Close

Building Collapse Rescue Operations: Technical Search Capabilities

BY TOM DONNELLY

Search is the foundation of the structural collapse rescue operation. If victims can't be located, they can't be rescued. It is imperative that every piece of equipment in the rescue/urban search and rescue (USAR) arsenal be considered during a collapse search and rescue operation. Most rescue companies/USAR teams carry a full complement of technical search equipment that has been successfully used at collapse rescue operations.

Equipment used in urban disaster settings are of two categories: physical search and technical search. Often, factors such as the type of building construction determine which equipment to use. For example, electronic equipment is very effective for structures with large concrete slabs or those made of steel.

LISTENING DEVICES

Many rescue/USAR teams use a life detector listening system. This equipment can transform a collapsed structure into a large sensitive microphone in which signals from entombed victims are magnified. The system converts vibrations from victims into audible and visual signals (photo 1). In collapse search and rescue, the key purpose of the listening device is to detect sounds from victims such as calling, crying, knocking, moving, breathing, or even the vibration of a heartbeat. Seismic/acoustic listening devices are specifically designed to locate trapped victims in collapsed structures.

(1) Photos by author.

The advent of state-of-the-art electronic devices has added a positive dimension to technical search. Electronic devices (photo 2) are capable of detecting acoustic sound (voice) and seismic sound (movement or knocking) produced by survivors within a collapsed structure. The objective is to triangulate the exact location (photo 3).

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This technical search is augmented with the physical void search operation. After searchers detect a signal with the listening device, they then try to locate the source of the sounds. The operator listens to the sensors. The sounds heard will depend on the material on which the sensor sits. Steel will generally ring clear, wood will produce a more muffled sound, and concrete will produce a ring similar to that of steel.

Although listening devices can filter a wide range of frequencies, they are best used in an environment where there is minimal noise. Depending on the level and amount of debris, the detection range of listening device sensors are from five to 25 feet for acoustic sounds and about 50 to 150 feet for seismic sounds. These devices can be very effective in identifying the location of a victim within a collapsed structure. As few as two sensors may be used, positioned every 20 to 30 feet. While listening, the operator or another team member will call out or knock. In this phase of the operation, the objective of the listening device is to detect sound. As the listening operation progresses, up to six sensors (photo 4) may be used; personnel are strategically positioned at each sensor. Generally, it is more efficient to start with sensors and then triangulate the listening search based on the probability of the victim's location.

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Interference when using listening devices, structure-borne sounds, can affect the listener's ability to detect a signal from the victim.

Natural interference such as wind, sleet, or flowing water will cascade off parts of the structure and produce signals, making it difficult for the rescuer to detect a signal. Man-made sounds from equipment will not be a problem if the sensors are placed so they reduce the interference. It's important that personnel working in the search mode be fully aware that a listening operation is underway.

The location and placement of sensors are critical. The goal should be to access a clean hard surface. Loose sand gravel, carpeting, and roof membrane seriously reduce the effectiveness of the sensor to pick up signals. Attempt to get to the solid parts of the structure—foundation walls, beams, columns—where there is a chance that a victim may be able to knock against a wall or a structural part in a void.

Collapse rescue listening systems have several advantages for rescue personnel at a collapse search and rescue operation if the personnel are trained in their use:

1 They can detect sounds made by conscious buried victims within a collapsed structure.

2 They cover a large area and triangulate the victim's location and enable rescuers to begin the physical search and rescue mission by tunneling to the victim.

3 They may be used to verify other search tactics.

4 When spaced evenly throughout a collapsed structure, the listening devices can detect the slightest sounds within a collapsed structure; they can detect victims within the structure.

5They can be strategically placed around a collapsed structure as part of the overall void search and rescue operations.

The usefulness of listening devices diminishes over time as the victim's condition deteriorates. Victims must be capable of making a response that can be heard through rubble and above ambient noise.

SEARCH CAMERA

Search cameras make it possible to locate a victim within a void, assess the victim's condition, and help assist with extrication. Using a search camera is an intuitive process and basically an extension of the human eye. The cameras have audio capability (photos 5, 6); some of the latest versions also have thermal and video capabilities and a fiber-optic scope.

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Pneumatic and electric hammer drills are used to bore an inspection hole so the camera can be inserted in the rubble (photo 7). The snake eye camera has a flexible tube that can be easily inserted into a bored hole. The search cam camera has an audio sensor that enables the camera operator to speak with a victim entombed in a void (photo 8). This benefit allows search teams to look into surface voids and other hard-to-reach areas through existing cracks and openings.

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The search camera can be used to help a tunneling operation, to plan a breach in an area, to monitor a victim's location, and to communicate with the victim. Reassuring the victim and letting him know that searchers are nearby may help to strengthen the victim's desire to survive.

Experience has shown that boring is the best way to gain access so the rescuer can use a search camera to locate the victim. Rescue companies/USAR units carry a wide assortment of boring tools.

When using a search camera, the operator must remain oriented and employ a systematic search plan. When searching void spaces, the searcher often uses a landmark as a reference point from which to start the search and then expands the search (photo 9). Communicating which areas have been covered and those that have not been reached is a very important part of the collapse rescue plan.

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Technical search devices add an accelerated dimension to the overall collapse rescue plan. They increase the potential for saving lives in a structural building collapse.

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