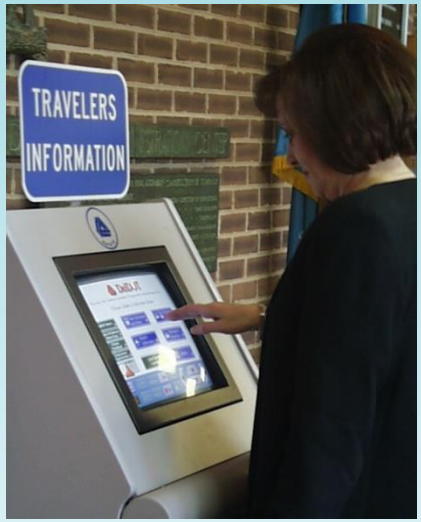
MODULE 2b

Operational Functionality

Developing Your Operational Functionality Program

1. Assemble collaborating agencies, stakeholders
2. Establish objectives
3. Develop corridor concept of operation
4. Agree on concept
5. Develop operating plan
6. Identify improvements, resources
7. Develop implementation strategy
   - Responsibilities
   - Priorities
   - Public information program



Sample Operations Concepts

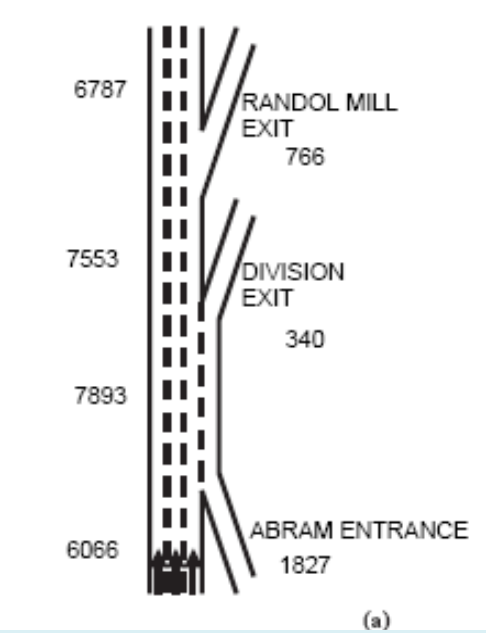
- Time managed operation
- Area or corridor signal coordination
- Through traffic priority
- Long distance travel priority
- Person movement priority
- Maintain travel times/speeds on selected facilities
- Evacuate high intensity trip generator

Examples

SH 360, Arlington

Examples

SH 360, Arlington

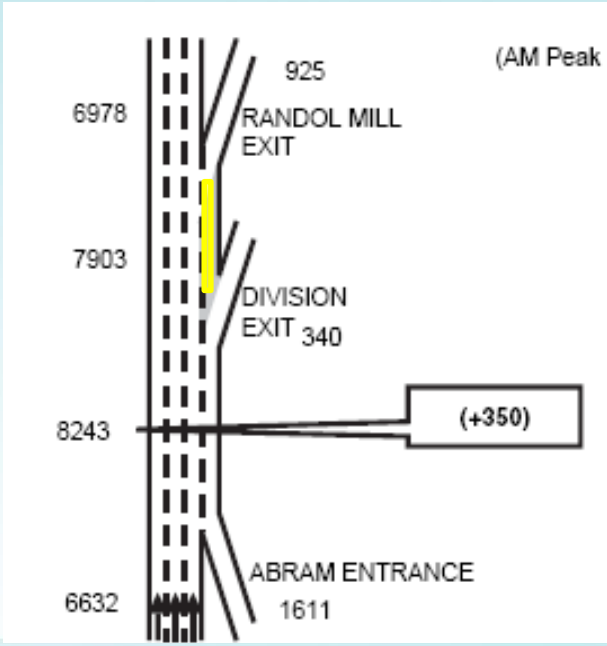


Deficiency

- **Congestion in short weave between Abrams on ramp and Division exit ramp**
- **Lane drop at Division exit**
- **Second exit ramp to Randol Mill**

Solution

- **Extend auxiliary lane to Randol Mill exit**



Examples

SH 360, Arlington (after)

Examples

SH 360, Arlington (after)

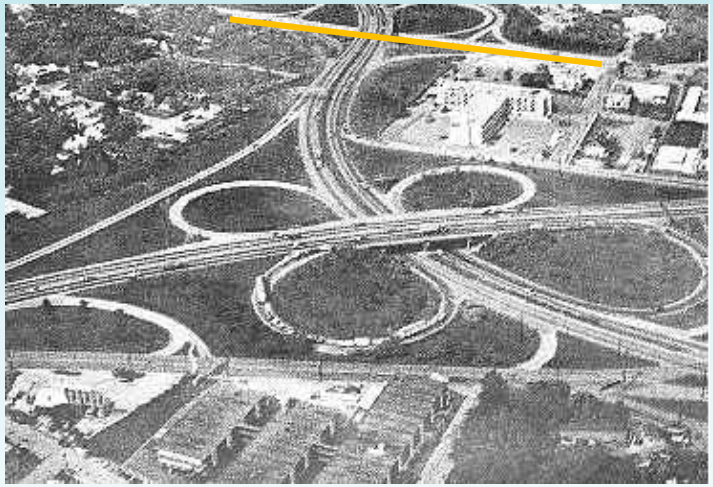
Examples

SH 360, Arlington

- Cost - $150,000 (contract change)
- Benefits
  - $200,000 annual delay reduction
  - 76% fewer injury crashes

Examples

I-40 – I-275 Interchange,
Knoxville, TN



Examples

- I-670 reconstruction, Columbus, OH

Traffic changes

Internet Sources

- FHWA freeway management website
  - http://ops.fhwa.dot.gov/freewaymgmt/index.htm
- FHWA arterial management website
  - http://ops.fhwa.dot.gov/arterial_mgmt/index.htm
- FHWA incident management website
  - http://www.ite.org/M&O/resources.asp
- ITE management and operations website
  - http://www.ite.org/M&O/resources.asp
- FHWA travel demand management website
  - http://ops.fhwa.dot.gov/tdm/
- FHWA real time traveler information website
  - http://ops.fhwa.dot.gov/travelinfo/index.htm
- FHWA work zone mobility and safety program website
  - http://ops.fhwa.dot.gov/travelinfo/index.htm
- FHWA emergency transportation operations website
  - http://ops.fhwa.dot.gov/eto_tim_pse/index.htm
- FHWA operations performance measurement website
  - http://ops.fhwa.dot.gov/perf_measurement/index.htm

Preserving and Recapturing Operational Functionality

Questions?

Exercise

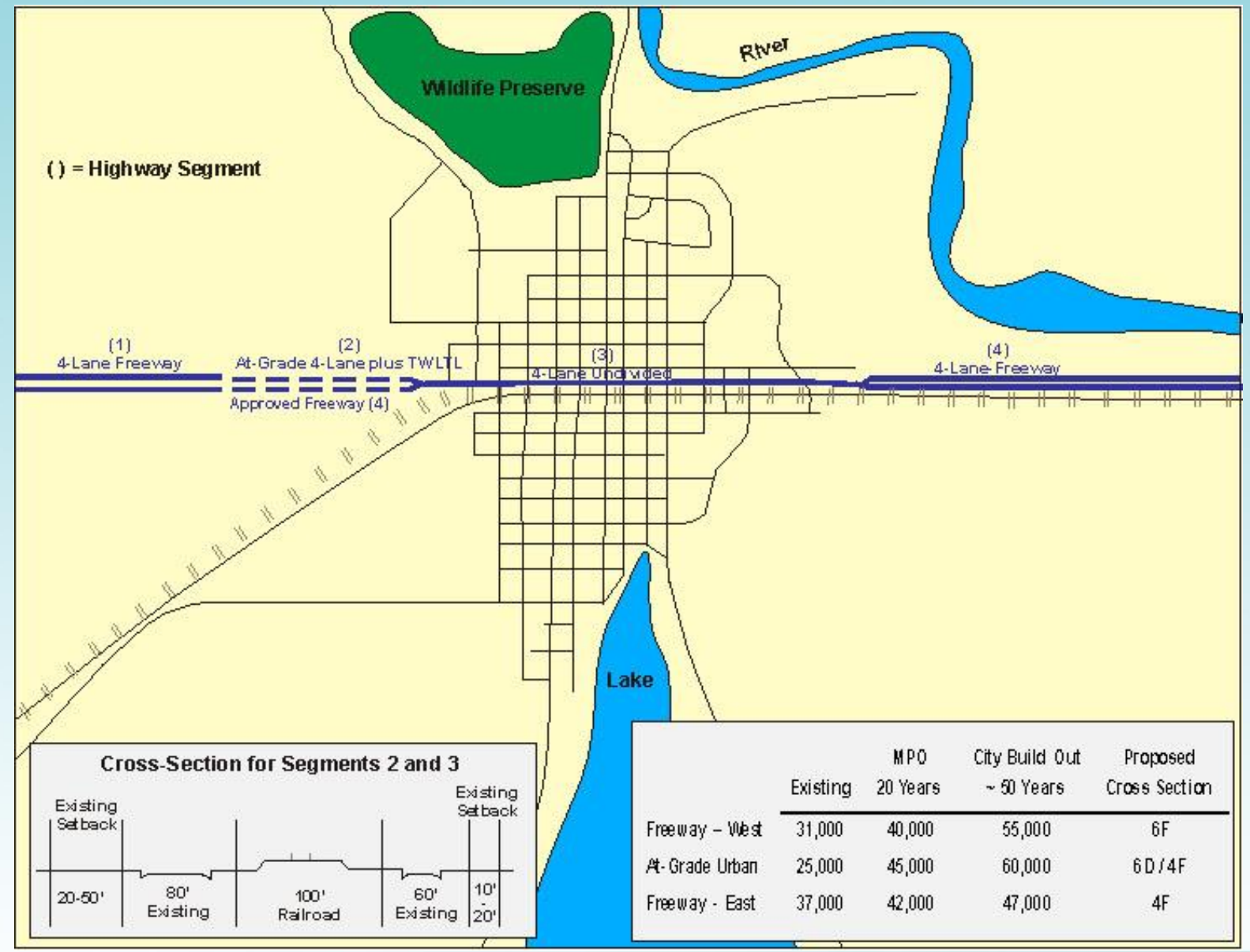

EXERCISE

Develop A Functionality Preservation Strategy

- Recommend strategy to preserve the functionality of this highway for at least the next 50 years.
  - Short term: 0-5 years
  - Medium term: 5-20 years
  - Long term: 20-50 years

- Details on handout

Develop A Functionality Preservation Strategy



	Existing	MPO 20 Years	City Build Out ~ 50 Years	Proposed Cross Section
Freeway – West	31,000	40,000	55,000	6F
At-Grade Urban	25,000	45,000	60,000	6D/4F
Freeway - East	37,000	42,000	47,000	4F

Develop A Functionality Preservation Strategy

Looking west with highway on right and local street on left of rail line

Existing state highway

Texas Transportation Institute

Develop A Functionality Preservation Strategy

- Example

Time Period			Strategy	Comment
Short	Medium	Long		
			Planning and development coordination	
✓	✓	✓	Development overlay district	Manage development and reserve ROW for long term configuration
			Access management	
✓	✓	✓	Increased intersection spacing	Consider future interchange locations
			Traffic operations	
			Minor roadway improvements	
			Major roadway improvements	
			Right of way actions	
			Other	

Develop A Functionality Preservation Strategy

Group reports and discussion

- 3 minutes: your team's recommendations
- Discussion after last report

Break

MODULE 3

Right of Way and Functionality

Factors Affecting ROW Functionality

- Acquisition
- Protection
- Utility Accommodation

Right-of-Way Acquisition

Right-of-Way Acquisition

- ROW planning and acquisition are critical to:
  - Functionality
  - Project development
- Planning affects function and acquisition
- Acquisition can be:
  - Time consuming
  - Socially sensitive

Potential Functionality Loss

- Right-of-way acquisition delays
  - Construction delays
  - Increased right-of-way cost
- Insufficient right of way
  - Insufficient for desired improvement
  - Cannot accommodate utilities or other features
- Resulting functionality shortfalls
  - Congestion
  - Safety
  - Other project objectives

ROW Best Practices or Countermeasures

- Right-of-way plan
  - Provide adequate ROW for ultimate needs
  - Consider alignment that shifts ROW to parcels with willing sellers
  - Avoid ROW alignments causing environmental impacts

ROW Best Practices or Countermeasures

- Improve acquisition methods
  - Obtain more ROW through local planning/platting process
  - Use land consolidation strategies to reduce number of parcels to be acquired
  - One-agent concept: use same agent in area to ensure consistency, efficiency, and accountability
  - Coordinate and communicate early and frequently
    - With property owners
    - Between ROW staff
    - With other agencies

Right-of-Way Protection

Right-of-Way Protection

- Important for future new and improved facilities
- General topics for ROW protection
  - Early or advance acquisition
  - Coordination in local planning and development
  - Roadside management

Interstate 4 at SR 408, Orlando, Florida

Early Acquisition and Protection

Method	TxDOT Authority	Local Authority	Purchase/ Possession	Obtain Rights
Acquisition				
Fee simple/negotiated purchase	●	●	●	
Condemnation	●	●	●	
Early acquisition – hardship purchase	●	●	●	
Early acquisition – protective purchase	○	●	●	
Early acquisition – donations	⊙	●	●	
Dedication through platting		●	●	
Preservation	●			
Option to purchase	⊙	●		●
Right of first refusal	●	●		●
Reservation through platting		●		●
Purchase development rights	●	●		●
Development agreement	●	●		●

○ - **More limited than local authority in some cases.** ⊙ - **More limited but also requires Commission approval.**

Protection via Coordination with Local Agencies

- TxDOT authority ends at the ROW line
- Activities most requiring coordination:
  - Subdivision
  - Zoning
  - Site plan review
  - Short /long-range planning
  - Roadway design plans and schematics (during project development)
  - Corridor/access management planning
  - Local major thoroughfare design standards and policies

Protection via Roadside Management

- ROW encroachment prevention
  - Encroachment identification
    - Development review, permits, monitoring, maintenance
  - Policies and regulations for roadside encroachment management
- Outdoor advertisement management
  - ROW Manual Vol.7 - Beautification
  - Local billboard ordinances

Potential ROW-Related Functionality Loss

- ROW factors causing functionality loss
  - Lack of coordination with local planning
  - Insufficient ROW requirements for major local thoroughfares
  - Lack of ROW reservation
  - Delay in ROW acquisition
  - Limitations on early acquisition
  - Failure to protect existing corridors
- Forms of functionality loss
  - Delayed construction/improvements
  - Inability to implement planned improvements
  - Deterioration in mobility and safety

Best Practices or Countermeasures

- Local agency coordination
  - Use multi-jurisdictional partnering to preserve, protect, or acquire ROW for long-term facility needs
- Early acquisition methods
  - Seek funds and authority for use in protective ROW purchases
  - Seek donations
- ROW protection via local thoroughfare plans and authority
  - Protect needed ROW via in local planning/platting process
  - Incorporate TxDOT (or other agreed) ROW and/or design requirements into local development regulations

Best Practices or Countermeasures

- ROW protection and roadside management
  - Utilize computer technology such as GIS, database, and Internet to facilitate outdoor advertising permitting and management
  - Pursue the use and enforcement of local building and parking setbacks and sign ordinances to prevent encroachment in TxDOT ROW

Utility Accommodation

Utility Accommodation and Relocation

- Utility accommodation and relocation are major concerns for highway engineers
  - Joint use of ROW is in public interest and can avoid additional cost for exclusive utility ROW
  - Utility facilities are not owned or controlled by highway agencies
  - Joint use requires extensive collaboration

Preparing For Utility Coordination

- Assess highway and utility needs early in project development
- Identify alignments that minimize conflict
  - Ultimate
  - Design life
- If adjustments needed, do it just once
- Critical steps in the utility adjustment process:
  - Identify utility facilities and their ownership
  - Determine utility conflicts
  - Develop utility plans
  - Obtain, review, and approve agreements
  - Relocate utilities

TxDOT-Utility Cooperative Management Process

- Major activities:
  - **Preliminary information**: annual meetings
  - **Project specific information**: initial project notification, preliminary design meetings, and field verification
  - **Design and utility construction phase**: design conference, intermediate design meetings, final design and initial construction coordination meeting, and pre-letting utility meeting
  - **Construction phase**: utility meeting after award and utility coordination meeting during project construction

Potential Functionality Loss

- Factors leading to utility-related project delays:
  - Failure of utility conflict identification
  - Late project notification to utility owners
  - Limited staffing and fiscal resources
  - Unresponsive or uncooperative utility owners
  - Lengthy process to obtain required agreements for reimbursable utility relocations
- Forms of functionality loss
  - Increased construction costs
  - Delayed construction/improvements
  - Deterioration in mobility and safety

Best Practices or Countermeasures

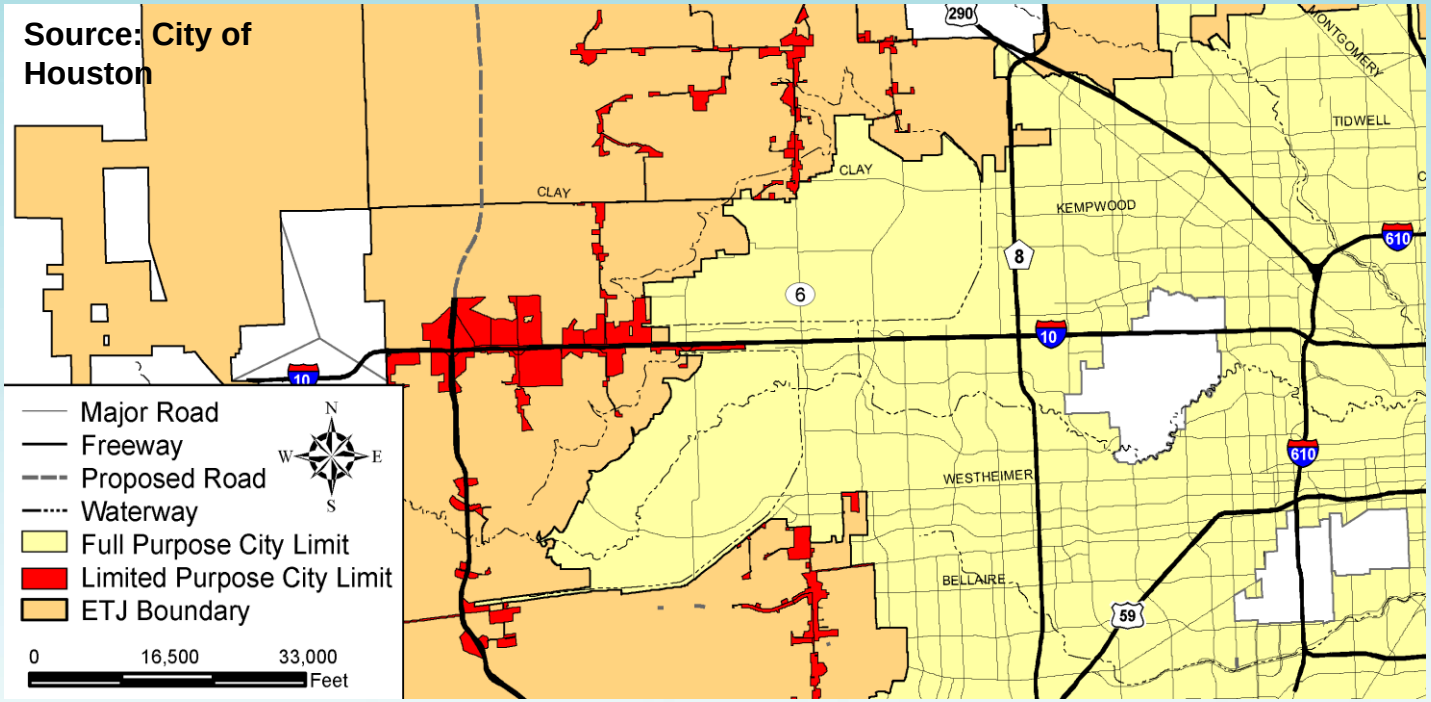
- Utility coordination
  - Involve utilities early and frequently
  - Maintain good working relationships with utilities
- Utility relocation
  - Avoid relocating utilities where possible

- Utility conflict detection and management
  - Detect utility conflicts early and accurately
  - Use advanced utility conflict management systems to effectively inventory and track utility conflicts

Best Practices or Countermeasures

- Utility Accommodation
  - Consider protecting certain urban arterial highways from new utility installations
  - Consider innovative utility accommodation practices such as utility corridors or joint
  - Acquire ROW for utility accommodation

Functionality Case Study:
IH-10 Katy Freeway, Houston TX



Limits: Between SH 6 and Loop 610

Length: 11.5 miles

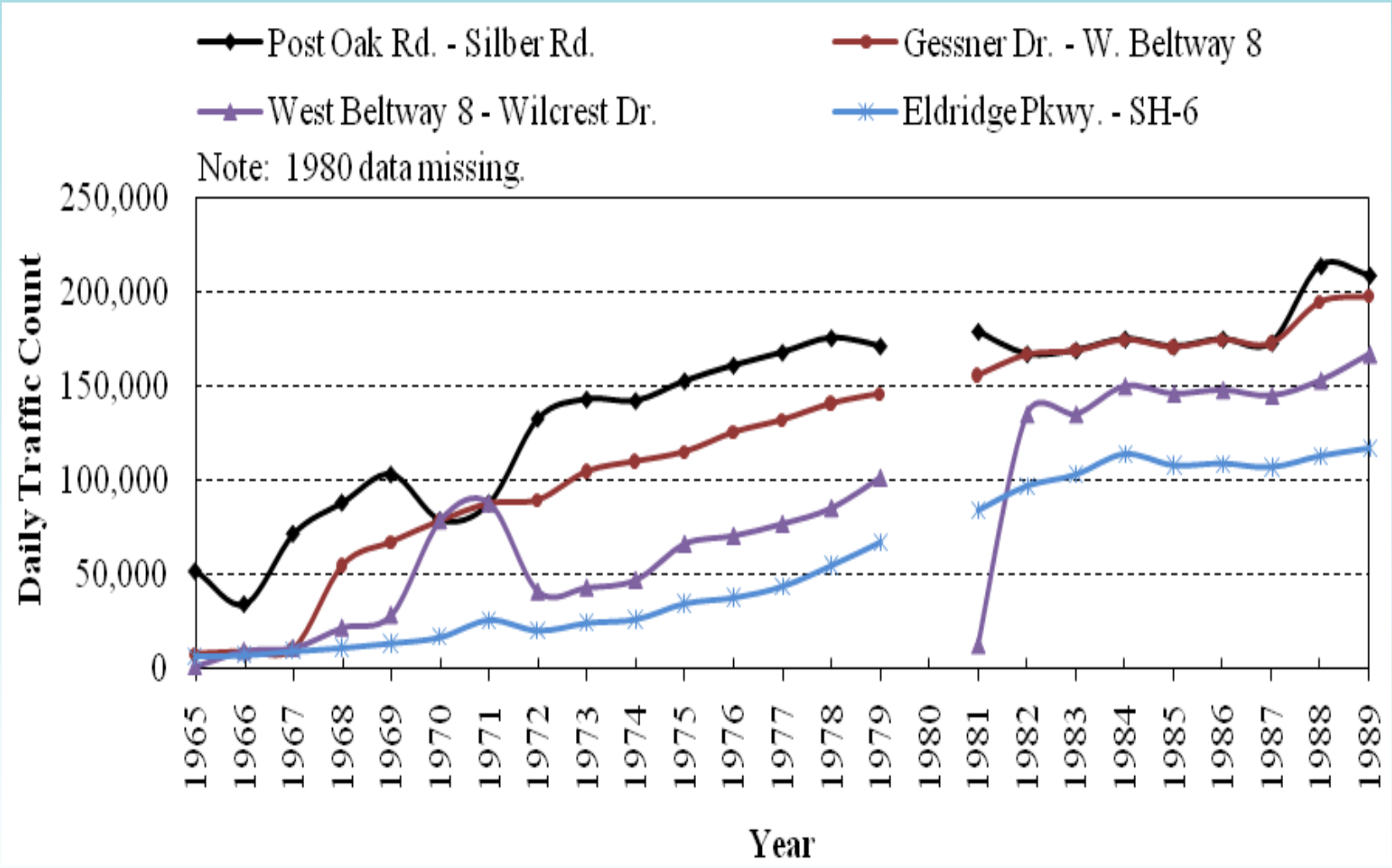
Historic Review

Year	Event
1930s	Originally SH 73 (generally located along the route of today's IH 10)
1941	West Houston portion of SH 73 designated as US 90
1953	US 90 between Katy and Loop 610 designated as full freeway
1954-1968	US 90 between Katy and Loop 610 upgraded to freeway
1980s	Katy Freeway Transitway between Loop 610 and SH 6
1992	100 ft. railroad right of way along Katy Freeway acquired from Union Pacific Railroad
2000s	Katy Freeway reconstruction

Key Areas Affecting Functionality

- Right of way and ROW constraints
- Mainlane, frontage, and interchange design
- Travel demand/systems management
- Planning and development
- Coordination and partnerships

Early Development in West Houston



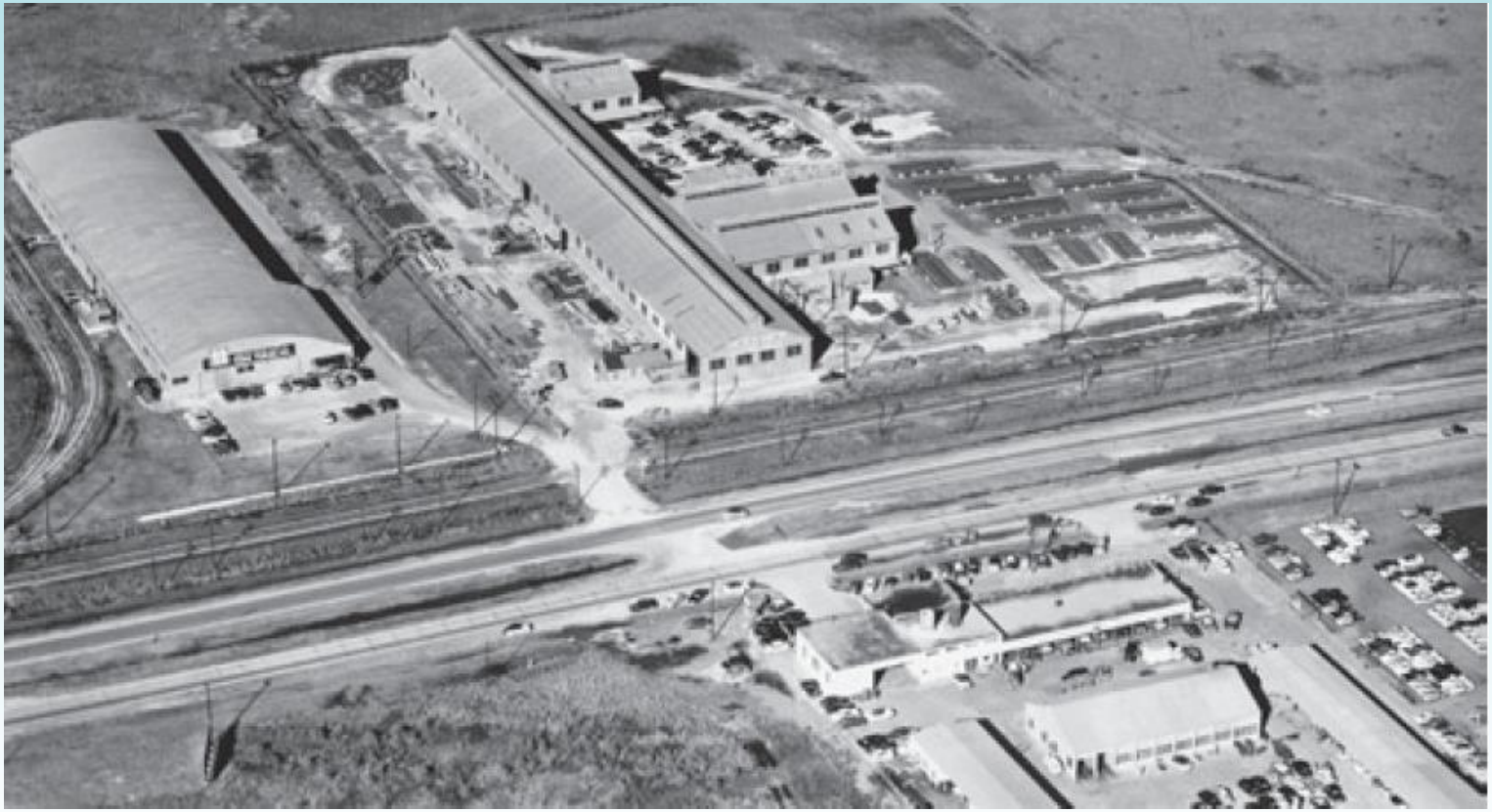
IH-10: Early Planning

Inside vs. Outside Loop 610

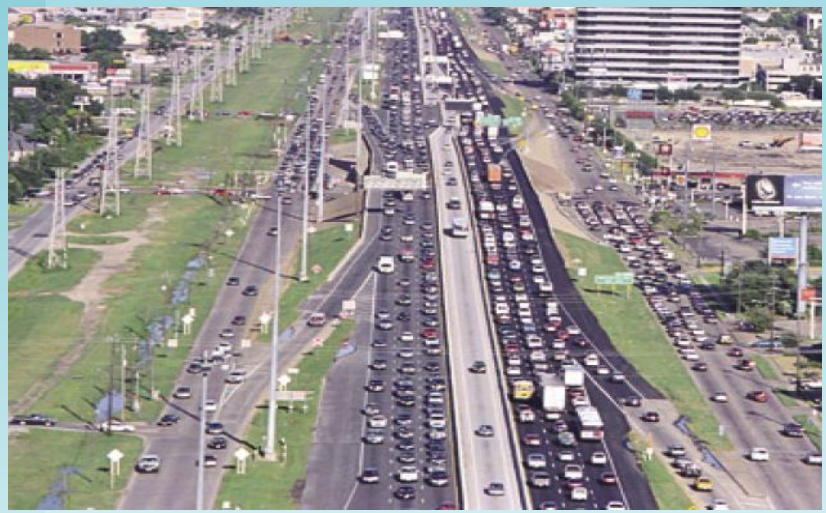
- Different engineers in charge of planning/design
- Disagreed on ultimate ROW needs
- Inside – ample ROW acquired, designed for future
- Outside – under-designed in existing ROW
  - Major constraint, source of delay for future expansion

IH-10 West: Early Planning

- 1954 view of US 90 as a 4-lane divided highway just west of today's Loop 610



Katy Freeway Upgrade in 1960s



IH-10 outside of Loop 610:

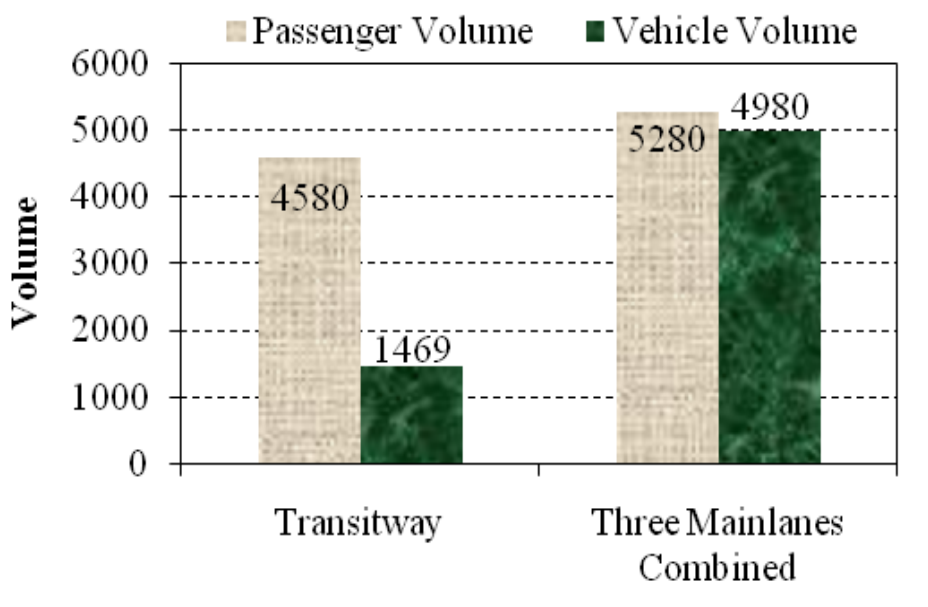
- Built on existing ROW
- 3 main + 2 frontage lanes
- ROW limit prevented further improvement

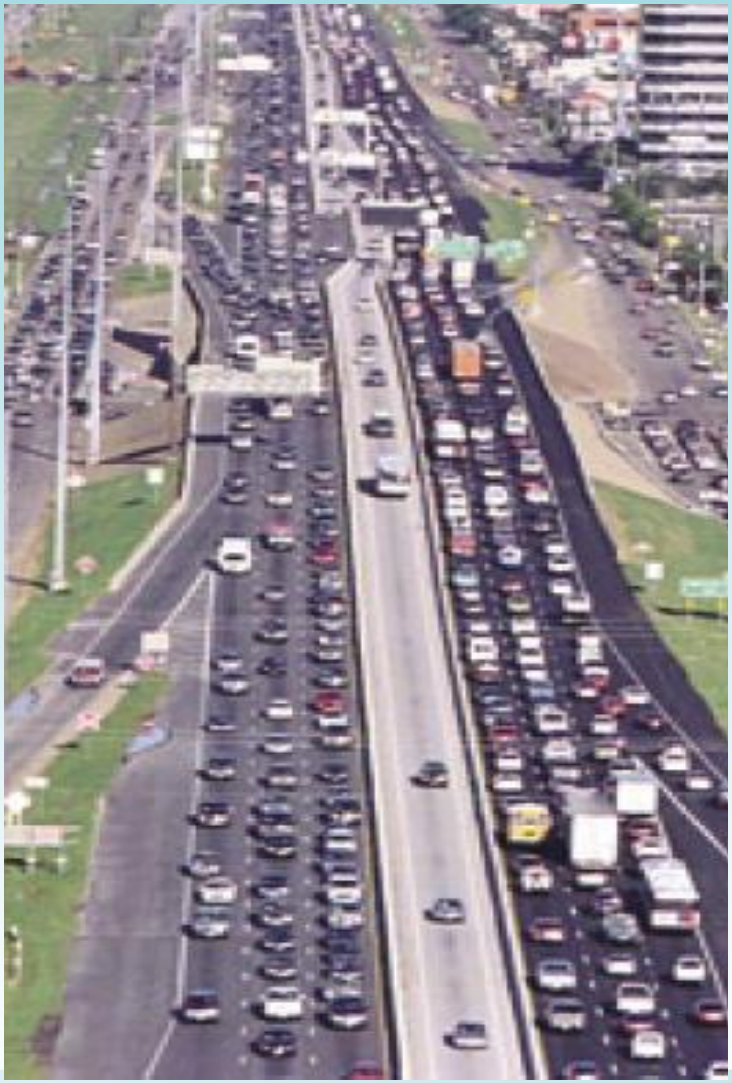
IH-10 inside of Loop 610:

- 10 main lanes minimum
- Currently still in service

Katy Freeway Transitway (1980s)

- SH 6 to IH 610: 15 min. on transitway vs. 45 min. on general lanes
- Served 23% of vehicle volume but 46% of passenger volume during morning peak hour

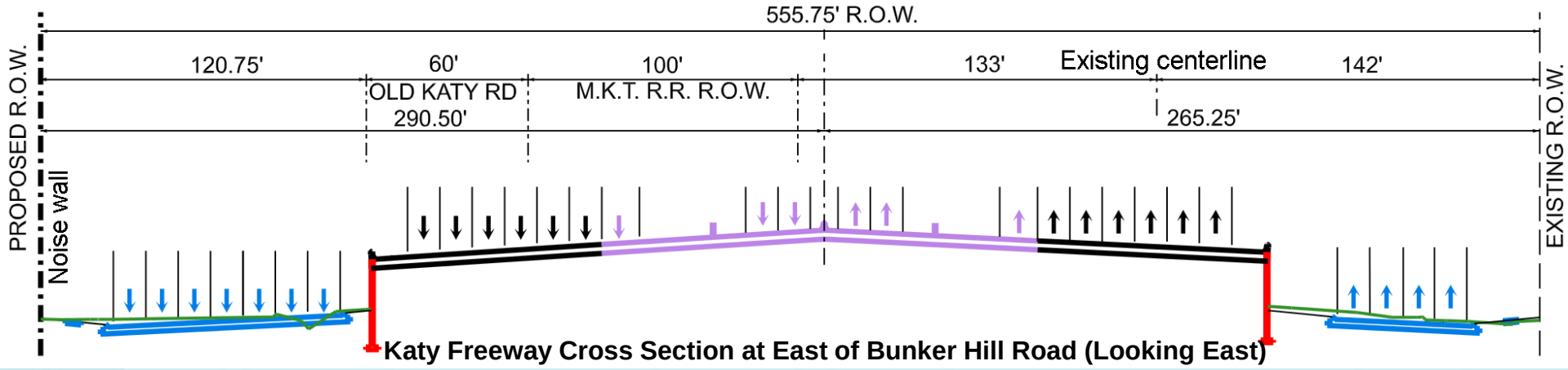




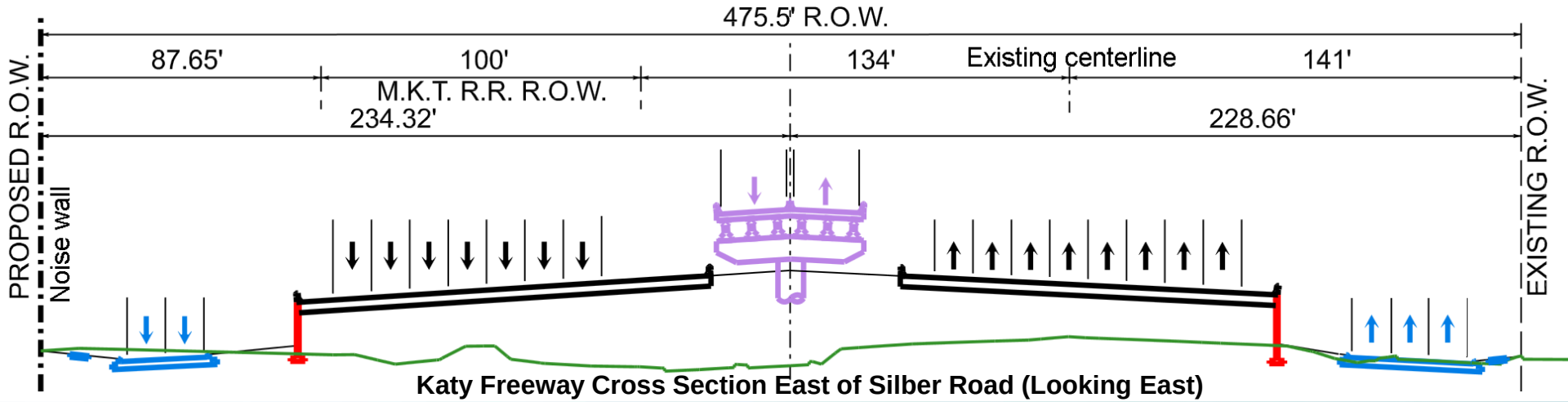
Katy Freeway Reconstruction (2000s)

- Study for expansion started in mid-1980s
- 1992: 100 ft. railroad ROW along Katy Freeway acquired from UP Railroad
- 1995: Katy Freeway MIS - preferred alternative selected
- Later involvement of HCTRA - HOV lanes converted to HOT lanes
- August 2002: FHWA issued Record of Decision
- March 2003: FHWA, TxDOT, and HCTRA signed agreement finalizing operational/financial arrangements
- October 2008: grand opening of the new freeway

Katy Freeway Reconstruction – Final Design



Katy Freeway Cross Section at East of Bunker Hill Road (Looking East)



Katy Freeway Cross Section East of Silber Road (Looking East)

The New Katy Freeway

IH10 at SH 6, Before Construction

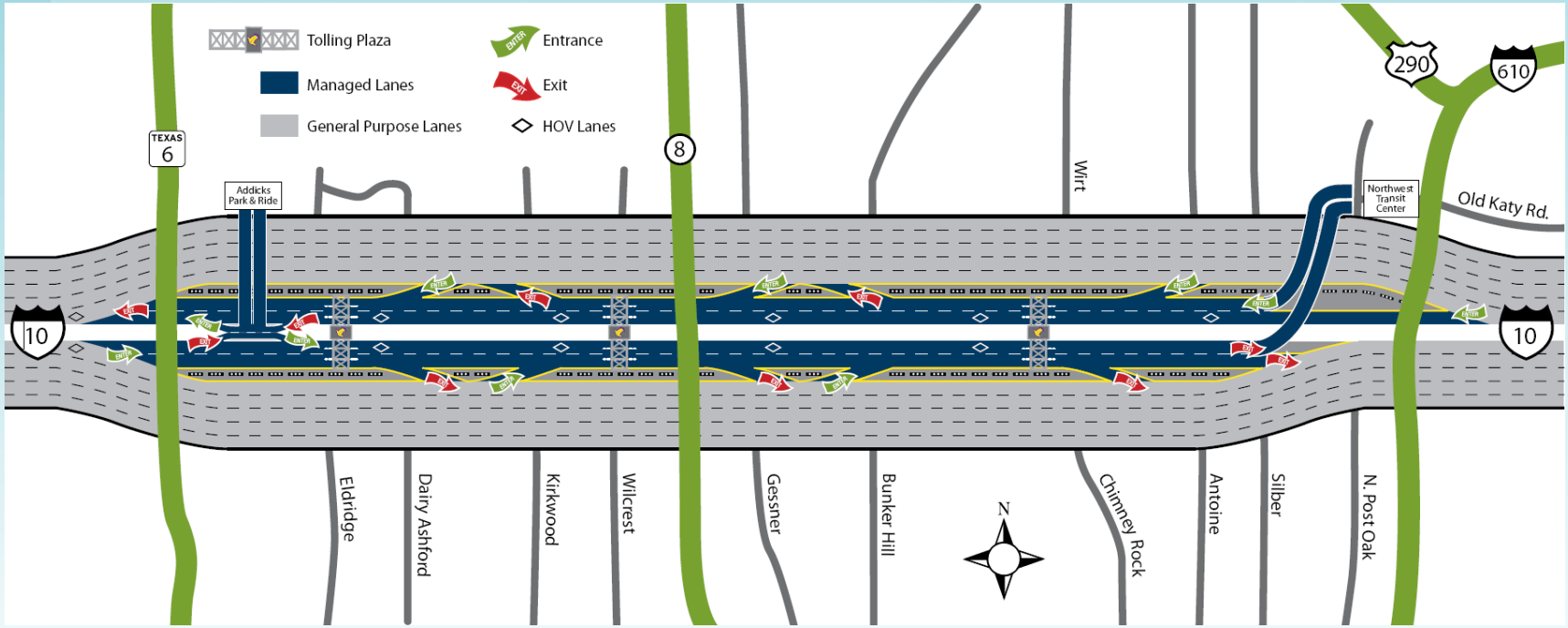
IH10 at SH 6, After Construction

I-10 at Beltway 8

Before Construction

After Construction

Katy Freeway Managed Lanes



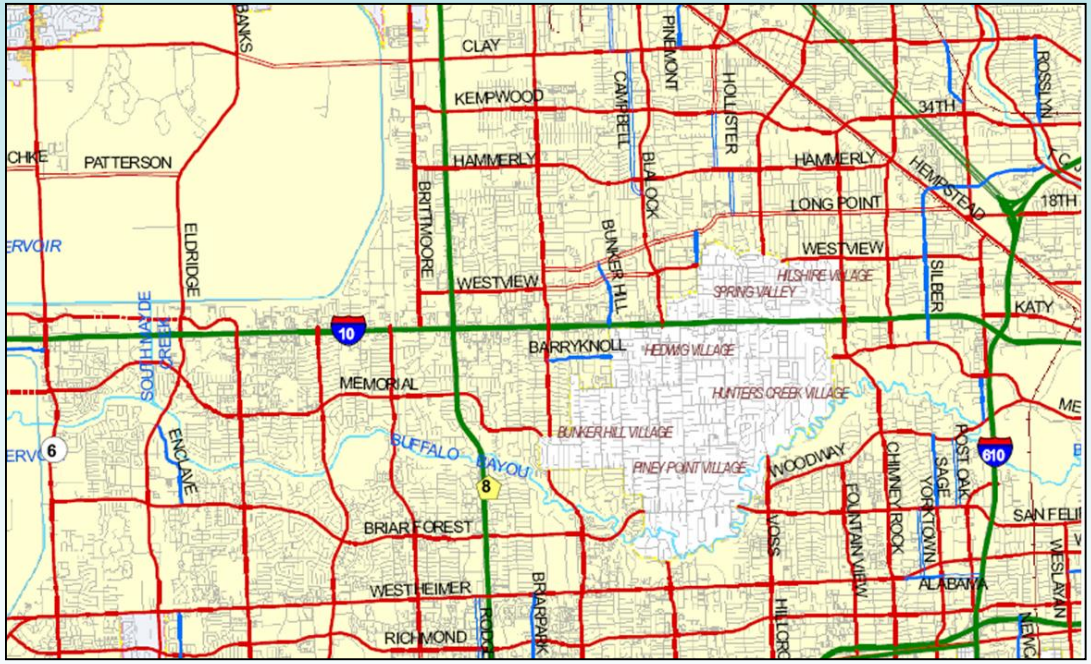
Katy Freeway Managed Lanes

- Opened April 2009
- 4 managed lanes between SH 6 and Loop 610, separated by barrier
- Combine HOV lanes, transit, and toll roads; first in Texas
- METRO and school buses use for free
- Dynamic tolling method used
- Provides faster option and funding source for maintenance

Katy Freeway Managed Lanes Video

Local Thoroughfare Planning

- Houston's adopted in MTFP 1942
- General 1 mile thoroughfare grid system
- Houston's adopted in MTFP 1942
- Plan amendments considered once per year via public hearing
- I-10 functionality supported through local street connectivity



City of Houston 2008 Major Thoroughfare and Freeway Plan

Katy Freeway Case Study Discussions

- Importance of ROW preservation
- Use of minor improvements
- Use of managed lanes
- Interagency collaboration (FHWA, TxDOT, HCTRA, and METRO)
- Local thoroughfare planning support

MODULE 4

Safety and Functionality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Keeping Up with Safety Changes

- Complaints
- Requests
- Performance measures

Clearing undergrowth on the right side would significantly improve sight distance through the curve and allow motorists to judge more accurately the length and sharpness of the curve—and more importantly see oncoming traffic.

Safety Performance Measures

- Crash rates
  - Segments
    - Crashes/100 MVM
    - Serious injuries + fatalities/100 MVM
    - Fatalities/100 MVM
  - Intersections
    - Crashes/million entering vehicles
    - Fatalities/million entering vehicles (rarely used)
- Crash severity (segments and intersections)
  - Percent fatal or serious injury crashes
  - Severity index (weighted severity)

Before: Outdated guardrail at the SR 7/SR 705 interchange with I-5 in Tacoma.

After: The replacement guardrail meets current safety standards, and creates a continuous transition to the bridge rail, removing the blunt end that had existed previously.

Data Sources for Performance Measures

- Crash report information (TxDOT)
  - Crash record information system (CRIS)
  - Accident history database
- Safety performance analysis
  - Highway Safety Information System (HSIS)

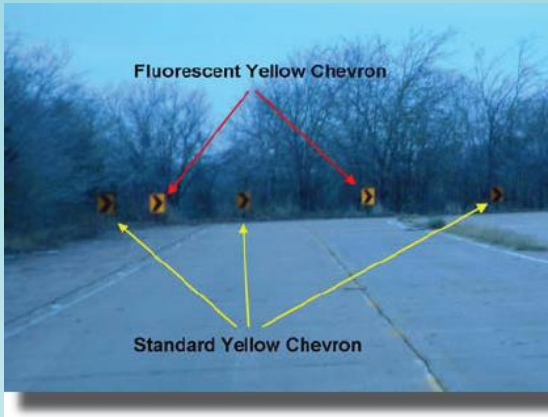
Causes of Safety Deterioration

- Design deficiencies
- Changed conditions, such as:
  - Pavement
  - Roadside objects
  - Sight obstructions
    - Development
    - Plants
    - Signs
  - Development access
  - Traffic volume or composition
    - Vehicle types
    - Modes
  - Sign, marking deterioration or loss
  - Shoulder, roadside erosion

Example of blue bike lane between right turn lane and shared right-through lane (Portland, OR)

Causes of Safety Deterioration

- Changed conditions (cont.)
  - Increased volumes
    - Total
    - Merge
    - Weave
    - Turns
  - Warrants for improvement are exceeded
    - Access management/medians
    - Lanes, ramps
    - Lighting
    - Signals



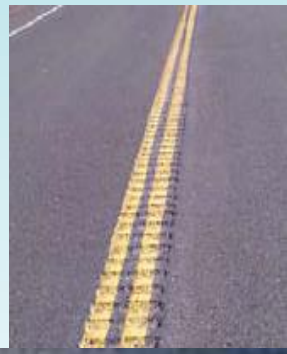
Source: Texas Transportation Institute

Stimulus photo illustrating enhanced chevron visibility.

Doubling-up of the sign proved effective at this site because tree limbs partially blocked the right side sign.

Causes of Safety Deterioration

- Changed conditions (cont.)
  - Signals not retimed periodically
  - Increased pedestrian, bicycle activity
  - Speed limit not commensurate with conditions
  - Hazards installed over time
    - Poles and boxes
      - Utility
      - Signals
      - Lighting
    - Signs
    - Drainage structures



Factors Related to Safety Deterioration

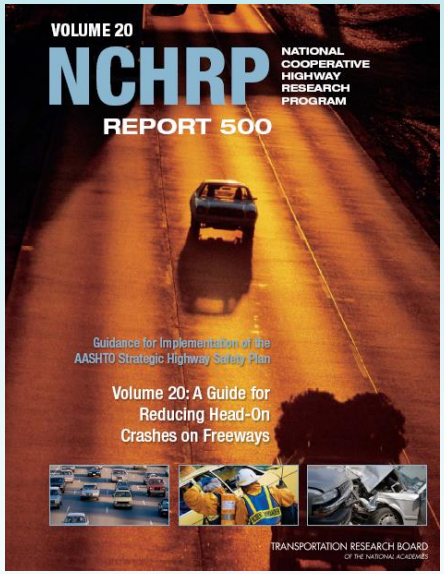
- Access management
- Horizontal, vertical curves
- Cross-sections
- Clear zone
  - Width
  - Obstructions
- Sight distances
- Interchange spacing, merge, weave sections
- Drainage
- Pedestrian, bicycle facilities
- Drainage
- Grades
- Intersection design
- Lighting
- Roadway delineation
- Traffic control
- Design consistency
- Maintenance conditions
- Pavement friction

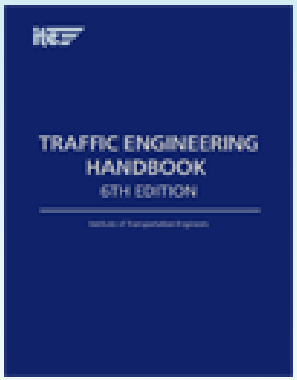
Deterioration of pavement edge and shoulder due to poor drainage.

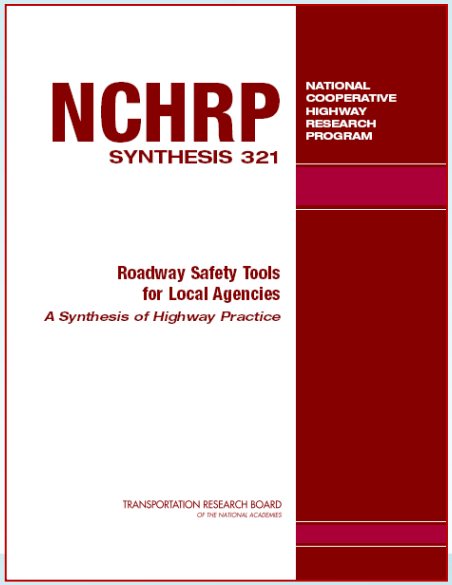
Application of skid-resistive pavement surface in curve.

Countermeasures

- Multiple sources
  - ITE Traffic Engineering Handbook, chapter 5
  - NCHRP Report 500 (several volumes)
  - NCHRP Synthesis 321







Countermeasures
Example – Rural Run-Off-Road

Potential Causal Factor	Some Possible Countermeasures
Excessive speed	Reduce speed limit; enforce
Slippery pavement	Reduce speed limit; enforce Overlay pavement Provide adequate drainage Groove pavement Provide SLIPPERY WHEN WET signs
Inadequate roadway lighting	Improve lighting
Poor visibility of curve warning sign	Increase sign size
Inadequate roadway design	Widen lanes Re-align curve Install guardrail
Inadequate delineation	Install/improve warning signs Install/improve Pavement markings Install/improve delineation
Inadequate shoulder	Upgrade shoulder
Inadequate pavement maintenance	Repair road surface

Source: *Traffic Engineering Handbook*, 6th edition, Institute of Transportation Engineers

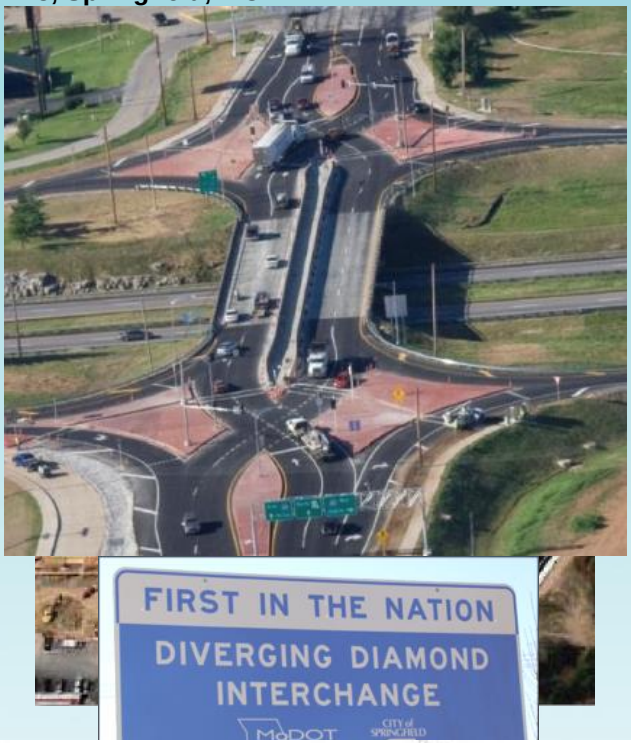
Countermeasures
Example – Rural Roadside Safety

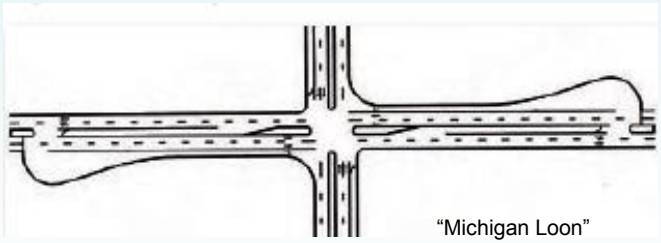
- ~50% of all crashes run-off-road
- Fatalities usually involve fixed objects
  - Trees, shrubs
  - Culverts, ditches, curbs
  - Utility poles
- Improvement options
  - Remove obstacle
  - Relocate or redesign obstacle to be less likely struck
  - Use breakaway base
  - Shield obstacle with barrier or other device
  - Delineate obstacle (only if other methods not viable)

Countermeasures – Geometrics Examples

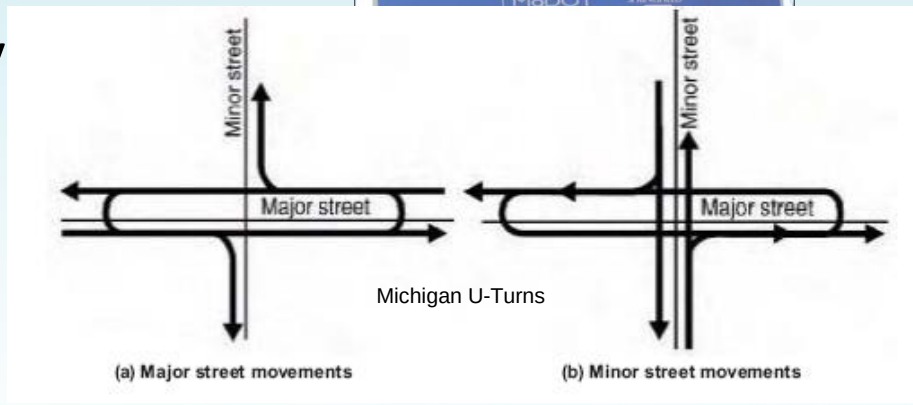
- Geometric design
  - Improve access control
    - Close/consolidate access points
    - Relocate access to side road
    - Add turn/speed change lanes
    - Increase distance to ramps
    - Redesign access for higher speed
  - Improve curve features
    - Widen lanes or shoulders through curve
    - Realign to increase radius
    - Increase sight distance
  - Increase roadside recovery distance

Diverging Diamond Interchange, I-40 at Hwy 13, Springfield, MO





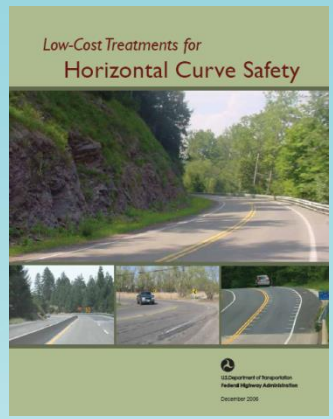
"Michigan Loon"

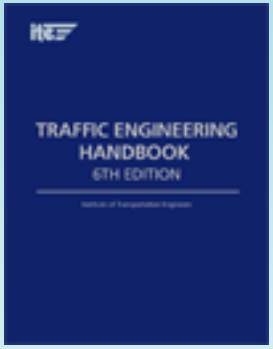


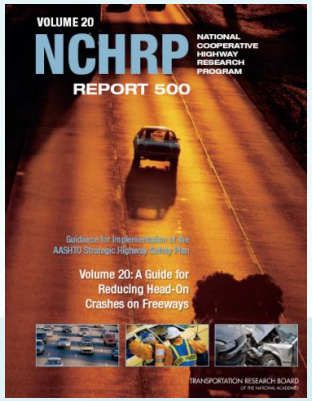
Michigan U-Turns

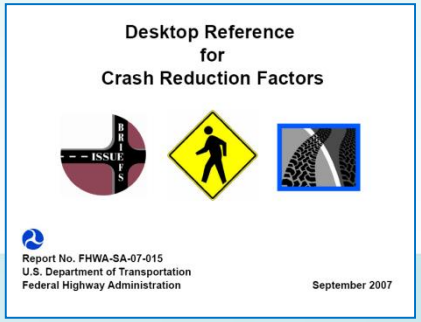
Tools, Sources

- Low Cost Treatments for Horizontal Curve Safety (FHWA)
- Interactive Highway Safety Design Model (IHSDM) (FHWA)
- Highway Safety Manual (FHWA)
- NCHRP Report 500 – several volumes (TRB)
- Traffic Engineering Handbook (ITE)
- Desktop Reference For Crash Reduction Factors (FHWA) and Highway Safety Improvement Program Manual (TxDOT)
- SafetyAnalyst software (FHWA)
- Highway/Utility Guide (FHWA)







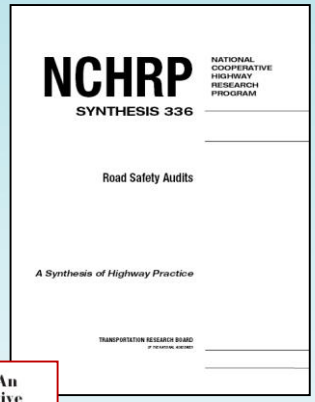


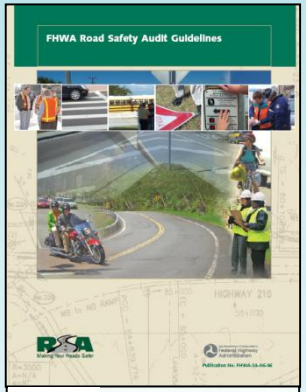
Assessing Safety in Design

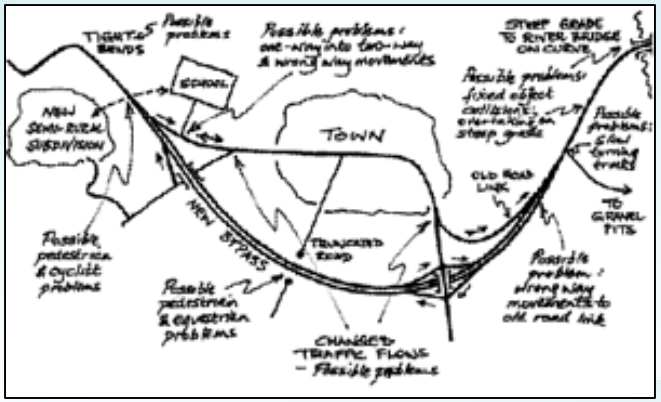
Starting Point		Work Stage
Existing		1. Use performance measures to identify problems
		2. Analyze crash records and existing conditions
		3. Identify effective countermeasures
		4. Select best countermeasure
New design	Road Safety Audit Review Each stage	1. Project feasibility/initial schematic design
		2. Preliminary design
		3. Final design
		4. Pre-opening

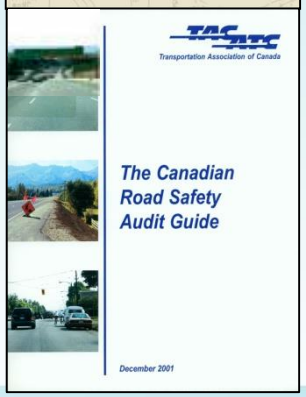
Road Safety Audit (RSA)

- Proactive low cost effort to prevent crashes before they happen
- Performed by specially trained personnel
  - RSAs and crash prevention
  - Independent of design team
  - Not unlike value engineering









RSA Benefits

1. Can
   - Help produce designs that result in fewer and less severe crashes
   - Reduce costs by identifying safety issues and correcting them before projects are built
2. Considers human factors in all facets of design
3. Raises profile of safety
4. Promotes awareness of safe design practices
5. Integrates multimodal safety concerns

RSA Finding Examples

- Sight line obstructions resulting from proposed improvements
- Insufficient merge or weave section length
- Transition problems
- Temporary pavement marking still clearly visible
- Improper sign sizes used
- Missing traffic control devices
- Proposed pole unconstructable; utility beneath
- Potential for wrong way turns
- Drainage headwall creates clear zone obstruction
- Water ponds in curb lanes

- Combination horizontal and vertical curves create condition well below design speed
- View of signal heads will be obstructed from one approach when trucks present
- Guardrail lacks end treatments
- Traffic signal timing insufficient for pedestrians
- Insufficient night visibility
- CCTV camera view blocked by overhead sign
- Near right traffic signal has insufficient target value
- Sidewalks to or at bus stops badly cracked/broken

TxDOT Programs

- Highway Safety Improvement Program
  - 90% federal, 10% state/local
  - Hazard elimination (non-Interstate)
- High Risk Rural Roads
  - Major and minor collectors
  - Fatal/incapacitating injury rate above statewide average
  - Excludes Interstates, bridges, general maintenance
- Administered by TxDOT Traffic Operations Division

Internet Sources

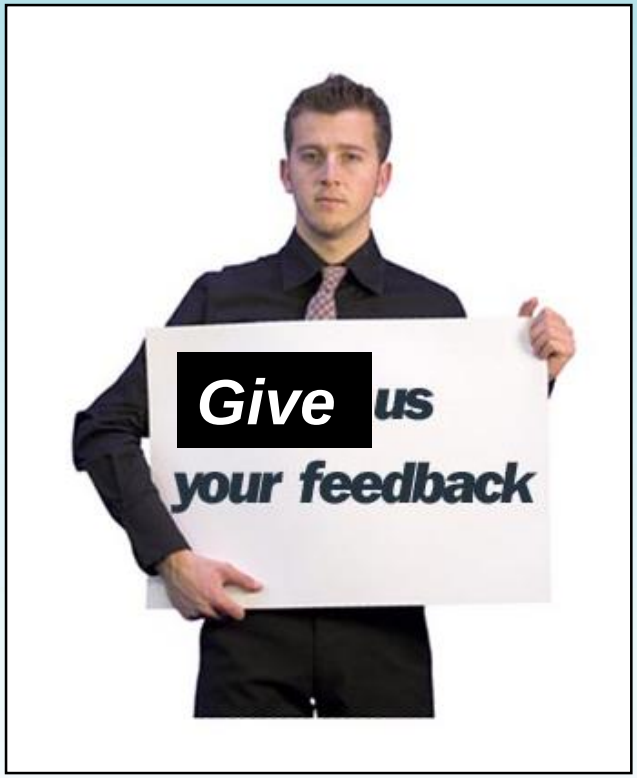
1. http://www.safety.fhwa.dot.gov
2. http://www.ite.org/safety/default.asp
3. http://www.nhtsa.dot.gov
4. http://www.fars.nhtsa.dot.gov
5. http://www.transportation.org
6. http://www.atssa.com
7. http://www.ihsdm.org
8. http://safety.fhwa.dot.gov/rsa/guidelines/
9. http://www.safetyanalyst.org
10. http://www.highwaysafetymanual.org

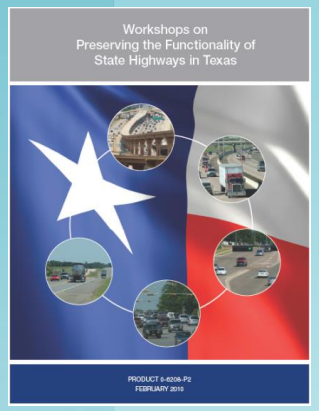
Preserving and Recapturing Safety Functionality

Questions?

Participant Feedback on Workshop

- How can we improve this workshop?
  - Content?
  - Organization?
  - Time on each topic?
  - Instructor delivery?
  - Other?
- Please complete evaluation form





Preserving and Enhancing the Functionality of Highways in Texas

….for attending!

Questions Later?

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