1. Types of Collapses
2. Plan of Action
3. Case Studies
4. Best Practices & Lessons Learned
5. Preventative Maintenance Tips
6. Questions & Answers
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Roof Collapse Types

- Snow Loads
- Water Loads
- Roof Loading (replacements, HVAC)
- Deterioration (roof deck issues)

Snow Loads

Contributing Factors:
- Excessive snowfall with unusual drift loads
- Snowfall with ice build-up under the snow
- Extreme cold covering or freezing roof drains
- Drift loads over the top of roof top units

Photo courtesy of Google Images
**Water Loads**

- **How does this happen:**
  - Typically severe cold with previous freeze/thaw cycles
  - Partially blocked roof drains
  - Frozen gutters and downspouts
  - Upper roofs draining onto a lower roof that has drainage problems
  - Whatever else Mother Nature can dream up...

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**Contributing Factors:**

- No addition of structural steel when new units installed
- Damaged roof decking or structural members
- Not properly sized curbs or framed roof openings
- Opening in deck not bearing on a structural support
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Roof Loading

Contributing Factors:

- Overall lack of maintenance
- Unforeseen conditions (unknown water entry)
- Other sources of water entry into the roof system (Condensation, Plumbing, etc.)
- Unknown conditions due to accessibility issues preventing thorough roof deck inspections

Photo courtesy of Google Images

Deteriorated roof decking
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Accumulation of growth at roof drain and downspout

Topics of Discussion

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Levels of Response

ACTION PLAN
1. Safety
2. Damage Assessment
3. Clean Up

Photo courtesy of Google Images

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Action Plan

1. Safety
   • Clear Area
   • Emergency Personnel
   • Shut-off utilities
   • Restrict area/access

Photo courtesy of Google Images

Safety…
2. Damage Assessment

- Contact Experts
  - Roofing/Envelope
  - Structural
- Emergency Restoration
- Determine Source & Extent
- Respect Perimeter
- If Safe...Relocate
  - Stabilize
  - Clean
  - Remove

Assess Damage - Safely

- Visual Examination
- Findings
- Evaluation
Best Practices: Insurance Requirements & Protocols

- Know Your Insurance Company
- Who’s the Point of Contact for your District?
- Common Pitfalls
- Sense of Urgency
- Documentation
  - Written
  - Photos

Common Pitfalls
- Photos and documentation, notification to all parties, key personnel on-site, lead contact person for the property/owner

Action Plan

3. Clean Up
- Restoration
- Safety
- Professionals
  - Document
  - Restore
Topics of Discussion

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Manitowoc Public School District

• What happened: Ceiling Collapse vs. Roof Collapse
• Damage Control
  - Next Steps
  - Clean-up Restoration
  - Closed Classrooms
  - Created 2 Work Zones (North/South)
  - Phase 1 Environmental DEMO North Zone
  - Phase 2 GC Rebuild North Zone
  - Phase 3 Repeat Phase 1 & 2 South Zone

Lincoln High
• What happened: Ceiling Collapse vs. Roof Collapse
• Damage Control
  - North/South
  - Created 2 Work Zones: North/South
  - Phase 1 Environmental DEMO North Zone
  - Phase 2 GC Rebuild North Zone
  - Phase 3 Repeat Phase 1 & 2 South Zone
• False NEWS

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Lincoln High

- No KNOWN Cause
- Contributing Factors
  - 87-year-old building
  - 1999 remodel
  - Remodel, new ceiling and lights attached to the plaster
  - Current main concrete staircase work being completed
  - Mother Nature
    - Thunderstorms
    - Snow loads

Photo courtesy of Google Images
Ceiling retrofit not secured to roof structure....
High to low roof heights
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**Maintenance Shop**

- Water Load Collapse
- Source: Roofs, Drainage
- Damage Control
- Clean-up/Restore Action

**Manufacturing Building**
What Part Collapsed?

- Structural Metal Roof Collapse
- Source: Roofs, Drainage, Structure?
- Damage Control
- Clean-up Restore Action

Photo courtesy of Google Images
What Part Collapsed?

- RTU/SNOW Collapse
- Source: Roofs, Drainage, Structure
- Damage Control
- Clean-up Restore Action
Topics of Discussion

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6. Questions & Answers

Lessons Learned...

• First 24 hours is Critical!
• Correct the Source
• Damage Control
• Dispatch Resources

Correct the Source & Damage Control

• Common Sense – Do the obvious!
• Clear area
• Secure site
• Communicate
• Assess
• Temporary recovery
• Remediate
• Recover

Photo courtesy of Google Images
Correct the Source & Damage Control

- Dispatch Resources
  - Primary & secondary companies
  - 24-hour service
  - References - don’t know until you need it. Network.

Know Your Insurance Company

- Contract – 24-hour availability?
- Know your procedures and limits
- Contract & spending authority
- Others to be involved (internal and external)
- Required Documentation
  - Insurance Co. Requirements
  - District Requirements
  - Other Parties involved or at fault

Common Pitfalls

- No Notification to Insurance Company
  - Even if NO Claim
- No Documentation
  - No photos before clean-up or existing conditions
- No Contract or Outside Resources (Professional)
  - Need to be notified at time of event
- No Insurance Information from Outside Vendors (COI or Contract)
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Topics of Discussion

1. Identifying the Source of a Collapse
2. Collapse Action Plan & Process
3. Best Practices & Lessons Learned Case Study
4. Preventative Maintenance Tips
5. Question & Answer

Remediation Contractors
Who knows your buildings
Police Department
Fire Department

PROACTIVE VS REACTIVE MAINTENANCE

How to Avoid Roof Collapses...
MAINTENANCE ITEMS

- Perimeter Flashings
- Roof Equipment Flashings
- Clean Drains and Debris
- Roof Splits and Open Seams
- Pipe, Gas Lines, and Electrical Penetrations
- Metal Edge Inspections
- Heat Loss
- HVAC Leaks
- System Deterioration

PERIMETER FLASHINGS

- EPDM and most single ply membranes shrink
- Can be replaced to extend the life of roof membrane

CLEAN DRAINS AND DEBRIS
HEAT LOSS

- Inspect early morning in the frost or heavy dew
- Signs of wet insulation

HVAC LEAKS

- Location of HVAC unit in comparison to leak
- Where is water dripping?
- Off duct work
- Off metal deck
- What type of rain?
- Duration
- Direction
- Hard wind driven

SHINGLE DETERIORATION

- Curling
- Granular loss
- Cracking & splitting
Reactive Roof Management

• Deferred Maintenance
• Premature Failure
• Increased Costs

Proactive Roof Management

SUCCESS

• Roof Management Program
• Extend Life
• Predictable Cost Control

COMPONENTS: FIVE YEAR ROOF ASSET MANAGEMENT PLAN (RAMP)

1. PERFORM COMPREHENSIVE BASE LINE SURVEY
2. COMPILE FINDINGS
3. RECOMMEND ACTION PLAN AND BUDGETS
4. IMPLEMENT ACTION PLAN
Detection Methods for Water Entry
- Non-destructive Leak Investigation
- Infrared Moisture Survey

Non-destructive Leak Investigation

Infrared Roof Moisture Surveys
1. Do not clear roof drains and leave debris on roof surface. Do: Remove from roof.
2. Do maintenance inspections after severe storms (especially high winds).
3. Do not use roof cement on EPDM (rubber) roofs.
4. Do note changes in the condition of the roof materials since the last inspection.
5. Do not access the roof with heavy snow or ice.