Heat Straightening of Steel Bridge Members Demystified

What is heat straightening?

A process by which damaged steel members are repaired.

The process uses thermal expansion and contraction to bring the member back into proper alignment.

What can be heat straightened?

- Beams and girders
- Columns
- Trusses
- Any steel member

Auto Plant Column

Bascule Bridge over Miami River

Lake Rd. over I-75 Flint
What types of damage can be repaired?

- Impact
- Overloading due to section loss
- Geometry changes due to foundation issues
- Adding/adjusting camber
- Weld distortion
- Any unintended movement

How does it work?

• When heated, steel will expand equally along all 3 axes.
• While cooling, it will contract equally along all 3 axes.
• Net result is the same dimensions with which you started.

Add a restraint

• Put the same block in a vise and heat. Do not increase pressure while heating.
• Block cannot expand along one axis, all expansion occurs along other two.
• While cooling, contraction still occurs along ALL 3 axes.
• This differential results in shortening the block.

Hydraulic “pusher” restraint

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Yes, but how does it WORK?

Allow me to introduce the “Vee” heat

Temperature and cooling

- Steel is rolled at 1700°F or higher.
- Heat straightening is limited to 1200°F.
- The phase transformation temp for steel is 1333°F.
- Forced cooling should never be used for heat straightening.
- All other heat treatments for steel are done at temps higher than 1300°F.
- Some involve forced cooling/quenching.
- The rate of cooling plays a large part in the results of heat treating.

When done properly, heat straightening has no deleterious effect on steel.

Patience is required

- The process takes time and cannot be rushed.
- Not allowing full cooling will limit the movement gained per heat cycle.
- Efficiency is the key to completing the repair in the least amount of time.
- Continuous working hours are a major factor.
- Impacts to traffic are greatly reduced compared to alternatives.

Northbound I-65 Delta River Bridge: McInnis
Active heat straightening

- Severe, localized deformations cannot be straightened normally.
- Degree of curvature is too great.
- Same temperature limits apply.
- Restraining force is gradually increased while heating, moving the area slowly in one heat cycle.

Wyoming over M-10

SR-281 Cleburne County, Alabama Bridge Builders

- Welded girder.
- Roadway underneath was on a grade.
- Combination of steel composition and weld metal is most likely.
- Concern was breaking the bottom fillet weld.
Summary

- Heat straightening can be used to repair a wide range of steel deformations.
- If properly performed, the member will suffer no ill effects from the process.
- It is not a matter of "hot working" the member back into position.
- Repairs have been performed for over 40 years. Hundreds of beams have been straightened with no reported failures.
- Tens of millions of dollars have been saved by not replacing beams.
- When in doubt, ask.