THE PRACTICAL DESIGN/VALUE ENGINEERING PARTNERSHIP – *It Works*

PD  VE

2009 AASHTO Value Engineering Conference

San Diego, California
August 30 – September 2, 2009

By Warren Knoles, P.E., AVS
Crawford, Murphy & Tilly, Inc.

AASHTO
The Voice of Transportation

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Presentation

PD  VE

- Introduction
- The Project
- Practical Design (PD) Philosophy
- Practical Design Workshop (PDW) Process
- PDW Results
- Traditional VE/PDW Job Plan Comparisons
- PDW Evaluation/Lessons Learned
- Conclusions

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Introduction

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- Value Methodology (VM) – A Powerful and Flexible Tool
- Opportunity: Apply VM to MoDOT Interchange Project
- Partner “Practical Design” and Value Engineering

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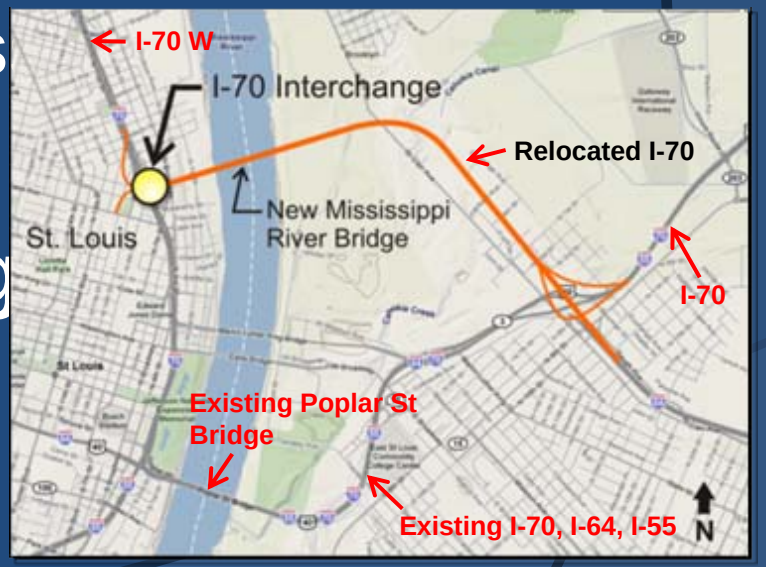
THE PROJECT

- New Missouri I-70 Mississippi River Bridge (MRB) Interchange
- Location: Downtown St. Louis, MO

THE PROJECT

- **Purpose and Need**
  - Relieve Poplar St. Bridge Congestion
  - Improve I-70 System Linkage
  - Improve Downtown Acces
  - Improve Local Access
- **Original Concept Desig by EIS Consultant**



Project Location

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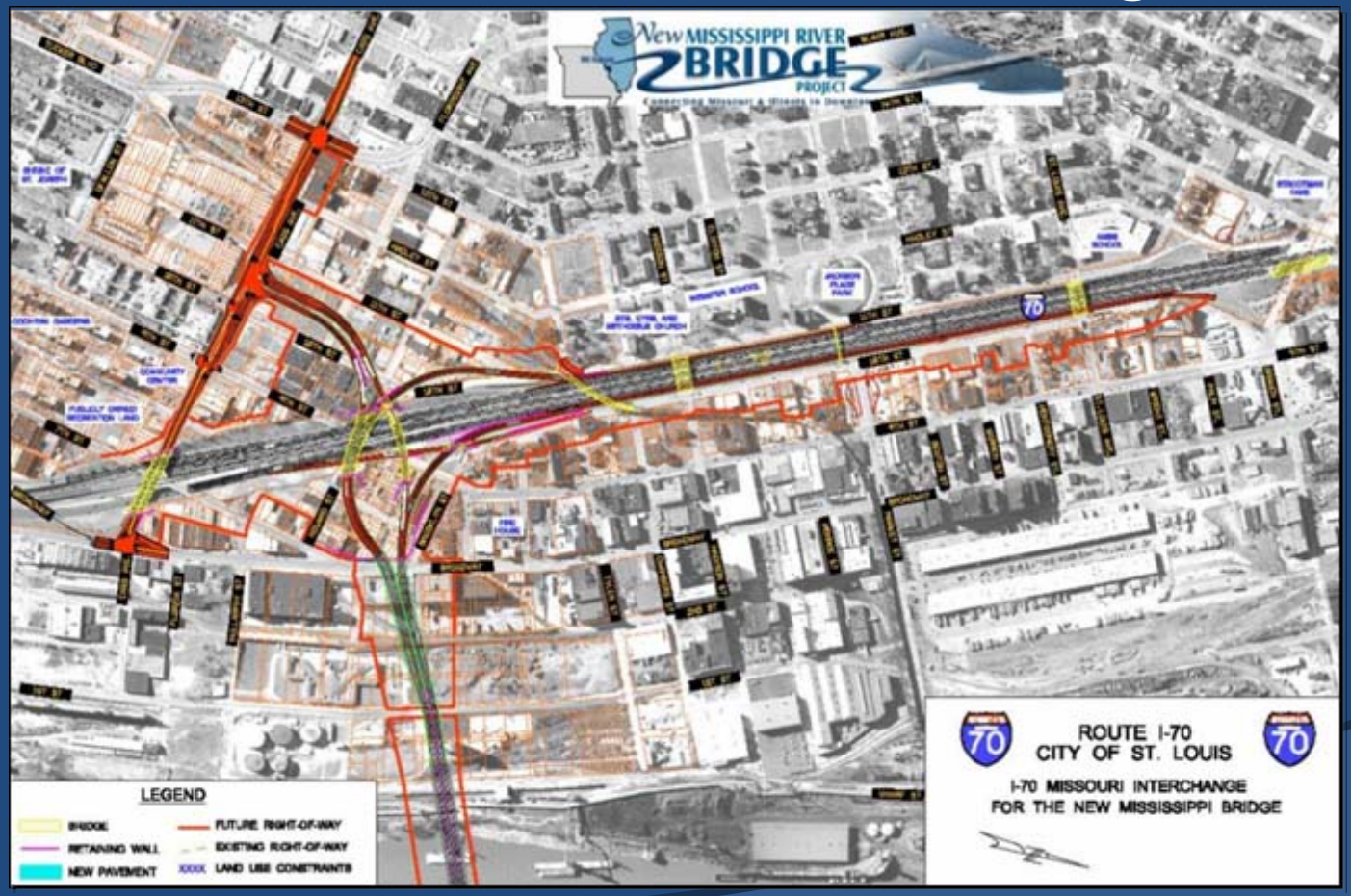
THE PROJECT

- First Phase of I-70 Interchange



THE PROJECT

- **Challenge: Design to $49 Million Budget**
- **Two MoDOT Methods:**
  - VE Study – Preliminary Plans
  - “Practical Design” Cost Reductions

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“PRACTICAL DESIGN” Philosophy

MoDOT Practical Design Manual

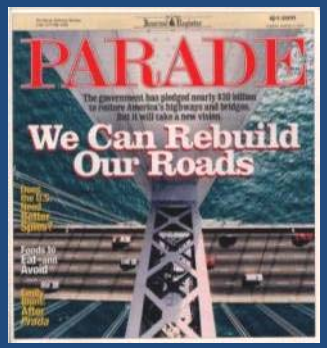
Pioneered by MoDOT 2003-2005

Goal: “Best Value for Least Cost”

- Pete Rahn, MoDOT Director

“Many good projects rather than just a few perfect ones”

- Kevin Keith, MoDOT Chief Engineer
Midwest Contractor (Nov 10, 2008)



PD “Has stretched Missouri’s road dollar considerably”

- Pete Rahn, Parade Magazine
(March 8, 2009)

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“Practical Design” Philosophy

- Allow flexibility for Project-specific locations
- Collaborate on the Solution
- Safety will not be compromised
- Practical Design Savings → Reduced Function
- Is reduced function needed for this project or worth the cost?

Practical Design Workshop (PDW)

- **Incorporate Value Methodology into MoDOT Practical Design Process**
- **1-Day "Practical Design Workshop"**
- **Purpose of PDW**
  - Reduce cost without compromising essential functions
  - Incorporate PD/VE Concepts from start of design
  - Incorporate contractor input into design

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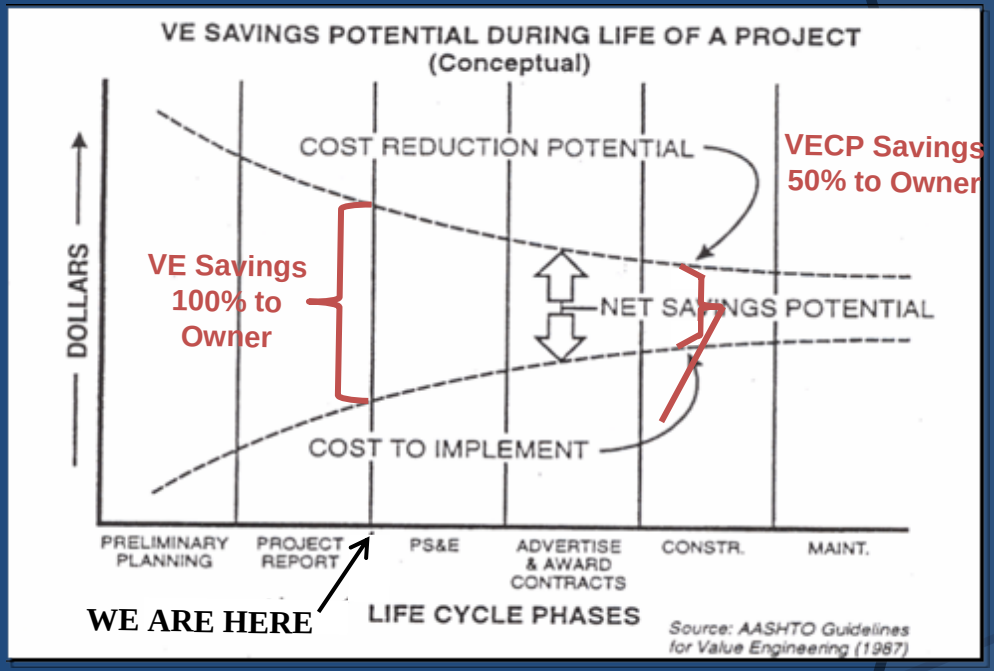
Practical Design Workshop

- **Goals**
  - Capture 100% of VE Savings
  - Net Savings Potential 4:1 +/-
  - Minimize engineering re-work



PDW Process

- **Workshop Duration: 1 Day**
- **PDW Team Make Up:**

• MoDOT		8
• CMT Design Team		7
• Utilities Consultant		1
• Construction Specialist	1	
• FHWA	1	
• Facilitators	2	
Total	**20**	

PDW Process

- **Location: MoDOT Project Office near site**
- **Facilitators:**
  - Information Phase: MoDOT Project Director
  - Balance of Workshop: Warren Knoles, P.E., AVS

PDW PROCESS: Information Phase

- Pre-Workshop Project Information Package
- Project Presentation by MoDOT Project Director and CMT Project

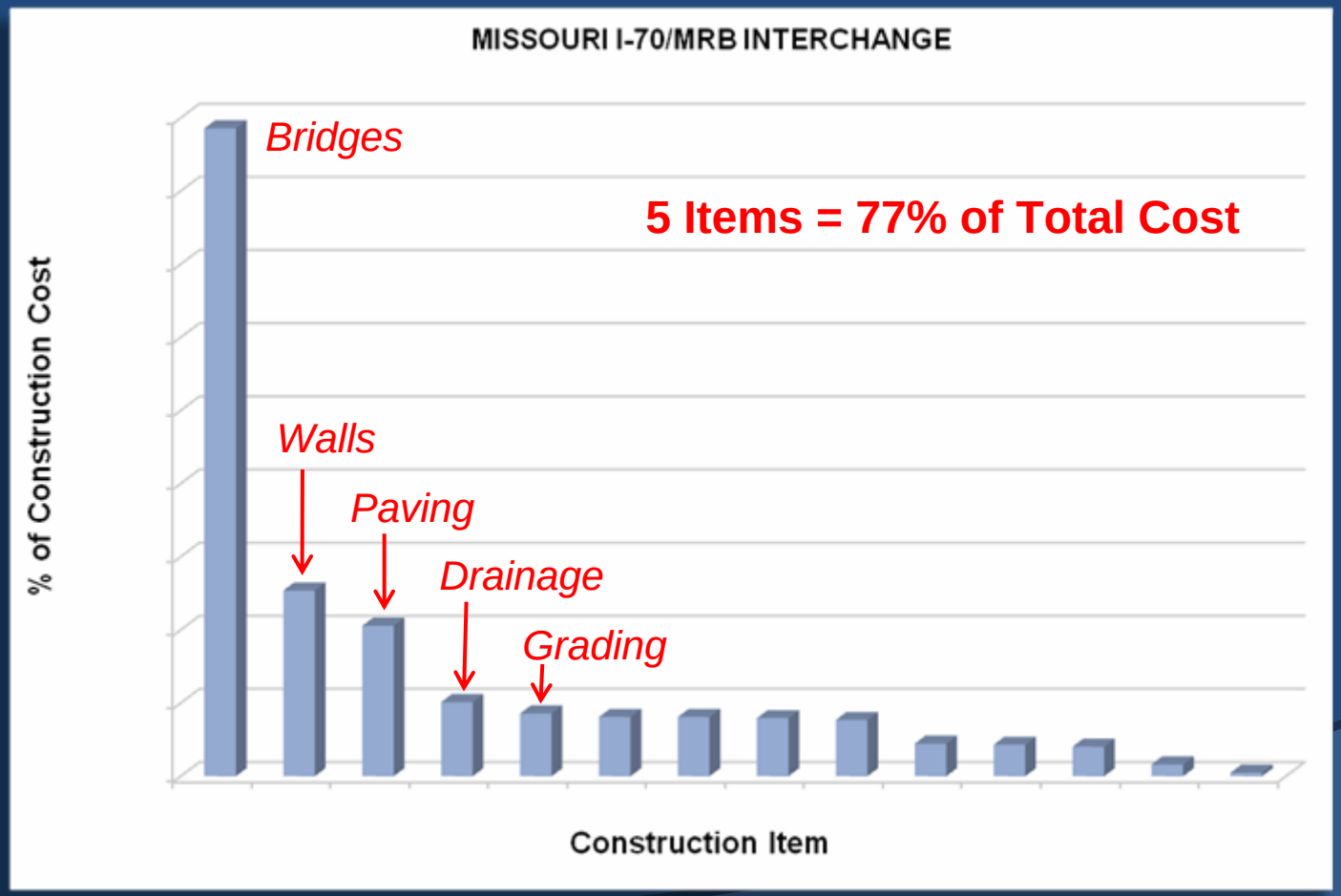
PDW PROCESS: Information

- 1 ½ Hour Site Visit

- Site Visit Observations Recorded

PDW PROCESS: Information Phase

- Baseline Cost Model



PDW PROCESS: Function Analysis Phase

- **Prepared-in-Advance FAST Tree**
- **Higher Order Functions from EIS**
  - Relieve Poplar St. Bridge Congestion
  - Sustain Downtown Economic Development

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PDW PROCESS: Function Analysis Phase

- **Basic Functions**
  - Improve River Crossing Capacity (Add New MRB) – Not in Scope
  - Improve System Linkage (ISL)
  - Improve Downtown Access (IDA)
  - Improve Local Access (ILA)

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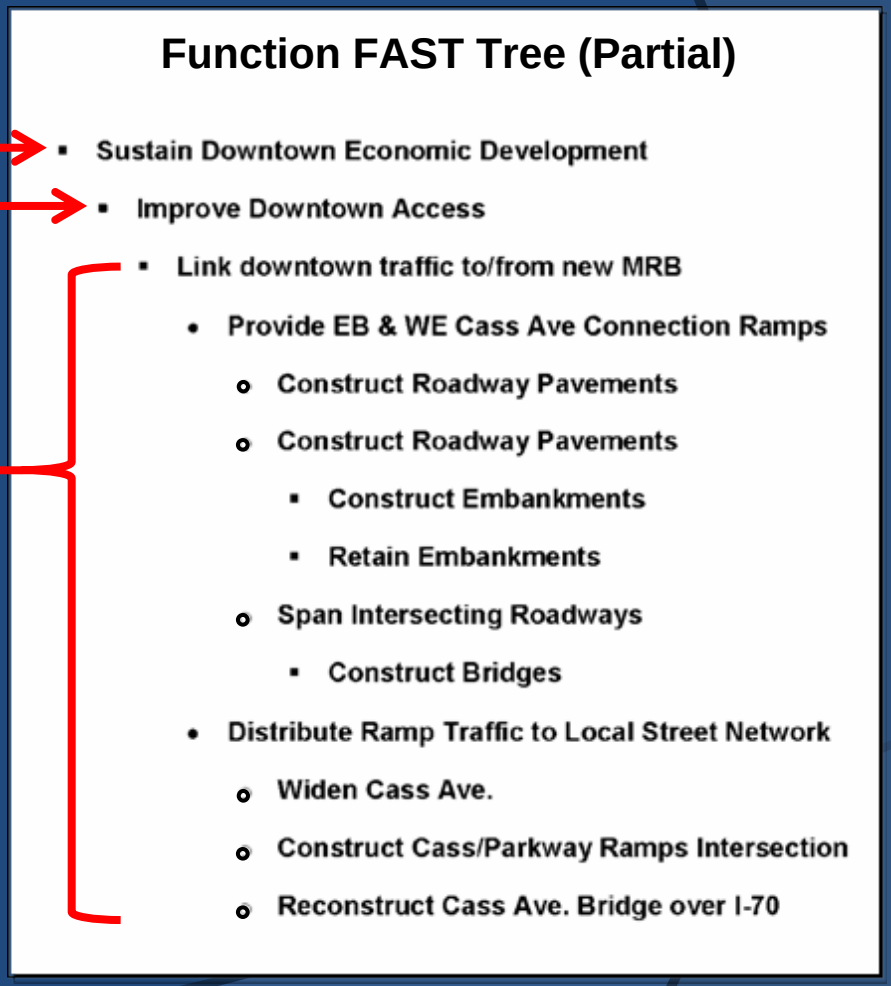
PDW PROCESS: Function Analysis Phase

- Function FAST Tree
  - Higher Order Function
  - Basic Function
  - Secondary Functions



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PDW PROCESS: Function Analysis Phase

- **Functional Components Selected for Analysis**
  - Bridges
  - Retaining Walls
  - Roadways
  - Pavement Structure
  - Earthwork
  - Traffic Control
  - Utilities
  - Demolition
  - Drainage
  - Materials
  - Right-of-Way

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PDW PROCESS: Function Analysis Phase

- **Analyze Functional Components by Applying 7 Functional Analysis Questions**
  - What is it?
  - What does it do?
  - What is its cost?
  - What is its worth?
  - What else would work?
  - What does that cost?
  - Can it be eliminated?

PDW PROCESS: Creative Phase

- Brainstorming of Creative Ideas
- “Improve Downtown Access” Basic Function – Entire Team
- “Improve System Linkage” and “Improve Local Access” – 3 Sub-Groups

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PDW PROCESS: Creative Phase

- **Each Sub-Group assigned 4 Functional Components**
- **Each Sub-Group**
  - Brainstormed creative ideas
  - Presented ideas to whole PDW team
  - Accepted creative ideas from the other 2 Sub-Groups

PDW team break-out session

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PDW PROCESS: Evaluation Phase

- **PD Alternatives**
  - 2- Rating = Decrease in Functionality/ Decrease in $
- **Both VE and PD Alternatives Considered**

9-Cell Matrix Methodology [2]

PROBABLE EFFECT ON FUNCTION	PROBABLE EFFECT ON COST: Increase	Same	Decrease
Increase	Requires additional funding (2+)	✓ (4)	✓ (5)
Same	X (1)	Possible different approach (3)	✓ (4)
Decrease	X (1)	X (1)	Scope deferral, reduction or elimination (2-)

[2] SAVE International Value Analysis Module I
Basic Certification Workbook, Enlign Consultants and Advantage Facilitation Services, (Ft. Collins)

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PDW PROCESS: Evaluation Phase

- **Each Sub-Group rated ideas using 9-Cell Matrix**
- **VE Alternatives:**
  - 5 Rating = Increase Functionality/ Decrease in $
  - 4 Rating = Same Functionality/ Decrease in $

9-Cell Matrix Methodology [2]

PROBABLE EFFECT ON FUNCTION	PROBABLE EFFECT ON COST: Increase	Same	Decrease
Increase	Requires additional funding (2+)	✓ (4)	✓ (5)
Same	X (1)	Possible different approach (3)	✓ (4)
Decrease	X (1)	X (1)	Scope deferral, reduction or elimination (2-)

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PDW PROCESS: Development Phase

- **Each Sub-Group – Developed 2-3 PD/VE Proposals**
- **Recorded on PDW Worksheets**
  - Original & Proposed Concepts
  - Cost Impacts
  - Advantages/Disadvantages
  - Additional Discussions
  - Cost Calculations
  - Sketches

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PDW RESULTS

- **Creative Ideas: 80**
- **PD/VE Proposals: 14**
- **Total PD/VE Savings: $13.6 Million**
  (28% of Baseline Cost Estimate)
- **Owner Acceptance: 100%**

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PDW Results

- **Comparison to FHWA Nationwide Data**

	FHWA[1] FY03-FY07	PDW
• Avg. # of Recommendations per VE Study	7.3/Study	14
• Approved VE Recommendations as % of Construction Cost	7.5%	28%
• Average % Approved Recommendations	45%	100%

[1] FHWA website: www.fhwa.dot.gov/ve

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PDW RESULTS –PDW Proposals

- **Practical Design Proposals**

  <u>Savings</u>

  - ISL/R10 & IDA/R4 - Reduce inside ramp shoulders from 10’ to 4’ $4.392 M
  - G5 - Re-Use existing substructure $547 K on I-70 overpass bridges

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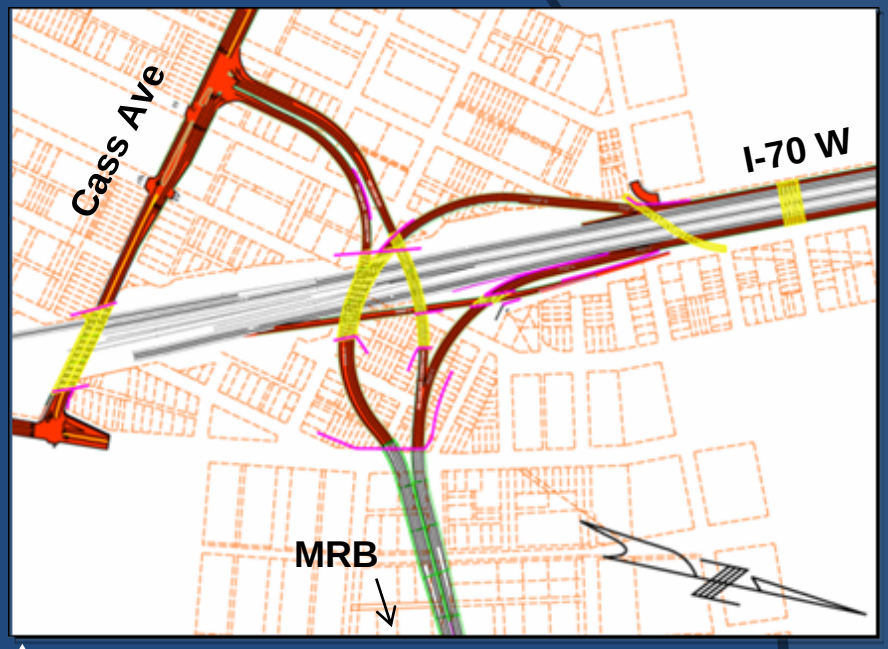
PDW Results

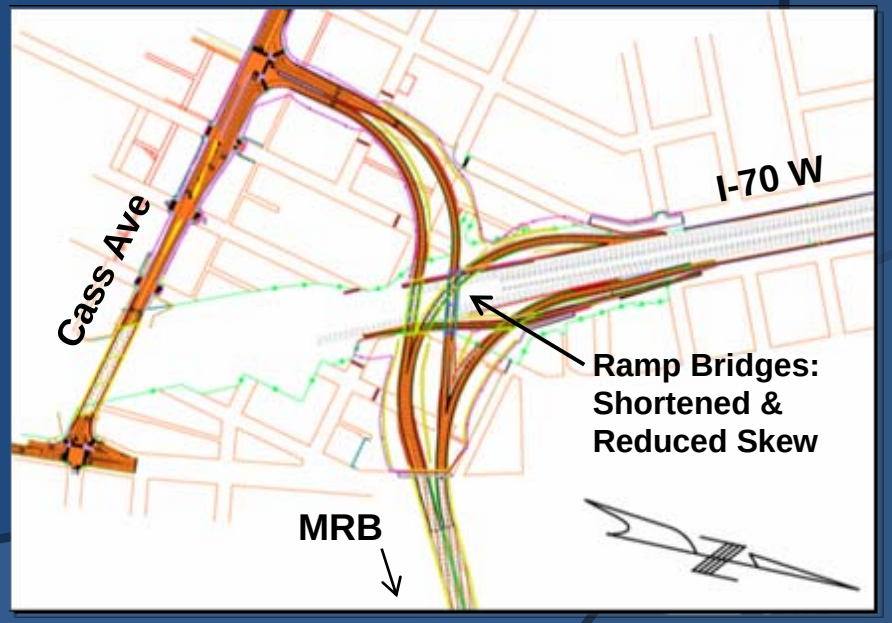
Selected PDW Proposals

- **Value Engineering Proposal**
  - ISL/B7, IDA/B16 & IDA/R15 - Shorten and reduce skew on ramp structures over I-70
  - Savings: $363,000



Original Concept Design

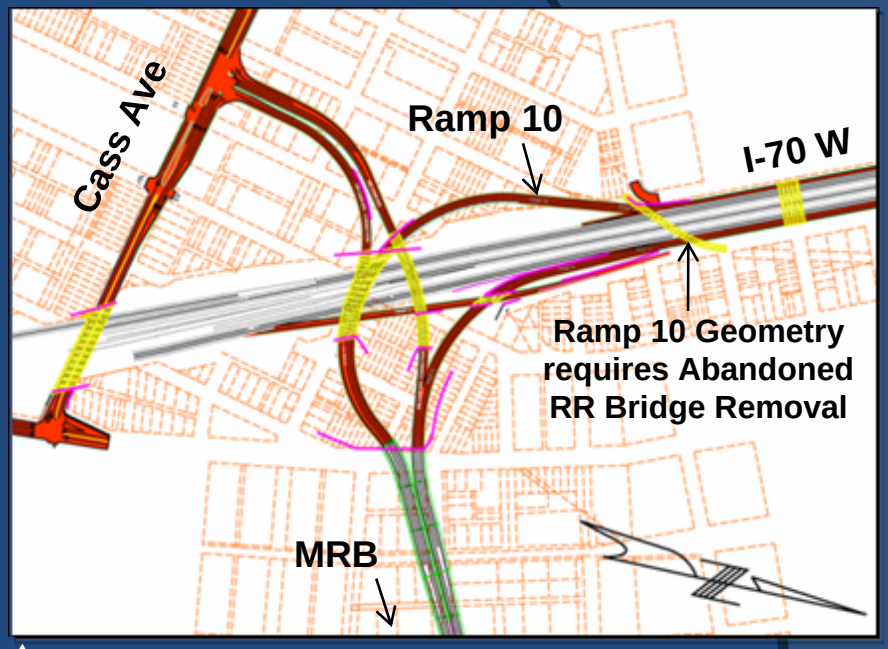
Revised Interchange



PDW Results

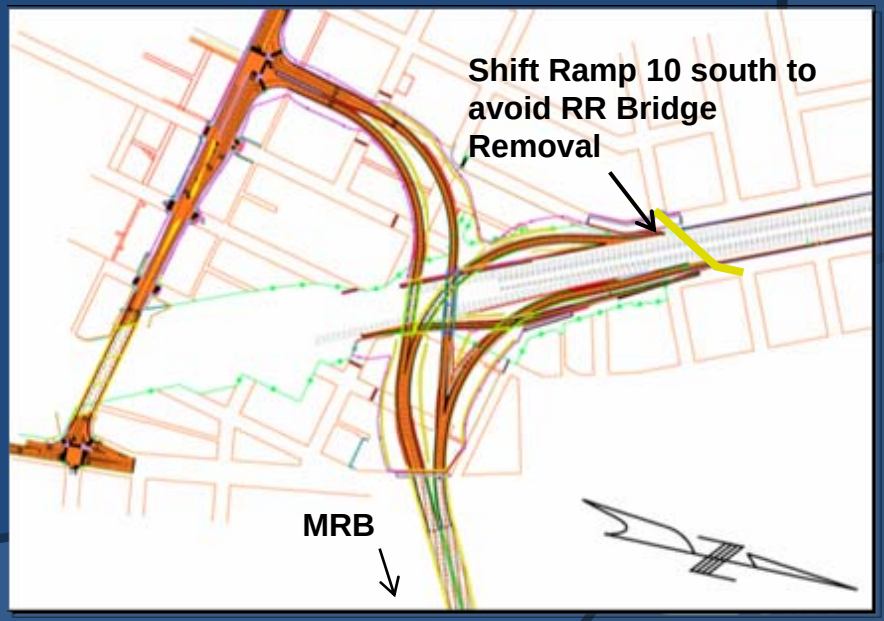
Selected PDW Proposals

- **Value Engineering Proposal**
  - ISL/R17 - Shift Ramp 10 south to avoid abandoned RR Bridge Removal
  - Savings: $720,000



Original Concept Design

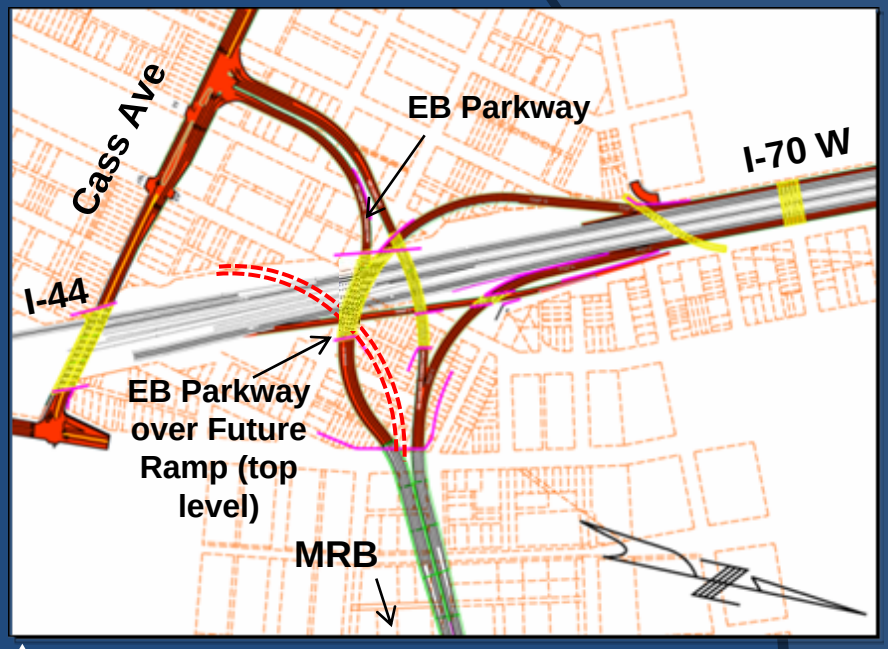
Revised Interchange



PDW Results

Selected PDW Proposals

- **VE Proposal**
  - ISL/B15 & ISL/R10 - Route EB Parkway Ramp under Future SB I-44 Ramp. Result: Reduce height of Interchange Piers and Retaining Walls along I-70 by 19’-30’
  - Savings: $5,065,000



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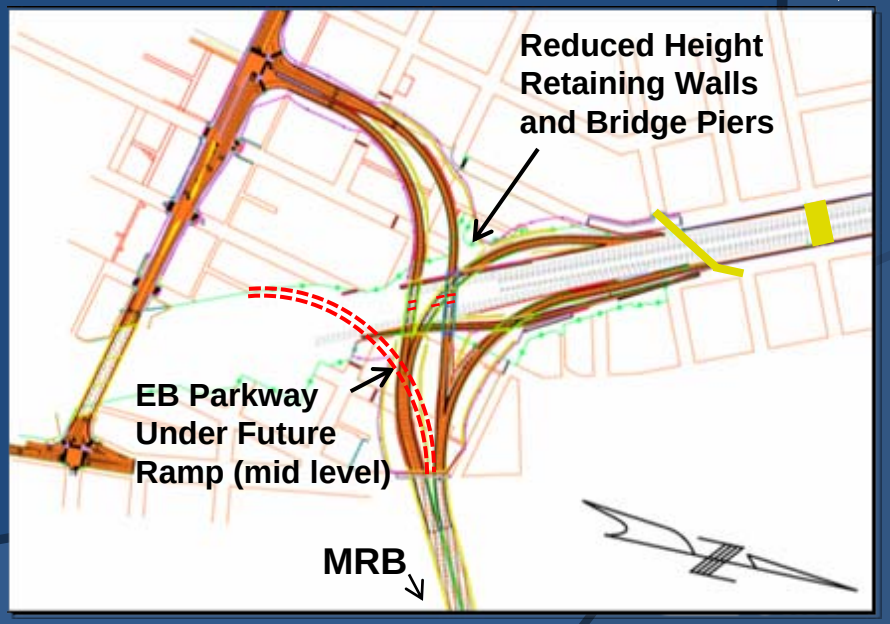
Revised Interchange



PDW PROCESS: Presentation Phase

- Each Sub-Group presented top 1-3 PDW Proposals to entire PDW Team
- Remainder of PDW Proposal Development: Post Workshop by Design Team

Traditional VE/PDW Job Plan Comparisons

- **Timing**
  - Traditional: 30% - 75% Design (FHWA)
  - PDW: EIS Concept Design (15-20% +/-)
- **Benefits**
  - Clarifies scope to Design Team
  - Alternative VE/PD concepts built into Design - Eliminates Re-work

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Traditional VE/PDW Job Plan Comparisons

- **Team Composition – Design Team Members**
  - Traditional: Prohibits Design Team Leadership (FHWA)
  - PDW: Includes Design Team Leadership

    (Note: Original concept plan prepared by another consultant)
- **Benefits:**
  - Allows Completion of VE/PD Proposals by Design Team post-workshop

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Traditional VE/PDW Job Plan Comparisons

- **Team Composition – Owner Decision Makers**
  - Traditional: Owner decision makers present only during Information & Presentation Phases
  - PDW: Included Owner Project Director, Project Managers & FHWA Project Manager
- **Benefits**
  - Scope clarification throughout workshop
  - Presence of Decision Makers prevents wasted time on un-approvable proposals

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Traditional VE/PDW Job Plan Comparisons

- **Team Composition - Number**
  - Traditional: 5-7 (AASHTO)
  - PDW: 18 (20 Including Facilitators)
- **Benefits**
  - Synergy of extensive Design/Construction experience
  - 3 Sub-Groups of 5-6 members brainstorming concurrently generates many ideas quickly

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Traditional VE/PDW Job Plan Comparisons

- **Team Composition: Contractor Representative**
  - Traditional: Owner & Consultant discipline experts (Engineers)
  - PDW: Construction contractor/estimator with VECP experience
- **Benefits**
  - More quickly identify constructability/traffic control VE concepts
  - Ability to estimate and economize all cost components of a construction item (e.g. labor, equipment, traffic control, etc.)

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Traditional VE/PDW Job Plan Comparisons

- **Workshop Duration**
  - Traditional: 4-5 Days
  - PDW: 1 Day
- **Benefits**
  - May allow higher level/more experienced personnel to be assigned to Workshop Team
  - 1 Day commitment of staff may increase DOT willingness to use VM
  - Lower cost/may be sufficient to derive Primary VE benefits on some projects

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Traditional VE/PDW Job Plan Comparisons

- **Workshop Time Allocation**

Phase	Traditional Hours	PDW Hours
Information	4	2.75
Function Analysis	4	3.75
Creative	8	
Evaluation	8	0.50
Development	12	1.00
Presentation	4	.50
TOTAL	**40**	**8.50**

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Traditional VE/PDW Job Plan Comparisons

- **Function Analysis**
  - Traditional: FAST Diagram developed by VE Team during Workshop
  - PDW: FAST Tree or Diagram prepared by PDW Facilitator in advance
- **Benefit**
  - Allows more time in a 1-day workshop for brainstorming creative ideas and PD/VE proposal development

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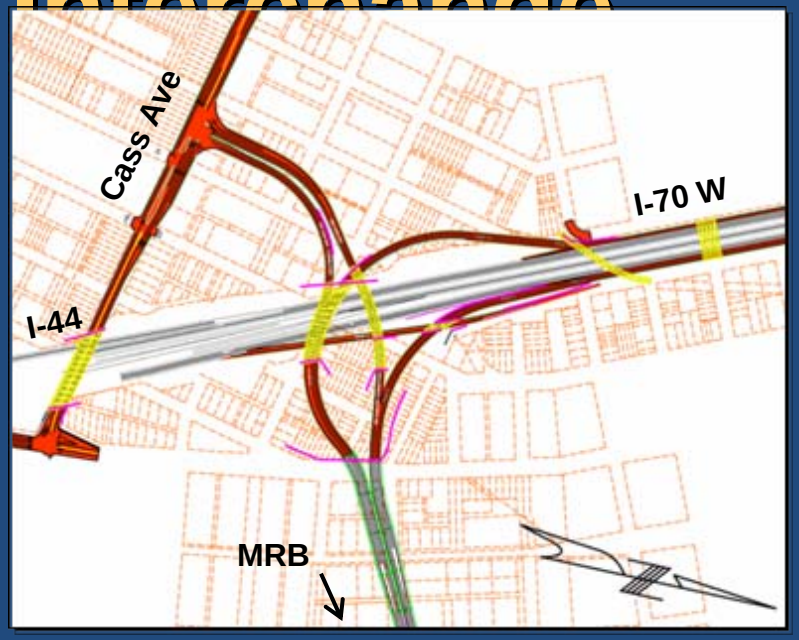
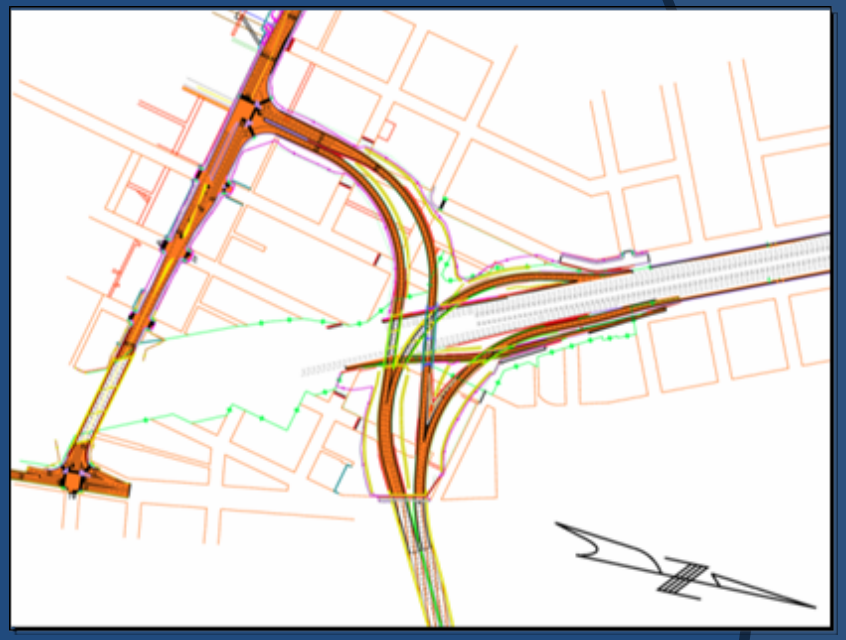
Traditional VE/PDW Job Plan Comparisons

- **VE/PDW Proposal Implementation**
  - Traditional: VE Study recommendations sometimes not implemented
  - PDW: Implementation more likely since PDW Team consists of Owner Decision Makers and the Design Team

PDW RESULTS: Revised Interchange



Original Concept Design



Revised Interchange

- **Operationally Equivalent**
- **28% Lower Cost**

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PDW TEAM EVALUATION (1-5 Scale)

- Effectiveness in Identifying Feasible PD/VE Concepts 4.38
- Format of PDW 4.31
- PDW Facilitators 4.87
- OVERALL RATING **4.52**

PDW Team

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PDW LESSONS LEARNED

- More time needed for review of Pre-Workshop Info Package (1-2 weeks minimum)
- 1-Day PDW sufficient for a straight-forward project
- 2-Day PDW desirable for complex projects

CONCLUSIONS

PD  VE

- Value Methodology is flexible and adaptable to Owner design processes
- Practical Design Workshop (PDW) can be effective in enhancing value and reducing project costs
- PDW identifies both PD (reduced function) and VE (equivalent function) Cost Savings
- Owner can select VE Savings only or both

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CONCLUSIONS

PD  VE

- **PDW might be used more frequently on smaller projects**
- **On larger projects:**
  - Conduct PDW by Design Team at beginning of design
  - Follow by 2nd PDW or independent VE Study later in Design Process

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The Practical Design/Value Engineering Partnership – *It Works*

PD  VE

QUESTIONS?