

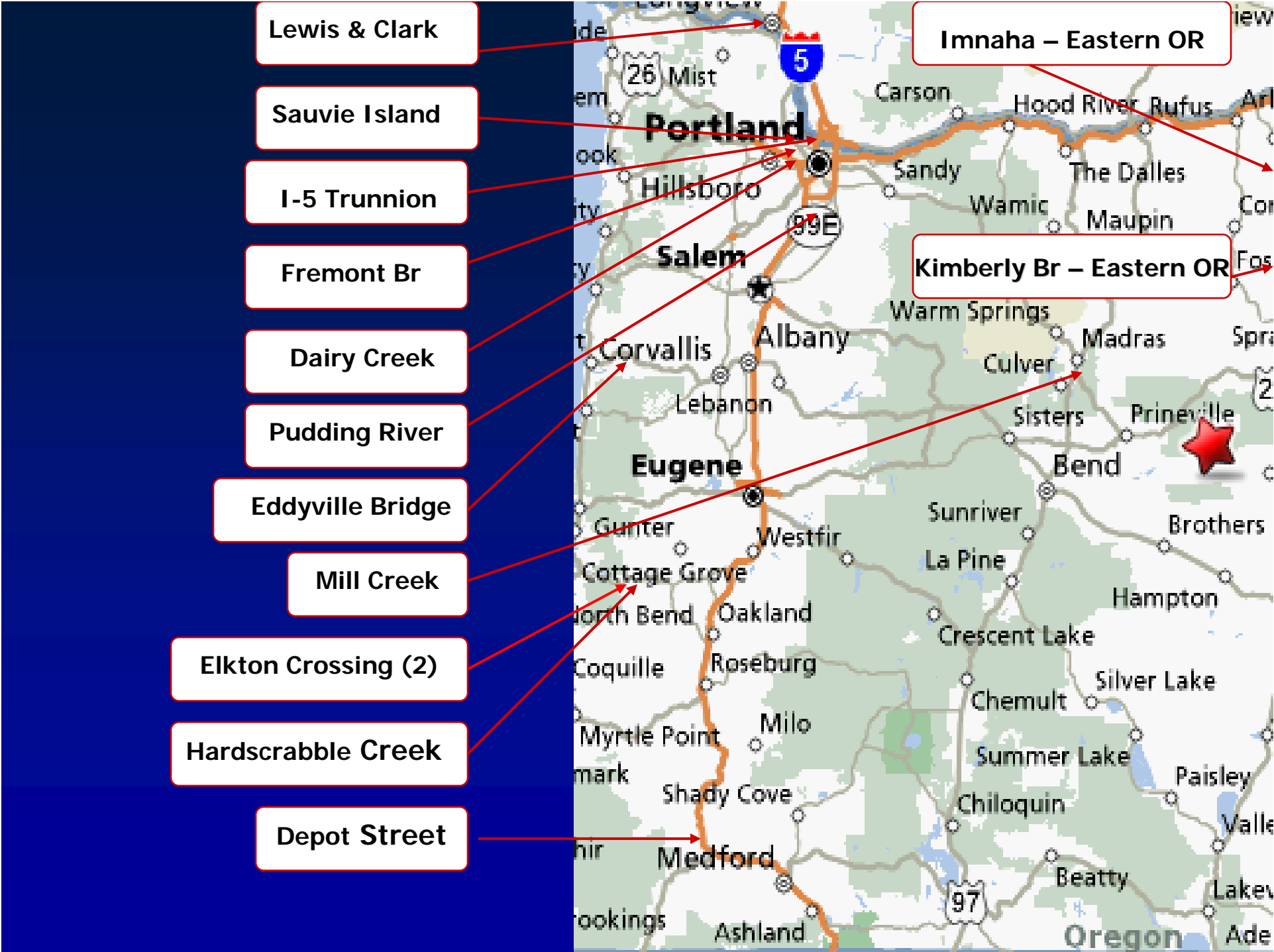
ODOT's Approach to Implementing ABC

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Bridge Engineering Section**

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Introduction

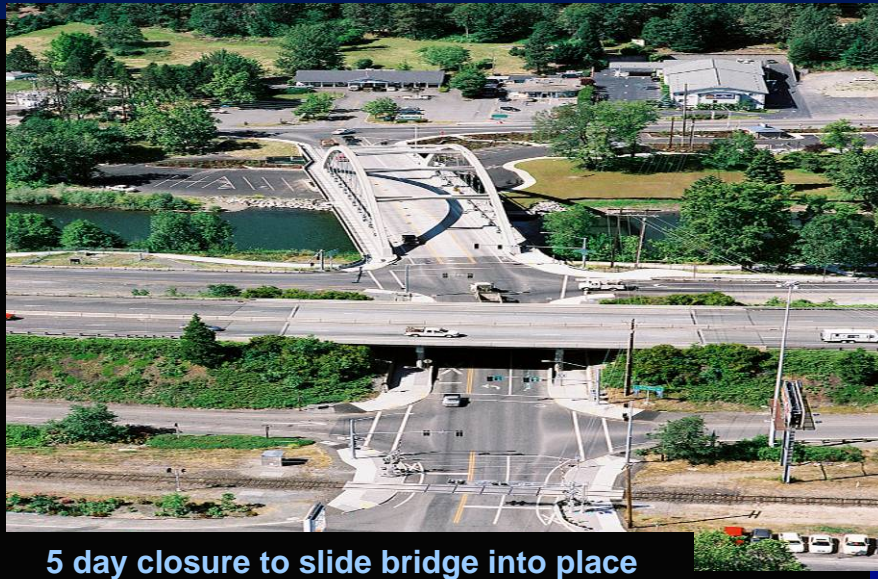
- ▶ Oregon DOT has done several ABC projects
- ▶ 11/16 completed in last 5-6 years
- ▶ Skidding, floating, precast deck systems
- ▶ Incentive/Disincentive approach
- ▶ Limit window of road closures duration
- ▶ Industry driven and State guidance
- ▶ Bridge Design and Drafting Manual (BDDM)



Pudding River Bridge, Truss Replacement



Depot Street Bridge over Rogue River 2007



5 day closure to slide bridge into place

306-foot Concrete Tied Arch

77-foot wide

5,000 tons



Bridge Built Upstream Alongside



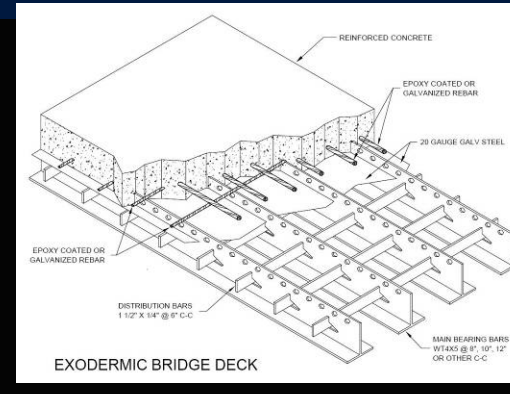
Mammoet Skids and Track

Elk Creek Bridge Move

Won 3 Awards: * APWA Project of the Year; * AASHTO America's Transportation; and * ASCE Outstanding CE Achievement



Mill Creek Rapid Deck Replacement



- ▶ Deck cut & removed in sections
- ▶ Flexible schedule for work and traffic windows
- ▶ 540 ft of exodermic steel grid deck replaced in 24 days



ABC Definition

- ▶ A process applies to incorporating innovative technologies, contracting methods, design and construction techniques and/or prefabricated elements and systems, to minimize impacts to the traveling public, local community and environment.

ODOT BDDM Guidance

Section 1.1.2.9 - Outline

- ▶ Introduction
- ▶ Decision making framework & Matrix
- ▶ Steel structures
- ▶ Concrete structures
- ▶ Full-depth deck & end panels and wingwalls
- ▶ Seismic related
- ▶ Use of SPMT

http://www.oregon.gov/ODOT/HWY/BRIDGE/standards_manuals.shtml

ODOT BDDM – Outline Cont.

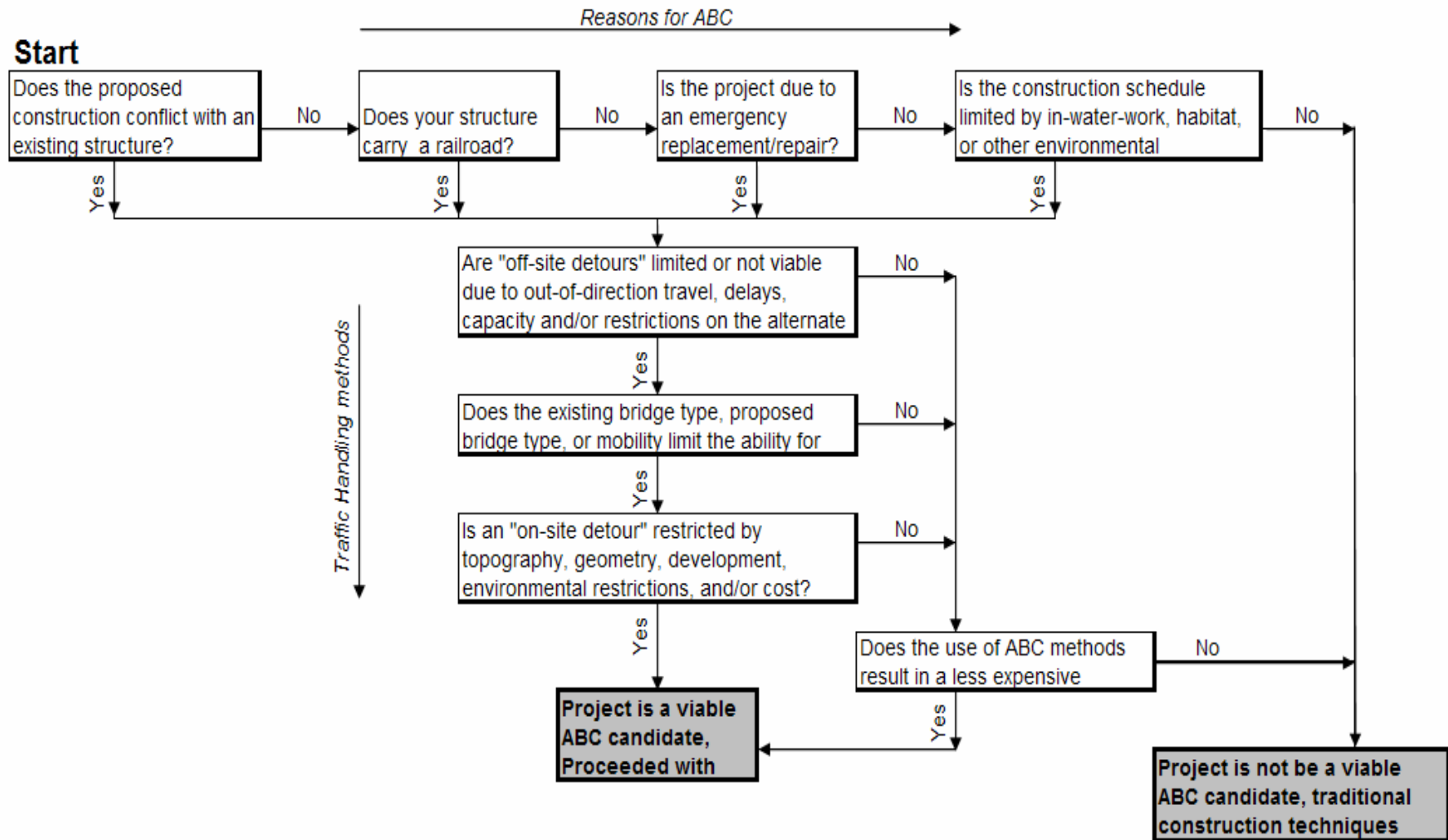
- ▶ Geotechnical consideration
- ▶ QA/QC for prefabricated elements
- ▶ Cost consideration
- ▶ HYRISK economic analysis tool
- ▶ Project listing

http://www.oregon.gov/ODOT/HWY/BRIDGE/standards_manuals.shtml

Decision Making Framework

- ▶ Decide when and where ABC would be most effective during early project planning
- ▶ Options allowed:
 - Design-bid-build method OK
 - Approved contractor's alternate methods OK
 - Design-build method OK
- ▶ Criteria established in flowchart serves as a guide

Decision Making Flowchart



Attribute - Complexity

| Attribute | ABC | Convent'l BC |
|---------------|--|--|
| 1. Complexity | <ul style="list-style-type: none">▶ Engineer less familiar with ABC techniques – more complex▶ More surveys for control points▶ May require pick points▶ May require more complex construction techniques▶ May need new specs▶ May add risk to Contractor▶ May require special equipment▶ Good with D/B and A+B with incentive/disincentive | <ul style="list-style-type: none">▶ Engineer more familiar with conventional construction techniques therefore, considered less complex.▶ Contractors more familiar with methods used in conventional construction, therefore considered less complex.▶ Standard specs exist |

Attribute - Schedule

| Attribute | ABC | Convent'l BC |
|-------------|---|--|
| 2. Schedule | <ul style="list-style-type: none">▶ Facility to reopen to traffic in hours or over weekends▶ Slightly longer design time▶ More planning & coordination▶ Parallel construction off CPM▶ Off-line/shorter field erection▶ Approach/utility impacts time▶ Use incentive/disincentive▶ Constructible details▶ Coordinated demolition plan▶ Tight control of scheduling▶ Details may not fit in field▶ Industry participation in PBES/ABC▶ Include contractor on design or constructability review | <ul style="list-style-type: none">▶ Typical field construction season in months or years▶ Typical design schedule▶ Often bridge work is controlling in CPM▶ Sequential activities typical and limitations may exist▶ Public delay cost may be high |

Attribute - Budget

| Attribute | ABC | Convent'l BC |
|-----------|--|--|
| 3. Budget | <ul style="list-style-type: none">▶ More expensive due to non-typical construction method▶ Increased design cost▶ Limited historical bid data▶ Reduced users delay costs▶ 1st cost vs. LCC cost with savings due to reduced traffic impacts and delays | <ul style="list-style-type: none">▶ Typical estimate given condition and conventional required structure type▶ Typical project costs▶ Incentives/disincentives may not be effective and could adversely impact project costs.▶ In-depth study to effectively apply incentive/disincentive |

Attribute – Design Quality

| Attribute | ABC | Convent'l BC |
|-------------------|---|--|
| 4. Design Quality | <ul style="list-style-type: none">▶ Design quality just as good as that of conventional▶ Limited design criteria for some elements▶ Construction loads may control design and need checking▶ Require to show full connection details | <ul style="list-style-type: none">▶ Design quality is expected to be good from standard and best practice. |

Attribute – Construction Quality

| Attribute | ABC | Convent'l BC |
|-------------------------------|--|--|
| 5. Construction Quality | <ul style="list-style-type: none">▶ Individual prefabricated elements are of higher quality under shop-controlled environment.▶ Construction quality could suffer in the field assembly due to time pressure. | <ul style="list-style-type: none">▶ Construction quality depends on the contractor and inspection staff. |

Attributes – Discipline Required

| Attribute | ABC | Convent'l BC |
|------------------------|--|--|
| 6. Discipline required | ▶ May requires more upfront coordination between technical and non-technical disciplines and public relations. | ▶ Standard project design and construction teams |

Attribute – Experience Required

| Attribute | ABC | Convent'l BC |
|------------------------------|---|--|
| 7. Experience required | <ul style="list-style-type: none">▶ ABC experience is desirable especially regarding knowledge of ABC construction methods, new technologies, implementation of new design and details▶ May require additional research and resources▶ May require specialty construction experience. | <ul style="list-style-type: none">▶ Standard project design experience▶ Standard bridge construction experience |

Attribute – Public Communications

| Attribute | ABC | Convent'l BC |
|--------------------------|--|---|
| 8. Public Communications | <ul style="list-style-type: none">▶ May require more early and upfront communication with the public for temp/short road closures▶ May need to develop a communication plan with stakeholders | <ul style="list-style-type: none">▶ Typical |

Attribute – Demolition of existing structure

| Attribute | ABC | Convent'l BC |
|--|--|--|
| 9. Demolition of existing structure | <ul style="list-style-type: none">▶ May require full demolition plan▶ May need to provide staging place near site for off-line demolition▶ May need coordination for change-over structures▶ May not require temporary structure to be in place for long duration | <ul style="list-style-type: none">▶ Typical construction with either road closure or requires staging▶ Require full design of temporary structures for longer duration in place |

Attribute – Quality Control

| Attribute | ABC | Convent'l BC |
|---------------------|---|---|
| 10. Quality Control | <ul style="list-style-type: none">▶ ABC elements should be verifiable during construction▶ May require constructability review | <ul style="list-style-type: none">▶ Typical |

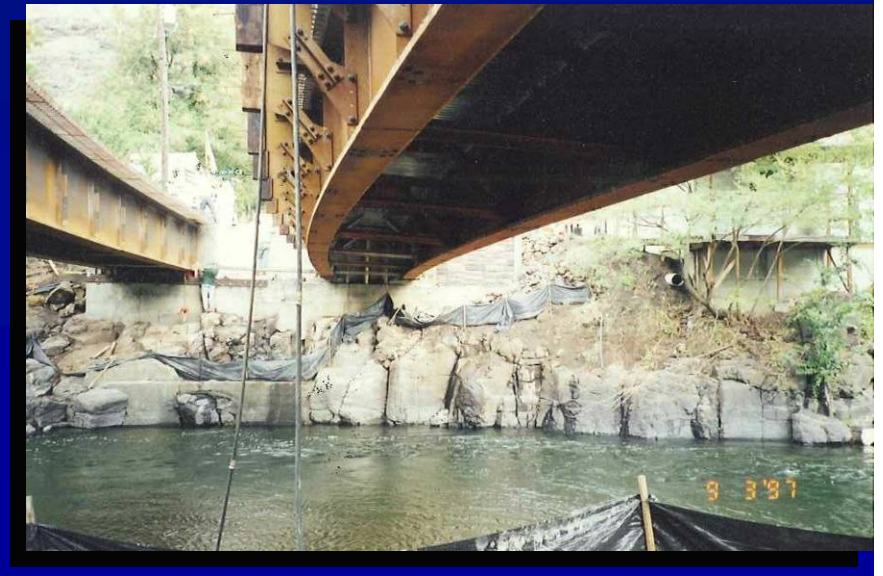
Attribute – Owner staffs

| Attribute | ABC | Convent'l BC |
|------------------|--|---|
| 11. Owner staffs | <ul style="list-style-type: none">▶ Some additional effort may be expected of the owner staff in design or review of non-conventional details/procedures.▶ May require more staff in a much more condensed timeframe. | <ul style="list-style-type: none">▶ Standard practice |

Summary: Knowing how each attributes could impact the project and its schedule; considering them in the design and construction to minimize surprises

Steel Structures

- ▶ Proven cost effectiveness and sustainable
- ▶ Plate Girders with precast deck panels
- ▶ Details available – FHWA's manual
- ▶ Some new developments – NSBA workshop
 - Modular systems – decked girder systems
 - Orthotropic decks
- ▶ Steel Arch
- ▶ Steel Truss



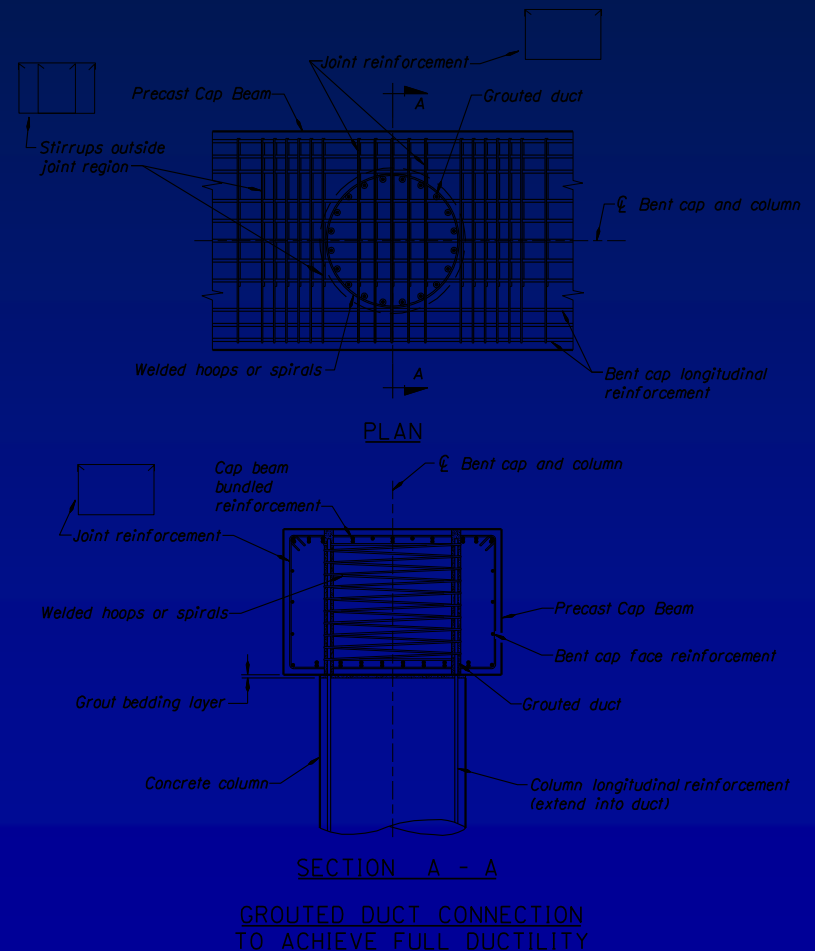
Concrete Structures

Prestressed Precast (PPC) vs. CIP

- ▶ Mass production of elements (PBE)
- ▶ PPC costs less than CIP in OR
- ▶ PPC Preferred – curvature, aesthetics and longer span designs
- ▶ Connection details exist – good durability
- ▶ Full depth deck & end panels, approaches and wingwalls – encourage more use

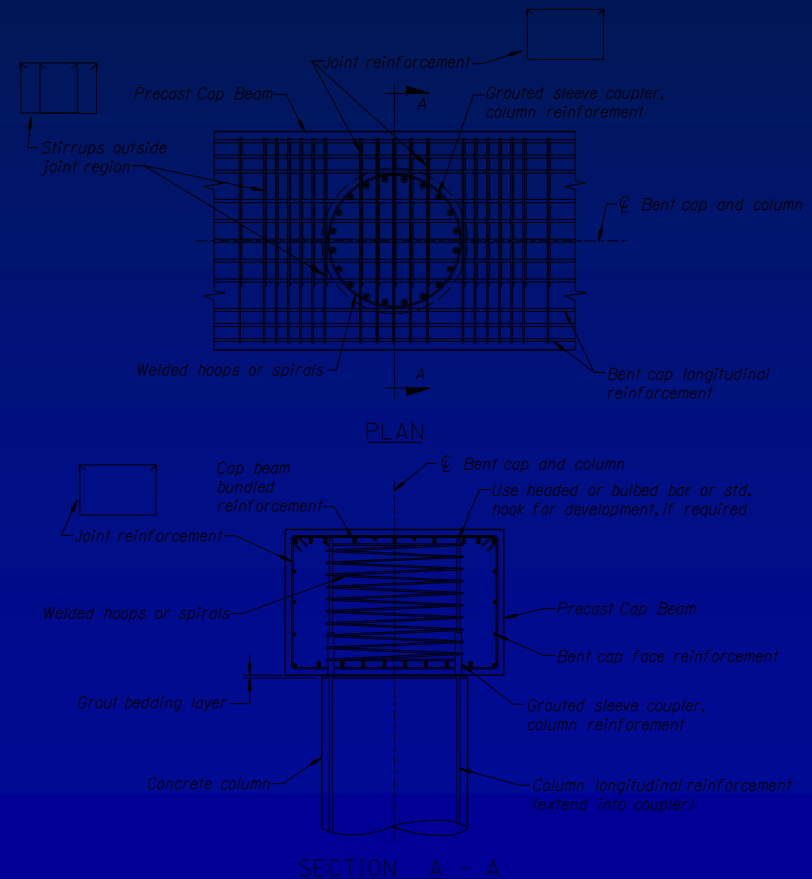
Seismic Connection Grouted Ducts

- Require to submit new connections proposal to ODOT for approval
- Good for single and multi-span bridges
- OK for SDC A, B and C
- More from NCHRP 12-74 for high seismic hazard



Seismic Connection Grouted Sleeve Coupler

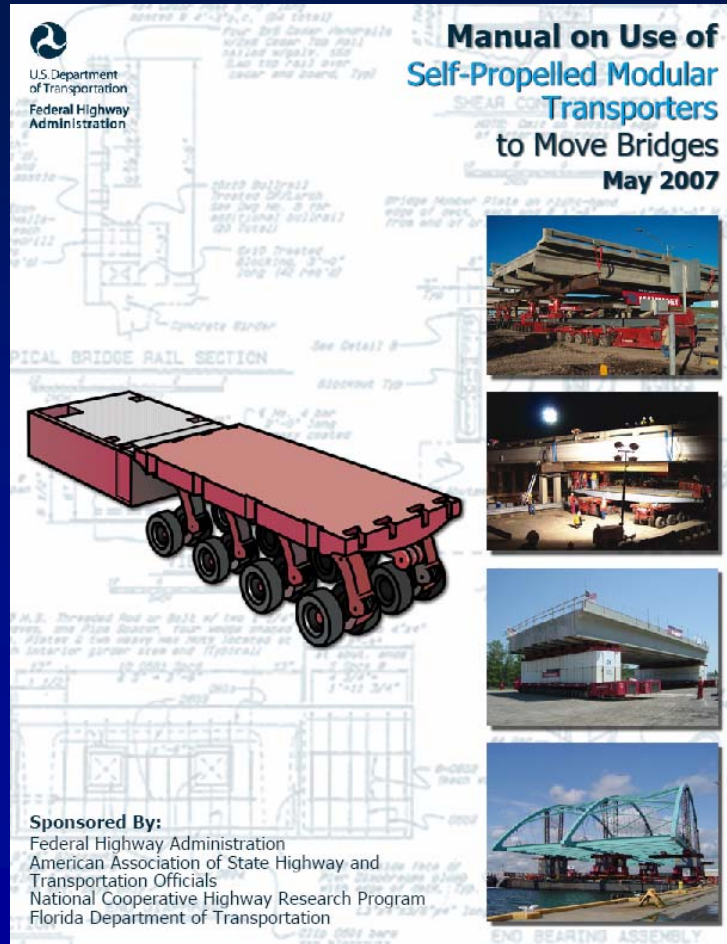
- Connections in the work:
- Superstructure-substructure
 - Pile-to-pile
 - Bent cap-to-column
 - Bent-to-bent cap
 - Deck-to-girder
- Achieve full ductility



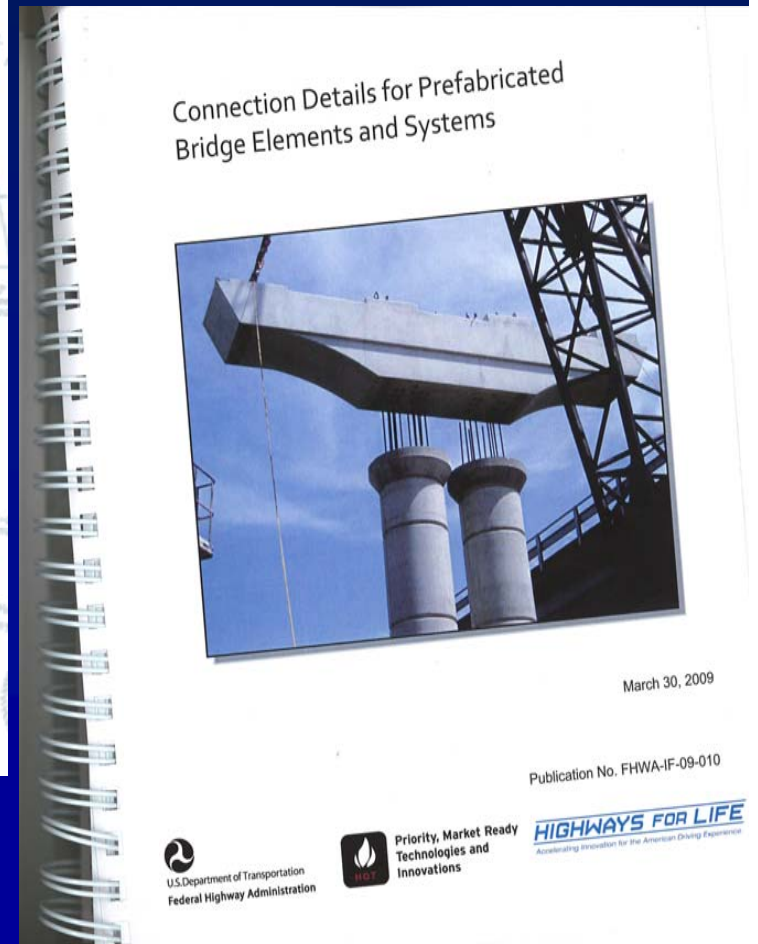
GRouted SLEEve COUPLER CONNECTION
TO ACHIEVE FULL DUCTILITY

FHWA Resources: SPMT & Connection Details

- Incredible machines
- Heavy lift X1000 tons
- Maneuverability
- Precision
- Distortion control
- Fastest erection scheme



- State of Practice
- 150+ connection details



Geotechnical Consideration

- ▶ Spread footings
- ▶ Precast reinforced concrete spread footings
- ▶ Driven piles
- ▶ Drilled shafts
- ▶ Micropiles

Geotechnical Consideration

- ▶ Accelerated embankment construction
- ▶ ODOT GDM – Chap 9 more info
 - All-weather materials (stone in lieu of “borrow”)
 - Light-weight fill (geofoam) applications
 - Geogrid reinforced embankments
 - Ground improvement techniques
 - Surcharge (with/out vertical wick drains)

QA/QC for Prefabricated Concrete Elements

- ▶ ODOT' Standards Section 00550 applies
- ▶ Prestressed slabs, box beams, girders, columns, arch ribs and piles
- ▶ Bridge railings, end panels
- ▶ Pile caps/abutments
- ▶ SIP forms
- ▶ Culverts
- ▶ Manholes and utility vaults

QA/QC for Non-Prestressed Elements

- ▶ ODOT Standard Section 00540 applies
- ▶ Required to submit min. qualifications:
 - Submit QC plan
 - Names and qualifications of key personnel
 - History of similar projects
 - Procedure for tracking materials certifications
 - Lifting, shipping and handling
- ▶ Solicit input from ODOT Bridge Materials Engineer

Cost Consideration

- ▶ ABC reduces users cost big time
- ▶ Utah DOT has demonstrated SF\$ is lower
- ▶ ODOT WZTAnalysis Tool (delays, operations and detours) for Incentive/Disincentive
- ▶ <http://intranet.odot.state.or.us/tsestimating/>
- ▶ Bonus or penalty for on time delivery
- ▶ Contract innovation: A+B bidding, lane rental

Cost Consideration

- ▶ Maintenance of traffic costs
- ▶ Contractor's operation costs
- ▶ Owner agency's operation costs
- ▶ Political capital and public praise
- ▶ HYRISK Tool
 - Road closure
 - Detour length
 - ADT, ADTT, traffic speed, veh. occupancy rate...
 - Total community cost associated with closure

Summary

- ▶ ODOT encourages and supports ABC
- ▶ Guidance in BDDM is advisory
- ▶ Precast elements, seismic connection details, cost study, standards and specs
- ▶ Geotechnical and fill materials
- ▶ More work to come
- ▶ http://www.oregon.gov/ODOT/HWY/BRIDGE/standards_manuals.shtml#Bridge_Design_Drafting_Manual