



Training Standard

North County Technical Rescue Team

TOPIC:

Structural Collapse Operations

PURPOSE:

The purpose of this procedure is to establish guidelines for conducting building/structural collapse operations.

DEFINITIONS:

- **OES Operational Levels**
 - Basic: Type 4, Minimal Training
 - Light: Type 3, RS-1 level, Light frame/basic rope rescue skills, Low angle/single person loads.
 - Medium: Type 2, RS-2 level, Deals with reinforced and unreinforced masonry, concrete tilt-up, heavy timber construction types, Trench rescue and advanced rope rescue.
 - Heavy: Type 1, RS-2 level + Trench, confined space.
- **Beam** - A horizontal structural member
- **Bearing wall** - An interior or exterior wall that supports a load in addition to its own weight
- **Cantilever beam**- A beam supported on only one end
- **Chord** – Main members of trusses as distinguished from diagonals.
- **Collapse** – The failure of any portion of a structure
- **Column** – A vertical structural member



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- **Cribbing** – Short pieces of lumber used to support or stabilize an object
- **Girder** – A structural element that supports a floor or roof beam
- **Hydraulic shore** – Shores or jacks with movable parts that operate by hydraulic fluid
- **Impact load** – A load applied to a structure suddenly, such as a shock wave or a vibrating load.
- **Joist** – Lumber used as a floor or roof beam
- **Mechanical strut** – An adjustable mechanical support
- **Pneumatic shoring** – Shores or jacks with movable parts that are operated with compressed gas.
- **Scab** – A short piece of lumber, usually 2X4 that is nailed to an upright to prevent shifting of shoring
- **Screw Jack** – A shore or jack with interchangeable parts. Threads allow the jack to be lengthened or shortened.
- **Secondary collapse** – A collapse which occurs after the initial collapse.
- **Shoring** – The general term used for lengths of lumber, screw jacks, hydraulic jacks, pneumatic jacks and other devices that can be used to support structural members. Individual supports are called shores, cross-braces and struts.
- **Vertical collapse zone** – The expected area that a falling wall or other structural member will cover when it collapses.

TACTICAL CONSIDERATIONS:

I. ARRIVE ON-SCENE

- A. First arriving company officer should take Command and begin an immediate size-up of the situation.



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- B. Spotting Apparatus. The first-in company should spot the apparatus in a position that it will not be affected by a secondary collapse of the structure. Consideration should also be given to traffic conditions and if they will be affected.
- C. Staging. Command should institute Level 1 and Level 2 staging procedures immediately. The management of emergency and civilian traffic is critical from the onset of structural collapse operations.
- D. Assess the need for additional resources. Command should immediately begin to assess the need for additional resources. If additional resources are necessary, Command should put in an early call for them. At that time, Command should identify a Level 2 staging area. If it is later determined that the additional resources are not needed, Command can return those units to service. Command should assess the need for outside heavy equipment early, and request mobile cranes, front-end loaders, etc., with large capacity. (Example: 110-ton crane).
- E. Assess the Hazards. Command should do an immediate hazard assessment or should delegate that responsibility to a **Safety officer**. Some hazards associated with structural collapse are: potential for secondary collapse, explosion with fire due to broken gas and electrical lines, falling debris, toxic atmosphere, etc.
- F. Secure the Hazards. **Safety Officer** should secure all hazards as soon as possible. This will include shutting off the utilities (i.e., gas, electrical, water). If it is not possible to secure all hazards, Command should notify all rescue personnel operating on scene of the hazards present.

During Phase I of structural collapse operations, Command must consider the fact that if strong control of the incident is not gained quickly, it could easily escalate into an out-of-control situation. A typical structural collapse operation will have a lot of unorganized, well-intentioned efforts by civilian personnel. This situation may make the entire operation unsafe. Command must focus attention early on building a good strong Command structure that will support a campaign operation.

Pre-Rescue Operations



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I. REMOVAL OF SURFACE VICTIMS

Initial on scene companies should be directed in rescuing victims that can be seen on the surface. Rescuers must be aware of all the physical hazards present at the scene of a structural collapse.

II. ESTABLISH A PERIMETER

While initial rescue of surface victims is going on, Command should establish a perimeter around the whole collapse site and keep all incoming civilian personnel out of the immediate area.

III. ESTABLISH TRANSPORTATION CORRIDOR

During initial stages of a campaign operation, Command should attempt to ensure that there will be roadways into and out of the collapse site. This may include establishing liaison with the Police Department and having P.D. re-route all traffic well around the collapse site.

IV. ESTABLISH VICTIM STAGING AREA

Command should designate Treatment and Transportation Officers. An area should be established away from the hazards of the collapse to account for, treat, and transport victims.

V. REMOVE ALL CIVILIAN & NON-ESSENTIAL RESCUE PERSONNEL

After initial surface victim removal has been completed, Command should ensure that all personnel are removed from the collapse site. This will allow for the removal of all civilians and the re-grouping of rescue personnel so that a specific action plan can be instituted for the search and rescue of the remaining trapped victims. At this time, Command should order a PAR from officers. Members previously operating in the collapsed structure should be quickly debriefed as to building layout and possible location of victims.

VI. ESTABLISH BUILDING TRIAGE TEAM

After all personnel have been removed from the collapse site, Command should establish building triage teams. This may include structural engineers and/or fire department personnel that are specifically trained in the recognition of structural collapse. Prior to these teams engaging in triage



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activity, Command shall notify them as to the specific action plan and building marking system. If there is a possibility of hazardous materials involvement, Command should assign a Haz Mat Technician to each building triage team.

Rescue Operations

I. ESTABLISH ACTION PLAN FOR SEARCH TEAMS

After all personnel have been removed from the collapse site and all personnel accounted for, Command shall establish a specific action plan for the search and rescue of the remaining victims. This action plan shall be distributed to all rescue personnel that will be operating at the collapse site.

II. ESTABLISH ACTION PLAN FOR SEARCH & RESCUE

Prior to beginning search and rescue operations, Command shall design specific search teams. This may include personnel with technical search equipment (i.e., acoustic, fiber optic, etc.), dog teams, or firefighter using the hailing (call-out) method of searching for victims. After the building triage teams have completed evaluations of buildings, the search teams will conduct searches of those buildings. Search teams should use standard building marking system after building has been searched. If building triage teams determine that the building is structurally unstable, search and rescue teams shall not enter until appropriate shoring and stabilization has been accomplished.

After the removal of all personnel from the collapse site and before resuming building triage and search, a lobby control shall be established and no personnel will return to the collapse site without going through lobby control.

III. ESTABLISH RESCUE TEAMS

Rescue teams will follow search teams that have searched previously triaged buildings. Each rescue team shall consist of at least two (2) trained members of the Technical Rescue Team. If there is a possibility of hazardous materials involvement, each rescue team shall have at least one (1) Haz Mat Technician with air monitoring equipment. Rescue teams are not to attempt rescue in a building that has been determined to be unsafe by the building



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triage teams. Command should assign each rescue team a specific radio designation.

IV. LOCATING VICTIMS

After the search teams have searched a building and received a "positive" find (i.e., acoustic or fiber optic positive reading), the building should be verified again by another means if possible (i.e., search dogs or hailing system). If the building is known to have live victims trapped, rescue teams shall attempt to locate the victims. If the rescue team must support structural components of the building prior to entry, they shall do so and make the area as safe as possible.

V. BREACHING WALLS, FLOORS, AND ROOFS

If at all possible, rescue teams should attempt to gain access vertically. The horizontal breaching of walls should be done only if there is no other means to reach the void space that victims may be trapped in. Horizontal breaching of load bearing walls may precipitate a secondary collapse of the structure. The potential for secondary collapse is less if rescue teams breach structural members from above or below. Prior to breaching a structural load bearing member, a specially trained structural collapse specialist (structural engineer, architect, technical rescue specialist) should approve and oversee the breaching operation. If the atmospheric conditions are not known in the room of desired entry, a "pilot" hole shall be punched to monitor the atmosphere prior to breaching operations.

VI. CONFINED SPACE ENTRY & RESCUE

After the victim has been located, the rescue team should treat that space the victim is located in as a confined space. Rescue team members should proceed with the rescue, following confined space rescue operation guidelines. The rescue team leader shall designate the proper method of entry into the space and shall ensure the safety of the entry rescuers. All spaces shall be monitored for flammable, toxic, and an oxygen deficient atmosphere before entry is made. All members making entry shall be on SCBA with appropriate tender to rescuer ratio of 1:1.

VII. RESCUE AND EXTRICATION OF VICTIMS



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Once the rescue team has located the victim(s) an immediate assessment of the victim shall be done. Rescue teams should consider the effect lifting objects off the victim will have on that victim (i.e., crush syndrome). The rescuers shall determine the safest and most effective method of victim extrication. The rescue team leader shall ensure the safety of the extrication of the victim.

VIII. TRANSFER TO TREATMENT AREA

Once the victim has been removed to a safe location, he/she shall be transferred to the **Treatment Area** for medical assessment.

IX. REMOVAL OF RESCUE TEAMS FROM THE BUILDING

After all located victims have been removed from the building, the rescue teams should "pull out" of the building and update the marking system. Rescue teams should keep in mind that any cribbing and shoring in place should be left in place. The removal of those systems could precipitate a secondary collapse.

Phase IV Selected Debris Removal

I. LOCATING VICTIMS

If rescue teams have not been able to locate victims through other methods, then they should be located by removing debris. If there is a potential for live victims, rescue teams must be very careful when removing debris so as not to cause a secondary collapse or further injury to the victim(s).

If a victim location is known, either by family members or previously rescued victims, an attempt should be made to remove debris to reach that victim. In light-weight frame construction buildings, this could be accomplished by cutting and hand removing structural members. If the building is of reinforced concrete, it may require breaking large pieces into smaller and more manageable size pieces. This may also require the use of a crane to pick up and move the structural components to reach potential victims.

Rescue team members should assist in the break-up and removal of structural components. A safety officer shall oversee all of these operations



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to ensure site safety for all operating personnel. If structural components are removed from the site, they should be marked in some way so as to I.D. them with the particular building for future investigative purposes.

As debris is removed, all operations should be stopped periodically to search (acoustic, dog team, hailing) for victims. After enough debris has been removed to reasonably ascertain that there are not any victims, then search and rescue operations can be suspended in that building.

General Debris Removal/Termination

Prior to beginning this phase, Command shall call for a PAR.

After it has been determined that no victims could be found alive in the building, a general debris removal can begin. If there is a potential for deceased victims to be trapped in the rubble, removal crews should be alert for signs of those deceased victims.

During general debris removal, if heavy equipment operators spot a sign of a deceased victim(s), a selected debris removal shall be conducted to remove the victim(s) respectfully. Coroner and/or other investigative personnel should be notified to handle the removal of the body(ies).

As debris is removed, each dump truck load shall be marked as to the general area found and final location of the debris. This will help investigators to complete their investigations and reports.

Command may elect to turn general debris removal over to the Responsible Party for final disposition of the building. If this is done, the R.P. should be notified of the proper handling of debris for investigative purposes.

Prior to termination of the incident, Command shall account for all personnel that have been operating at the collapse site. Each company officer should ensure crew and equipment accountability before returning to service. If Command has not previously addressed the issue of C.I.S.D., he/she may consider doing so during the termination phase.

Additional Considerations

A. Heat. Consider rotation of crews.



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- B. Cold. Consider the affect of hypothermia on victims and rescuers.
- C. Ambient Conditions. Consider the affects of rain or snow on the hazard profile.
- D. Time of Day. Consider having proper lighting on scene for night time operations.
- E. Consider the effect on family and friends; keep family informed.
- F. Consider news media; assign a P.I.O.