HOW TO CONSTRUCT
and/or
INSPECT A NEW HANDICAP RAMP

Fort Belvoir Installation Safety Office Construction & Code Compliance Branch (703) 806-3447

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https://www.belvoir.army.mil/safety

LEARNING OBJECTIVES

- Compute: rise, run, slope, cross-slope
- Identify slope grade that meets ramp criteria
- Identify size, location and when landing is mandatory; directional changes of ramp
- Use handrail and “toeboard” specifications to determine minimum ramp width
- Construct the shortest possible ramp using allowable slopes and thresholds

REQUIREMENTS

- All remodels, new construction must comply with Architectural Barriers Act (ABA) guidelines found at http://www.access-board.gov/ada-aba/final.pdf
  - Do not use UFAS standards for anything, they have been rescinded. http://www.access-board.gov/ada-aba/dod-memorandum.htm
- For handicap ramps – as discussed in this presentation - these new standards are the same as the old 1994 standards.
- Contracts **SHALL** specify "…ramp and stairs shall comply with current ABA standards…"

DEFINITIONS

- **Rise**: Elevation change, expressed in inches
- **Run**: distance across ground; length of ramp
- **Ramp**: sloped path of travel with a grade of 1:12 through 1:20, no steeper. Generally, ramps need handrails on both sides
- **Handrail**: support bar located 34”-38” above finished floor (AFF)
- **Guardrail**: OSHA-mandated fall protection located 38”-42” AFF

DEFINITIONS

- **Sideguard**. A horizontal barrier integral to the guardrail that prevents a 4” sphere from passing under it. Used to protect wheelchairs and crutches from going under the guardrail. Also referred to as “toeboard” or lower railing. Without sideguards, ramp must be 12” wider on each side, beyond the guardrail/handrail
- Landing. Nearly-level flat area at top and bottom of ramp. Can overlap with door swing space. Also used to describe mid-point landing.

Basic Rules of Ramp Design

SLOPE

- Maximum of 1 inch of elevation change for every 12 inches of length (rise and run) (1:12) (1 inch:1 foot) (1”:1’)
  - Every 30 inches of elevation change, a landing must be installed
    - » Provides rest area for person climbing the platform
    - » Provides deceleration area for wheelchair descent
- Minimum: A sloped walking surface is not a “ramp” if it is less steep than 1:20
  - Example: a 66.6 foot long sloped walkway with a 40 inch rise is not a ramp. No need for handrails, or a midpoint landing.

Basic Rules of Ramp Design

RAMP

1:12 thru 1:20

- 30”:30’ thru 30”:50’
- 40”:40’ thru 40”:66’

(40 inch rise needs a 40’ ramp, and ramp also needs a

a 5 foot landing= 45’)

NOT A RAMP

1:21 and less steep

- 30”:51’ and longer
- 40”:66.6’ and no landing or handrails needed

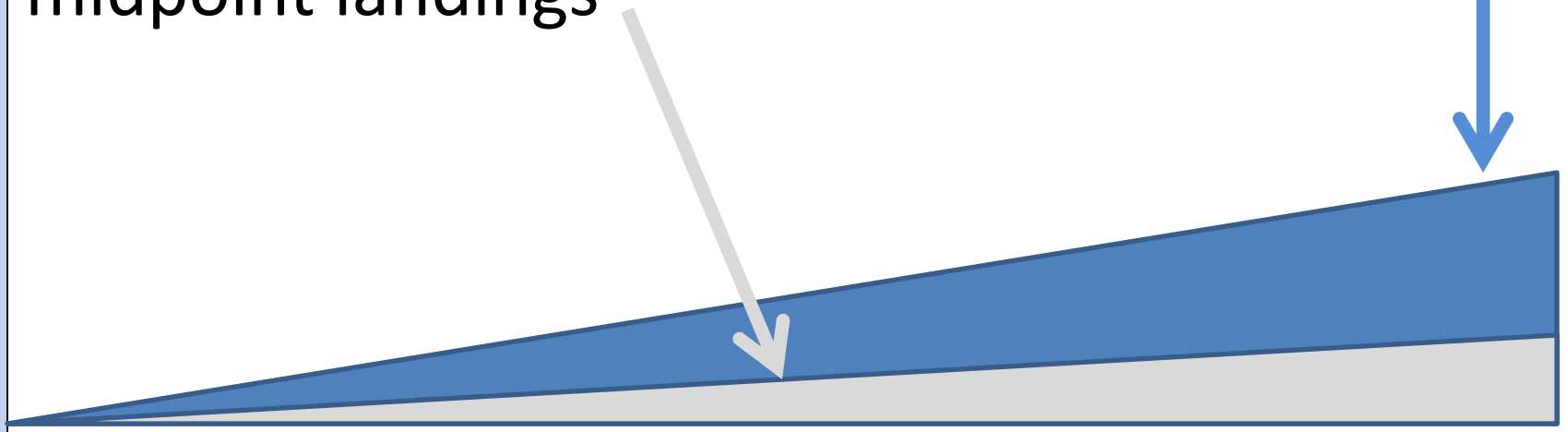
Basic Rules of Ramp Design

Comparison of slopes

Max allowable slope on most ramps is 1:12

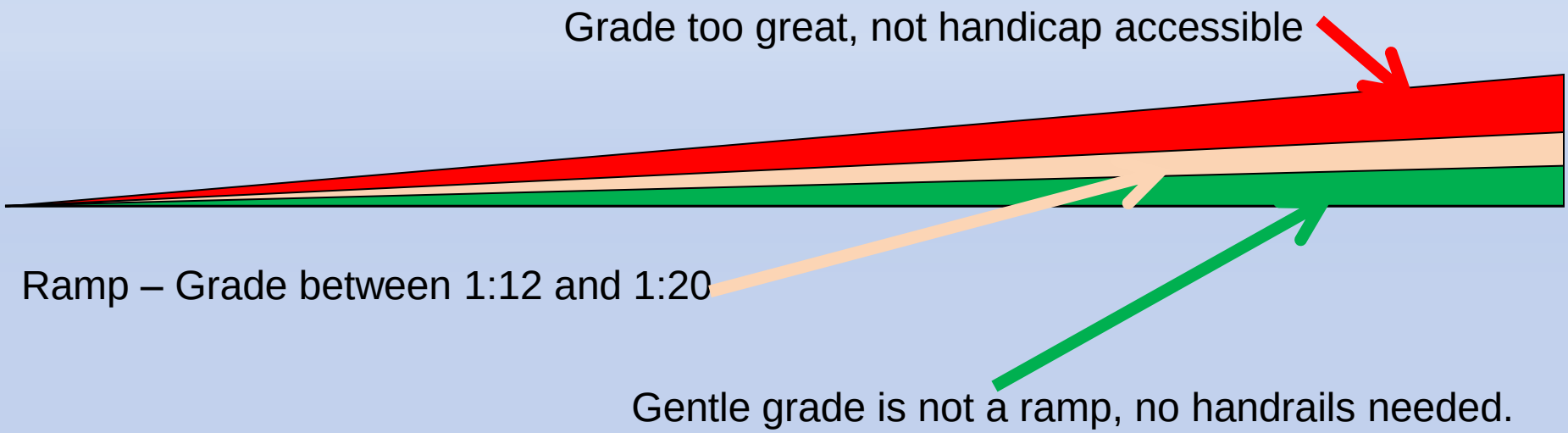
Min slope to be called a “ramp” is 1:20

Below 1:20 does not need handrails or midpoint landings



"Handicap Ramps How-To Guide" ... Ft Belvoir Installation Safety Office (703) 806-3447

Basic Rules of Ramp Design

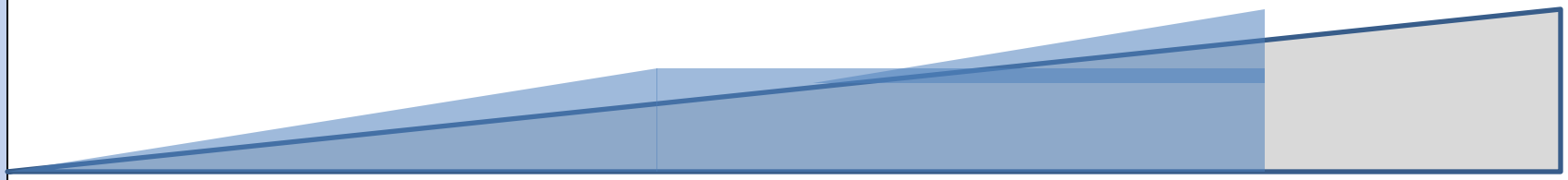


Basic Rules of Ramp Design

Comparison of slopes

Should we build a long, shallow incline that does not need handrails, or build the steepest ramp permissible by ABA?

- Steep ramp (1:12) requires expensive hand rail
- Steep ramp requires landings every 30” of rise
- Shallow incline (not a ramp!) consumes more space, and may cost more in materials



Basic Rules of Ramp Design

SLOPE %	RISE OVER RUN	RATIO	GRADE	USAGE
100%	1 in 1	1:1	45°	
50%	1 in 2	1:2	22.5°	
12.5%	Steeper than 1:10, but not steeper than 1:8	1:8	7.1°	Alteration only. Max rise 3” 1:8-1:10 (equals a 24”-30” long ramp, then a landing)
10%	Steeper than 1:12, but not steeper than 1:10	1:10	5.7°	Alteration only. Max rise 6” 1:10-1:12 (equals a 60”-72” long ramp, then a landing)
8.33%	1”:1’; 30”:30’	1:12	4.7°	Steepest allowable for ramp
6.25%	1 in 16	1:16	3.5°	1:12 - 1:16 slope range. Max rise 30” max run 30’
5%	1 in 20	1:20	2.86	1:16 – 1:20 slope range. Max rise 30” max run 40’
5.2%	1 in 19	1:19	3.01°	Is a ramp
5%	Accessible route 1.5” in 30”	1:20	2.86°	Not a ramp
2.083% (“level” by ADA)	1 inch in 4ft or ¼”pf slope	1:48	1.19°	Allowable cross-slope for walking surfaces, including ramps, parking areas, landings. Also used as a typical engineering spec for drainage. Not a ramp.
2%	1 in 50; 2 in 100; 1.2” (1 ¼”) in 60”	1:50	1.14 °	Common engineering specification
1%	1 in 100; 1 inch in 8.33 feet .6 inch (6/10) in 60” (5’)	1:100	.57 °	Potential inadequate drainage

How do we calculate slope?

Rise/Distance = Slope

30 inch rise over 30 feet of run

30’x12”=360”

30”/360”= 12, expressed as “one in twelve” (1:12)

26” elevation change, how long does the ramp need to be? A minimum of 26 feet long

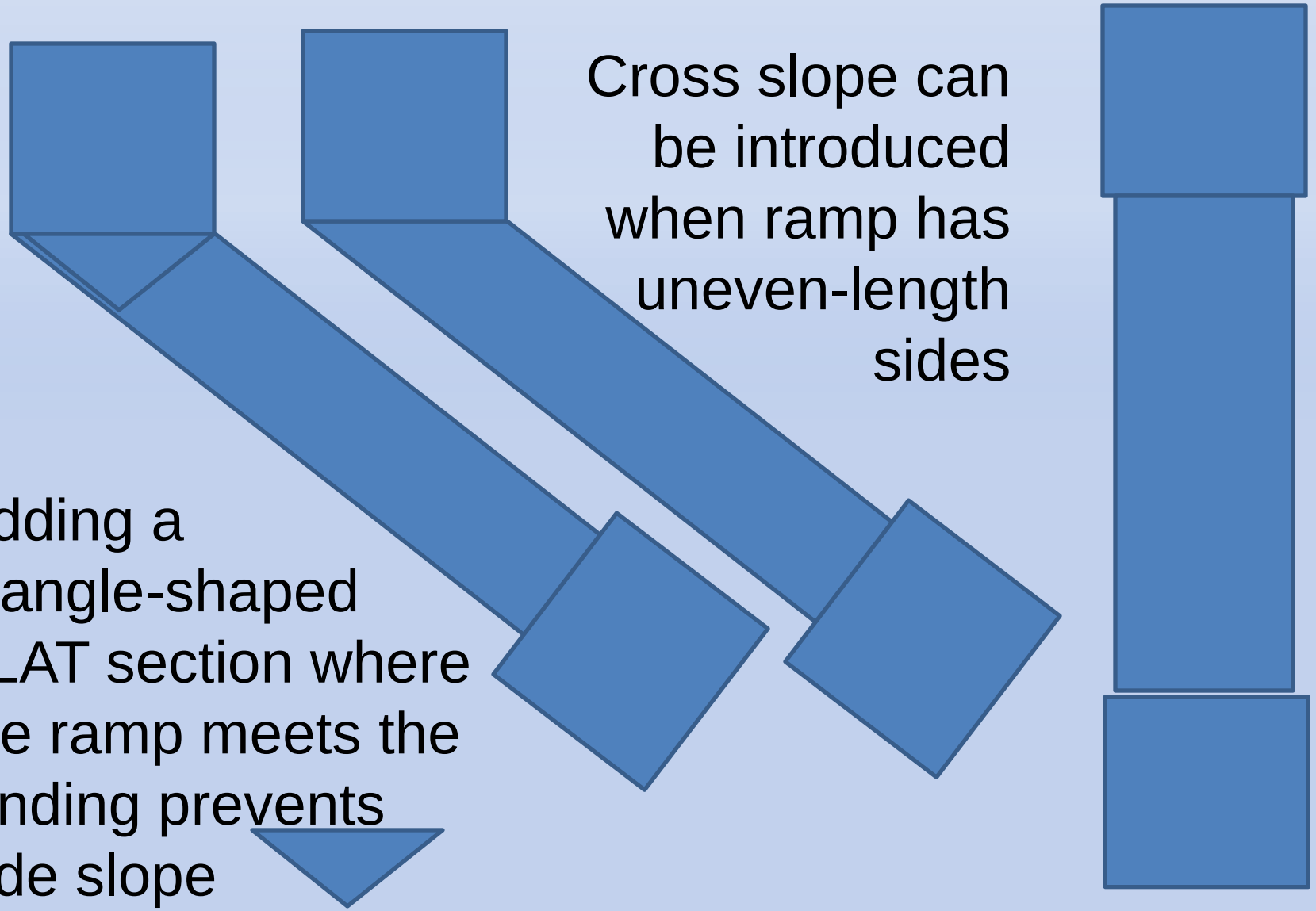
31” elevation change, how long does the ramp need to be? 31 feet plus a midpoint landing

What is Cross Slope?

Cross-slope

- #1 error – greatest cause of demolition/redo
- Excessive cross-slope causes wheelchair user to feel unbalanced; person on crutches can fall over
- Measured perpendicular (90˚) to running length
- Sides of ramp MUST be the same length, or undesired cross-slope will occur.
- Maximum permissible cross-slope is:
  ¼” per foot (pf)
  1:48
  1 1/8” over 50”
  1 ¼” over 60”.

Angled Ramps & Cross Slope

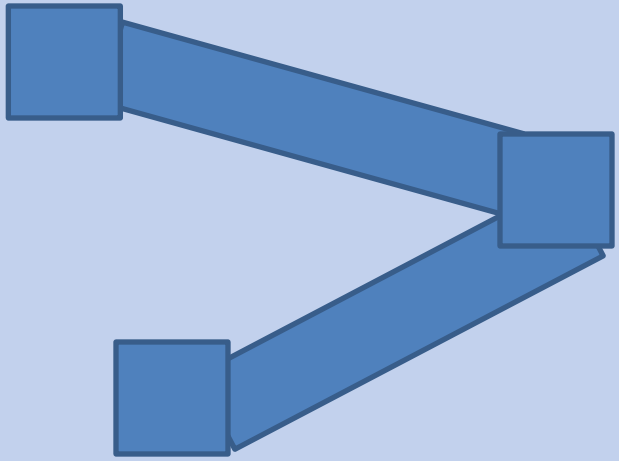


Cross slope can be introduced when ramp has uneven-length sides

Adding a triangle-shaped FLAT section where the ramp meets the landing prevents side slope

Landings

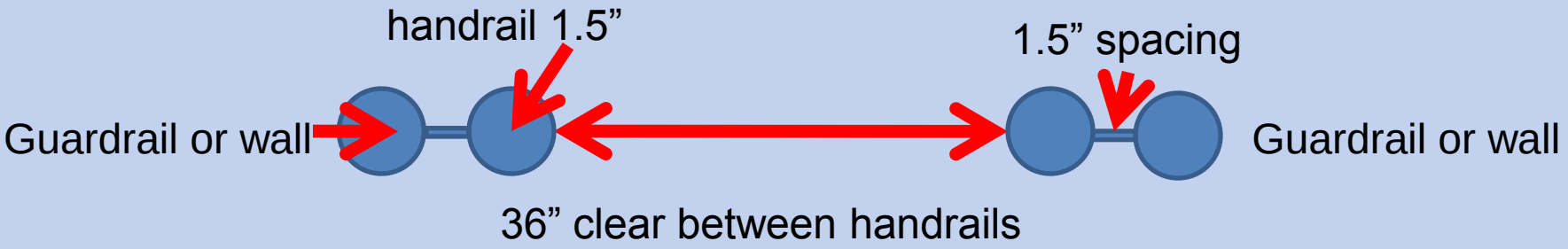
- Landings are installed at the top and bottom of ramp. Can be existing porch stoop or sidewalk. Must be “at least as wide as the ramp that leads to it”; and 60” deep
- Landings are mandatory when a ramp changes direction. These landings shall be 60” x 60” minimum.



How wide must a ramp be?

- Depends on:

1. Use of side guards
2. Mounting method of guardrail/handrails

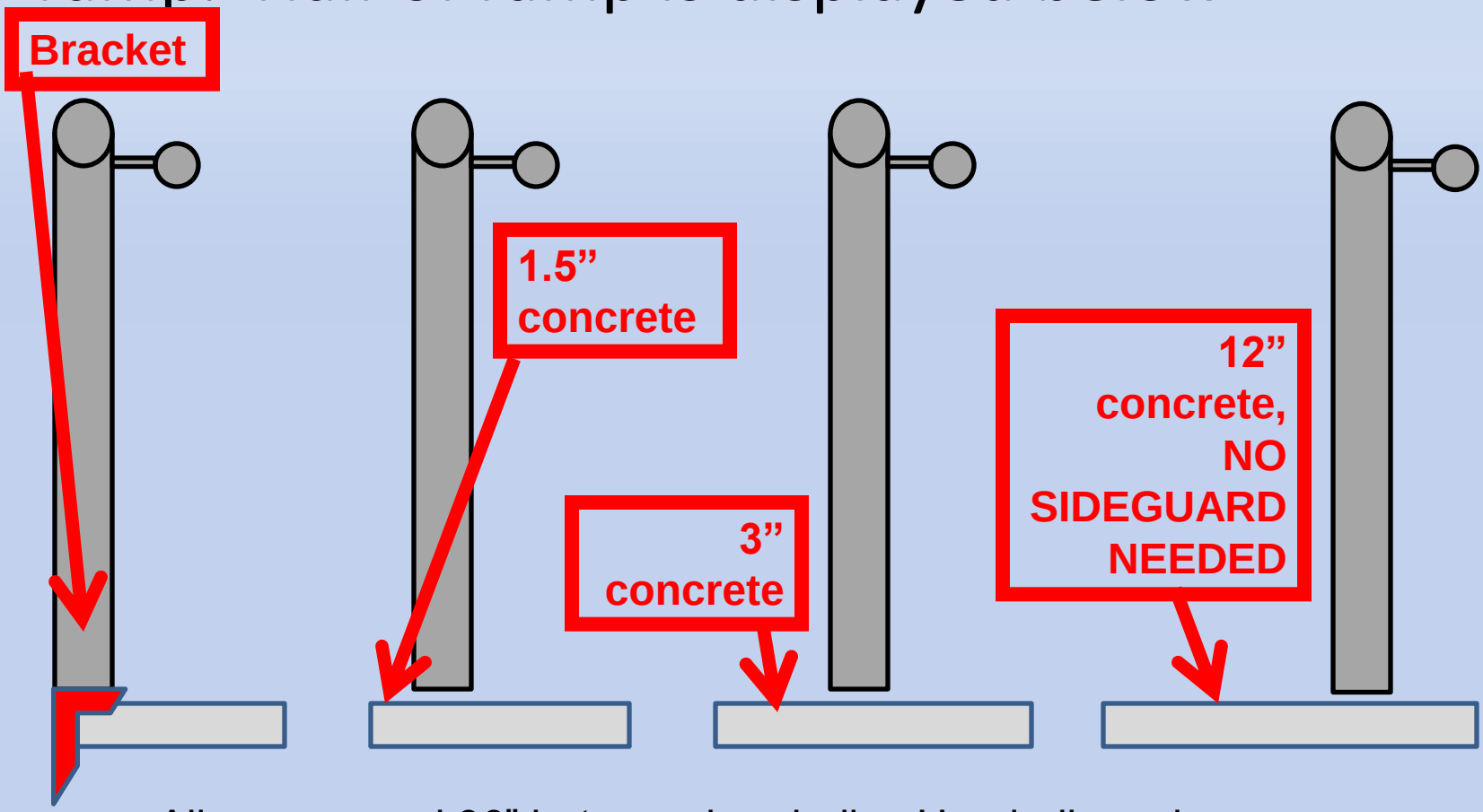


36+1.5+1.5+1.5+1.5= 42” absolute minimum width of ramp, assuming that the handrails are mounted to a wall

If handrails are mounted to 1.5” diameter guardrails, add 3”
If guardrails are mounted into concrete, add another 5” (50” wide ramp)

How Should We Mount the Guardrail?

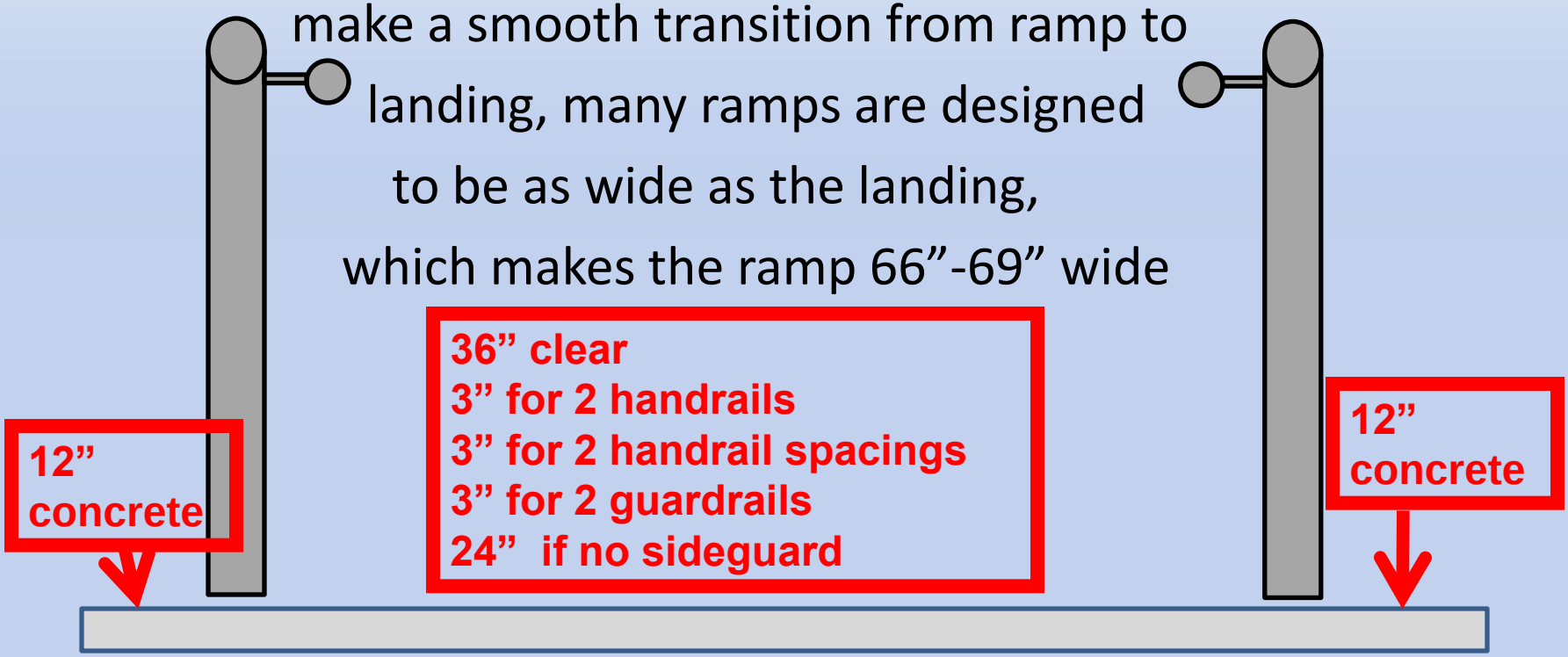
- Mounting technique determines total width of ramp. Half of ramp is displayed below



All ramps need 36” between handrails. Handrails and mounting bracket add another 6”, for a minimum of 42 inches.

How Should We Mount the Guardrail?

Since landing must be 60” deep, many designers prefer a square landing, making the landing 60” wide, too. Add 6” total for guardrail mounting, and the landing ends up being 66”x66”. To make a smooth transition from ramp to landing, many ramps are designed to be as wide as the landing, which makes the ramp 66”-69” wide



Basic Rules of Ramp Design

- Handrails
  - If you install them, they must meet ABA code, (even for gently-sloped areas not considered a ramp according to ABA)
  - Handrails not required by ABA for elevation changes of 6 inches or less. Example: 6 foot long ramp with 6 inches of elevation change does not need handrails.
  - Cannot be 2x4 or any other dimensional lumber
    - Must be round/oval/rounded square & be able to be gripped underneath the rail
  - Must be very sturdy – 200 lb of side force

How To Build The Shortest Possible Ramp

- Consume elevation
  - Door threshold can be ½” (this is a savings of 6” of ramp run)
  - Landings can slope 1:48, or about 1 ¼ over a 60” span, saving 2 ½ feet over two landings.
- Careful planning can save a minimum of three feet of ramp length

The Wrong Way To Build A Ramp

Rise is 16 inches, but the run is only 15 feet.

2110

This angled ramp is too steep, and must be jackhammered up / redone

The Wrong Way To Build A Ramp

Level shows that the slope of the near-side is different than the slope of the far side.

This ramp also has excessive cross-slope

The Wrong Way To Build A Ramp

Level shows excessive cross-slope

The Wrong Way To Build A Ramp

Second attempt. Ramp stretched by angling off to the side. Still missing a 90˚ transition from the upper landing to the ramp, which caused excessive cross-slope.

This angled ramp has too much cross-slope, and must be jackhammered up and redone (again).

The Right Way To Build A Ramp

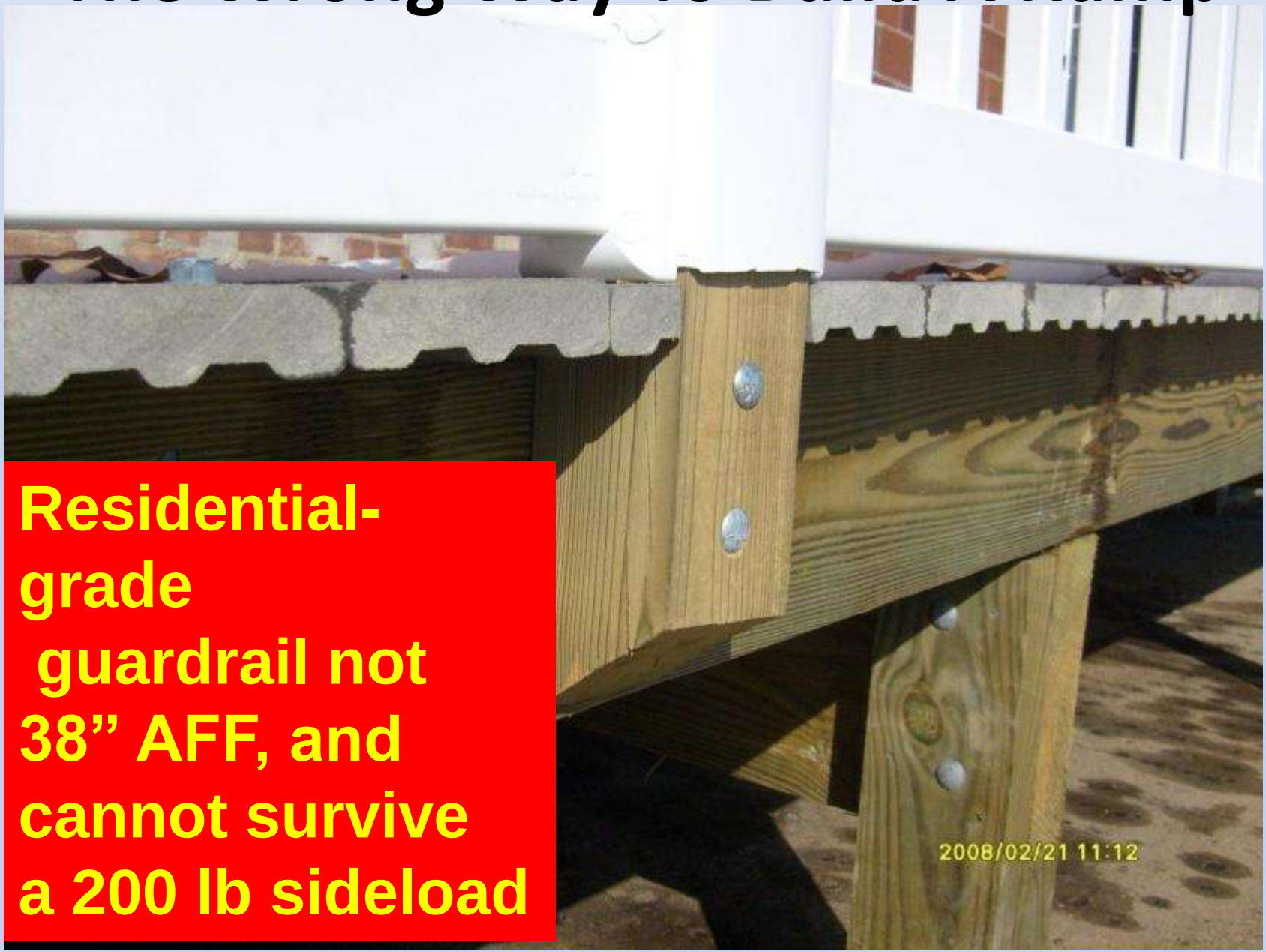
Third try was done correctly. Triangle transition is flat to the landing. Beginning of ramp is 90˚ to landing.

The Wrong Way To Build A Ramp

Warehouse converted to retail sales. PO installed ramp under their own contract

Warehouse loading docks are 48”. Max rise without a landing is 30”. Where is the midpoint landing?

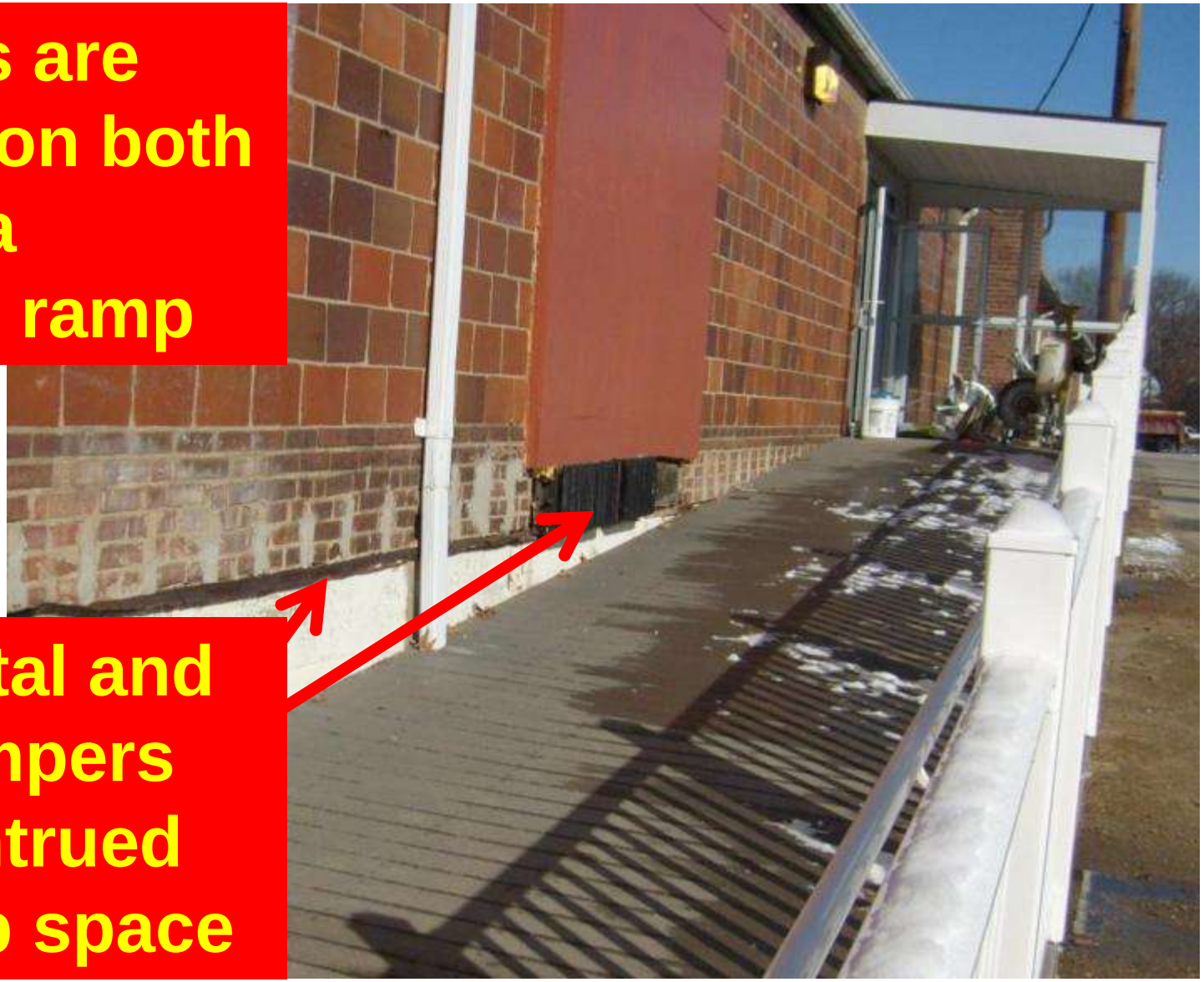
The Wrong Way To Build A Ramp



Residential-grade guardrail not 38” AFF, and cannot survive a 200 lb sideload

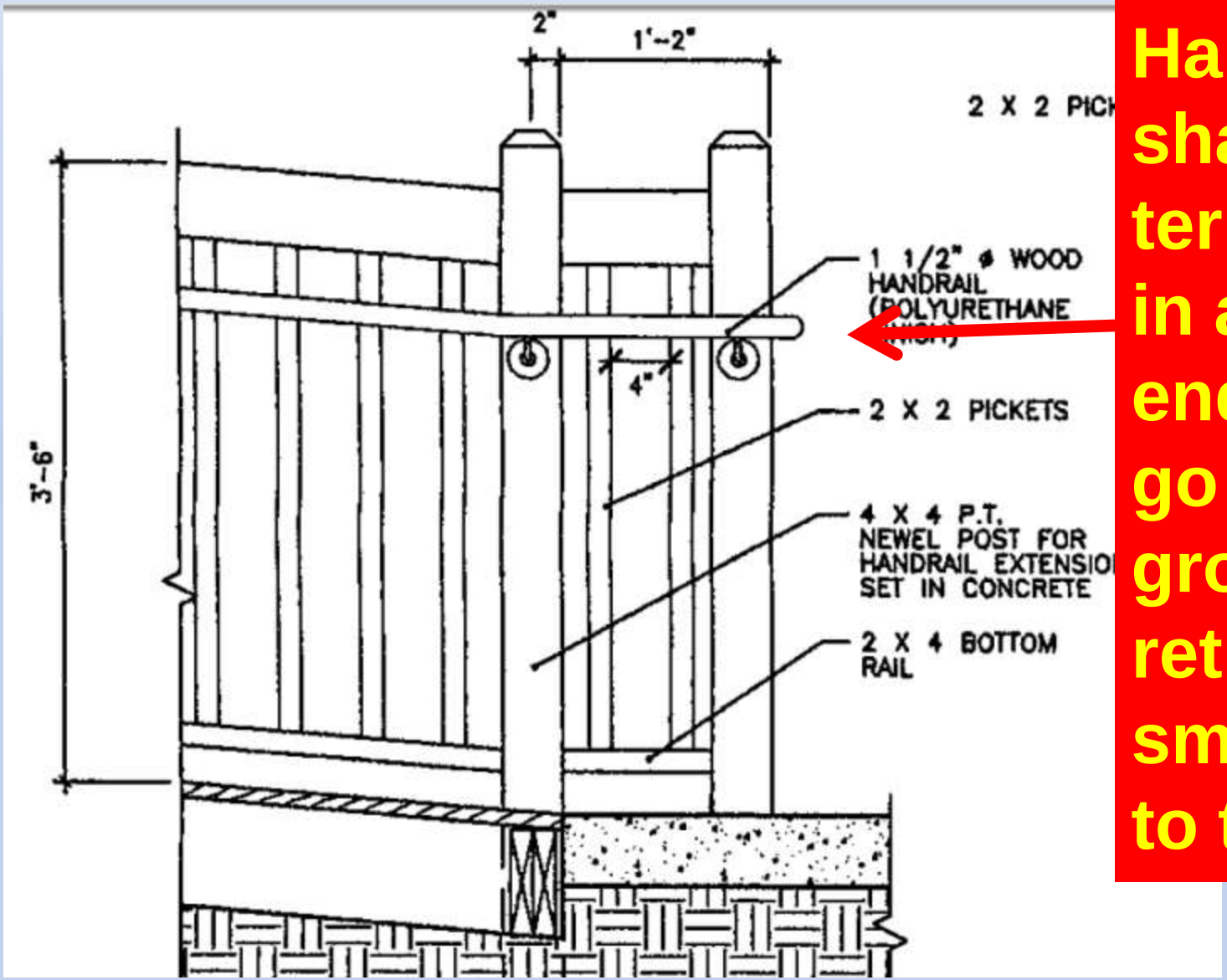
The Wrong Way To Build A Ramp

Handrails are required on both sides of a handicap ramp



Sheetmetal and dock bumpers cannot intrued into ramp space

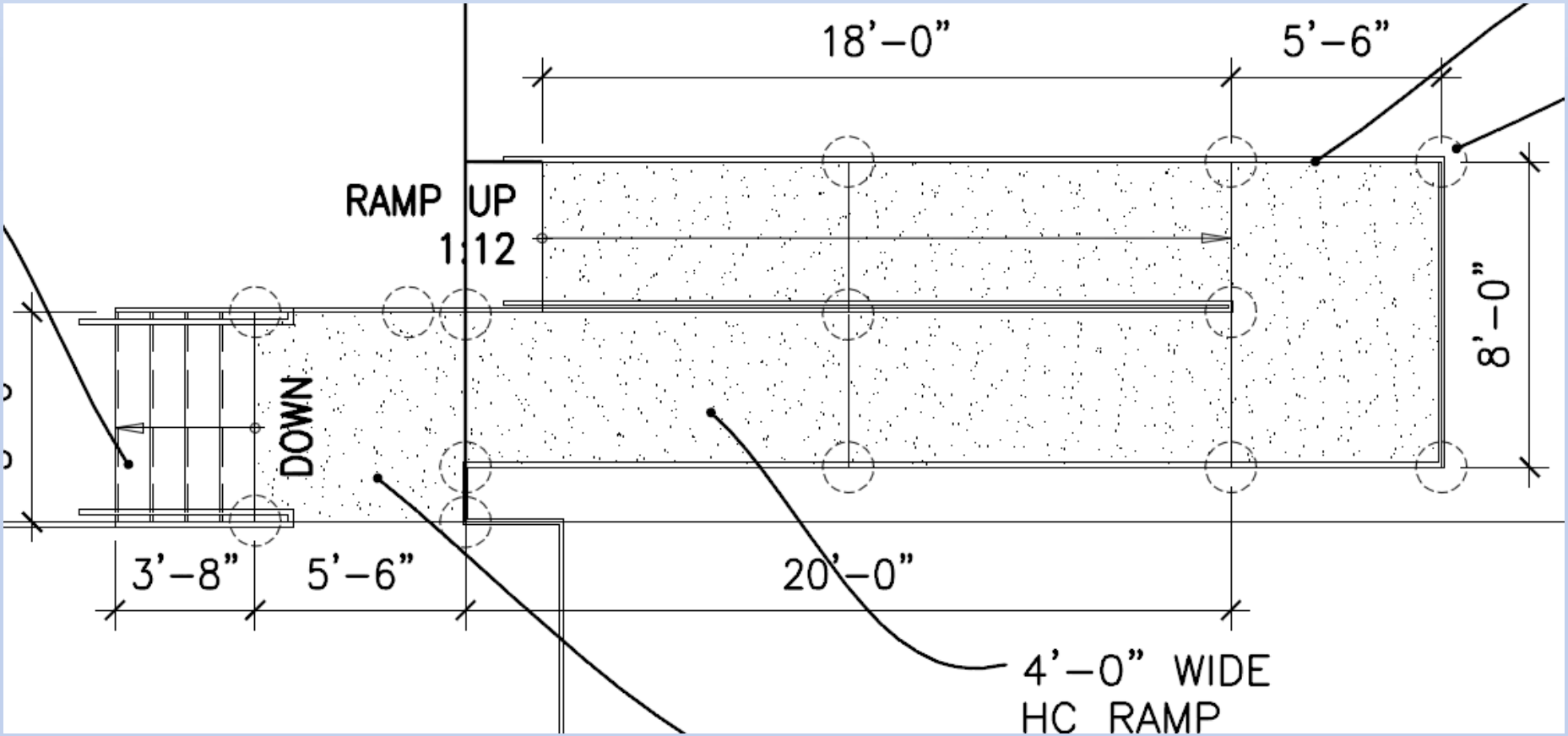
The Wrong Way To Build A Ramp



Handrails shall not terminate in a sharp end. Must go to ground, or return smoothly to the post

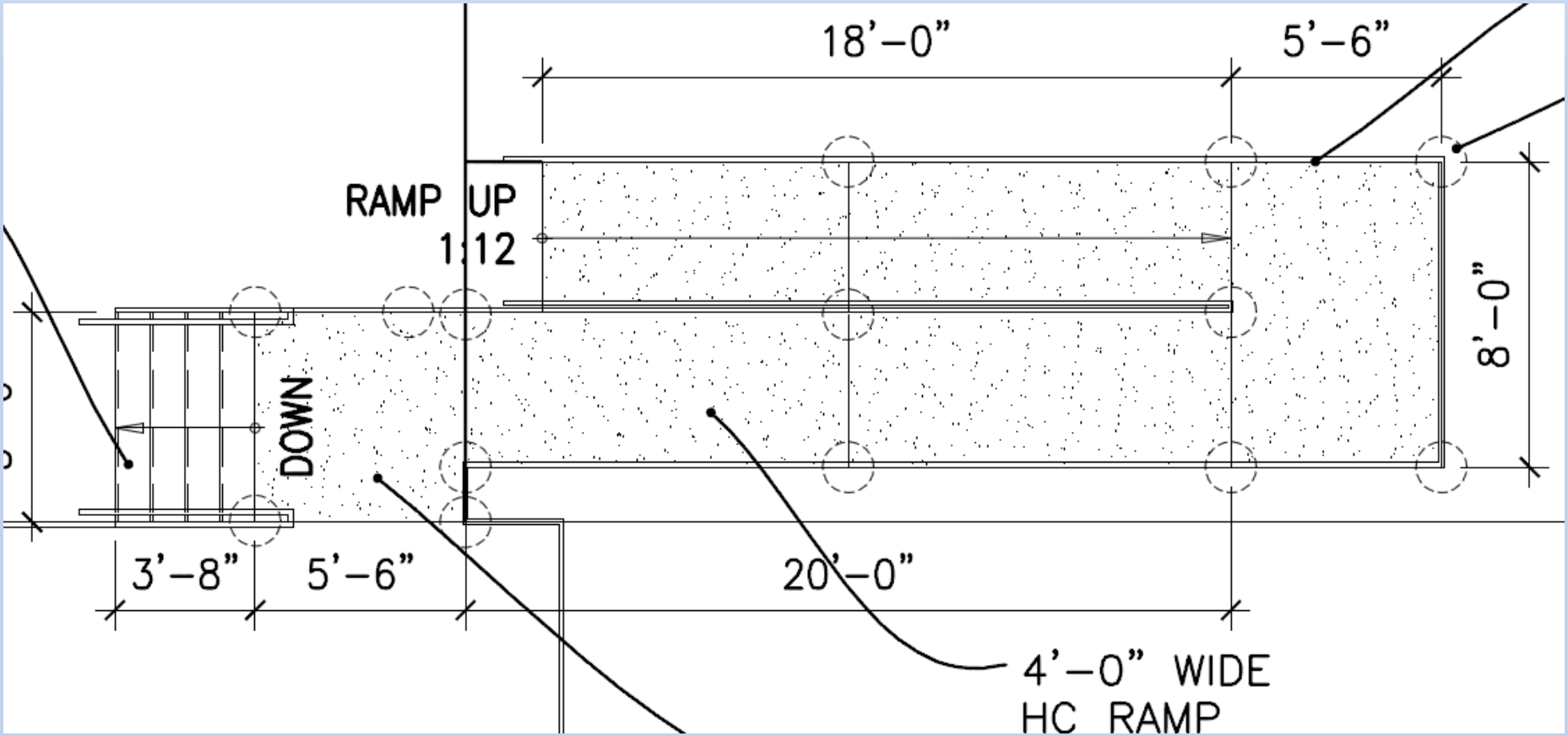
The Wrong Way To Build A Ramp

48” rise requires 48’ of run. 18’+20’=38’. Contractor included *sloped landings* to achieve 1:12, which is illegal



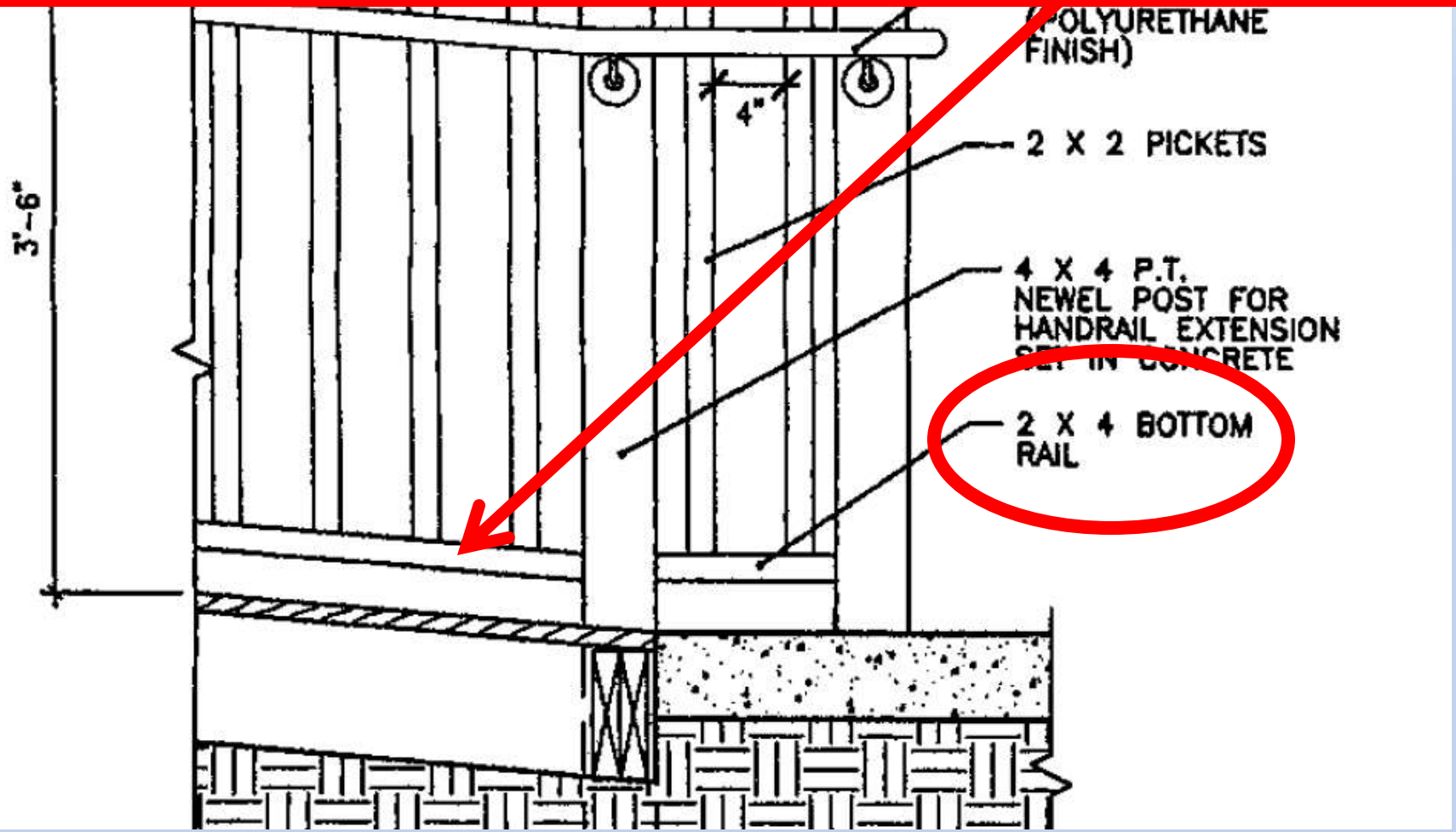
The Right Way To Build A Ramp

How wide must a ramp be? 48” wide with side guards, or 66” without. 36” clear between handrails + 1 ½” handrails (3” wide total), + 1 ½” (3”total) spaced away from guardrail + guardrail mounting surface of 6”= 48” with side guards



The Wrong Way To Build A Ramp

What is a side guard? A feature that does not allow a 4” sphere to penetrate. Prevents wheelchair casters from slipping off the edge of a 48” wide ramp.



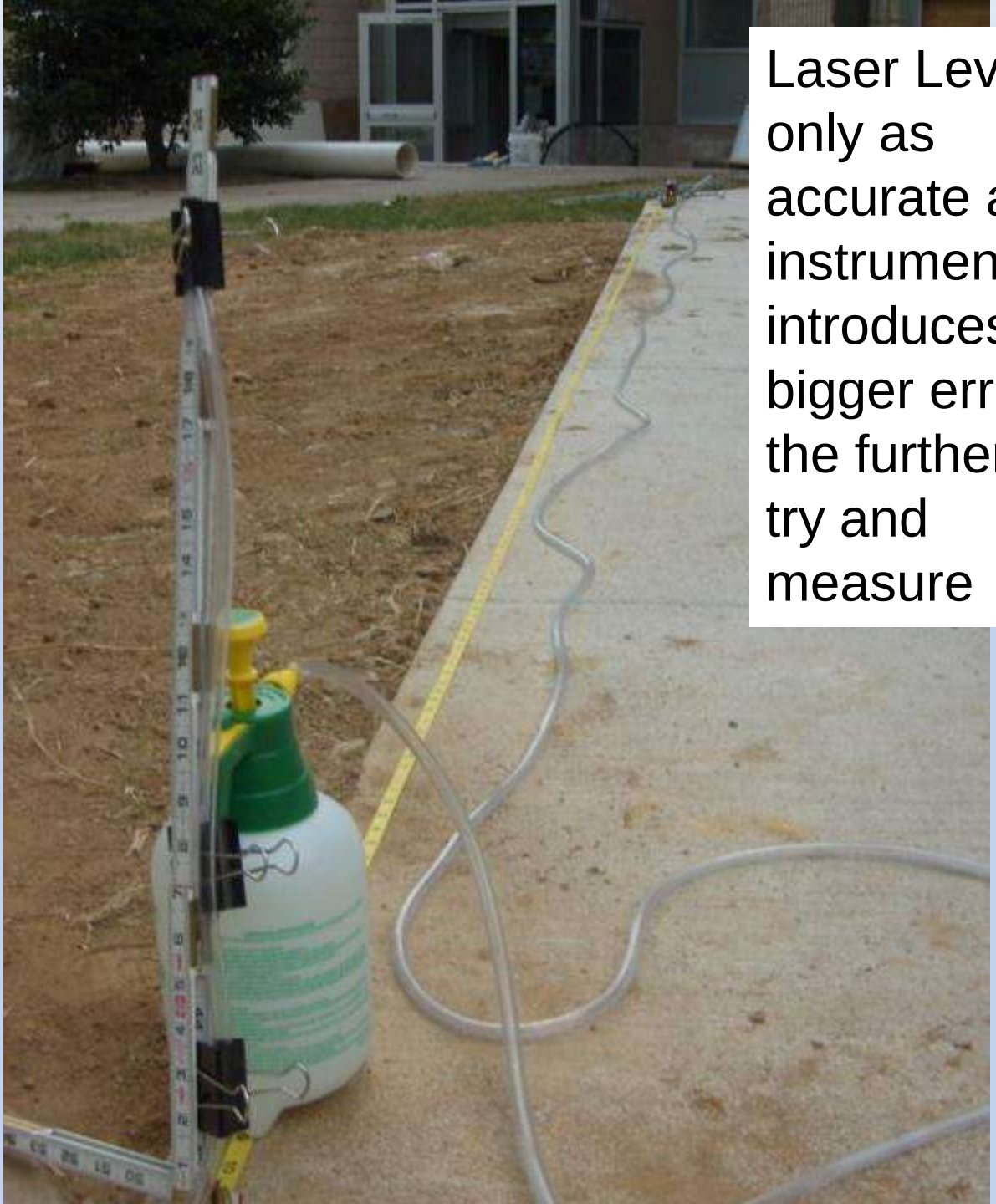
How To Measure A Ramp (or forms)

Measuring rise over run. At the 5 foot mark, with 5 inches of lift from the scale, the bubble level should indicate level.

How To Measure A Ramp (or forms)

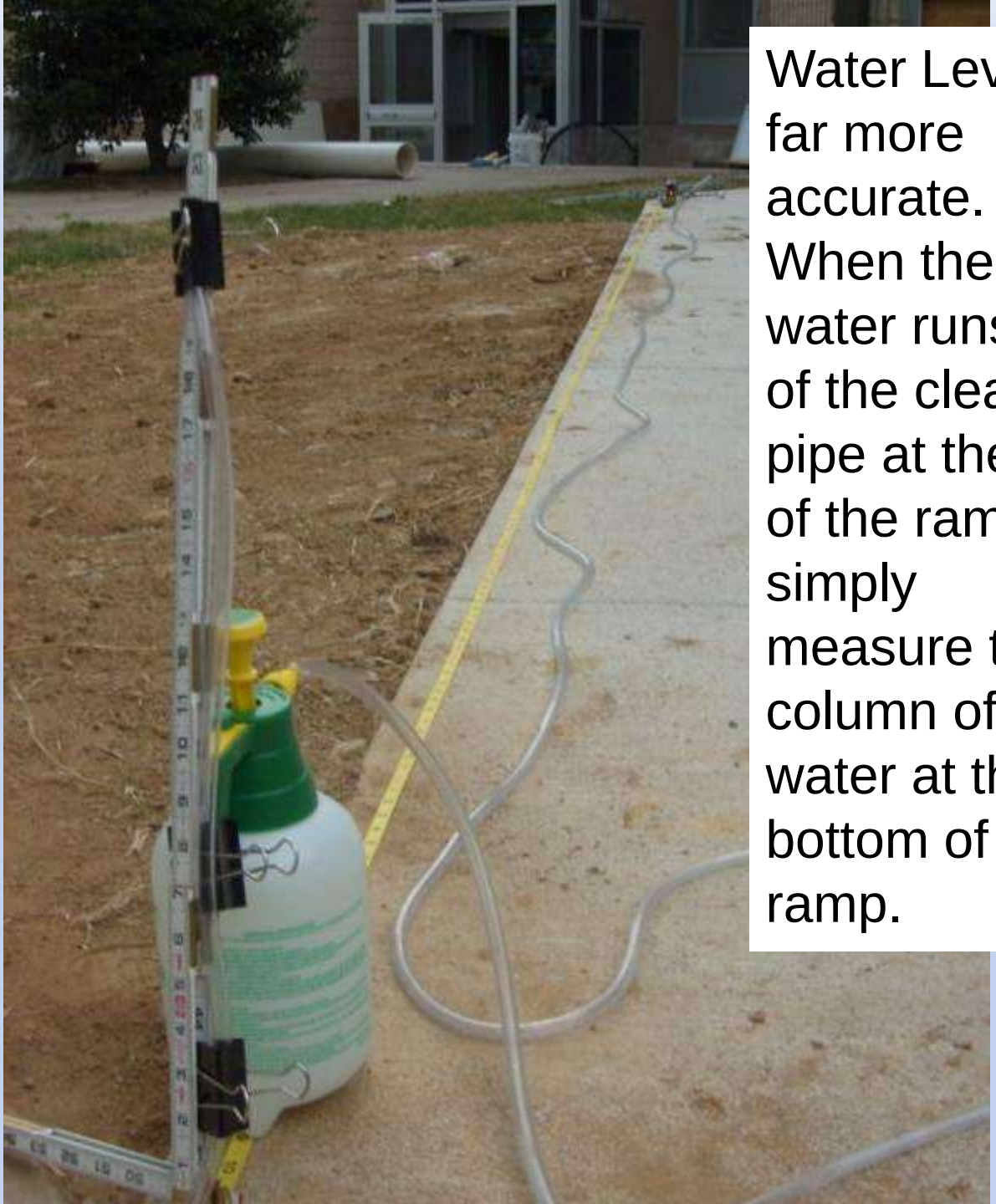
Measuring rise over run. At the 5 foot mark, with 5 inches of lift from the scale, the bubble level should indicate level.

Two different methods of measuring elevation change.



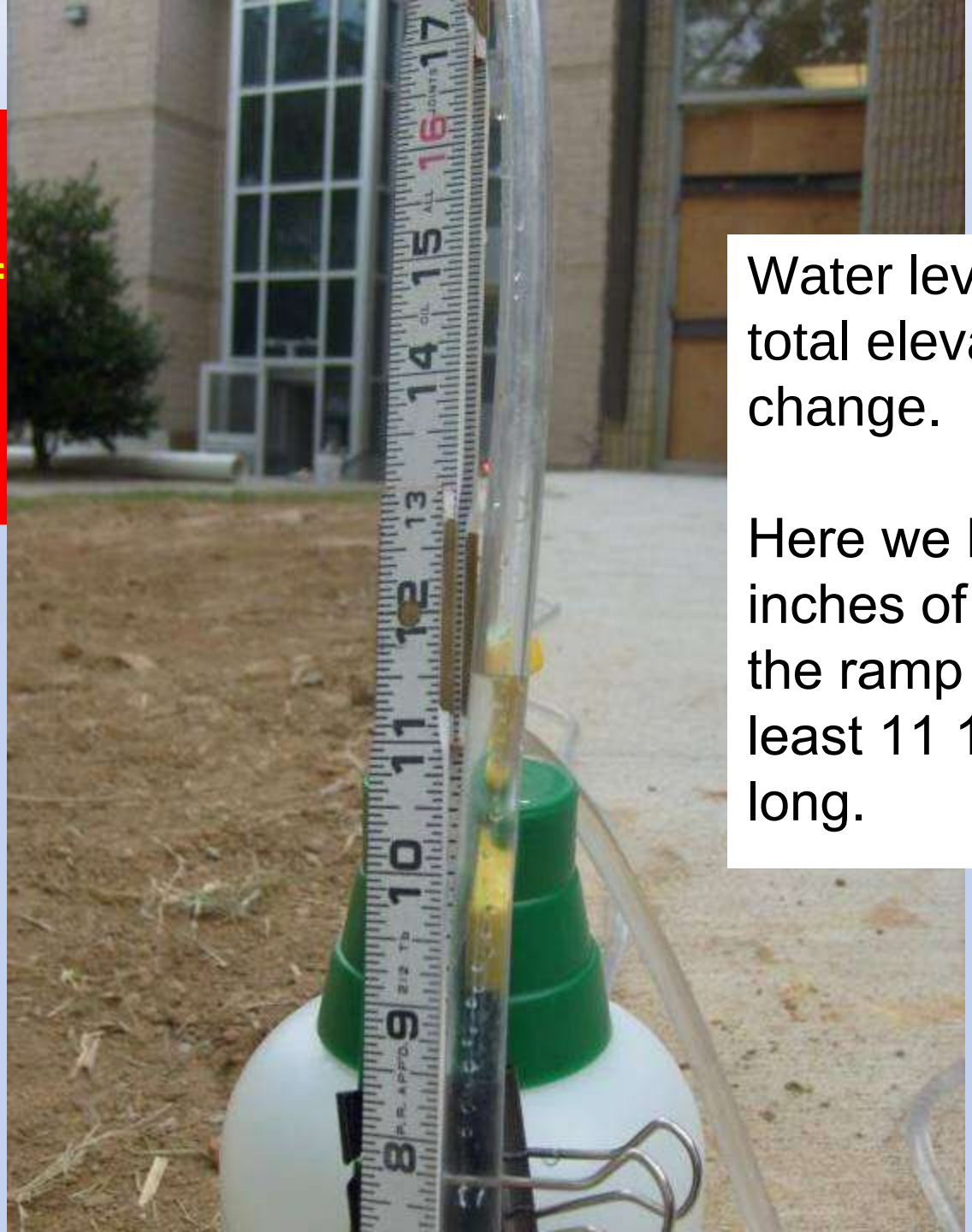
Laser Level is only as accurate as the instrument, and introduces bigger errors the further you try and measure

Two different methods of measuring elevation change.



Water Level is far more accurate. When the water runs out of the clear pipe at the top of the ramp, simply measure the column of water at the bottom of the ramp.

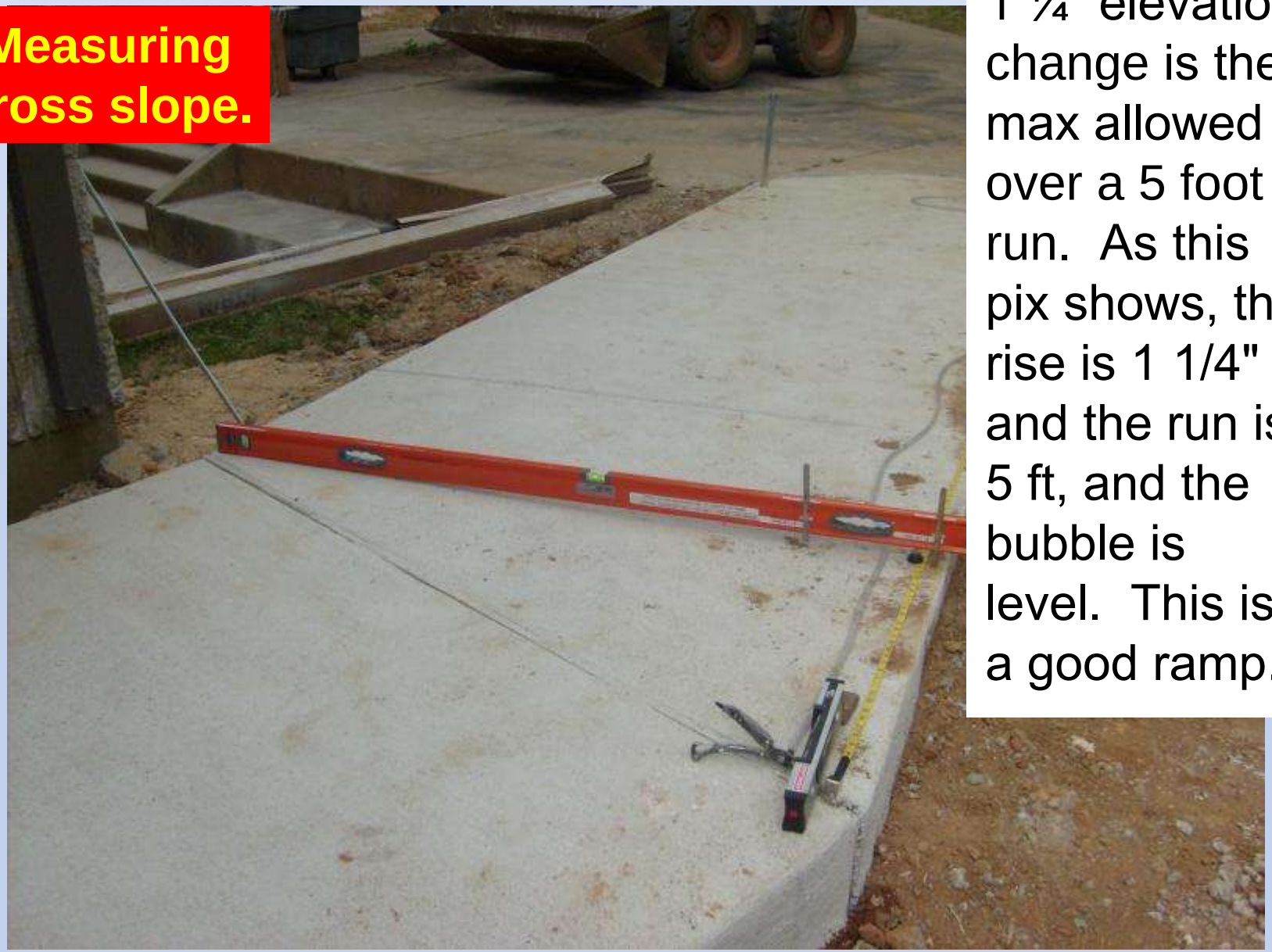
Two different methods of measuring elevation change.



Water level indicates total elevation change.

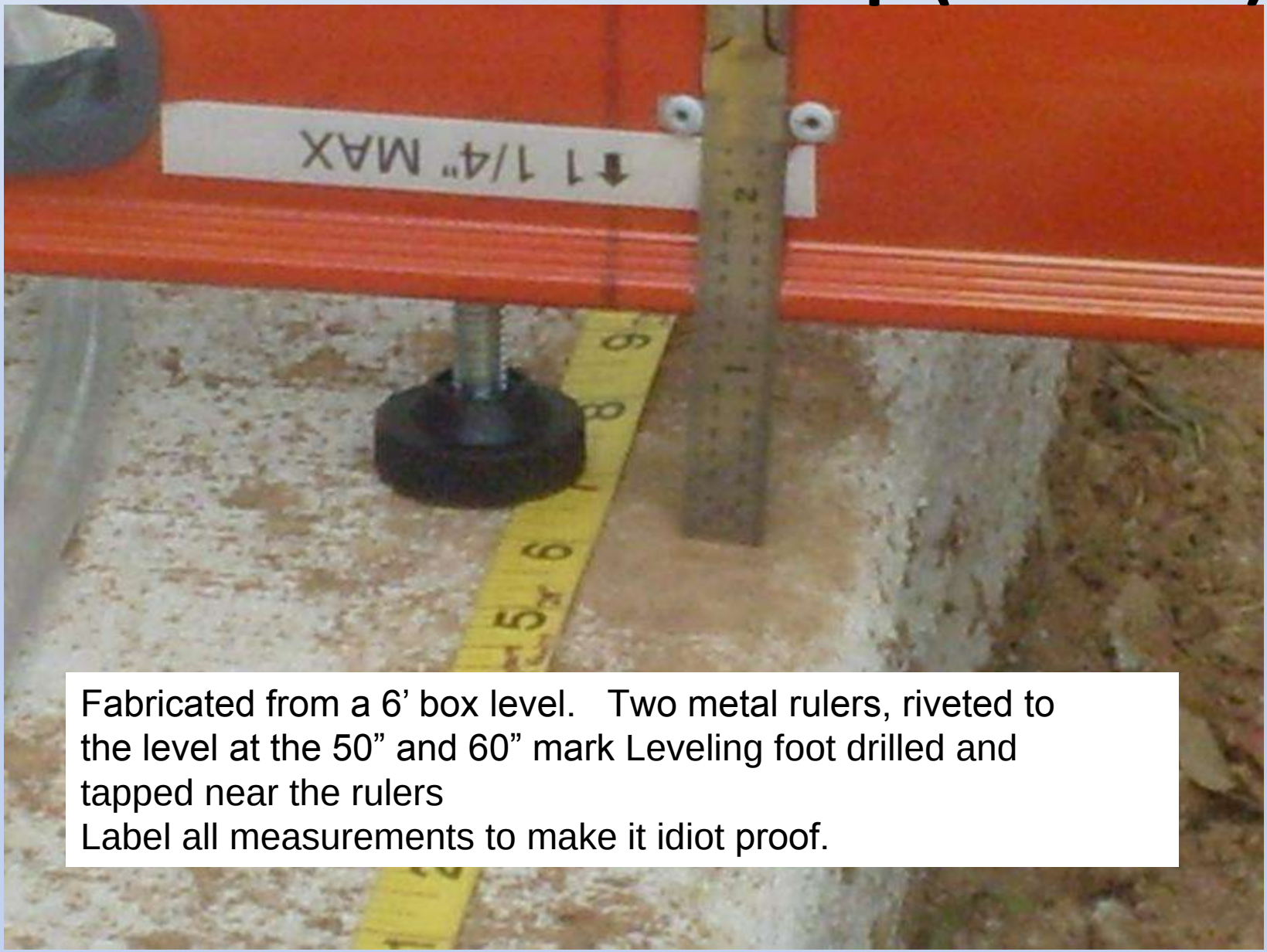
Here we have 11 1/2 inches of water, so the ramp shall be at least 11 1/2 feet long.

Measuring cross slope.



1 ¼” elevation change is the max allowed over a 5 foot run. As this pix shows, the rise is 1 1/4" and the run is 5 ft, and the bubble is level. This is a good ramp.

How To Measure A Ramp (or forms)



Fabricated from a 6’ box level. Two metal rulers, riveted to the level at the 50” and 60” mark Leveling foot drilled and tapped near the rulers
Label all measurements to make it idiot proof.

The Wrong Way To Build A Ramp

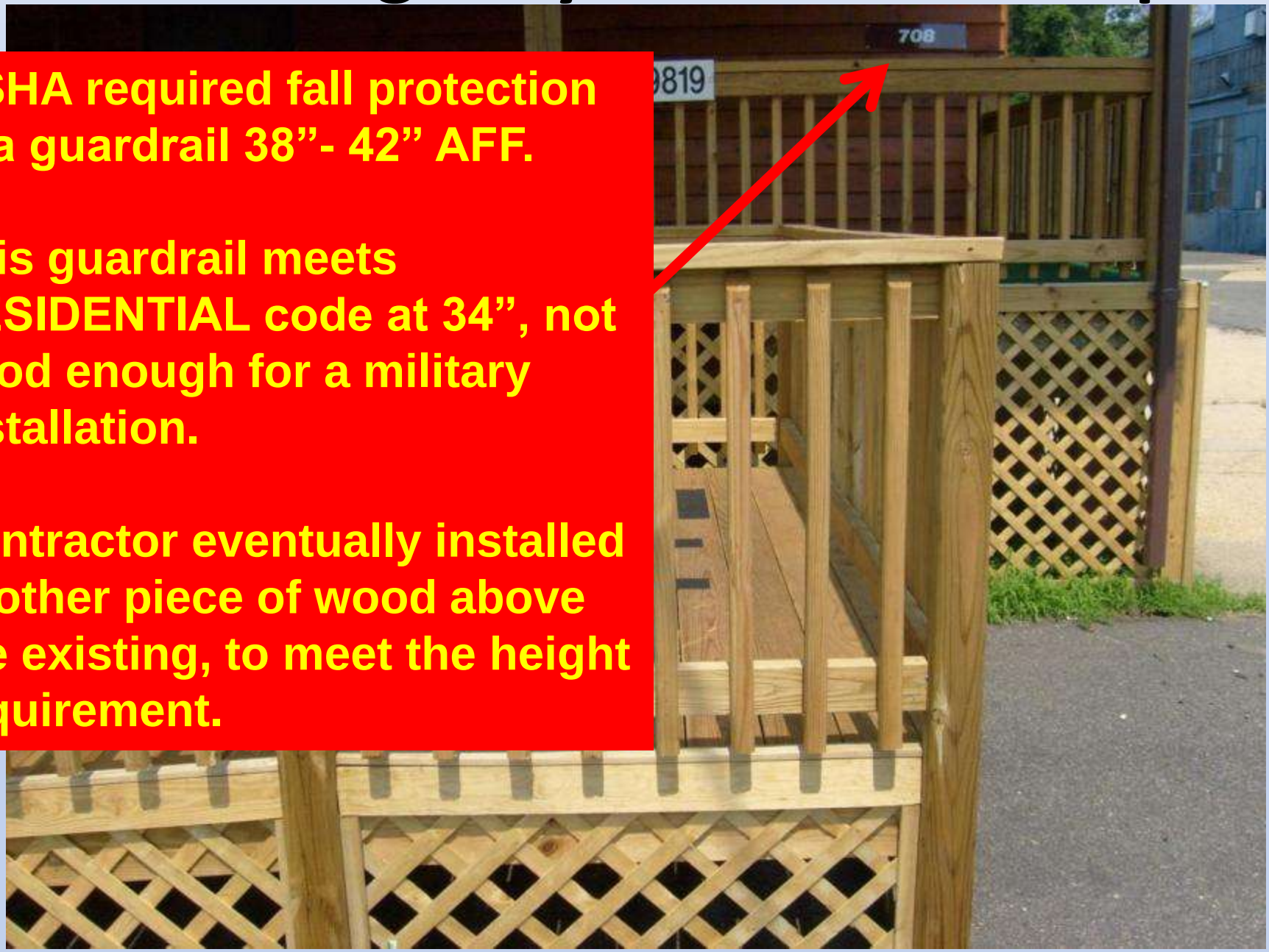
Warehouse converted to retail sales. Ramp constructed by private contractor who "usually builds the ramps" for this retail store. Store exclusively employs handicap.

The Wrong Way To Build A Ramp

Midpoint landings shall be 60” x 60” minimum

Do the math – in your head! 8 boards across, and they look like 2x6. So they are actually 5.5” wide, for a total width of 44 inches. No way that we have a legal landing here!

The Wrong Way To Build A Ramp



OSHA required fall protection is a guardrail 38”- 42” AFF.

This guardrail meets RESIDENTIAL code at 34”, not good enough for a military installation.

Contractor eventually installed another piece of wood above the existing, to meet the height requirement.

The Wrong Way To Build A Ramp

Ramp handrails shall extend past the landing for a distance of at least 12”. No sharp, pointy ends allowed!

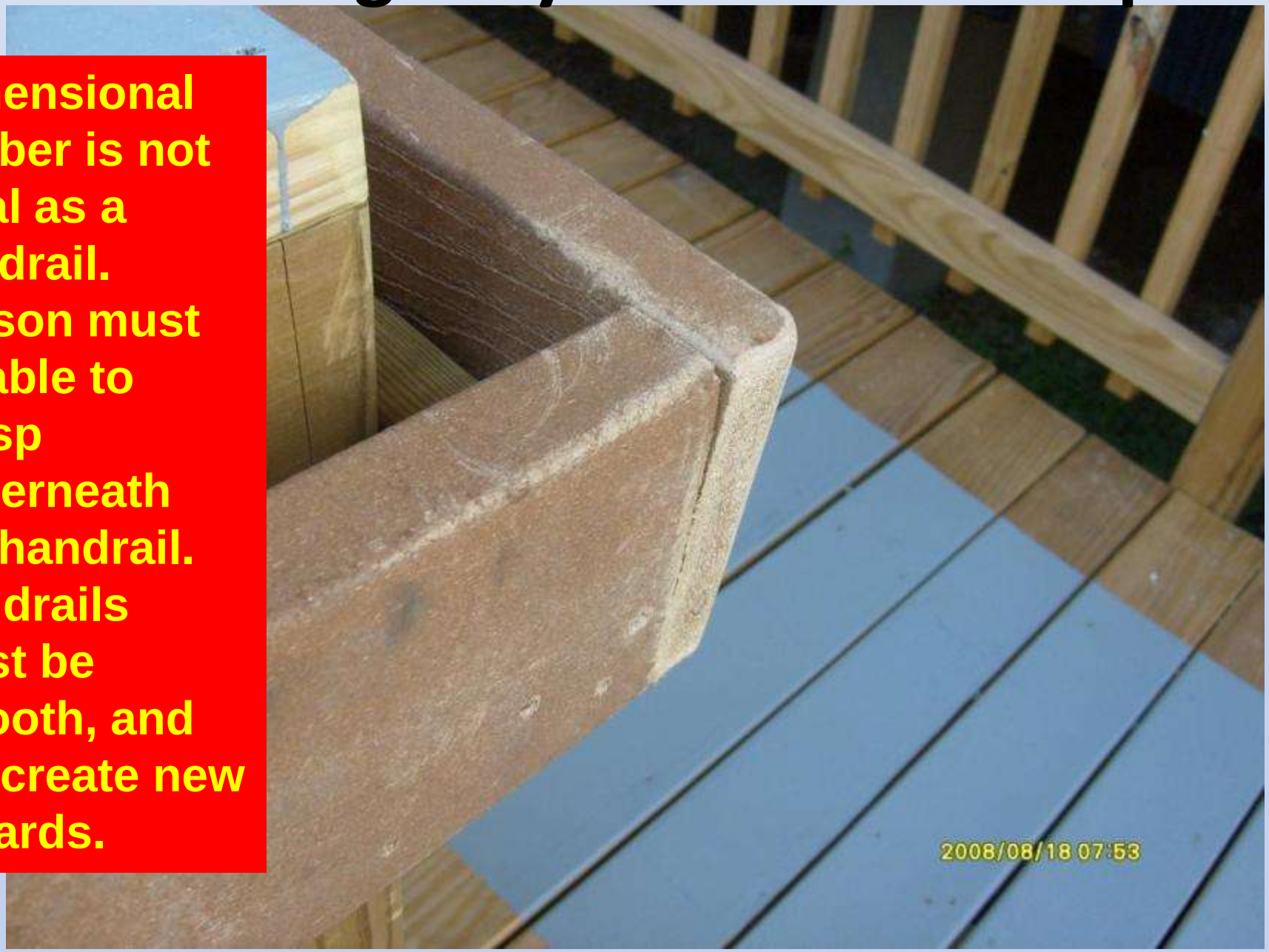
The Wrong Way To Build A Ramp

Stair handrails shall extend past the last step for a distance equal to that step.

The Wrong Way To Build A Ramp

The ugly truth – some contractors are not qualified to install handrails, let alone an entire handicap ramp.

The Wrong Way To Build A Ramp



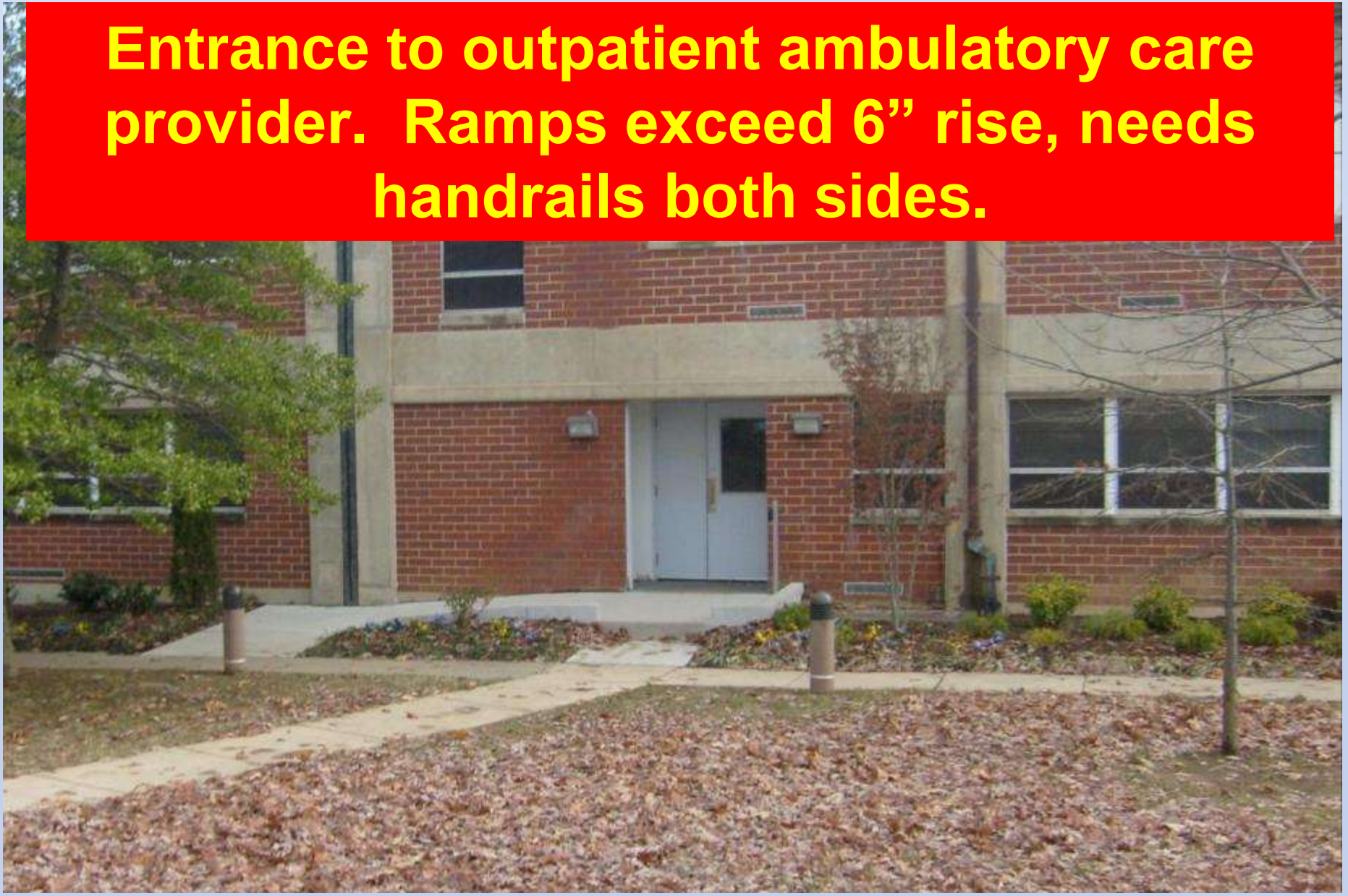
Dimensional lumber is not legal as a handrail. Person must be able to grasp underneath the handrail. Handrails must be smooth, and not create new hazards.

The Wrong Way To Build A Ramp

More ugliness. Using TREX brand composite as a semi-self-supporting wooden handrail will cause the rail to fail. Trex is very heavy, and in this application, it is unsupported.

The Wrong Way To Build A Ramp

Entrance to outpatient ambulatory care provider. Ramps exceed 6” rise, needs handrails both sides.



The Wrong Way To Build A Ramp

Cross-slope is THREE INCHES too steep.
Midpoint landing not level .

The Wrong Way To Build A Ramp

Discovered under a tarp – by Installation Safety.

The Wrong Way To Build A Ramp

RISE 46 5/8”. RUN 36’ 10”. Jackhammer it and try again. Rise cannot exceed 30” without installing a landing. A rise of 30” must be over 30 feet of ramp length. This situation requires a two-section ramp with midpoint landing. Total length 47 feet plus a 5 foot midpoint landing = 52 feet plus upper landing

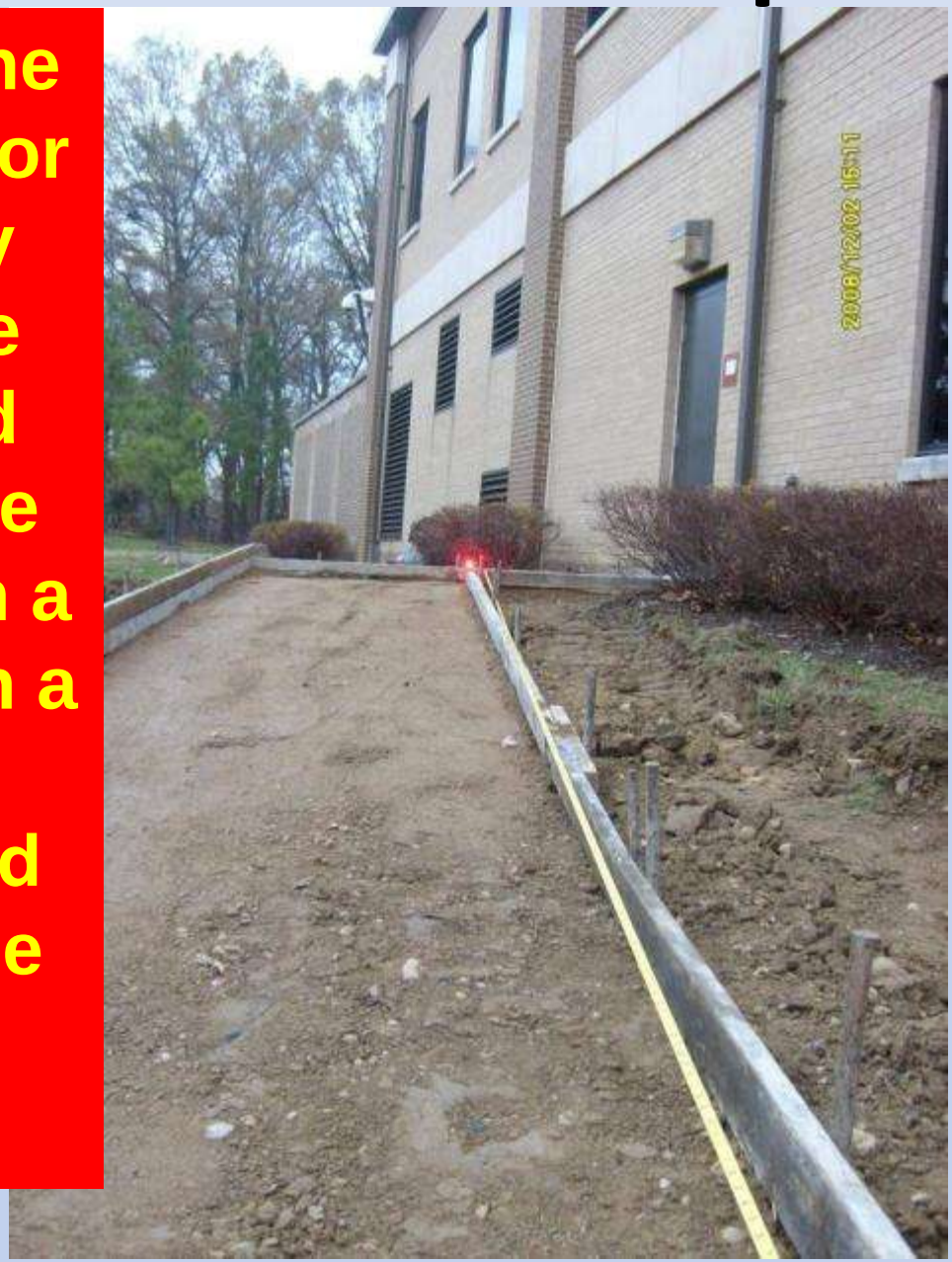
The Wrong Way To Build A Ramp

A fitting end for a brand new (and illegal) handicap ramp

The Wrong Way To Build A Ramp

The Wrong Way To Build A Ramp

Once contractor laid the forms and went home for the night, Base Safety surveyed the concrete forms with a laser and tape measure. Here we are measuring rise with a laser level, and run with a tape measure. Rise cannot exceed 30”, and run must be at least the same number, but in “feet”.



The Wrong Way To Build A Ramp

Taped area is a level landing. Failure to make a clean 90° break from the landing to the ramp will result in undesired cross-slope!

The Wrong Way To Build A Ramp

Angled ramp is missing the triangle transition. 6 foot box level is placed where the seam should be, measuring the 2” of elevation change across the ramp. This ramp is illegal, and must be jackhammered up and redone.

The Wrong Way To Build A Ramp

With the metal scale (ruler) set at 1 ¼” (60 inch ramp), the box level does not indicate a level condition. Resetting scale to 2 ¼ inches resulted in a level condition, exceeding permissable cross-slope. Jackhammer it.