

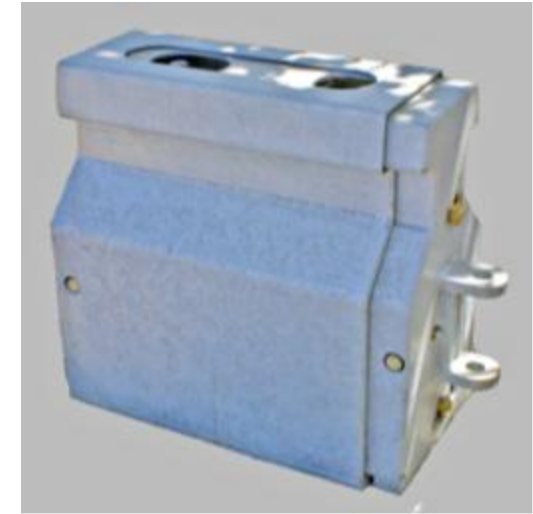
Strategic Use of Highway Capacity



Boston, MA SE Expressway



Moveable Barrier System Components:



Variable Length Barrier

- 18" Reactive Tension System (RTS) Barriers
- Barrier Transfer Machine (BTM) lifts barriers by the "T-Top"
- Lateral transfers of 8 - 24 ft. in one pass, up to 10 mph
- VLBs allow for radius curves, tapers, & expansion joints
- NCHRP-350 TL3 & TL4, MASH TL3

Moveable Barrier Managed Lane Benefits

- Increase Capacity with existing roadway or with less construction
 - Quicker Deployment of managed lane
 - Less Expensive than adding lanes
- Flexibility to Reconfigure Lanes
 - Special events
 - Construction/Maintenance Operations
 - Emergency/Incident Management
- Add Capacity where adding lanes is difficult
 - ROW acquisition, Bridge issues, Roadside Geometry
- Interim or Permanent Solution

Case Study: I-30 in Dallas, Texas

- Texas Department of Transportation (TxDOT) and the Dallas Area Rapid Transit (DART) sought a short-term strategy to increase capacity on the I-30 corridor
- Led to the implementation of the first contraflow High-Occupancy Vehicle (HOV) lane to use a movable barrier in Texas

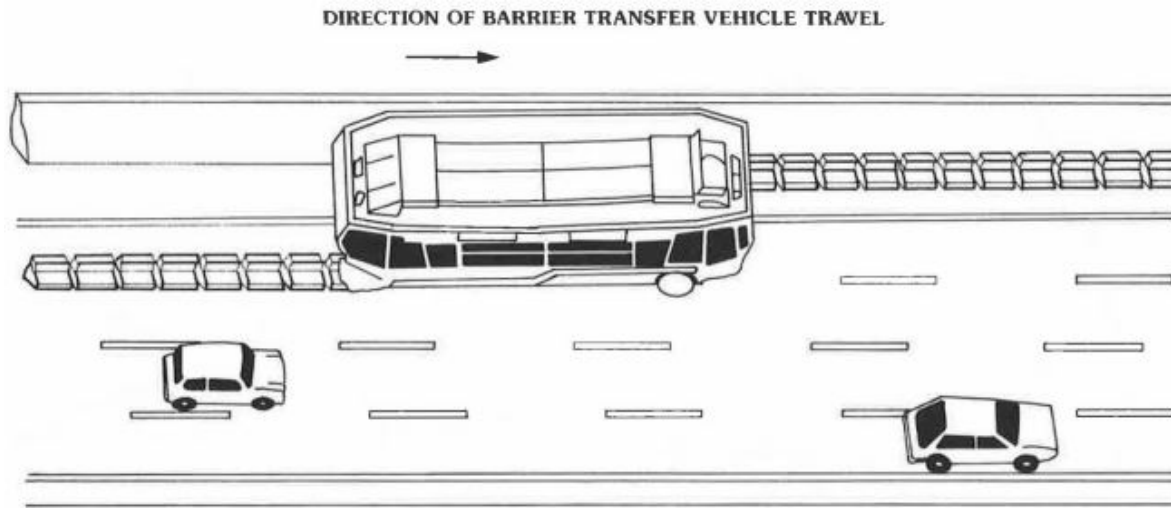
Project Intent and purpose

- In 1989, DART considered options after voters rejected a bond initiative to expand rail
- DART wanted to build transit-supportive infrastructure that could begin operating in 18-24 months
- Corridor identified because of significant congestion, 65-70% of peak period travel in the peak direction

Feasibility Assessment

- Reviewed design alternatives and operational issues
- Three options:
 1. An **exclusive HOV** facility in the median
 2. A **concurrent flow HOV** facility on the inside shoulder
 3. A **contraflow HOV** facility using a lane in the off-peak direction
- Chose **contraflow HOV** because of time limitations, and constraints from existing bridges

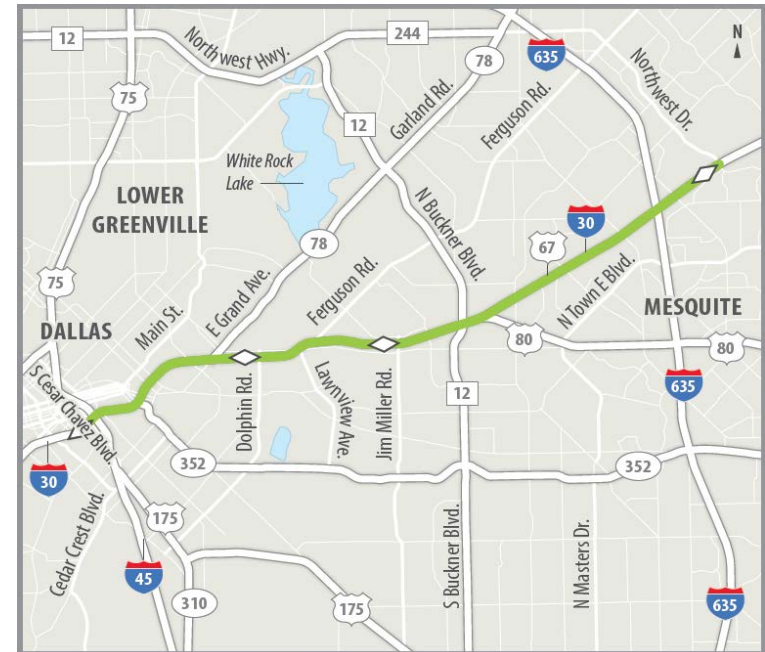
Concept of contraflow and Movable Barrier



Concept of “borrowing a lane” in the opposite direction for use as an HOV lane

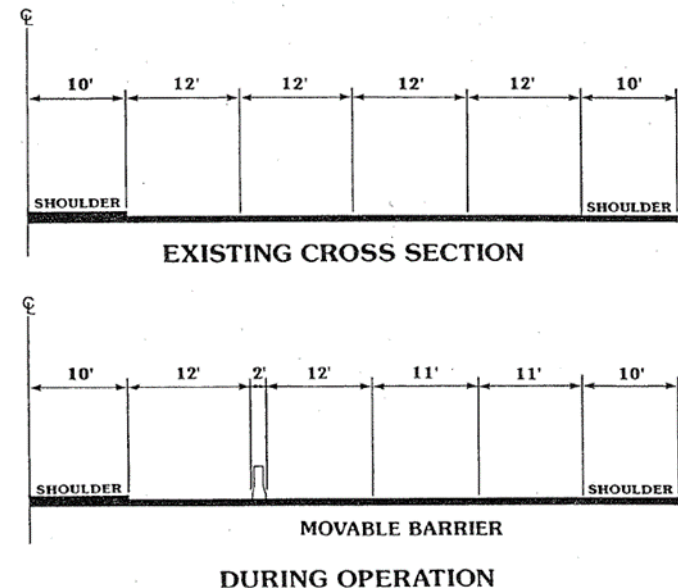
Implementation and Deployment

- Construction started in **December 1990**
- First 5.2-mile segment opened in **September 1991**
- Expanded in **1994**, and again in **2003**
- Currently **11-mile facility** with **22 miles** of movable barrier and 4 barrier transfer machines



Design Considerations

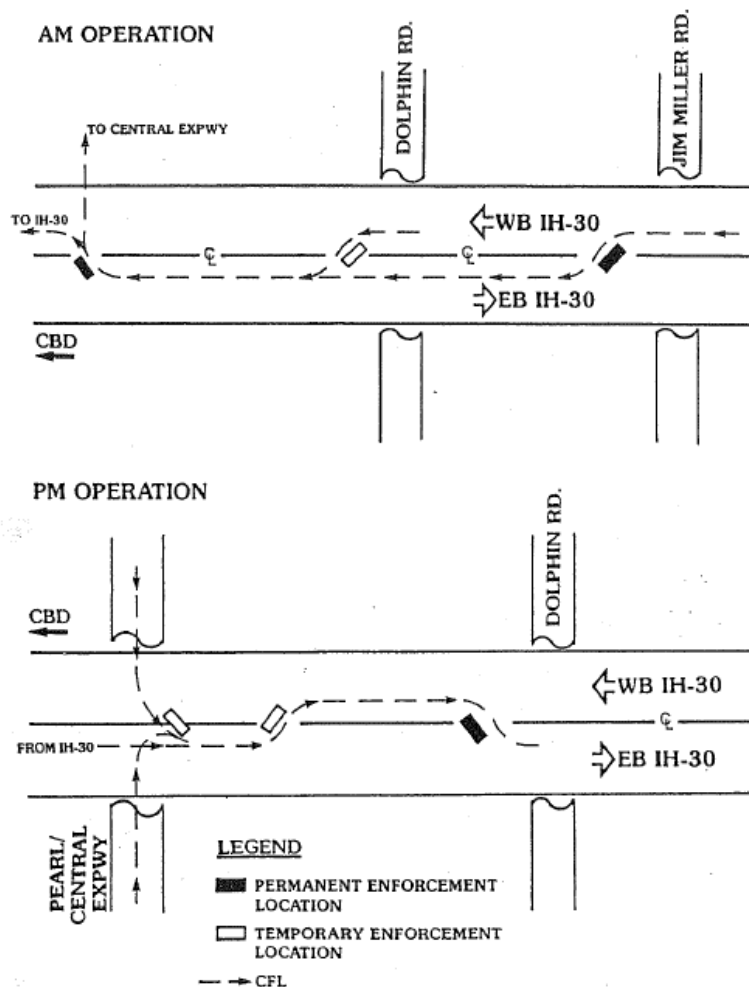
- I-30 needed to have specific features to ensure proper placement of movable barrier
- Freeway re-striped to make accommodation
- Some sections of the inside shoulder were leveled off to reduce elevation difference from general purpose lanes
- Space to store barrier transfer vehicles at termini



Concept of Operations

- A plan that **outlined key steps** for the movable barrier
 1. Vehicle for the morning peak period **will be stored near downtown** on the freeway median and parked on the inside shoulder during operating hours
 2. The vehicle will then **close the lane** by moving the barrier back to the midpoint and returning to the storage building
 3. For the afternoon peak direction, **storage for the barrier transfer vehicle** will occur in the median area at Dolphin Road

Carpool (HOV) Enforcement



- HOV Lanes require enforcement to ensure traveler compliance
- Barrier-separated facility had limited access points
- More access points leads to increased potential for HOV violations

Perspective from DART

- Operated facility from 1991 to 2013
- Saw many benefits of the movable barrier
 - **Inherent safety benefit** as opposed to pylons and lane striping
 - Protects moving traffic from crashes on either side
 - After opening, saw a **9-12 minute travel time reduction**
- **Lessons learned**
 - Wanted to integrate **more technology** (Note: TxDOT installed automatic gates in 2016)
 - **Congestion now occurs in both directions**, as opposed to ~30 years ago. More of a public acceptance challenge to “borrow a lane.”

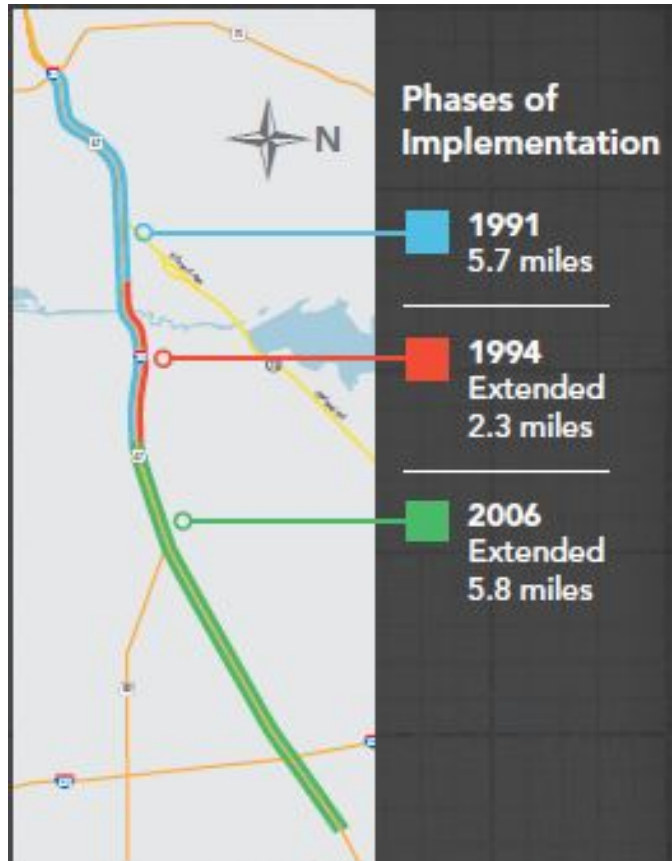
Perspective from TxDOT

- Operates facility from 2014 to present
- Felt facility helps to capture excess capacity for the peak direction
- Current operational costs
 - \$212,000 per month (or roughly \$2.5 million annually) to support operations and maintenance
 - \$100,000 per year for the Dallas County Sherriff (patrol twice per week with an irregular schedule)

Summary

- DART and TxDOT implemented the I-30 contraflow movable barrier system as a **short-term improvement**
- ...but it still operates almost **30 years later** with little issues
 - **Increased safety** from physical separation
 - **Increased person throughout** from travel time savings, improved transit reliability

Safety With Flexibility: Reversible Lanes



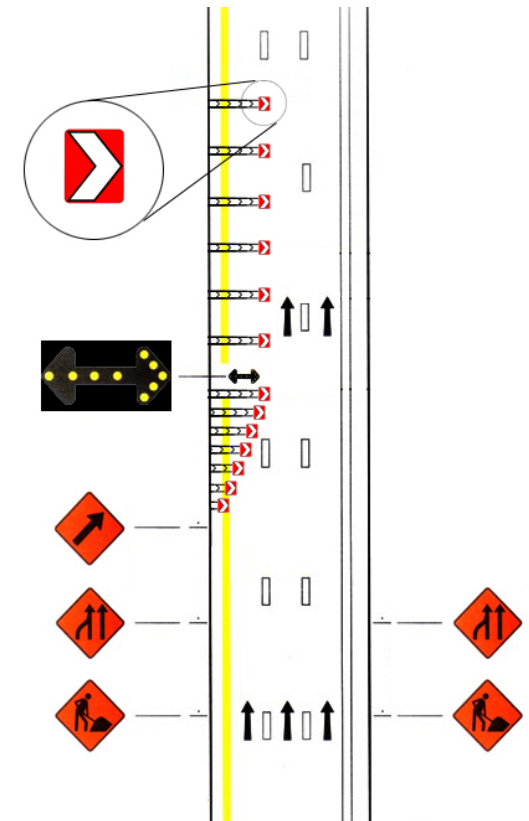
Moveable concrete barrier creates reversible lanes in minutes with positive barrier separation, returns lanes to general purpose traffic in off-peak.

Dallas, Texas:

- 15,000 drivers save 14 min/day
- Carpools increased 300%
- Bus ridership increased 38%
- Average vehicle occupancy: 2.9
- Benefit / Cost ratio 6.5:1
- DART's most important revenue route
- In 2010 TX A&M University reported the HOV lane carried 17,735 persons per day.

The Solution: Automate the Lane Closure process

- Plastic gates to delineate
- Remotely Controlled and solar powered
- Lane Closure Operating Time: **4 minutes**





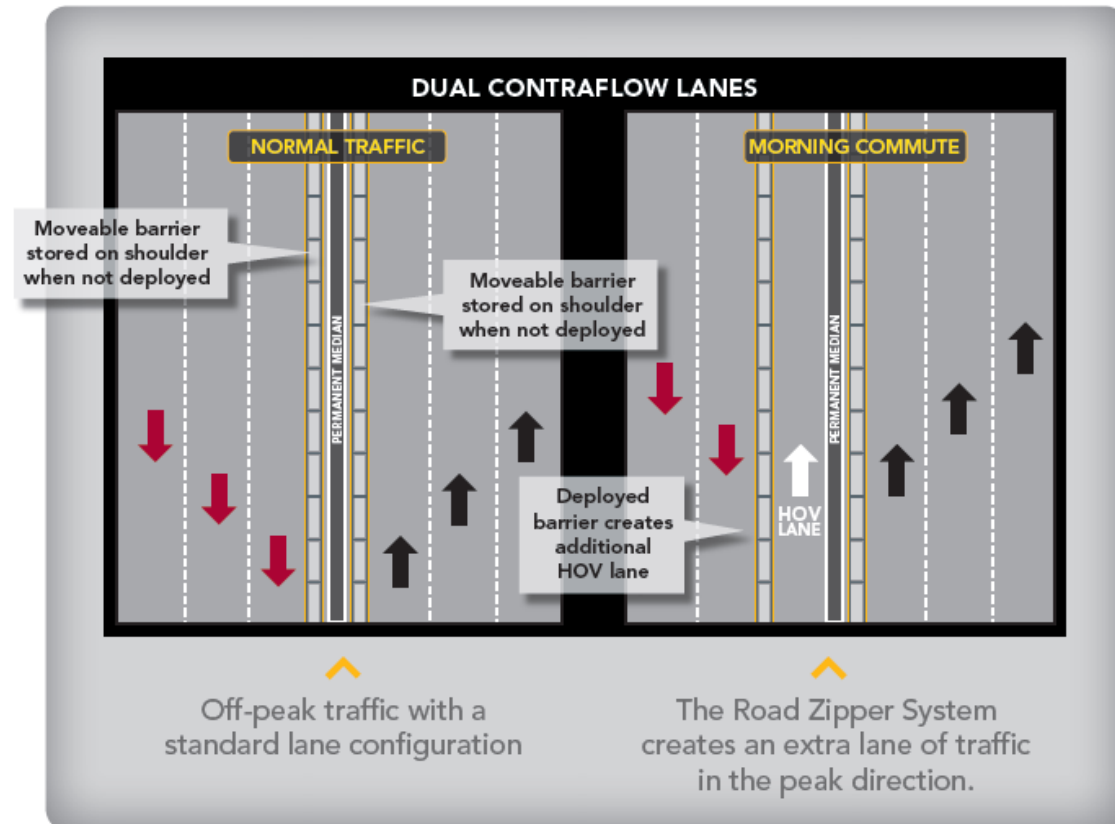
SWIFTGATE™



Boston, MA

Reversible / HOV - SE Expressway I-93

- In operation since 1995
- 6 Miles in Length
- Very narrow corridor, minimal shoulders in contraflow lane
- Operating Schedule
 - 5:00 am to 10:00 am
 - 3:00 pm to 8:00 pm
- 2+ HOV
- Time savings up to 15 min (am) and 10 min (pm)



Golden Gate Bridge

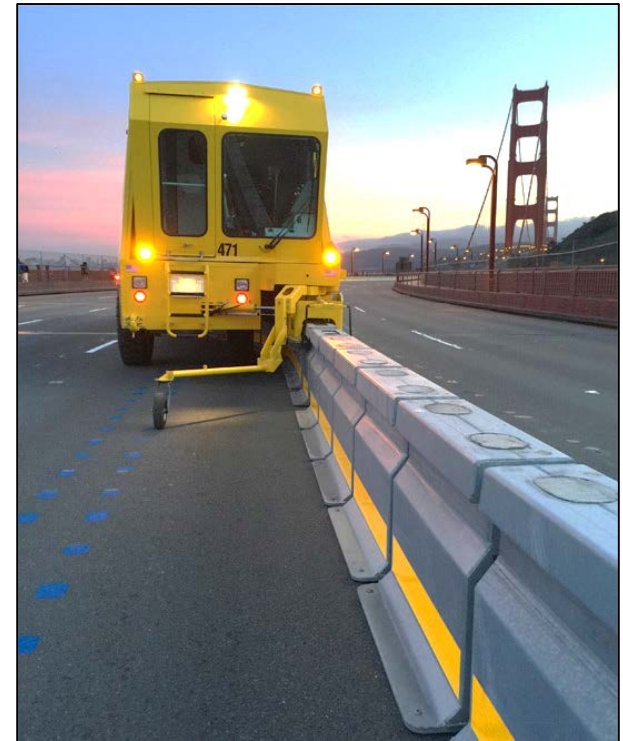
First month with the Road Zipper System

January 28, 2015:

“A southbound vehicle moved into the fast lane on the south end of the bridge. The driver hit the barrier, weaved off and then hit it two more times for a total of three hits in 150 feet.”*

February 14, 2015:

“Another southbound motorist moved from the lane nearest the sidewalk to the middle lane, hit another car and pushed that vehicle into the movable barrier.”*



“We’ll never know if, without the barrier, these incidents would have resulted in head-on collisions. What bridge travelers do know is that with the barrier in place mid-span, head-on accidents are relegated to history.”*

Ben Franklin Bridge, Philadelphia, PA

Moveable Median: Before & After

- Lights, striping & buffer lane
- Congestion
- Crossover accidents

- Recovered use of buffer lane
- More capacity
- Head-on collisions eliminated



Sydney - Victoria lane before and after Roadzipper



- Roadzipper system provides 4/2 in peak with 1 dedicated BRT lane.
- “Bus Only” lane from 5:30 am to 9:45 am

- Old layout was INFLEXIBLE with 3/3 that could not handle the peak traffic
- Delays of 18 minutes common for all users including buses



RTSGuard: Protection for Pedestrian / Bicycle Pathways



- 42” high
- MASH TL-3 approved
- Separates pedestrians and bicyclists from vehicle traffic
- Provides glare reduction for traffic

Provides flexibility to move the barrier for:

- Maintenance / Inspections
- Event or incident mgmt.
- Sweeping & cleaning

Managed Lanes Benefits With Moveable Barrier



- Mitigate traffic congestion
- Provide positive barrier protection
- Implement Managed Lanes for a fraction of the time and cost of new construction
- Meet regional mobility & safety goals
- Reclaim unused capacity
- Generate additional revenue
- Reduce injury accidents

Questions / Comments?

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**HOAN BRIDGE
MILWAUKEE, WI**