

Fall Protection for Engineers

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www.FallSafety.com

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PSPE & PIE 11am-12pm

19 September 2014

Nik Wallenda Team

- If we do it right the first time then “why do we need safety”



6 15 12

Niagara Falls Walk

Safety Tools

- NSPE Code of Ethics "3xSafety"
 - Safety is mostly Public Safety
- NSPE Body of Knowledge (BOK)
- Occupational Safety – Falls from Height
- OSHA and ANSI Z359 Fall Protection Code
- Hierarchy of Controls
- Grid (Hazard Analysis – MacCollum)
- Teams of CP and QP (SE)
- Board of Certified Safety Professionals BCSP
- Introduction to Fall Protection 4th ed. Ellis

Safety & Health for Engineers – Brauer

Construction Safety Engineering Principles – MacCollum

Sheraton Centre Hotel Toronto Escalator Handrail fall-over protection



NSPE Code of Ethics (2007)

1. Hold paramount the safety, health and welfare of the public (Fundamental Canon)
2. The services provided by engineers must be dedicated to the protection of the public health, safety and welfare (Preamble)
3. Engineers shall hold paramount the safety, health and welfare of the public (Rules of Practice)

NSPE Body of Knowledge (BOK)

- #13 Safety
- Safety: Product, process, design, occupational
- Occupational safety includes industry
- Construction safety is generally assigned to the general contractor with the authority to supervise subcontractors and assisted by "safety engineers"

Occupational Safety at Height

- Lifelines, Lanyards, Horizontal Lifelines, FASystems, Harnesses
- Access, Confined Space
- Planning for Construction
- Planning for Inspection
- Planning for Maintenance
- Planning for Rescue



Recognition of Fall Hazards

Fall Protection

Hierarchy of Safety Controls

- Elimination
 - Sequence CP
 - Strength SE
- Prevention
 - Railings SE
 - Keep away/restraint SE
- Fall Arrest
 - Anchor Points, HLL SE

-
- Training
 - Competent Person/QP
 - Warnings
 - Competent Person/QP

QP = SE; CP Competent Person, QP Qualified Person

Safety Grid - All Hazards

Eliminate

Guard

- Natural
- Mechanical
-

Plastic Skylights will Fail

- If plastic, there must be a metal screen due to uv degradation
- If laminated glass or screen used, it must pass E06.51.25 300 lbs/3 ft drop 10" dia. lead weights

Eggshells

NIOSH Hazard Alerts (2)



OR



Use Tool to recognize Skylight Fall Hazards

Recognized Hazard / Solutions	Eliminate		Guard		Safety Factor		Redundancy		Reliability
	List Hazard	Safety Sol'n	List Hazard	Safety Sol'n	List Hazard	Safety Sol'n	List Hazard	Safety Sol'n	Admin
+Gravity	Fall	Remove sky light	Fall	Screen or curb at 42"	Fall	Stronger skylight	Fall	Guardrail & cover	Planning & surveys
Structural/Mechanical *	Collapse	Cover & secure	collapse	Burglar bars	collapse	Test for 97%ile male weight	Fall Through	Screen & bars	Inspect Strength report
Radiant Energy	uv Plastic Degrad'n Firefighter Access	Screen or Glass 20 yrs <12" gap	Crazing at screw holes	Screen And Replace	leaks	Test for 20 yrs, Replace	Exposure to replace	ELI change-out tool	Test Miami Dade go 20yrs or 2 yr Xenon
* Attractive nuisance	Sit on	screen	Bounce* Trampoline	Guard rail	Stand on	screen	Two person	screen	Add warnings
*Burglar entry	Burglar access	Secure access & grill	Fill opening	Add grill	Screws remove	Larger w/tool	Two hazards	Screen & bars	Evaluat burglar method
*Maintain skylight/screen	Replace skylight	ELI change out tool	No barrier	Use DBI net frame	Weak structure	Alum. Ribs in skylight	Not enough protect	Add PFAS to Burglar B	Design screen limited opening

Natural Hazards include +Gravity

Grid – All Elevated Fall Hazards: eg unprotected Roof Hatch

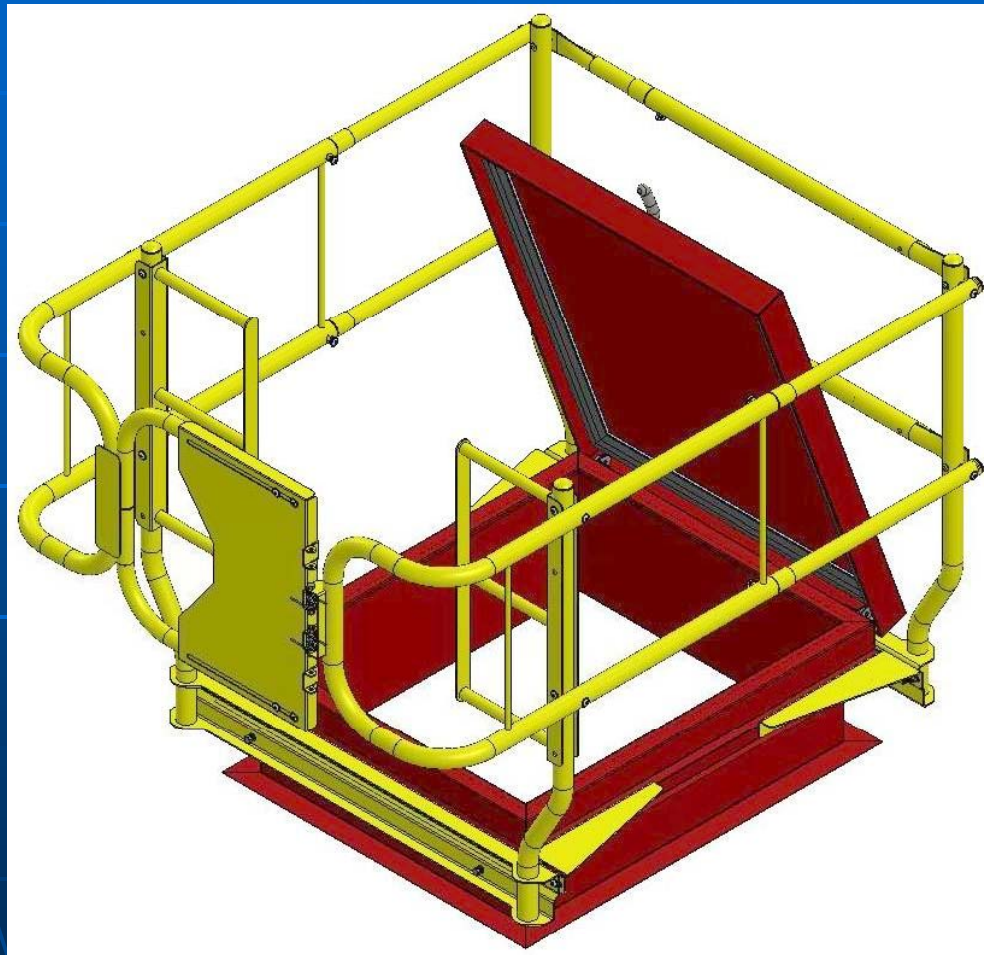


Roof Hatch access with Climbing Extension



Walk in, Walk
out System

Roof Hatch with Climbing Extension and Guardrail



Roof Fall Protection for skylights is becoming popular

Nets

- Safety Nets for People (6" openings)
- Safety Nets for Debris (1" openings)

ANSI A10.11 not reviewed since 1989

OSHA 1926.502(c) 1994

Platform Nets

Walking working surface

2011 introduced
in America



eg S. Africa World Cup stadiums
built this way in 2009; used in
NYC 2012 building construction

Board of Certified Safety Professionals (BCSP)

- Questions that challenge professionals and relate to safety
- eg Fall Protection:
- What is the dynamic capacity of a harness and lanyard according to Z359.13? 900-1200 lbf
- What is the minimum Anchor Point strength to support a fall using the above equipment with a test torso weight of 282 lbs? 2500-3600 lbf based on 1926.502

10% of NAFE members have CSP qualification:

"The measure of safety principles and awareness"

Aerial Work Platforms Fall Protection?



Anchor Point Strength and Compatibility

2. Use Tool to recognize Aerial Lift Fall Hazards

Recognized Hazard / Solutions	Eliminate		Guard		Safety Factor		Redundancy		Reliability
	List Hazard	Safety Sol'n	List Hazard	Safety Sol'n	List Hazard	Safety Sol'n	List Hazard	Safety Sol'n	Admin PrePlan
Gravity	Fall out while reaching	Restrain	Fall while step up on midrail	Screen up to 42"	Fall while transfer	Wishbone connect, follow procedure	Fall hazard and rescue	Guardrail & PFAS, training	Train to stay if rocking
Structural/Mechanical	Collapse due to bearing failure	Regular maintain check the certs	Ejection: Auto impact at base	PFAS and self-rescue	Collapse boom or tip over	Check outrigs fully out & PFAS	Bucket inverts	Restraint and PFAS & rescue method	Inspect Strength report
Structural/Mechanical	Lean on controls near ceiling	Lock-out & design of controls	Duck under rail: head injury	Use swing gate access	Lift does not respond to controls	Bleed hydraulics and/or descent device	Anchor Pt too low in bucket	Anchor Pt on bucket at 5 ft <u>and</u> or boom	Train: instrns for proper use
Structural/Mechanical	Sway	Proper set-up – Inflate tires	Tip over	Outriggers - Training	Stalls w/ load & angle	Higher capacity lift	Tip over	Guard <u>and</u> PFAS	Add alarm & warnings
Biological	Attack by bees	Remote distance tools	Attack by bees	PFAS Control Descent	Descent not fast enough	Increase descent speed	Attack by bees	Add suit and headgear	
Electrical	Touch power line	Keep 10' distance per OSHA & alarm	Touch while on ground	Training stay away or jump	Conduct'n	Use insulatd remote tools	Other hazards	Increase insulated equip't tools	

Fall Protection Design Standard

- Introduction – Principles/Applicability/Refs
- Definitions and Acronyms
- Design Requirements –
Elimination/Access/Passive/Active/Admin
- Documentation – Design/Calcs/Std/Anchor
labeling/Procedures/Training/Signage/Rescue
- Consultants
- Appendix

Fortune 100 Company with New Program 2014

Elimination

- Examples:

Locate equipment inside equipment rooms;
place cameras, lighting near floor with
protected access

Locate HVAC dampers, exhaust, louvers
lower or install platforms for maintenance
Access

Access to Elevated Work

- Consider work activities and requirements for space for inspection, maintenance and repair eg electronic equipment or gear box
- Access route 100% protection, think visibility and geometry for worker
- Walkways, stairs, fixed ladders

Fixed Ladders

- Avoid cages or wells
- Avoid if used more than 12x/year
- Provide horizontal grab bars on outside of roof hatches
- Provide horizontal grab bars for access and exit
- Ladder Safety Systems to meet Z359.16
- Self-closing gates
- Three Points of Control



Passive Fall Protection

- Guardrail height 42-45" on platforms 1926.500
- 19" max. gap vertically (eg cables)
- IBC for general public
- Self-closing gates (no chains or cables)
- Toeboards
- No deflection over 3" with 200 lbs load



Swing Gate

Active Fall Protection Systems

- Personal Fall Arrest System (PFAS)
- Must meet Z359 requirements
- Horiz. Lifelines must meet Z359.6 QP
- Snaphook gates must meet 3600 lb per Z359.12
- Withstand 2x impact force of 282 lb wt including anchorages approved by QP

HLL must be designed by a Structural Engineer according to ANSI Z359.6 Fall Protection Code 2007 and OSHA 1995

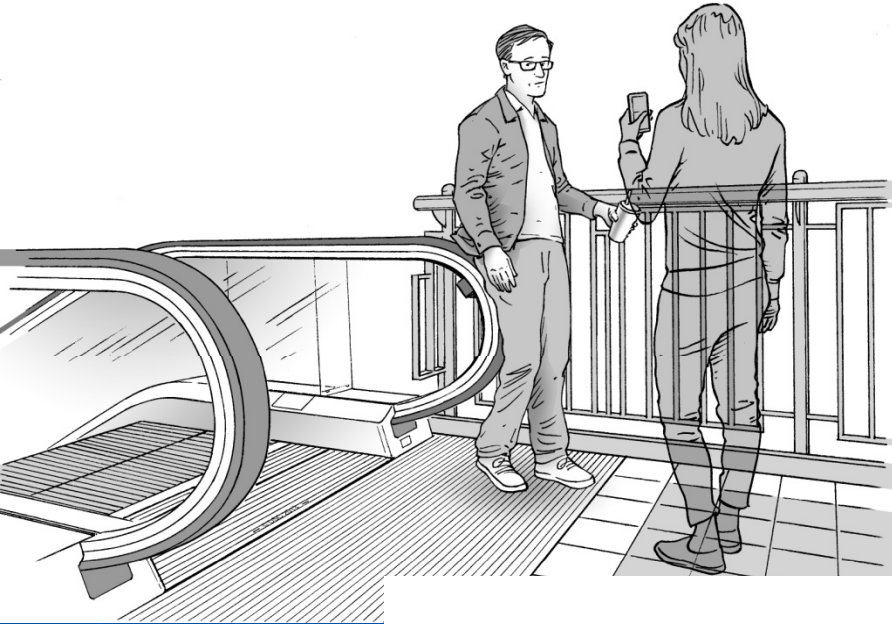
Engineering Drawings of FPS

- List of applicable codes, regs and stds
- Work method or use of system & type
- Name of engineer; notice for revision
- Fall distance diagram
- Anchorage specification
- Pendulum fall analysis
- Manufacturer list
- Access route

PtD*

- Prevention through Design*
- Supported by NIOSH
- Reference NIOSH.gov for more info
- Foreseeing hazards: design out
 - Example self-supported Escalators
 - Malls, Airports

See NIOSH Handout



Escalator Fatal Hazard

18"/sec belt speed

Falls 36-42 ft

4x per year in USA est.

Do you Recognize this Fall Hazard? How to eliminate it?



3

PtD

- Prevention through Design
- NIOSH initiative ref NIOSH.gov
- Elimination of hazards on drawing board
- Must know or identify work method(s)

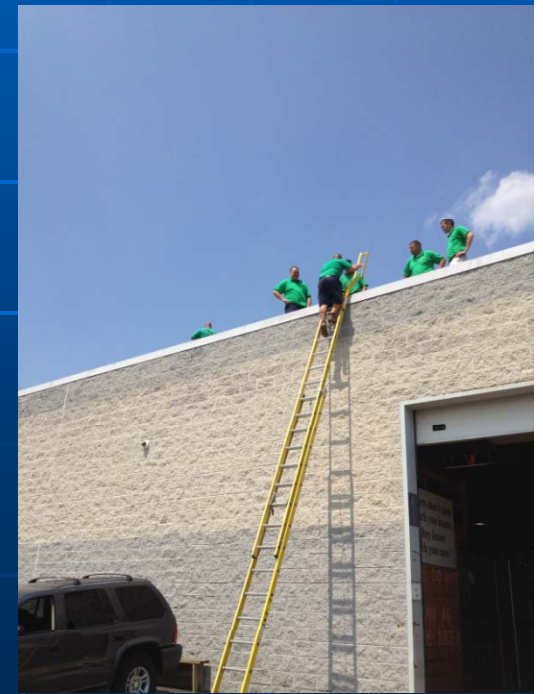
Quiz:

1 What length of extension ladder is required to access a flat roof 25 ft above ground Answer:

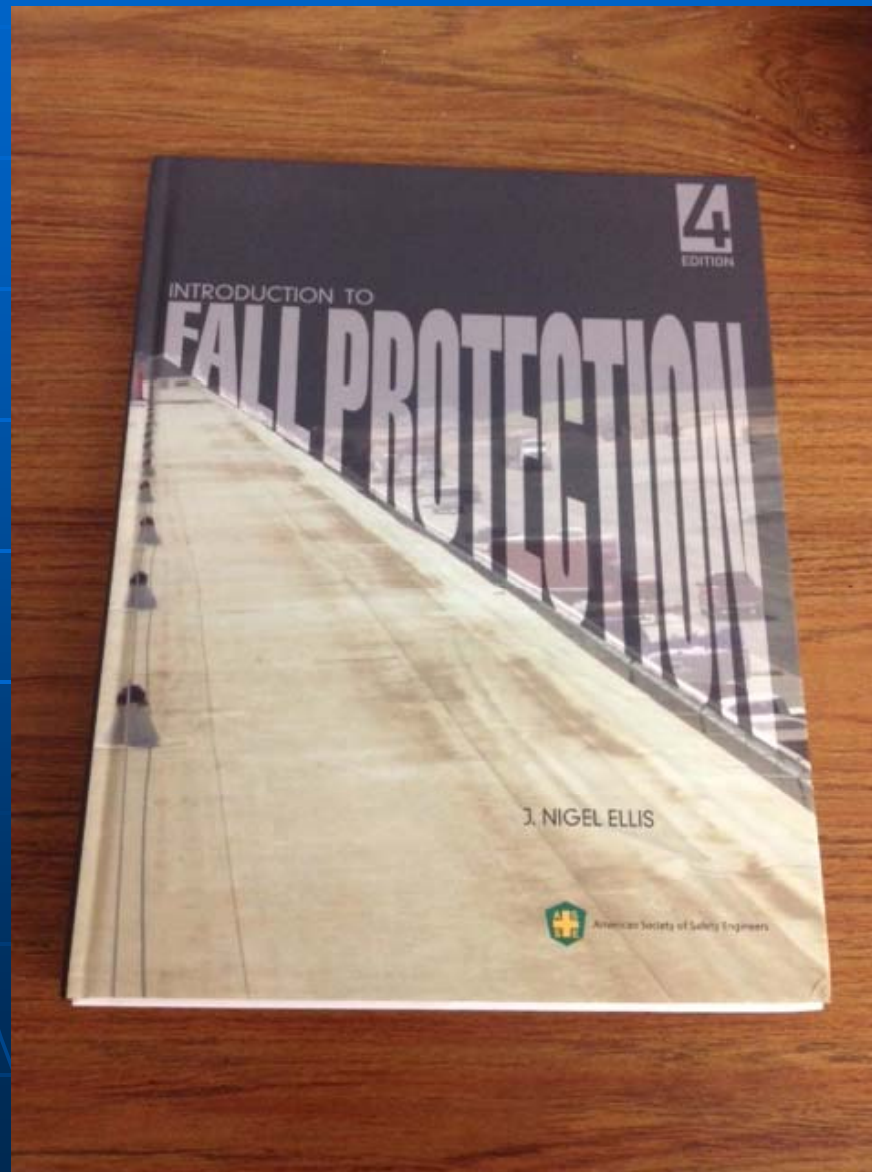
29 ft

2 What length of extension ladder is required to access a flat roof 25 ft above ground using a 3 ft walk-through extension Answer:

26 ft



Textbook on Fall Protection 4th Edition



ASSE.org

FallSafety.com

600 pages

13 Chapters, 10
real-world Q each

Competent Person and Qualified Person Courses

- Ellis Fall Safety Solutions LLP
- Wilmington DE
- Contact Jeff Strauss, VP
- 302 571 8470 x121
- Course Brochure? Ask Anna

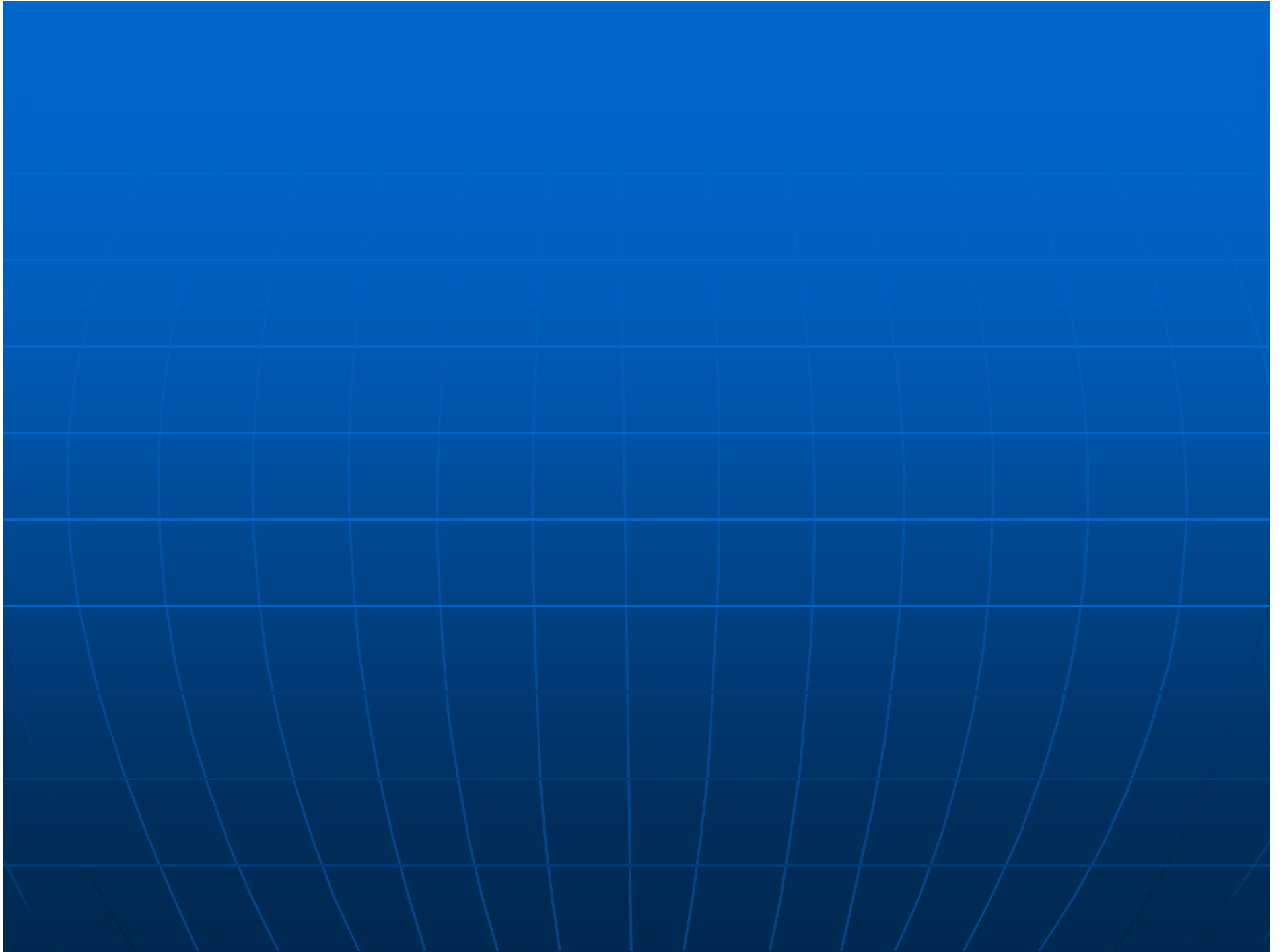
Contact Nigel with any Fall Protection
Question: Phone/text 302 521 7472c

Nigel@FallSafety.com

QUESTIONS?

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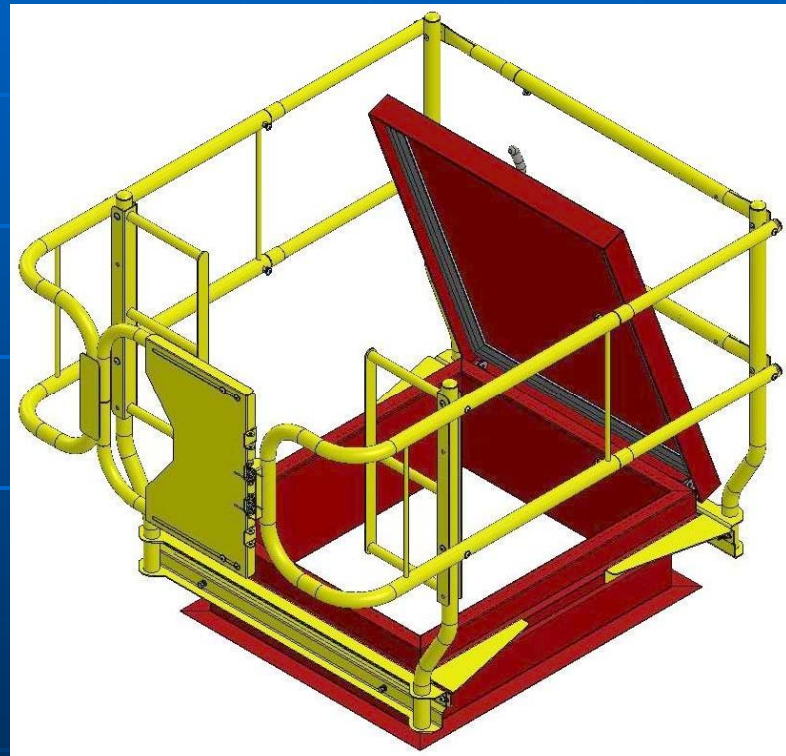


Roof Hatch

Crawl Out,
Crawl In



Walk in/Walk Out



Walk In/Walk Out
with Guardrails