Structural Inspection of Processing Plants

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Structural Condition Assessments

Structural Materials

- Steel
- Concrete (plain, reinforced, pre-stressed)
- Timber
- Other - Masonry, Aluminum, Fiber-Reinforced Polymer (FRP), etc.

Inspecting Structural Steel

- Corrosion (holes,delamination & loss of cross section)
- Cracking (overload & fatigue)
- Overloads (buckling & deflection)
- Member Impact Damage

Corrosion holes & delamination

Reinforced Concrete

- Concrete is strong in compression but weak in tension. Rebar is introduced so that steel, which is strong in tension, can carry the tensile load while concrete carries the compressive load.

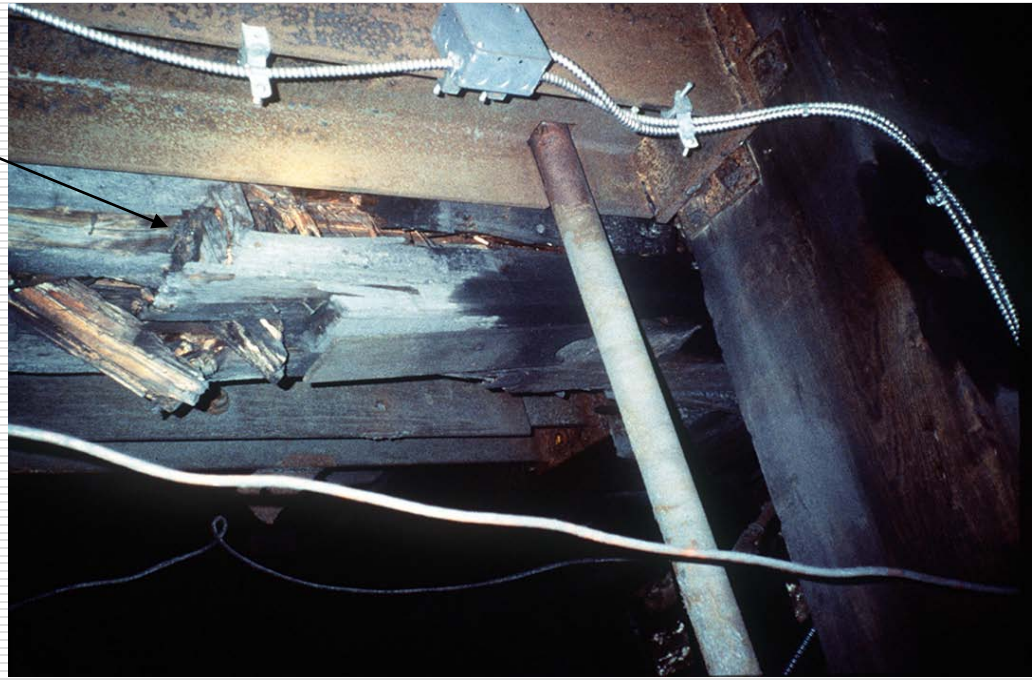
Inspecting Concrete Structures

- Cracking
- Delamination (Internal Splitting - Silos)
- Spalling
- Rebar Corrosion
- Crushing
- Impact Damage

Spalling & Corrosion from Exposure to Chemicals

Inspecting Timber Structures

- Cracking
- Deflection / Sag
- Crushing
- Fungi - molds, rot, dry rot
- Wood Boring Insect Damage



Inspection Tools

- Cleaning
  - chipping hammer, wire brush
- Inspection
  - chipping hammer, screw driver or ice-pick, plumb bob, flashlight, binoculars
- Measuring – tape, calipers, ultrasound, level
- Safety & Misc. - safety harness, dust mask, compass

MNM Surface - 56.11001
MNM Underground – 57.11001
Safe Access

- Safe means of access shall be provided and maintained to all working places.

MNM Surface - 56.14100
MNM Underground – 57.14100
Machinery & Equipment – Safety Defects

- b) Defects on any equipment, machinery, and tools that affect safety shall be corrected in a timely manner to prevent the creation of a hazard to persons.

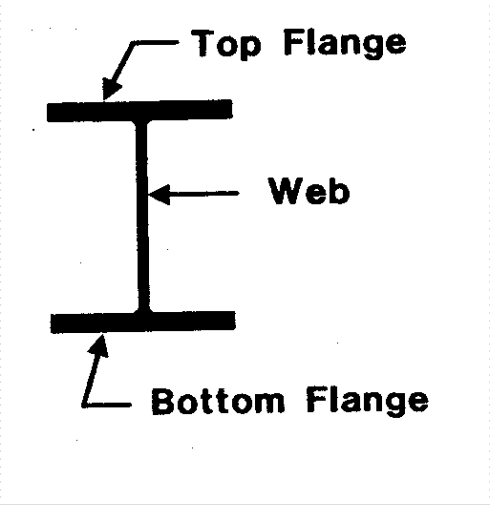
MNM Surface -56.14205
MNM Underground -57.14205
Machinery, Equipment, & Tools

- Machinery, equipment, and tools shall not be used beyond the design capacity intended by the manufacturer where such use may create a hazard to persons.

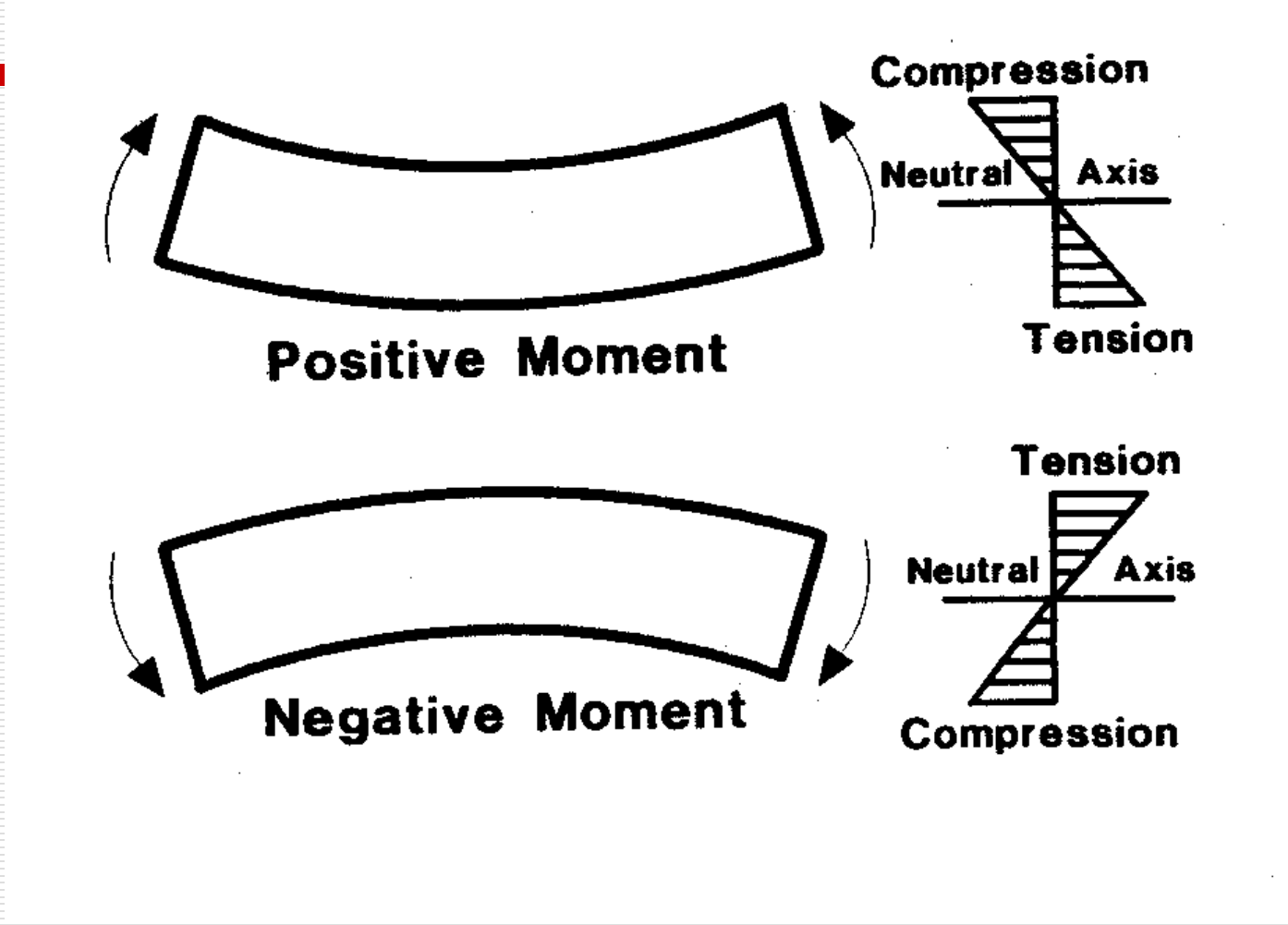
Inspection of Processing Plants

Beams - Bending & Shear Resistance

- Beams and girders are common members used to resist bending moments and shearing forces. Bending is resisted by flanges; shear is resisted by web.

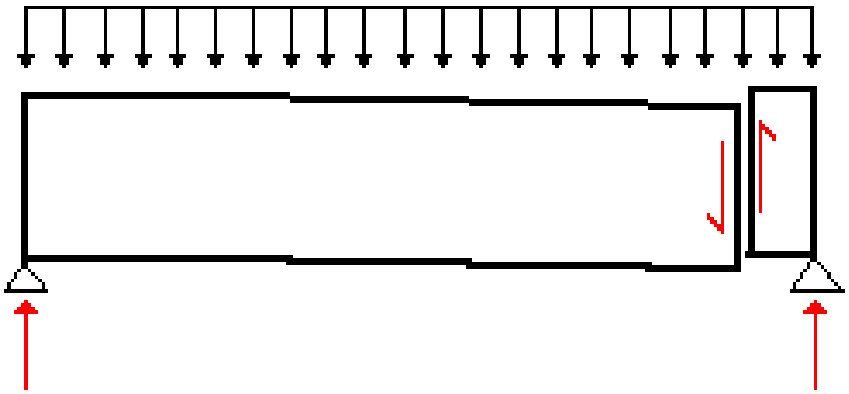


Bending Moment



Shear Force

- Equal (magnitude) but opposite (direction) forces which tend to slide one section of a member past an adjacent section.



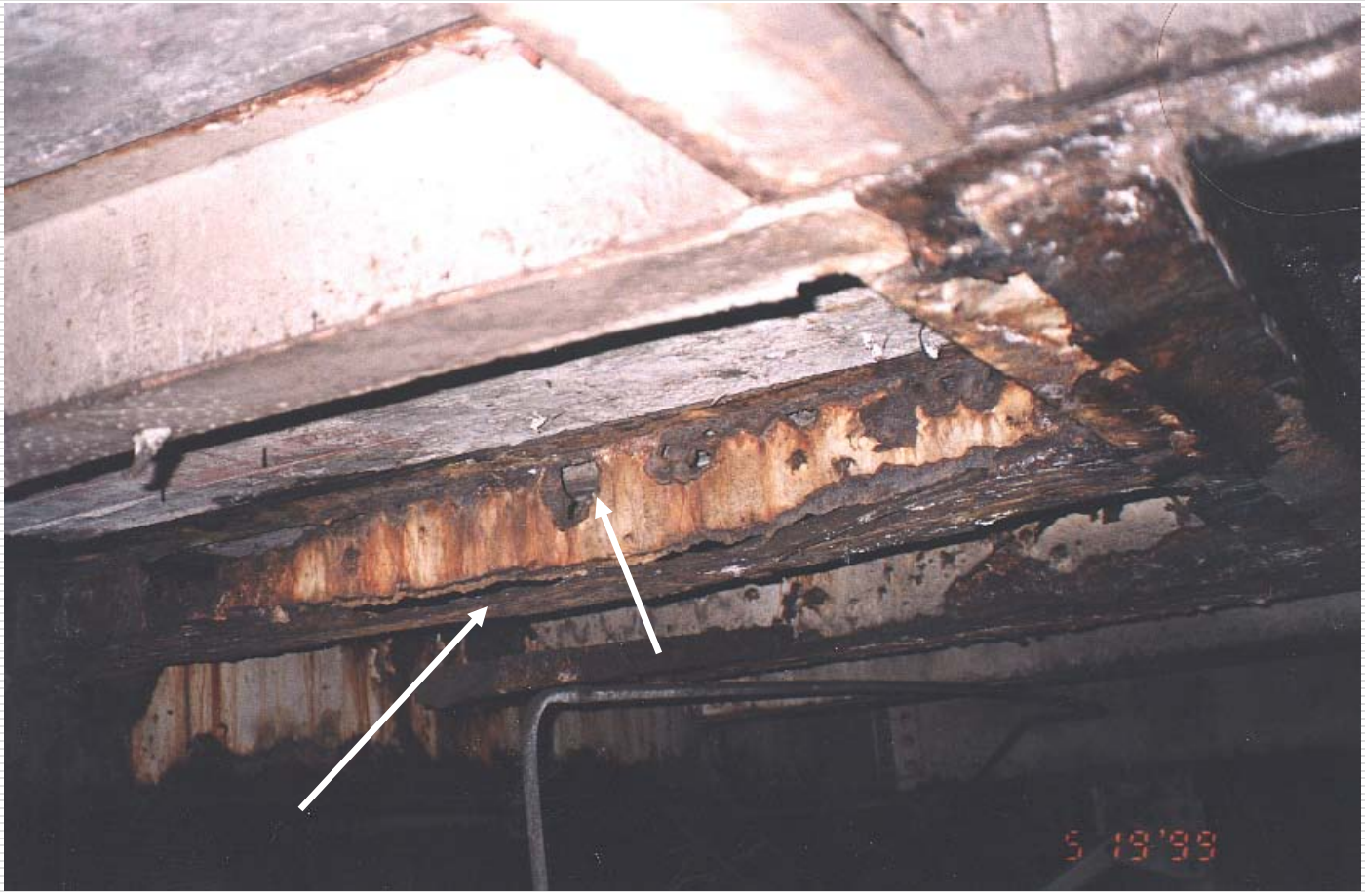
Corroded web of wide flange beam

Long corrosion hole at web to flange interface

This beam was still standing (?)

Corrosion hole in web of beam (hidden by piping)

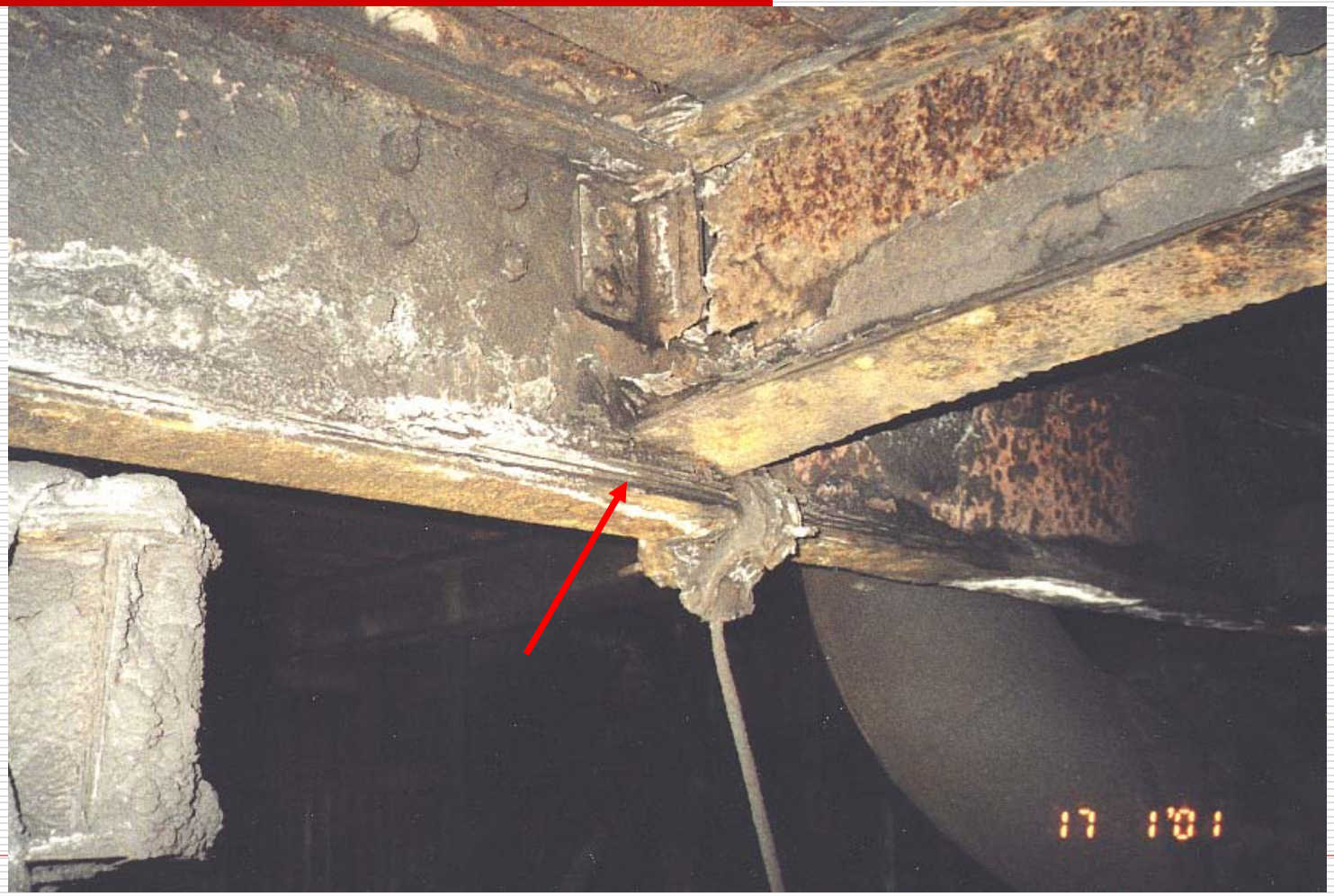
Corrosion holes in web of beam



Corroded web @ end of beam

Corrosion hole in web & buckled top flange

Heavy delamination of bottom flange



Buckled web

Buckled webs of corroded channels

Beam modifications need engineered!

Columns

Buckled column flanges @ web corrosion hole

Corrosion hole in web of column

Buckled flanges at bottom of column @ corrosion hole

Repaired column base (appears good)

Bad Repair At Column Base

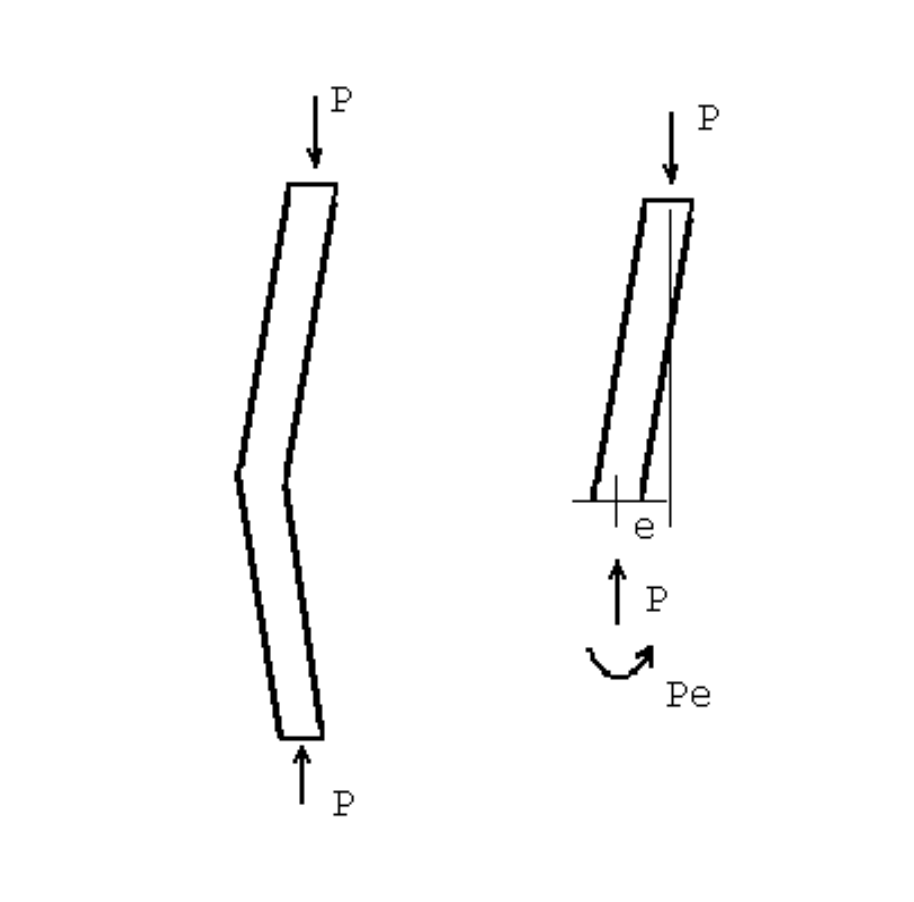
Another Bad Column Repair (base)

… a few feet up from base

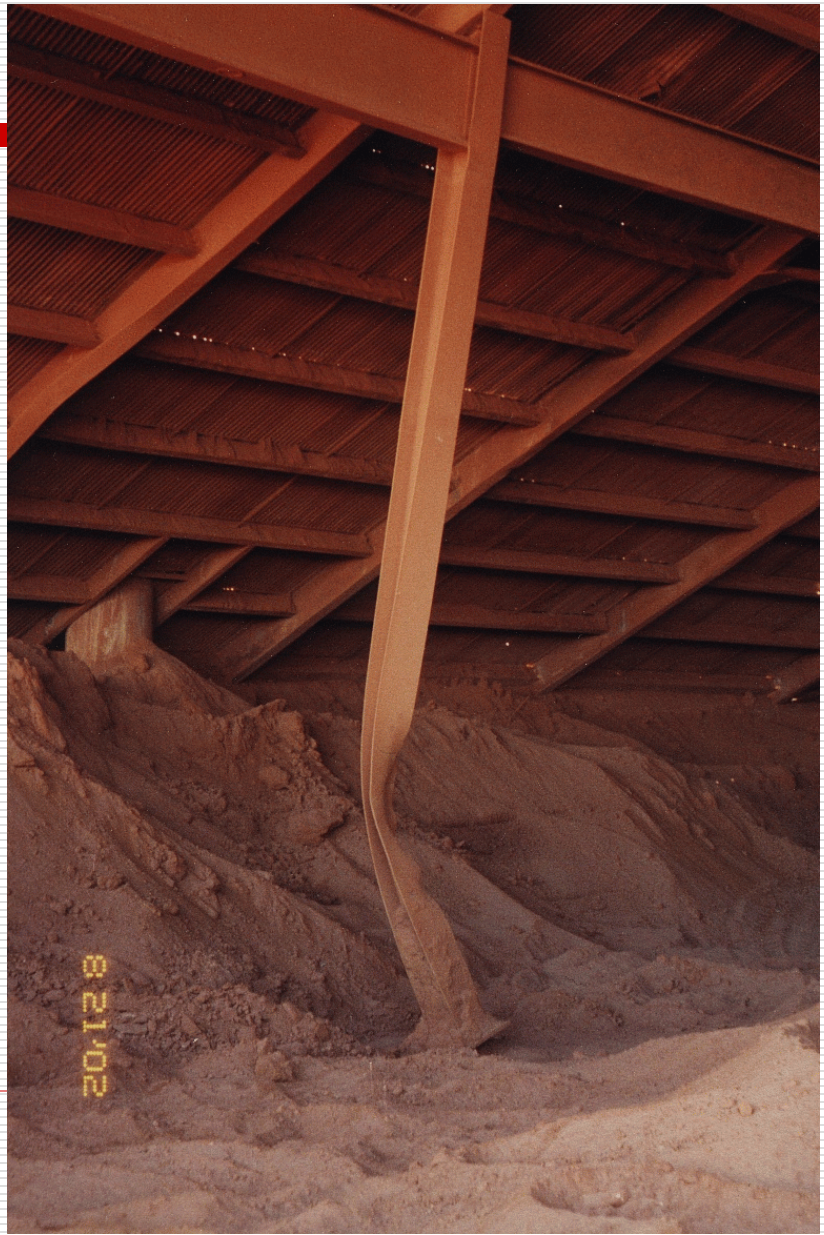
Rotted timber column

An equipment mishap – these types of repairs can be evaluated by an engineer

Crooked Column (creation of moment)



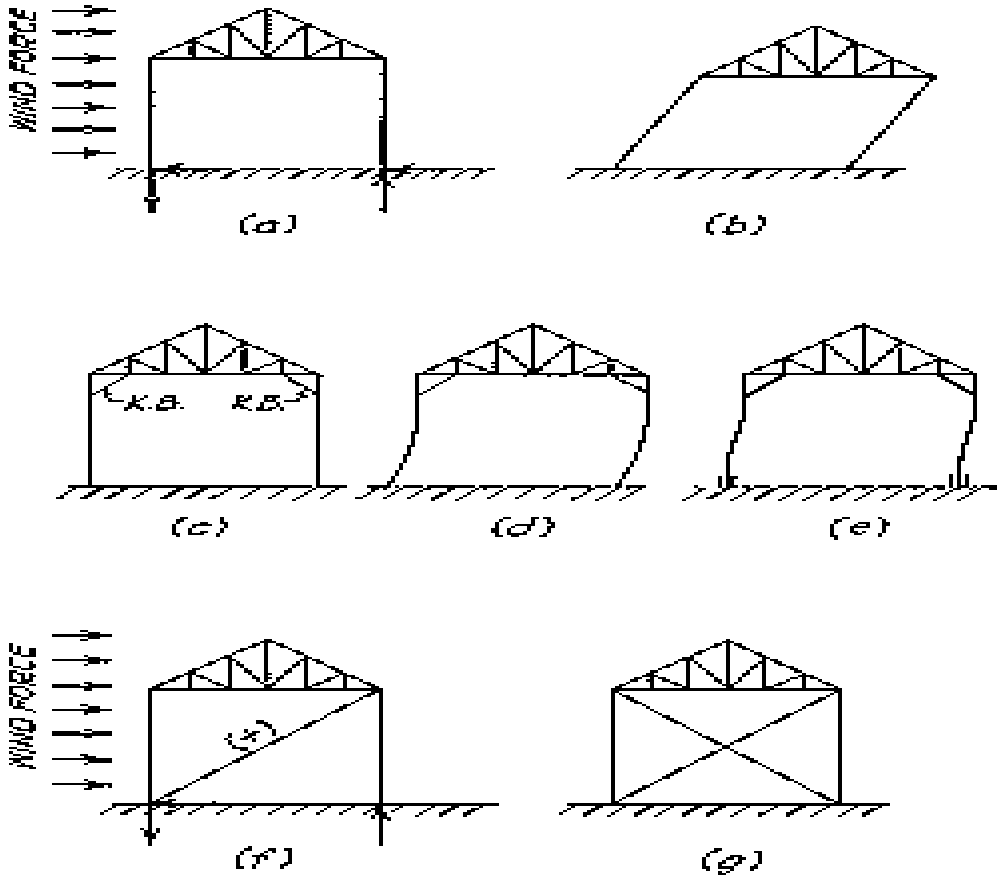
Severe equipment damage



Replacement time!

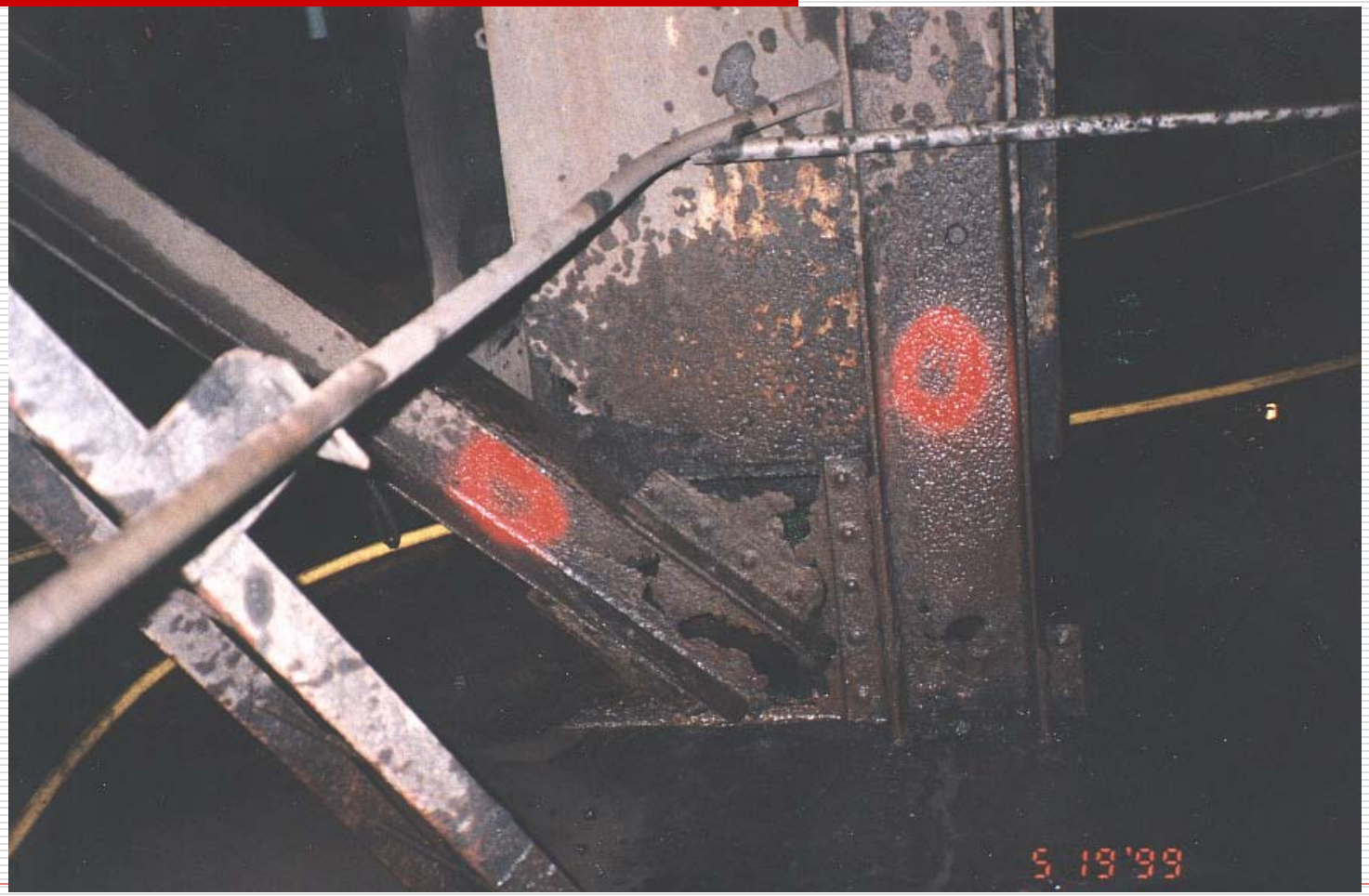
Inspect the column foundations

Don’t take the bracings out!



Corroded diagonal brace

Corroded diagonal and gusset plate

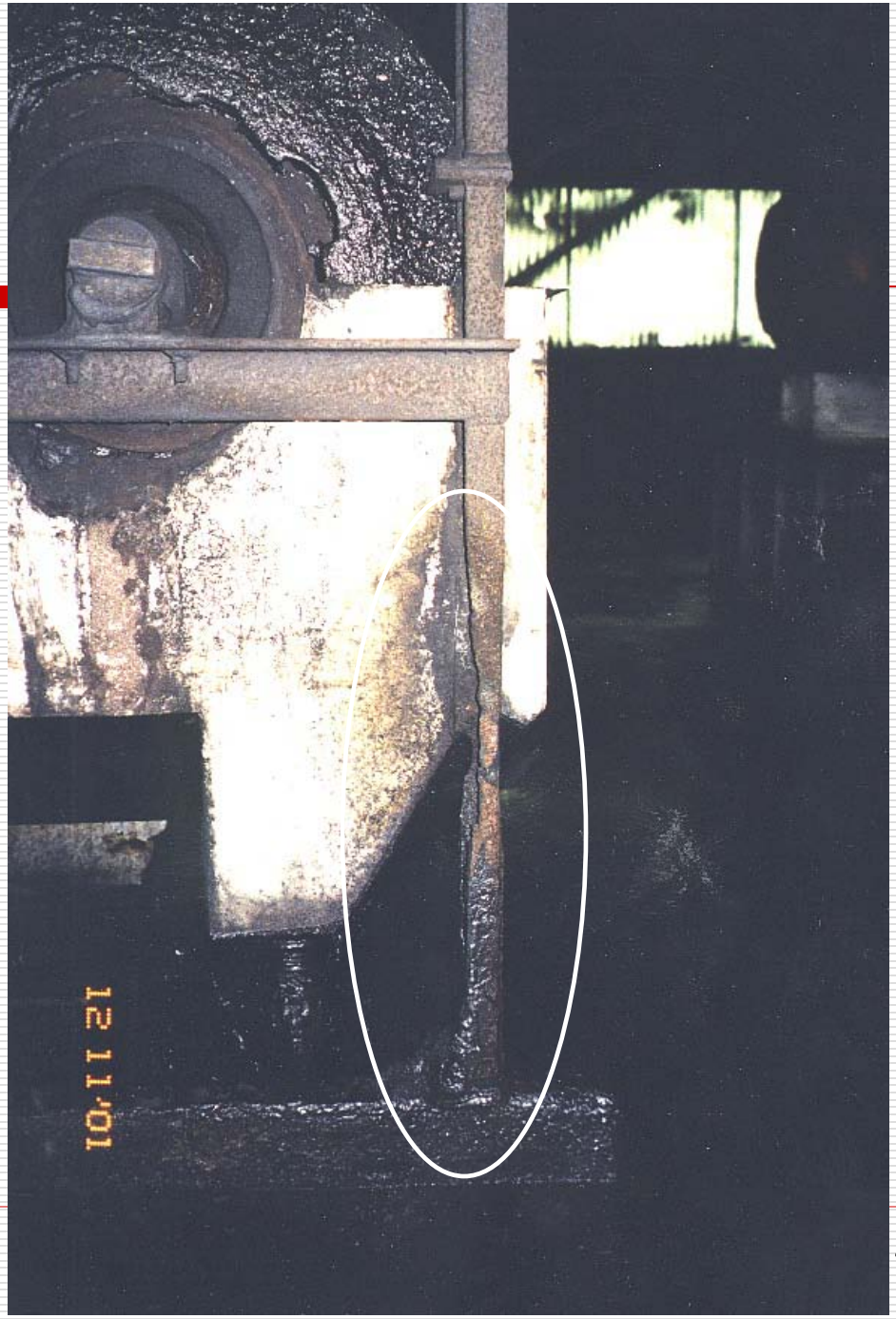


Corroded diagonal

Corroded channels/girts supporting the siding

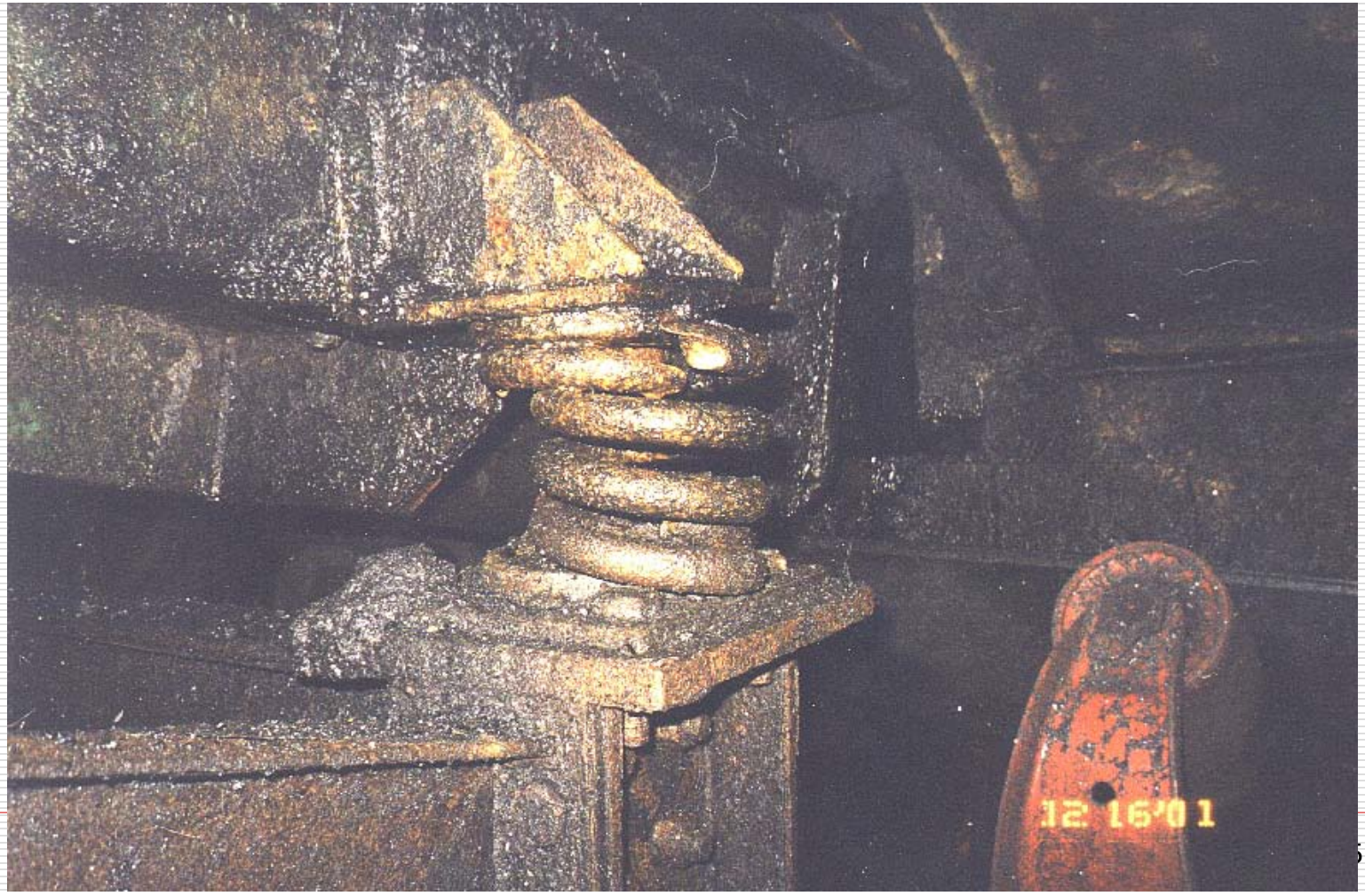
Check equipment supports! Corrosion hole in channel post for a magnetic separator

Corroded channel post support for a magnetic separator



Crack in a support beam for a shaker screen

Fractured spring support for vibrating equipment



Deteriorated concrete flooring

Floor slab cracks - a potential source of rebar corrosion

Look at floor grating - corrosion @ supports

Corrosion at support edge of grating

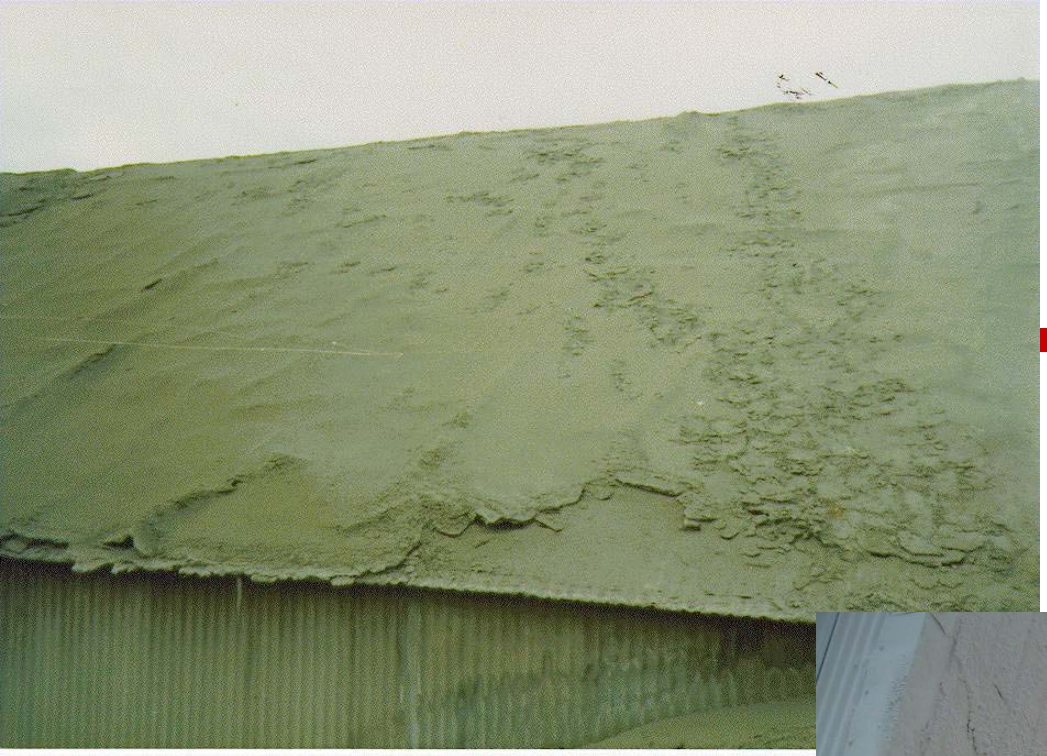
Corroded stair channels

Corroded angle supporting stair tread

Don’t forget to check the handrails!

Corrosion holes in handrail support post

Heavy Roof Loading



Roof Collapse Due to Clinker Buildup and Snow Load

Inside of Failed Structure

Collapsing Roof Support Purlins

Corrosion of bottom flange of roof support channel

Buckled Vertical Roof Truss Member

Bolted Connections

- Check tightness
- Look for
  - missing bolts
  - sheared bolts
  - elongated bolts
  - excessive corrosion

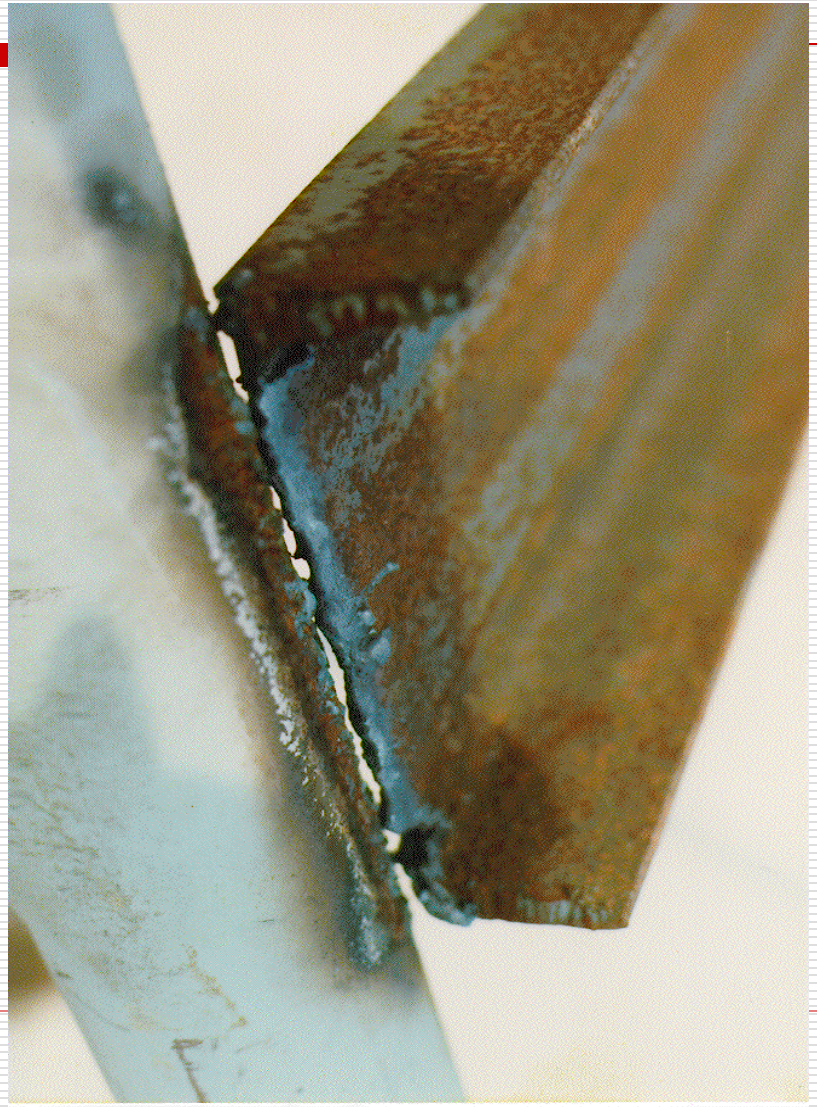
Inspect connections! Corroded bolt heads

Welded Connections

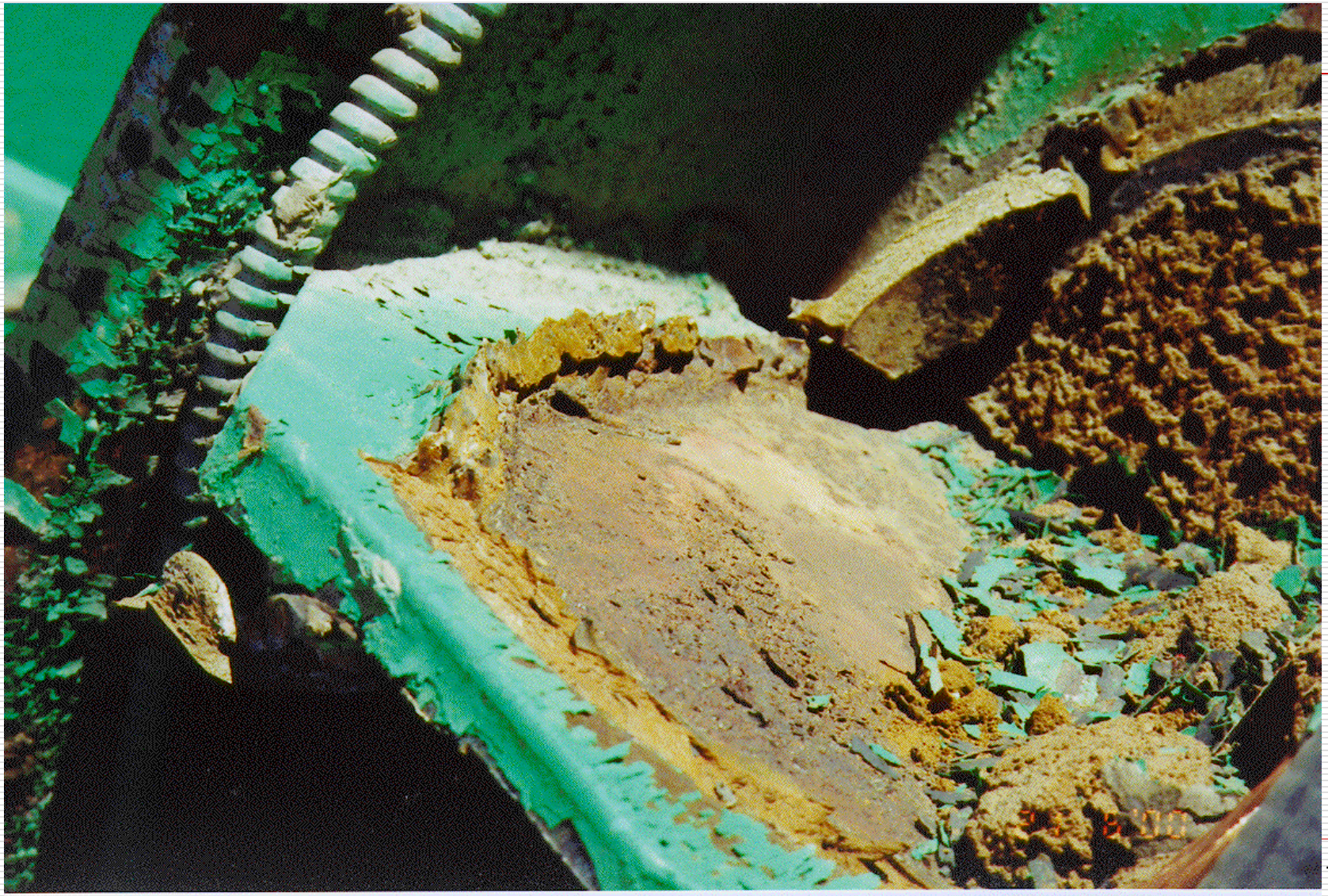
- cracked welds
- poor quality - irregular surface
- corrosion in connected parts
- Always use qualified welders

Fractured weld @ connection

Vibrating equipment - fracture & poor quality weld



Irregular weld surface w/porosity



Exposed rebar on the side of a concrete settling tank

Collapsed floor – Avoid this!

Plant collapses can be costly.

Recap - Inspection of Processing Plants

- Check the beams, columns, diagonal braces
- Examine members for buckling, corrosion, damage, excessive sag, holes, local buckling, and cracking.
- Examine connections for corrosion, missing or cracked elements
- Examine floors, roofs, walls, & foundation
- Examine equipment supports, stairways, & handrails