

## Safety Overview

Falls  
Scaffolding  
Excavation

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## Risky Business

- Between 1980 and 1989, how many people died from occupational injuries?
  - A. over 10,000
  - B. over 30,000
  - C. over 50,000

"C" is right: 63,589 died 17 a day!

Source: <http://www.cdc.gov/niosh/injury/traumastruct.html>

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## But is construction dangerous?

- Between 1980 and 1995, how many people in construction occupations died?
  - A. over 8,000
  - B. over 10,000
  - C. over 15,000

"C" is right: 17,000 died in construction occupations...  
So today will not be a good day for 3 people in construction in the U.S.

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## Expensive Accidents

- “Each year construction accidents about \$1Billion in workers’ compensation losses.”
- “The indirect costs (of an accident) can run 4 to 6 times the direct costs covered by insurance” ENR Nov. 2003 p. 108

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## OSHA

- Occupational Safety and Health Administration
  - Responsible for education and enforcement of workplace safety regulations
- ... so safety is the law...

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## Ethics defined:

- Ethics is a general term for what is often described as the "science (study) of morality". In philosophy, ethical behavior is that which is "good" or "right." The Western tradition of ethics is sometimes called moral philosophy.

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[en.wikipedia.org/wiki/Ethical](http://en.wikipedia.org/wiki/Ethical)

## AGC-Washington State Code of Ethical Conduct

- I believe that each of us, as individuals and organizations, owe our community, colleagues, customers and each other a duty and responsibility to conduct ourselves in an honest and ethical manner.
- To further express my commitment to the Principles of Skill, Responsibility and Integrity, I pledge to conduct myself according to the following standards:
  - My word is my bond and is stronger than a written contract.
  - I will treat others as I desire and expect to be treated by them.
  - I will put safety and compliance with codes, laws and regulations above profit.
  - I will respect and protect the environment.
  - I will do my best to produce quality projects on time, at good value.
  - I will assume responsibility for my actions.
  - I will strive to reach accord through personal negotiations and do my best to resolve disputes quickly, with integrity, and without personal attack or rancor.
  - I will endeavor to persuade others within my organization and all for whom I am responsible to embrace these standards.

• Adopted December 2000 by AGC of Washington's Board of Trustees.

<http://www.agcwa.com/Public/aboutAGCEthics.asp>

## Safety pays

- Saves Lives
- Saves Money
- Is the Law
  - Virginia Occupational Safety & Health enforces OSHA regulations in the state

## We're number 3!

- Construction is the third highest death rate from injury, 15.2 deaths per 100,000 workers.
- This puts it in third place in the U.S. just behind agriculture and mining.

## Where is the danger?

- Leading causes:
  - Falls from heights
  - Vehicle crashes
  - Electrocution
  - Machine accidents
  - Struck by falling objects

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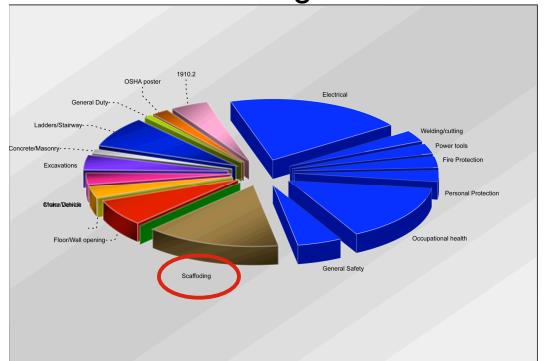
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## Scaffolding leads



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## Categories of violation

Scaffolding	15.00%
Floor/Wall opening	7.00%
Crane/Derrick	3.00%
Motor Vehicle	3.00%
Excavations	4.00%
Concrete/Masonry	1.00%
Ladders/Stairway	8.00%
General Duty	1.00%
OSHA poster	2.00%
Labor act	4.00%
Electrical	20.00%
Welding/cutting	3.00%
Power tools	3.00%
Fire Protection	3.00%
Personal Protection	3.00%
Occupational health	15.00%
General Safety	5.00%

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## Fall Protection

- Over 100,000 in construction occupations injured each year
- 150-200 die

Fall-General-1 of 9

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## Fall Protection

- Where protection is required, select fall protection systems appropriate for given situations.
- Use proper construction and installation of safety systems.
- Supervise employees properly.
- Use safe work procedures.
- Train workers in the proper selection, use, and maintenance of fall protection systems.

Fall-General-2

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## The 6 foot rule

- Construction Employers
  - must protect their employees from fall hazards and falling objects whenever an affected employee is 6 feet (1.8 meters) or more above a lower level.

Fall-General-3

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## Except when...

- In a Controlled Access Zone.
- A Controlled Access Zone is a work area designated and **clearly marked** in which certain types of work (such as overhand bricklaying) may take place without the use of conventional fall protection systems—guardrail, personal arrest or safety net—to protect the employees working in the zone.

Fall-General-4

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## Guardrails

- Often fall protection is provided by guardrails, temporary construction designed and built to keep workers from falling over an edge.
  - Toprail @ 42"
  - Midrail @ 21" or mesh from toprail to surface
  - Toprail supports 19" apart
  - No opening larger than 19" allowed in guardrail
  - Toprail cannot deflect more than 3" under a 200 pound load applied vertically within 2" of toprail

Fall-General-5

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## Arrest that Person!

- Personal Fall Arrest Systems
  - Decelerates fall
  - Usual form is a full harness
    - Harness must not induce over 1800 lbs on user
  - Be rigged to prevent falling over 6 feet
  - Bring user to complete stop in 3.5 feet
  - Inspect before each use

Fall-General-6

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## Or net

- Net positioned as close to work as possible.
  - Never over 30' (vert) from work
  - Max mesh is 6" o.c
  - Max mesh opening is 36" (no defective nets allowed)
  - Inspect weekly

Fall-General-7

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## Net horizontal extension

Vertical distance  
from working level  
to horizontal plane  
of net surface.

- Up to 5 feet (1.5 meters)
- More than 5 feet (1.5 meters) up to 10 feet (3 meters)
- More than 10 feet (3 meters)

Minimum required  
horizontal distance  
of outer edge of net  
from edge of working surface.

- 8 feet (2.4 meters)
- 10 feet (3 meters)
- 13 feet (3.9 meters)

Fall-General-8

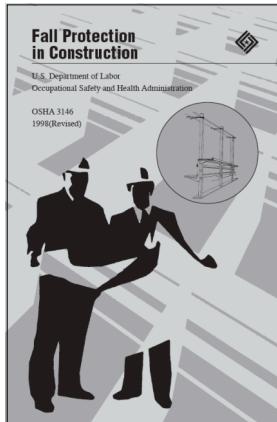
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**Fall Protection in Construction**  
U.S. Department of Labor  
Occupational Safety and Health Administration  
OSHA 3146  
1998 (Revised)

**For more detail...**

See PDF in Blackboard notes  
& come back in BC 1224 in Spring

Fall-General-9

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## Supported Scaffolding

sources: Washington State



- Inspect daily

sources: OSHA 3150 Guide to Scaffold use in the Construction Industry & Washington State University Scaffold Overview

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## Common mistake



- This is not a scaffold

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- To prevent this



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## A competent person required

A competent person is able to:

- identify existing and predictable hazards
- identify working conditions that are unsanitary, hazardous or dangerous and
- has authority to eliminate hazards

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## No defects

Damaged or weakened parts must immediately be:

- repaired, replaced, braced to meet minimum strength **or**
- removed from service until repaired.

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## Employee training required

- Recognizing hazards of the type of scaffold they'll be using
- Understanding the procedures to control or minimize hazards
- Hazards including: electrical, falling off the scaffold, and falling objects
- How to erect, maintain and disassemble the fall protection and falling object protection systems
- Using the scaffold and handling materials on the scaffold
- Maximum intended load and capacity
- Other information as needed

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## Fall Protection required during assembly/disassembly

- A competent person determines feasibility of fall protection.
  - Employer must provide maximum feasible fall protection.

Questions to ask are:

- Is there a nearby structure from which a lifeline can be dropped that the worker can tie off to?
- Can we install guardrails immediately after installing the fabricated frames and before moving to the next level?
- Can we sequence disassembly to keep the worker protected for the maximum feasible time?
- Whatever is feasible to do must be done during the assembly/ disassembly stages



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## Guardrails here too

- Guardrails consist of toprail, midrail and falling object protection, such as a toeboard
- The **toprail** must be between 38" – 45" high and withstand a 200 lb. force
- The **midrail** must be installed at a height approximately midway between the top edge and the platform surface and withstand a 150 lb. force
- A **toeboard**, when used, must be 3 ½ inches tall and able to withstand a 50 lb. force

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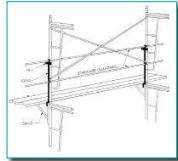
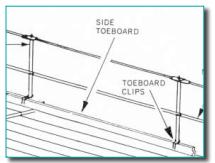
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## A little different guardrail

"X" brace can substitute for top rail or mid rail but **not both**.

- Cross bracing is acceptable in place of a **midrail** when the crossing point of two braces is between 20 inches and 30 inches above the work platform.
- Cross bracing can be used as a **top rail** when the crossing point is between 38 inches and 48 inches above the work platform.
- The end points at each upright must be no more than 48 inches apart.



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## Fall Protection?

How could this be remedied?



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## Stairs or ladders required

For platforms more than 2 feet above or below a point of access



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## Stay 10 feet from power lines!



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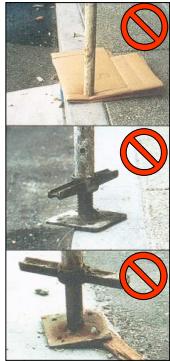
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### Keep level, solid footing



### No Shims allowed



### Make Solid Platforms

Each working level fully planked; no more than 1" gaps

Minimum platform and walkway width of 18"

Overlap planks between scaffold sections by at least 12"

Extend end over support 6" min (Maximum end extension 12")

Don't paint planks since they will hide defects

Front edge within 14" of the work

## Platforms must

- Be able to carry 4 times the intended load + scaffold weight
- Planks must not deflect more than 1/60 of span when loaded
- Not extend more than 18" beyond the point of support



## What's wrong with this picture?

- 1. No fall protection
- 2. Not fully planked
- 3. No ladder access
- 4. Bad shirt



## A Guide to Scaffold Use in the Construction Industry

Small Business Safety Management Series  
OSHA 3150  
2000 (Revised)



**OSHA**  
Occupational Safety and Health  
Administration  
U.S. Department of Labor

## For more detail

- See OSHA 3150 in your blackboard notes

## Excavation and Trenching

U.S. construction sites - 2003:

53 fatalities

74% caused by soil collapse

75% had no protective measures

sources: OSHA 226 Guide to Excavation and Trenching in the Construction Industry  
& Washington State Dept. of Labor guide

## Killer trench

- Over 4' deep
- No protective system
- Spoils within 2'
- Equipment working at edge
- No means of egress



## Have you seen this?



## Common Violations

- No shoring or protective system used when required by code
- Excessive surcharge loading (spoils piles too close to excavation)
- Access & egress for excavations over 4' deep (workers are not using ladders, are using prohibited step ladders or ladders do not extend 3' above landing)

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## To Trench Safely...

- Verify utility locations
- Identify/verify competent person
- Review soil classification
- Choose the correct protective system for soil type
- Verify safe installation
- Comply with all general protection rules
- Inspect site daily

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## Another Competent person needed

### Competent person

- Can identify existing or predictable hazards
- Knows the requirements of the rule
- Is trained in soils analysis and use of protective systems.
- Has authority to take corrective action

Registered Professional Engineer: (RPE)

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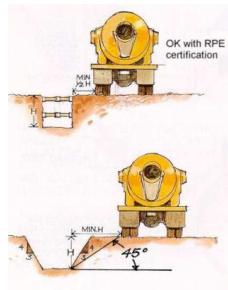
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## Avoid surcharges!

Surcharge load from vehicles



## Control Water!

- Water changes the physical properties of the soil, not for the better
- Use ditches to drain
- Or monitored pumps to keep water levels below 2'
  
- Here the pump is an overhead fall hazard
- Employee needs a lifeline & harness



## Making the (soil) grade - A

- **Type "A"**
  - Fine grained
  - Doesn't crumble
  - Hard to break up when dry
  - Examples:
    - Clay
    - Hardpan
    - Silty or sandy clay, clay loam
  - Not type A if clay is fissured, cracked, disturbed or subject to vibration



## Making the (soil) grade - B

### Type B

- Granular: coarse grains
- Little or no clay content
- Crumbles easily when dry
- Examples:
  - **Silt**-fine mineral particles in size between clay and sand
  - **Loam**-from fragments of rock deposits in water
  - **Angular gravel**-crushed rock-the angular nature of the individual rocks provides some resistance to movement



Angular gravel

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## Making the (soil) grade - C

### Type C\*

- Granular soil: very coarse
- Minimal cohesion
- Examples:
  - Sand
  - Gravel
  - Loamy sand
  - Submerged soil or soil with freely seeping water
  - Submerged rock that is not stable.



Loamy sand

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## Protection tied to soil

- Sloping
- Shoring
- Shields
- Designed by a Registered Professional Engineer

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## Protection required when

Use **protective systems** when there is potential for cave-in:

- Under 4' deep if potential for cave-in exists
- 4' to 20' deep
  - Sloping
  - Shield or shoring
- Over 20' deep approved in manufacturer's tabulated data or designed by registered professional engineer
- Protective system is not required for stable rock

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## Sloping: low cost if you have space

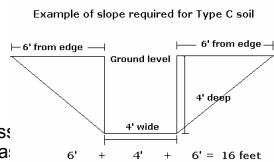
Sloping is the process of removing soil to eliminate the chance of a cave in. The required maximum allowable slope is determined by the class of soil. The requirements are as follows:

For each foot of trench depth, the ratio of slope measured from the trench edge at ground height must be:

Soil Type A -  $\frac{3}{4}$  to 1 ( $53^\circ$ )

Soil Type B - 1 to 1 ( $45^\circ$ )

Soil Type C -  $1\frac{1}{2}$  to 1 ( $34^\circ$ )



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## Shoring

Shoring is one of the most common used methods of worker protection. It is light-weight, portable and easy to install.

The manufacturer provides tabulated data with the shoring that provides the limitations, required spacing and proper use.



The above photo shows an example of aluminum hydraulic shoring.

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## Shields

Shields are manufactured by a number of companies and are designed to protect workers working within the confines of the shield.

Tabulated data for the maximum allowable depth it can be used. The tabulated data must accompany the shield when it is being used.

Additionally, the shield must be designed by a Registered Professional Engineer, be in good condition, and used properly.



## Engineered Methods



Retaining wall



Steel Sheet Piling



H piles and lagging  
(used at Burchard!)

## Egress

A trench that is 4' or more in depth must have a safe means for workers to get in and out of the trench.

A means of egress is required to be placed within each 25' of lateral travel.

The most common method is a straight ladder. If a ladder is used, it must extend a minimum of 3' above the landing. The use of step ladders is **not** permitted.

Other means include stairways, ramps and other means designed by a RPE.



## Excavations

OSHA 2226  
2002 (Revised)



## For more detail

- See OSHA 2226 in the Blackboard notes
- Attend BC1224 in Spring

What's wrong with this picture?



Force-field in effect?



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Would this be  
safer with  
hardhats?



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