## Suffolk County Fire Academy

*Trench Rescue Operations*
*Session 1*

Suffolk County
Fire Academy

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## House-Keeping

- Instructors
- Students
- Paperwork
- Student Manuals
- Exits
- Cell Phones and Pagers.

2

## Course Overview

- Session 1
  - Statistics, Standards, and Definitions
  - Soil Review
  - Trench Collapse
  - Protection and Shoring
  - Equipment Review
  - Case Studies
  - Hands-On Trench Op.


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## Course Objectives

- Conduct a size-up of a trench excavation to identify the potential hazards to victims and rescuers (NFPA 1006 12.2.1)
- Implement a hazard control plan (NFPA 1006 12.2.2)
- Develop a shoring plan for a nonintersecting trench ≤ 8' deep (NFPA 1006 12.2.3)
- Implement a trench shoring plan for a nonintersecting trench ≤ 8' deep (NFPA 1006 12.2.4).

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## Course Objectives

- Release a victim from soil entrapment in a nonintersecting collapsed trench ≤ 8' deep (NFPA 1006 12.2.5)
- Remove a victim from a trench (NFPA 1006 12.2.6)
- Disassemble support systems at a trench emergency incident (NFPA 1006 12.2.7)
- Terminate a technical rescue operation (NFPA 1006 12.2.8)

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## Statistics, Standards, and Definitions

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## Statistics

- NIOSH and OSHA
- 1992 – 2000 = 488 deaths (≈ 54/year)
- 2000 – 2006 = 271 deaths (≈ 45/year)
- 76% Caused By Cave-In
- Most Deaths Occur In Trenches 5ft – 8ft deep.

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## Causes of Death

- Suffocation
- Crushing Injury
- Loss of Circulation
- Being Struck By Fallen Object

***Two Types of Trench Incidents:***
***Live Victims (Rescue)***
***and***
***Dead Victims (Recovery)***

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## OSHA 1926, Subpart B

- General Requirements
  - Spoil Pile Must Be 2' From Lip
  - Means of Egress Every 25'
  - Determination of Atmospheric Hazard
  - Water Accumulation Plan
  - Determination of Soil Classification
  - Inspection By Competent Person.

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## Competent Person

- As defined in OSHA Standard 1926.650
  - A person who is ***capable of identifying*** existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees and who ***has authorization*** to take corrective measures.

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## Competent Person

- Must have specific training in and be knowledgeable about soil analysis, the use of protective systems, and the requirement of the standard
- Every excavation site (***including rescue operations***) must have a competent person as defined by OSHA.

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## Competent Person Responsibilities

- Must Be Able To Identify:
  - Evidence of Possible Cave-Ins
  - Failure of Protective Systems
  - Hazardous Atmosphere
- Frequency Of Inspections:
  - Prior to Start
  - As Needed
  - Hazard Increase.

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## NFPA 1006

- Standard for Technical Rescue Personnel Professional Qualifications (2021)
- Establishes ***minimum job performance requirements*** for emergency response personnel who perform technical rescue operations.

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## NFPA 1006

- Core Requirements Include:
  - Site operations
  - Victim Management
  - Basic Ropes and Rigging

- Level 1 & Level 2 Operators:
  - Level 1 – Non-intersecting, ≤ 8' in depth
  - Level 2 – Intersecting and/or ≥ 8' in depth.

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## NFPA 1670

- Standard on Operations and Training for Technical Search and Rescue Incidents (2017)
- Three Levels of Training
  - Awareness
  - Operations (Level 1)
  - Technician (Level 2).

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## Operations Level

- Procedure To Make Entry Into Trench
- Recognition of Unstable Areas
- Identify Probable Victim Location and Survivability
- Make Rescue Area Safe
- Control Utilities
- Identify Soil Types.

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## Operations Level

- Ventilation of Trench
- Identification of Bell-Bottom Excavation (pier hole) and Its Associated Hazards
- Procedures For Placing Ground Pads
- Provide Entry and Egress Paths For Entry Personnel
- Pre-Entry Briefing
- Record Keeping and Documentation During Entry.

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## Excavation vs. Trench

- Excavation – man-made cut, cavity, trench, or depression in the earth's surface formed by the removal of that earth
- Trench – a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width (measured at the bottom) is not greater than 15ft.

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## Excavation

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## Trench

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## Arrival

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## Soil Review

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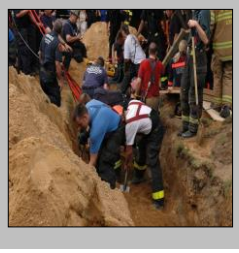
## Soil Facts

- One Cubic Yard = 2,700 lbs.
- One Gallon = 13 lbs.
- One Cubic Yard Will Fill 230, 1 Gallon Buckets.
- How much weight is on the victim?



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## Soil Physics

- Sheer Wall Collapse Speed = 45 mph
- One Cubic Foot Of Soil 100 – 120 lbs.
- 24” Of Soil On Chest 750 – 1000 lbs.

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## Cannot Out-run Dirt

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## Soil Types

| TYPE A | TYPE B | TYPE C |
|---|---|---|
| Most Stable | Less Stable | Least Stable |
| Load Rating ≥ 1.5T | Load Rating > .5T But < 1.5T | Load Rating ≤ .5T |
| Heavy, Strong Clay Cemented Soil Hard Pan | Granular Soil, Gravel, Silt, Loam, Sandy Loam | Granular Soils, Gravel, Sand, Sandy Loam, Clay |
| Not Fissured, Subject To Vibration Or Previously Disturbed | Can Be Previously Disturbed (But not Type C) Or Unstable Type A | Submerged Soil Or Soil From Which Water Is Freely Seeping |

**All Trench Rescues Are Considered Type C Soils**

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## Soil Types and Wall Collapse

| TYPE OF SOIL | NUMBER OF FAILURES |
|---|---|
| Clay / Mud | 32 |
| Sand | 21 |
| Wet Dirt (Silty Clay) | 10 |
| Sand, Gravel, Clay | 8 |
| Rock | 7 |
| Gravel | 4 |
| Sand and Gravel | 2 |

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## Soil Classification

- **Compact – Soil That Appears Compact Or Even Hard And Thus Stable**
- **Saturated – Soil From Which You Can See Water Actually Seeping**
- **Running – Loose, Free Flowing Soil Such As Sugar Sand.**

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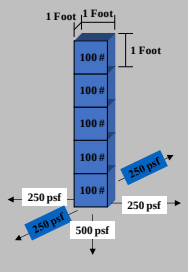
## Weight and Pressure of Soil

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## Victim Consideration

- **Medical**
  - **Crush Injury**
  - **Suffocation**
  - **Fracture/Dislocation**
  - **Head, Neck, Spinal Injury**
  - **Hypothermia**
- **Rescue**
  - **Non-entry/Self-rescue**
  - **Uncover Head And Chest First**
  - **Do Not Try To Pull The Victim Until They Are Completely Unburied**
  - **Rescue vs. Recovery.**

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## Trench Collapse

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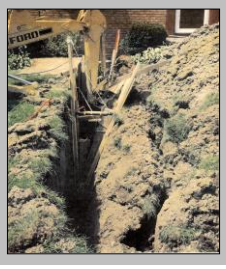
## Why Do Trenches Collapse

- Weight Of Soil
- Soil Type
- Tension Cracks Or Fissures
- Hydraulic Forces.



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## Increased Potential For Trench Rescues

- Underground Utilities
- Thousands of Open Trenches
- Lack of Contractor Training
- Lack of Enforcement
- More Complex Underground Engineering
- More Construction
- “Johnny Homeowner”
- Toxic Atmosphere In Trench.

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## In What Depth Do Most Trench Rescues Occur?

**5’ – 8’ Deep and less than 6’ Wide**

**Why?**

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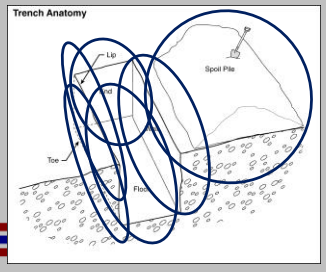
## Anatomy Of A Trench

- Trench and Excavation
- Floor
- Walls
- Ends
- Lip
- Toe
- Spoil Pile

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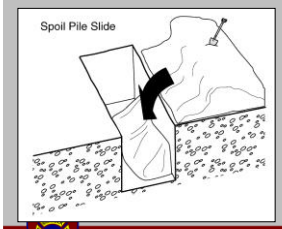
## Cave-In Types




*Spoil Pile Slide*

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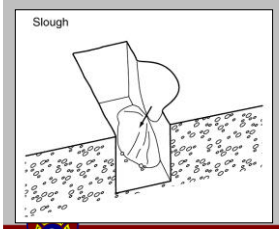
## Cave-In Types




*Slough or Belly Failure*

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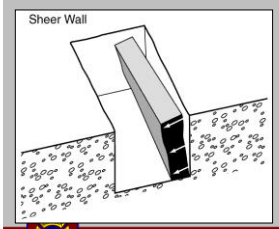
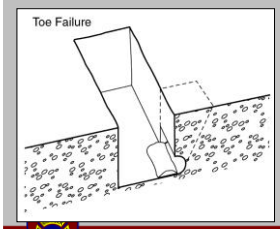
## Cave-In Types

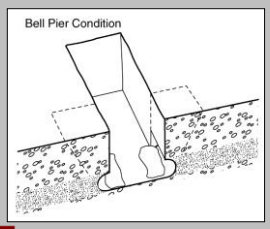



*Shear Wall Failure*

45

## Cave-In Types




*Toe Failure* *Bell Pier Condition*

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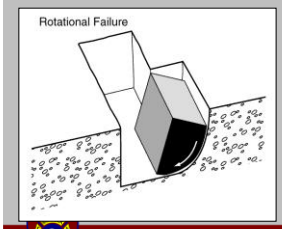
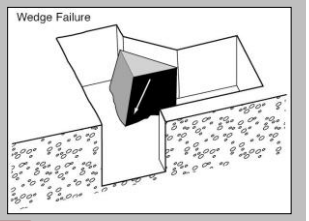
## Cave-In Types




*Rotational Failure* *Wedge Failure*

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## Protection and Shoring

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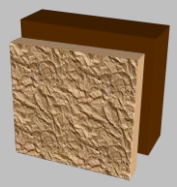
## Worker Protection Systems

- Sloping
- Benching
- Shielding
- Shoring.



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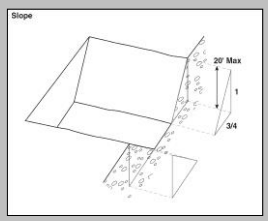
## Sloping

| Soil | Slope (Hoz : Vert) | Angle |
|---|---|---|
| Stable Rock | Vertical | 90° |
| Type A | ¾ : 1 | 53° |
| Type B | 1:1 | 45° |
| Type C | 1 ½ : 1 | 34° |

*Trench < 20'*

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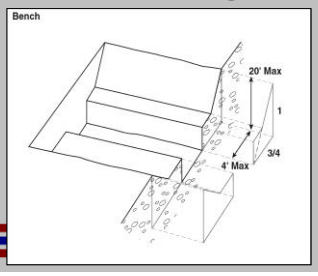
## Benching

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## Shielding

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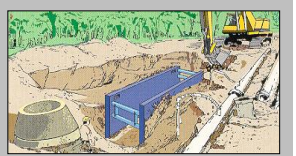
## Shielding



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## Shielding

55

## Shielding


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## Shoring

Same Side Panel Set

Opposite Side Panel Set

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## Pneumatic Shoring

- Type/Indications For Use
- Transfer of Energy
- Overlapping Zone of Pressure
- Installation Procedure
- Toe Nailing.

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## Timber Shoring

- Type/Indications For Use
- Transfer of Energy
- Scabbing
- Rails and Wedge Use.

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## Timber Shoring In Place

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## Emergency Shoring In Place

61

## Trench Walls Are Not Always Square

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## Equipment Review

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## Equipment Checklist

- Air Monitoring
- Ventilation
- Ladders
- Lighting
- Hazard Control
- Hand / Power Tools
- Ground Pads
- Shoring
- Patient Packaging
- Heavy Equipment
- De-watering
- Rehab.

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## Ground Pads

2" x 12"

Marking Ground Pad

4' x 8" x ¾"

Address Tripping Hazards

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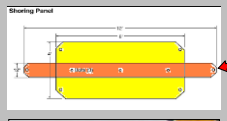
## Sheeting (Trench Panels)



Strong Back

Manufactured Panels

Rope For Lowering

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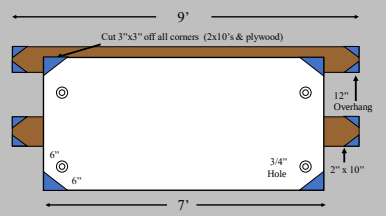
## Trench Panel Assembly

- 2 – 4’ x 7’ x ¾” Plywood (Glued and Screwed)
  or
- ¾” Thick 14 Ply Artic White Birch (Finland Form)

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## Wales

- Type/Indications For Use
  - Inside (Create Open Space)
  - Outside (Span An Opening)
- Transfer of Energy
- Installation Procedure
- Back-Filling.



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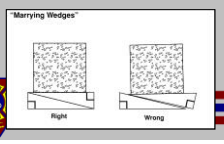
## Wedges




Filling Void Between Wale and Panel

Lift An Inch, Crib An Inch

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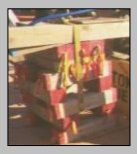
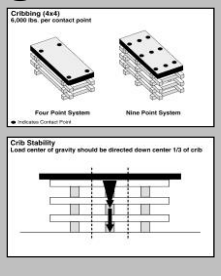
## Cribbing

- 4 Point and 9 Point System
- Generally 4x4 or 6x6 Sizes
- Weight Per Contact Point
- Height = No More Than 3x Base Width
- Overlap The Dimension Of The Lumber.



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## Cribbing

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## Air Bags

- High Pressure:
  - 80 – 100 psi
  - Limited lift height
- Low Pressure:
  - 7 – 12 psi
  - Higher lift
  - Lower capacity.

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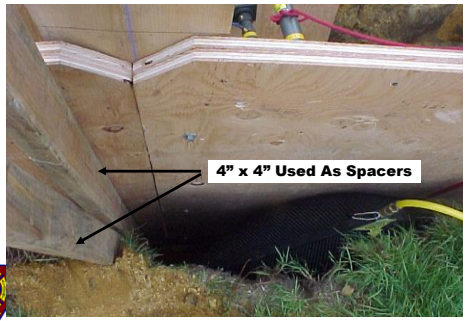


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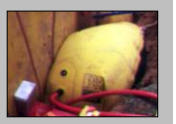
## Air Bags In Trench Rescue


Stacked High Pressure


Low Pressure Lift (W/ Rigging Strap)


Filling Slough Void

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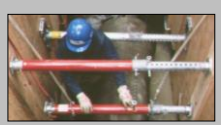
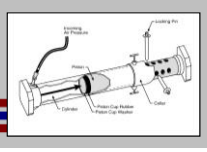
## Pneumatic Shores


Paratech


Airshore



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## Shores

Timber

Hydraulic

Screw Jacks

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## Paratech Struts

- Moveable Grooved Shaft (lockstroke)
- Moveable Acme Threaded Shaft (Acme Thread)
- Consists of a 3" dia. AL Alloy Tube With A Solid 2 ½" Dia. AL Alloy Ram
- Axial Crush Strength Exceeds 50,000lbs
- Working Load = 20,000lbs.

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## Paratech Struts (Lockstroke)

- Lockstroke Thread
  - Locks automatically in increments of 0.400"

15.3 - 21.8" – 6" stroke
23.6 - 35.6" – 12" stroke
35.4 - 57.1" – 24" stroke
54.5 - 90.1" – 36" stroke
* Without Bases *

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## Paratech Struts (Acme)

- Acme Thread
  - Permits "soft" placement with sensitive positioning

15.5 - 21.4" – 6" stroke
23.9 - 35.5" – 12" stroke
35.5 - 57.5" – 24" stroke
54.6 – 86.5" – 36" stroke
* Without Bases *

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## Paratech Strut Extensions

- Rule of Thumb:
  - No more than 3' ext. (1 – 3' Extension)
  - No more than 2 ext. (Not to exceed 3' – 2 – 1' Extensions or 1 – 1' and 1 – 2' Extension)
  - Added to base of strut


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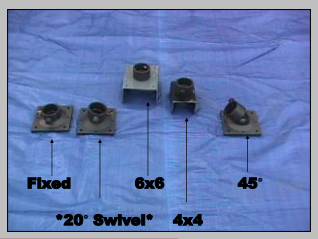
## Paratech Strut Bases

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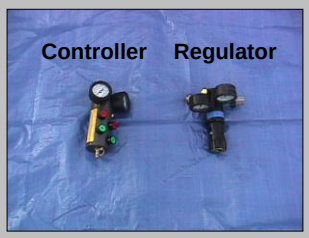
## Paratech Controls

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## Paratech Hoses

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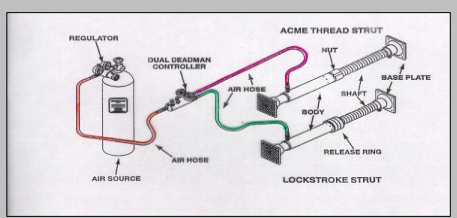
## Paratech System

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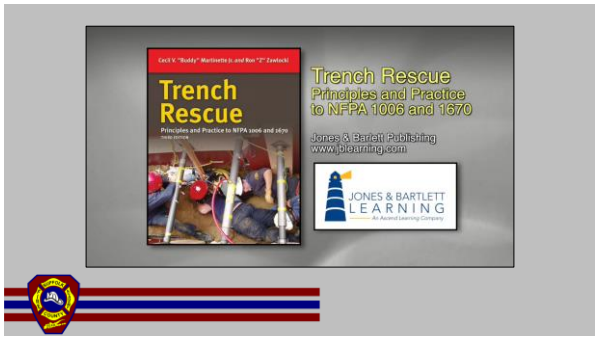
Trench Rescue
Principles and Practice to NFPA 1006 and 1670
Jones & Bartlett Publishing
www.jblearning.com
JONES & BARTLETT LEARNING

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The ART of Rescue
AIRSHORE
Airshore International - First on the market...and still number one!
For more information please have a look at our website:
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Airshore Struts

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## Tools and Appliances

- Shovel Types
- Hammers
- Duplex Nails
- Ventilation
- Dewatering
- Ladders.

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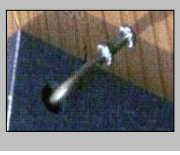
## Tools and Appliances

Fan For Vent

Centrifugal (High Pressure – High Volume)

Mud Hog Pump (Low Pressure – Low Volume)

Duplex Nail



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## Vac-Truck

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## Case Studies

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## Grand Junction, CO – March 2004


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## Grand Junction, CO – March 2004

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## Greenwich, CT – January 2007

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## North Babylon Case Study

- Wednesday, May 20, 2005 13:40 hrs.
- Weather – Sunny and Clear (To Start)
- NBFCo. Signal 23 – Trench Rescue
- BCFA Automatic Activation of SCTRT.

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## North Babylon Case Study

- Size-Up – Contractor Installing Sewer Line, Pinned
- TRT – Sidewalk Collapse and Trench Rescue.

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## North Babylon Case Study

- NBFCo. IC – Brian Iudica
- NBFCo. Ops Chief – John Jordan
- Mutual Aid
  - Deer Park
  - Babylon
  - West Islip
- TOB Fire Marshal
- SCPD ESU
- 1-0-1

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## North Babylon Case Study


- SCTRT Activation
  - FC 28
  - EFFD/WBFD
  - BFD
  - IFD
  - SCPD ESU
  - SCPD Aviation
  - SC EMS 1
  - SCEMS FC 20
  - SCEMS DMAT

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## North Babylon Case Study

TRT Leaders | Operations | Logistics



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Side-walk Removal – 1.5 Hours

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Trench Operation– 1.5 Hours

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Questions?

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