered prior to breaching structural materials.

5. When breaching has been determined to be the only viable option, a small hole should be cut first and a search camera employed to determine victim location and the stability of the overall situation.

6. Atmospheric monitoring shall be required prior to entering a breached space.

7. Shoring may be used to support weakened structural elements. Shoring will be attempted only by qualified personnel or under the direction of a practical shoring engineer or a Structural Collapse Specialist.

8. An evaluation of the base for shoring shall be conducted to determine its strength and general ability to support the shore operation.

9. Shoring is intended to stabilize access points to allow for ingress and egress. It is not intended to restore the structural elements to their original positions. When conducting shoring operations the following will apply:
- No attempt will be made to restore structural elements to their original position as this may cause additional structural collapse.
- Shoring materials will be kept as short as possible. The maximum length will be no longer than 50 times its width.
- Air shoring options will be used if possible due to the increased strength of this method.
- Wooden shoring materials, once placed, will not be removed.
- Commercial shoring equipment may be removed once wooden shoring has been placed.

Stage 3

Selected Debris Removal – Technician Level Personnel

1. Selected debris removal will be conducted following the development of a detailed plan of action. Heavy equipment may be necessary during this phase of the operation and shall be conducted with the support of a structural engineer or other qualified person.

2. Selected debris removal operations will be from selected areas where it has been determined through site evaluation that viable victims may be located.

3. Removal operations will always be conducted from the top down.

Stage 4

General Debris Removal – Technician Level Personnel

1. General debris removal shall be used only after all other methods of rescue have been exhausted and the decision has been made by the Incident Commander that no other victims will be found alive.

2. The operation will likely be managed by a Unified command of SORT personnel and structural engineers or other qualified individuals. Debris removal operations will be supervised by structural engineers and search operations and victim removal conducted by SORT personnel as the situation warrants.
STRUCTURAL COLLAPSE RESCUE GROUP SUPERVISOR CHECKLIST

_______ Assign Technical Rescue incident management positions
_______ Secure the incident scene and establish access control points
_______ Request S.O.R.T. response with a minimum of 6 techs
_______ Request law enforcement assistance as necessary for scene control
_______ Remove non-essential personnel and by-standers
_______ Shut-down utilities
_______ Develop building and site diagram with access points
_______ Establish operational and safety zones
_______ Evaluate structural integrity
_______ Divide collapse area into manageable areas
_______ Request technical expertise i.e. structural engineer, architect, search dogs etc.
_______ Request special equipment as required i.e., listening devices, search camera, infrared detection etc
_______ Develop an action plan and a contingency plan