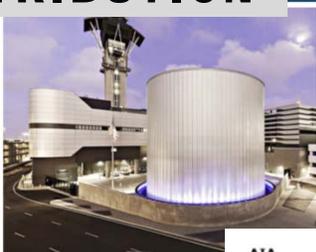


# 313 HEATING DISTRIBUTION



**JEFF ZUMWALT**  
**LALIT AGARWAL**

**AIA**  
Continuing  
Education  
Provider

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Credit(s) earned on completion of this course will be reported to American Institute of Architects (AIA) Continuing Education Session (CES) for AIA members.

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This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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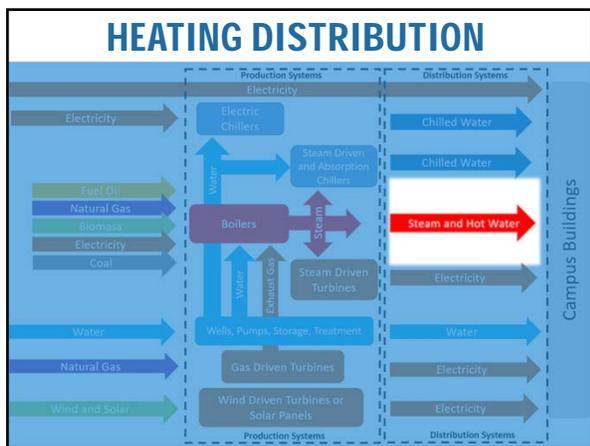
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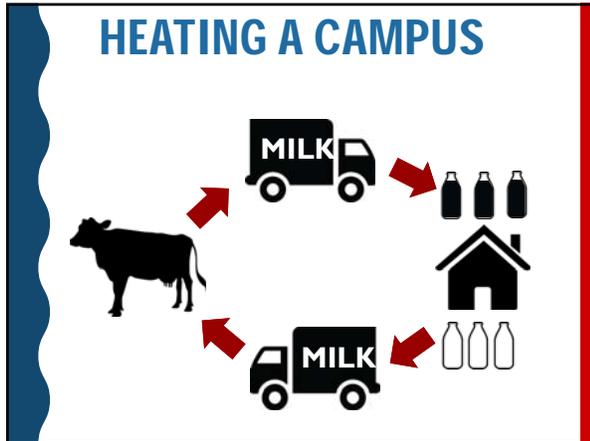
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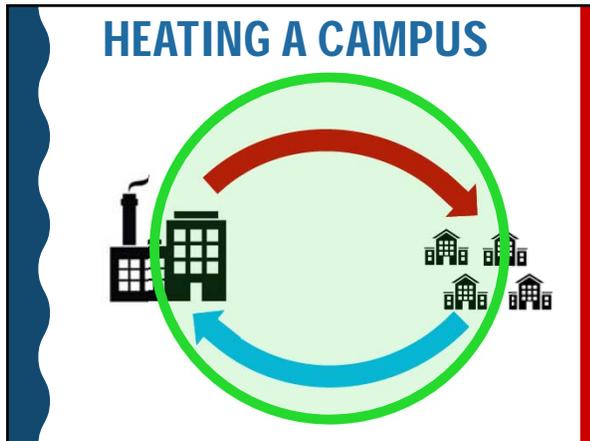
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- ### OVERVIEW
- Radial or Looped
  - How Pipe Fails
  - Steam or Hot Water
  - Pipe Materials
  - Direct Buried or Tunnel
  - Costs

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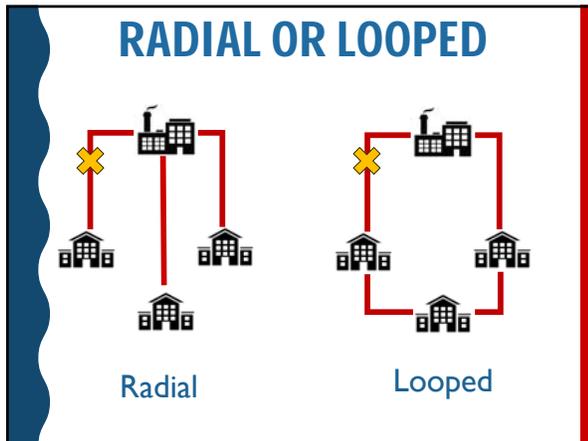
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### HOW PIPE FAILS



- Corrosion
- Expansion
- Water Hammer
- Excavation

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### CORROSION

External and Internal

Water + Iron + Oxygen = Rust

Solution:  
No Water,  
No Iron, or  
No Oxygen



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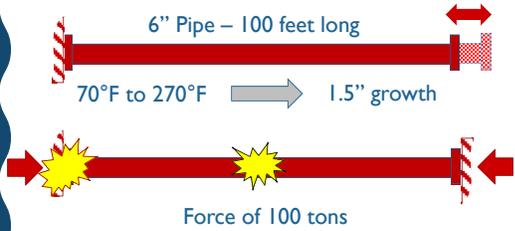
### EXPANSION

6" Pipe – 100 feet long

70°F to 270°F → 1.5" growth

Force of 100 tons

Solution:  
Add Flexibility



The diagram illustrates the expansion of a 6-inch pipe that is 100 feet long. It shows the pipe at 70°F and then at 270°F, where it has grown by 1.5 inches. A force of 100 tons is shown acting on the pipe, which is fixed at both ends. The solution is to add flexibility to the pipe.

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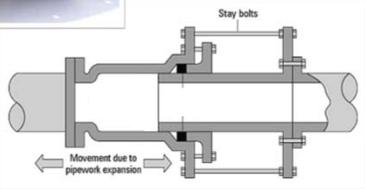
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### EXPANSION



Stay bolts

Movement due to pipework expansion

The image shows a photograph of a bellows expansion joint and a cross-section diagram of a pipe with stay bolts. The diagram shows the pipe expanding and the stay bolts holding it in place. The movement due to pipework expansion is indicated by arrows.

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### EXPANSION



The photograph shows large industrial pipes with expansion joints, illustrating the practical application of expansion solutions in a real-world setting.

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### STEAM INDUCED WATER HAMMER

Steam →  
Condensate  
Steam →  
Steam → Slug

Solution:  
Remove condensate from steam line

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### STEAM INDUCED WATER HAMMER

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### STEAM INDUCED WATER HAMMER

Traps  
**Float**  
Inverted Bucket  
Thermostatic  
Thermodynamic  
Nozzle

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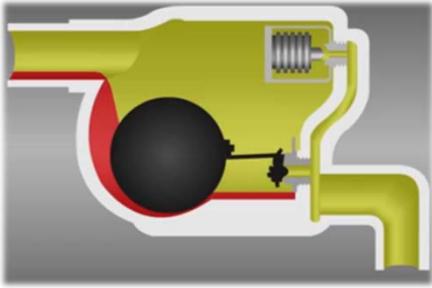
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### FLOAT TRAP



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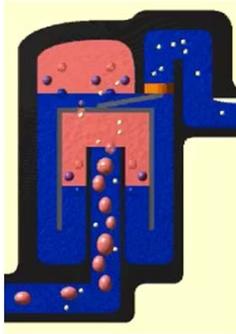
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### INVERTED BUCKET TRAP



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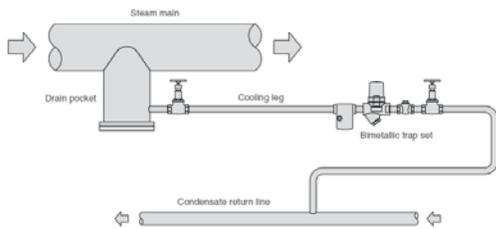
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### STEAM TRAPS



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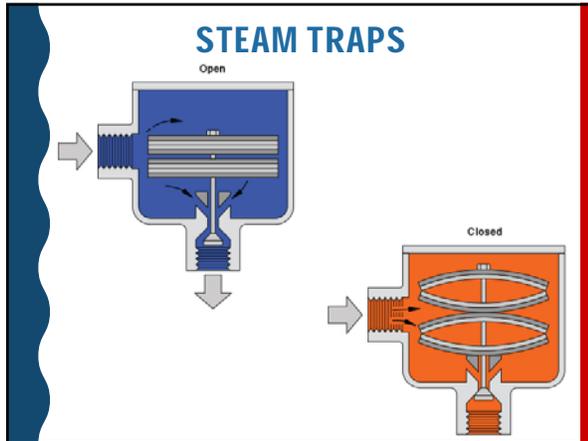
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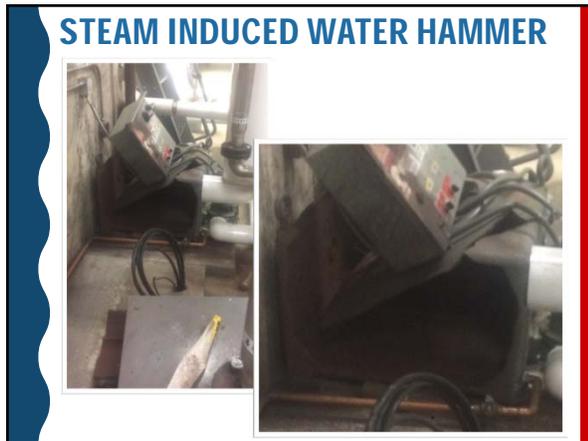
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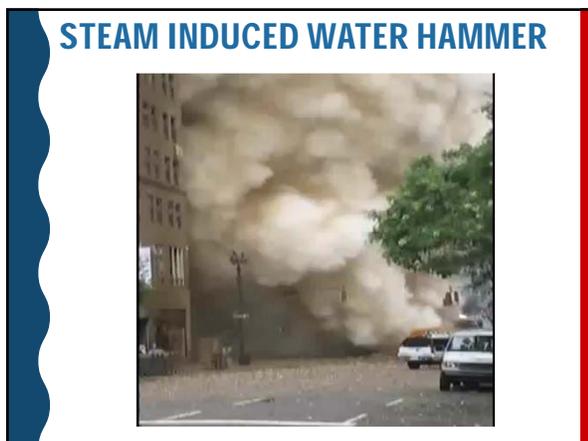
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### STEAM INDUCED WATER HAMMER



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### EXCAVATION



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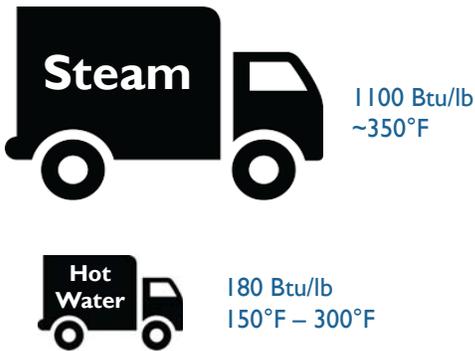
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### STEAM OR HOT WATER



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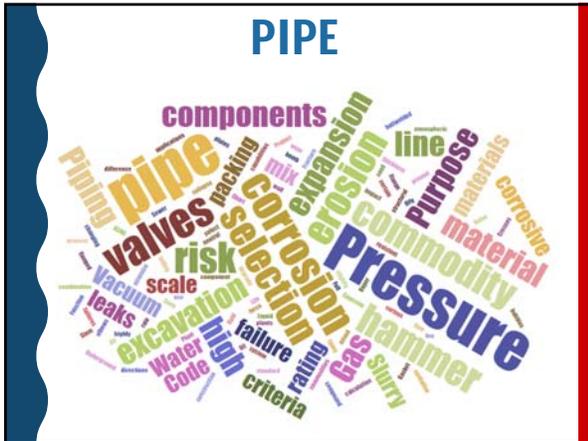
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**DIRECT BURIED PIPE**



**STEEL**

High Temp. = Steel

- Corrosion
- + Expansion
- + Water Hammer
- Excavation

\$500 - \$1,000/ft

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**DIRECT BURIED STEEL PIPE**



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## DIRECT BURIED PIPE



### PLASTIC

Low Temperature:  
Plastic is an option

- + Corrosion
- + Expansion
- + Water Hammer
- **Excavation?**

\$400 - \$700/ft

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## TUNNELS



- + Corrosion
- + Expansion
- + Water Hammer
- + Excavation

\$4,000 - \$7,000/ft

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## SHALLOW TRENCH



- + Corrosion
- + Expansion
- + Water Hammer
- + Excavation

\$2,000 - \$3,000/ft

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## COMPARISON

<b>Direct-Buried</b> <ul style="list-style-type: none"><li>+ Simple and fast</li><li>+ Lowest cost</li><li>- Less reliable</li><li>- More disruption</li></ul>	<b>Tunnel</b> <ul style="list-style-type: none"><li>+ High reliability</li><li>+ No disruption</li><li>- Very expensive</li><li>- Low flexibility</li></ul>
<b>Shallow Trench</b> <ul style="list-style-type: none"><li>+ Good reliability</li><li>+ Low disruption</li><li>- Expensive</li><li>- Low flexibility</li></ul>	

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## PIPE CAPACITY



100,000 GSF  
1,000 feet

What size pipe?

125 psig system  
4" pipe - \$400,000 (100,000 GSF)  
10" pipe - \$500,000 (1,200,000 GSF)  
+25% Cost = +1200% capacity

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## QUESTIONS?



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THIS CONCLUDES THE  
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