Designing Maintenance Access and Fall Protection (MAFP) Systems for Inspection and Maintenance of Existing Buildings
by Kelly Streeter, P.E.

Learning Objectives
- Learn how to evaluate the Maintenance Access and Fall Protection (MAFP) requirements existing buildings.
- Learn about the regulatory requirements and available standards (OSHA, ANSI, etc) for designing MAFP systems.
- Review challenging case studies of designing MAFP systems in existing buildings.
- Learn strategies for minimizing the architectural impact of various system installations.

Introduction or What is a MAFP System?
- Why Systems Are Needed
- Components of Design
- Regulatory Authorities
- Potential Components of System
- Procurement
- Training & Certification
- Historic Structures: Case Studies
- Anchor Testing Guidelines
Occupational Safety and Health (OSH) Act of 1970
29 USC 654
General Duty Clause
a. Each employer –
1. shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;
2. shall comply with occupational safety and health standards promulgated under this Act.
b. Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

And later, OSHA 1910

So what is the DUTY, according to OSHA?
- To keep employees SAFE; provide a SAFE working environment for EMPLOYEES.
- So this covers typical maintenance activities performed BY EMPLOYEES, not outside contractors.

Work Positioning – what gets you to your worksite
- LADDER
- LIFT

Fall Protection – two types:
1. Eliminate the risk
2. Guard the hazard
3. Protect the worker
The common punt: a very general specification section.

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The goal:
- Fully developed specifications and thoroughly designed and coordinated construction details so that cost estimates can reflect reality.
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Structural connection details
Manufacturer drawings
Fully developed specifications
Operations Manual
Training Program
Personal Protective Equipment (PPE)

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General building maintenance falls under the "General Industry" category. Relevant OSHA regulations are:

- General Industry (29 CFR 1910)
  - 1910 Subpart D: Walking-working surfaces
  - 1910.23: Guarding floor and wall openings and holes
  - 1910 Subpart F: Powered platforms, manlifts, and vehicle-mounted work platform
  - 1910.66: Powered platforms for building maintenance
    - Appendix A: Guidelines (Advisory)
    - Appendix C: Personal fall arrest system (section I - mandatory; sections II and III - non-mandatory)
  - 1910.67: Vehicle-mounted elevating and rotating work platforms [Aerial lifts]
  - 1910.132: General requirements
(6) Horizontal lifelines may, depending on their geometry and angle of sag, be subjected to greater loads than the impact load imposed by an attached component. When the angle of horizontal lifeline sag is less than 30 degrees, the impact force imparted to the lifeline by an attached lanyard is greatly amplified. For example, with a sag angle of 15 degrees, the force amplification is about 2:1 and at 5 degrees sag, it is about 6:1. Depending on the angle of sag, and the line's elasticity, the strength of the horizontal lifeline and the anchorages to which it is attached should be increased a number of times over that of the lanyard. Extreme care should be taken in considering a horizontal lifeline for multiple tie-offs. The reason for this is that in multiple tie-offs to a horizontal lifeline, if one employee falls, the movement of the falling employee and the horizontal lifeline during arrest of the fall may cause other employees to fall also. Horizontal lifeline and anchorage strength should be increased for each additional employee to be tied off. For these and other reasons, the design of systems using horizontal lifelines must only be done by qualified persons. Testing of installed lifelines and anchors prior to use is recommended.

- **Z359.0-2012** – Definitions and Nomenclature Used for Fall Protection and Fall Arrest
  - Provides terminology and definitions used in the code
- **Z359.1-2016** – The Fall Protection Code
  - A set of standards that covers program management; system design; training; qualification and testing; equipment, component and system specifications for the processes used to protect workers at height in a managed fall protection program
- **Z359.3-2017** – Safety Requirements for Lanyards and Positioning Lanyards
  - Establishes requirements for the performance, design, marking, qualification and verification testing and instructions for lanyards and positioning lanyards for users within the capacity range of 130 to 310 pounds
- **Z359.4-2013** – Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components
  - Establishes requirements for performance, design, marking, qualification, instruction, training, use, maintenance and removal from service of equipment used in preplanned assisted-rescue and self-rescue for one or two workers
- **Z359.6-2016** – Specifications and Design Requirements for Active Fall Protection Systems
  - Specifies requirements for the design and performance of complete active fallprotection systems, including travel-restraint and vertical and horizontal fall-arrest systems and is intended for engineers with expertise in designing fall protection systems
- **Z359.7-2011** – Qualification and Verification Testing of Fall Protection Products
  - Sets requirements for certification of ANSI Z359 Code products and components as well as requirements for third-party testing, witness testing and manufacturer selfcertification of fall protection products and components
- **Z359.11-2014** – Safety Requirements for Full Body Harnesses
  - Establishes requirements for the performance, design, marking, qualification, instruction, training, test methods, inspection, use, maintenance and removal from service of full body harnesses used for fall arrest, positioning, restraint, suspension and/or rescue applications
- **Z359.12-2009** – Connecting Components for Personal Fall Arrest Systems
  - Sets requirements for the performance, design, marking, qualification, test methods and removal from service of connectors
Z359.13-2013 – Personal Energy Absorbers and Energy Absorbing Lanyards
- Establishes requirements for the performance, design, marking, qualification, instructions, inspection, maintenance and removal from service of energy absorbing lanyards and personal energy absorbers

Z359.14-2014 – Safety Requirements for Self-Retracting Devices for Personal Fall Arrest and Rescue Systems
- Sets requirements for performance, design, qualification testing, marking and instructions, inspection, maintenance and storage, and removal from service of self-retracting devices including self-retracting lanyards (SRL’s), self-retracting lanyards with integral rescue capability (SRL-R’s), and self-retracting lanyards with leading edge capability (SRL-LE’s), comprising personal fall arrest or rescue systems

Z359.15-2014 – Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest and Rescue Systems
- Sets requirements for the design criteria, qualification testing (performance requirements), marking and instructions, user inspections, maintenance and storage and removal from service of single anchor lifelines and fall arresters for users within the capacity range of 130 to 310 pounds

Z359.16-2016 – Safety Requirements for Climbing Ladder Fall Arrest Systems
- Sets requirements for the performance; design; marking; qualification testing; instructions for use; inspection; maintenance and storage; and removal from service of vertically oriented climbing ladder fall arrest systems lifelines

Z359.18-2017 - Safety Requirements for Anchorage Connectors for Active Fall Protection Systems
- Establishes requirements for the performance, design, testing, marking and instructions for the use of anchorage connectors in travel restraint, fall arrest, rescue, work position, rope access and suspended component/tie-back line systems

Future Activity
- Planned ANSI/ASSE Z359 standards activity includes:
- New standards - in development:
  - Z359.9 – “Personal Equipment for Protection Against Falls – Descending Devices”
  - Z359.17 – “Safety Requirements for Horizontal Lifelines for Personal Fall Arrest Systems”
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Horizontal Lifelines
Discrete Fall Protection Anchors
Permanent Ladders
Moveable Ladders
Rigid Rails
Vertical Lifelines

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Design/Build
Potential Designers
Potential Installers
Case Study:
The New York Public Library

Restoration Architect:
Wiss, Janney, Elstner & Associates

Restoration Contractor:
Nicholson & Galloway

Fall Arrest Sub-Contractor
Vertical Access, LLC

In-house training policy
Third-party certification
Hardware inspection and recertification
Case Study:
Brooklyn Post Office & Court House

Restoration Architect:
Goody Clancy Associates

Fall Arrest Consultant
Vertical Access, LLC
Case Study: Islip Courthouse

Design Architect: Richard Meier
Consulting Architect: Quinn Evans
Access Consultant: Vertical Access, LLC
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- How to Test
- What to Test to

How to Test?
Probe if possible
Test to failure at select locations if possible
Reference ASTM E488 and ACI Publications
What I do:
Test 100% of anchors to 50% of anticipated ultimate OR 80% of anticipated yield.
Write a report.
Post results near roof doors.
Tag every anchor.

Rigid rail vs HLL systems

- **LOADS**: loads with HLL are MUCH higher
- **COST**: HLL is typically much cheaper
- **CLEARANCE**: HLL requires more careful clearance calculations (sag between 3 - 6 feet typically BEFORE energy absorber)

- **MAFP System Design Steps**:
  1. Identify maintenance activities and schedules.
  2. Identify access challenges and fall risks.
  3. Create access and fall protection plan: Who and How.
  4. Contact manufacturer or access consultant, if necessary, to understand regulatory requirements and design loading.
  5. Design MAFP System anchorages into Construction Documents.
  6. Write MAFP System into specifications: manufacturer or access consultant can help if required.
  7. Follow through on PPE and training requirements , if in-house crew OR Identify specialized contractors available to bid on maintenance activities.
  8. Create recertification plan for permanently installed components.
References

OSHA

ANSI
http://www.asse.org/practicespecialties/docs/Z359ArticleoftheMonth.pdf

Vertical Access Blog: regular regulatory updates
http://Verticalaccessllc.wordpress.com