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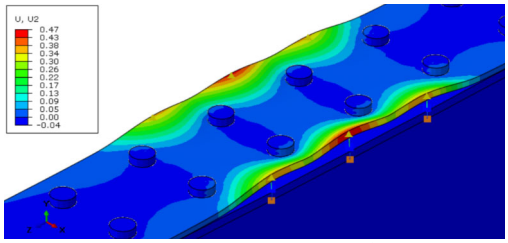
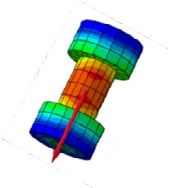
TPF-5(436)
Development of Criteria to Assess the Effects of Pack-out Corrosion in Built-up Steel Members

Project Update
January, 2023





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Objectives of TPF-5(436)

- Develop AASHTO-ready specifications for the evaluation of the effects of pack-out corrosion in built-up steel members.
- Provide guidance on the need for repairs in order to assist owners in programming when repairs may need to be made.
  - Identify the most effective methods of repairs and provide suggesting verbiage that could be used when preparing special provisions for repairs.
- Develop several case-study examples, including calculations that will be used for training users on the methodologies to be developed.
- TPF Partners include IN, IL, KS, MI, MN, PA, TX
  - S-BRITE Center staff and facility providing general support

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TPF-5(436)

RESULTS OF FATIGUE TESTING

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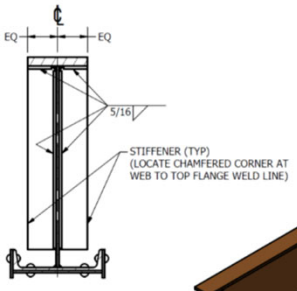
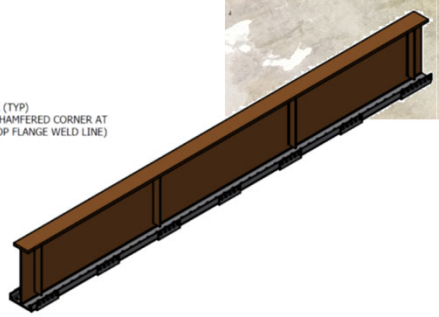
Fabricated “New/Old” Specimens for Fatigue Testing



SECTION C-C
SCALE 1 / 12.5



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Significant Pack-out and Section Loss


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Significant Pack-out and Section Loss

Significant Pack-out and Section Loss

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Testing Parameters

- Goal is to obtain data at near or slightly above real in-service stress ranges
  - Initially focused on 7 to 7.5 ksi stress ranges
  - Cat D CAFL
- Note
  - Members had significant damage as shown
  - Members were in service (in tension) for about 60 years on the Winona Bridge prior to this testing
  - Mean DL tension stress maintained (about 15 ksi)
- Tests run to “Upperbound” fatigue life
  - Lowerbound is 2.5% chance of cracking
  - Upperbound is 97.5% chance of cracking
    - i.e., these would be expected to crack
    - So, is some cracking is observed, that is not a concern

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Testing Results

- At 7.5 ksi…..
  - Lowerbound about 5.2 million
  - Upperbound about 15.6 million
  - 3 specimens run to just over 20 million cycles
  - 1 specimen run to 6.7 million
- Insignificant cracking observed on only one specimen
- Effectively Cat D CAFL seems reasonable even with significant pack-out

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Testing Results

- Since no cracking was observed, it was decided to increase the stress range to 12.5 ksi for two specimens
  - Above cat C CAFL
- At 12.5 ksi to 13.2 ksi…..
  - Lowerbound about 2.25 million
  - Upperbound about 7.2 million
  - 1 specimen run to just over 5.8 million cycles at 13.2
    - Upperbound life almost achieved
    - Cracking occurred at a rivet hole in channel, but not at pack-out
    - Test stopped and specimen repaired for strength testing
  - 1 specimen run to 5.6 million 12.5
    - About 1 million above the mean

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Testing Results

- Next slide combines all data to equivalent S_r and total N

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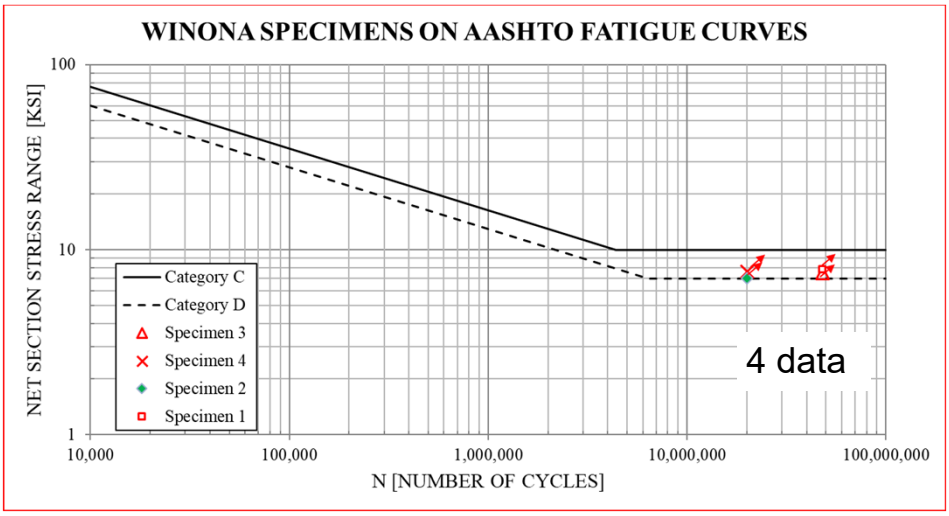
Results – Combined Equiv. S_r



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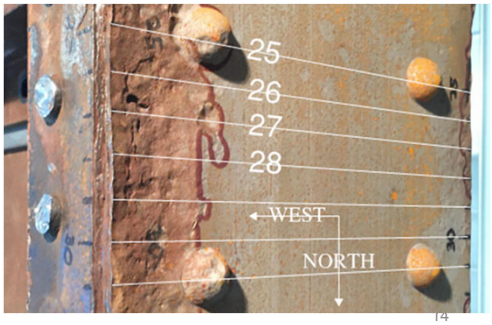
Conclusions

- There does not appear to be an effect of pack-out on fatigue life at these low level stress ranges
  - i.e., upperbound in-service stresses
    - Tension mean stress applied
- WHY?



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This is an Important Observation

- Existing data from *previous* testing seems to support the thought that the type of corrosion damage influences the fatigue life
- Specifically severe section loss and damage due to surface corrosion on individual plates is not the same as that due to pack-out

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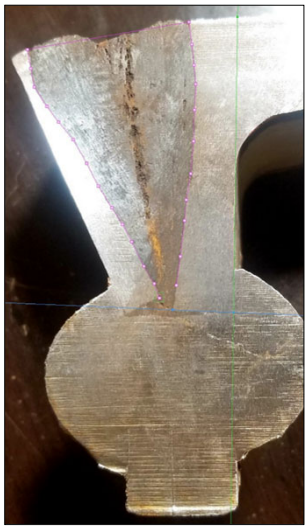
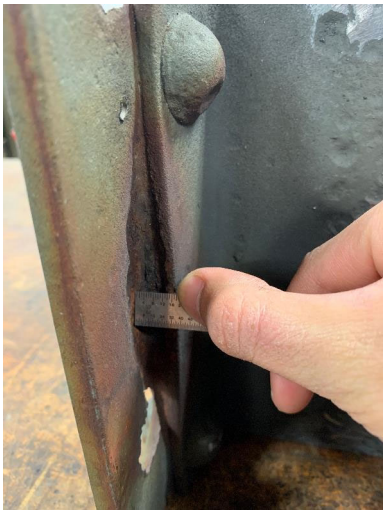
Surface of the Steel in Area of Pack-out not “Severe”
(Winona Chord)


“Surface” of the Steel Outside of Pack-out area Far Worse




Current Thoughts on Implementation

- For members with pack-out, if stress ranges are less than Cat D thresholds, no concerns regarding fatigue
  - Possibly consider Category C?
- We would still have infinite life even with severe pack-out corrosion if S_R is low
- Caveats would be a level of pack-out to set limits for these recommendations
  - Currently looking into this via FEA and laboratory data – comparing SCFs
  - Need to develop guidance on effects of surface corrosion

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Moving Forward

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Moving Forward – Big Picture

- Conducting internal redundancy strength tests of girders (tension flange)
  - One test with intact
  - One test with severed (cut) cover plate
- Evaluating the effect of pack-out removal on local stresses
  - Might increase S_r
  - Prelim. statement
  - Stay tuned

- Move forward with FEA parametric studies on effect of pack-out on SCF

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Moving Forward – Big Picture

- Develop simplified method to assess effect of pack-out corrosion on:
  - Strength
  - Stiffness
  - Fatigue/Fracture
- Develop guidance on when to introduce mitigation and repair strategies
  - When do I need to fix the pack-out?
- Prepare AASHTO-ready specification language for evaluating the affect of pack-out corrosion on built-up members and connections
  - Possible new Guide Specification?

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