

Technical Rescue

AWARENESS LEVEL TRAINING

INSTRUCTOR MANUAL



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS GENERAL

Introduction

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Definitions

Aluminum Hydraulic Shoring. Pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (walers) and designed specifically to support the sidewalls of an excavation and prevent cave-ins.

Angle of Repose. The greatest angle above the horizontal plane at which loose material (such as soil) will lie without sliding.

Attendant. A term used to describe U.S. federally regulated industrial workers who are qualified to be stationed outside one or more confined spaces, who monitor authorized entrants, and who perform all of the following duties:

- (a) Remain outside the confined space during entry operations until relieved by another attendant
- (b) Summon rescue and other needed resources as soon as the attendant determines that authorized entrants might need assistance to escape from confined space hazards
- (c) Perform non-entry rescues as specified by the rescue procedure listed on the permit (see Entry Permit)

Auger. A screw-like shaft that is turned to move grain or other commodities.

Authority Having Jurisdiction. (AHJ) The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Authorized Entrant. A term used to describe U.S. federally regulated industrial workers who are designated to enter confined spaces and who meet the following training requirements for each specific space they enter:

- (a) Hazard Recognition. The ability to recognize the signs and symptoms of exposure to a hazardous material or atmosphere within the space and to understand the consequences of exposure and the mode of transmission (i.e., injection, ingestion, inhalation, or absorption) for the hazard.
- (b) Communications. The ability to carry out the method by which rescue services are to be summoned in the event of an emergency, the method by which the entrant will communicate with the attendant on the outside of the space, and a backup method of communication should the primary system fail.
- (c) Personal Protective Equipment (PPE). The ability to use all PPE appropriate for the confined space.
- (d) Self-Rescue. The ability to carry out the method by which the entrant will escape from the space should an emergency occur.

Bastard Search. No victim exists due to the report being inaccurate or the victim/individual has left the area.

Benching or Benching System. A method of protecting employees from cave-ins by excavating the side of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.



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Blanking and Blinding. A form of hydraulic energy isolation that is the absolute closure of a pipe, line, or duct by fastening a solid plate (such as a spectacle blind or skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure within the pipe, line, or duct with no leakage beyond the plate.

Blitz or Hasty Team. Minimum number of experienced rescuers that are sent out to locate the victim

Boil. The hydraulic backwash below a dam, sometimes described as a vertical whirlpool.

Boil Line. A point, below a dam, where the current splits, flowing upstream and downstream.

Cave-In. The separation of a mass of soil or rock material from the side of an excavation or trench, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Collapse Zone. See Rescue Area.

Compact Soil. Means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Compact soil does not crumble, can be excavated with vertical side slopes, and is plastic when moist. Compact soil is hard to break up when dry, and exhibits significant cohesion when submerged. Compact soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Competent Person. One who is capable of identifying existing and predictable conditions in the surroundings or in the working area that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate such conditions.

Confined Space. A space that has the following characteristics:

- (a) Is large enough and so configured that a person can enter and perform assigned work
- (b) Has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits)
- (c) Is not designed for continuous human occupancy

Conveyor belt. A system to transfer goods, products or stock along a continual moving track.

Cribbing. Various lengths and dimensions of sturdy material, usually wood or plastic, used in rescue operations to stabilize or support vehicles, machinery or parts of structures.

Cross Braces (or Struts). The individual horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales. (See also Shoring.)

Disturbed Soil. Soil that has been previously excavated. Within the last 25 years.



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Eddy. Is the swirling of a fluid and the reverse current created when the fluid flows past an obstacle. The moving fluid creates a space devoid of downstream-flowing water on the downstream side of the object. Fluid behind the obstacle flows into the void creating a swirl of fluid on each edge of the obstacle, followed by a short reverse flow of fluid behind the obstacle flowing upstream, toward the back of the obstacle. This phenomenon is most visible behind large emergent rocks in swift-flowing rivers.

Electrical Drain Time. The time frame in which the electrical potential is completely lost in the electrical circuit.

Engulfment. The surrounding and effective capture of a person by a fluid (e.g., liquid, finely divided particulate) substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

Entrant. Means an employee who is authorized by the employer to enter a permit space.

Entry Permit. A written or printed document, established by an employer, for non-rescue entry into confined spaces.

Excavation. Any man-made cut, cavity, trench, or depression in an earth surface, formed by the removal of earth.

Extrication. The removal of trapped victims from a vehicle or machinery.

FEMA Task Force Search and Rescue Marking System. Distinct markings made with international orange spray paint near a collapsed structure's most accessible point of entry.

Full-Cycle Machines. Machinery that is thought to be isolated (electrically or mechanically) may continue to move to complete its cycle.

Groundpads. Plywood or similar material used to distribute weight around a trench operation.

Hasty or Blitz Team. Minimum number of experienced rescuers that are sent out to locate the victim

Hazard Analysis. The process of identifying situations or conditions that have the potential to cause injury to people, damage to property, or damage to the environment.

Hazardous Atmosphere. Any atmosphere that is oxygen deficient, contains a toxic or disease-producing contaminant, or is potentially explosive. A hazardous atmosphere could be immediately dangerous to life and health, but not necessarily.



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Hazardous Atmosphere for Confined Space. Any atmosphere that could expose personnel to the risk of death, incapacitation, injury, acute illness, or impairment of the ability to self-rescue, due to one or more of the following causes:

- (a) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL)
- (b) Airborne combustible dust at a concentration that meets or exceeds its LFL
- (c) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent
- (d) Atmospheric concentration of any hazardous substance that could result in exposure to personnel in excess of its dose or permissible exposure limit (PEL)
- (e) Any other atmospheric condition that is immediately dangerous to life or health (IDLH)

Helical flow. Is found in steep sloped channels. Water quickly rises from the deep middle to the shallow bank.

High Angle. Refers to an environment in which the load is predominately supported by the rope rescue system.

Hydraulics. Is a topic of science and engineering dealing with the mechanical properties of liquids.

IDOL. Indiana Department of Labor

Immediately Dangerous to Life or Health (IDLH). Any condition that would do one of the following:

- (a) Pose an immediate or delayed threat to life
- (b) Cause irreversible adverse health effects
- (c) Interfere with an individual's ability to escape unaided from a hazardous environment

Incident Command System (ICS). The combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident (as described in the document *Incident Command System*) or training exercise.

Incident Management System. The management system or command structure used during emergency operations to identify clearly who is in command of the incident and what roles and responsibilities are assigned to various members.

Laminar flow. The water close to the river bottom moves at a slower rate than the water at the surface.

Last-Seen-Point. The most likely location to find a victim or object under the water obtained by witness interviews, use of reference points or objects, and/or physical evidence.

Life Safety Harness. A system component that is an arrangement of materials secured about the body and used to support a person during rescue.



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Life Safety Rope. A compact but flexible, torsionally balanced, continuous structure of fibers produced from strands that are twisted, plaited, or braided together and that serve primarily to support a load or transmit a force from the point of origin to the point of application.

Litter. A transfer device designed to support and protect a victim during movement.

Litter Attendant. A person who both accompanies and physically manages the litter.

Load. That which is being lowered or raised by rope in a high angle system. Some examples include a rescue subject, a rescuer, and subjects in a litter with a litter attendant.

Lockout. A method for keeping equipment from being set in motion and endangering workers.

Low Angle. Refers to an environment in which the load is predominately supported by itself and not the rope rescue system (e.g., flat land or mild sloping surface).

Low head dam. Is a uniform barrier across a body of moving water

Machinery. The moving parts of a particular machine.

Magnitude. Size or extent of the incident.

NFPA. *National Fire Protection Association.* This organization develops safety standards for the fire service. The proposed standards can then be adopted by the individual departments or local governments.

National Search and Rescue Plan. A document that identifies responsibilities of U.S. federal agencies and serves as the basis for the National Search and Rescue Manual, which discusses search and rescue organizations, resources, methods, and techniques utilized by the federal government.

OSHA. *Occupational Safety and Health Administration.* A part of the Department of Labor entrusted with enforcing safety in the workplace.

Oxygen-Deficient Atmosphere. Air atmospheres containing less than 19.5 percent oxygen by volume at one standard atmosphere pressure.

Oxygen-Enriched Atmosphere. Air atmospheres containing more than 23.5 percent oxygen by volume at one standard atmosphere pressure.



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Permit Required Confined Space. A Confined Space that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere
2. Contains a material that has the potential for engulfing an entrant
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section
4. Contains any other recognized serious safety or health hazards (including fall, environmental, and equipment hazards)

Personal Flotation Device. (also named PFD, lifejacket, life preserver, Mae West, life vest, life saver, cork jacket, life belt) is a device designed to keep a wearer afloat and their head above water.

Personal Protective Equipment (PPE). The equipment provided to shield or isolate personnel from infectious, chemical, physical, and thermal hazards.

Public Safety Diving. Underwater diving, related to team operations and training, performed by any member, group, or agency of a community or government-recognized public safety diving or water rescue team.

Rapid Intervention Crew. At least two members available for rescue of a member or a team if the need arises.

“Reach, Throw, Row, Go.” The four sequential steps in water rescue with progressively more risk to the rescuer. Specifically, a “go” rescue involves physically entering the medium (e.g., in the water or on the ice).

Recovery Mode. Level of operational urgency where there is no chance of rescuing a victim alive.

Reference Object. An object, (like a person or a boat), that is the same size as the object that sank below the surface of the water. This reference object is used to assist a witness in describing the last seen point.

Registered Professional Engineer. A person who is registered as a professional engineer in the state where the work is to be performed.

Rescue. Those activities directed at locating endangered persons at an emergency incident, removing those persons from danger, treating the injured, and providing for transport to an appropriate health care facility.

Rescue Area. (or Hot, Danger, or Collapse Zone). An area surrounding the incident site (e.g., collapsed structure or trench) whose size is proportional to the hazards that exist.

Rescue Mode. A level of operational urgency where there is a chance that a victim will be rescued alive.



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Risk. A measure of the probability and severity of adverse effects that result from an exposure to a hazard.

Risk Assessment. An assessment of the likelihood, vulnerability, and magnitude of incidents that could result from exposure to hazards.

Risk/Benefit Analysis. A decision made by a responder based on a hazard and situation assessment that weighs the risks likely to be taken against the benefits to be gained for taking those risks.

Running Soil. Means soil which is underwater or is free seeping.

Safety Officer. An individual qualified by the authority having jurisdiction to maintain a safe working environment.

Safing. This term is used to explain removing hazards, placing ground pads, establishing ventilation, monitoring, etc. to assure the site is safe to work around the trench.

SAR. Search and rescue.

Saturated Soil. Means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or shear vane.

Scope. Extent of activity or range of operations

Sheeting. The members of a shoring system that support the sides of an excavation and are in turn supported by other members of the shoring system.

Shield (or Shield System). A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structures.

Shoring (or Shoring System). A structure such as a metal hydraulic, pneumatic/mechanical, or timber shoring system that supports the sides of an excavation and is designed to prevent cave-ins.

Size-Up. A mental process of evaluating the influencing factors at an incident prior to committing resources to a course of action.

Slough-in. This type of collapse results in an undercut area of the trench wall and creates a large unsupported overhang of soil.

Spoil Pile. The material that is excavated from the trench. The spoil pile should be a minimum of two feet (2') from the lip of the trench.



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Strainer. An obstruction in a flowing body of water that allows the current to pass through it but does not allow the clear passage of larger objects such as people or boats.

Superimposed loads. Loads that place stress on trench walls. Examples include backhoes, pipes, cable, trench shields, rescuers, students, spoil pile, etc.

Surcharge Loads. Any weight near the lip of the trench that increases the likelihood of instability or secondary cave-in.

Surface encumbrances Structures that were designed to be supported by the dirt which was in the trench. Examples include utility poles, roadways, foundations, etc.

Swift Water. Water moving at a rate greater than one knot (1.15 mph).

Tabulated Data. Any set of site-specific design data used by a professional engineer to design a protective system at a particular location.

Tag-out. A method of tagging, labeling, or otherwise marking an isolation device during hazard abatement operations to prevent accidental removal of the device. (See also Lockout.)

Technical Rescue. The application of special knowledge, skills, and equipment to safely resolve unique and/or complex rescue situations.

Tension Crack. Crack like openings that indicate soil under tension.

Terrain. Specific natural and topographical features within an environment.

Thermocline. Dividing line between sun-warmed, upper layers of still water and markedly cooler lower layers.

Topographical Map. A graphical representation of the earth's surface, drawn to scale and reproduced in two dimensions, that reflects the topographical features of the area depicted.

Trench (or Trench Excavation). A narrow (in relation to its length) excavation made below the surface of the earth. (OSHA definition of Trench – An excavation that is deeper than it is wide and less than 15 feet wide.

Trench Box (or Trench Shield). A manufactured protection system unit made from steel, fiberglass, or aluminum that is placed in a trench to protect workers from cave-in and that can be moved as a unit. (See also Shield.)

Uprights (or Strongback). The vertical members of a trench shoring system placed in contact with the earth, usually held in place against sections of sheeting with shores and positioned so that individual members do not contact each other.



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Utilities. Gas/electrical/water/pneumatic sources of energy or power.

Vehicle. A device or structure for transporting persons or things; a conveyance.

Vehicle Posts. Starting at the front of the vehicle, alphabetically with A, the areas of the vehicle where the roof support is connected to the body.

Virgin Soil. Soil that has never been excavated. Soil that has never been dug in.

Watermanship Skills. Capabilities that include swimming, surface diving, treading water, and staying afloat with a reasonable degree of comfort appropriate to the required task.

Wilderness. An uncultivated, uninhabited, and natural area usually, but not necessarily, far from human civilization and trappings.



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This Technical Rescue Awareness course has been developed by fellow firefighters within the State of Indiana. The members of the technical rescue committee of the Indiana Fire Chief Association followed the guidelines of IOSHA and NFPA 1670. This course is meant to provide you a means to identify and properly react to uncommon, dangerous and difficult rescue situations. Further training in each discipline is required before any actual rescue operations are undertaken.

Instructors should obtain a copy of NFPA 1670 and pay particular attention to the appendix section to gain additional understanding of the limitations of the Awareness Level Responder.

Instructors should review all instructor notes in the powerpoint slides for additional information.

Certification:

The Indiana Board of Firefighter Personnel Standards has established the following requirements for this course. Each individual is required to attend 100% of the twelve-hour class, be Hazardous Materials Awareness certified and successfully pass the state written exam by 70%.

Purpose Statement:

The Purpose of the Course is to enhance the students understanding of the following capabilities:

1. Assessing Technical Search and Rescue Hazards within their response area
2. Identifying the appropriate level of Operational Capability (organizational) as established by the AHJ
3. Implementing the appropriate Functional Capabilities (individual) when engaging in technical rescue events as established by the AHJ
4. Identifying appropriate Awareness Level Operational / Functional capabilities for INITIAL COMPANY OPERATIONS at technical rescue events.



Overview

This program is brought to you
by the
Indiana Department of Homeland Security
and the
Indiana Fire Chief Association's
Technical Rescue Committee

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Certification

- Requirements for certification
 - Certified in Hazardous Materials Awareness
 - 100% attendance of the 12 hour awareness course
 - Passing the state written exam by 70%

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Purpose Statement

- Purpose of the Course is to enhance the students understanding of the following capabilities:
 - Assessing Technical Search and Rescue Hazards within their response area. (Community Risk Analysis)
 - Identifying the appropriate level of Operational Capability (organizational) as established by the AHJ. (Guidelines)
 - Implementing the appropriate Functional Capabilities (individual) when engaging in technical rescue events as established by the AHJ. (Procedures)
 - Identifying appropriate Awareness Level Operational / Functional capabilities for INITIAL COMPANY OPERATIONS at technical rescue events.

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Scope:

This course will cover basic and general knowledge on the following topic areas: Structural Collapse Rescue, Rope Rescue, Confined Space Rescue, Vehicle and Machinery Rescue, Water Rescue, Wilderness Rescue, and Trench / Excavation Rescue. These seven areas are identified in NFPA 1670. The information you will be provided will be at an awareness level. In most cases, you will not be the rescuer.

AHJ Requirements:

This course does not contain hands on training. The department or agency (AHJ) is responsible for compliance of administrative responsibilities as outlined in NFPA 1670, Operations and Training for Technical Rescue Incidents. These responsibilities include development of policies and procedures that stipulate the level of response offered by the organization and the level of training offered to address the level of response. Each agency should acquire a copy of NFPA 1670 as a reference document in meeting these responsibilities.

Incident Response Plan:

Each department or agency needs to have an action plan and policies in place to handle these types of rescue incidents. Proper planning includes knowing where your agency is in terms of technical rescue training, level of operation, and when to call additional resources. Mutual aid agreements can provide you with additional external resources, some of which may be at a higher level of training. They must have total control over all resources requested. If conditions warrant the operation may be halted by the Authority Having Jurisdiction (AHJ).



General Scope

- Course Requirements & Standards
 - Follows guidelines of NFPA Standards and OSHA Regulations.
 - Refresher training should be conducted annually.
 - Further training is required for actual rescue operations and practices.

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AHJ Requirements

- NOTE
 - This course DOES NOT contain hands on training
 - The AHJ is responsible for training per NFPA 1670
 - Operations and Training at Technical Rescue Incidents
 - The AHJ must assure members have
 - Hazardous Materials Awareness certification

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General

- AHJ must conduct hazard and risk analysis to determine feasibility of conducting Technical Rescue Operations
 - Information to make informed decision
 - Likelihood of incident
 - Where it might occur
 - Effects on the community

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Departments or agencies are required to establish written standard operating procedures/guidelines consistent with one of the following NFPA 1670 functional capabilities: Awareness, Operations, or Technician.

(Use Sample Policy Handout for Discussion)

Hazards associated with technical rescue incidents.

Most people who have entered the fire service possess the type of personality that likes to jump in and get the job done. They are action oriented. They want to take action and help now. This trait is often a great asset, but it can also make them the biggest hazard on the scene. When emotions take over, dangerous attempts at a rescue are executed without the proper training or equipment. This is where strong, competent, levelheaded leadership must gain control of the scene to prevent the loss of one of our own.

Protecting rescuers is the highest priority during technical rescue incidents.

Elements of Safety at a Technical Rescue

Personnel Accountability Safety System (PASS).

The department or agency must be accountable for EVERYONE operating at an incident. There are various forms of PAS available, but the Authority Having Jurisdiction must insure that whatever system is utilized, it must account for EVERYONE operating at the incident at all times.

General

- Safety at a technical rescue
 - Personnel accountability system (PAS)
 - Account for all members at incident
- Evacuation procedures / guideline
 - **Everyone** operating at the incident must know correct actions if evacuation order is given
- Evacuation Signals (example from FEMA US&R)
 - Evacuate – 3 short blasts (1 second each)
 - Cease Operations – 1 long blast (3 seconds long)
 - Resume Operations – 1 long and 1 short blast



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Evacuation Procedures/Guidelines.

EVERYONE operating at the incident must know these procedures/guidelines. Each sector must know what its' actions will be in the event an evacuation order is given. These procedures/guidelines should be identified in the risk/benefit analysis and the operational procedures/guidelines established by the department or agency. This information should be shared at the incident briefing prior to initiating the Incident Action Plan.

- Evacuation Signals
 - Evacuate 3 short blasts (1 second each)
 - Cease Operations 1 long blast (3 seconds long)
 - Resume Operations 1 long and 1 short blast

Personnel Protective Equipment.

Each department or agency is responsible for determining personnel protective equipment. The decision as to what must be worn is based on the incident and what hazards are present or could become present during the incident.

Size-Up (Hazard and Risk Assessment)

The need for continuous six-sided approach to size up must never be overlooked. Every technical rescue, no matter what magnitude, can change very rapidly. The initial size up will set the groundwork for the entire incident.

Scope, Magnitude, Nature of the Incident.

The incident may affect local areas only, or encompass a multi county area. Is it only a building collapse, or it a building collapse because of a tornado? In some areas the magnitude of the incident may not have been realized or planned for.

Location and number of victims.

Size up determines an approximate number of victims and possible locations. Time of day, area affected and nature of the incident will assist in this determination.



General

- PPE
 - Each AHJ is responsible for determining appropriate level of PPE
 - In most cases, will not be structural firefighting gear



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General

- Hazard & risk assessment (scene size-up)
 - Continuous (Six sided approach)
 - Every technical rescue, no matter what magnitude, can change in a second
 - Initial size-up will set ground work for entire incident

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Risk / Benefit Analysis.

Will the end result justify the means? What is an acceptable level of risk you are willing to accept? How long has the victim been incapacitated? Are you utilizing your resources for the greatest amount of good for the most people? These questions not only pose a moral issue but an ethical one as well. Greater risk for more success, little risk for little success. There will come a time when no matter what efforts you put forth, the end result will be the same.

Pre-Planning.

This will address more than one way to get to the area. Roads may be closed because of debris, structural damage, unstable roadways and bridges. Knowing the buildings and hazard locations in your response district, will help you with an emergency response. The department or agency is required by NFPA 1670 to identify all possible technical rescue hazards.

Pre-planning will minimize the risk of rescuers, maximize resources and mitigate consequences of the incident.

Community resources that maybe required for technical rescue incidents must be identified before the need arises.

Environmental Factors.

Loss of life can be expected to rise in time of extreme heat and cold. The victim's chances for survival are, in part, dependent on the conditions of the environment. How will rain, sleet and snow effect your operation? Do you have a contingency plan for these types of conditions?

Patient Contact/Condition.

Safety is paramount before any actions are taken. Can you see or hear the victim? Does the victim know you are there? Some methods that can be utilized are, hailing, tag lines, hard line communication systems, and radios.

Availability / Necessary Resources.

What resources do you have available? Remember both internal and external. Utilize local resources by explaining to them what you need and send them a letter of intent prior to your need. Private Contractors, Registered Professional

General

- Size-up (con't)
 - Scope, magnitude, nature of incident
 - Location and number of victims
 - Time of day, Area affected, complexity of incident
 - Risk / benefit analysis
 - Will the end result justify the means
 - Pre-plans
 - May provide structure information
 - Environmental factors
 - Extreme heat and cold

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General

- Size-up (con't)
 - Patient contact/condition
 - Your safety is paramount
 - Can you see or hear patients?
 - Hailing, tag lines, radios, con-space systems
 - Does the patient know where they are?
- Availability / needed resources
 - What resources do you need?
 - What resources do you have available?

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Engineers, equipment rental shops, and Public Works agencies can all assist in the event of an emergency.

Incident Management System / Incident Command System.

In order to manage any incident, command and control must be established. The incident command system should be in place before an operations is implemented.

The incident command system includes management of all emergency and non-emergency personnel.

The recommended span of control when using the incident command system is 5 to 1.

Command.

The incident commander is responsible for the entire incident. Command need not be trained to the level of the incident, but must have the resources available in order to make an informed decision. Command may halt any and all operations at any technical rescue incident.

Safety.

The Safety Officer should be trained to the level of the incident. There are certain established methods of rescue that the normal fire ground safety officer may not be aware of and deem them unsafe, when in fact they are standard to the specific type of incident.

Safety is the responsibility of everyone.

ADDITIONAL POSITIONS TO CONSIDER BASED ON INCIDENT COMPLEXITY

Operations Section Chief

The operations section is responsible for establishing a rescue plan, informing all division/groups of the plan, and insuring the plan is carried out. This individual must be trained to the type of incident. In the rescue division, working outside of your level of training is not acceptable.

General

- IMS / ICS
 - In order to manage the incident, command and control must be established.
 - Positions Filled (*minimum*)
 - Command
 - Responsible for entire incident
 - Safety
 - Should be trained to level of incident



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- Additional IMS / ICS Positions to consider
 - Operations Section Chief
 - Rescue Branch Director
 - » Establish rescue plan
 - » Inform all personnel of the plan
 - » Insure the plan is carried out
 - Optional Positions
 - Finance, Logistics, Planning, PIO
 - Others outlined in NFPA 1561 Standard for FD Incident Management



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Optional positions

Logistics Section, Public Information Officer, Staging Area Manager, Rehab Unit, Fire Branch, EMS Branch, and others as outline in NFPA1561, Standard in Fire Department Incident Management.

Scene Control.

Control Zones – These zones will replicate the zones established during a hazardous materials incident. Hot, warm and cold. Establishing these zones early will afford the incident commander control over the incident vs. the incident controlling the commander. These zones should be established for all technical rescue incidents when the first fire department or police department representative arrives on scene.

Witness Interviews.

Who, what, where, why, and when must be extracted from all individuals in the area. Where were they standing when the incident took place? What did they see or hear? The department or agency should establish forms to assist in this information gathering for the various types of possible incidents identified in their jurisdiction.

Patient Contact.

Control who talks to the victim and what the victim hears. It does no one any good to say things that will only upset the victim. Lying is not acceptable, but limiting the information is. Prudence in this matter will be of benefit to your agency and the victim.

Bystander Interaction.

This includes family that has been told of the incident and they are there to see their loved ones. Establishing control zones will keep all non-essential personnel out of harms way. The department or agency personnel interacting with the public can also pose problems. If numerous people tell “their” version of what’s going on, the real story may become overlooked. This is the importance of a Public Information officer.



General

- Scene control
 - Control zones
 - Hot, warm, cold
 - Witness interviews
 - Who, what, where, when, why from all people in area
 - Patient contact
 - Control who talks to victim and what victim hears
 - Bystander interaction
 - Control zones will keep non-essential people out of harms way



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

GENERAL

Police Assistance.

The Police departments are an extremely valuable resource at your disposal. From the local to state level, most are willing to cooperate with you. Like all other members working on the scene, they must be kept apprised of the situation and any and all potential problems.

Machinery/Vehicles.

All too often, notices are sent out because a rescuer was killed at the scene of an incident. Whether it is traffic on a back-road or a 6-lane highway, a conscious effort must be made to protect all personnel operating at the incident. Do not utilize personnel to block traffic. With machinery, find someone with expertise. What are the actions of a “full cycle machine”? Call for assistance.

Utilities.

Notify the proper authorities. Unless you are “qualified, certified, or properly trained” do not attempt to manipulate their equipment. Have their emergency contact numbers available ahead of time.

General

- Scene control
 - Police assistance
 - PD is a valuable resource
 - Machinery / vehicles
 - Find someone with expertise (machines)
 - What are the actions of a full cycles machine?
 - Use apparatus to block traffic, not personnel
 - Utilities
 - Have emergency contact information ahead of time. Know capabilities and resources.

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS GENERAL

Course Objectives

This course has been designed to meet the 2004 edition of NFPA 1670. Students should reference the standard for specific objectives for the awareness level in each subject addressed.

At the completion of each subject, the student should be able to implement the relevant initial company operations below.

Initial Company Operations

- 1.) **Upon Arrival - Establish Strong visible command**
 - a. Provide initial report
 - b. Implement ICS / NIMS
 - c. Establish minimum positions
 - i. Command
 - ii. Safety
 - d. Establish additional Command Staff and General Staff positions as needed
 - e. Consider Unified Command for Complex Incidents

- 2.) **Identify the need for Technical Rescue**
 - a. Conduct Rapid Size-up Considering the following:
 - i. Scope, Magnitude and Nature of the incident
 - ii. Location / complexity of the incident
 - iii. Risk vs. Benefit (rescue or recovery)
 - iv. Scene Access
 - v. Functional Capabilities of Available Resources
 - vi. Location of Additional, Trained Resources.
 - vii. Environmental Conditions

- 3.) **Recognize the General Hazards involved in the incident.**
 - a. Make area safe for all responders
 - i. Identify all Hazards
 - ii. Control / Limit Traffic
 - iii. Control / Limit Access
 - iv. Mitigate hazards within your capabilities



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

GENERAL

- 4.) **Identify the appropriate resources for the incident**
- a. Consider Functional Capability
 - i. Awareness
 - ii. Operations
 - iii. Technician
- 5.) **Initiate the appropriate emergency response system**
- a. Consider all Available response systems as identified by the AHJ
 - i. Local
 - ii. County
 - iii. State
 - iv. National
- 6.) **Initiate Site Control Measures**
- a. Establish personnel accountability system (control access points)
 - b. Develop Incident Action Plan and Communicate the plan to EVERYONE
 - c. Establish and Communicate an Evacuation Plan for EVERYONE
 - d. Secure the General Area
 - e. Secure Witnesses and Conduct Interviews for Intelligence
 - f. Establish Control Zones (Rule of Thumb)
 - i. Hot Zone 100' critical functions
 - ii. Warm Zone 200' support functions
 - iii. Cold Zone 300' Command and Control functions

Outside Cold Zone Liaison to Rest Of World
- 7.) **Establish Patient Contact without endangering Personnel**
- a. Establish Location of All Patients
 - b. Establish verbal contact with the patient
 - c. Determine Patient Condition (from a safe distance)
 - d. Assist with NON-ENTRY RESCUE
(without endangering personnel)



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Emergency providers have become an organized faction that responds to a large number of diverse types of emergency and non-emergency incidents. These incidents range from responses to automobile fires to collapses of multistory buildings. Our emergency response personnel continue to provide life saving action in all incidents whether they are formally trained or not. Due to that type of culture it is important for responding companies to have the needed knowledge to safely evaluate, and establish a method to start mitigation of each type of incident without exposing our personnel. The safety of our personnel continues to be the highest priority of each incident. Personnel that respond to these incidents need to be aware of hazards associated with each type of incident. In this section you will be able to identify general principles for a structural collapse.

Earthquakes, wind storms, floods, heavy snow, inadequate construction techniques, explosions, rain, fire, transportation accidents, and decay due to age affect buildings no matter where they are located across the globe.

The following program will cover what you the responder should expect to find at these incidents; including the initial response by the local residents, selecting strategies during initial size-up, destructive forces expected due to the type of disaster, and the initial information that is needed to direct incoming rescue forces. Along with discussions of the different building designs, their weaknesses, and how the different damaging forces will cause adverse structural loading and the resultant collapse patterns. Emergency responders from each community have a different method for addressing the same problems as found elsewhere in the nation. Communities must evaluate the probability of each type of damaging forces that affect their location. This will help us effectively plan for these special emergencies, and their special hazards. Protecting our personnel and the occupants that remain in those damaged structures will be the result of these efforts.

Structural Collapse



Overview

- Functional Capabilities of Responders
- Initial Response and Size-up
- Causes of Collapse
- Potential Secondary Collapse Indicators
- Phases of Response
- Categories of Building Construction
- Collapse Patterns
- FEMA US&R Marking Systems
- Structural Triage Criteria
- Initial Company Operations



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

It is the intent of this program to train fire department personnel to be competent at surface rescues. Surface rescues involve minimal removal of debris and building contents to extricate easily accessible victims.

Awareness Level Personnel can perform the following functions: Size-up, Site control, Scene Management, Hazard Identification, Basic Search and Removal of Readily Accessible Victims. (surface rescue)

Operations Level Personnel can do all of Awareness Level Plus: Conduct rescues from Light Frame, Ordinary, Un-reinforced and Reinforced Masonry Construction.

Technician Level Personnel can do all of Awareness and Operations Levels Plus: Conduct rescues from Concrete Tilt-Up, Reinforced Concrete and Steel Construction.



Functional Capabilities

Awareness Level Personnel can:

- Perform Size-up, Site control, Scene Management, Hazard Identification, Basic Search and Removal of Readily Accessible Victims. (surface rescue)

3

Functional Capabilities

Operations Level Personnel can do all of Awareness Level Plus:

- Conduct rescues from Light Frame, Ordinary, Unreinforced and Reinforced Masonry Construction.

4

Functional Capabilities

Technician Level Personnel can do all of Awareness and Operations Levels Plus:

- Conduct rescues from Concrete Tilt-Up, Reinforced Concrete and Steel Construction.

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

Size-up Defined: The conscious process involving very rapid but deliberate consideration of the critical factors and development of a rational plan of attack.

**Size-up is a SIX SIDED APPROACH: TOP, BOTTOM,
And ALL FOUR SIDES
INITIAL INFORMATION GATHERING**

Information gathering techniques will be crucial to the efficient transition of the Technical Rescue Specialist into the incident. It is important for these incoming forces to carefully verify information obtained from the first responders and other individuals at the disaster site. By the time the information exchange takes place, the first responders will probably be subjected to the following:

Long periods of physically and emotionally draining work. Feelings that it's not possible that other victims have survived within a badly collapsed structure.

A need to experience closure that the incident is over.

Feelings by relatives/friends of the missing that they have surely survived and are entrapped.

The information gathering must therefore, proceed as swiftly and unemotionally as possible, while testing all current assumptions. Information from others on structural safety issues should be recorded, but the Search Specialist should perform his own assessment, independently, as in any good check.



Size-up Defined

The conscious process involving very rapid but deliberate consideration of the critical factors and development of a rational plan of attack

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Size up is
A
Six Sided Approach
THE TOP
THE BOTTOM
ALL FOUR SIDES

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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Initial Size-up

After assuming command of the incident, a size-up of the structural collapse incident should be completed and the following factors should be taken into consideration:

Survey Incident Area:

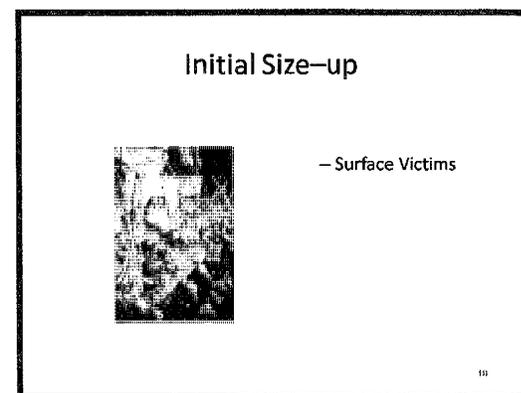
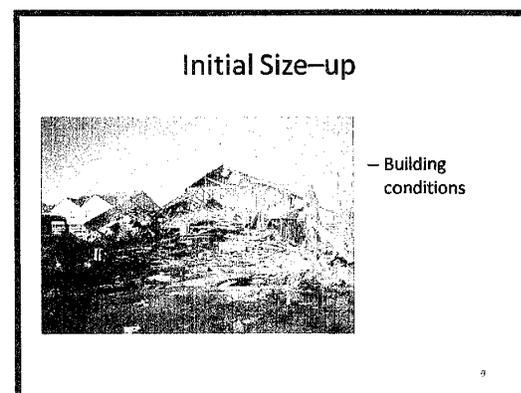
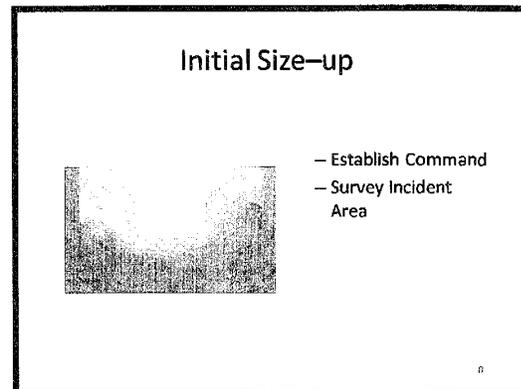
- Scope, nature and magnitude of the incident
- Complete a 360 of the structure, from a distance
- Assess the extent of the collapse
- Check for hazards adjacent to the structure
- Accessibility to the scene
- Environmental factors

Check Building Conditions:

- Are corners straight
- Are openings racked
- Age of building
- Construction type and occupancy
- Collapse extent – localized or extensive
- Potential for secondary collapse
- Number of structures involved

Surface Victims:

- Remove readily accessible victims
- Interview them about other victims
- Survey entire area for other victims and damage
- Total number of victims – needs to be identified early



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

Mutual Aid / Outside Assistance:

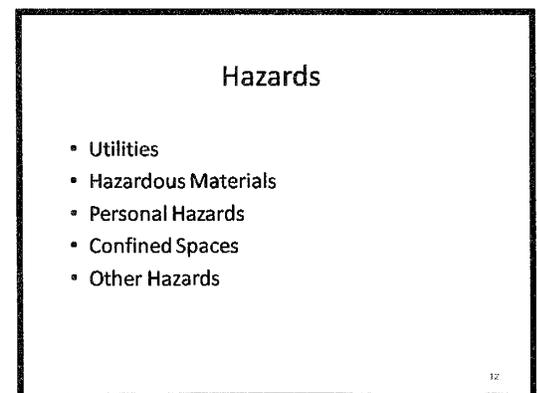
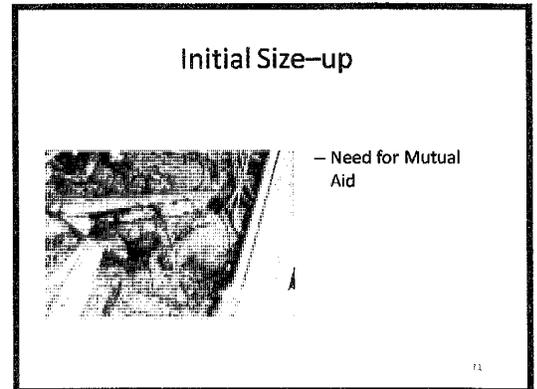
- When in doubt, call them out
- Pre-plan response needs
- Include closet technical rescue teams

Hazards

General hazards associated with search and rescue operations at structural collapses can present the organization with uniquely challenging situations. The organization should consider the following potential hazards when responding to structural collapse incidents:

Utilities: Control of the utilities in and around a structural collapse is critical to ensure the safety of responding personnel and victims. As responders, you should consider the following utility hazards when approaching a technical rescue incident:

- Electrical services (primary and secondary)
- Gas, propane, fuel, oil or other alternative energy sources (primary systems)
- Water
- Sanitary systems
- Communications
- Secondary service systems (i.e., compressed, medical or industrial gases)



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Hazardous Materials: Collapsed structures might include various materials unique to an occupancy that, when released during a structural collapse, could pose a hazard to victims and responders. As responders, you should consider the following hazards when approaching a technical rescue incident:

- Recognize the potential for the structure to have hazardous materials
- Determine what the hazards will be to victims and responders
- How can you contain, confine or divert the materials

Personal Hazards: At a site of any structural collapse, there are many dangers that pose personal injury hazards to responders. As responders, you should consider the following personal hazards when approaching a technical rescue incident:

- Trip hazards
- Fall hazards
- Blows
- Punctures
- Impalement, etc.

Confined Space: Some structural collapses necessitate a confined space response. As responders, you should consider the following confined space hazards when approaching a technical rescue incident.

- A collapse could cause a confined space
- Recognize the need for a confined space team
- Know how to approach a confined space as an awareness trained person



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

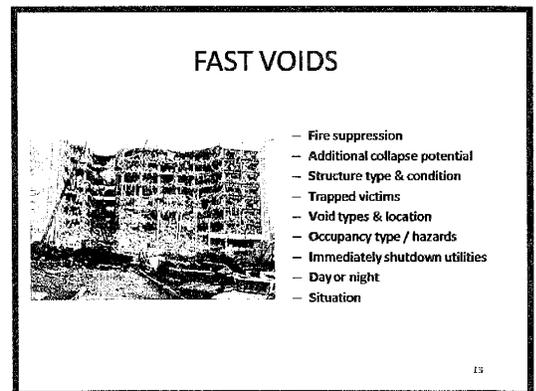
Other Hazards: There are numerous other hazards associated with structural collapses. The department / agency should make every effort to identify the hazards that might be encountered and assure their responders are trained to recognize these hazards and respond accordingly:

- Recognition of building materials and structural components of light-frame ordinary construction
- Recognition of unstable collapse and failure zones of light-frame ordinary construction
- Recognition of collapse patterns and probable victim locations in light-frame ordinary construction

“FAST VOIDS”

Fast Voids is an acronym for items that should be addressed as part of the size-up process.

- Fire Suppression – Is there a fire or a potential?
- Additional collapse potential – Is building still moving? Loose / hanging debris.
- Structure type & condition – Old, new, under construction, vacant, etc.
- Trapped victim rescue – Confirmed / unconfirmed / dead / alive?
- Void types – location & number (or potential)
- Occupancy type / hazards – residential, commercial, nursing home, etc.
- Immediate utility shut down – Can you do or do you need utility company?
- Day or night – Might dictate number of potential victims.
- Situation – Cause of collapse? (explosion, collision, etc.)



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

Causes of Collapse

Natural Disasters:

- **Earthquakes** –both the initial tremor and aftershocks may cause shaking that has its greatest effect on weak, heavy structures that are rigidly coupled with their sites.
- **Wind** – hurricanes and tornadoes cause damage due to wind velocity, airborne missiles and difference in atmospheric pressure. Wind affects mostly light, un-engineered buildings and structures that are penetrated, thereby causing high uplift/blowout forces.
- **Floods** –Two Major Categories: Coastal Flooding and Inland Flooding. Coastal flooding occurs when the steep up surges of hurricanes combined with their high winds produce combined forces from wind and flooding. The damage from flooding is caused by hydrostatic lateral pressure/lifting, hydrodynamic forces due to velocity and wave height, and debris impact from waterborne objects. More deaths occur from flooding than any other weather related event. As the system moves inland and stalls, rainfall amount of 20 to 40 inches can occur over several days causing widespread flash flooding.

Overloading of Structural Components:

- **Snow and Heavy Rain** – cause roof collapse due to overload. Most often occurs in long span construction with relatively flat roof, where roof beam or truss fails, leading to partial collapse. Snow build-up causes more complete collapse due to failure of vertical supporting elements. Clogged drains and pooled water on flat roofs.



Causes of Collapse

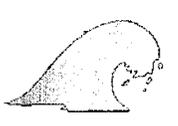
- Natural Disasters
 - Earthquakes
 - Hurricanes/Tornados



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Causes of Collapse

- Natural Disasters
 - Floods
 - Coastal
 - Inland



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Causes of Collapse

- Overloading of Structural Components
 - Water
 - Snow
 - Stacked building materials
 - HVAC equipment
 - Water tanks
 - Anything added after construction



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

- **Construction Problems** – most often caused by lack of temporary lateral bracing or inadequate vertical shoring. Failures have occurred during concrete pours, while placing large roof beams and trusses, and during lifting of large concrete slabs. In addition, collapse has been caused by overloads due to stockpiling materials and non-engineered alterations.

Structural Aging/Deterioration:

- Age of structure
- Quality of materials and workmanship
- Maintenance of structure
- Occupied or vacant
- Weather exposure (water, wind, hot & cold)
- Breakdown of mortar

Structural Decay – has led to collapse of older buildings and bridges. Collapse can be most devastating when vertical support member's fail leading to multi-floor collapse. In older buildings, the exterior un-reinforced masonry walls can be left standing full height without any bracing by pancaked floors. Walls could later fall in on floor debris pile, or out into the street, or adjacent buildings – very significant hazard.

- Expansion/contraction
- Undermining foundations
- Insect infestation
- Improper alteration
- Removal of structural components



Causes of Collapse

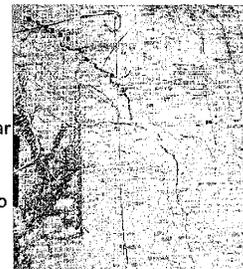
- Structural Aging/Deterioration
 - Age of structure
 - Quality of materials & workmanship
 - Maintenance of structure
 - Occupied or vacant



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Causes of Collapse

- Structural Aging/Deterioration (con't)
 - Weather exposure
 - Breakdown of mortar
 - Rotting of structural members
 - Expansion/contraction



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Causes of Collapse

- Structural Aging/Deterioration (con't)
 - Undermining foundations
 - Insect infestation
 - Improper alteration
 - Removal of structural components



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Explosions:

- **Accidental** – caused by natural gas build-up, industrial dust, drug labs, explosive storage, flammable liquids/gasoline tankers, malfunctioning utilities.
- **Intentional** – demolition (controlled), mining (below grade), road construction (blasting).
- Light weight wood and steel structures often have the weakest part blown out to reduce pressure (i.e., roof or wall skins, windows) entire roof or the wall may be blown out. Reinforced concrete structures contain blast better, often causing greater loss of life, and if columns or walls are badly damaged, collapse of floors can result. Precast structures are especially vulnerable since large concrete parts can become disconnected or blown out leading to progressive collapse.

Fire:

- Wood or metal roof/floors often collapse due to burn through and can pull exterior masonry or concrete walls in or leave them standing in an unbraced condition.
- A steel structure left standing after a fire can have significantly reduced strength due to loss of original heat treatment.
- A remaining concrete structure can be damaged due to spalling and shearwalls and can be cracked due to expansion of floors.



Causes of Collapse

- Explosions
 - Accidental
 - Natural Gas
 - Industrial Dust
 - Drug Labs
 - Intentional
 - Demolition
 - Mining
 - Road construction



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Causes of Collapse

- Fire
 - Wood/metal roof collapse
 - Steel left standing after a fire
 - Concrete



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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

Collision Impact:

- Vehicles
- Aircraft
- Train
- Debris/materials (storm/explosion)
- Construction equipment

Terrorism:

- Difficult to plan for
- Watch for secondary devices or attacks that are used to injure or kill responders

Causes of Collapse

- Collision Impact



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Causes of Collapse

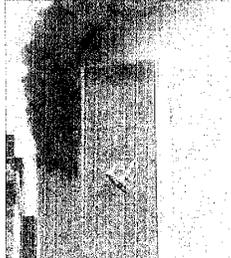
- Collision Impact (cont)
 - Vehicle, trains, ships, and aircraft may crash into structures.
 - Structural collapse during these incidents adds to the danger of the situation.



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Causes of Collapse

- Terrorism
 - Difficult to plan
 - Watch for secondary device or attack.



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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

Potential Secondary Collapse Indicators

- Leaning Walls
- Smoke or water seeping through joints
- Unusual sounds
- Sliding plaster
- Dust
- Aftershocks
- Sagging Floor or roof assemblies
- Separating walls
- Racked or twisted structure
- Missing, strained, or damaged points of connection of structural elements

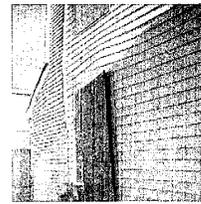
Phases of Response

It is important for all to understand the typical chronology of a Technical Rescue incident. The emergency response normally occurs in the following phases:

- **Spontaneous Rescuers** - unskilled, neighbors, community response teams, and passers-by will heroically help remove lightly trapped and/or injured victims. These rescuers have often acted far beyond their normal skill level and often save three-fourths or more of the total. Survival rates are relatively high, since victims are not normally entrapped. Professional firefighters, law enforcement officers, and emergency medical personnel may participate and better organize the response. This phase will often end after the first few hours.
- **Planned Community Response** – by trained community response teams. Call-out and visual searches would be used to locate and rescue the non-structurally trapped. Some lifting of objects (furniture, bookcases, etc.) would be done as well as mitigation of hazards (extinguish small fires, turn off gas, observe/refer hazardous materials).



Potential Secondary Collapse Indicators



– Leaning Walls

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Potential Secondary Collapse Indicators



• Smoke or water seeping through joints

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Phases of Response

- **Initial Spontaneous Response**
 - Unskilled neighbors, community response teams, and passers-by

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Phases of Response

- **Planned Community Response**
 - Trained community response teams (C.E.R.T.)



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

- **Void Space Rescue** – by emergency services rescue forces. Search elements would help prioritize site to make better risk vs. benefit judgments. Rescue would proceed using existing cavities, duct/plumbing shafts, basements, and/or small cut openings in easily breachable floors and walls. Some shoring might be done to protect safe haven areas and otherwise protect emergency responders and/or victims. This phase may start the first day, but often, not until after some organizing efforts have taken place, requiring at least one hour. Only trained personnel should attempt entry into void spaces.

- **Technical, Urban Search & Rescue Teams** - by trained Technical Rescue Specialists, aided by equipment. Site or sites would be re-evaluated, re-searched, and prioritized for the ten-day long effort. Extensive cutting, shoring, etc., may be done to penetrate the structure. Cranes may be used to remove layers of structural debris or parts of the structure that are hazardous.

Categories of Building Construction

- **Light-Frame** – Mostly wood frame

- **Heavy Wall** – URM, Tilt-up, low-rise buildings with concrete and masonry walls.

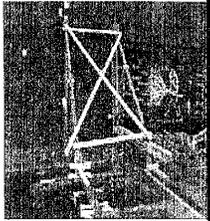
- **Heavy Floor** – Concrete frame buildings and highway bridges.

- **Pre-cast Concrete** – fairly heavy floors and some heavy walls.



Phases of Response

- Void Space Rescue



Phases of Response

- Technical Rescue Teams
 - Trained technical rescue specialists



Categories of Building Construction

- **Light-Frame** – Mostly wood frame
- **Heavy Wall** – URM, tilt-up, low-rise buildings with concrete and masonry walls
- **Heavy Floor** – Concrete frame buildings and highway bridges
- **Pre-cast Concrete** – fairly heavy floors and some heavy walls.

Construction Code Classifications by Building Type

Construction code classifiers	Fire-retardant	Non-combustible	Ordinary	Heavy timber	Wood
NFPA 220 classifications	I	II	III	IV	V
NFPA 1070 Construction types	Light frame				
	Heavy wall				
	Heavy floor				
	Pre-cast concrete				



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

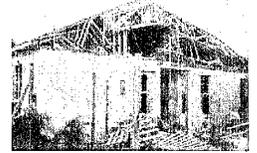
Light Frame Construction

- These structures can vary from 1 to 4 stories and contain from 1 to over 100 living units.
- Their principal weakness may be in lateral strength of walls or interconnection of the structure, especially at the foundation.
- They are unique in that the vertical load resisting systems (joist, beams, studs and posts) are covered with a “skin” to form the lateral load resisting system. This is different than other bearing wall systems.
- Relatively modern apartment buildings have walls that are braced using only plaster/gypsum or inadequately designed plywood.
- Homes with crawl spaces can shift or slide off their foundations.
- Masonry chimneys can crack and fall off or into the structure.
- Masonry veneer (bricks) can fall off walls and shower adjacent areas with potentially lethal objects.
- Structures can separate at offsets in floor/roof levels (such as porches and split level houses).
- A great danger of fire exits for these structures due to the presence of so much fuel.



Light-Frame

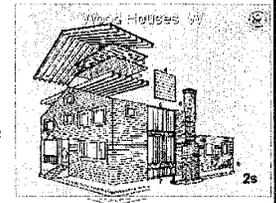
- Materials are generally lightweight
- High degree of structural flexibility
- Principle weakness is in lateral strength



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Light-Frame

- Constructed with skeletal structural frame
- Wood or light-gauge steel components
- Provide support to the floor and roof assemblies.



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Examples of Light-Frame Construction

- Residential
- Multiple low-rise
- Light commercial up to four stories.
- Light-gauge steel
- Commercial, business, and light manufacturing.



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

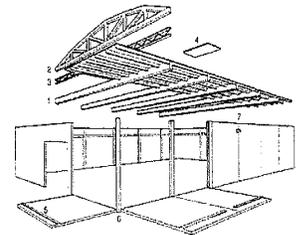
Heavy Wall Construction

- Materials are generally heavy and utilize an interdependent structural or monolithic system, which makes the structure inherently rigid.
- Usually built without a skeletal structural frame and utilizes a heavy wall support and assembly system that provides support for the floors and roof areas.
- Some heavy wall construction occupancies use tilt-up concrete construction of one to three stories in height and consist of multiple, monolithic concrete wall panel assemblies.
- They also can use interdependent girder, column and beam systems for providing lateral support of floor and roof assemblies. These occupancies can include commercial, mercantile and industrial usage.
- Other materials are now being used in tilt-up construction, such as, reinforced and un-reinforced masonry buildings typically of low-rise construction, one to six stories in height and of any occupancy.



Heavy Wall

- Materials are generally heavy and utilize an interdependent structural system.



Heavy Wall

- Interdependent girder, column, and beam system
- Provides lateral wall support of floors and roofs.
- Commercial, mercantile, and industrial occupancies



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

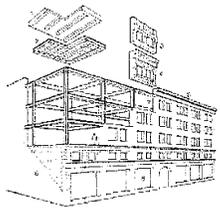
Heavy Floor Construction

- Built utilizing cast-in-place concrete construction consisting of flat slab panel, waffle or two-way concrete slab assemblies.
- Pre-tensioned or post-tensioned reinforcing steel rebar or cable systems are common components used for structural integrity.
- Vertical structural supports include integrated concrete columns, concrete-enclosed steel frame or steel frame, which carry the load of all floor and roof assemblies. This also includes heavy timber construction.
- The reinforcing steel, along with the varying thicknesses of concrete structural slab and girder supports utilized in this construction assembly, pose significant concerns with respect to breaching and void penetration.
- The loss of reinforcement capability and the integrity of structural loading capacity of the floor and wall assemblies create significant safety and operational considerations during collapse operations.
- Structural steel frame construction utilizes a skeletal framing system consisting of large-load-carrying girders, beams, and columns for structural support. These components represent a substantial weight factor for individual and assembly components. Floor systems consist of cast-in-place concrete slabs of varying thicknesses poured onto metal pan or structural metal floor decks and also might include pre-cast and post-tensioned concrete plank systems. These concrete/metal pan floor assemblies are supported by the structural steel framing system.



Heavy Floor

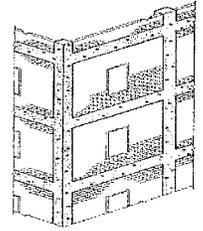
- Cast-in-place concrete construction
- Flat slab panel, waffle, or two-way concrete slab assemblies.



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Heavy Floor

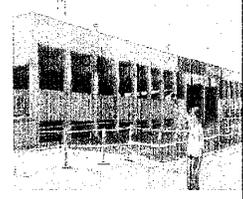
- Vertical structural supports include
 - Integrated concrete columns
 - Concrete enclosed steel frame
 - Steel frame



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Heavy Floor

- Exterior construction
 - Metal
 - Masonry veneer
 - Curtain wall
 - Composite material panels.
- Offices, schools, apartments, hospitals, parking structures.



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INSTRUCTOR MANUAL

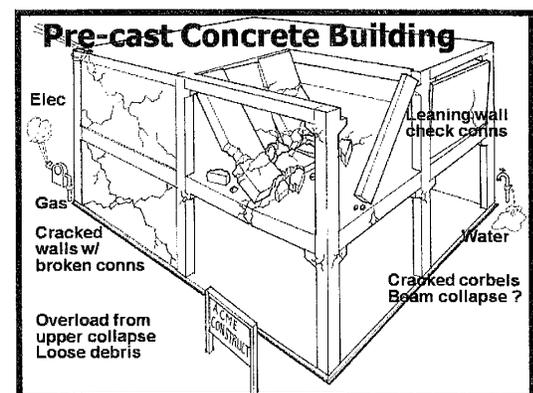
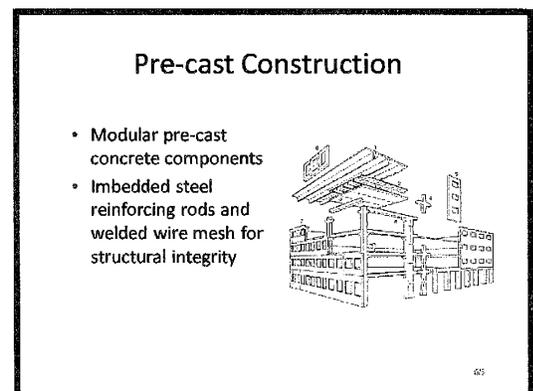
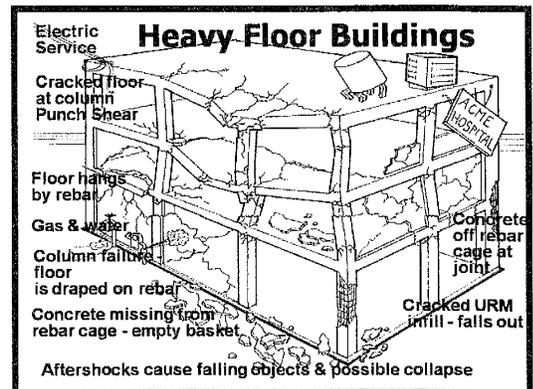
TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

- The exterior construction might consist of metal or masonry veneer, curtain wall, or composite material panel systems. Additionally, pre-cast concrete or stone clad panel systems might be present.
- Multiple assembly or component failures might be present in a collapse situation where isolated or multiple collapse conditions or collapse configurations exist.
- Examples of this type of construction include offices, schools, apartments, hospitals, parking structures, and multipurpose facilities. Heights vary from single-story to high-rise structures.

Pre-cast Construction

- Structures of pre-cast construction are built utilizing modular precast concrete components that include floors, walls, columns, and other subcomponents that are field-connected at the site.
- Individual concrete components utilize imbedded steel reinforcing rods and welded wire mesh for structural integrity and might utilize either steel beam and column or concrete framing systems for the overall structural assembly and building enclosure.
- These structures rely on single or multipoint connections for floor and wall enclosure assembly and are a safety and operational concern during collapse operations.
- Examples of this type of construction include commercial, mercantile, office, and multiuse or multifunction structures, including parking structures and large occupancy facilities.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

Collapse Patterns

Light Frame Collapse Patterns

- These structures are unique in that they may be described as **Skin and Bones** structures. The lateral load resisting Skin is separate from the vertical load resisting studs, posts and columns.
- Collapse usually occurs when the sheathing on the lower walls have insufficient strength to resist the lateral forces and the walls rack (become parallelograms). This is called an **Offset Collapse Pattern**.
- If there is a sufficiently heavy load on these walls, they can completely collapse as the wall top moves sideways a distance equal to its height, as shown in the slides.
- This movement causes the structural collapse to be in the form of part or all of the building being projected away from its original foundation by the height of the story walls that fail.
- This can happen in a split level house as well as a three or four story building.
- When the bottom story of multi-story, light frame structure fails in this way, additional stories can collapse due to the impact of the first story hitting the ground.
- This type of collapse usually leaves many voids that are relatively accessible from above.
- In wood structures, when the lower floor rests directly on the foundation, but is not well connected to that foundation, the entire structure can slide over or off the foundation.



Collapse Patterns

- **Light Frame** - wood frame buildings
1 to 4 stories, residential & other
- **Heavy Wall** - URM, TU, & other low rise
w/concrete or masonry walls
- **Heavy Floor** - Concrete frame bldgs
- **Precast Concrete** - fairly heavy floors & some w/heavy walls

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Light Frame Collapse Patterns

1st Story Walls are Racked by Quake

Initial Condition

Since 1st story walls can still support vertical load, they keep their original length & project upper stories away by length of story height

Collapse Projects Structure Beyond it's Boundary

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Light Frame Collapse Patterns

chimney breaks at roof or fire box

initial condition

roof & floor over weak garage are projected away

collapse projects weak story away

Split Level House

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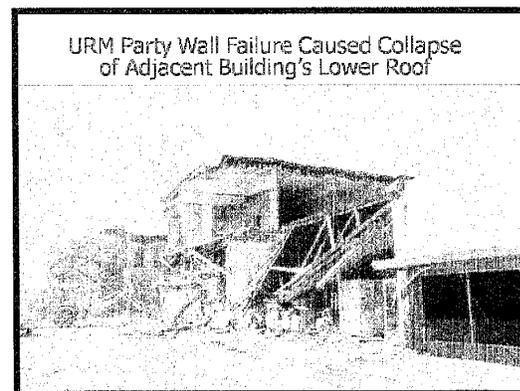
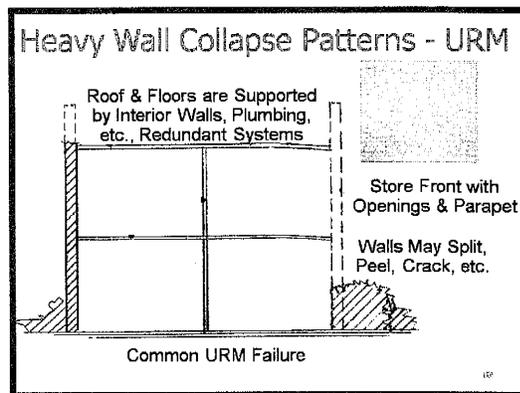
TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

- In all cases, a great danger of fire exists as a result of the combination of broken gas (or other fuel) lines and combustible debris.

Heavy Wall Collapse Patterns

- Collapse is usually partial and is strongly related to the heavy, weak bearing walls falling away from the floors. This is the **Wall Fall Collapse Pattern**.
- In URM buildings the walls normally fall away from their original position, but most often don't project out as far as their height.
- The combination of the weak interconnection of the masonry pieces and gravity tend to cause the debris to stay within ten to fifteen feet of the building face.
- When property line walls fall on an adjacent, lower buildings, these structures will usually have some sort of roof/floor collapse.
- However, in collapse due to failure of interior columns or due to fire, it is possible to have the very precarious situation of multi-story heavy walls that are left standing without any laterally supporting floors/roof. Under such conditions, it is probable that the walls could fall such that they extend their full height along the ground.
- When the wood roof and/or floors collapse, many easily accessible voids can be created.
- Areas adjacent to the walls where the heavy debris falls often contain badly injured or dead victims.
- The combination of broken gas lines and debris can lead to fire.



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TECHNICAL RESCUE AWARENESS

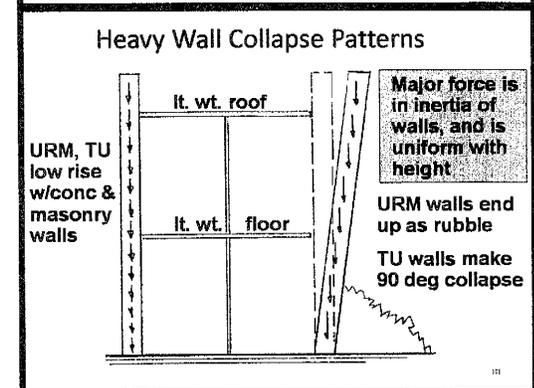
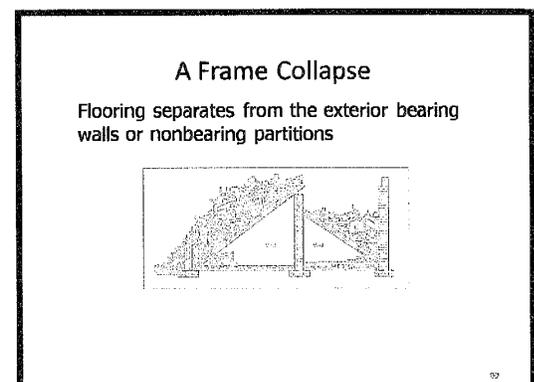
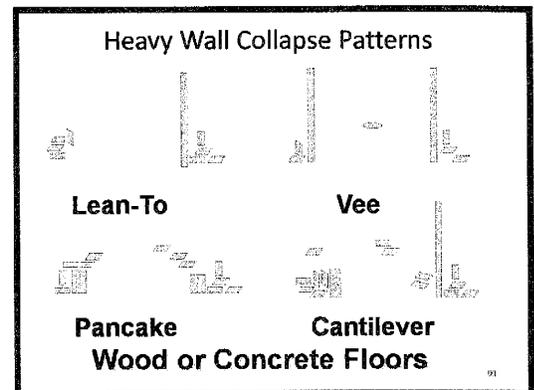
STRUCTURAL COLLAPSE

- As mentioned previously, the experience with this type of building lead to the development of the five NFPA collapse patterns which follow:
 - **Lean-to:** Formed when one wall collapses, leaving the other end with questionable support (URM, TU, Heavy Floor & PC Concrete).
 - **Vee:** Occurs when interior support fails. More common in decay/overload column (URM, Heavy Floor & PC Concrete).
 - **Pancake:** Occurs when all vertical support fails (URM, Heavy Floor & PC Concrete).
 - **Cantilever:** A pancake collapse with extended floors (URM, Heavy Floor & PC Concrete).
 - **A-Frame:** Occurs with Lean-to collapse in adjacent structures.

- **Walls in tilt-up buildings** normally fall away from the roof or floor edge, but since they are very strong panels, the top of the wall will fall as far away from the building as its height. This **Wall Fall Collapse** is somewhat different from the one that involves URM construction.

- Since tile-ups have longer roof/floor spans, the adjacent section of roof will then collapse, although it may still be supported at its far end.

- Tension forces will be imposed on the roof system, therefore, all beam-to-beam and beam-to-column connections may be damaged and/or pulled-out.



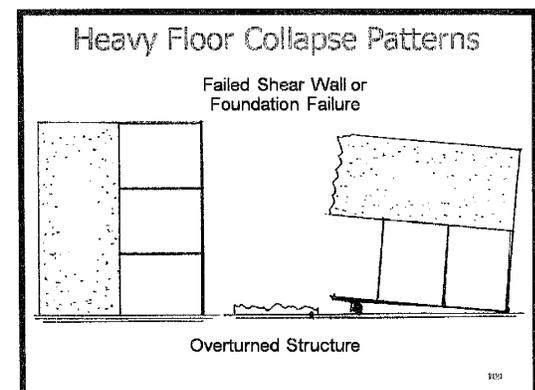
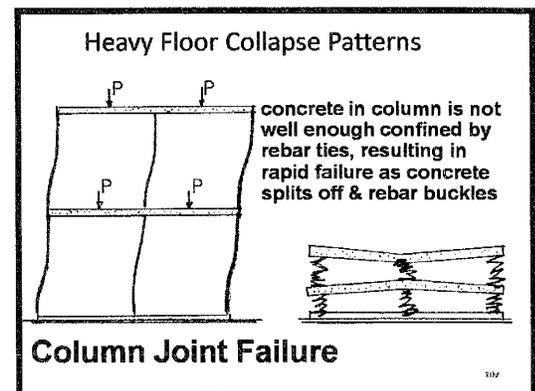
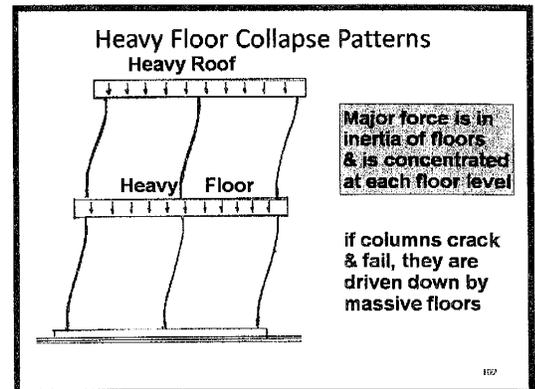
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TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Heavy Floor Collapse Patterns

- A heavy floor collapse can be only partial to complete. It is usually caused when columns or walls, weakened by motion, are unable to support the heavy floors.
- The collapse patterns all share the pattern of thin void spaces forming within the original plan area of the building.
- These heavy floor structures usually fall on themselves, but they can project laterally as they fall, if the columns and/or walls are strong enough to not fracture. In other words, the columns can fail due to hinging at the top and bottom, and then the collapse becomes an **Offset Pancake**.
- The voids can be very difficult to access, since even though the heavy floors can have dropped tens of feet, they are still usually well interconnected with reinforcing steel.
- The height of remaining voids between floors in **Pancake Collapse** buildings, will depend on what projections the slabs originally had (for example; beam stems, flat slab drops) and partly crushed contents.
- Tall, moment-resistant frame structures, in which tension to compression reversal causes an almost explosive failure of exterior columns, may **overturn**, but more often they will collapse within their plan boundaries because of high gravity forces.
- Many partially collapsed concrete frame structures will contain parts of slabs and/or walls that are hanging off an un-collapsed area.

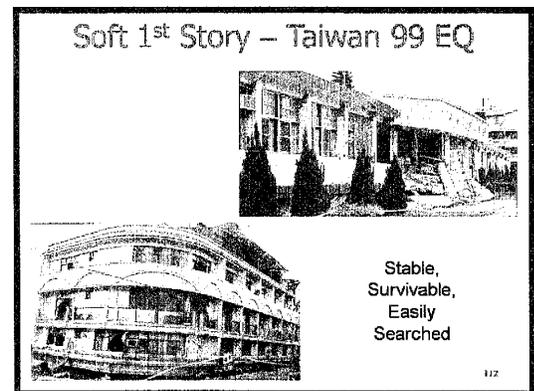


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TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

- This has been observed in corner buildings in which only the street-front bays collapse due to torsion effects and in long buildings or those with several wings, where some bays do not collapse.
- **Torsion Effects** occur in concrete frame structures when URM infill is placed in exterior property line walls for fire resistance. These walls become stiffer than all other parts of the building, and cause a temporary, eccentric condition, which can lead to a collapse of the columns on the opposite side of the building.
- **Overtuned**, normally taller structures with shear walls will often fail due to tension/shear failure at the base.
 - Under these conditions, the structure can project sideways by it's full height.
 - Survivability should be high.
- **Soft First Story Collapse** occurs in buildings that are configured such that they have significantly less stiffness (many fewer walls or no walls) in the first story than in the stories above.
 - This configuration often occurs in buildings where the first story occupancy is commercial (where openness is desirable) and the upper stories are residential.
 - The damage becomes focused on the "Soft Story", as what lateral resistance that is present becomes overwhelmed.
 - This configuration is not viable in concrete construction, and has been prohibited in some modern building codes.
 - The collapse is often limited to the one "Soft Story", as the building becomes on story shorter.
 - Survival rate is very high above the second floor.



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TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

- The first story should be accessed by cutting through the second floor.
- **Mid Story Collapse** can occur when a middle story is configured with much different stiffness than the stories above and below. **Can occur at any abrupt change in stiffness.**
 - It can occur when a story has no walls and the ones above and below have significant walls.
 - It can occur when a story has stiff, short columns and the ones above and below have longer, more limber columns.
 - Survival should be high above and below the collapsed story; however access to stories above may be blocked.
- **Pounding** can cause a mid-story collapse, leaving a difficult problem to assess, due to remaining floors being overloaded.
 - A pounding collapse normally occurs when two adjacent buildings have floors that are at different elevations.
 - The very stiff /strong edge of a floor in one building will cause the collapse of the adjacent building's column when they collide.
- Fire is usually not a problem for heavy floor buildings, unless the contents are particularly combustible.



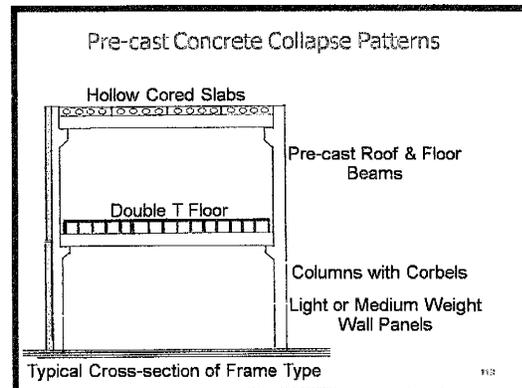
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TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Pre-Cast Concrete Collapse Patterns

- A pre-cast collapse is usually caused when the pre-cast parts become disconnected from one another and the structure very rapidly loses stability.
- The collapse normally contains numerous layers of broken and unbroken pieces of slabs, walls, beams and columns. The best description of this is **Random Parts Collapse**.
- It is difficult to predict how far the parts can be projected away from the original structure's position, but gravity normally will drive them downward without projecting them, laterally, away from the building.
- The voids can be difficult to access, but the slab can be removed, layer by layer, since interconnections are normally poor to non-existent.
- Pre-cast parking garages have performed particularly badly.
 - They may be as large as 400ft X 400ft and be as many as eight stories.
 - Most do not have cast in place floor topping to help tie the structure together.
 - Most common failure is a column collapse caused by un-intended shear overstressing columns near ramps or at girder connections.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

FEMA US&R Marking Systems

- In this section we will discuss the following topics that involve structure marking and location:
 - Identification of Individual Buildings
 - Structure/Hazard Evaluation Marking System
 - Search & Rescue Assessment Marking System
 - Victim Marking System
- These are important communication methods that are used to designate what operations have been preformed. It is extremely important that these standards be followed, so that critical information can be shared with all responders that may be working the same incident. Standard nomenclature is critical for efficient UR&R operations.

Identification of Individual Buildings

- The standard system for locating a building on any block involves the following considerations.
 - Using existing numbers and filling in the unknowns, or
 - If the numbers are all unknown, keep the numbers small, on odd and even sides.



FEMA US&R Marking Systems

- Identification of Individual Buildings
- Structure/Hazard Evaluation Marking System
- Search & Rescue Assessment Marking System
- Victim Marking System



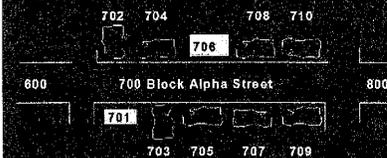
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Identification of Individual Buildings

Spray paint address on street and street names at corners

I. D. by Street & Number

- Case 1 - If some numbers are known, fill in



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TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Identification of Individual Building

- The standard systems for building layout is as follows:
 - Sides A, B, C and D start at the street side and goes clockwise.
 - Quadrants are marked with A, B, C and D with E being the center core.
 - Stories are designated as 1 (for ground) 2, 3, 4, etc.
 - Basements are designated as B1, B2, etc.

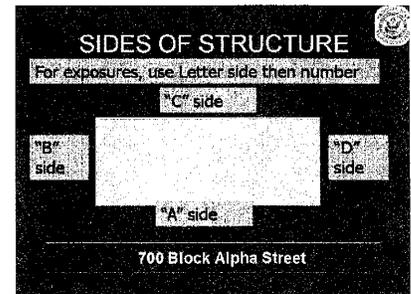
Structural Triage Criteria

The following information needs to be considered in determining risk/benefit that will aid in prioritization.

- **Occupancy** – the type of activity done in the building, as well as, the potential maximum number of occupants.
- **Structural Type** – what type of materials are involved, in order to help identify difficulty of access, type of collapse, potential hazard mitigation needs, etc.
- **Collapse Mechanism** – how building failed in order to provide an indication of type of voids that might be available for victim survival.
- **Time of Day** – refers to the time of the event, which caused the collapse. This is a critical factor when combined with the occupancy type. For example, if an earthquake occurs at 2100 hours and collapses an office building and an apartment building, the apartment building would normally represent the higher potential for a success rescue than would the office building. If the event occurred at 1000 hours, the opposite would be true.



Identification of Individual Buildings



Structure/Hazard Evaluation Marking System

- Rapid (5 to 15 min per bldg) assessment w/ scoring system and sketch map of area w/ bldg I.D..
- Triage team must maintain discipline to evaluate all buildings in group, not stop to solve problems.
- Incident Commander to use triage score as they see fit and establish initial priority for Search & Recon team.

Structure Triage Criteria

- **Occupancy**
- **Structural Type**
- **Collapse Mechanism**
- **Time of Day**
- **Prior Intelligence**
- **Search and Rescue Resources Available**
- **Structural Condition of the Building**



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TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

- **Prior Intelligence** – information from the general public, local authorities, first responders, etc., relating to known trapped victims.
- **Search and Rescue Resources Available** – does the particular building require resources beyond what is readily available to the task force (i.e., heavy equipment required to gain access.)
- **Structural Condition of the Building** – generally, can search and rescue operations proceed with a minimum of stabilization effort.

Triage Scoring Factors

The following factors will be used to obtain a numerical score for each structure in a group of buildings. The intent is, the higher the numerical score the better the risk/benefit ratio.

- **ZERO OCCUPANTS PROBABLE.** A notation of "ZERO" would be written in the score column if the earthquake occurred at a time of day when the type of occupancy contained in the structure was such that the building would have been normally unoccupied (school rooms on Sunday, retail shops at 6 A.M., etc.). The triage team would then proceed to the next building.
- **TOTAL NUMBER OF POTENTIALLY TRAPPED VICTIMS.** This will be assessed knowing the type of occupancy, the floor area of collapsed entrapping structure, the time of day the incident occurred, and the type of collapse. The following are the average total number occupants for various occupancies:
Based on units other than area:
Schools 25 to 35 students per classroom
Hospitals 1.5 occupants per bed
Residential 2.0 occupants per bedroom
Others 1.5 occupants per parking space

SCORING SYSTEM

- Zero victims probable, write zero, go to next
- No. of potentially trapped victims 1 to 50 (potential no. of victims divided by 5)
- Condition of voids 1 to 20 (compact - separate layers - part collapse)
- Time req'd to access victim 1 to 20 (one day to two hours)
- Danger of additional collapse -1 to -20 (low chance to high chance)
- Special occupancy children + 25
- Each known live victim +5

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TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Based on area: Variation

Schools, Library 1 per 70 SQ. FT. 50-100

Hospitals 1 100 80-150

Multi Residential 1 200 100-300

Commercial 1 100 50-200

Office, Inc Govt. 1 150 100-200

Public Assembly 1 25 10-050

EOC, PD, FD 1 125 100-150

Industrial 1 200 100-300

Warehouse 1 600 400-900

- The **Time of Day** that the incident occurred may indicate that there was very little possibility of a structure being occupied. The type of collapse (auto garage only, partial collapse) may also indicate that few occupants would remain entrapped even if many occupied the structure during the incident. All these factors should be considered when calculation **Total Number of Trapped Victims**.
- The numerical value of this criterion will vary from 1 to 50 as the number of potentially trapped victims varies from 1 to more than 200. Between 5 and 250 the value is the total number of possible trapped victims divided by 5.
- **CONDITION OF VOIDS.** This criterion will attempt to assess the degree of survivability of the potentially trapped victims. Victims don't survive well in tightly compacted collapsed areas consisting of rubble masonry, badly broken cast in place concrete and pre-cast concrete. Hollow, survivable voids are often found under wooden floor panels that are collapsed into angular interlocking planes and in reinforced concrete structures, where floors have projecting beam elements, parts of columns/walls and furnishings that hold the slabs apart.



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TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

- Partly collapsed structures may have large triangular voids or entrapped victims in large voids due to blocked exits etc. These large voids have the best chance of having surviving entrapped victims. The value of this criteria will vary from 1 to 20.
- **TIME REQUIRED TO ACCESS VICTIMS.** This will be an estimate of the time required to get to the first victim. It should include the time required to cut through floors/roofs etc., and the time required to shore/brace the access route and appropriate adjacent structures. The numerical value will vary from 1, for more than one day, to 20 for taking only two hours.
- **DANGER OF ADDITIONAL COLLAPSE DUE TO AFTERSHOCK.** This criteria will be represented by a minus number between -1 for low probability to -20 for high probability of additional collapse, assuming the proposed shoring/bracing is installed from criteria 3.
- **SPECIAL OCCUPANCY INFORMATION.** For this criteria one will add 25 points if the occupancy is a school, day care center, hospital, or other occupancy that could involve children. In addition 5 points should be added for each potential live victim that is confirmed by previous intelligence, search, etc.
- **"NO GO" CONDITIONS.** These would include structures that are on fire, have significant haz mat spills or otherwise have conditions that would make search and rescue operations too risky. Buildings with "NO GO" conditions would be expected to be re-evaluated when those conditions were mitigated, and some comment would be made regarding this should be recorded on the form.

NO-GO CONDITIONS

- FIRE
- HAZMAT
- Need to add info on when No-GO is to be Re-evaluated & Revisited

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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Structure/Hazard Evaluation Marking System

- Structural/Hazard Evaluation should take place **AFTER** a priority list of structures has been established by the Incident Commander, using Triage or just common sense, if only a few structures are involved.
- The greatest area of concern is not with the fully collapsed structures, but with those that have partly collapsed. The Triage Team should be prepared to fill out the US&R Structure/Hazard Evaluation Form, identifying structure type, occupancy, hazards, etc. In addition the Triage Team will generate notes and diagrams regarding search operations (locations of voids, shafts, shoring, etc.). It is anticipated, however, that in some cases the assessment will only indicate that the building is too dangerous to conduct US&R operations.
- The term safe should be understood by the Triage Team in a context very different from that of "**safe for occupancy**". All the structures will be damaged, and the value judgment of "**safe enough for the risks of US&R**" will need to be measured.

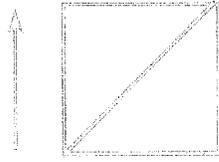
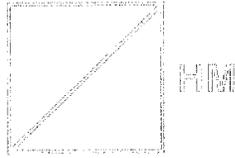
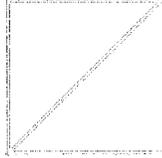
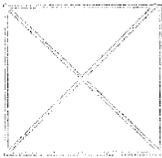
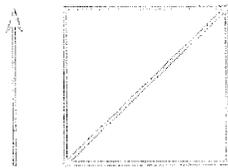
Structure/Hazard Evaluation Marking System

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

<p style="text-align: center;"><u>Structure/Hazard Evaluation Marking System</u></p> <ul style="list-style-type: none"> • Triage Team makes a 2' x 2' box on building adjacent to accessible entry. • Done after doing Hazards Assessment and filling out Structure / Hazards Evaluation. • Box is spray painted with using International 	<div style="display: flex; align-items: center;">  <ul style="list-style-type: none"> • Arrow next to Marking Box indicates the direction of Safest Entry to Structure </div>
<div style="display: flex; align-items: center;">  <ul style="list-style-type: none"> • Structure relatively safe for S&R ops. There is little chance of further Collapse. <ul style="list-style-type: none"> - Victims could be trapped by contents - or could be unconscious </div>	<div style="display: flex; align-items: center;">  <ul style="list-style-type: none"> • HM indicates hazardous material condition in or adjacent to structure. S&R Ops normally will not be allowed until condition is better defined or eliminated. </div>
<div style="display: flex; align-items: center;">  <ul style="list-style-type: none"> • Structure is Significantly Damaged. Some areas may be relatively safe, but others may need shoring, bracing, removal, and/or monitoring of hazards <ul style="list-style-type: none"> - Building could be completely pancaked </div>	<p style="text-align: center;">STRUCTURE / HAZARDS MARK - SUMMARY</p>
<div style="display: flex; align-items: center;">  <ul style="list-style-type: none"> • Structure is NOT SAFE for Rescue Ops and may be subject to Sudden Collapse. Remote search Ops may proceed at significant risk. If rescue Ops are undertaken, Safe Haven areas, & rapid evacuation routes (with Structure Monitoring) Should be Created. </div>	<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p>15JAN07 HM NATURAL GAS ENG-1</p> </div> </div> <p style="text-align: center;">No entry until gas is turned off. When it's mitigated, should line out the HM mark and record new date and Crew</p>



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

Search & Rescue Assessment Marking System

Standard SAR assessment marking is designed to perform two functions:

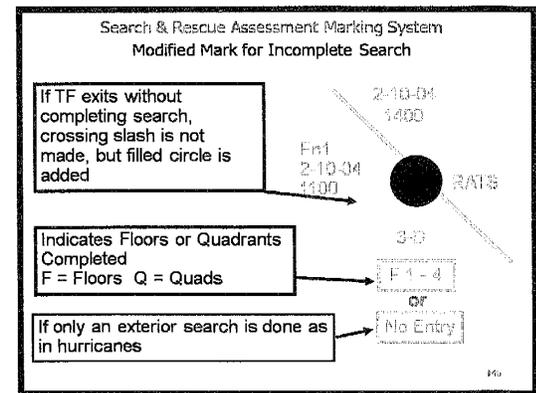
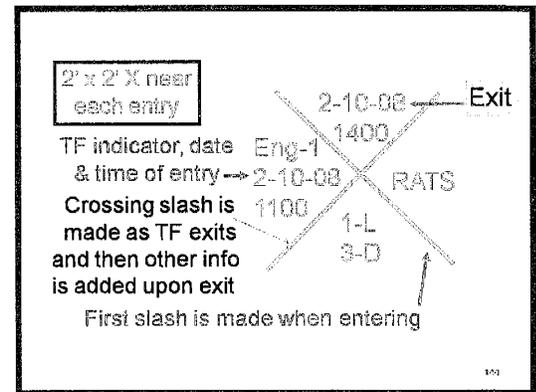
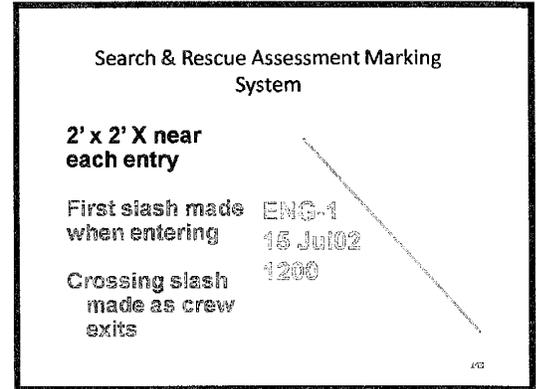
- First, when SAR personnel enter the building or parts of the building, the initial diagonal line is drawn so that others will be informed of on going operations.
- When operations are completed in the building (or parts of the building) the crossing diagonal line will be drawn and information added to indicate by whom and what was accomplished.
- The finished mark can then indicate to other SAR forces the outcome of previous operations.

Incomplete Search Assessment Marking

- This new system is to provide a method to indicate that a search was not completed. The team may have entered the structure and only search a portion of the structure for whatever reason.
- The extent of the search should be determined by the information placed in the new system.

Stick-on Search Assessment Marking

In September 2006, a stick-on search marking system was approved in order to reduce the use of paint in incidents when many structures are involved. These are to reduce the damage (of the paint) to non-totally damaged structures.



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Victim Marking System

This series of markings is used to indicate the location of each victim discovered on the incident site:

- The marks are made with orange spray paint or crayon.
- Marks will normally be initiated after a search is preformed unless the victim is immediately removed.
- The **V** is intended to be about 2 feet high and located as near to the victim as practicable.
- It could be painted on a nearby wall surface or directly on a piece or rubble.
- As arrow may be added to indicate the exact victim location.
- The Search Team indicator should be included as shown.
- The circle is added when the victim is **confirmed**.
 - As an example, the **V** could be placed when only one K9 has indicated that a victim has been located. The circle could be added when the initial **find** is **confirmed** by another K9 or some other search tool.
 - However, when K9's are working in pairs, no mark should be made after the first dog indicates a victim because it may influence the second dog.
- A horizontal line is added if the victim is **confirmed to be dead**.
- An **X** is drawn completely through the circle after the victim has been removed.

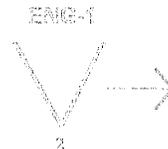
Victim Marking System

Potential Victims

Mark can be painted on a nearby wall or directly on a piece of rubble

Arrow may be added to indicate the exact victim location

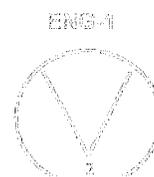
Number of victims under V



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Victim Marking System

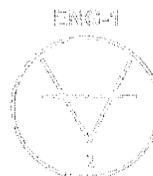
- Confirmed Live Victim
- Circle is added when the victim is confirmed



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Victim Marking System

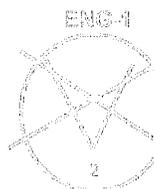
- Confirmed Dead Victims
- Horizontal line is added if the victim is confirmed to be dead.



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Victim Marking System

- Large "X" is drawn completely thru the circle after the victim has been removed



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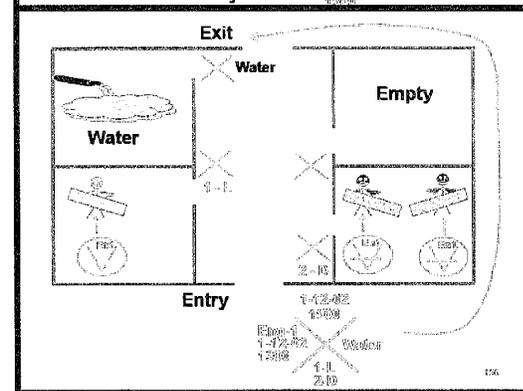
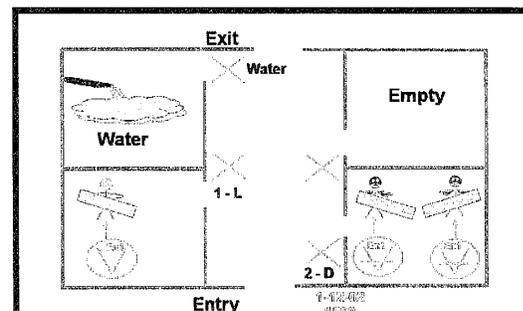
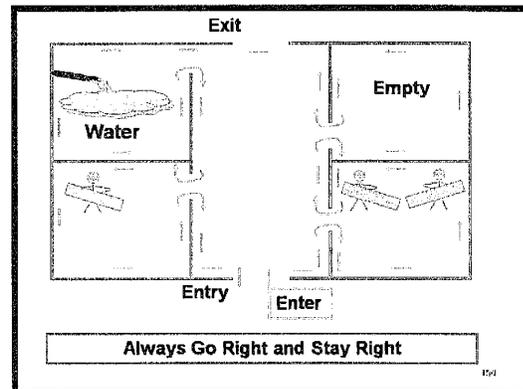
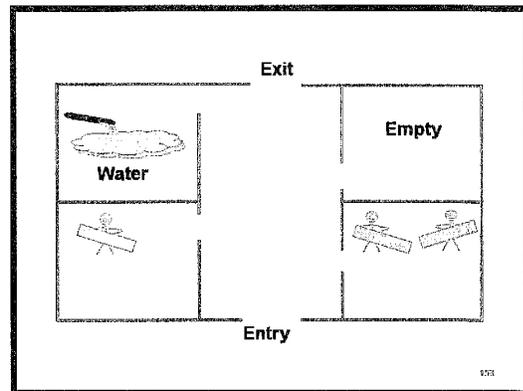
INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Search Assessment & Victim Location Marking

- An example that illustrates the use of the Search Assessment & Victim Locating Marking system is illustrated as follows.
- The basic information is as follows:
 - There is a front entry and rear entry/exit.
 - There are four enclosed rooms in the building.
 - Room 1 has four deceased victims.
 - Room 2 is empty except for normal contents.
 - Room 3 has a broken water pipe and is flooded.
 - Room 4 has one live victim.
- Enter the building, mark first slash, unit ID, date and time.
- When entering rooms make first slash and then second slash when exiting each room and record findings.
- Once search is complete, draw second slash on exterior search marking, complete all data and prepare to go to the next building.



INSTRUCTOR MANUAL

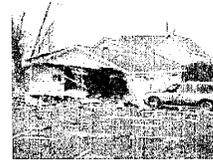
TECHNICAL RESCUE AWARENESS

STRUCTURAL COLLAPSE

Initial Company Operations

- Establish Strong Visible Command
- Identify the need for Technical Rescue
- Conduct Rapid Size –up
 - Size of structure
 - Occupancy type
 - Structure type
 - Collapse mechanism
 - Weather
 - Exposures
 - Time of Day
 - Location of victims
- Recognize and Mitigate existing hazards
 - Gas
 - Electric
 - Water
 - Haz-mat
- Establish Scene Control
 - Isolate bystanders, family, personnel
 - Banner Tape, cones, Police
 - Set up Collapse Zones
- One of the final tasks is a complete survey of all SIX sides. During the recon stage, personnel are noting possible entry points and verify any contact with any viable victims. This stage is the most hazardous to first in companies, mainly due to the overwhelming urge to assist victims in need. The most important factor that one must remember is that Structures are unstable or unsupported and that secondary collapse is a high concern.

Structural Collapse Scenario



- Early morning tornado goes through local neighborhood.
- Neighbors report not seeing the people who live in this residence.
- Address Initial Company Operations

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS STRUCTURAL COLLAPSE

Structural Collapse Summary

- Size-up of existing and potential conditions at structural collapse incidents.
- Identification of the resources necessary to conduct safe and effective structural collapse search and rescue operations.
- Development and implementation of procedures for carrying out the emergency response system.
- Development and implementation of procedures for carrying out site control and scene management.
- Recognition of general hazards associated with structural collapse incidents including the recognition of applicable construction types and categories and the expected behaviors of components of materials in a structural collapse. Identification of five types of collapse patterns and potential victim locations.
- Recognition of the potential for secondary collapse.



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

ROPE

Rope Rescue Defined

Rope rescue is the providing of aid to those in danger of injury or death in an environment where the use of rope and related equipment is necessary to perform the rescue safely and successfully.

Types of Rope Rescue

- Rope rescue can be divided into two categories, high angle rescue (OVER 60° elevation) and slope evacuation.
- High angle rescue, also known as Vertical rescue, is defined as a rescue where the rescuer and/or victim have all their weight supported by rope.
- Slope evacuation, also called low angle evacuations, are rescue's where the weight of the rescuers is on the ground and the victims weight is on the litter tenders or rescuers.

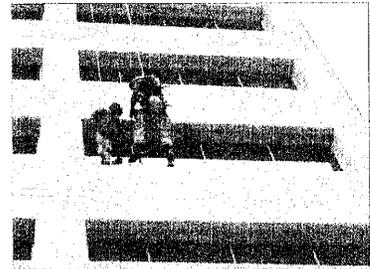
Uses for Rope Rescue

Rope rescue can come in to play with a wide variety of rescues. Rope rescue is the basic foundation for most disciplines of rescues. Rope rescue is used in:

- High Angle (anything greater than 60°)
- Slope Evacuations
- Confined Space Rescue
- Trench Rescue
- Water Rescue
- Wildland Search and Rescue
- Structural Collapse



ROPE RESCUE



Rope Rescue

- Providing aid to those in danger where the use of rope and related equipment is needed to perform safe rescue.

Types of Rope Rescue

- High angle
 - Vertical rescue
 - Victim and rescuers have all weight supported by rope
- Slope evacuation
 - Low angle
 - Weight of rescuer on ground
 - Victims weight on litter tender or rescuer



Uses for Rope Rescue

- Basic foundation for most rescue disciplines
 - High / Low Angle Rope Rescue
 - Confined Space Rescue
 - Trench Rescue
 - Water Rescue
 - Wildland Search & Rescue
 - Structural Collapse Rescue



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS ROPE

Rope Rescue Standards

- ***NFPA 1983 Fire Service Life Safety Rope and System Components***

This standard is to provide minimum performance requirements and a reasonable degree of safety for new life safety rope and new system components used to support fire service personnel and civilians during rescue, firefighting, and other emergency operations, or during training evolutions.

Necessary Resources

- NFPA 1983 Compliant Equipment
- NFPA 1670 Functional Capability for Conducting Technical Search & Rescue
- NFPA 1006 Minimum Job Performance Requirements for Technical Rescue Operations
- Personnel trained to identify level of functional capability.

Obtaining Resources

- Mutual Aid Agreements
- Agreements with Private Sector
- Memorandum of Agreement (MOA)
 - Public
 - County
 - State
 - National



Rope Rescue Standards

- NFPA 1983
 - Fire Service Life Safety Rope and System Components
 - Performance standard for rope & hardware
 - Life Safety Rope 15:1 Safety Factor
 - Third Party Testing for Equipment
 - Inspection and Maintenance Requirements

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Necessary Resources

- NFPA 1983 compliant equipment
- NFPA 1670/1006 compliant policies and procedures
- Personnel trained to identified level of functional capability

6

Obtaining Resources

- Mutual Aid Agreements
- Agreements with Private Sector
- Memorandums of Agreement (MOA)
 - Public
 - County
 - State
 - National

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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

ROPE

Hazards

- Rope rescue operations are often required in areas where elevation differentials exist.
- The possibility of someone falling, or something falling on someone, should always be considered and mitigated.
- The “general area” around a rope rescue scene is the area within 300’ft. (Or more, as established by command).
- Making the area safe includes, but not limited to:
 - Controlling/ limiting traffic and sources of vibration in the area.
 - Controlling/limiting access to the area by unnecessary personnel.
- Identifying hazards and removing and / or reducing their impact.
- There are numerous hazards associated with rope rescue operations.
- All members operating at a rope rescue operations must know the hazards and how to avoid them.
- The most common hazard at a rope rescue operation is falling.
- Most rope rescue operations involve elevations, and with elevation, whether it is a roof, a water tower, or anything in between, there is always a chance of falling. Any responder with a chance of falling must, per AHJ policy, be secured.

Recognize Hazards

- Rope rescue operations are often required in areas where elevation differentials exist. The possibility of someone falling, or something falling on someone, should always be considered and mitigated.



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

ROPE

Other hazards associated with rope rescue include:

- Trip hazards
- Uneven or wet ground
- Entanglement or pinching hazards (i.e. hands caught in rope equipment)
- Falling objects (i.e. equipment, rocks, building components)
- Utilities
- Atmospheric hazards
- Weather
- Untrained responders (misuse and abuse of equipment)
- Hostile by-standers/victims
- Hazards specific to the location of the rescue.
- In all disciplines of “technical rescue”, if you count the numbers of deaths or serious injuries that occurred after “rescuers arrived on scene”, there are many more rescuers hurt or killed than victims.

Making the area safe

- Controlling / limiting traffic and sources of vibration in the area.
- Controlling / limiting access to the area by unnecessary personnel.
- Identifying hazards and removing and / or reducing their impact.
- It is the responsibility of the AHJ to pre-plan your response area to identify the location and hazards of potential rope rescue incidents and prepare for them through training and response procedures/guidelines.



Hazards (con't)

- Falls / elevation
- Trip hazards
- Uneven, wet ground
- Entanglement, pinching hazards
 - Hands caught
- Falling objects
- Utilities
- Weather / atmospheric hazards
- Untrained responders
- Hostile by-standers / victims
- Location



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Hazards (con't)

- Making the area safe includes, but not limited to:
 - Controlling / limiting traffic and sources of vibration in the area.
 - Controlling / limiting access to the area by unnecessary personnel.
 - Identifying hazards and removing and / or reducing their impact.

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General safety considerations

- Pre-plan
 - Potential rope rescue locations
 - Identify hazards
 - Falls
 - Overhead obstructions
- Prepare for incident
 - Training
 - SOG's / SOP's

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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

ROPE

Personal Protective Equipment

- Harness – ANSI approved
- Gloves appropriate for rope rescue work
- Helmets – ANSI approved
- Eye Protection – ANSI approved

System Implementation

- Know and understand the procedures for implementing the emergency response system.
- Know who to call and how to activate them.
- Operation / Technician Level – fire companies with specialized equipment, technical rescue, and heavy rescue teams.
- Local – County Emergency Management, trained volunteers
- State – Resources include specialized teams, equipment, task forces, and the National Guard.
- National- Includes FEMA Task Forces, the military, and many other supporting agencies. (There are 28 FEMA Task Forces.)

Scene Management

- Implement site control and scene management.
- Includes achieving and maintaining control and security of the site and perimeter.
- Includes management of ALL civilian and non-emergency personnel.
- Establishment of operational zones.
 - HOT
 - WARM
 - COLD (300' perimeter)

Personal Protective Equipment

- ANSI approved Harness
- Gloves appropriate for rope rescue work.
- ANSI approved Helmet
- ANSI approved Eye Protection

12

System Implementation

- Know and understand the procedures for implementing the emergency response system.
- Know who to call and how to activate
 - Operation / Technician Level
 - Local
 - State
 - National

13

Scene Management

- Implement site control and scene management.
 - Includes achieving and maintaining control and security of the site and perimeter.
 - Includes management of ALL civilian and non-emergency personnel.
 - Establishment of operational zones.
 - (Hot, Warm, Cold) 300' perimeter

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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

ROPE

Size -up

- It has been said that the first 5 minutes of an operation determine the next 5 hours.
- That can never be overstated in rope rescue.
- First-due companies operating at the awareness level, are not considered “rescuers”, they have many very important tasks to complete to ensure the overall success of the operation.
- These duties include:
 - Your size-up should be continuous.
 - Size-up should start with pre-incident planning.
 - Size-up then continues with information received with the initial alarm and information given enroute.
 - Once on the scene, the size-up should remain continuous as conditions change.
 - Size-up should include, but not limited to, the initial findings on the scene including the following:

1. Scope, magnitude, and nature of the incident.
2. Location of the incident.
3. Risk versus benefit analysis (rescue versus recovery)
4. Access to the scene
5. Environmental factors
6. Available / necessary resources.
7. Ability to contact victim (can this be performed without endangering rescuers or victims)

Size-up

- Scope, magnitude, nature of incident
- Location of incident
- Risk vs. benefit analysis
 - Rescue or recovery?
- Access to the scene
- Environmental factors
- Available / needed resources
- Ability to contact victim
 - Without endangering rescuers or victims





INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

ROPE

Secure the general scene around the incident.

1. This area will include an area within 300 ft. (or more, per incident command)
2. Make the area safe for rescuers
 - Control / limit traffic
 - Control / limit access to area by unnecessary personnel.
 - Identify the hazards and remove or reduce their impact.

Notify a qualified rescue team to perform the rescue. These teams should be identified by AHJ or department SOP / SOG.

Size -up (con't)

- Secure the general area
 - 300' area or more
- Make area safe for rescuers
 - Control / limit traffic
 - Control / limit access
 - Identify all hazards
 - Reduce or remove them
- Notify qualified rescue team per SOG's / SOP's

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS ROPE

Student Activity 1 Low Angle Incident

Activity Information

Time of Day: 4:00 pm

Sunset: 7:00 pm

Weather conditions: Clear, 68 F, wind @ 10mph.

Weather forecast: Rain during the night starting at 8:00pm, 38 degrees for a low tem.

Responding to a down person in a rural area.

While enroute you are advised that a cyclist had traveled down a steep decline. Upon your arrival you find a person at the bottom of a steep decline (50 degrees). The person is lying approximately 90 to 100 feet from the road at the bottom of the 50 degree decline. You are unable to establish verbal communications with the victim. The decline is grown over with brush and tall grass. There are several large rocks in the area that the victim traveled.

Response:

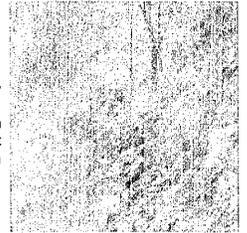
1 transporting BLS ambulance with 2 EMT.

1 Engine company with 3 firefighters trained to first responder level.



Rope Activity 1

- Low Angle Incident
- Activity Information
- Time of Day: 4:00 pm
- Sunset: 7:00 pm
- Weather conditions: Clear, 68 F, wind @ 10mph.
- Weather forecast: Rain during the night starting at 8:00pm, 38 degrees for a low tem.



Rope Activity 1

- Responding to a down person in a rural area.
- While enroute you are advised that a cyclist had traveled down a steep decline. Upon your arrival you find a person at the bottom of a steep decline (50 degrees). The person is lying approximately 90 to 100 feet from the road at the bottom of the 50 degree decline. You are unable to establish verbal communications with the victim. The decline is grown over with brush and tall grass. There are several large rocks in the area that the victim traveled.
- Response:
- 1 transporting BLS ambulance with 2 EMT.
- 1 Engine company with 3 firefighters trained to first responder level.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS ROPE

Student Activity 2

High Angle

Activity Information

Time of Day: 10:00 am

Weather conditions: Clear, 73 F, wind @ 10mph.

Weather forecast: No change for the next 24 hours

Response to a worker injured at water tower.

XYZ Construction Company has been hired to complete repair work on the town water tower. The tower is 150ft tall. The construction worker was completing repair work on a support strut at the 120ft level.

While enroute you are advised that a construction worker has become injured when his rigging system failed, allowing him to fall 40ft before the rigging system jammed. The injured construction worker is conscious and complaining of back injuries. The tower is located in a field with a gravel drive that is 12ft wide. The ground and drive are soft due to heavy rains within the past 24 hours.

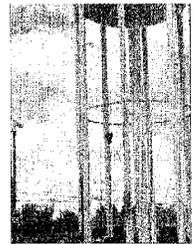
Response:

- 1 Transporting BLS ambulance with 2 EMT.
- 2 Engine Company with 3 firefighters trained to first responder level.



Rope Activity 2

- Activity Information:
- Time of Day: 10:00 am
- Weather conditions: Clear, 73 F, wind @ 10mph.
- Weather forecast:
- No change for the next 24 hours



Rope Activity 2

- Response to a worker injured at water tower.
- XYZ Construction Company has been hired to complete repair work on the town water tower. The tower is 150ft tall. The construction worker was completing repair work on a support strut at the 120ft level.

Rope Activity 2

- While enroute you are advised that a construction worker has become injured when his rigging system failed, allowing him to fall 40ft before the rigging system jammed. The injured construction worker is conscious and complaining of back injuries. The tower is located in a field with a gravel drive that is 12ft wide. The ground and drive are soft due to heavy rains within the past 24 hours.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS ROPE

Rope Rescue Summary

- Recognize the need for rope rescue.
- Identify resources necessary to conduct rope rescue operations.
- Identify how the emergency response system is activated when rope rescue is required.
- Identify how to conduct site control and scene management.
- Recognize general hazards associated with rope rescue.
- Identify personal protective equipment used for rope rescue incidents.

Rope Rescue Summary

- Recognize the need for rope rescue.
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- Identify how the emergency response system is activated when rope rescue is required.
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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS CONFINED SPACE

Confined Space: Rescue

Awareness-level functions:

- Perform non-entry retrieval.
- Implement the emergency response system for confined space emergencies.
- Implement site control and scene management.

The Confined Space Law

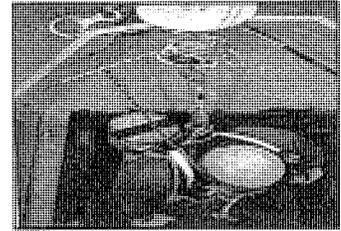
The permit required confined space law was promulgated on January 1, 1993 and took effect on April 15, 1993. This law was enacted after many years of discussion and comments being relayed to OSHA. The law is Title 29 Code of Federal Regulations number 1910.146, or 29CFR1910.146.

In addition to identifying many workplace and rescue issues, it essentially identifies two basic types of confined spaces, based on their types of hazards. The first, is commonly called a “confined space”, or as the law refers to it as a “non-permit” confined space. This identifies the ingredients required to call any space something that is confining, however not necessarily dangerous to health or life by itself. The law indicates that a “confined space” means a space that:

- 1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- 2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and
- 3) Is not designed for continuous employee occupancy.



Confined Space Rescue



1

Awareness Level

- Awareness-level functions:
 - Perform a non-entry retrieval.
 - Implement the emergency response system for confined space emergencies.
 - Implement site control and scene management.

2

Confined Spaces

- OSHA law
 - 29CFR 1910.146
- IDOL
 - Adopted OSHA law
- Law identifies two types of spaces
 - Permit
 - Non-Permit



3

Confined Spaces

- Non-permit
 - Large enough and so configured to bodily enter
 - Limited or restricted means of entry and exit
 - Not designed for continuous human occupancy

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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

CONFINED SPACE

Note that the definition requires that the space meet ALL of the above conditions. It cannot be a confined space if it only has one or two of the characteristics.

The next definition shows that the confined space defined above is more dangerous to the entrant. The law says: Permit-required confined space (permit space) means a confined space that has one or more of the following characteristics:

- 1) Contains or has the potential to contain a hazardous atmosphere;
- 2) Contains a material that has the potential for engulfing the entrant;
- 3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- 4) Contains any other recognized serious safety or health hazard.

Regulations do *not* cover spaces that are *too small for complete bodily entry*:

- Regulations only address confined spaces that are large enough for the entire body of an employee to enter.
- Entry is considered to have occurred when any part of the entrant's body breaks the plane of the entry portal.



Confined Spaces

- Permit required confined space
 - A confined space that contains one of the following:
 - Contains or has the potential to contain hazardous atmosphere (IDLH)
 - Contains a substance that could engulf the entrant
 - Contains inwardly converging walls/floors that could trap the entrant causing asphyxiation
 - Other recognized serious health or safety hazard

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Basic Characteristics of Confined Spaces

- Regulations do *not* cover spaces that are *too small for complete bodily entry*:
 - Regulations only address confined spaces that are large enough for the entire body of an employee to enter.
 - Entry is considered to have occurred when any part of the entrant's body breaks the plane of the entry portal.

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS CONFINED SPACE

OSHA Statistics

The Occupational Safety and Health Administration (OSHA) has statistics indicating that 30% of the fatalities in confined spaces are would-be rescuers. The term “would-be rescuers” include bystanders or good Samaritans that simply try to jump into the space thinking they will just quickly drag the entrant out. This high mortality rate is the result of these untrained responders not understanding the hazards involving confined spaces. Up to 90% of these fatalities are results of atmospheric hazards per industry statistics.

Reasons to Enter Confined Spaces

- Inspections / maintenance
- Rescue
- Training

Generally employees who work in process vessels:

- Must squeeze in and out through narrow openings to enter and exit the space.
- Perform work in the space while cramped or contorted.
- May be exposed to hazardous substances / atmospheres.
- May be exposed to the moving parts of a mixer

Majority of confined space rescue incidents:

- Involve unconscious victims.
- Usually require complex rescue operations.

Confined Spaces

- OSHA statistics
 - Confined space deaths
 - 30% of deaths are would-be rescuers
 - Up to 90% of deaths are due to atmospheric problems
- Reasons to enter confined spaces
 - Inspections / maintenance
 - Rescue
 - Training

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Basic Characteristics of Confined Spaces

- Majority of confined space rescue incidents:
 - Involve unconscious victims.
 - Usually require complex rescue operations.

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS CONFINED SPACE

"Not designed for continuous human occupancy" focuses on the *design of the space* rather than its primary function. It is the criterion as to whether a human can occupy a space under normal operating conditions.

All permit spaces must have danger signs, or other effective means, to designate confined spaces in the workplace.....1910.146(c)(2):

If an employer decides that its employees will enter permit spaces....1910.146 (c)(4):

- They must develop and implement a written permit space program in compliance with 1910.146 regulations.
- They must make available for inspection by employees / authorized representatives a written permit space program.

OSHA's permit-required confined space program (permit-space program) requirements:

Employers whose employees enter a permit space are required to have a *written permit-required confined space program*.

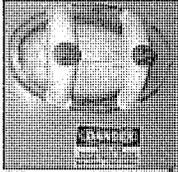
Purpose of a *written permit space program*:

- Systematic approach to permit space operations.
- Prevent mistakes / misunderstandings of confined space operations and risks.
- Regulate employee entrance into permit spaces.
- Protection reference for employees.
- Direct / guide personnel.



Basic Characteristics of Confined Spaces

- *All permit spaces must have danger signs, or other effective means, to designate confined spaces in the workplace.....1910.146(c)(2):*

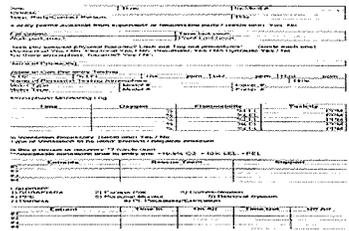


Basic Characteristics of Confined Spaces

- OSHA's permit-required confined space program (permit-space program) requirements:
 - Employers whose employees enter a permit space are required to have a *written permit-required confined space program*.
- Purpose of a *written permit space program*:
 - Systematic approach to permit space operations.
 - Prevent mistakes / misunderstandings of confined space operations and risks.
 - Regulate employee entrance into permit spaces.
 - Protection reference for employees.
 - Direct / guide personnel.

10

**Sample Permit
OSHA 1910.146**



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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS CONFINED SPACE

Designated positions for a confined space operation:

Authorized Entrant

- Means an employee who is authorized by the employer to enter a permit space.

Attendant

- Means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

Entry Supervisor

- Means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations and for terminating entry as required.

An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.



Designated Positions for Confined Space Operations

- Authorized Entrant
 - Means an employee who is authorized by the employer to enter a permit space.
- Attendant
 - Means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

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Designated Positions for Confined Space Operations

- Entry Supervisor
 - Means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations and for terminating entry as required.

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Designated Positions for Confined Space Operations

- An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS CONFINED SPACE

Examples of Types of Confined Spaces

"Many workplaces contain spaces which are considered 'confined' because their configurations hinder the activities of employees who must enter, work in, and exit from them" (ref. CFR 1910.146 Federal Register, Thursday, January 14, 1993)

Examples of types of confined spaces

- Silos - Industrial or Agricultural
- Manholes - Sanitary or Storm
- Rail Cars Liquid Tank or Dry Bulk
- Industrial Storage Tanks

- Other confined space examples:

Utility vaults	Vats
Wells	Tank cars
Tunnels	Tubs
Silos	Sewers
Septic tanks	Ship holds
Scrubbers	Vessels
Pumping stations	Pipelines
Storage tanks	Incinerators
Furnaces	Grain storage facilities
Cookers	Compartments
Caves	Crawl spaces
Boilers	Bins

Confined Space Atmospheric Hazards

OSHA's analysis of *hazardous atmospheres* related to confined space deaths and injuries:

Basic categories:

- Asphyxiating
- Flammable and explosive
- Toxic

Examples of Types of Confined Spaces			
Utility vaults	Vats	Wells	Tank cars
Tunnels	Tubs	Silos	Sewers
Septic tanks	Ship holds	Scrubbers	Vessels
Pumping stations	Pipelines	Storage tanks	
Incinerators	Grain storage facilities	Furnaces	
Cookers spaces	Compartments	Caves	Crawl
Boilers	Bins		

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Confined Space Atmospheric Hazards
<p>• OSHA's analysis of hazardous atmospheres related to confined space deaths and injuries:</p> <p style="margin-left: 20px;">Basic categories:</p> <ul style="list-style-type: none"> Asphyxiating Flammable and explosive Toxic <p>Consequence of OSHA findings - final ruling - 1910.146 requirement related to hazardous atmospheres and testing:</p> <p>Employers must test and monitor entry spaces with instruments which will detect <i>all</i> aspects of hazardous atmospheres that may be encountered in the confined spaces.</p>

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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

CONFINED SPACE

When testing for Atmospheric Hazards test in the following order:

- Oxygen deficiency
- Flammable gases / vapors
- Toxic gases / vapors

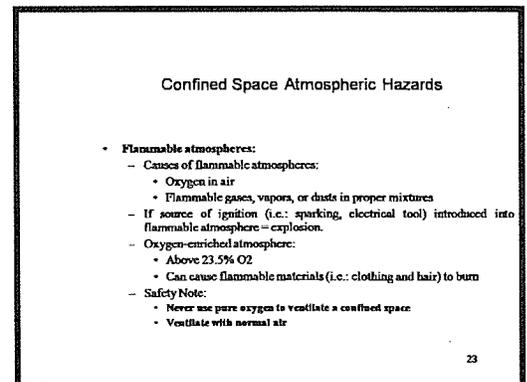
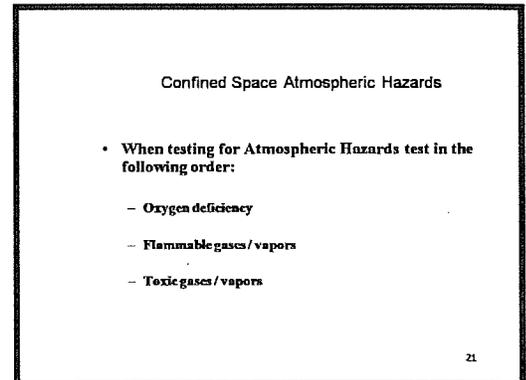
Oxygen-deficiency atmospheres:

OSHA term: "asphyxiating atmosphere"

Contains less than 19.5 % oxygen, which is inadequate for entrant's respiratory needs when performing physical work even if the space contains no toxic materials.

Flammable atmospheres:

- Causes of flammable atmospheres:
 - Oxygen in air
 - Flammable gases, vapors, or dusts in proper mixtures (**in a confined space, a flammable gas may not be in excess of 10% of its lower flammable limit or LFL**)
- If source of ignition (i.e.: sparking, electrical tool) introduced into flammable atmosphere = explosion.
- Oxygen-enriched atmosphere:
 - Above 23.5% O₂
 - Can cause flammable materials (i.e.: clothing and hair) to burn
- Safety Note:
 - Never use pure oxygen to ventilate a confined space
 - Ventilate with normal air



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS CONFINED SPACE

Sources of toxic hazardous substances that can be found in confined spaces:

Liquids	Gases
Vapors	Mists
Solids	Dusts

Safety notes:

- Every possible atmospheric hazard, which may be encountered in a confined space, cannot be listed.
- Your safety depends on your knowledge and application of proper rescue procedures prior to responding to a confined space emergency.
- Atmospheric testing and monitoring, as well as preplanning of rescue procedures, is a critical aspects of your safety.
- Rescuers should approach all confined spaces as having oxygen-deficiency, flammable, and toxic atmospheres until determined otherwise!

Dome / Bridge Hazards:



Confined Space Atmospheric Hazards

- Sources of toxic hazardous substances that can be found in confined spaces:
 - Liquids
 - Vapors
 - Gases
 - Mists
 - Solids
 - Dusts

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Confined Space Atmospheric Hazards

- Safety notes:
 - Your safety depends on your knowledge and application of proper rescue procedures prior to responding to a confined space emergency.
 - Atmospheric testing and monitoring, as well as preplanning of rescue procedures, is a critical aspects of your safety.

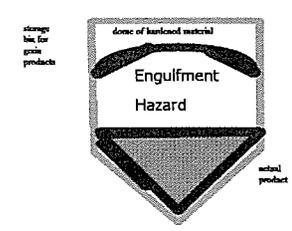
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Confined Space Atmospheric Hazards

- Safety notes:
 - Rescuers should approach all confined spaces as having oxygen-deficiency, flammable, and toxic atmospheres until determined otherwise!

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Illustrations of dome / bridge hazards:



The diagram shows a cross-section of a dome-shaped structure. On the left, a vertical stack of items is labeled "storage bin for grain products". On the right, a vertical stack of items is labeled "solid product". The top of the dome is labeled "dome of hardwood material". The central area of the dome is labeled "Engulfment Hazard".

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS CONFINED SPACE

Illustration of engulfment in unstable bridged material

Grain Bin Rescue
Over 60 deaths per year nationwide
Non-entry rescue (cutting sidewalls)

Example of engulfment in substance attached to walls of space

Other Hazards:

- **Extreme temperatures** (i.e. confined space that has been just steam cleaned).
- **Slippery surfaces or drop-offs** (i.e.: can result in slips and falls; wet surface increases the likelihood of electric shock in areas where electrical circuits, equipment, and tools are used water is present).
- **Scaffoldings** (i.e.: collapse of the support system).
- **Falling objects** (i.e.: particularly in spaces which have topside openings for entry and/or work being done above rescuer).
- **Drowning** (i.e.: submersion in liquid / solid in the confined space).
- **Burns** (i.e.: contact with hot materials [steam], scalds from liquids, electrical lines).
- **Crushing** (i.e.: entrapment by compressing substances - soil, grain)
- **Impalement** (i.e.: stabbing by a sharp object).

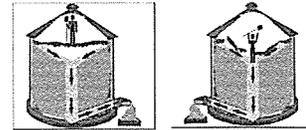
Psychological hazards:

- Most challenging aspect of confined space rescue = psychological stress generated by many potential hazards.



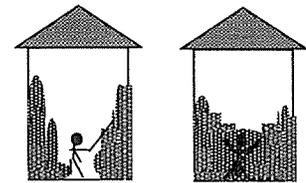
Illustration of engulfment in unstable bridged material

Grain Bin Rescue
Over 60 deaths per year nationwide
Non-entry rescue (cutting sidewalls)



20

Example of engulfment in substance attached to walls of space



20

Other Hazards

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Psychological Hazards

- Most challenging aspect of confined space rescue is psychological stress generated by many potential hazards.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS CONFINED SPACE

Mechanical Hazards:

- Electrical, augers, backhoes, welding equipment
- Difficulty with isolation - the process where the space is removed from service by
- Lock out/Tag out procedures, a method for keeping equipment from being set in motion
- Removing belt and chain drives, mechanical linkages when possible
- A computer from a remote location can turn on equipment or release a product
- Blanking and bleeding - pneumatic and hydraulic lines
- Securing - mechanical moving parts within a confined space with chains, bars, chocks, blocks and other devices

Lock-Out/Tag-Out Kit:

- Padlocks
- Hasps & tags
- Plug & valve covers
- Chain
- Electrical Tester

When lock-out procedures can not be accomplished, firefighters or law enforcement officers should be placed at the isolation point with strict orders not to allow anyone access or to reapply power to the area.



Mechanical Hazards

- Electrical, augers, backhoes, welding equipment
- Difficulty with isolation - the process where the space is removed from service by
- Lock out and Tag out procedures- preferably at disconnect switches remote from the equipment

Mechanical Hazards (cont)

- Removing belt and chain drives, mechanical linkages when possible
- A computer from a remote location can turn on equipment or release a product
- Blanking and bleeding - pneumatic and hydraulic lines
- Securing - mechanical moving parts within a confined space with chains, bars, chocks, blocks and other devices
- Double block and bleed

Lock-Out/Tag-Out Kit

- Padlocks
- Hasps & tags
- Plug & valve covers
- Chain
- Electrical Tester

When Lock-Out is not possible

Position firefighter or law enforcement officer at the isolation point with strict orders "not to allow anyone access or to reapply power to the area".



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

CONFINED SPACE

Size-up

The initial duties of the first due fire or rescue service companies are numerous. These first in companies must realize that there are many things that need to be accomplished or at least verified as completed prior to anyone entering a confined space.

Size-up is obviously the first task that needs to be performed. A good initial size-up will help ensure that all responding rescue personnel have an understanding of the conditions that were found early in the incident. This will also help to ensure that the incident command structure is put into place and that adequate resources are being assigned to the incident. During size-up, access to the space and number of victims should be determined. In addition, contact with the patient should be attempted if it can be done safely.

Securing the scene early in the incident will ensure that the general area is safe, not only for bystanders, but also for subsequent responding rescue units and personnel. The general area should be made safe by ensuring the control of traffic, whether vehicular or pedestrian. All unnecessary persons must be kept away from the area. This may include industrial workers who are trying to help their co-worker. Unless they are trained rescuers, knowledgeable in the space and have rescue capability, they should remain in an advisory capacity. Remember that these workers have the victim's best interest in mind, and as such, can be a very valuable asset to the rescue. They must be made aware of their role in the rescue, such as providing better access to the area or the space, and determining the proper isolation points for numerous electrical or mechanical hazards. This is considered Lockout/Tagout per 29 CFR 1910.147. There may be the need to shut down all sources of vibration or excessive noise in the area in order to complete the rescue effectively. These co-workers will help ensure this can happen.



Size-up

- Determine need for Technical Rescue
- Determine best access to space
- Make contact with victims if safe to do so
- Attempt to determine # of victims
- Interview attendants / acquire copy of permit
- Secure area around space
 - Control / limit traffic & sources of vibration
 - Shut down vehicles and equipment
 - Control / limit access to general area by unnecessary personnel



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

CONFINED SPACE

The attendant at the scene will be one of the most valuable sources of information as to what happened in the space. In addition, anyone who may have been in the space recently should be located to help with gathering information. This may not be feasible if the space is a utility vault or other such area, which workers access regularly without assistance.

While information is being gathered, the first responding unit(s) must ensure that a qualified rescue team is being notified to respond for assistance. This team must be identified by the AHJ prior to the incident, to ensure a quick response without any confusion.

Qualified rescue teams need to be notified. The AHJ or department SOP/SOG should identify these teams.

Don't get pushed into someone else's emergency. The law requires the owner of the permit required confined space to provide for a rescue team prior to any entry. This does not mean that we by virtue of being the Fire Department are obligated to provide this service. The owner of the space, if he wants to utilize the Fire Department instead of his rescue team, must have an agreement with that Fire Department, that they will provide this specialized service.

In addition, while information is being gathered, initial rescue actions that may be completed by awareness level units should be:

- Monitoring, to determine any potential atmospheric problems this would include oxygen levels, combustibility, and any potential toxins. Someone trained and qualified to complete the air-monitoring task should complete monitoring.
- Ventilation of the space, ensuring contaminants is not being moved to an area that could become a problem. This would include providing warm or cool air to the victims if necessary.
- Non-entry rescue if a pre-rigged device is available and the victim may be moved out without additional injury,



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

CONFINED SPACE

awareness personnel should attempt to use the device **IF** they are knowledgeable in its operation and can do so without entering the space.

Although the reasons for a confined space rescue are numerous, rescue personnel must gain information as to the types of spaces, and the type of work that was being performed prior to any rescue team attempting to enter the space. It should be assumed that if a space was deemed to be simply a confined space, the rescue team must reclassify it to a permit-required confined space if the rescue service has been called there to perform a rescue.

Confined Space Activity 1

Manhole Incident

Activity Information

Time of day 11:00 am

Weather conditions: Cloudy, 86 F, winds are clam

Weather forecast: 80% chance of heavy rain

Responding to an injured person in a manhole.

Acme construction has been contracted to inspect the storm sewers within the town. The crew is working in a manhole in the middle of Main Street. The manhole is 10 ft deep and 32”in diameter. While a construction worker was climbing down the ladder rung broke causing the worker to fall to the bottom of the manhole. The worker is conscious, complaining of pain in both legs and lower back.

Confined Space Activity 1

- Manhole Incident
- Activity Information
- Time of day 11:00 am
- Weather conditions: Cloudy, 86 F, winds are calm
- Weather forecast: 80% chance of heavy rain

Confined Space Activity 1

- Responding to a injured person in a manhole.
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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

CONFINED SPACE

Response:

1 transporting BLS ambulance with 2 EMT.

1 Engine Company with 3 firefighters trained to first responder level.

- 1) What are the incident conditions upon your arrival?
- 2) What are the hazards?
- 3) What is the victim's condition? Are the injuries life threatening?
- 4) What resources are needed?
- 5) Using information from your own community, where are they coming from, how long will it take for them to arrive?
- 6) What is going to be your course of action?

Confined Space Activity 1

- 1) What are the incident conditions upon your arrival?
- 2) What are the hazards?
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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

CONFINED SPACE

Confined Space Activity 2

Industrial Incident

Activity Information

Time of Day: 2:00 pm

Weather Condition: Clear, 32 degree's F

Weather forecast: clear with a low of 18 degree's

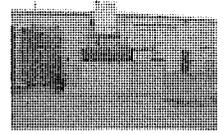
Responding to a trapped person in a storage vessel

An employee of ACME manufacturing has been assign to clean and repair a large storage vessel that maintains small plastic pellets after a small fire at the bottom of the vessel melted a small amount of the pellets. The vessel is 40ft tall and 8ft in diameter. It has an auger system at the bottom that used to remove pellets from the vessel. The employee used a ladder to gain entry into the vessel. While cleaning the vessel the employee became sick and is not able to get out on his own. There is no ventilation going into the vessel. The employee was wearing a dust mask for respirator protection.

Upon your arrival the plant manager who states that they have not been able to communicate with the employee for 20 minutes. They have completed air monitoring with an O2 reading of 19.5%, LEL 0%, and CO with 0%.

Confined Space Activity 2

- Industrial Incident
- Activity Information
- Time of Day: 2:00 pm
- Weather Condition: Clear, 32 degree's F
- Weather forecast: clear with a low of 18 degree's



Confined Space Activity 2

- Responding to trapped person in a storage vessel
- An employee of ACME manufacturing has been assigned to clean and repair a large storage vessel that contains small plastic pellets. Previously, a small fire at the bottom of the vessel melted a small amount of the pellets. The vessel is 12ft tall and 8ft in diameter. It has an auger system at the bottom that is used to remove pellets from the vessel. The employee used a ladder to gain entry into the vessel. While cleaning the vessel the employee became sick and is not able to get out on his own. There is no ventilation going into the vessel. The employee was wearing a dust mask for respirator protection.

Confined Space Activity 2

- Upon your arrival the plant manager states that they have not been able to communicate with the employee for 20 minutes.



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

CONFINED SPACE

Response:

1 transporting BLS ambulance with 2 EMT's.

- 1 Engine Company with 3 firefighters trained to first responder level.

- 1) What are the incident conditions upon your arrival?

- 2) What are the hazards?

- 3) What is the victim's condition? Are the injuries life threatening?

- 4) What resources are needed?

- 5) Using information from your own community, where are they coming from, how long will it take for them to arrive?

- 6) What is going to be your course of action?

Confined Space Summary

- Recognize the need for confined space search and rescue.
- Identify contacting and communicating with victims were possible.
- Recognize and identify the hazards associated with non-entry confined space emergencies.
- Recognize confined spaces.
- Be able to perform non-entry retrieval.
- Identify the emergency response system for confined space emergencies.
- Identify site control and scene management for confined space incidents.

Confined Space Activity 2

- 1) What are the incident conditions upon your arrival?
- 2) What are the hazards?
- 3) What is the victim's condition? Are the injuries life threatening?
- 4) What resources are needed?
- 5) Where are resources coming from in your community? How long will it take for them to arrive?
- 6) What is going to be your course of action?

Confined Space Summary

- Recognize the need for confined space rescue.
- Identify contacting and communicating with victim were possible.
- Identify hazards associated with non-entry confined space rescue.
- Recognize Confined spaces.
- Be able to perform non-entry retrieval.
- Identify the need for lock out/tag out procedures.



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

Water:

Need for water rescue training in the fire service.
At a minimum, all personnel in the fire service should be trained to the *awareness* level in water rescue. Most jurisdictions have some type of body of water (lakes, rivers, ponds, retention ponds, etc.). In addition, most jurisdictions have the potential for flooding. This may include areas near rivers and lakes that flood slowly over a period of time or deadly flash flooding. If there is a water-related emergency, there is usually a request for the local fire department to respond.

Many water-related incidents require resources and expertise beyond the normal capability of some fire departments, including divers, technicians, and teams trained to the operations or technician level. Many fire departments lack the necessary personal protective equipment and technical rescue equipment. This list of equipment may include PFD's, ropes, exposure suits, helmets, boats, SCUBA diving equipment, etc. The AHJ should consider the use of mutual aid when they lack the necessary trained personnel and equipment.

NFPA 1670 recognizes four different water related disciplines at the operations and technician level. They are dive, ice, surf, and swift water.

Hazards:

Firefighter (human) nature

Action oriented - Need to do something now
Make rescue attempts without proper training or equipment



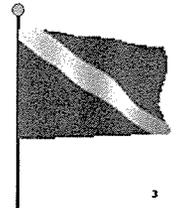
Water Rescue

- Need for water rescue awareness
 - Most FD's have some body of water
 - Potential for flooding
 - Many water incidents require resources beyond capability of FD
 - Operations and technician trained
 - Proper PPE
 - Technical rescue equipment



NFPA 1670

- Water related disciplines
 - Dive
 - Ice
 - Surf
 - Swift water



Hazards Associated with Water Rescue

- Firefighter (human) nature
 - Action oriented
 - Need to do something now
 - Make rescue attempts without proper training or equipment



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WATER

An average of 7 public safety rescuers die each year in water related incidents.

WHY?

Sound judgment, good reasoning, and disciplined plan of action were not followed.

The temptation to enter an uncertain environment was too great.

Lack of training and expertise in water related emergencies.

Environmental hazards.

Environmental hazards can include temperature extremes. Extreme cold causes hypothermia, frostnip, and frostbite. When rescuers are cold, that can affect their ability to think clearly or perform simple motor skills. Cold temperatures can also cause equipment failures, including boat motors, diving regulators, etc. In hot temperatures, rescuers can easily become exhausted, overheated, and dehydrated. Personal protective equipment, designed to keep the wearer from sinking in the water, can also cause overheating on a hot day.

Weather, such as snow, rain, and fog, adds another hazard to the incident. High winds often produce waves large enough to keep rescue teams from operating on or near the water. As soon as rescue team members get wet, they are much more prone to become hypothermic.

Body heat is lost to still water 25 times as fast as to still air of the same temperature.

The aquatic environment can add hazards to the scene. This can include aquatic life, animal life, and insects. Plant life, like seaweed, can reduce or impair visibility. It can also become an entanglement hazard.

The water quality in itself can be a hazard. Heavy sediment or silt can result in zero visibility. Some aquatic environments contain harmful bacterial or viral biohazards.



Hazards Associated with Water Rescue (con't)

- An average of 7 public safety rescuers die each year in water related incidents.
 - **WHY?**
 - Sound judgment, good reasoning, and disciplined plan of action was not followed.
 - The temptation to enter an uncertain environment was too great.
 - Lack of training and expertise in water related emergencies.

5

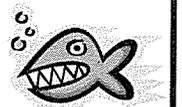
Environmental Hazards

- Extreme temperatures
 - Cold
 - Hypothermia, frostbite, equipment malfunctions
 - » Effects ability to think clearly & fine motor skills
 - Heat
 - Hyperthermia, overheating in PPE
 - Underwater survival time lost in hot temperatures
 - » Exhaustion, dehydration

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Environmental Hazards (con't)

- Weather
 - Rain, snow, high winds, fog
 - Accelerates hypothermia
 - In still water, body heat is lost 25 times greater than in air at the same temperature
- Aquatic environment
 - Animal life, fish, insects
 - Plant life, seaweed
 - Biohazards, bacterial, viral



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

General hazards.

Utilities such as electrical, gas, sanitary, and communications can present a hazard at the water rescue incident. If this is the case, requesting assistance from the responsible utility company, early into the incident, can prove to be very valuable, if not life saving.

Various hazardous materials can be present at water rescue incidents. Operating in this environment will require the assistance from a qualified hazardous materials team. They should be prepared to advise on the proper personal protective equipment and decontamination procedures/guidelines.

Personal hazards at a water rescue incident can include simple trips and falls on uneven, steep, and slippery terrain, which are typically found at the water's edge. The presence of such hazards often requires the assistance of rope rescue technicians. They can rig systems to assist personnel and equipment up and down steep, slippery terrain.

Hazards associated with dive operations.

A water rescue incident may require the assistance of trained, qualified SCUBA divers. SCUBA diving can be a decompression sickness, nitrogen narcosis, oxygen toxicity, and embolism. Drowning of a diver may result from panic or anxiety. These conditions may have been the result of the diver getting lost, trapped, or by them losing their air supply. Entrapment in a submerged vehicle is also another danger for divers trying to attempt rescues within them.

Fatigue and exhaustion are common hazards to divers. Their equipment is extremely heavy and difficult to don. Once the diver is in the water, the equipment is no longer heavy. Getting into the water is the difficult part. Assisting a diver by helping them into their suit and equipment and by carrying their equipment to the water's edge will make for a more effective and safer water rescue incident.

Without the proper protective suit, a diver can become hypothermic in a short period of time. The suit, designed to

General hazards

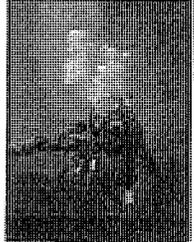
- Utilities
 - Electric, gas, sanitary, communications
- Hazardous materials
- Personal hazards – water's edge
 - Tripping, falling
 - Steep, slippery terrain
 - Drop-offs
 - Holes
 - Hidden obstructions
 - Cause injury, entanglement



8

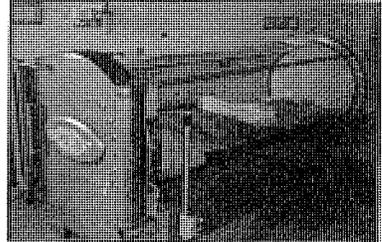
Dive Operation Hazards

- Barotraumas
 - Decompression sickness
 - Nitrogen narcosis
 - Oxygen toxicity
 - Embolism
- Drowning
 - Fatigue
 - Lost diver
 - Loss of air
 - Anxiety reactions



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Dive Operation Hazards



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

keep them warm in the water, can also become a hazard outside of the water. A diver fully dressed in their equipment, outside the water, can easily become heat stressed and dehydrated. A diver will often ask to stage or wait in the water during standby if they are fully dressed in their suit and equipment.

There are certain pre-existing medical conditions that can make SCUBA diving a very hazardous activity. Divers who smoke and/or use medications are at higher risk.

Hazards associated with ice operations.

As it was mentioned earlier, the colder the temperatures, the more likely it is there will be a problem with hypothermia and frostbite. During ice dive operations, there is also the chance for the malfunctioning of diving regulators. Support personnel can help a diver by keeping their regulator dry and warm until it is needed.

Sudden facial contact with cold water can trigger a response called the immersion reflex, this is formerly called the mammalian diving reflex.

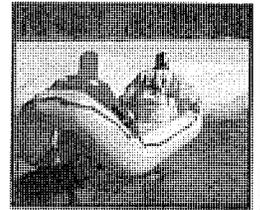
Emotions can run very high when there is a person who has broken through the ice and is now holding on to the ice shelf. This victim cannot last very long in this environment and may slip under the water in a short period of time. Knowing this, many would-be rescuers attempt to execute a rescue without the proper equipment and training, only to become another statistic. Rescuers trained at the operations or technician level should not attempt a “go” rescue without thermal protection, buoyancy, and an attached rope. Anyone attempting this type of rescue with anything less will very likely be taking an ice water bath or find themselves trapped under the ice shelf. Although your fire fighting turn out gear may keep you warm on a cold day, it is not the proper personal protective equipment for a water/ice rescue.

Hazards associated with surf operations.



Ice Operation Hazards

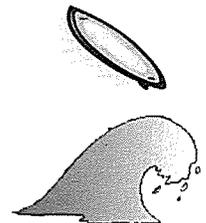
- Cold injuries
 - Frostbite
 - Hypothermia
- Thin ice
 - Sudden immersion reflex
 - Entrapment under ice



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Surf Operation Hazards

- Breaking waves
 - Generate extreme force
- Undertows, tides, current



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

Surf operations do not generally come to mind when discussing water rescue in the state of Indiana. Even though you will not find any ocean water front property in Indiana, you will find large fresh water lakes such as Lake Michigan. Some of the storm related and hydraulic hazards found at ocean beaches can also be found at fresh water lake beaches.

Storms and high winds can produce very large waves and swells. These large waves can capsize a boat and make it very difficult to keep track of people in the water.

As large waves approach the beach and the bottom contour rises quickly, the large waves will break over. This type of large, breaking wave can produce thousands of pounds of force, crushing and destroying anything in its path. Other surf related hazards might include undertows, tidal surges, and currents.

Hazards associated with swift water operations.

The major hazard associated with fast moving inland water is the constant, awesome, relentless power of water. Swift water found in streams, rivers or flooded ravines can sweep people away without mercy and with a force they cannot overcome.

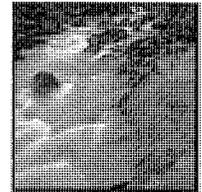
In swift water, the water moves you into objects that are stationary. A type of stationary hazard is the strainer. A strainer is an obstruction in the river that allows the current to pass through it but does not allow the clear passage of larger objects such as people or boats. An example would be a downed tree lying in the river. A person could quickly drown if caught in a strainer.

Rescuers must always be aware of possible weather changes while working in or near a moving body of water. A heavy downpour, from an upstream storm, can transform a placid stream into a killer wall of water. If you ever find yourself swept away in this type of condition, do not try to stand up. Trying to place your feet on the stream bottom can get your feet caught in a hole or trapped in debris. If your feet are



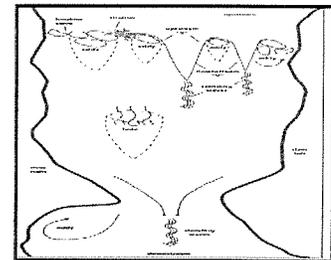
Swift Water Operation Hazards

- Awesome, relentless power of moving water
- Strainers & debris
 - Stationary objects
- Holes
- Obstructions
 - Above the water surface
 - Below the water surface
 - Upstream "V"
 - Downstream "V"



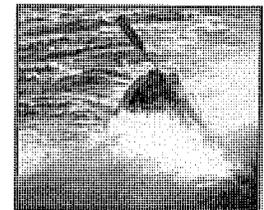
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Swift Water Operation Hazards



Swift Water Operation Hazards (con't)

- Current patterns
 - Laminar flow
 - Helical flow
 - Upwelling
 - Eddies
 - Back current
- Heavy downpours
 - Make quiet streams swiftwater



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

stuck, your upper body will be bent over by the water force and you will quickly drown. Try to float on your back with your feet up and pointed down stream.

If you were driven into a stationary object, it would be better to hit it with your feet instead of your head. Also, it is usually best to not fight the current. Guide yourself towards shore, on an angle, with the current.

During flood conditions, it would be likely to find obstructions in or just under the moving water. A person could be smashed into or held against these objects by the fast moving current. An upstream or downstream V in the water can indicate an obstruction just under the water.

An object in the water can create an eddy effect, but can also create a hole and make the object unstable and floating in the hole created by the fast-moving water.

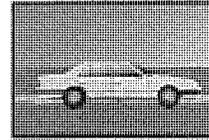
Some other current patterns found in fast moving water can include laminar flow and helical flow. In laminar flow, the water close to the river bottom moves at a slower rate than the water at the surface. This is due to the friction or drag at the bottom. Helical flow is found in steep sloped channels. Water quickly rises from the deep middle to the shallow bank. The twisting action of this current then drives the surface water out to the middle where it then plunges back down to the bottom. An eddy is a type of back current found on the downstream side of a stationary object.

The weight of water is 62.4 lbs per cubic foot and typically flows downstream at 6 to 12 miles per hour. Water in an enormous force, it can pick up house and move them down stream, so what can it do to a motor vehicle.

When a vehicle stalls in the water the water's momentum is transferred to the car. For each foot the water rises, 500lbs of lateral force is applied to the automobile. But the biggest factor is buoyancy. For each foot the water rises up the side of the car, the car displaces 1500lbs. of water. In effect the automobile weighs 1500lbs, less for each foot the water rises.

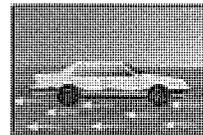


Swift Water Operation Hazards (con't)



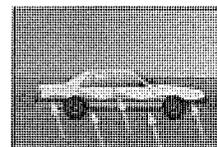
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Swift Water Operation Hazards (con't)



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Swift Water Operation Hazards (con't)



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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WATER

Two feet of water will carry away most automobiles!!!

Hazards associated with low head dams.

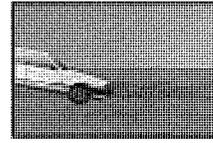
By definition, a low head dam is a uniform barrier across a body of moving water. The dam is usually level or horizontal, with water falling equally along its entire face. The low head dam is also known by another name. It is also called the “Killing/Drowning Machine”.

One of the reasons the low head dam is hazardous, is because it does not look particularly dangerous. Some people treat these dams as aquatic thrill rides. Another problem with the low head dam is the illusion that is perceived from upstream. It is difficult to see the drop in the river, at the dam, when approaching the dam from upstream.

As water flows over the dam and falls vertically, it drives to the bottom and then rises to the surface slightly downstream. At this point, some of the water continues to flow downstream while some of the water flows back upstream towards the dam. This point, where the water breaks into two different directions, is known as the “boil line”. Once you have crossed the “boil line”, you have entered the “Killing/Drowning Machine”. This type of flow on the downstream side of a dam is also known as a vertical whirlpool.



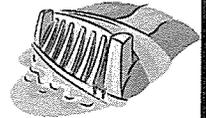
Swift Water Operation Hazards (con't)



**Two Feet of Water
Will Carry Away Most
Automobiles!!!**

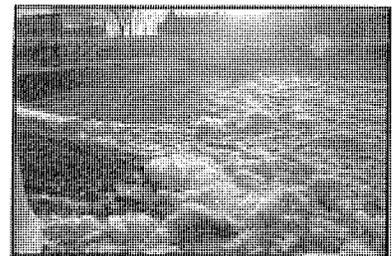
Low Head Dam Hazards

- The killing / drowning machine
 - Boil line
 - Point where water breaks in two directions
 - Illusion
 - Cannot be perceived from upstream
 - Do not look dangerous
 - Hydraulic
 - Vertical whirlpool
 - Aeration in the hydraulic
 - Causes cavitation to boat props

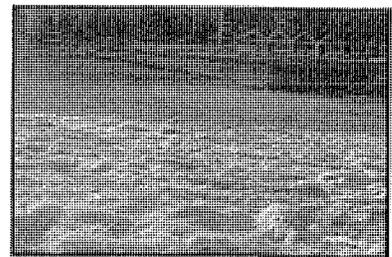


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Low Head Dam Hazards



Low Head Dam Hazards



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

At this point, it seems obvious why personnel should never let themselves get caught in a vertical whirlpool.

Attempting a rescue or recovery in a vertical whirlpool without the proper training and equipment will just cause the body count to rise. Do not be misled into thinking you can drive a boat into a vertical whirlpool to execute a rescue or recovery. Because of the aeration of the water in the hydraulic, objects become less buoyant and boat motors become useless due to the cavitations of the boat propellers. A boat being driven into the face of a low head dam will quickly fill up with water, turn over, and dump its occupants into the Killing Machine.

Personal protective equipment during water rescue incidents.

Firefighting helmets, boots, and turnout gear are not typically appropriate personal protective gear for water rescue incidents. If you want to perform water rescues, wearing the proper thermal protection, with buoyancy, is essential. Personal Flotation Devices (PFD), helmets, gloves, and taglines for personnel on steep embankments are some of the other pieces of PPE items you may find necessary for a water rescue incident. Common outerwear for performing water rescues might include cold-water rescue suits, wet suits, and dry suits.

All personnel working at the scene, in a boat, near the water, or as a line tender, should wear a properly fitted PFD (personal flotation device). Having a PFD hang around your neck, without it being secured, will not do you any good if you fall into the water. Secure it properly. Support personnel who find it necessary to wear their turnout coat for warmth, will often wear their PFD under their coat. Equipment you might consider adding to your PFD could include a whistle and a rescue knife.

Water Rescue PPE

- Firefighting helmets, boots, and turnout gear are **NOT** appropriate for water rescue
- Proper PPE includes the following
 - Wet suits / dry suits / exposure suits
 - Thermal protection
 - PFD's (whistle & knife & strobe light or light stick)
 - Worn by all personnel
 - » In or near water
 - » On a boat
 - glines / lifelines
 - helmet, gloves


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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

The cold water near drowning incident.

There are many factors that can influence the chance of a victim surviving “cold water near drowning”. Younger victims tend to have a better chance of surviving. The victim’s health can also be a factor. Temperature and clarity of the water plays a major role. Colder, clean, fresh water provides the victim with the best chance of survival. Cold water is considered below 70 degrees F. Even if a drowning incident happens on a hot summer day, the victim is usually found at the bottom of the water. This means the victim is probably below the thermocline, where the temperature is usually below 70 degrees F. Length of submersion is another factor. The less time the victim is under water, the better the chance of survival. In the past, if a victim was under the water for 60 minutes or less, you should still be in rescue mode.

Recently, victims have been revived after being submerged for more than one hour. If you would like to give a “cold water near drowning” victim the benefit of a doubt, stay in rescue mode whenever the victim has been submerged for 90 minutes or less. After 90 minutes, you may consider changing the mode of your incident to recovery mode. Other factors that can influence the chance of victim survival include prompt, aggressive, high quality BLS and ALS patient treatment. Remember, a patient is not dead until they are warm and dead.

First Due Company Operations:

Upon arrival, begin your size-up. What is the scope and magnitude of this incident? What type of incident is this? Are victims above or below the surface of the water? Evaluate the environmental factors involved. Those factors can change quickly with changing weather conditions. If the sun is about to set, you will need to consider lighting for the scene. Water levels and current changing drastically (flash flooding).

Assess the hazards at the scene. As soon as possible, determine the location and number of victims. As with any

Cold Water Near Drowning

- Age of victim
- Temperature of water
 - Below 70°F
 - Patient could be below thermocline
- Length of submersion
 - Under 90 minutes
 - Still rescue mode
 - Quality BLS & ALS treatment



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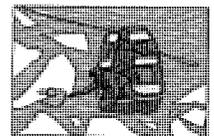
Size-up

- Scope, magnitude, type of water rescue incident
 - Environmental factors
 - Change in weather conditions
 - Loss of daylight
 - Water levels
 - Current changes

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Size-up (con't)

- Assessment of hazards
- Location & number of victims
- Risk / benefit analysis
 - Rescue vs. recovery
- Access to scene



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

other rescue incident, do a risk/benefit analysis. Is this a rescue or a recovery? All personnel operating on the scene need to know this information. Are there any access problems at the scene for responding companies?

The initial tasks that must be performed by a first responder to a water rescue incident require an overall level of control at the scene. This means keeping control of all personnel. Also, it is necessary to control the bystanders. This is assistance of police personnel to establish site security. Establish command and use your incident command system. Accountability and safety of your personnel is paramount. Evaluate the resources you have available and those that will be needed.

Secure and interview any witnesses to the incident. If a victim, boat, plane, or vehicle has disappeared below the surface of the water, any witness will be extremely valuable. Witnesses should be interviewed separately. If witnesses are interviewed together, one could influence the other. Witnesses should be kept at the scene for as long as possible. If they do need to leave the scene, collect their personal information. They may need to be interviewed in the future.

Try to establish a “last seen point”. You can triangulate the “last seen point” with more than one witness. A helpful technique in assisting the witness to describe the “last seen point” is to use a reference object. A reference object is the same size object (such as a boat or a person) that sank below the surface of the water. In order to create the reference object, put a person, boat, etc. in the water and have the witness visualize the “last seen point”. Also, gather in formation on the number of possible victims and age and sex if known.



Water Rescue

- Awareness Level Personnel May:
 - Establish scene control
 - Establish IC
 - Initiate accountability & safety
 - Evaluate patient condition
 - Can patient assist with rescue?
 - Activate Needed resources



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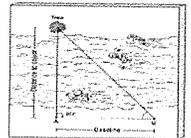
Water Rescue

- Awareness Level Personnel May: (con't)
 - Secure & interview witnesses
 - Keep witnesses at scene
 - Interview witnesses separately
 - Collect witnesses' personal information

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Water Rescue

- Awareness Level Personnel May: (con't)
 - Establish last seen point
 - Triangulate with multiple witnesses
 - Use a reference object
 - Hole in ice is great last seen point
 - Don't destroy it



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

At an ice incident, such as a person or a snowmobile through the ice, there is usually a well- defined hole in the ice. Upon arrival at the scene, rescuers may find that the victim is now below the surface of the water. That hole in the ice provides an excellent last seen point. Don't destroy it!

Evaluate any other physical evidence that might be found at the scene. This evidence could help determine the probability of a victim location. This type of evidence might include notes, clothes, footprints, etc. If a vehicle has entered the water, evidence such as tire tracks, debris, or oil and bubbles surfacing may be found.

Identifying the need for a water rescue response beyond the awareness level.

The AHJ should have an emergency response system established for water related incidents. This is especially important if a single agency does not have all the necessary equipment and trained personnel. This emergency response system should include the response of divers, ice divers, swift water technicians, etc. They should be trained to the operations or technician level.

Police personnel and evidence technicians can be very valuable at many water rescue incidents.

Specialized equipment is often necessary. Such equipment includes diving equipment, sonar, boats, tow trucks, extrication equipment, dog teams, lift bag systems, etc.

EMS should be included in the rescue response. It is not unreasonable for the AHJ to dispatch an ambulance for each victim and have an extra ambulance standing by for diver support. The AHJ may find it appropriate to request air transport to stand by if there is a prolonged rescue and a need for the patient to be transported to a level I trauma center.

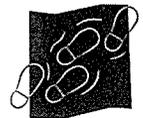


Water Rescue

- Awareness Level Personnel May: (con't)
 - Identify number of victims
 - Identify age and sex of victim, if possible

Water Rescue

- Awareness Level Personnel May: (con't)
 - Evaluate physical evidence
 - Notes
 - Clothes
 - Footprints
 - Tire tracks
 - Debris
 - Oil slick
 - Bubbles



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Water Rescue

- Beyond the awareness level
 - AHJ must have emergency response plan
 - Operations & technician level personnel
 - Police & evidence technicians
 - Specialized equipment
 - Boats, tow trucks, etc.
 - EMS response
 - Ambulance for patient(s)
 - Ambulance for divers
 - Aeromedical transport



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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WATER

This type of incident could cause first arriving personnel to tire quickly in a prolonged incident. Consider rehab personnel early on in the incident. Try to keep the incident operating in rescue mode.

For personnel trained to the operations or technician level, a simple operational plan may include: reach, throw, row, and go. A “reach” rescue should provide the least amount of risk to rescue personnel, while a “go” rescue would involve the most risk to rescue personnel.

You may arrive on the scene of a water or ice rescue incident with the victim still at the surface in need of a surface rescue. You should quickly request the response of technicians and equipment necessary to execute this type of rescue. While technicians are preparing for a “go” rescue, it would be appropriate for trained personnel to attempt a “reach” or “throw” rescue, minimizing the risk. This victim hanging on at the surface could suddenly sink below the surface while the rescue is attempted. For that reason, consider requesting divers early on in the incident. This option provides the best possible chance of survival to the victim.

Scene Considerations

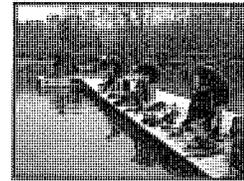
- Rehab personnel early
- Operational plan
 - Reach, throw, row, go



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Scene Considerations

- Request divers early in an incident
 - Victims at the surface may submerge
 - Keep incident operating in rescue mode



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WATER

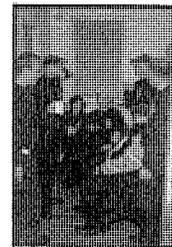
Initial Company Operations

Exercise

1. **Establish Strong visible command**
 - Establish command
 - Give a size up of the scene
 - Implement ICS
 - Establish minimum positions
 - Command
 - Safety
 - Establish additional Command Staff and General Staff positions as needed.
 - Consider Unified Command for Complex Incidents
2. **Identify the need for Technical Rescue**
 - Conduct Rapid Size – up Considering the following
 - Scope, Magnitude and Nature of the incident
 - Location / complexity of the incident
 - Risk vs. Benefit (rescue or recovery)
 - Scene Access
 - Functional Capabilities of Available Resources
 - Location of Additional, Trained Resources.
 - Environmental Conditions
3. **Recognize the General Hazards involved in the incident.**
 - Make area safe for all responders
 - Identify all hazards
 - Control / Limit Traffic
 - Control / Limit Access
 - Mitigate hazards within your capabilities

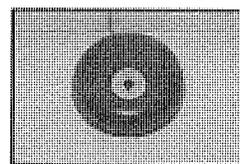
Water Rescue Scenario

- It is a Saturday morning just after shift change, the truck's have been checked and everyone is enjoying a cup of coffee.



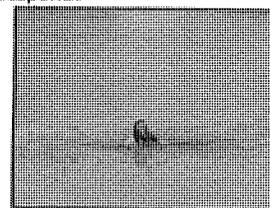
Water Rescue Scenario

- The alarm sounds for a person through the ice on a retention pond in your district.



Water Rescue Scenario

- How will you respond?



INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

WATER

4. Identify the appropriate resources for the incident
 - Awareness
 - Operations
 - Technician

5. Initiate the appropriate emergency response system
 - Consider all available response systems as identified by the AHJ
 - Local
 - County
 - State
 - National

6. Initiate Site Control Measures
 - Establish personnel accountability systems (Control access points)
 - Develop Incident Action Plan and Communicate the plan to EVERYONE
 - Establish and Communicate an Evacuation Plan for EVERYONE
 - Secure the General Area
 - Secure Witnesses and Conduct Interviews for Intelligence
 - Establish Control Zones (Rule of Thumb)
 - Hot Zone 100' critical functions
 - Warm Zone 200' support functions
 - Cold Zone 300' Command & Control
 - Outside Cold Zone – Liaison to Rest of the World



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WATER

7. Establish Patient Contact with endangering Personnel

- Establish Location of all patients
- Establish verbal contact with the patient
- Determine patient condition (from a safe distance)
- Assist with **NON –ENTRY RESCUE (without endangering personnel)**

Water Summary

Recognize the need for water search and rescue.
Describe implementing the assessment phase.
Identify the resources necessary to conduct safe and effective water rescue operations.
Identify the emergency response system for water rescue emergencies.
Identify the site control and scene management procedures at water rescue incidents.
Identify the general hazards associated with a water rescue incident.
Identify the rescue vs. recovery mode when concerned with cold water near drowning patient.
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Identify the rescue vs. recovery mode when concerned with cold water near drowning patient.

Water Rescue Summary

- Recognize the need for water search and rescue.
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Water Rescue Summary

- Identify the site control and scene management procedures at water rescue incidents.
- Identify the general hazards associated with a water rescue incident.
- Identify the rescue vs. recovery mode when concerned with a cold water near drowning patient.

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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

VEHICLE / MACHINERY

On Scene Approach

The first arriving unit should provide all responding units with a scene size up. The initial responder should complete a scene survey including a six-sided approach. This should include all four sides of the incident scene and what is above and below the incident. Scene conditions should be identified. Is there any fire and if so what is fueling the fire. Initial crowd control should be established. Responders should be aware of hazards presented by bumpers, shocks, hood/hatch pistons, and suspension systems. All present a hazard to the responders as well as bystanders.

Scene Conditions

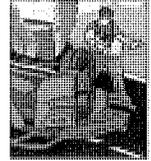
Electrical hazards at the scene should be identified. Electrical hazards at the scene include hazards presented by the vehicle such as batteries or capacitors storing energy. Utilities at the scene should also be considered. Power lines should always be treated as energized until confirmed off by the utility company. When machinery is involved the electricity should be locked out and tagged out. Other power sources to machinery should also be secured such as air and hydraulic supplies.

Vehicle stability should be assessed by prevent further injury to victims or injuries to responders. To provide vehicle stability responders need to maximize the contact surface between the vehicle and the ground. On machinery, key points should be supported to prevent further injury to the victim. It is important to identify the resources needed to support the weight of large machinery. Special resource such as large timbers or metal may be needed to support the machinery.



On Scene Approach

- Survey scene
 - Six-sided approach
 - Inside / Outside Circles
- Scene conditions
 - Fire
 - Fuels
 - Crowd control
 - Hydraulic bumpers
 - Shocks, hood/hatch pistons, suspension



2

Scene Conditions

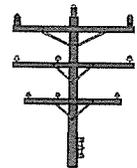
- Vehicle stability
 - Maximize contact surface between car & ground
 - Support key points on machines
 - Prevents further injury to victim
- Hazardous materials
 - Identify
 - Control
 - Remove



3

Scene Conditions

- Electrical hazards
 - Vehicles
 - Batteries
 - Capacitors
 - Utilities
 - Powerlines
 - Machines
 - Lock out / tag out
 - Multiple sources



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

VEHICLE / MACHINERY

Patient Injuries

The mechanism of injury should be noted during the size up of the incident. Trauma to the head, face, hands, and arms may be the result of damage to the windshield, airbag deployments, contact with the steering wheel, impact to the A/B post, contact with the rear view mirror, impact with the roof, contact with an auger, roller, conveyor belt, etc.

Trauma to the chest, stomach, and hips may be the result of impact with the steering wheel, airbag deployment, impact to the doors, resistance from seat belts, etc. Trauma to the legs and feet may be front movement of the steering column and steering wheel, movement of the dash board, impact to the doors, etc.

Internal injuries from the impact may affect internal organs, the spine, brain, blood vessels, etc. External injuries may affect the head, neck, shoulders, arms, hands, legs, feet, back, hips, etc. External injuries may include bruises, fractures, lacerations or amputations.

Environmental Conditions

Environmental conditions may have an affect on the incident. Extreme heat or cold may play a big factor in patient care. Steps should be taken to prevent hyperthermia or hypothermia. Weather conditions also are a factor to deal with. Rain, sleet or snow may have an affect on the scene as well. Slick road conditions also presents hazards to responders as well. Darkness can affect the incident scene; adequate lighting of the scene should be established early in the incident.



Patient Injuries

- Mechanism of injury

- Trauma

- Head, face, hand and arms

- » Windshield, airbags, steering wheel, A/B post, rear view mirror, roof, auger, roller, conveyor, belt etc.

- Chest, stomach and hips

- » Steering wheel, airbag, door, seat belts, etc.

- Legs and feet

- » Steering wheel, dash board, door, etc.



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Patient Injuries (con't)

- Internal

- Organs, spine, brain, blood vessels, etc.

- External

- Head, neck, shoulders, arms, hands, legs, feet, back, hips, etc.

- Bruises, fractures, lacerations, amputations

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Environmental Conditions

- Extreme heat & cold
- Rain, sleet and snow
- Darkness



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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS VEHICLE / MACHINERY

Identify & Notify Resources

Safe and effective operation at the incident scene involves several agencies. Police can be used for crowd control and traffic control at the incident scene. It is important to preserve any evidence at the scene for the police. Some accidents may require accident reconstruction or further investigation.

Fire departments on scene should maintain scene safety by extinguishing any fires, preventing fires, handling spills or leaks caused by the incident. Spills/leaks may involve fuels/fluids used in the vehicle, or hazardous materials transported by the vehicle. Fuels systems should be secured, electrical systems on the vehicles involved should be shut down. Fire departments also may provide the extrication for the incident and assist EMS with patient handling.

EMS's role should be to handle assessment of the patient, packing of the patient, assess patient disentanglement and extrication, handle the patient, and provide transportation of the patients to the hospital.

Tactical Objectives for Extrication

Responders should make sure the scene is safe from hazards, and that fire suppression is available. The vehicle should be stabilized to prevent any further movement of the vehicles involved. Safe access should be created for EMS to access patient. Disentanglement of the patient should be done as to prevent any further injuries to the patient. Responders may be needed to assist EMS with handling the patient.



Identify & Notify Resources

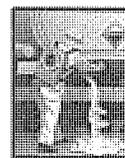
- Safe & effective operation
 - Police
 - Crowd control
 - Traffic control
 - Preserve scene
 - » Accident reconstruction
 - » Investigation



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Identify & Notify Resources (con't)

- Fire department
 - Maintain scene safety
 - Extinguish fires
 - Prevent fires
 - Spills / leaks
 - » Fuels
 - » Haz-mat
 - Maintain vehicle safety
 - Fuel system
 - Electrical system
 - Assist EMS / extrication



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Identify & Notify Resources (con't)

- EMS
 - Patient assessment
 - Packaging
 - Assess patient disentanglement & extrication
 - Patient handling
 - Transportation



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Identify & Notify Resources (con't)

- Tactical Objectives for Extrication
 - Scene Safe / Fire Suppression
 - Vehicle stabilization
 - Create safe access for EMS
 - Safe disentanglement of patient
 - Assist EMS



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

VEHICLE / MACHINERY

Identify Hazards

Air bag systems have become common in most vehicles. Air bags are designed to protect passengers in the vehicles; however undeployed air bags present hazards to responders. An undeployed air bag may get activated during an extrication possibly injuring responders. Air bag may be identified through the use of logos. Common logos are: SRS, SLR, Airbag, Side Airbag, Knee Impact Airbags, Head Impact Airbags, and Head Curtain Airbags. Once the battery has been disconnected on the vehicle it may take 30 seconds to 30 minutes for the electrical system to drain, and not allowing the airbag to deploy. To prevent further injuries to victims or injuries to responders the following safety distances are a rule of thumb. 5 inches from side airbags, 10 inches from drivers airbags, and 18 inches from passengers airbags are recommended distances between the airbag and the victim/rescuer.

Fuel Systems present a hazard to responders. The majority of the vehicles on the road today use either gasoline or diesel fuel. Gasoline powered automobiles are a common site in every community. A new hazard with gasoline powered automobiles is Flex Fuel Automobiles which allow the vehicle to operate off of gasoline or E-85 which contains ethanol. Diesel powered vehicles usually have larger fuel tanks. Vehicles powered by Compressed natural gas or LPG present the hazards of a pressurized tank carrying the fuel in them. The vehicles require extra attention when involved in a fire. Electric cars / industrial machines present a big hazard with the multiple batteries carried on them, contained larger than normal quantities of battery acid. Hybrid vehicles have both a high voltage and a low voltage system. Rescuers should be aware of the vehicles since they involve more than 1 battery, and being able to locate them. Hybrid vehicles use a high voltage system using capacitors to power the vehicle until it reaches a set speed which then engages the internal combustion engine to power the vehicle. Hybrid vehicles may appear to be shut off, but they may actually be in a sleep mode waiting for the accelerator to be depressed, which could cause the vehicle to move.



Identify Hazards

- Air bag systems
 - Logos
 - SRS, SLR, airbag, side airbag, knee impact airbags, head impact airbag, head curtain bag, etc.
 - Electrical drain time
 - After battery disconnected
 - » 30 seconds – 30 minutes
 - Safety distances
 - » Keep space between rescuers / patients
 - » 5" – side airbags
 - » 10" – drivers airbag
 - » 18" – passengers airbag

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Identify Hazards (con't)

- Fuel systems
 - Gasoline
 - Diesel
 - Large quantities
 - Compressed natural gas or LPG
- Electrical systems
 - Electric cars / industrial machines
 - » Battery acid
- Hybrid Vehicles
 - Capacitors used for energy surge



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INSTRUCTOR MANUAL

TECHNICAL RESCUE AWARENESS

VEHICLE / MACHINERY

Rescuers need to make sure hybrid vehicles are shut down, placed in park and stabilized before working in or on the vehicle.

Energy absorbing bumpers have been known to be launched as far as 100 feet or could wrap around the vehicle. Hood and hatch back pistons should not be cut and have the possibility of being projectile hazards at the scene. Battery location may vary depending upon make and model of the automobile. The most common location is under the hood, but other locations may include under the back seat, trunk or in the wheel wells.

Seat belt pretensioners are designed to draw the seat belt tight during deployment. These pretensioners include an explosive charge that pulls back on the seat belt. These pretensioners may be located low and midway up on the B post, low on the C post or in inner front and rear seat bucklers.

Gears, Chains, Pulleys, Augers & Conveyor
Industrial or heavy equipment may be powered by one or more power sources. Some common sources are electric, motors, air or hydraulic. It is important to identify the power source and lock and tag it out. This equipment is usually constructed from rugged materials, which makes it hard to use common extrication equipment on. Extrication from heavy equipment usually involves disassembling it to free the victim. Some equipment may have chemicals involved with the normal production. Some equipment may have components that have stored potential energy such as springs, which if cut or improperly disassembled can cause further injuries. Some heavy equipment are full cycle machines, which once they are started will continue movement until it returns to its starting position.



Identify Hazards (con't)

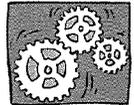
- Hydraulic shocks
 - Absorbing bumpers
 - Bumpers have been known to be launched as far as 100 feet or could wrap around the vehicle.
 - Hood / hatch back pistons
- Battery locations
 - Under hood (high or low)
 - Under back seat
 - Trunk
 - Wheel wells



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Identify Hazards (con't)

- Seat belt pretensioners
 - Low and mid B post
 - C post low
 - Inner front and rear seat bucklers
- Gears, chains, pulleys, augers & conveyor belts
 - Power source
 - Electric, motor, air or hydraulic
 - Lock out / tag out
 - Rugged construction
 - Chemical hazards
 - Stored potential energy
 - Full cycle machines



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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS VEHICLE / MACHINERY

Beware of stored potential energy or full cycle machinery.

Some incidents may be in remote areas, which could cause a delay in getting to the patient, such as in the middle of a factory. It will require additional time and resources to move equipment to the incident. Disassembly of machinery may require special tools. A good resource to use is maintenance personnel who are familiar with the equipment and who usually have the proper tools.

Awareness Level Personnel may assist with:
Scene safety-protection of rescuers is the #1 priority
Control access to the scene
Clear access to the vehicle or machine
Assist with the initial stabilization-cribbing

Size-up

Establish need for Technical Rescue
Identify number and location of patients
Establish scene control
Establish traffic control
Rescuer safety
Crowd Control
Crowds restrict rescuers' activities
Verify machines rendered safe
Shut off power
Main disconnect
Lock out/tag out



CAUTION!

Beware of stored potential energy or full cycle machinery

Example: machinery that continues to move after power is removed

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Identify Hazards (con't)

- Gears, chains, pulleys, augers & conveyor belts (con't)
 - Remote areas
 - Delay getting to patient
 - Disassembly of machines
 - Maintenance personnel
 - » Very helpful



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Vehicle & Machinery Rescue

- Awareness Level Personnel may assist with:
 - Scene safety
 - Protection of rescuers #1 priority
 - Control access
 - Clear initial access to vehicle or machine
 - Assist with initial stabilization
 - Cribbing

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Size-up

- Establish need for Technical Rescue
- Identify number and location of patients
- Establish scene control
- Establish traffic control
 - Rescuer safety
- Crowd control
 - Crowds restrict rescuers' activities
- Verify machines rendered safe
 - Shut off power
 - Main disconnect(s)
 - » Lock out / tag out

FIRE LINE DO NOT CROSS

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS VEHICLE / MACHINERY

Scenario #1

Dispatch

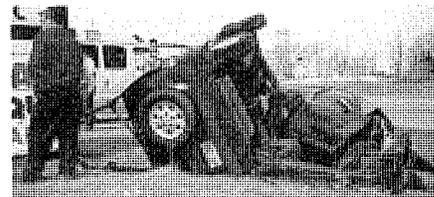
- You are dispatched to an intersection on the local highway
- Dispatch reports a 2 vehicle accident with injuries
- Fire Department, Law Enforcement, and EMS have been dispatched

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Scenario #1

- Is this a Technical Rescue?
- What Level of Responders will be needed?
- What actions can you take?

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Scenario #1

- Is this a Technical Rescue?
 - This incident requires more complex vehicle stabilization.
- What Level of Responders will be needed?
 - Operations level responders are needed for the stabilization.
- What actions can you take?

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS VEHICLE / MACHINERY

Scenario #2

Dispatch

- You are dispatched to local farm for a farmer trapped in an auger.
- Fire Department, Law Enforcement, and EMS have been dispatched

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Scenario #2

- Is this a Technical Rescue?
- What Level of Responders will be needed?
- What actions can you take?

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Scenario #2

- Is this a Technical Rescue?
 - The farmer is trapped in an auger.
- What Level of Responders will be needed?
 - Operations level.
- What actions can you take?

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS VEHICLE / MACHINERY

Summary

Recognize the need for vehicle and machinery search and rescue.

Identify the resources necessary to conduct safe and effective operations.

Identify the emergency response system for vehicle and machinery incidents.

Describe the need for site control and scene management at vehicle or machinery incident.

Identify the general hazards associated with vehicle and machinery rescues.

Identify traffic / crowd control procedures.

Vehicle & Machinery Summary

- Recognize the need for vehicle and machinery search and rescue.
- Identify the resources necessary to conduct safe and effective operations.
- Identify the emergency response system for vehicle and machinery incidents.

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Vehicle & Machinery Summary

- Describe the need for site control and scene management at vehicle or machinery incident.
- Identify the general hazards associated with vehicle and machinery rescues.
- Identify traffic / crowd control procedures.

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

Define Wilderness: Wilderness is generally defined as a natural environment on Earth that has not been modified by human activity.

Will searches always take place in the wilderness?

Introduction

National Search and Rescue Plan established in 1956. Updated 1999.

The National Search and Rescue plan designates the United States Coast Guard as the federal agency responsible for maritime SAR and the United States Air Force as the federal agency responsible for inland SAR.

Most Wilderness Searches are handled by local agencies and do not require a national level response.

DEFINE SAR "Search And Rescue"

- The process of locating lost, missing, or overdue individuals and removing them from danger.
- SAR is a service not a hobby

SAR RESPONSIBILITIES

- US Coast Guard: Responsible for maritime search on waterways.
- US Air Force: Responsible for inland SAR operations.
- Department of Interior: Responsible for national parks.
- Department of Agriculture: Responsible for US forest land.
- Bureau of Land Management: Responsible for all other US owned land.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

Indiana Department Of Homeland Security

The Indiana Department of Homeland Security operates Search and Rescue support functions. Resources from the state should be requested through your local Emergency Management Agency.

- Training
- Response
- Support

Search Training is a 3 Tier System.

- Awareness
- Operations
- Technician

Local Search and Rescue Jurisdiction

Indiana law changed July 2007 requiring that all missing persons, adult and child, runaways and abductions must have immediate police response and an investigation conducted by the Law Enforcement Agency that it occurred in. Law Enforcement has overall responsibility for missing persons.

Remember All Missing, Abduction and Runaway scenes are considered crime scenes.

INDIANA DEPARTMENT OF HOMELAND SECURITY

- The Indiana Department of Homeland Security operates Search and Rescue support functions. Resources from the State should be requested through your local Emergency Management Agency.

- Training
- Response
- Support

INDIANA SAR PLAN

- Title 10 of the Indiana Code makes reference to disaster SAR, only.
- There is currently no plan for Civil SAR.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

What are you searching for?

- Elderly Walkaways
- Alzheimer's Patients
- Despondents

Drug-Affected

- Missing Children
- Mentally Retarded
- Lost Hikers
- Disaster Related Search
- Response to Criminal-Abduction and fugitive Incidents

What should you not do as a first responder.

- Conduct interviews without Law Enforcement
- Conduct investigation
- Walk in potential crime scenes
- Law Enforcement is the best resource to obtain information and secure a scene.

Recognize the need for Search and Rescue

Upon your arrival it has been determined jointly by Fire and Police that information gathered indicates that a person is missing. If local trained assets are not on the scene a pre-determined response plan should be placed into action.

Initiating Site Control and Scene Management

The Incident Command System (ICS) is the preferred method of on-scene incident management for all SAR operations.

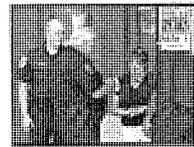
- All Search & Rescue operations will be managed by the concepts of the Incident Command System (ICS)/National Incident Management Systems (NIMS), with the responsible Law Enforcement Agency as the Command Agency.

WHAT ARE YOU SEARCHING FOR

- Elderly Walk-aways
- Alzheimer's Patients
- Despondent's
- Drug-Affected
- Missing Children
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- Lost Hikers
- Disaster Related Search
- Response to Criminal-Abduction and fugitive Incidents

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INITIATING SITE CONTROL AND SCENE MANAGEMENT

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

Initial task of first in agencies

- Establish ICS
- Evaluate search urgency
- Obtain lost person report
- Determine type of response
- Determine available resources
- Determine probable search area

Site Control

- Non-Emergency Personnel
- Self Dispatched Agencies or Individuals
- Search Dogs
- Isolation of Family

There are four core elements in Wilderness SAR operations:

1. Locate the victim
2. Access the victim
3. Stabilize the victim
4. Transport the victim

Many times in a wilderness search and rescue, the time is spent in trying to locate the victim. Due to this time in determining the location of the victim, the other areas might have to be reduced for survivability.



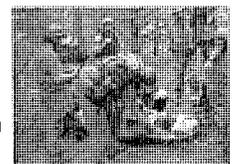
SITE CONTROL

- Non-Emergency Personnel
- Self Dispatched Agencies or Individuals
- Search Dogs
- Isolation of Family



CORE ELEMENTS

- Locate the victim
- Access the victim
- Stabilize the victim
- Transport the victim



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

There are seven (7) components that are used to complete the elements of a SAR operation:

1. **Pre-planning** - The Organization and Management Guidelines. Includes call-out procedures/guidelines and equipment.
2. **Notification** - We have to be notified of a problem before we can handle it.
3. **Planning and Strategy** - The process of gathering information so that an assessment can be done.
4. **Tactics** - Type of response or solution to handle the problem.
5. **Operations** - The field phase where the tactical solutions are carried out.
6. **Suspension** - Operation is discontinued.
7. **Post Incident Analysis** - Evaluation of the participants, methods and strategies.

Valuable resources in wilderness search and rescue:

- Search dogs are able to cover a tremendous amount of area in a short period as compared to humans.
- Trackers are trained to look for clues and many times familiar with the area.
- Aircraft is able to cover a large area and technology allows the crew to search more in depth.
- Ground air search specialist.
- Rope rescue specialists.
- Water rescue specialists.
- Trench rescue specialist.
- Collapse rescue specialist

Types of Search K-9's

- **Air scent**
- **Trailing**
- **Cadaver / Human Remains**
- **Disaster**
- **Articles**



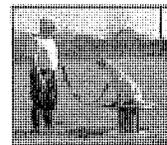
RESOURCES

- Search dogs
- Trackers
- Aircraft
- Ground / Air search specialist
- Rope Rescue Specialist
- Water Rescue Specialist
- Trench Rescue Specialist
- Collapse Rescue Specialist



TYPES OF SEARCH K-9's

- Air scent
- Trailing
- Cadaver / Human Remains
- Disaster
- Articles



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

Calculating search urgency is a tool that can be used to determine the response that is going to be given to a search and rescue. The following factors are taken into consideration: (See Relative Urgency Rating form)

- Subject Profile
- Weather Profile
- Equipment Profile
- Subject Experience Profile
- Terrain and Hazards Profile
- History of Incidents in this area
- Bastard Search (see definition in front of book)

Note: The lower the value of each factor and of the sum of all factors, the more urgent the situation. (See Relative Urgency Rating Factors Sheet)

There are three broad types of responses used dependant on search urgency.

- 1) **Emergency Response** - Based on information, convinced death or serious injury could occur if help does not arrive. Blitz or Hasty Team - minimum number of experienced rescuers that are sent out to locate the victim. This is followed by a support team with additional equipment. The margin of safety is fairly narrow and a perceptible amount of risk involved in the necessary response.
- 2) **Measured Response** - based on when appropriate information on hand is insufficient to dictate the exact outline of a search and rescue action plan.
- 3) **Evaluative Response** - Occurs when the reported problem is unconfirmed or seems likely to resolve itself.



The lower the value of each factor and of the sum of all factors, the more urgent the situation.

BROAD TYPES OF RESPONSES

- Depends on search urgency
 - Emergency response
 - Based on information
 - Convinced death, serious injury if no help
 - Blitz or hasty team
 - Minimum number of experienced rescuers sent to locate victims
 - Followed by support team
 - Additional equipment
 - Narrow margin of safety
 - Perceptible amount of risk

BROAD TYPES OF RESPONSES (con't)

- Measured response
 - Appropriate information on hand is insufficient to dictate exact outline of S & R action plan
- Evaluative response
 - Occurs when reported problem is unconfirmed
 - Seems likely to resolve itself



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

Isolating witnesses or reporting parties

Lost person searches are very stressful events for everyone, but especially for the family and friends involved.

Unfortunately, everyone who walks up to offer assistance wants to loiter around the family or the witnesses and ask questions.

The family members then end up answering the same questions over and over and over.

Move the witnesses or family members to areas where they will not be disturbed by bystanders and responders.

This provides the interviewer with the best setting to obtain information.

Buildings, Tents, or Response vehicles can be used.

Lost person(s) report

This goal of interviewing and obtaining information from participant(s) or witnesses is to devise an effective course of action.

Each lost person receives a file.

Part I - Is information that is critical in determining decisions of the initiation phases of a search.

Part II - May be significant later in the mission.

As with any rescue operation rescuers are faced with certain hazards. There are four general hazards associated with wilderness SAR operations:

1. **Personal Hazards** include blisters, scrapes, scratches, falls, blows, bruises, dehydration, etc.
2. **Environmental Hazards** include insect bites and stings, poisonous plants, exposure injuries, snow-blindness, altitude illness, lightning, sunburn, dangerous wildlife, etc.
3. **Terrain Hazards** include cliffs, avalanches, standing water (e.g., ponds, lakes), flat ice (e.g., ponds, lakes), moving water, caves, mines, wells, high winds, snow, coastal white water surf, etc.

ISOLATING WITNESSES OR REPORTING PARTIES

- Lost person searches are very stressful events for everyone, but especially for the family and friends involved. Unfortunately, everyone who walks up to offer assistance wants to loiter around the family or the witnesses and ask questions. The family members then end up answering the same questions over and over and over.

ISOLATING WITNESSES OR REPORTING PARTIES

- Move the witnesses or family members to areas where they will not be disturbed by bystanders and responders.
- This provides the interviewer with the best setting to obtain information.
- Buildings, Tents, or Response vehicles can be used.

LOST PERSON(S) REPORT (See Appendix)

- Interview and obtain information from
 - Participants
 - Witnesses
 - Establish Strategic Objectives
 - Establish an Incident Action Plan
- Each person lost receives a file
 - Part I - Information critical in determining decisions of the initiation phase of search
 - Part II - May be significant later in mission

RECOGNIZING GENERAL WILDERNESS HAZARDS

- Personal
 - Blisters, scrapes, scratches, falls, blows, bruises, dehydration, etc.
- Environmental hazards
 - Insect bites, stings, poisonous plants, exposure, snow-blindness, altitude illness, lightning, sunburn, animals



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

4. **Man-Made Hazards** include booby-trapped stills and labs, hazardous materials dumps, trained attack dogs, etc.

There are four basic methods of establishing a probable search area:

1. **The Theoretical Method.** The probable search area is generated in this method by using tables that express the area as a function of distance traveled by the lost subject. This necessitates a reliable determination of the Point Last Seen (PLS). The area's boundary is a circle drawn on the map centered on the PLS. The length of its radius is the maximum distance the victim could have journeyed in that terrain in the time elapsed since he was last seen.
2. **The Statistical Method.** Case studies of people in the wilderness provide the data for this method.
3. **The Subjective Method.** Historical data, intuition, the location of the natural barriers and clues, and consideration of the physical and mental limitations of the victim are taken into account.
4. **The Mattson Method.** Balances subjective and objective information and uses individual personnel to view their probable search area independently, then combining their percentage of where he/she thinks they are to the rest of the group. The total percentage from all personnel involved is added and the greatest percent is where the search will be started.

WILDERNESS HAZARDS (con't)

- Terrain
 - Cliffs, avalanches, standing / moving water, ice, caves, mines, wells, winds, snow, surf, etc.
- Man-made hazards
 - Booby-trapped stills & drug labs, haz-mat dumps, attack dogs, etc.

ESTABLISHING PROBABLE SEARCH AREAS Methods Used

- **Theoretical Method**
 - Using tables that express area as a function of distance traveled by the lost subject
 - Reliable point last seen (PLS)
 - Radius is maximum distance victim could have journeyed
 - » In given terrain
 - » In time elapsed since last seen

ESTABLISHING PROBABLE SEARCH AREAS Methods Used

- **Statistical Method**
 - Based on data from case studies
- **Subjective Method**
 - Historical data
 - Intuition
 - Location of natural barriers & clues
 - Consideration of physical & mental limitations

ESTABLISHING PROBABLE SEARCH AREAS Methods Used

The Mattson Method. Balances subjective and objective information and uses individual personnel to view their probable search area independently, then combining their percentage of where he/she thinks they are to the rest of the group. The total percentage from all personnel involved is added and the greatest percent is where the search will be started.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

Three types of search tactics used to search for the victim(s):

Type I (Detection Phase) - Hasty Teams (Minimum number of experienced rescuers that are sent out to locate the victim)

Type II - Open Grid is relatively fast, efficient search of locales of high probability using methods that produce the highest results per hour using search dogs, wide search patterns flown by aircraft, and open grid sweep searches. with three to seven searchers widely spaced at approximately 300-600 feet.

Type III - Close grid

- 30 searchers
- Walk a line 15-20 ft. apart
- Maybe less for evidence recovery

SEARCH TACTICS

- Type I (Detection phase)
 - Hasty teams
- Type II
 - Open grid
 - Fast & efficient
 - Search of locales of high probability
 - Using methods to produce highest results / hour
 - Dogs
 - Planes
 - Open grid sweeps
 - » 3-7 searchers spaced 300-600 ft. apart

SEARCH TACTICS (con't)

- Type III
 - Close grid
 - 30 searchers
 - Walk a line 15-20 ft. apart
 - Maybe less for evidence recovery



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

SCENARIO #1

YOU ARE CALLED FOR A 45 YEAR MALE WHO HAS BEEN MISSING SINCE 2 AM TODAY'S DATE. IT IS NOW 7AM AND THE FAMILY HAS CALLED 911. THE FAMILY STATES HE HAS NO KNOWN MEDICAL PROBLEMS. AND KNOWS THE AREA WELL. HE WAS SEEN BY HIMSELF AT 2AM.

THE WEATHER IS 62 DEGREES AND CLEAR. HIS FAMILY SAYS HE WAS WEARING A RED WIND BREAKER. THE AREA HE WAS LAST SEEN IS RURAL AND NEAR THE MAIN RIVER. THERE IS CURRENTLY A FLOOD WARNING FOR THE AREA.

INSTRUCTORS NOTES.

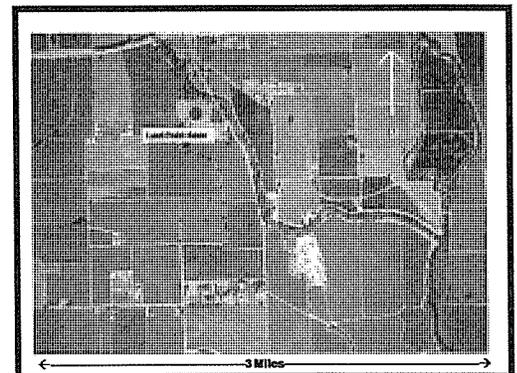
HAVE STUDENTS USE THE SEARCH URGENCY CHART AND MISSING PERSONS INTERVIEW FORM.

THERE ARE NO LOCAL ASSETS. HAVE THE STUDENTS LIST WHAT ASSETS THEY WILL NEED AND WHERE THEY WILL COME FROM.

SCENARIO

- You are called for a 45 year male who has been missing since 2 am today's date. It is now 7am and the family has called 911.
- The family states he has no known medical problems. And knows the area well. He was seen by himself at 2am.
- The weather is 62 degrees and clear. His family says he was wearing a red wind breaker. The area he was last seen is rural and near the main river. There is currently a flood warning for the area.

Weather	62 Deg and Clear
Location	Rural farm area.
Search Assets	No Local Assets



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH

Wilderness SAR Summary

- Recognize the need for wilderness search and rescue.
- Identify the emergency response system of wilderness search and rescue incidents.
- Identify site control and scene management procedures for wilderness search and rescue incidents.
- Recognize the general hazards associated with wilderness search and rescue incidents.
- Recognize the type of terrain involved in wilderness search and rescue incidents.
- Recognize the limitations of conventional emergency response skills and equipment in various wilderness environments.
- Identify the collection and recording information necessary to assist operational personnel in wilderness search and rescue.

Wilderness SAR Summary

- Recognize the need for wilderness search and rescue.
- Identify the emergency response system of wilderness search and rescue incidents.
- Identify site control and scene management procedures for wilderness search and rescue incidents.
- Recognize the general hazards associated with wilderness search and rescue incidents.
- Recognize the type of terrain involved in wilderness search and rescue incidents.

Wilderness SAR Summary

- Recognize the limitations of conventional emergency response skills and equipment in various wilderness environments.
- Identify the collection and recording information necessary to assist operational personnel in wilderness search and rescue.
- Identify how to isolate any reporting parties or witnesses.



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS WILDERNESS SEARCH



Appendix

Wilderness Search

Forms

Relative Urgency Rating Factors

	Factor Value	Numeric Rating
<u>Subject Profile</u>		
<u>Age</u>		
Very Young	1	
Very Old	1	
Other	2-3	
<u>Medical Condition</u>		
Known or suspected injured or ill	1-2	
Healthy	3	
Known Fatality	3	
<u>Number of Subjects</u>		
One Alone	1	
More than one (unless separation suspected)	2-3	
<u>Weather Profile</u>		
Existing hazardous weather	1	
Predicted hazardous weather (<8 hours)	1-2	
Predicted hazardous weather (>8 hours)	2	
No Hazardous weather predicted	3	
<u>Equipment Profile</u>		
Inadequate for the environment	1	
Questionable for the environment	1-2	
Adequate for the environment	3	
<u>Subject Experience Profile</u>		
Not Experienced, does not know area	1	
Not experienced, knows area	1-2	
Experienced, not familiar with the area	2	
Experienced, knows the area	3	
<u>Terrain and Hazards Profile</u>		
Known hazardous terrain or other hazards	1	
Few or no hazards	2-3	
<u>History of Incidents in this Area</u>		
Bastard Search	2-3	
SUM		

Appropriate Response to UrgencyRatings

<i>Factor Sum</i>
8-12
13-18
19-24
25-27

Lost Person Check List

NOTE: File separate report for each person. Detailed answers are needed to identify clues when found in the field. Place "none", "NA", or "unsure" in blanks as appropriate.

Part I: Information critical to immediate decisions and the initiation phases of a search. Record all of Part I information at the time of first notice of a lost or overdue person.

Incident Number:	Date:	Time:
Report Taken By:		
Name of Missing Person:		
Hours Overdue		
Local Address		
Home Address:		
Nicknames:		

Physical Description

Age:	DOB:	Race:	Color:
Height:		Weight:	Build:
Hair Color:		Hair Length:	Sideburns:
Facial Hair:		Straight/Curly/Wavy	Balding:
Eye Color:		Facial Features	Shape: Complexion:
Any distinguishing marks, scars, tattoos:			
General Appearance:			

Clothing

Shirt, Sweater	Style	Color
Coat	Style	Color
Rain Gear	Style	Color
Pants	Style	Color
Gloves	Style	Color
Glasses	Style	Color
Shoes	Style	Color
Other Clothing		

Equipment

Pack	Style	Brand	Color
Tent	Style	Brand	Color
Sleeping Bag	Style	Brand	Color
Food	What	Brands	Amount
Water	Canteen Style	Amount	
Flashlight	Matches	Knife	Map
Compass	Ropes/Hardware	Fishing Equipment	
Firearms	Type	Brand	Ammo.
Camera	Brand	Money	Amount
Snow Shoes	Type	Brand	Binding Type
Ice Axe	Brand	Cover	
Skis	Brand	Length	Color

Trip Plans

Going to	Via
Purpose	
How Long	How many in group
Group Affiliation	Transportation
Started at	When
Car located at	Type of Car
License	Verified
Alternate car at	Type of Car
License	Verified
Pick up/Return Time	Where

Last Seen

When	
Where	
By whom	Present
If not present, location	Phone
Going which way	How long ago
Special reason for leaving	
Unusual comments before leaving	
How long overdue	

Experience

Familiar with area	How recently	
If not local experience in what other areas		
Education in outdoor environment		
First Aid Training		
Scouts	Where	When
Military Service		
How much overnight experience		
Ever been lost before		
Ever go out alone		
How many long trips before		
General athletic condition and abilities		

Contact Person Would Make Upon Reaching Civilization

Home address	
Phone	Anyone home
Friend	
Home Address	
Phone	
Friend	
Home Address	
Phone	

Health

General Condition	Physical Handicaps
Medical Problems	
Psychological problems	
Any known external factors that could affect subjects behavior.	
Medications	
Consequences without medication	
Eyesight without glasses	

Actions Taken So Far

By (Friends, Family)
Actions Taken
When

Part II: Information that may be significant later in the incident. Can be obtained after initial actions are taken and further information on the subject is necessary.

Personality Habits

Smoke	How often	Brand
Drink	Brand	
Drugs	Type	
Hobbies, interest		
Work		
Outgoing or quiet	Evidence of leadership	
Religion	Serious	
Feeling towards adults		
What does the person value most		
Who is person closest to in the family		
Status in school/work		
Any recent letters		
Give up easy or keep going		
Where was person born and raised		
Any trouble with the law		

For Children

Afraid of what animals
Afraid of Dark
What training regarding to do when lost
What are persons actions when hurt
Talks to strangers; accepts rides
Active type or lethargic

For Groups Overdue

Any person clashes in the group
Any strong leaders
What is the competitive spirit of the group
What would actions be if separated
Any persons especially close
What is the experience of the leader and rest of group

Family (To Prevent Media/Press Complications)

Father's Occupation	
Parents separated/Divorced	
Families desire to employ special assistance	
Name, relationship, address, phone of contact relative if in good condition:	
Name, relationship, address, phone of contact relative if in poor condition or dead.	

INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

NIOSH Conducts research on various safety & health problems

Trench & Excavation Fatalities 1992-2001:

- 452 Fatalities
- 54 per year average
- 76% of the fatalities occurred from cave-ins

Human Nature

OSHA statistics are riddled with workers who have been disemboweled or decapitated by backhoes, and would-be rescuers are frequently buried in secondary collapses. **In fact, as many as 65% of all deaths in trench cave-ins are would-be rescuers.** Trench rescues are a risk in all jurisdictions, however are not common occurrences.

It is important for rescuers to maintain discipline and not allow themselves to be forced into making an unsafe entry into an unsafe trench due to pressure from bystanders.

Facts You Should Know

- 1,000 to 4,000 injuries per year
- Most deaths occur in trenches 5 ft to 10 ft in depth

Most trench work occurs in trenches with these dimensions.



NIOSH

- ◆ Conducts research on various safety & health problems

Trench & Excavation Fatalities 1992-2001:

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- ◆ 54 per year average
- ◆ 76% of the fatalities occurred from cave-ins

Human Nature

- ◆ Would-be rescuers jump in & start digging
- ◆ Backhoe operators try to dig victim out
- ◆ *As many as 65% of all deaths in trench cave-ins are would-be rescuers.*

Facts You Should Know

- 1,000 to 4,000 injuries per year
- Most deaths occur in trenches 5 ft to 10 ft in depth

Causes of Death:

◆ Excavation/trenching/cave-in	411	75.8%
◆ Struck by Object	35	6.5%
◆ Struck by vehicle/equipment	19	3.5%
◆ Caught in or compressed by equip.	14	2.6%
◆ All others	63	11.6%

- Leading cause in excavation/trenching/cave-in - suffocation



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

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Leading cause in excavation/trenching/cave-in - suffocation

Excavation

Man-made cavity or depression in the earth's surface, which may include any excavation from basements to highways.

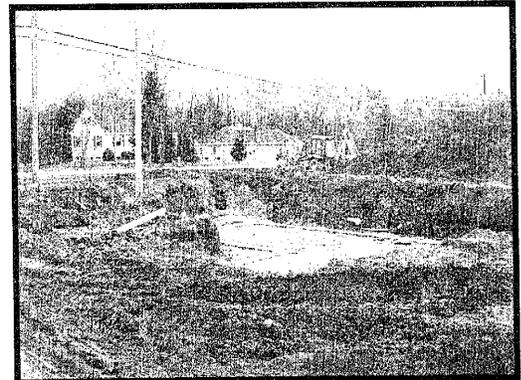
Excavations are wider than they are deep

A basement is a good example of an excavation.

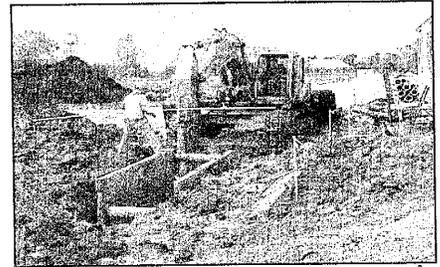
Trench

Temporary excavation in which the length of the bottom exceeds the width of the bottom (generally limited to excavations that are less than 15 feet wide at the bottom and less than 20 feet deep); narrow excavation (in relation to the length) made below the surface of the ground. **Trenches are deeper than they are wide**

Knowing the difference between a trench and excavation is good information to convey to the trench rescue team while in route



A trench according to OSHA



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

Terms to Know

Angle of repose	Safing
Sloping	Compact soil
Spoil pile	Excavation
Disturbed soil	Tension cracks
Saturated soil	Trench
Running soil	Virgin soil

These are only a few of the terms you need to know

Terms are important so responders can better communicate with jobsite workers.

Soil Facts to Consider

What is the average weight of a cubic foot of soil?
(1 foot long X 1 foot wide X 1 foot deep = 1 cubic foot)

Cubic foot: 100 or more pounds depending on moisture content, air, etc.

Cubic yard: about 3000 pounds (1-1/2 tons)

Weight of average small Collapse approximately 4000 lbs. (two tons)

Facts

Most trench incidents occur between 5' to 10' in depth & less than 6' wide.

Clay looks strong, but is very deceptive.

False. Clay is extremely dangerous, as it usually fails / collapses in large sections.



Terms to Know

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Sloping	Compact soil
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These are only a few of the terms you need to know

Soil Facts to Consider



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

<u>Soil</u>	<u>Number of Failures</u>
Clay and/or mud	32
Sand	21
Wet Dirt (probably silty clay)	10
Sand, gravel and clay	8
Rock	7
Gravel	4
Sand and gravel	2

Trench Requirements

- > 4ft you must ladder
- > 5ft you must shore
- Ladder within 25' reach
- Ladder must extend 3' above lip of trench

A ladder must be placed when the trench is 4' or deeper and entrants must not be more than 25' away from the ladder.

Parts of a Trench

Lip	Toe
Floor	Belly
Spoil Pile	

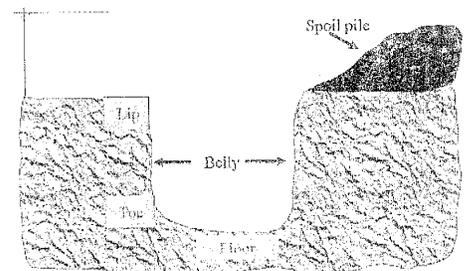
Soil and Wall Collapse

<u>Soil</u>	<u>Number of Failures</u>
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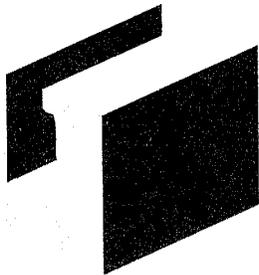
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Parts of a Trench



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

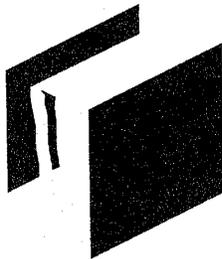
Slough-In (Belly In)



1

This collapse reinforces the importance of approaching a trench from the end, not the side, as there is an undermined ledge left.

Sidewall-In (Side Wall Shear)



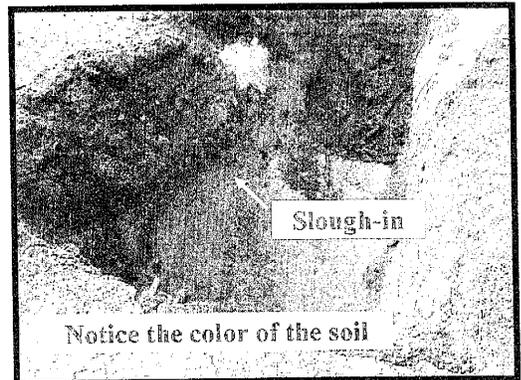
2

Common collapse with clay

Types of Collapses

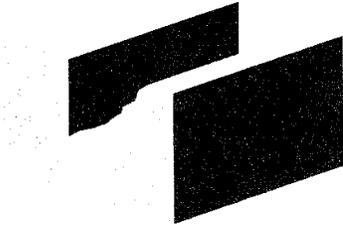
- ◆ Slough-in (Belly In)
- ◆ Sidewall-in (Side Wall Shear)
- ◆ Shear-in (Lip Slide)
- ◆ Spoil-in (Spoil Pile Slide In)

15



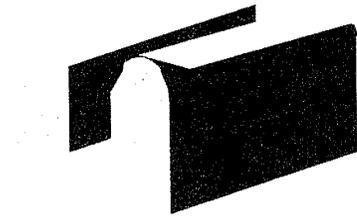
INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

Shear-In (Lip Slide)



Common collapse due to weight of spoil pile

Spoil-In (Spoil Pile Slide In)



Vibration

Vibration is extremely destructive to trench stability. Vibration will speed-up the collapse of the walls, and will magnify any other factors, which are affecting the trench. The most common sources of vibration are the digging operations themselves and vehicles passing by. Other sources to consider are trains, processing operations from nearby industry, and motors running near the trench. Vibration is particularly dangerous at rescue scenes, but is usually a factor, which can often be controlled. Rescuers must be careful to not add vibration to a scene by careless use of vehicles, generators, or other equipment.



Vibration

- ◆ Extremely dangerous
- ◆ Typical sources
- ◆ Roadways
- ◆ Railroads
- ◆ Digging operations
- ◆ Nearby construction/industry



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

Rescue work also causes vibration.

Stop sources of vibration

Vibration contributes significantly to the likelihood of further collapses. *Eliminate sources of vibrations by stopping traffic for at least 300 feet.* Search for other possible sources of vibration such as train tracks, nearby industry, or machinery operating near the site and shut down these operations.

Law enforcement can help with this task.

Superimposed loads

- ◆ Add weight & stress to trench
- ◆ Examples
 - Spoil pile
 - Heavy equipment
 - Work materials (cable, vaults, pipe)
 - People

Surface Encumbrances

- ◆ Other structures whose support relies on the soil at or near the trench
- ◆ Examples
 - Roadways
 - Utility poles
 - Foundations

Environmental factors
affecting trench stability

Superimposed Load



Surface Encumbrances

- ◆ Other structures whose support relies on the soil at or near the trench
- ◆ Examples
 - Roadways
 - Utility poles
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INSTRUCTOR MANUAL

TECHNICAL RESCUE

AWARENESS

TRENCH

Wet soils (saturated) / Submerged Soils

Wet soils of any type are dangerous due to the added weight of the water, the loss of friction due to the moisture, and the mechanics of the movement of the water through the soil. Trenches, which have been dug below the water table, will "draw" water into the open hole. Water seeping into the trench will undermine the trench walls pulling them into the trench. This will lead to wall collapse, entrapment and/or drowning of anyone in the trench.

Exposure to Elements

Time the longer the trench is open, the more unstable it will become

Sun and wind will dry out the soil allowing cracks to develop

Freezing and thawing will work soil loose and develop cracks

Previously disturbed soils

The most stable soils are those, which have gone undisturbed for thousands of years. Each grain of soil was dropped or blown into its position creating a "locking" effect between grains. Once the earth has been disturbed, it is impossible to return it to its original stability. Excavation within last 25 yrs is disturbed.

Wet Soils/Submerged Soils

- ◆ Added weight
- ◆ Loss of friction
- ◆ Movement of water carrying soil
- ◆ Standing water undermining trench walls

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Exposure to Elements

- ◆ Time - longer trench is open the more unstable it will be
- ◆ Sun and wind
- ◆ Freezing / Thawing

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Previously disturbed soils are common due to trenches being located in easements

Excavation within last 25 years makes soil previously disturbed

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INSTRUCTOR MANUAL

TECHNICAL RESCUE

AWARENESS

TRENCH

Buried utilities (Call 811 in Indiana)

Trenches are excavated to allow for the installation of various utilities. Since most utilities run in easements, it is almost certain that some form of underground utility will be encountered during excavation.

811 can be called for an emergency utility locate. If unsure of what utilities are involved, call all of them.

Understanding utility colors can assist with hazard identification. Rescuers can look for flags or spray paint markings as part of their initial size-up.

Secondary collapses

By far the most lethal hazard in trench rescues is the likelihood of secondary collapse. Once a collapse has occurred, the remaining sections of trench wall will have much less stability. The fallen section of dirt typically leaves a larger section unsupported, which in-turn fails, which leaves an even larger section unsupported, which also fails. Unfortunately, these secondary collapses seem to occur just about the time that a rescuer is attempting to dig out the initial victim and are responsible for the high number of rescuer deaths.

Buried Utilities

- ◆ Must be located
- ◆ Often requires time-consuming hand digging
- ◆ Common problem since most trenches are located in easements
- ◆ OSHA requires that all utilities or other structures exposed in trenches be properly supported.

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Call 811

Two working days before you dig

MARKINGS COLOR CODE

Communications	Orange
Electric	Red
Excavation Boundaries	White
Natural Gas	Yellow
Sewer	Green
Water	Blue

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Secondary Collapses

- ◆ Walls are undermined from initial collapse
- ◆ Walls are often left more unstable than before initial collapse
- ◆ Often occur while "quick" rescue attempt is being made

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INSTRUCTOR MANUAL

TECHNICAL RESCUE

AWARENESS

TRENCH

Speed of Collapsing Dirt.

Studies have shown that *trench walls often collapse in less than 1/10th of a second*. A well-intentioned rescuer who thinks that he can climb out, or can be pulled-out by a rope before a collapse catches him, is inviting trouble.

Unlike a building, dirt does not "creak" prior to collapse, providing a means of early warning. Dirt falls fast and quiet.

Rescues are usually long operations

People who are buried in cave-ins are usually "frozen" in the position they were in when the collapse occurred. Often arms and legs are bent at odd positions and in many cases, the victim has suffered fractures. Victims cannot merely be pulled-out from under the dirt. Therefore, *the victim must be completely uncovered before he can be removed from the trench*. Attempting to "yank" a victim will only result in additional injury, and will not release the victim. Most rescues require as much as 4-10 hours to complete.

Trenches dug too deep or too wide

OSHA provides guidelines for the general construction of trenches up to 20 feet deep and 15 feet wide. Excavations beyond these dimensions require special engineering by a Registered Professional Engineer (RPE).

Speed of Collapsing Dirt

- ◆ Often less than 1/10 of a second
- ◆ Normal escape methods ineffective
- ◆ Being pulled out with a rope
- ◆ Running out

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Rescues are Usually Long Operations

- ◆ Commonly last 4-10 hours
- ◆ Victims must be completely uncovered before removed
 - Often frozen in position
 - Limbs commonly bent at odd angles
 - Fractures are common

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Contractors Often Ignore OSHA Limits

- ◆ OSHA only provides regulations for trenches up to 20' deep; deeper requires special engineering
- ◆ Contractors who have ignored safety requirements may have also ignored the 20' limit

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

OSHA regulations

OSHA has published regulations dealing with trenches in 29 CFR Part 1926, subpart P. This standard regulates the construction and occupation of trenches over 5 feet deep and shallower trenches with special hazards. These regulations apply to rescuers as well as workers.

Indiana has adopted OSHA regulations through the Indiana Department of Labor.

PROTECTIVE SYSTEMS

OSHA provides three methods for protecting workers in trenches...sloping/benching, shielding, and shoring. No worker is to enter a trench greater than 5 feet deep unless one of these protections is in place.

Types of Worker Protective Systems

- ◆ Sloping
- ◆ Benching
- ◆ Shielding
- ◆ Shoring

Determined by:

- ◆ Soil class
- ◆ Workspace required
- ◆ Economic factors



State Level

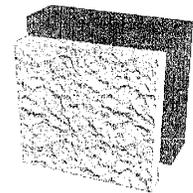
- ◆ Follow OSHA regulations
 - 29 CFR 1926 Subpart P - Excavation
- ◆ Must adopt equal or more stringent regulations

Indiana

- ◆ Is an OSHA State
 - Federal OSHA - Oversees State Program
 - IDOL governs state & municipal employees
- ◆ Has adopted-by-reference Federal OSHA regulations
 - 29 CFR Part 1926
 - Failure to comply results in large fines

Types of Worker Protective Systems

- ◆ Sloping
- ◆ Benching
- ◆ Shielding
- ◆ Shoring

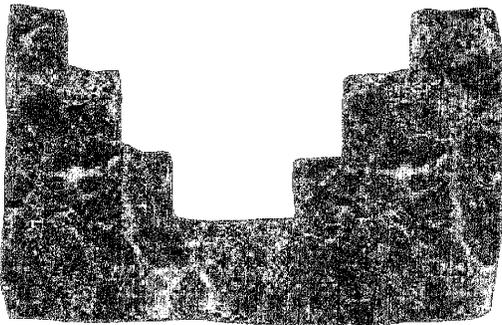
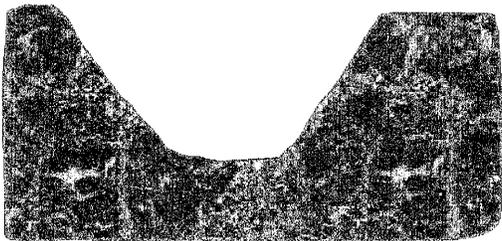


INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

Sloping/Benching

Sloping involves cutting back the sides of a trench to an angle at which the earth will no longer slide. OSHA defines sloping angles for each class of soil. The angle, which is sought, is referred to as the "**angle of repose**" and is merely the angle at which the soil will no longer slide.

- For departments with no equipment.
- Best for recovery, not rescue
- Tabulated data sheet is used as guide



Sloping Principles

- ◆ Laying back soil to its Angle of Repose
- ◆ Requires opening a lot of land
- ◆ Only option in some soils



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

Shielding Principles

Shielding involves the use of extremely strong metal boxes, which have been engineered to withstand the pressure of the earth for the size trench that is being worked in. Trench shields (also called trench boxes) are strong enough to protect a worker from cave-ins as long as the worker stays within the shield. Trench shields must be installed no more than 2 feet off the bottom of the trench and even with or above the trench lip.

Two basic types of shields:

- Steel, non-adjustable
- Aluminum, adjustable

Shoring Concept

Shoring is a method of protecting the worker by constructing a support system within the trench, which will pressurize the trench walls, enough to create "arches" of support, which will hold-up the trench walls. *Shoring is designed to be strong enough to stop the walls from starting to move, but is not designed to be strong enough to stop moving dirt.*



Shielding Principles

- ◆ Strong metal "boxes" designed to withstand the pressure of collapsing soil
- ◆ Must be engineered for size trench & soil class
- ◆ Must be level with or extend above lip of trench.
- ◆ Must not be more than 2' up off the bottom
- ◆ Usually dragged down a trench - worker may be inside as long as no lifting is required

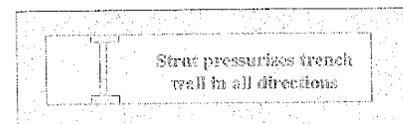
Two basic types of shields

- ◆ Steel, non-adjustable
- ◆ Aluminum, adjustable

Manual
Hydraulic
Pneumatic

Shoring Concept

- ◆ Works by creating "double funnel effect"



- ◆ Strong enough to prevent soil from starting to move, but not strong enough to stop moving dirt



INSTRUCTOR MANUAL

TECHNICAL RESCUE

AWARENESS

TRENCH

Shoring systems may be constructed with a variety of materials and may be constructed in a variety of configurations. The simplest system contains two elements, crossbraces and uprights. The crossbraces pressurize the walls while the uprights distribute the pressure vertically. As more strength is required, additional elements are added to strengthen the system, much like beams are added to a structure. These beam-like members are called walers.

OSHA provides charts for timber shoring and hydraulic shoring for dry trenches up to 15 feet wide and 20 feet deep. Manufactured Shoring Systems come with documentation of component strength for various conditions. This documentation is prepared by a registered professional engineer and is called Tabulated Data.

Tabulated data is based on three items:

1. Depth of trench
2. Width of trench
3. Type of soil

Also referred to as "Tab Data", these sheets are also used to determine proper bench / slope.

In general, the weaker, deeper and wider the trench, the stronger and more numerous the shoring members must be.

Specific Types of Shores

- ◆ Manufactured Shoring systems come with documentation of component strength for various conditions. This documentation is prepared by registered professional engineer and is called Tabulated Data. Which should be referenced frequently.

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

Specific Types of Shores

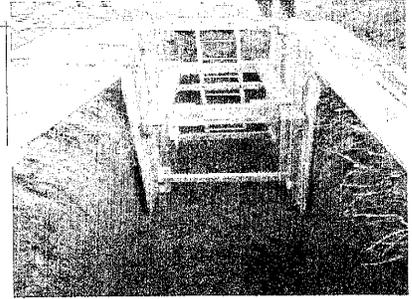
- Timber
- Screw jack
- Pneumatic

**Sheeting (trench panel) is applied to the trench wall, and Shoring holds the sheeting in place.

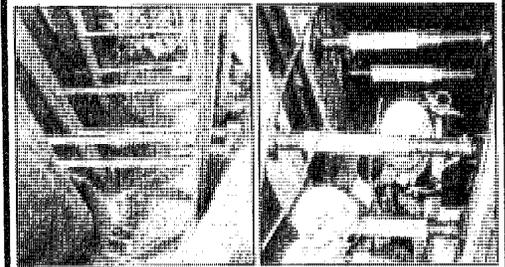
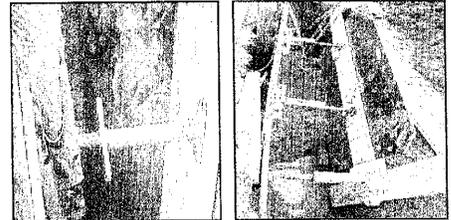
Pneumatic

- ◆ Most expensive
- ◆ Air driven with locking collar & pin
- ◆ Limited working range
- ◆ Relies on OSHA timber charts for uprights & walers

Timber Shoring



Screwjack Shoring



INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

Size- Up Considerations for Rescue Operations

Depth of Trench
Soil Type
Entry Point
Weather Conditions
Width of Trench
Spoil Pile
Exit Point
Level of Training

Water Content
Impact of Loads
Location of Victims
Angle of Repose
Supports in place
Manpower
Equipment Availability
Gathering of Information
EMS (life support)

Size –Up Considerations

- ◆ Depth of Trench
- ◆ Width of Trench
- ◆ Soil Type
- ◆ Spoil pile
- ◆ Entry point
- ◆ Exit point
- ◆ Weather conditions
- ◆ Level of Training

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Size –Up Considerations (cont)

- ◆ Water content in Trench
- ◆ Impact of nearby LOADS
- ◆ Location of Victim(s)
- ◆ Angle of Repose
- ◆ Supports in place

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Size –Up Considerations (cont)

- ◆ Manpower
- ◆ Equipment availability
- ◆ Witness Information
- ◆ EMS (life support)

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INSTRUCTOR MANUAL

TECHNICAL RESCUE

AWARENESS

TRENCH

Secure Immediate Area

- Prevent use of heavy equipment
- Stop sources of vibration within 300'
- Set-up Zones (Hot, Warm, Cold)
- Attempt to locate and mark victim location

Do not allow the use of heavy equipment

Do not allow the contractor to use his backhoe to try and uncover the victim. This will most likely only injure the victim further and bury him deeper when the vibration causes more of the walls to collapse.

Personal protective equipment

At minimum:

- Head Protection (Construction Helmet)
- Eye Protection (Safety Glasses)
- Hand Protection (Leather Work Gloves)
- Foot Protection (Steel Toe / shank Boots)

Provide head and eye protection to victim if possible by lowering them into trench

View Trench by Approaching from end

- Stay at least 10 feet away from incident site
- Inspect trench for spoil pile location (is it too close or steep?)
- Inspect walls for signs of impending or recent failure
- Evaluate both ends for possible hazards prior to approaching the open trench

Ask the students:

What type of collapse is this?

How far back is the spoil pile?

Layers of soil?

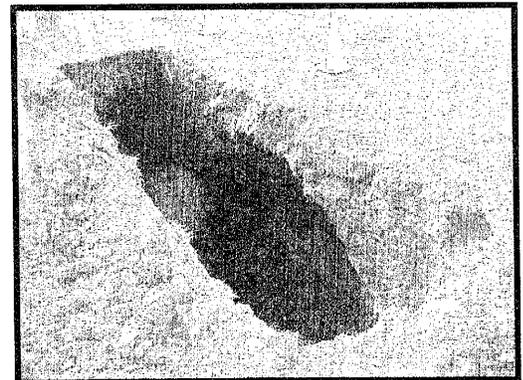
Water in trench?

**Point out how water undermines the trench wall.

Secure Immediate Area

- ◆ Prevent use of heavy equipment
- ◆ Stop sources of vibration within 300'
- ◆ Set-up zones (Hot, Warm, Cold)
- ◆ Attempt to locate and mark victims position

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INSTRUCTOR MANUAL

TECHNICAL RESCUE

AWARENESS

TRENCH

Establish Ground Pads if Available

Sheeting material or dimensional lumber

Look around the scene / jobsite. Assign jobsite workers to gather this material and stage it in the warm zone. This gets material needed for the rescue and helps keep non-essential personnel out of the hot zone. Workers will now be part of the solution, not the problem.

Consider Non-Entry Rescue

Place ladder as soon as possible for non-entry rescue and emergency escape of responders who may fall into the trench

Ladders off of fire apparatus or the jobsite can be used.

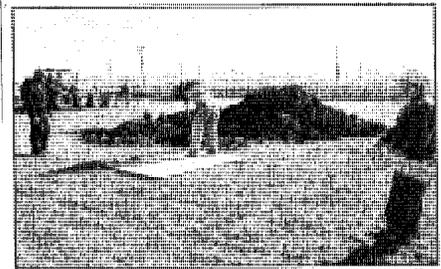
Air Quality Monitoring

May be considered confined space if dug in areas where air is bad.

Should monitor all trenches to be safe

Readings should be taken from the top, middle, and bottom. Person assigned this task should be on a ground pad, away from any unstable area.

Establish Ground Pads if Available



Consider Non-Entry Rescue



Air Quality Monitoring

- ◆ May be considered confined spaces if dug in areas where air is bad
- ◆ Should monitor all trenches to be safe



INSTRUCTOR MANUAL

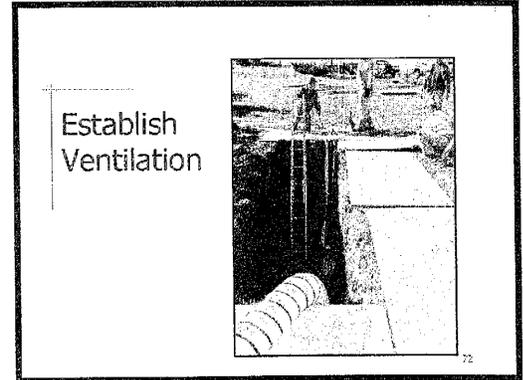
TECHNICAL RESCUE

AWARENESS

TRENCH

Establish Ventilation

Consider utilizing smoke ejectors to provide ventilation for victims



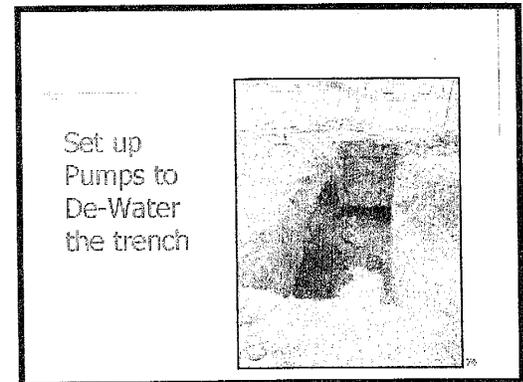
Implement Water Removal Systems

Pumps

Above ground level pumping

Monitor air in trench for CO from pumps

If contractor has a de-watering system going, keep it running unless it is unsafe



Pumps can also be obtained:

-DPW

-County Highway

-Local rental stores

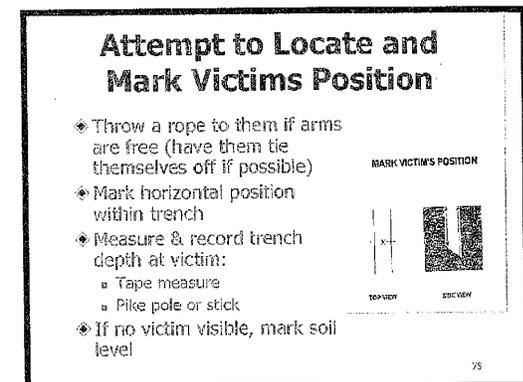
Attempt to Locate and Mark Victims Position

Throw a rope to victim if arms are free (have victim tie themselves off if possible)

Mark horizontal position within trench if possible

Measure and record trench depth at the victim

If no victim visible, mark soil level



INSTRUCTOR MANUAL

TECHNICAL RESCUE

AWARENESS

TRENCH

Initiate Removal of Superimposed Loads

Use personnel with shovels to begin removing spoil pile at least 2' provided the lip is safe and groundpads are available to distribute the weight of personnel working near the lip.

Rescuers should access the spoil pile from the back, pulling dirt away from the trench

Have EMS Prepare for Injuries

Fractures, Lung injuries, Head injuries, Spinal injuries, Respiratory system injuries, Hypothermia, Crush syndrome.

A separate EMS component should be established for rescues



Prepare for injuries

- ◆ Fractures
- ◆ Lung injuries
- ◆ Head injuries
- ◆ Spinal injuries
- ◆ Respiratory system injuries
- ◆ Hypothermia
- ◆ Crush syndrome

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INSTRUCTOR MANUAL TECHNICAL RESCUE AWARENESS TRENCH

Steps to Trench Rescue

Preparation
Response
Assessment
Hazard Control
Support Operations

Steps to Trench Rescue

Gaining Access
Disentanglement
Packaging
Removal
Termination

10 Steps to Trench Rescue

- ◆ Preparation
- ◆ Response
- ◆ Assessment
- ◆ Hazard Control
- ◆ Support Operations

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10 Steps to Trench Rescue

- ◆ Gaining Access
- ◆ Disentanglement
- ◆ Packaging
- ◆ Removal
- ◆ Termination

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INSTRUCTOR MANUAL

TECHNICAL RESCUE

AWARENESS

TRENCH

Trench & Excavation Summary

- Recognize the need for trench and excavation rescue.
- Identify the resource necessary to conduct safe and effective trench and excavation emergency operations.
- Identify the emergency response system for trench and excavation incidents.
- Identify site control and scene management procedures for trench and excavation incident.
- Recognize the general hazards associated with trench and excavation emergency incidents.
- Recognize typical trench and excavation collapse patterns, the reasons trenches and excavations collapse, and the potential for secondary collapse.
- Identify how a rapid, non-entry extrication of non-injured or minimally injured victims is initiated.
- Recognize the unique hazards associated with the weight of soil and its associated entrapping characteristics.

