Joseph A. Weber
ODOT Mechanical Engineer 1920-45
Joseph A. Weber

- Designed 4 bascules
- 3 swing spans
- At least one ferry
- Provided example bascule design in Hool and Kinne
- Close friend of Conde McCullough
Form and function
Umpqua River Bridge US 101
Reedsport, Oregon

- 430 ft. thru truss swing span
- Constructed in 1936
- ADT = 9400, 50 to 100 openings per year
- 43 inch diameter bronze / steel bearing supports 2.3 million pounds
Maintenance Records Indicate a History of Problems with Center Bearing

- 1983 four shear bolts fail due to excessive friction in bearing
- 1984 bearing is remachined and returned to service
- 1990 painting contract
- 1992 machinery and drive upgrade
- 2005 occasional severe vibrations during operation
Classic Bronze-Steel Lens Bearing

- 43 inch diameter bronze lower lens – 11’-0” spherical radius tensile strength = 121 ksi
- Cast steel upper lens- 10’-8” spherical radius tensile strength = 77 ksi
Summer 2005 Problems Surfaced

- Severe vibration in the bearing would occasionally occur during operation
- Testing including drive pressure, span position, vertical vibration and Acoustic Emission
Severe Vibration was not captured during testing

- AE testing indicated NE corner of bearing to have the most AE activity

- Baselines for drive torque and vibration during normal operating were determined
Oil Contamination

- Investigation found the lubrication path blocked with sand-blasting grit
- Even though reservoir was full, no oil was getting to the bearing
- Likely occurred during 1990 paint contract
Lubrication was partially restored

- Short of complete disassembly, an effort was made to clean out oil passages and force oil into system
After 3 months of smooth operation a second performance test was completed.

Drive torque, vibration and AE were lower during the 2nd test, indicating a positive effect of the cleaning.
Spring 2006 Problems Return

- The four shear bolts that prevent the bronze disk from rotating shear off during an opening
- Same thing occurred in 1984
Plans Begin for Removal of Bearing

- Jacking Plans are engineered
- Jacks, pumps and bracing are procured
- Contract let to remachine bearings
- Coordinated bridge outage with local industries and the USCG
Jacking Plans

- Total dead load on center bearing is 2.3 million pounds
- Jacks must also support full highway traffic for 2 weeks
- Need at least 1 inch of vertical lift at center bearing
Locations for Jacking
16-280 ton jacks are specified
Main girder needs web stiffening

• 1984 jacking did not stiffen the webs
• FEA predicts a safety factor of 1.2 against web buckling under design load
• This is unacceptably low given the consequences of failure
Transverse Girder are well stiffened

- Since the transverse girder were originally designed to carry these loads no modifications were necessary
Extra jacks equate to low operating pressures

- All jacks are rated for 10,000 psi and have locking collars
- 3 hp pump will raise bridge 1 inch in 4 minutes
- Design pressure at lift off is 2000 psi
End Jacks are used to assist with lift

- By inserting a ½” plate under the end jacks, almost 1 million pounds can be removed from the jacks at the center pier.
- Readjusting the loads in the truss was very humbling.
From analysis to practice
Flossing and inspection of bearing
Bearing Removal
Bearing Removal
Bearing Removal
Details of wear
Bearing Removal
“If it’s worth doing, it’s worth over doing”
Michael Koob WJE Inc.

- Even though the 1984 jacking worked fine, the margins were quite small.
- When picking up large, heavy, important structures it is good to have extra capacity in the lifting system.
- All people working under the bridge could appreciate the security of the jacking system.
Machine Shop

- Hardness testing indicates the bronze 60% harder than the cast steel
- Steel has a C.E. of 1.32 (not weldable)
- Lens geometry and surface finishes are restored at Oregon Iron Works
Reinstall Bearing
Reinstall Bearing
Reinstall Bearing
She runs smooth as silk

- First test opening occurred on August 15, 2006
- A SHM system was installed to monitor drive torque every opening
- Bridge has ran smoothly since the rehab
A Job Well Done!
The man who made it all work
Thank you Virgil!
District 7 Bridge Maintenance Crew