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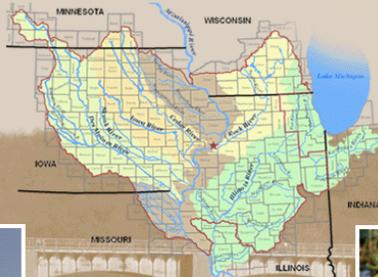
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Rock Island District

SERVING FIVE RIVER BASINS IN FIVE STATES



FLOOD DAMAGE REDUCTION



NAVIGATION



EMERGENCY MANAGEMENT



RECREATION



ECOSYSTEM RESTORATION

A LEADER IN INTEGRATED WATER RESOURCES MANAGEMENT



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BOLTED COMPONENT MITER GATE REPLACEMENT PROJECT

BY

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STRUCTURAL ENGINEER

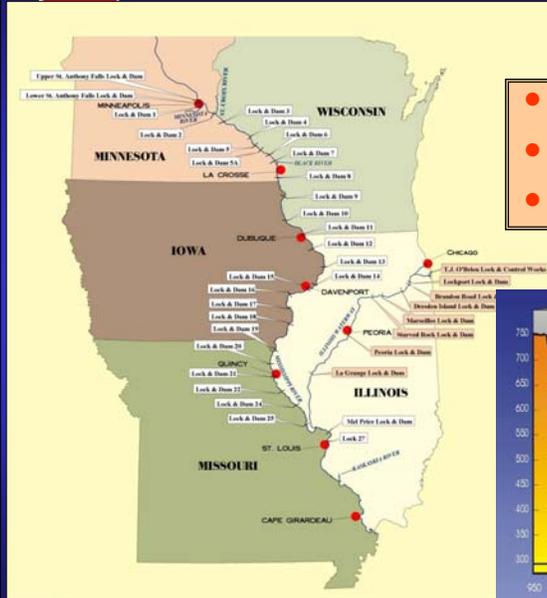
ROCK ISLAND DISTRICT

FEBRUARY 2010

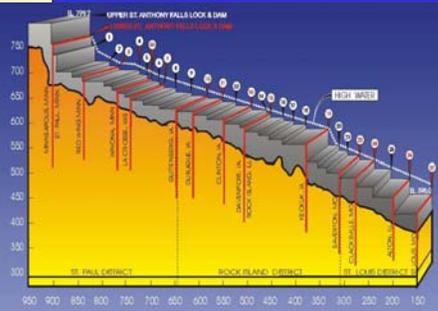
One Team: Relevant, Ready, Responsive and Reliable



UMR-IWW NAVIGATION SYSTEM



- 37 Lock Sites
- 1,200 Miles of River
- Constructed 1930-45



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Typical Upper Mississippi & Illinois River Lock



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Typical Miter Gate



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Typical Repair Method



Lift out Gate



Place Spare Gate



Repair Gate

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Need for Maintenance-Friendly Gates



- Barge Impact Happens
- Routine maintenance
- Increased maintenance frequency as gate gets older
- Declining O & M budgets



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In-place Repair



- Allowing maintenance without lifting gate out of water
 - Place Diagonal tensioning nuts above water



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Customer Feedback (Operations)



- Problems:
 - All-welded structures are hard to repair piece-wise and require extensive weld testing
 - Time consuming: Transport gate off-site, Fabricate new parts, Transport gate to lock
- Suggestions:
 - Make gate easier to work on: bolted connections
 - Standardize gates: use interchangeable parts

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Goals



- Divide the gate into components
- Bolt components to gate for easy replacement
- System-wide component interchangeability
- Allow for in-place repair

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Component Design



- Main Gate Components
 - Top Girder
 - Bottom Girder
 - Vertical Beams/Girders
 - Skin Plate panels
 - Diagonals
 - Gudgeon Hood
 - Pintle Socket
 - Quoin Girder
 - Miter Post
 - Strut Hood
- Individual components can be welded and then bolted to the gate
- Larger diameter bolts to reduce installation time/cost
- Maximize use of readily available structural shapes

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Interchangeability



- Use one design for 14 locks (more Regionally)
- Spare components (top girder, skin plate panels) on hand for quick replacement
- No fabrication delays

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Project Overview



- Design Replacement Miter Gates for Locks 20-22 on the Upper Mississippi River
- 3 Gate Heights: 20-ft, 27-ft and 33-ft
- Weights: 110 tons (20), 115 tons (27) and 130 tons (33)
- Total contract \$10.9M
- Maintenance-Friendly Design: Bolted Connections
- Tight Schedule: 5 months to produce Plans & Specs
- Schedule and Design Accuracy Required 3D BIM CADD

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What is BIM?



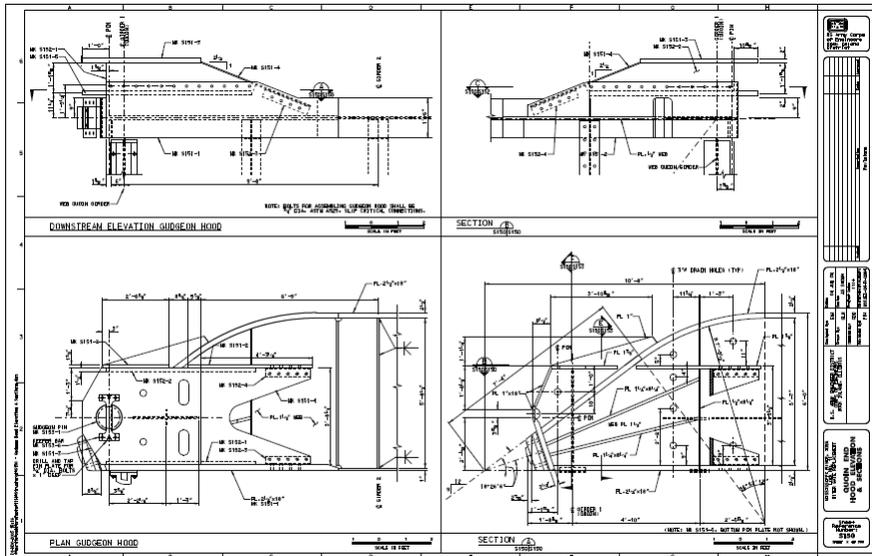
- **B**uilding Information Modeling (BIM)
- **B**uilding - The design project, as you envision it for the client
- **I**nformation - The drawings, schedules, and specifications, fully coordinated
- **M**odeling - The digital description that can be explored and evaluated before you build

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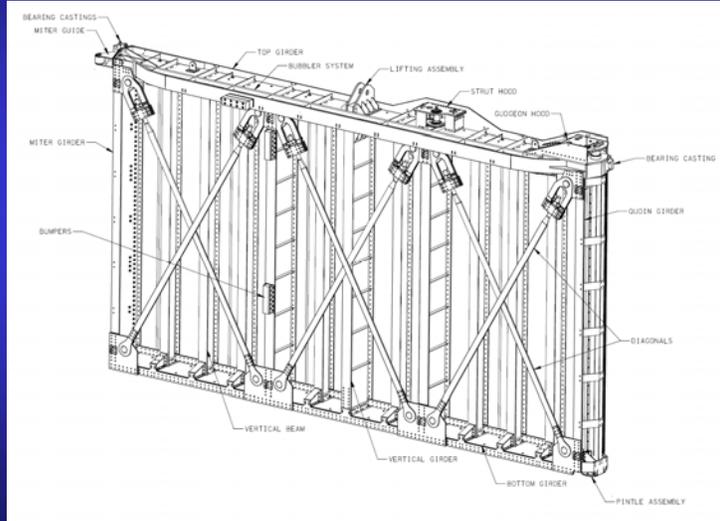
Traditional 2D Drawing





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Component Design

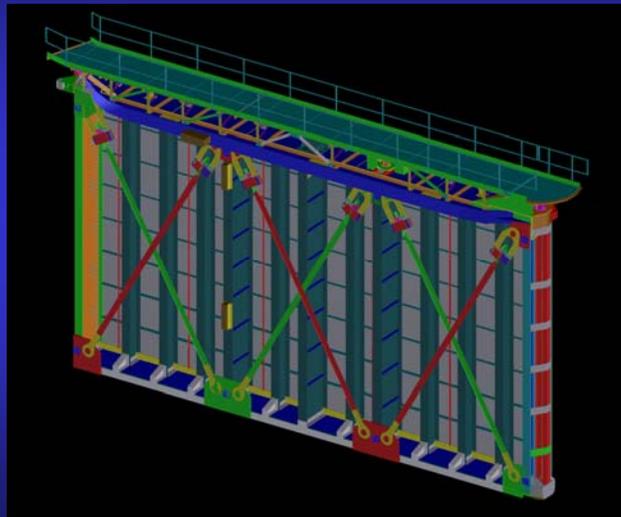


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Component Design

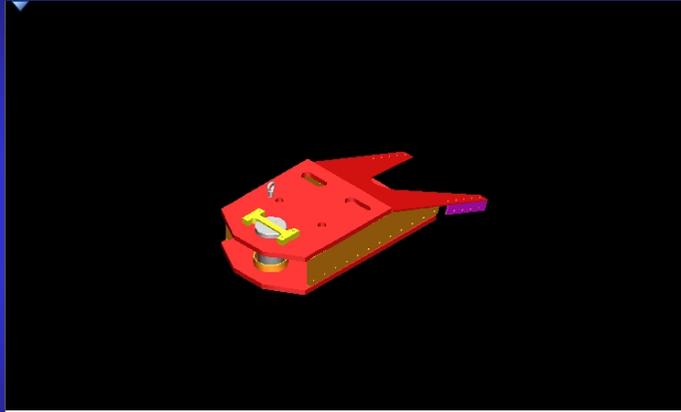


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Miter Gate Model



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Drawing Production (Overall Sections/Views)



Model.dgn

- Source of geometry/information



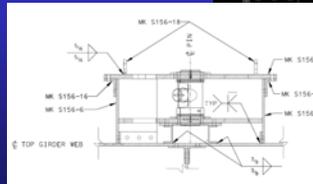
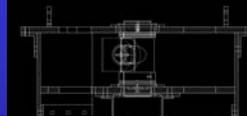
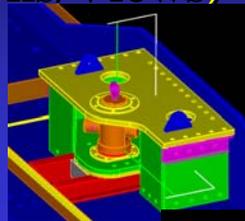
Extraction.dgn

- 2D Snapshot of Model
- Manual "re-calculating" in Model.dgn



Drawing.dgn

- Reference 'Extraction.dgn'



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Of Design Interest



- ASTM A709 Steel with AWS D1.5
- AISC Quality Certification Program, Category III, Major Steel Bridges (CBR) Category with:
 - Fracture Critical endorsement (F)
 - Sophisticated Paint System endorsement (P)
- Slip-Critical and Pretensioned Bolted Connections (No Snug-Tight)
- 4,500 Bolts per Gate Leaf

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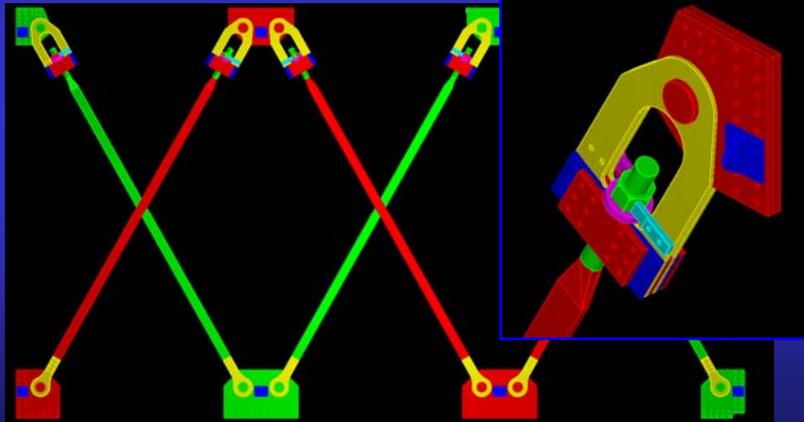


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Of Design Interest



- Diagonals: Pinned Ends with Hydraulic Tensioning Capability



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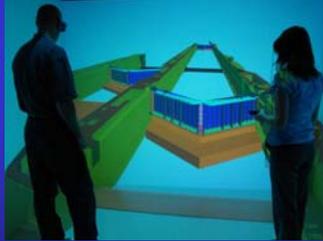
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Interactive Review



Review

- Monthly Review Meetings with Operations (Chiefs, Structural Maintenance Crew, Lockmasters, Divers)
- Changes emailed with 3D Adobe PDF's
- BCOE Review in 4-Sided Virtual environment



Courtesy of U.S. Army Research,
Development and Engineering
Command

Results

- Very productive dialogue = better operable/maintainable design
- Incorporated changes early in design vs. last minute changes

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Technical Reviews and Regional Teaming



- Multidistrict reviews – St. Paul and St. Louis Districts
- Utilized lessons learned from Portland District to prepare the technical specifications

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Conclusion



- Bolted Component Design
- 3D Interactive Reviews
- System-wide Interchangeability
- In-place Repair

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Acknowledgements



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Questions ?



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