

Lesson Title

Conducting The Search

Learning Objectives

The rescue of victims from perilous situations in a dangerous environment
Using the IFSTA manual technical rescue for structural collapse
To recognize the need for incident management, communications, rescue action plan,
Operational capability, scene safety, structural instability, initial search, void search,
patient removal.

Time Frame

3 hours

Level of Instruction

Presentation
Visual
Performance Activities

Materials Needed

Projector
Handouts
Information Sheets
Job Sheet
Atmospheric monitor, listening devices, thermal imaging cameras, 1/2-inch dynamic kernmantle rope, Gasoline powered chain saw, electric chain saw, compliment of carpenter tools, hydraulic rescue tool system.

Instructions to the Instructor

The first hour and a half will be used for the classroom presentation. You will use the overhead projector with the transparencies with this lesson. You will also use the student handouts during this time. The second hour and a half will be used for the performance activities in the field. You will need the assortment of light construction materials and tools at this time.

References

IFSTA Manual Technical Rescue for Structural Collapse First Edition, Chapter 2
First Due Rescue Company Instructor's Manual
NFPA 1006
NFPA 1670

Course Goals

To instruct students on the proper rescue operation of conducting a search in a collapsed building.

Summary

There is a systematic process that must be followed for a structural collapse operation to be performed efficiently. (ie:) evaluating the site, conducting the search and marking the site as progress is made. After the site has been properly surveyed and searched, the need to locate and rescue identified victims remaining is the next step in the operation.

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CONDUCTING THE SEARCH

NOTES

A search operation must be well organized and use the tools available to on scene personnel.

THE GOAL OF A RESCUE OPERATION IS:

To find and remove victims!

1. Search Safety

- The scene of a building collapse is dangerous for rescue personnel. All other persons are to be removed from the area.
- Survey the building for additional problems and be prepared to provide lighting for rescue operation.
- Assignment of a safety officer to keep an eye on the building and the rescuers is very important.

2. COMMUNICATION/BUDDY SYSTEMS:

- Communication with the incident commander, sector officer as well as the other rescuers is of the utmost importance in order to enhance the rescue operation. The use of the buddy system is important so there is no freelancing and safety of your partner is kept in mind at all times. Remember: *If one person leaves, then all must leave.*

3. EVACUATION / ESCAPE PROCEDURES:

- Due to the probability of a second collapse, a signaling system must be used at all times. The most common system in use is:
 - ◆ Cease Operation/All Quiet: one long blast of air horn for three seconds.
 - ◆ Evacuate the Area: three short blast of air horn, one second each.
 - ◆ Resume Operations: one long and one short blast of air horn.

4. GATHERING INFORMATION:

- The type of occupancy provides information as to the number of possible victims and their location in the building. Witnesses and bystanders may provide enough information to establish an initial search.

5. TYPES OF COLLAPSE:

- **Lean-To-collapse** -Victims found under the suspended floor or on top at the lower end.
- **V-Shape collapse**-Victims found under the two suspended floor pieces or on top of the floor in the middle of the V.
- **Pancake collapse** - Victims found under the floors.
- **Cantilever collapse**- Victims found under the floors as in the pancake collapse.
- **A-Frame collapse** - Highest survival rate for victims found near interior partitions or at exterior walls.

6. BUILDING MARKING SYSTEM:

- It is crucial to have a marking system in place so that the same area will not be checked twice. Start at street and go clockwise with a number or letter for all sides.
- A hazard assessment form is to be filled out by search personnel or hazardous materials specialist to identify structure as being safe.

7. TASK FORCE BUILDING MARKING SYSTEMS:

- Marking system of a structural collapse should be used and followed to enhance the search.
- **Square box** : Relatively safe for search and rescue operations
- **Square box with slash** from top right corner to left corner: structure mostly safe but some areas may need shoring.
- **Square box with an X**: not safe for rescue operations.

- Arrow located next to the marking box indicates the direction of safest entry to the structure.
- HM: Indicates hazmat condition in or adjacent to structure. Search and rescue operation normally will not be allowed until condition is better defined or eliminated.

8. SEARCH ASSESSMENT AND MARKING SYSTEM:

- Rescuers should use the search assessment marking system to document search activities.
- In the area next to the building marking box this gives the location of identified victims.
- This marking system should be used by all three potential search components, which are physical, canine, and technical.
- *Note: All personnel should notify incident commander upon entry to a structure.*
- A structure hazards evaluation form is noted and reviewed at this time.
- Marking system;
 - ◆ Entry to a structure - a single 24 inch diagonal slash from upper left to lower right indicates the team I.D. and time entered the structure
 - ◆ Exiting the structure - cross the first diagonal line to form a cross
 - ◆ The X creates a quadrant and provides the following information.
 - ◆ The left quadrant contains search team information.
 - ◆ Top quadrant indicates the time and the date.
 - ◆ Right quadrant is used for specific hazards.
 - ◆ Bottom quadrant contains victim findings dead or alive.
 - ◆ After determining victim information, this is given to the incident commander for a subsequent search.

AREA MAPPING AND MARKING SYSTEM:

- The marking of a grid of the area and filing that information for future use is very important.
- Steps to be followed in assessing building collapse are:
 - ◆ Do a walk around site collecting information.
 - ◆ Determine structure type.
 - ◆ Interview survivors and bystanders.
 - ◆ Conduct call out and listening procedures.
 - ◆ Obtain building layout
 - ◆ Set up shoring operations.
 - ◆ If basement; determine condition.
 - ◆ Avoid falling debris hazards unless they can be removed and/or shored.
 - ◆ Assess for additional hazards.

9. TYPE OF SEARCHES:

- Three methods of searches:
 1. Physical Search: is when there is easy accessibility to patients.
 2. Canine Search: should be performed by US&R disaster trained dogs and handlers. Canines can search larger areas in a short period of time and detect conscious and unconscious victims.
 3. Technical Search: requires specialized equipment such as listening devices, cameras and thermal imaging devices.

10. VOID SEARCH:

- Void searches provide the highest probability of human survival.
- Six-sided survey is vital to perform because it gives the rescuer a total look at the building.
- Check void areas first.
- Safety is of the utmost important in void areas.
 - ◆ Check for loose or hanging debris.
 - ◆ Check floors for stability.

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11. GUIDELINES FOR VOID SEARCH:

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- Check void areas first.
- If space is too small to enter, circle the area and call out and listen for sounds.
- Know the different types of construction to know where the different types of voids may be.
- **WARNING:**
 - ◆ *Gaining access to a collapsed structure through a basement can be extremely hazardous; additional collapse or falling debris will create life-threatening hazards.*

12. V-SHAPE VOID COLLAPSE/VOID:

- These types of voids have a higher survival rate for victims that are located on the floor below due to the sheltering effect of the collapse.
- Victims on the top of the collapsed floor usually are:
 - A. At the bottom or near the center of the "V".
 - B. Trapped in the rubble in different places.
 - C. The survival rate for victims in the area may be higher than victims in the area of most debris.

13. UNSUPPORTED LEAN-TO COLLAPSE:

- The collapse may move victims to a lower portion of the lean-to or the floor below.
- Be careful on moving any debris that supports the base, this may cause the floor to slide and collapse the void.

14. SUPPORTED LEAN-TO COLLAPSE:

- Most victims can be found at the bottom of the lean-to near the wall surrounded by debris.
- Large objects can be responsible for victims to be hung up on.

- Victims could be on the floor below the collapsed floor, under the large void created at the opposite end.
- Survival in this area is low to medium.

15. PANCAKE COLLAPSE:

- A collapse of this type may drop victims straight down in the collapsed pile.
- Victims may be on several floors and located anywhere in the debris.
- Survival rate is very low.
- Survivors may be found in individual voids and may require extensive searching procedure and detailed debris removal.

16. A-FRAME COLLAPSE:

- Highest survival rate for victims is located near a partition wall near the center of the collapse.
- If victims are located on the floor above, they can become entrapped or pinned in the debris near both exterior walls, which will have a lower survival rate.

17. HAZARD REDUCTION AND ACCESS BY STRUCTURE TYPE:

- The hazards associated with a collapse will determine the methods of access by rescuers. Listed below are characteristics associated with structural types.
- **Light Frame Buildings:**
 - ◆ The term associated with residential homes and apartments up to four stories that are constructed of wood. Light frame buildings lack lateral strength of the walls and connections, which may cause collapse to occur. Light frame structures are highly susceptible to fire due to surface to mass ratio of splintered wood and other light frame materials.

Rescuer in light frame collapse should always check for stability problems.

- Rescuers should perform the following:
 - ◆ Shut off all utilities to eliminate fire hazards.
 - ◆ Assess for chemical hazards.
 - ◆ Avoid or topple damaged chimneys.
 - ◆ Raker shore all leaning multi-story buildings at each floor line.
 - ◆ Remove or stabilize any hanging debris.
 - ◆ Use vertical shore for the safety of rescuers.

18. VICTIMS SEARCH AND ACCESS.

- ◆ In light frame buildings, victim access is best done by making a horizontal entry through existing cavities or through walls.

➤ **Unreinforced Masonry Buildings (Heavy Wall).**

- ◆ These types of buildings range from one to six stories in height and may be residential, commercial, or industrial.
- ◆ They usually have heavy masonry walls with wood floors.
- ◆ The weakness of these buildings is in the lateral strength of the walls and the connections between the walls and the floor or roof assemblies.
- ◆ Collapse of these buildings are usually due to heavy weakened walls falling away from the floors. When working in this type of collapse, watch out for cracked walls, loose masonry components, check for cracked wall at corners, and unsupported collapsed floors.

➤ **Safety considerations that are associated with unreinforced masonry building:**

- ◆ Access through wood floors vertically is easier and less dangerous than trying to gain entry. Avoid if all possible cutting large beams or more than two joists in a row.

Avoid cutting walls, they may have some stability strength and any cuts will reduce that wall strength.

- ◆ Check roof and floor joists and beams to make sure they are sitting on their original flat surface.
- ◆ Be aware of any remaining uncollapsed damaged walls that may fail due to after shock, avoid them or shore them.
- ◆ Be aware of any falling debris or tripping hazards.
- ◆ Use extreme caution with basements. The large amount of unstable debris overhead is a major hazard. Shore it for safety.
- ◆ **WARNING:**
The failure of wood columns or beams can be sudden.

19. VICTIM SEARCH AND ACCESS:

The collapse of unreinforced masonry structures will have wood floors that collapse in large planes and broken masonry. This type of collapse usually calls for special listening devices. Victim access is made by making a horizontal entry through existing openings. Vertical access is made through floor and roof openings. Remember to cut small beams rather than large beams. NOTE: Please use caution when cutting through masonry walls.

20. HEAVY WALL TILT/UP REINFORCED MASONRY:

Walls in this type of collapse fall away from the roof and floor edge, but because of the very strong panels the walls will fall as far away from the building as is their height.

- Lean - to - is formed when one exterior wall collapses, leaving the floor supported at one end.
- V-shape- occurs when an interior supporting wall or column fails.

Pancake - occurs when all vertical support members fail and the floors collapse on top of one another. This is common in heavy floor structures.

- Cantilever - a pancake collapse is where some of the floor planes extend out as unsupported members.

21. CONCRETE FRAME BUILDING (HEAVY FLOOR):

- Structure of this type can be residential, commercial or industrial. They have concrete frame and may be up to 12 stories tall, which may include concrete highway bridges.
- The collapse of these structure are due to poor column reinforcement and inadequate connection. These may fall down on themselves or fall laterally if the columns are strong enough.
- Rescuers should check the following:
 - ◆ Check to see if concrete remains within the reinforcement of the columns.
 - ◆ Check for cracking of the columns.
 - ◆ Check for diagonal shear cracking in major beams adjacent to supporting columns and wall.
 - ◆ Check in concrete shear walls.
 - ◆ With a partial collapse, check the floors that support the collapsed load.
- Heavy shoring may be the only safe procedure, keep in mind all safety precautions.
 - ◆ Avoid cutting concrete walls.
 - ◆ Avoid cutting concrete columns.

Concrete frame building may have brick infill and may be cut if they have no support status.

22. VICTIM SEARCH AND ACCESS:

- Rescuer probably will not be able to hear victims calling out because of the amount of concrete.
- For victim access locate existing vertical access shaft. Cut holes in roof/floor slabs, remove large pieces only after all rebar have been cut.

23. PRECAST CONCRETE BUILDINGS:

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- These structures may be commercial or residential and include parking facilities and are usually 1-12 stories in height.
- The weaknesses of these structures are usually at the interconnection of parts used to connect floors, walls and roofs. Precast section become unstable and breaks loose. Rescuer should check for beams to column connections for broken welds and cracked corbels.
- For stability, column cracking at the top and bottom joists as well as panel connections and shear wall connections at floor area should be checked.
- **VICTIM SEARCH AND ACCESS:**
- Because of the concrete, rescuer will not be able to hear call out of victims. The listening devices will depend on the interconnection of the collapse structure parts.
- Effectiveness of acoustic sensors and seismic sensors are not good due to the poor transfer through broken concrete slabs.
- Search dogs may indicate the direction of scent that may be flowing around large slabs across the building. After layers have been moved, dogs can recheck the area.
- In partial collapse it is very important to check the floors that support the collapse load.
 - ◆ Check for further cracks.
 - ◆ For safety, heavy and multishoring may have to occur.
 - ◆ Beware of large slab, they may shift when shoring occurs.
 - ◆ Remove or avoid hanging pieces.
 - ◆ Shore beams adjacent to badly cracked columns.
 - ◆ Remove or shore unstable large precast pieces.
- *Note: Conventional shoring may be ineffective due to the weight of precast pieces. Think big!*

For victim access, the removal of large pieces may be more efficient than cutting holes in the concrete. Try to make horizontal entry through existing cavities.

➤ **Victim Concerns**

During structural collapse there are four types of rescue situations to consider.

1. Victims Injured But Not Trapped:

These victims may be injured by falling debris. The appropriate action is to remove the victims to a safe location for treatment. Remember victim removal may not be performed by the recon team but by civilians, which account for 50% of all urban searches and rescue victims.

2. Nonstructural Entrapment:

Victims may be trapped by debris such as furniture etc. Rescuer can locate the victims and move them to a safe location. This type of entrapment occurs in about 30% of all search and rescue situations.

3. Void Space Entrapment:

This entrapment occurs in both partial and complete structure collapses. The victims are usually trapped by small debris and building contents and usually located within void spaces. At this time shoring and stabilization will have to be used and special resources as canines and electronic devices are to locate victims.

- ◆ *NOTE: Void space rescue requires special skills or more depending on resources and the situation. About 50% of urban searches and rescue fall into this category. This rescue is performed by light or medium rescue teams.*

4. Entombed Victims

Victims in this case are trapped by parts of the structure. These structures must be stabilized and shored and may only be reached after some of the component have been lifted, moved, breached or broken. In most cases the victims may have to be stabilized and packaged inside the structure before removing to a safe location. These rescues may take between 4 to 8 hours to perform. About 50% of urban search and rescue victims fall in this category. They are usually rescued by highly trained and specially equipped rescue teams; such as state and local US&R teams, or US&R response teams.

- ◆ Note: An extensive effort to extricate live victims is most important. Rescuer must realize not to waste time on non-emergency tasks, such as removing dead bodies or finding and removing trapped animals when there is the possibility of locating a living person.

Summary:

For a structure collapse search operation to run efficiently and safe. A systematic process for evaluating the site, conducting the search and marking the site as process is made is very important. After the site has been properly surveyed and searched, rescuers must move to the next phase of operation: The rescue of identifying victims.