

Case Studies of Design-Build Project Delivery for Highway Pavements

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By

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Acknowledgment

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Presentation Outline

- **Objective and Background**
- **Design-Build (D-B) Case History Projects**
- **Pavement Aspects in D-B Contracts**
 - **Pavement Design Requirements**
 - **Warranties and Maintenance Agreements**
 - **Construction Quality Programs**
 - **Pay Adjustments (Incentives & Disincentives)**

Objective

Review pavement aspects in three design-build contracts from Texas:

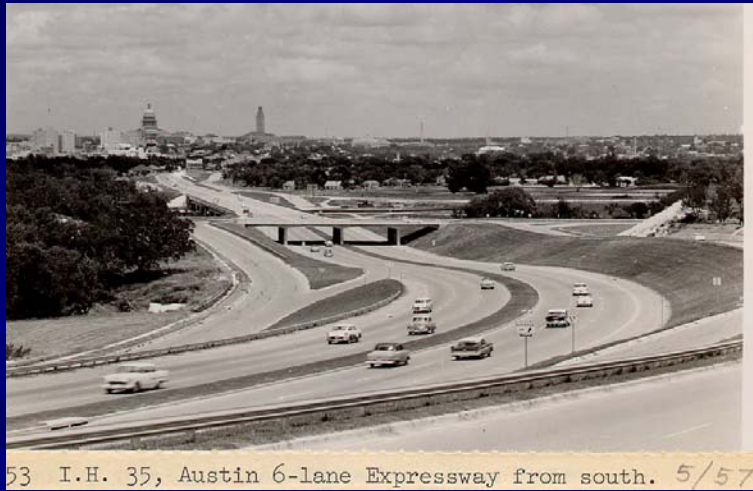
- **State Highway 130 (SH 130)**
- **State Highway 45 Southeast (SH 45 SE)**
- **US 183A**

Background on Design- Build Contracting for Highways

The Big Picture of Highways

High demand & limited resources!

Austin 1950s



Austin Now



Photos from texasfreeway.com and aaa-texas.com

**Alternative/innovative
contracting is part of the
solution!**

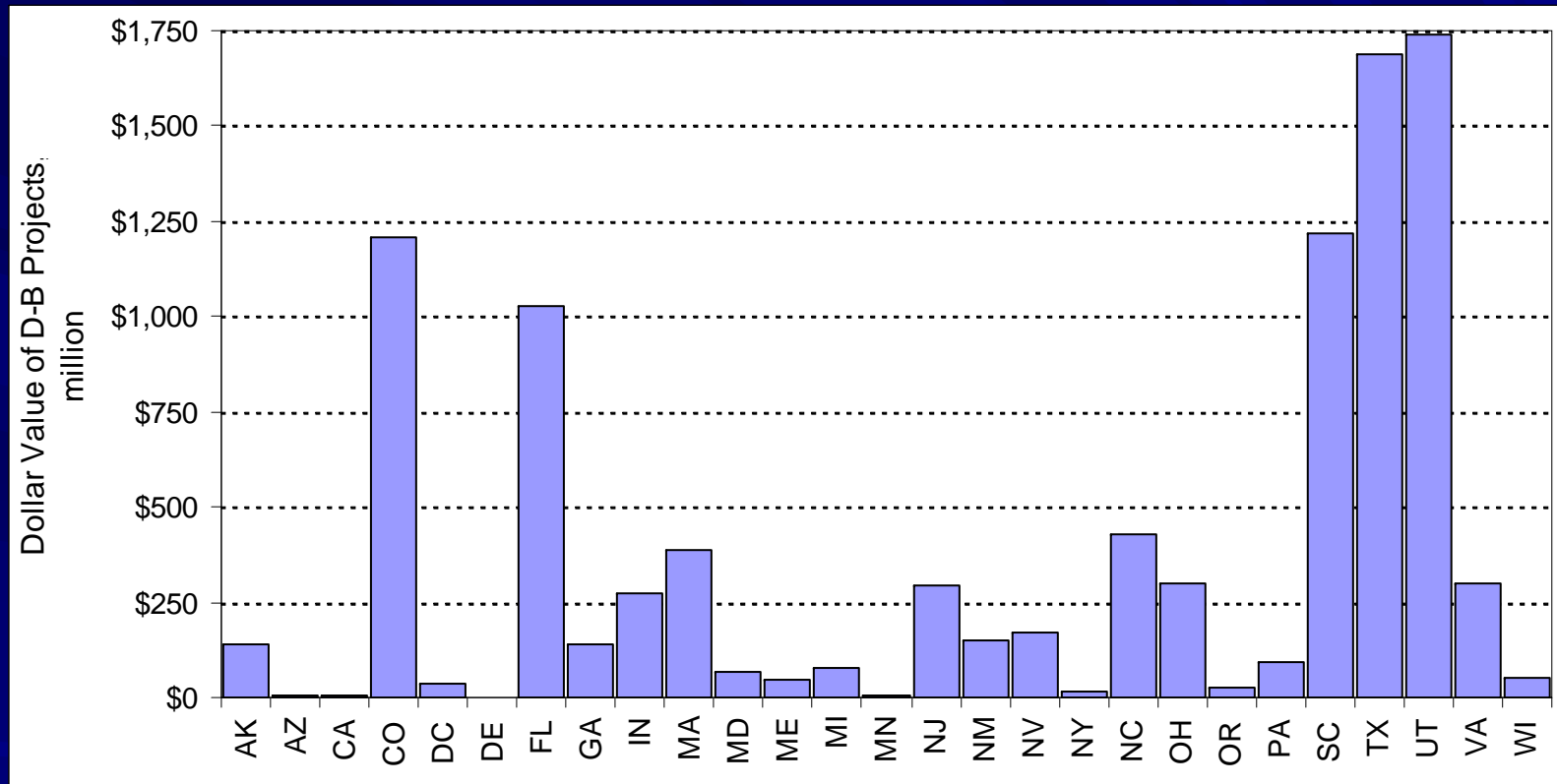


Design-Build Project Delivery

A system of contracting whereby one entity performs both architectural/engineering work and construction under a single contract.

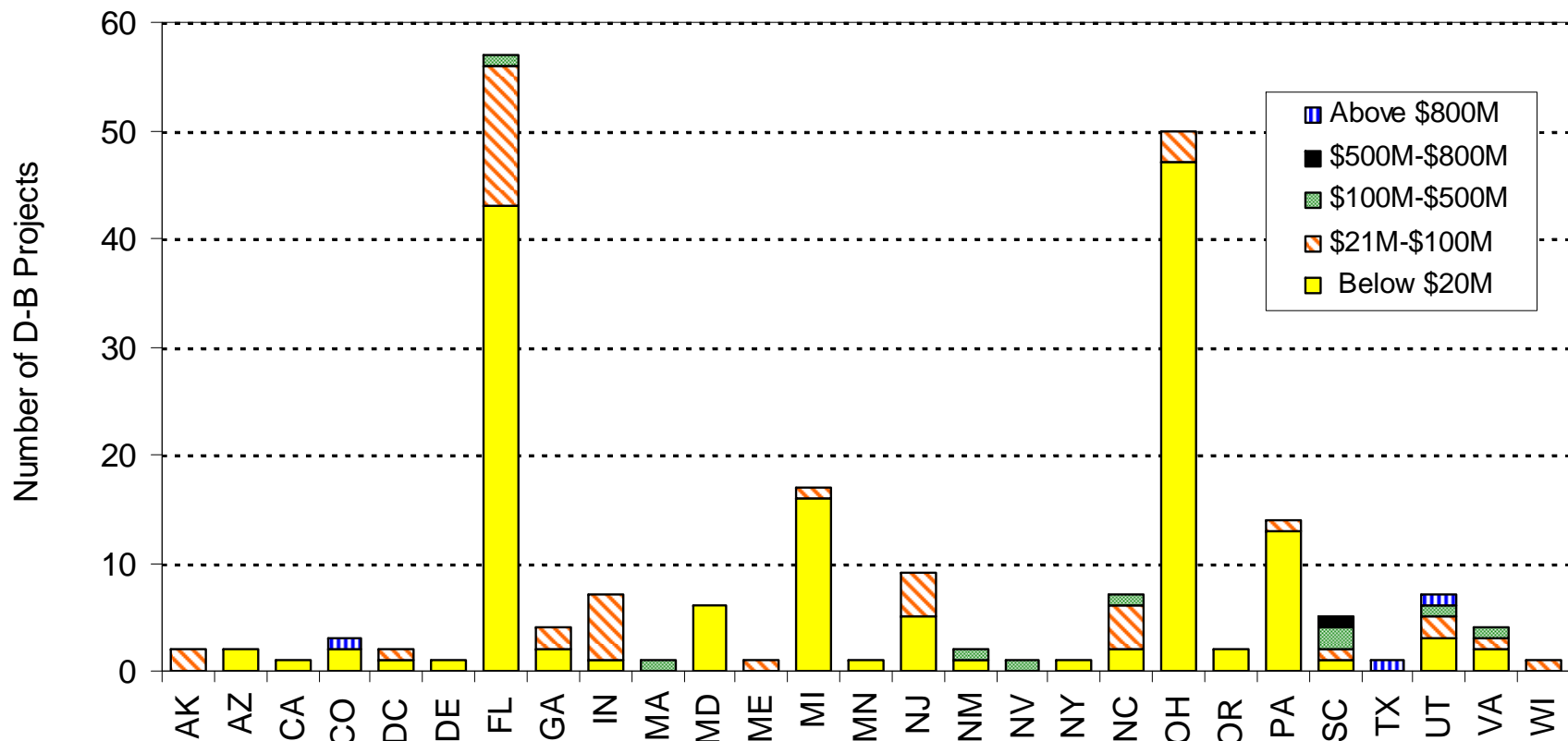
Source: Design-Build Institute of America (DBIA).

Dollar-Value of D-B Highway Projects Approved under SEP-14 (1990-2003)



Data Source: FHWA

Number of D-B Highway Projects Approved under SEP-14 (1990-2003)



Data Source: FHWA

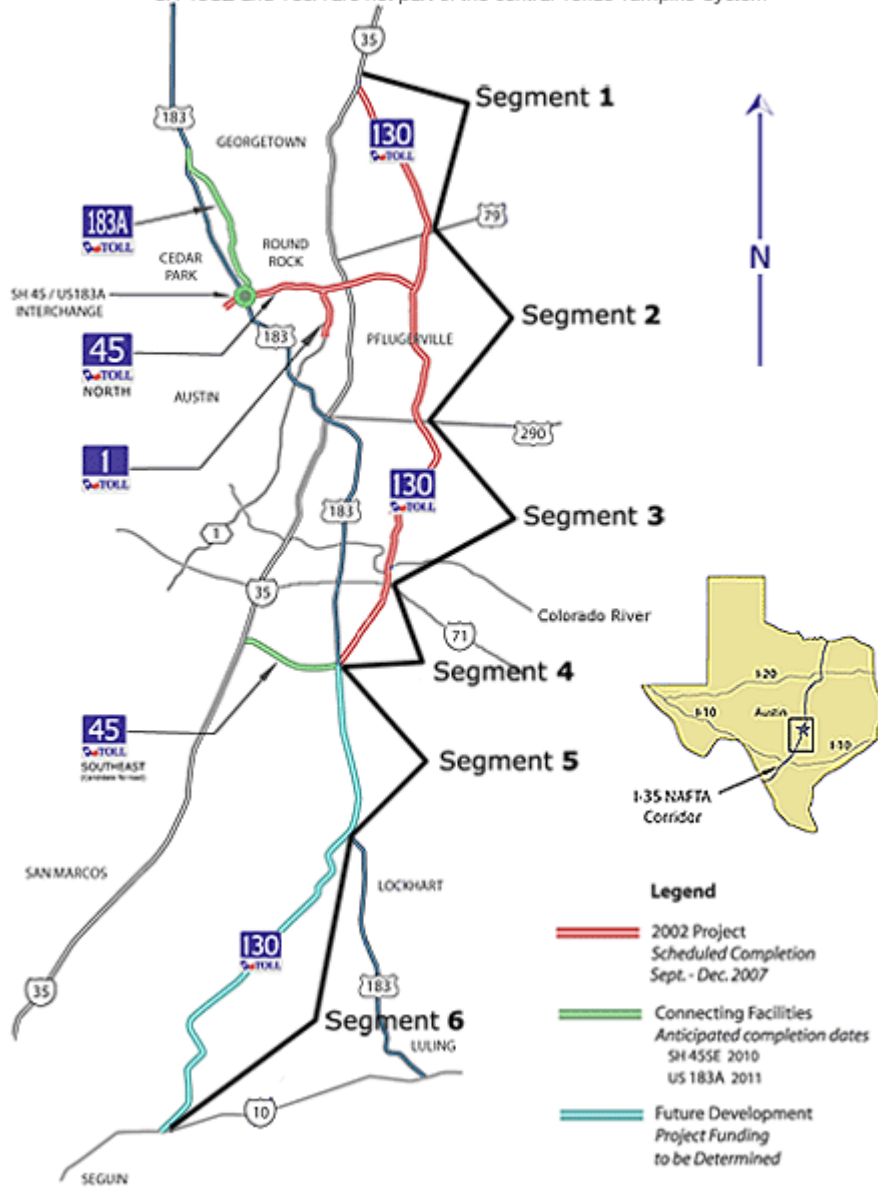
Texas D-B Case History Projects

| Project | Owner | D-B Team | Approx. Length, mi | Approx. Budget, \$ | Construction Period |
|----------|---|---------------------------------|--------------------|--------------------|---------------------|
| SH 130 | TxDOT/TTA | Lone Star Infrastructure | 49 | 1.3B | 2002-2008 |
| SH 45 SE | TxDOT | Zachry Construction Corporation | 7.4 | 150M | 2007-2009 |
| US 183A | Central Texas Regional Mobility Authority (CTRMA) | Hill Country Constructors | 11.5 | 238M | 2005-2007 |

TTA: Texas Turnpike Authority (A Division of TxDOT)

Central Texas Turnpike System*

*SH 45SE and 183A are not part of the central Texas Turnpike System



Map Source: Lone Star Infrastructure website (www.sh130.com)
Photo Source: Central Texas Turnpike System (CTTS) website (www.centraltexasturnpike.org)

Project Development

- The three projects were developed using Comprehensive Development Agreements (CDAs) under SEP-14 program.
- CDA*: A public-private partnership allowing a consortium of companies to perform a combination of finance, design, construct, maintain and operate a roadway under the guidelines of TxDOT.

* Definition Source: R.M. Brown, TxDOT

Pavement Design Requirements

Pavement Design Requirements

| Project | Pavement Type Selection | Pavement Design Method | Design Life, years |
|--------------------------|-------------------------|--|-------------------------------|
| SH 130 (Segments 1-4) | D-B Team | Rigid: AASHTO 1993 Guide & 1998 Supplement Flexible: AASHTO 1993 Guide | Mainline*: 30 Frontage: 20 |
| SH 45 SE | TxDOT | Prescribed by TxDOT as 10-13 inch CRCP | NA |
| US 183A | D-B Team | Rigid: AASHTO 1993 Guide & 1998 Supplement Flexible: AASHTO 1993 Guide | Mainline*: 40 Frontage: 20 |

*In the case of rigid pavement selection, only CRCP is acceptable for the mainline pavement.

Warranties & Maintenance Agreements

Warranties Vs. Maintenance Agreements

| Attribute | Warranty | Capital Maintenance Agreement |
|-----------|--|---|
| Bidding | Embedded in the bid price of the original construction (typically as a bid item) | Separate fixed-price contract |
| Execution | Obligatory | Usually optional for the SHA (e.g., Utah I-15 & Texas SH-130) |

Warranty & Maintenance Agreement Durations

| Project | Warranty | Maintenance Agreement |
|----------|----------|-----------------------|
| SH 130 | 1 year | 15-year (optional) |
| SH 45 SE | 1 year | None |
| US 183A | 5 years | None |

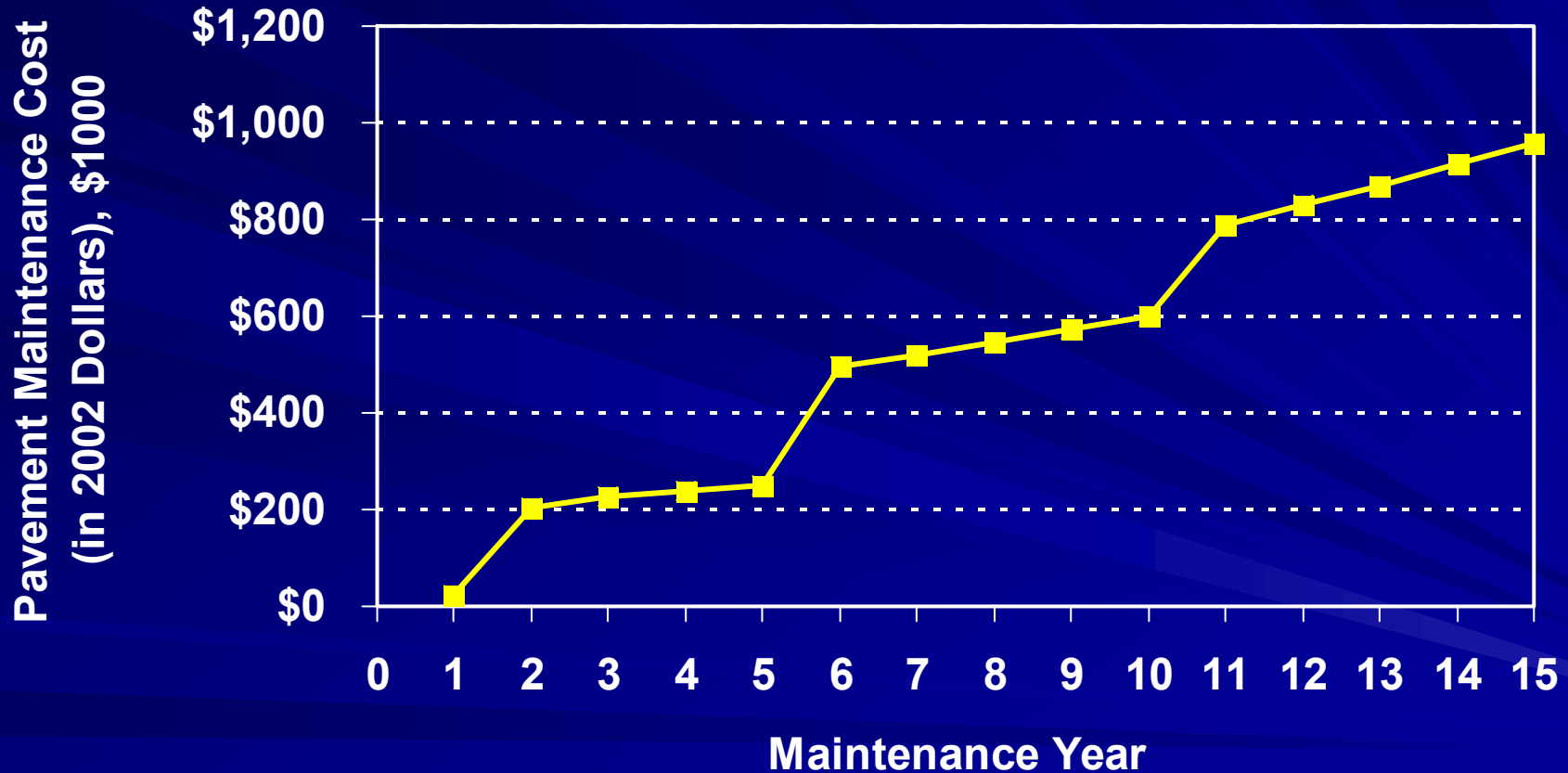
SH 130 Capital Maintenance Agreement (CMA) (Contractor's Pavement Maintenance Responsibilities)



- Pavement Maintenance Program: Collect, analyze, and report:
 - Pavement surface conditions: distress, IRI, & skid resistance
 - Traffic: ADT and truck counts
 - Falling Weight Deflectometer Testing (FWD) for evaluating the pavement structural capacity
- Pavement Repairs:
 - Prescribed maintenance activities (depending on performance data)
 - Rehabilitation (depending on IRI, distress score, and remaining structural life)



SH 130 CMA (Pavement Maintenance Cost)



Segments 1-4 only (49 Miles)



SH 130 CMA (Performance Monitoring Schedule)

| Year | FWD | IRI | Modulus | Layer Thickness | Distress | Skid Resistance |
|------|-----|-----|---------|-----------------|----------|--|
| 1 | Yes | Yes | Yes | Yes | Yes | if any 0.1-mile section has more than 5 wet weather accidents in one year. |
| 2 | | Yes | | | Yes | |
| 3 | | Yes | | | Yes | |
| 4 | Yes | Yes | | | Yes | |
| 5 | | Yes | | | Yes | |
| 6 | | Yes | | | Yes | |
| 7 | | Yes | | | Yes | |
| 8 | Yes | Yes | | | Yes | |
| 9 | | Yes | | | Yes | |
| 10 | | Yes | | | Yes | |
| 11 | | Yes | | | Yes | |
| 12 | Yes | Yes | | | Yes | |
| 13 | | Yes | | | Yes | |
| 14 | Yes | Yes | | | Yes | |
| 15 | | Yes | | | Yes | |



SH 130 CMA



(Concrete Pavement Maintenance-Mainline & Shoulders)

- Seal cracks wider than $\frac{1}{4}$ "
- Seal joints wider than $\frac{1}{4}$ "
- Repair spalls & potholes within 72 hours of discovery
- Clean and reseal joints where sealant has failed or is missing.
- Repair punch-outs of low severity or higher
- Repair faulting of $\frac{1}{8}$ " or more
- Eliminate edge drop-offs greater than 2" and less than 4" and more than 50 feet in length
- Eliminate all edge-drop offs greater than 4"



SH 130 CMA

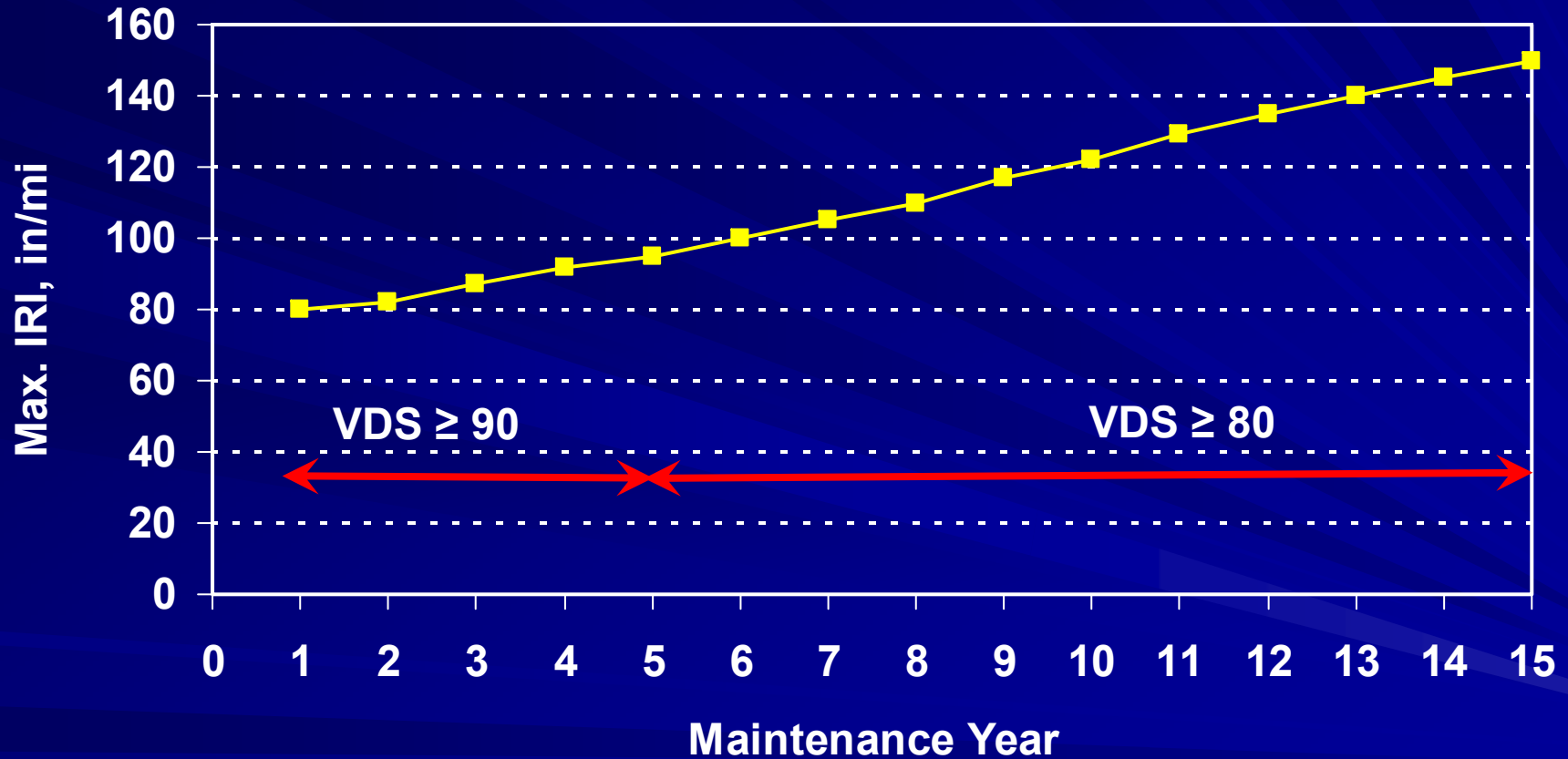


(Asphalt Pavement Maintenance-Mainline & Shoulders)

- Seal cracks wider than $\frac{1}{4}$ "
- Fill ruts deeper than $\frac{1}{2}$ "
- Patch elevation differences greater than $\frac{1}{4}$ "
- Immediately patch any potholes and base failures
- Eliminate all edge-drop offs greater than 4 inch



SH 130 CMA (Pavement Performance Requirements)



VDS : 0-100 Visual Distress Score



US 183A Warranty (Pavement Warranty Requirments)

- **Duration: 5 years**
- **Bond: \$10,000,000**
- **Pavement Surface Condition Monitoring:**
 - **Responsibility: CTRMA**
 - **Section: 0.1 lane-mile**
 - **Frequency: Yearly or as determined by the CTRMA**
 - **Method: CTRMA's pavement management system capabilities**



SH 183A Warranty

Concrete Pavement Performance Thresholds & Corrective Actions

| Perf. Indicator | Threshold Limit | Recommended Corrective Action |
|--------------------------|-----------------|--|
| Punchouts | None Allowed | Full Slab (100 ft) Replacement |
| Cracking (various types) | No M&H Severity | Full Slab Replacement |
| Shattered Slab | None Allowed | Full Slab Replacement |
| Spalling | No M&H Severity | M Severity: Partial Depth Repair H Severity: Replace Joint (3' either side) |
| Joint Sealant Damage | No M&H Severity | M Severity: Partial Depth Repair H Severity: Replace Joint (3' each side) |
| Popouts | 10 per slab | Full Slab Replacement |
| Scaling | 10 SF per slab | Full Slab Replacement |

For CRCP, Slab = a 100ft length of pavement one lane in width.



SH 183A Warranty Asphalt Pavement Performance Thresholds & Corrective Actions

| Perf. Indicator | Threshold Limit | Recommended Corrective Action |
|----------------------------|---|---|
| Long & Transverse Cracking | Long: 5% segment length Trans: 5% segment area | Rout and Seal |
| Block & Fatgue cracking | None Allowed | Mill and resurface or microsurface (block cracking only) |
| Debonding | None Allowed | Mill and resurface |
| Raveling | 1% of segment area | Mill and resurface or treat surface using chip seal or microsurfacing |
| Flushing | 1% of segment area | Mill and resurface |
| Popouts | 15 yd ² | Mill and resurface |
| Rutting | 0.5" | Microsurfacing or mill and resurface |

Construction Quality Management



SH 130



Construction Quality Programs

- **Developer is responsible for providing a Construction Quality Control/Quality Assurance Program (Construction QC/QAP):**
 - **Quality control: Developer**
 - **Quality assurance and acceptance: Independent Construction Quality Assurance Firm (CQAF).**
 - **Oversight: TxDOT**

Oversight: Owner Verification Tests (OVT), records auditing, dispute resolution tests, etc.



US 183A



Construction Quality Programs

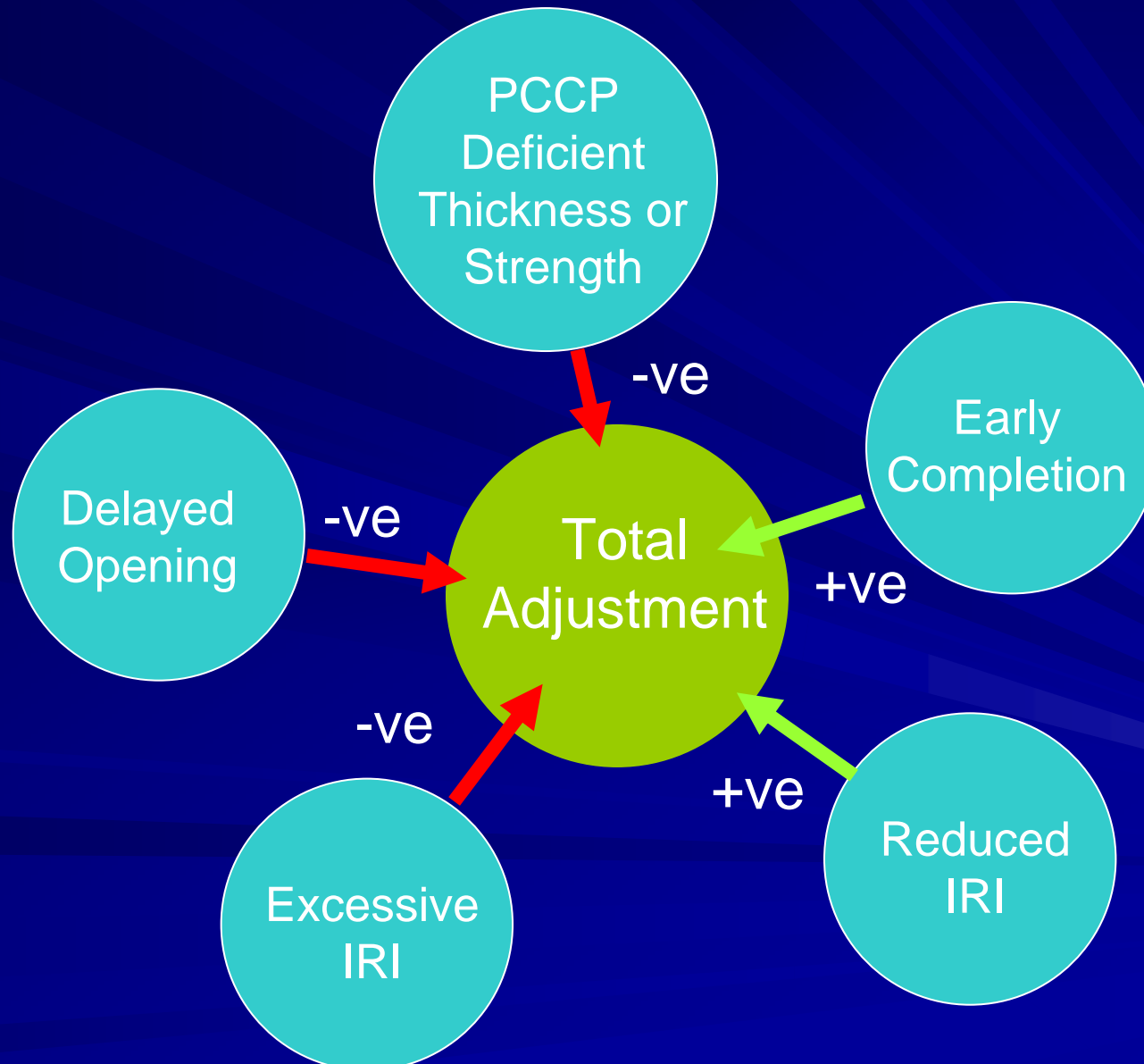
| Program | Responsible Party | Key Elements |
|-----------------------|---|--|
| Quality Control | Developer | <ol style="list-style-type: none">1. Preparation of mix designs2. Sampling and testing of all materials at the supply points3. Daily on-site inspections of materials and work4. Establishment of a systematic approach to the project documentation, processes, etc. |
| Quality Assurance | Developer's Independent CQA Organization* | <ol style="list-style-type: none">1. Audit of developer's records, and processes (including acceptance)2. Review and approval of mix designs3. Spot-check alignment and grades |
| Independent Assurance | CTRMA | Verification sampling and testing |

*CQA manager is hired by the Developer, but reports to both the Developer's and the CTRMA.

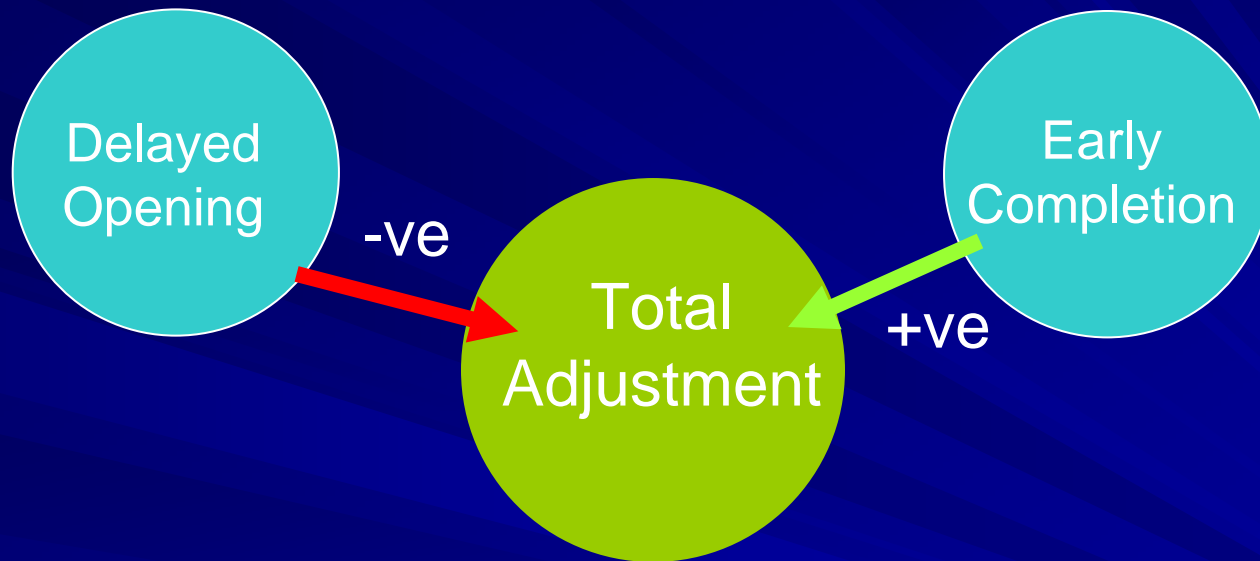
Pay Adjustment (Incentives & Disincentives)



SH 130 Pay Adjustments



US 183A Pay Adjustments



No pay adjustment for pavement quality.

Findings

- **Each D-B contract contains a combination of specification types:**
 - **SH130: QA, 1-year warranty, optional 15-year maintenance contract, and incentives/disincentives**
 - **US183A: QA and 5-year warranty**
- **D-B teams have greater leeway in roadway geometric design and construction management than in pavement design.**
 - **SH130 and US 183A: Owner specifies design method (i.e., AASHTO 1993/1998 Pavement Design Guide) and key inputs**
 - **SH 45 SE: Pavement design is prescribed by the owner (10-13 in CRCP) to ensure compatibility with the existing adjacent pavement**

Findings

- **Pavement performance monitoring during warranty or maintenance agreement:**
 - SH130 15-year maintenance agreement: D-B team
 - US183A 5-year warranty: owner
- **Pavement corrective actions during warranty or maintenance agreement are prescribed by the owner (perhaps to guard against quick fixes).**

Thank you for your attention!