

**Basic Structural Collapse Operations**  
 Session 1




Suffolk County Fire Academy

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**House-Keeping**

- Instructors
- Students
- Paperwork (SCFA, NYS)
- Student Manuals
- Exits
- Cell Phones and Pagers.



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**Structural Collapse Course Series**

- Basic Structural Collapse = Awareness Level
- Medium Level Structural Collapse Concepts
- Medium Structural Collapse Operations: Exterior Shoring
- Medium Structural Collapse Operations: Interior Shoring
- Medium Structural Collapse Operations: Tools
- Medium Structural Collapse Operations: Void Search and Rescue.



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### Course Overview

#### 2 Sessions

#### • Session 1

- Regulations and Standards
- Building Construction Review
- Hazard Evaluation and Size-up
- Safety At Structural Collapse
- Structural Collapse Assessment.




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### Course Objectives

- Recognize the need for structural collapse search and rescue (NFPA 1006 6.1.6, NFPA 2500 6.2.2)
- Identify the resources necessary to conduct structural collapse search and rescue operations (NFPA 1006 6.1.7, NFPA 2500 6.2.2)
- Define the emergency response system for structural collapse incidents (NFPA 2500 6.2.2)
- Identify the procedure for site control and scene management (NFPA 2500 6.2.2).




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### Course Objectives (Cont'd)

- Recognize general hazards associated with structural collapse incidents, including the recognition of applicable construction types and categories and the expected behaviors of components and materials in structural collapse (NFPA 1006 6.1.1, NFPA 2500 6.2.2)
- Identify the types of collapse patterns and potential victim locations (NFPA 2500 6.2.2)
- Recognize the potential for secondary collapse (NFPA 2500 6.2.2).




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### Course Objectives (Cont'd)

- Describe the procedure of visual and verbal searches at structural collapse incidents, using approved methods for the specific type of collapse (NFPA 1006 6.1.2, NFPA 2500 6.2.2)
- Define a search and rescue / search assessment marking system, including a victim location and structure marking system, such as the ones used by the FEMA National Urban Search and Rescue Response System (NFPA 1006 6.1.3, NFPA 2500 6.2.2)
- Understand the process of removing readily accessible victims from structural collapse incidents (NFPA 1006 6.1.4, NFPA 2500 6.2.2)

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### Course Objectives (Cont'd)

- Describe the procedure for identifying and establishing collapse safety zones (NFPA 2500 6.2.2)
- Discuss the need for reconnaissance of the structure(s) and surrounding area (NFPA 1670 6.2.2)
- Identify support functions to the operations and technician level while functioning within the IMS (NFPA 6.1.5, NFPA 2500 6.2.2).




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### Session Objectives

- Demonstrate Knowledge Of Applicable Regulations And Standards
- Understand A Basic Knowledge Of Building Construction As It Relates To Structural Collapse
- Understand The Need For Incident Size-up And Identify Necessary Components
- Identify Safety Concerns Involving Structural Collapse
- Demonstrate Knowledge Of Collapse Causes And Warning Signs.




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# Regulations and Standards




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## Regulations & Standards NFPA 2500 (New Consolidation)

- Standard for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services (2022)
- USAR Operations
- Rope
- Confined Space
- Vehicle & Machinery Rescue
- Water Rescue
- Wilderness Rescue
- Trench.




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## Regulations & Standards NFPA 2500

- Identifies And Establishes Levels Of Operational Capability For Safe And Effective Operations At Technical Rescue Incidents
- Awareness
- Operations
- Technician.





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**Regulations & Standards  
NFPA 2500 – Awareness**

- Size-up, Site Control, Scene Management, Hazard Identification, Basic Search And **Removal Of Readily Accessible Victims.**

**“Surface Victims”**



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**Regulations & Standards  
NFPA 2500 – Operations**

- Rescue From Light Frame, Ordinary, Unreinforced And Reinforced Masonry Construction.



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**Regulations & Standards  
NFPA 2500 – Technician**

- Rescue From Concrete Tilt-up, Reinforced Concrete And Steel Construction.



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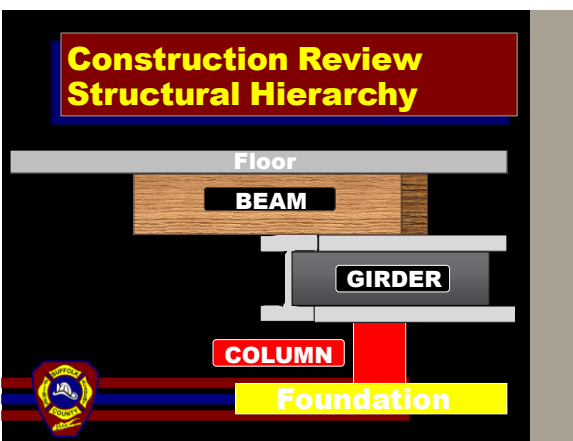
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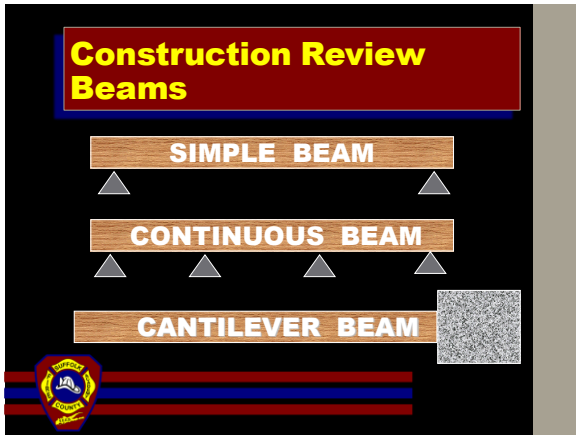
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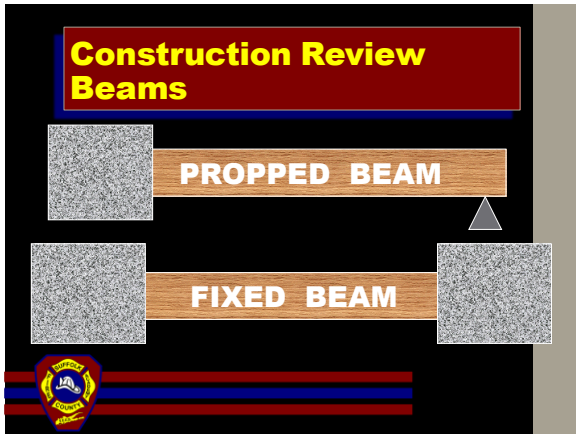
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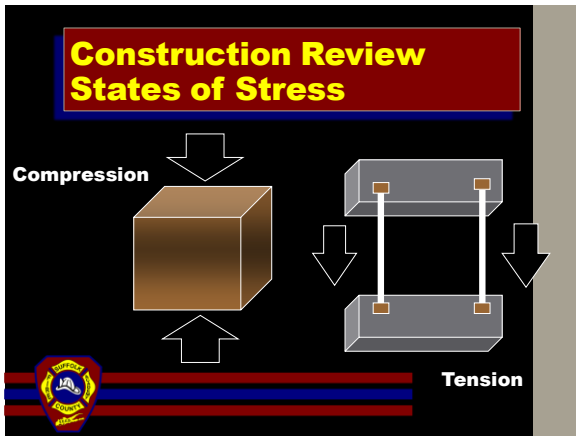
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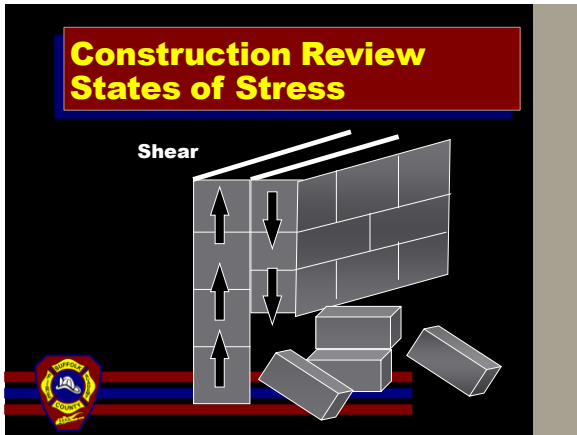
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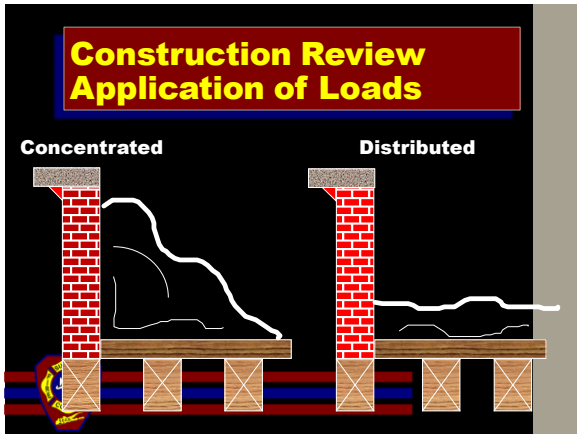
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### Construction Review Structural Loads

- **Wind Load – The Force That Is Trying To Shear The Building From The Ground**
- **Thermal Load – The Expansion And Contraction On The Structure Due To Weather Conditions**
- **Static Load – Load That Is Constant But Applied Slowly. May Change With Time, Stock.**



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### Construction Review Structural Loads

- **432 Park Ave New York, NY**
- **One Of The Tallest Residential Buildings In The City**
- **Lighted Floors Are Open Sections Of The Building Designed To Allow Wind To Pass Thru.**



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### Construction Review Truss Hazards

- **Lack Of Redundancy**
- **Fail In 5 To 10 Minutes**
- **Gusset Plate Nails (1/4")**
- **Workmen Alterations**
- **Integral System**
- **Surface To Mass Ratio.**



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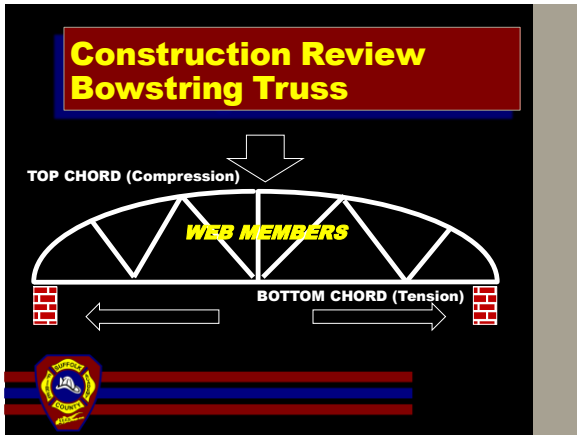
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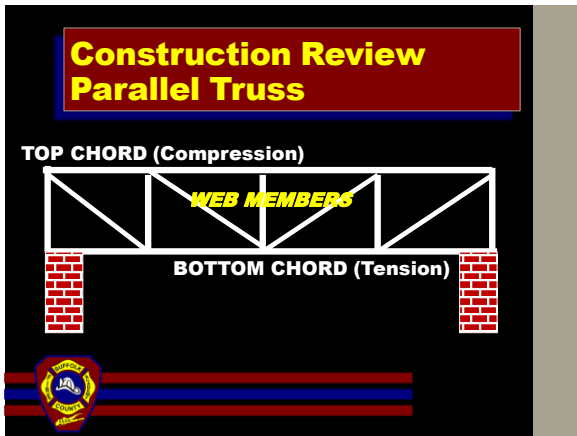
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### Construction Review Parallel Truss



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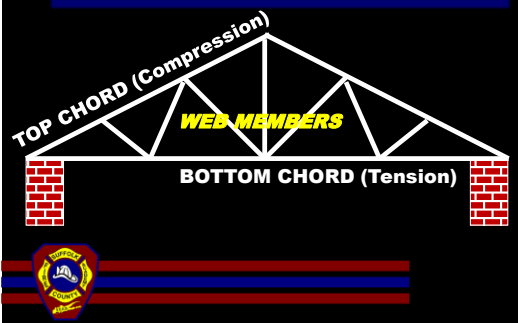
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### Construction Review Peaked Truss



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### Construction Review Peaked Truss



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**Construction Review  
Bowstring Truss**



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**Hazard Evaluation  
and Size-up**



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**Structural Collapse  
Hazard Evaluation**

- Cause Of The Collapse (Fire, Environment, Accident, Terrorist)
- Hazards Involved (Fire, Hazmat, Flooding, Etc.)
- Incident Conditions – Structural Stability
- Time Of Day
- Occupancy.



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**Structural Collapse Causes Explosion**



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**Structural Collapse Causes Overloaded Floors/Roofs**



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**Structural Collapse Causes Structural Fatigue**



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## Structural Collapse Caused By Fire

- One Of The Most Common Causes We Deal With In The Fire Service
- Fire Behavior – Flashover / Backdraft
- Prolonged Burning / Multiple Fires
- Water Damage (Lack Of Run-off)
- Building Construction Susceptible To Fire (Unprotected Steel, Truss, Etc.).



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This Fire Started at 3pm. Photo taken 1 hour into the incident.

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**Structural Collapse Warning Signs**

- **Bulging Walls**



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**Structural Collapse Warning Signs**

- **Cracks In Walls**



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**Structural Collapse Warning Signs**

- **Unusual Sounds / Plaster and Wall Dust**



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**Structural Collapse Warning Signs**

- Vibrations, Sagging Floors or Roof



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**Structural Collapse Warning Signs**

- Separating Walls, Columns Out of Plumb



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**Structural Collapse Warning Signs**

- Racked Windows and Doors



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### Structural Collapse Warning Signs



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### Structural Collapse Initial Size-up

- Building Condition
- Collapse Extent
- Surface Victims
- Survey Area
- Number Of Victims
- Mutual Aid, Technical Rescue Team.



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### Structural Collapse 6-Sided Approach



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**Structural Collapse  
F.A.S.T. V.O.I.D.S.**

- **F – Fire Suppression**
- **A – Additional Collapse Potential**
- **S – Structure Type and Condition**
- **T – Trapped Victim Rescue.**




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**Structural Collapse  
F.A.S.T. V.O.I.D.S.**

- **V – Void Type and Location**
- **O – Occupancy Type and Location**
- **I – Immediate Utility Shutdown**
- **D – Day or Night**
- **S – Situation (Collapse Cause).**




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***Safety At Structural  
Collapse***




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### Structural Collapse Hazards

- Unstable Area Of Operation – Secondary Collapse
- Confined Spaces
- Atmospheric Problems (Toxic/Oxygen Deficient)
- Environmental Hazards (Hypo/Hyperthermia)
- Hazardous Materials
- Falling Debris.




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### Structural Collapse Personal Safety

- Good Discipline – don't become apart of the problem
- Team Integrity
- Personal Accountability
- Proper Personal Protective Equipment (PPE)
- Clear Communications
- Proper Training.




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### Structural Collapse Scene Safety Precautions

- Utility Control
- Collapse Safety Zone
- Rescue Shoring
- Prevent Vibrations
- Lighting
- Monitor Atmosphere
- Monitor Structure Movement.




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**Structural Movement Monitors**

- Transit
- Tell-tales.




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**Structural Triage**

- Evaluation To Determine Most Viable Buildings/Areas
- Where Do You Think The Most Viable Areas Are In This Photo?




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**Structural Collapse Assessment**



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**USAR – Urban Search and Rescue**

- Mission: Save Trapped Victims While Minimizing Risk To Victims And Operators
- Specialized Team, Will Take Time To Arrive
- Fire Department Will Be First On Scene – Must Understand Collapse Concepts And Operations.

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**Survival Rate vs. Time of Extrication**

30 Minutes	99.3%
1 Day	81%
2 Days	36.7%
3 Days	33.7%
4 Days	19%
5 Days	7.4%.



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**Collapse Incident Review**

- Oklahoma City Bombing - 1995
- World Trade Center – 2001
- Plasco Building, Iran – 2017
- Yun Tsui Building, Taiwan – 2018.
- Surfside Collapse, Miami – 2021



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### Oklahoma City Bombing

- April 19, 1995
- 359 people in the building
- 169 killed (including 19 children)
- All 169 ultimately recovered, 166 during the rescue effort
- Last 3 recovered after demolition of the building.




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What was one of the greatest hazards, as far as debris, at this site?

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### Oklahoma City Bombing

- 161 Deaths Occurred In Federal Building
- 2 Deaths Occurred In The Water Resources Building
- 4 Deaths Occurred In The Athenian Building
- 2 Deaths Occurred In Outside Areas.




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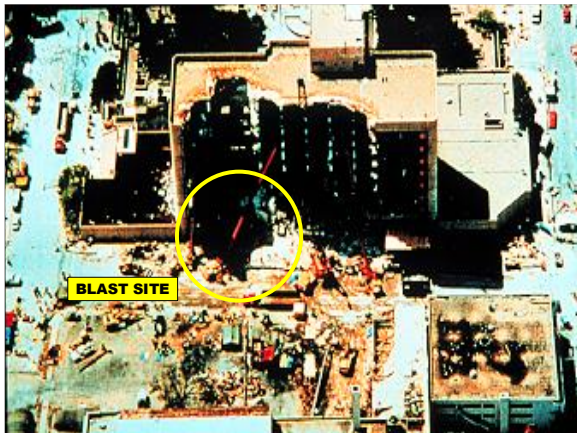
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**Oklahoma City Bombing**

- 26 Reported Injuries To Rescuers, All Minor
- Dehydration To Rescuers = Largest Issue
- Last Live Person Rescued From Building Was 11 Hours After The Blast.



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Are these members of a specialized USAR Team?



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### Oklahoma City Bombing

- The List Of Missing Was Available To Command On Day 3
- It Took Several Days To Find Clean Copies Of The Building Footprint
- Rescue Operations Took 17 Days, 15 Hours, And 4 Minutes
- 25 Operational Periods.




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### World Trade Center

- September 11, 2001
- Estimated 17,400 People In The WTC Complex At The Time Of The Attack
- 2,606 Killed (Including 343 Firefighters And 71 Law Enforcement Officers)
- Over 1,000 Victims Still Not Identified.




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## World Trade Center

- Largest Search And Rescue Operation In U.S. History
- Evacuation Of Over 25,000 People Prior To The Collapse
- Impact Event With Intense Fire Condition
- Progressive Collapse Of Floors, Leading To A Chain Reaction, Massive Pancake Type Collapse
- Approximately 90 Minutes From Impact To Collapse.




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Construction Type?




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## World Trade Center

- Debris Scattered Over Almost 17 Acres
- Difficult To Establish Geographical Markings
- Hundreds Of Voids Searched
- Rescue Effort And Search Conducted For Months
- Magnitude Of Persons Missing Unknown For Several Days.




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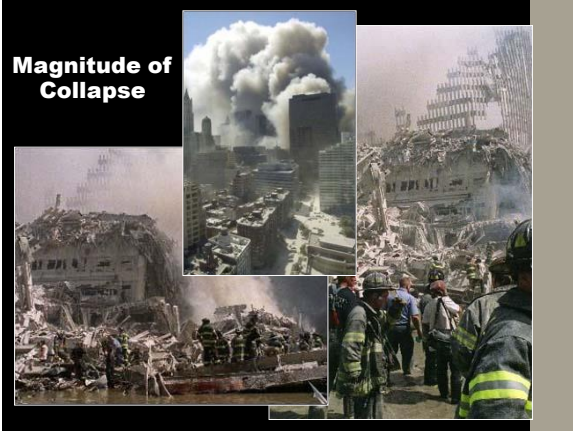
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**Magnitude of Collapse**

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**Plasco Building, Iran**

- **January 19, 2017**
- **Approximately 20 Firefighters Killed (No Reported Civilian Deaths)**
- **Fire Started On The 9<sup>th</sup> Floor**
- **North Wall Collapsed After 4 Hours Causing The Entire Building To Collapse**
- **Again, Light-weight Construction Resulting In A Pancake Collapse.**




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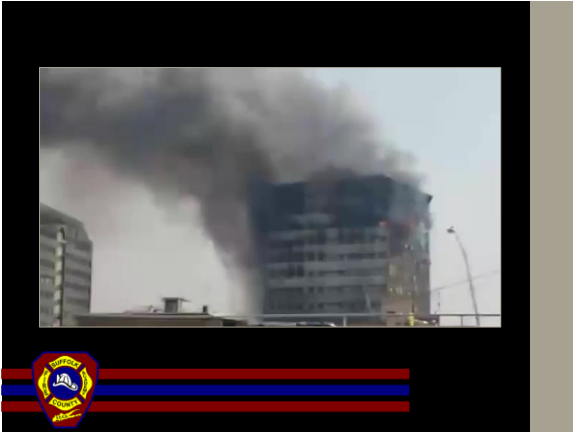
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**Yun Tsui Building, Taiwan**

- February 6, 2018
- Hualien Earthquake - 6.4 Magnitude
- 17 Deaths
- 14 Of The 17 Deaths Resulted From The Partial Collapse Of The Yun Tsui Building
- Search And Rescue Efforts Conducted For Weeks
- Officials Tried Shoring The Building Using Large, Steel Columns.



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**Surfside Condominium Collapse, Miami**

- June 24, 2021 – 1:22AM
- Saltwater Corrosion of Rebar and Building Component Deterioration Due To Water Leaks
- 98 Deaths
- Rescue Operations Conducted For 14 Days Before Switching To Recovery
- Operations Concluded On July 23<sup>rd</sup>.



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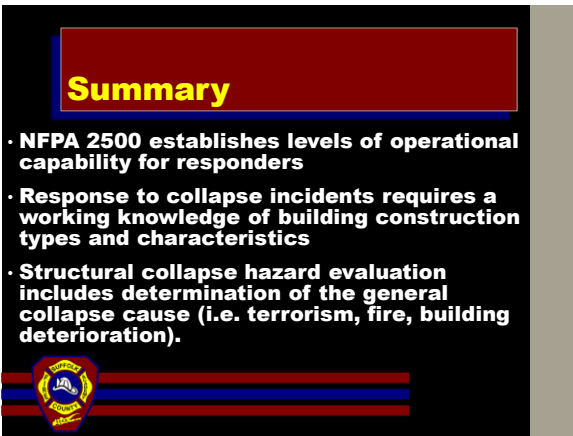
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**Summary (Cont'd)**

• **Remember F.A.S.T. V.O.I.D.S.**

- **F – Fire Suppression**
- **A – Additional Collapse Potential**
- **S – Structure Type and Condition**
- **T – Trapped Victim Rescue.**



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**Summary (Cont'd)**

• **Remember F.A.S.T. V.O.I.D.S.**

- **V – Void Type and Location**
- **O – Occupancy Type and Location**
- **I – Immediate Utility Shutdown**
- **D – Day or Night**
- **S – Situation (Collapse Cause).**



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**Summary (Cont'd)**

• **Collapse Incident Hazards:**

- **Unstable Area Of Operation – Secondary Collapse**
- **Confined Spaces**
- **Atmospheric Problems (Toxic/Oxygen Deficient)**
- **Environmental Hazards (Hypo/Hyperthermia)**
- **Hazardous Materials**
- **Falling Debris.**



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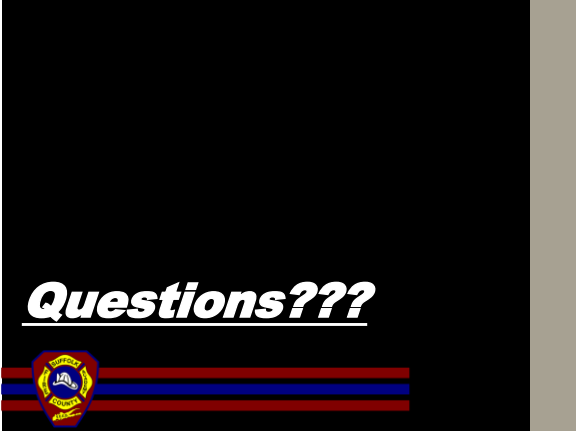
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