Fall Protection:
How Does It Affect My Building Operations & Maintenance?
Thank you for attending today’s session!

• Please let us know your name and/or location when you sign in
• We ask everyone to mute their telephone during the presentation
• If you have questions or comments, use the chat tool provided during the presentation
• At the end un-mute your telephone for general questions and answers
• Please mute cell phones to avoid background noise
• Do not touch microphones in conference rooms
James Justus, PE

• Associate/Shareholder at FEA
• 28 years of experience
• Licensed in multiple states
• Past President of the South Carolina Society of Professional Engineers
• Member of the NCEES Civil Engineering Exam Committee, Structural Subcommittee (PE Exam)
• Incidental Practice Task Force – South Carolina State Board of Engineering
• Has spoken to dozens of groups on fall protection issues
• Performed numerous fall protection evaluations, designs, load tests
• Has worked with multiple regional offices of OSHA on fall protection issues, currently working with Cal-OSHA on multiple projects
Learning Objectives

• Definitions
• Standards
• Types of Fall Protection Devices
  • Building Mounted Devices
  • Personal Devices
Why is this Important?

Impacts many Building Maintenance Operations
- MEP
- Roofing/Building Envelope (window washing, drain cleaning, etc.)
- General cleaning/maintenance

When is it an Issue?
- 24 hours a day, 7 days a week, 365 days a year. OSHA regulations do not discount safety at any time. All buildings and maintenance/management personnel must be in compliance at all times.

Give examples – how could it impact the areas noted above (for example)?
- HVAC – roof top unit near roof edge, cooling tower maintenance
- Electrical – lights near roof edge, street lights, high ceiling areas
- Plumbing - mechanical rooms, high ceiling areas, piping on roofs to pumps, towers, etc.
- Roofing/Building Envelope – hopefully pretty obvious issues here!
- General maintenance – accessing taller ceilings, cleaning around stairwells, shafts, etc.

What is an building owner/manager supposed to do?
- Follow the regulations
- Hopefully you’ll understand better after the presentation!
Each employee working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is 6 ft or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches above walking/working surface must be protected.

I'll just be out here for a minute.
Top 5 Most Frequent OSHA Standards Violations

October 1, 2010 through September 30, 2011

<table>
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<tr>
<th>Section</th>
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Falls account for about 200 deaths and 25,000 disabling injuries each year. They are the leading cause of injuries each year in the maintenance and construction industries.
Definitions

Fall Prevention or Restraint
- Safety measures taken to ensure workers cannot fall off an unprotected edge. Examples include: Handrails, parapet walls, other physical barriers, etc.

Fall Protection
- Safety measures taken when travel or work must occur near an unprotected edge, and the worker has the potential to fall off the edge. Examples include anchors, tie backs, davits, cable rigging, etc.

Inspections
- Performing inspections of areas for the purposes of determining future work and/or safety requirements.

Worker Access/Travel Zones
- Areas where workers may pass through while traveling to a work zone

Work Zones
- Area in which physical work will take place
Costs Incurred When a Fall Occurs

Most important: Cost of Human Life or Injury

• Death - $850,000 average
• Injury - $4,000,000 average

Secondary Importance: Cost of Subsequent Events

• Litigation - $750,000 (typically settlement costs)
• OSHA Fines - $50,000
• Future Compliance - $50,000
What happens during a fall?

Forces on the Human Body:

200 Pound Person...
6 foot free fall....
• Impacts the ground at approximately 5 mph
• Generates approximately of 4,000 pounds of force upon impact
• Typically non-life threatening injuries

200 Pound Person...
24 foot free fall....
• Impacts the ground at approximately 20 mph
• Generates upwards of 64,000 pounds of force on impact
• Typically serious injury or death
Applicable Fall Prevention/Protection Standards

Occupational Safety & Health Administration
- 1926-Subpart M – Fall Protection Standards (1995)
- OSHA interpretation letters
- IBC 2012 Mechanical Code
- IBC 2012 Electrical Code
- IBC 2012 Existing Buildings Code

ANSI
- Standards A10.32 & Z359

California OSHA
- Section 3212 Floor Openings, Holes, and Roofs (2004)
- GISO Subchapters 1-8

Local Rules and Laws (New York, California, etc.)
Elevated Areas - Definitions

- Elevated Area – any level that is more than 6 FEET above the next level (OSHA 1926)
  - Construction Standard
- Elevated Area – any level that is more than 4 FEET above the next level (OSHA 1910)
  - Industrial Standard

Which one do we recommend to follow? Maintenance can involve both areas
- FEA recommends the 4-foot criteria to be safe
Elevated Areas - Definitions

• Unprotected Elevated Area – an area with no walls or guardrail systems at least 42 inches in height to protect from a fall.

• Protected Elevated Area – an area protected on all sides by walls or guardrail systems at least 42 inches in height
  • Note: Protection Systems must extend at least 30” past work area.
Protected Elevated Areas
Unprotected Elevated Areas
Work Zone Definitions

- Protected Work Zone – an area within an Elevated Area that is surrounded by permanent or temporary barriers which prevent inadvertent access out of the area.

- Unprotected Work Zone – an area within an elevated area that has no permanent or temporary barriers.
Unprotected Elevated Area & Unprotected Work Zone
Unprotected Edges - Definitions

- Per OSHA - Inspections can occur with no protection
  - Restrictions are minimal, assumption is inspector is very aware of the dangers in the area being inspected.

- Travel areas have some limitations
  - Restrictions are more severe than inspections, assumption is you are paying attention while walking but thinking about the work

- Working areas have most restrictions
  - Most highly restricted areas, assumption is you are paying attention to the work, not to the potential fall hazard

- Applies to all personnel
  - Doesn’t matter if personnel are visitors, employees, contractors, temporary, etc. All rules apply to all personnel at all times.

- Public spaces are highly restricted – no hazard is allowed to exist!
Unprotected Edges - Definitions

Unprotected Elevated Area – Unprotected Edge
- Restricted Zone – Unprotected Edge
  - Work Area must remain 15 feet away from an unprotected Edge
  - Travel path must be at least 6 feet away from an unprotected edge
  - IF YOU CANNOT COMPLY, YOU CANNOT TRAVEL TO OR PERFORM WORK NEAR THE EDGE!

How to Solve – Move the Work Zone!
or Provide Protection!
• Either Temporary
  • Lanyards, temporary work barriers, temporary tie offs
• or Permanent
  • Railings, Fall protection anchors, etc!
Restricted Zone – Travel Path Less than 6 Feet
Restricted Zone – Work Area Less Than 15 Feet From Unprotected Edge
What does this mean for Building Operations?

- Travel areas to work sites inside restricted zones (within 6 feet of an unprotected edge) should:
  - Have temporary physical barriers installed at the edge
  - Or Fall Prevention systems (rails, walls, retractable lanyards, etc.)
  - Or Fall Protection systems (anchors, tie off points) and must be load tested, certified, and used.

OR

- MOVE THE TRAVEL ZONE!
What does this mean for Building Operations?

- Work sites inside restricted zones (within **15 feet** of an unprotected edge) should:
  - Have temporary physical barriers installed at the edge
  - Or Fall Prevention systems (rails, walls, retractable lanyards, etc.)
  - Or Fall Protection systems (anchors, tie off points) and must be load tested, certified, and used.

OR

- MOVE THE WORK AREA!
What does this mean for Building Operations?

• Signage to be provided at each access point to Unprotected Elevated Areas

• Contractors must be notified of the operational limits

• Compliance with the operations plan must be enforced. **If not, liability will pass back to Owner/Operator.**

• Development of Fall Protection Plans showing Protected Elevated Areas, Restricted Zones, Travel Paths, Unprotected Edges, Protected Work Zones, and Fall Protection Devices.
What does this mean for Building Operations?

Provide Signage for Worker Access

Example Plan to get to Cooling Tower
What does this mean for Building Operations?

Locate Equipment and Worker Access to Comply

Note – Diagram taken from older IBC Mechanical Code, appropriate dimension should be 15-feet to equipment to be worked on, not 10-feet.
What does this mean for Building Operations?

Make fall protection part of your safety program

Make fall protection part of your safety program and ensure that everyone has a role to play in preventing falls. Most successful programs have the following elements:

**Management Commitment**
- Business owners and managers are as committed to workplace safety as they are to any other critical part of the business.

**Accountability**
- Supervisors and employees are held accountable for following safe work practices.

**Employee Involvement**
- Employees are involved in the day-to-day effort to maintain a safe workplace.

**Hazard Identification**
- Supervisors and employees know how to identify hazards.

**Hazard control**
- Supervisors and employees know how to eliminate or reduce exposure to hazards.

**Accident & Incident Investigation**
- Accidents and near misses are investigated and their causes prevented from happening again.

**Training**
- Employees learn safe work practices through classroom training and instruction.

**Evaluation**
- Business owners and managers evaluate their safety goals at least yearly and use the evaluation to set new goals.
What does this mean for Building Operations?

**Building Owners & Managers** - Ensure that those who do exterior construction or maintenance work know how to protect themselves from falls, are aware of installed anchorages, and know how to use their fall-protection equipment.
Quick Break!

“Someone calling themselves a customer says they want something called service.”
Building Façade Access
Regulations & Building Operations Issues
(window cleaning, façade maintenance)
Applicable Façade Access Standards

Occupational Safety & Health Admin. (OSHA)
  - Safety Requirements for Scaffolding - Walking - Working Surfaces
  - Powered platforms for building maintenance
  - Scaffolds

American National Standards Institute (ANSI)
  - “Standard” for the Industry

Local Governments
- State of California
- State of Washington
- City of New York
- City of Chicago
How do the Regulations Affect Building Owners/Managers?

- Examples of Systems
- Fall Protection Anchorages
- Permanent vs. Temporary Systems
- Testing/Certifications
- Plan of Service
PERSONAL FALL ARREST SYSTEM

Three Major Components of Fall Protection

A. Anchor
B. Bodywear
C. Connecting Devices

The ABC’s of Fall Protection
Definitions

Permanent Powered Systems - Anchorages

**Permanent Powered Platform with Carriage System**

Typically installed on high rise structures dating back to the 1950’s.

**Moveable Davit Arm and Socket System**

Typically installed on mid to high rise structures, especially those built after 1970 or so.
Definitions

Davits - Anchorages

A device, used singly or in pairs, for suspending a powered platform from work, storage and rigging locations on the building being serviced. Unlike outriggers, a davit reacts its operating load into a single roof socket or carriage attachment.

Davit Arm and Socket System with Pedestal Base
Definitions

Outriggers - Anchorages

A device used for suspending a working platform from work, storage, and rigging locations on the building being serviced. Unlike davits, an outrigger has at least two supporting points acting into two or more distinct support points.

Outrigger Systems

Temporary

Permanent
Temporary Outrigger Installation
Fall Protection Systems – Fall Protection Anchorages

Anchor Examples:

• Dedicated Tiebacks
• Equipment Screen Wall Columns
• Cooling Tower Support Frames
• Building columns, framing systems
Fall Protection Systems - Definitions

Miscellaneous Systems - Anchorages

Monorail System

Parapet Clamp/C-hook

Note: FEA strongly discourages the use of parapet clamps and/or C-hooks due to difficulties in certifying the wall construction and the clamp attachment.
Fall Protection Systems – Definitions

Permanent Fall Protection Anchorages

Fall Protection Pedestal Tieback

Fall Protection Eye-bolt Tieback
Fall Protection Systems – Definitions

Other Temporary Fall Protection Anchorage Devices

- Shadow Beam Anchors
- Hook Anchors
- Beam Trolleys
- Carabiners
- D-Bolt Anchors
- Roof Anchors
- Cross-Arm Straps
Definitions

Swingstages or Suspended Scaffolding

A system comprised of an approved platform suspended from above with two or more lines supported from roof top mounted permanent or temporary systems. The platform must be power assisted, and shall have a braking system independent of the power supply. There is no maximum height threshold, however, systems must be anchored to the building every 30-feet or less while in use above 100-feet.

Note:
For swingstage use – multiple independent lines required!!
- Support lines for the stage (one or two per end)
- One for person, attached to the individuals harness
  - Unless in a dual line stage
- Each line must be secured independently
- Each line must be anchored to a certified fall protection device
Definitions

Boatswains’ Chair (Bosun’s Chair)

A single-point adjustable suspension scaffold consisting of a seat or sling designed to support one employee in a sitting position.

Note:
For Bosun Chair use - Two lines required!!

• One for the chair itself

• One for person, attached to the individual’s harness

• Each line must be secured independently

• Each line must be anchored to a certified anchorage!
Fall Protection Systems – Additional Info
Rope Descent Systems

(Bosun’s Chairs, Controlled Descent Devices, etc.)

• OSHA Allows use of RDS on descents up to 300 feet in most jurisdictions.

• RDS not allowed in New York City and California except when no other option exists to access the facade
  • If allowed, various limitations apply

• RDS descents must have wind stabilization devices when over 100-feet in height.
Certification
• A written, signed, and dated statement by a registered design professional (engineer or architect), confirming the performance of the system to the outlined requirements.
• Must be registered in the state where the system resides.

Inspection
• A written, signed, and dated statement by a competent person confirming the system has not degraded or does not present a hazard for continued use by workers.

Competent Person
• A person who, through experience and training, is capable of identifying hazardous or dangerous conditions and of training other employees to identify such conditions.
Fall Protection Systems – Fall Protection Anchorages

• Fall Protection Anchors are required for all buildings in which personnel access the building exterior or travel or perform work on a regular basis in restricted zones (no fall restraint) on elevated levels.
  • Requirement is retro-active; personal fall protection anchorages required regardless of construction date (2001 ANSI/OSHA regulation, 5 year phase in)

• Design Criteria:
  • Anchorages must be capable of sustaining an ultimate load of **5,000 pounds per attached employee**
    • Must be independent for each employee, or designed for multiple employees
    • Must be provided at each roof level
    • Placement must minimize free fall distance
    • Counterweights **MAY NOT** be used as fall protection anchorages
Fall Protection Systems – Permanent Vs. Temporary

• For all buildings with restricted work or travel zones, or exteriors accessed from elevated areas - proper anchorage points shall be provided.
  • For buildings less than 300 feet in height, temporary support systems (outriggers, etc.) may be provided by the contractor. Fall protection anchors are still required!
    • System and personnel must be tied-back to independent, appropriate, permanent anchorage devices to prevent falls
  • Buildings greater than 300 feet require a permanent stage system unless constructed prior to 1991. If constructed prior, temporary system may be used. Fall protection anchors are still required.
    • Explicitly defined as an Owner provided and maintained system.
Fall Protection Systems – Anchorage Testing & Certification

- All building provided systems need to be inspected and load tested in the field before being placed in initial service.

- Subsequent load tests are required at:
  - Intervals not to exceed 10 years, or
  - After a fall event, or
  - When buried anchorages or connections are exposed during roof replacement activities

- Certification and load testing is required to be completed under the supervision of a licensed design professional (engineer or architect), licensed in the state where the building is located.

System certifications should be maintained on site
Fall Protection Systems - Testing Criteria

Static load tests must be performed in each of the primary directions the system will be utilized in service.

**Primary Support Systems (stage lines, chair lines):**
- Twice the rated load for the attached systems (swing stages, bosun chair, CDA, etc.)
- Rated load is typically 1,000 to 2,000 pounds per rigging line supporting the system
- Therefore testing is 2,000 to 4,000 lbs per location

**Fall Protection Anchorages:**
- 2,500 pounds per individual to be protected (50% of ultimate (failure) load)

**Passing Test - No permanent deflection or damage to component being tested**
Fall Protection Systems - Testing & Certification

Periodic Inspections

• All systems (permanent & temporary) need to be inspected annually by a competent individual. This includes:
  – Structural Supports and Fall Protection Anchorages
  – Electrical and Control Systems
  – Motors and Wire Ropes

• Working platforms and their associated support systems need to be inspected by the user for visible defects before every use and after each occurrence which could affect the platform's structural integrity.

• Maintenance Inspections are required for permanent platform systems every 30 days or upon each use, whichever is less.
Fall Protection Systems - Testing & Certification

Testing Examples

Fall Protection Testing

Davit System Testing
Inadequate Fall Protection Systems

No way this device meets the 5,000 lb. minimum load requirement
Fall Protection Systems - Plan of Service

- Defined by ANSI I-14.1-2001 as a written plan that informs the Building Owner or operating agent:
  - When windows to be cleaned are located in areas where workers may utilize suspended equipment;
  - Where workers may be exposed to hazardous conditions;
  - Where the public may be exposed to overhead operations/hazards.
Fall Protection Systems - Plan of Service

Owner/Building Obligations

• Provide documentation to the contractor that the system has been inspected & certified for use according to OSHA regulations.

• Provide written procedures for the operation, safe use, and inspection requirements for all systems provided by the Owner. Including:
  – Owner generated procedures & system descriptions.
  – Pictorial methods of instructions.
  – Manufacturer’s operating manuals.
Fall Protection Systems - Plan of Service

• Contractor Obligations:

Provide a written plan that includes:

• Locations where suspended scaffolding equipment will be used (drop zones).
• Primary support systems.
• Location of fall protection anchorages.
• Identification of hazardous areas.
• Areas requiring public protection.
• Employee qualification requirements.
• Other related issues.
Fall Protection Systems - Plan of Service

Building Example

EXTERIOR ACCESS NOTES FOR ZONE 1:

1. ONLY USE ANCHORS FOR SPECIFIED ZONE
2. USE FALL PROTECTION ANCHORS FOR SUPPORT
3. ARROWS DENOTE INTENDED USE OF ANCHORS
4. USE DAVIT SOCKETS, ADAPTOR, ARMS FOR STAGE SUPPORT
5. ONLY ONE PERSON IS TO USE ONE FALL PROTECTION ANCHOR AT ONE TIME.
6. DO NOT USE THE DAVIT SOCKETS FOR FALL PROTECTION.

KEY:

- SPECIFIED ANCHORS
- DAVIT SUPPORT
- FALL PROTECTION
- DIRECTION OF USE
Fall Protection Systems - Plan of Service

Owner/Building Example

- Roof Top Pedestal Fall Protection Tieback
- Wall Mounted Fall Protection Tieback
- Davit Pedestal Base Cable Shown Not to Be Used
- Portable Davit Socket
- Portable Davit Arm Inserted in to Portable Davit Socket.
Fall Protection Systems - Plan of Service

Management Office Issues:

- System Inventory/Modification
- Certifications
- Record Keeping
- Vendor Contracts
- Equipment/Roof Top Plans

Vendor Issues:

- Vendor Equipment Certifications
- Employee Training
- Operational Use Plans
Fall Protection Systems - Risk Management

• Understand What You Have
  – Building Inventory
  – Compliance Audit
  – Record Keeping

• Identify / Certify Existing Fall Protection

• Add Fall Protection Where Necessary

• Verify Compliance of Primary & Secondary Supports

• Confirm Contractor Compliance
  – *If the contractor doesn’t comply with the plan, remove from building!*
Fall Protection Systems

Typical Historical Costs

• **Evaluation/Testing / Inspection**
  - Compliance Audit ($2,000 - $5,000)
  - Fall Protection Anchorage Testing (tiebacks) ($500 - $1,500/per anchor)
  - Davit Testing ($500 - $2,500 /per davit)

• **Design**
  - Simple Designs (concrete slab, etc.) ($2,500 - $5,000)
  - Complex Anchor Designs (unusual framing, multiple systems) ($20,000+)

• **Installation**
  - Fall Protection Anchors (tiebacks) ($1,000 - $5,000 each)
  - Davit Arm Assemblies ($5,000 - $15,000 ea.)
  - Permanent Stage Systems ($2,500-$5,000 per linear foot)

• **Annual Inspections** ($1,000 - $5,000 per building per year)
  - Could be performed as part of window cleaning contract by contractor
Fall Prevention & Protection

PERSONAL FALL ARREST SYSTEM

ABC’s of Fall Protection

Anchor

Body wear

Connecting Devices
Fall Prevention & Protection

BODYWEAR

• Full Body Harness
  – Used for fall arrest, ladder climbing, work positioning, confined space entry and rescue

• Belts
  – Used for fall restraint or positioning only
ABC’s of Fall Protection

Personal Fall Arrest

Body Wear

- DuraFlex Python Harnesses
- Non-Stretch Harnesses
- Body Belts
- Linemen’s Belts
- Specialty Harnesses
Full Body Harnesses

You must inspect before each use !!!

1) Check impact load indicators
2) Check webbing for cuts, change in texture, loose or cut stitching
3) Inspect hardware for fractures, burrs etc.

When in doubt throw it out
Improper Harness Fit

Too loose, Too high

Too loose, too low

In a fall, all forces will hit you in one spot
Full Body Harnesses

Harnesses should be stored in clean dry environment.

• Periodic hand washing with mild soap and warm water is recommended

• Hang inside to dry (UV degrades webbing)

• DO NOT put in dryer
Fall Prevention & Protection

C = Connecting Devices
   “Critical Link”

• Lanyards:
  – Rope, Webbing, Steel
  – Used with shock absorbers for fall arrest
  – Used without shock absorbers for fall restraint or positioning

• Fall Limiters:
  – Used for fall arrest
ABC’s of Fall Protection

• The Personal Fall Arrest System
  • Connecting Devices

- Manyard II Stretchable Shock-Absorbing Lanyards
- BackBiter Tie-Back Lanyards
- MinILite Fall Limiters
- MightyLite Self-Retracting Lifelines
- Positioning & Restraint Lanyards
- Rope grabs
- StretchStop & SofStop Shock-Absorbing Lanyards

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Select the Proper Fall Protection Equipment

Shock-Absorbing Lanyard or Self-Retracting Lifeline?
Always know your fall distance and select proper equipment to meet the fall clearance.

Illustration: 6 ft. (1.8m) Shock-Absorbing Lanyard with D-Bolt Anchorage Connector

<table>
<thead>
<tr>
<th>Distance</th>
<th>Description</th>
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<tbody>
<tr>
<td>3 1/2 ft. (1.1m)</td>
<td>Deceleration/Free Fall Distance</td>
</tr>
<tr>
<td>6 ft. (1.8m)</td>
<td>Height of Worker</td>
</tr>
<tr>
<td>9 1/2 ft. (2.9m)</td>
<td>Fall Arrest Distance</td>
</tr>
<tr>
<td>6 ft. (1.8m)</td>
<td>Length of Lanyard/Self-Retracting Lifeline</td>
</tr>
<tr>
<td>3 ft. (.9m)</td>
<td>Safety Factor</td>
</tr>
</tbody>
</table>

Total Estimated Fall Distance: 18 1/2 ft. (5.6m)

Remember...

UNDER 18 1/2 ft. (5.6m) always use a Self-Retracting Lifeline.
OVER 18 1/2 ft. (5.6m) a Shock-Absorbing Lanyard or Self-Retracting Lifeline can be used.

Always calculate your fall distance before selecting your fall protection equipment.
Review of Fall Protection
Major Components

ABCs of Fall Protection

• A Anchor/Anchorage Connector

• B Bodywear – Full Body Harness

• C Connecting Device – Lanyards & Fall Limiters
Where in the World Does Fall Protection Affect Me?

EVERYWHERE!
Questions?

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"Because they won't slow down when the signs say 'Road Work Ahead!'"
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Mark your calendars for...
• September 18, 2012: Data Centers, Today’s Energy Hog
• October 16, 2012: Building Information Modeling (BIM)

Thanks!