

# THE ROAD ZIPPER SYSTEM<sup>®</sup>

GE MONEY DESERVE INVESTORS HILL  
*Moving People. Safer. Faster. Smarter . . . Better*



## BEN FRANKLIN BRIDGE: PHILADELPHIA, PA



**BEFORE:** The Ben Franklin Bridge between Philadelphia, Pennsylvania and Camden, New Jersey, needed more lanes during peak periods. There was no protection from oncoming traffic, resulting in fatalities from head-on collisions.



**AFTER:** Now, The Road Zipper System balances traffic flow and creates positive protection which has eliminated crossover fatalities.



# WHY LINDSAY?



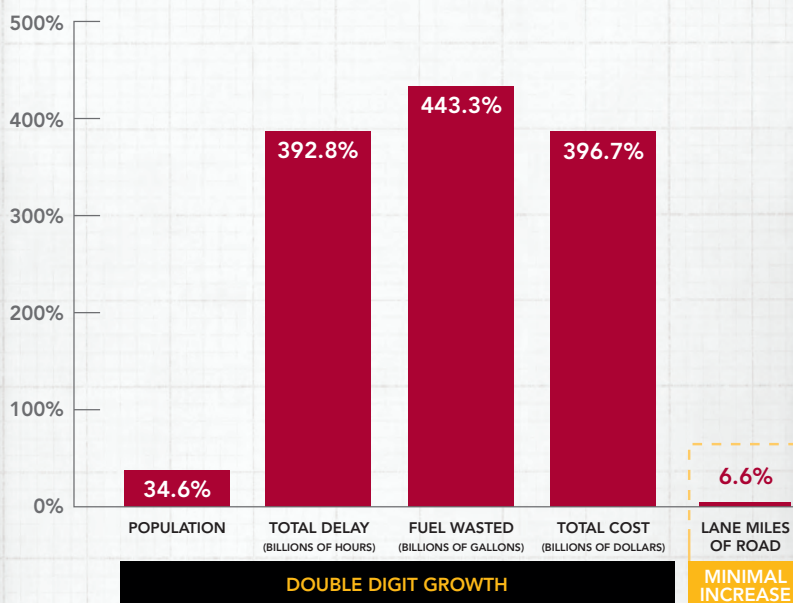
Lindsay Transportation Solutions™ is dedicated to quality construction, modern manufacturing techniques, a commitment to continuous improvement, and an understanding of customer needs.

Our flagship products are the Reactive Tension Barrier and The Road Zipper Machine – together known as The Road Zipper System®.

Road authorities and contractors around the world have been taking advantage of this low-cost, reusable solution to maximize budgets, reduce congestion, improve safety and increase traffic throughput since 1984.

*Moving People. Safer. Faster. Smarter . . . Better*

## CONGESTION TRENDS: 1982-2011

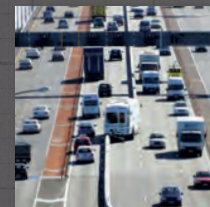


In the United States alone, there has been double-digit growth in every transportation metric, while the lane miles of new roads have only marginally increased. Lindsay's Road Zipper System is one of the most cost-effective and safe options for overcoming these challenges, now and in the future.

Urban Mobility Report. Texas A&M Transportation Institute

## INSTALLATIONS ACROSS THE WORLD, INCLUDING

- » Sydney, Australia
- » Philadelphia, PA
- » Washington, DC
- » New York, NY
- » Auckland, New Zealand
- » Boston, MA
- » San Juan, Puerto Rico
- » San Diego, CA
- » Dallas, TX
- » Honolulu, HI



# THE ROAD ZIPPER SYSTEM

## THE INNOVATIVE WAY TO MANAGE CONGESTION WITHOUT THE MAJOR INVESTMENT REQUIRED TO BUILD NEW ROADS AND BRIDGES

The Road Zipper System is designed to cost effectively increase capacity and reduce congestion by making more efficient use of new or existing roadways.

This technology is used for managed lanes and construction applications to create safe, dynamic highways that offer real-time roadway reconfiguration while maintaining positive barrier protection between lanes.

The Road Zipper System offers road authorities and contractors a practical strategy for making congested highway systems more efficient, safe and functional. These benefits can be realized in **less than one year and at a fraction of the cost of new construction.**

- **Eliminates cross-over accidents and fatalities by providing positive protection from oncoming traffic**
- **10-20% of the cost of adding a new lane**
- **Improves commuter travel times and fuel efficiency**
- **Adapts easily to changing traffic patterns and commuter needs**
- **Operates in all weather conditions**
- **Reusable and easily moves from project to project**
- **Reduces air pollutants**
- **Speeds implementation compared to new construction**

Applications include bridges, tunnels, managed lanes and high volume highways where additional right-of-way may not be available, the cost of construction is too high, environmental concerns may exist, or when the lack of funding may slow or prohibit support for new construction.

The Road Zipper System provides Bus Rapid Transit (BRT) and commuter buses opportunities to increase ridership and generate toll revenue while connecting corridors and avoiding constriction points.

Ultimately, this system is a quick and safe solution for long-term use.

## HOW IT WORKS



1. One-meter sections of highly reinforced concrete barriers are pinned together at each end to form a continuous barrier wall. The barriers have a "T" top, which acts as a lifting surface for The Road Zipper Machine.



2. The machine lifts (not drags) the barrier and passes it through a conveyor system. Unique, patented variable length barrier allows for lane curvature and expansion joints.



3. In one pass, the barrier is transferred up to 30 ft (9.1 m) and gently set down without damaging the road, at speeds up to 10 mph (15 km/h).

# WHAT IS THE COST OF ADDING CAPACITY?

## COST PER LANE MILE

HIGHER COST

TUNNEL



\$188 MILLION<sup>1</sup>

BRIDGE



URBAN  
FREEWAY



RURAL  
FREEWAY



THE ROAD  
ZIPPER SYSTEM



REVERSIBLE LANES USING  
TRAFFIC LIGHTS



REVERSIBLE LANES USING  
CONES

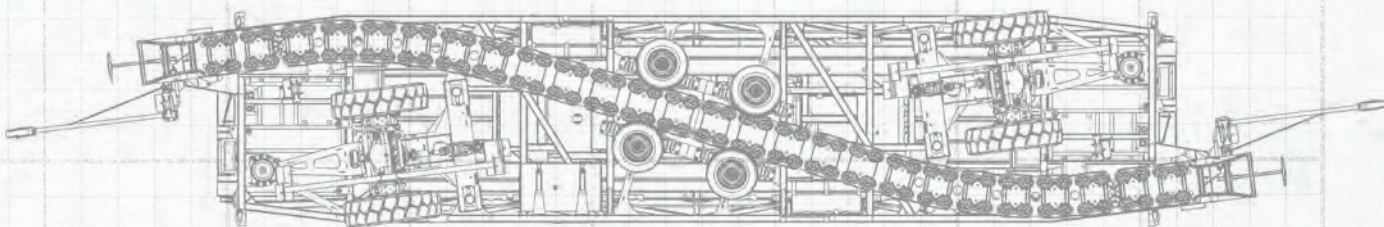
DO NOTHING (WITH HIGHER DEFERRED COST AT A LATER DATE)

NO PROTECTION

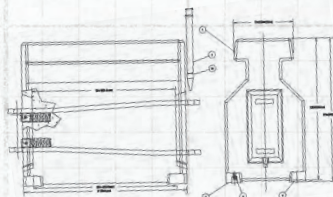
### THE CROSSROAD: WHERE LOW COST MEETS SAFETY

What is the cost of adding capacity - and at what price? The Road Zipper System is the only solution that's moveable, safe and stretches transportation dollars.

<sup>1</sup> Washington State Department of Transportation, <http://americandreamcoalition.org/highways/HighwayCosts.pdf>



The Road Zipper Machine



#### Reactive Tension Barrier

Heavily reinforced concrete barrier has better deflection and superior vehicle stability when compared to standard Temporary Concrete Barrier

# MANAGED LANES

Moveable barrier technology provides a quick and cost-effective solution for highway capacity improvements, without waiting for time-consuming study reviews. The Road Zipper System allows Transportation Authorities to preserve their corridor options for the following while providing a “fast-build” solution for mitigating congestion:

- Managed lanes
- Bus Rapid Transit (BRT)
- Reversible Lanes
- Contraflow
- HOV and HOT lanes
- Truck lanes

## Stretches transportation budgets

According to the FHWA, new urban freeway construction can cost up to \$15.4 million per urban lane mile. Moveable barrier is a fraction of this cost.

## Reduces congestion

Moveable barrier gives more lanes to the peak traffic direction for daily and weekend commuters.

## Increases safety

Positive barrier protection reduces the possibility of crossover, head-on accidents.

## Provides a fast-build solution

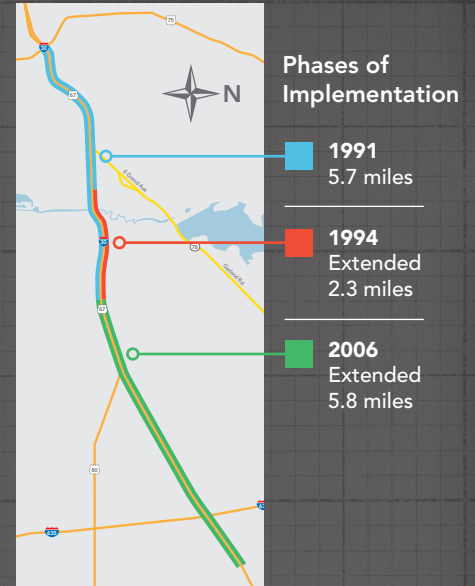
New construction can take years for planning and environmental reviews. Moveable barrier can often be deployed in less than one year.

## Offers green benefits

Improved air quality, increased fuel efficiency, and reduced atmospheric CO<sub>2</sub>.

## Creates dedicated lanes

HOV enforcement, reduced tolling costs, and safer truck traffic.



## INTERSTATE 30

DALLAS, TX

In operation since 1991

### THE PROBLEM:

Tidal flow congestion significantly beyond capacity in morning and evening

### THE ALTERNATIVE:

Add a new lane, of which an elevated portion would have meant 5-6 years and an estimated \$200M to complete (in today's dollars)

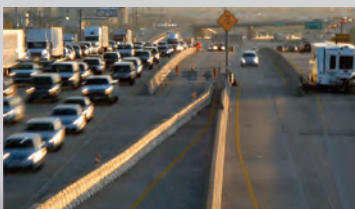
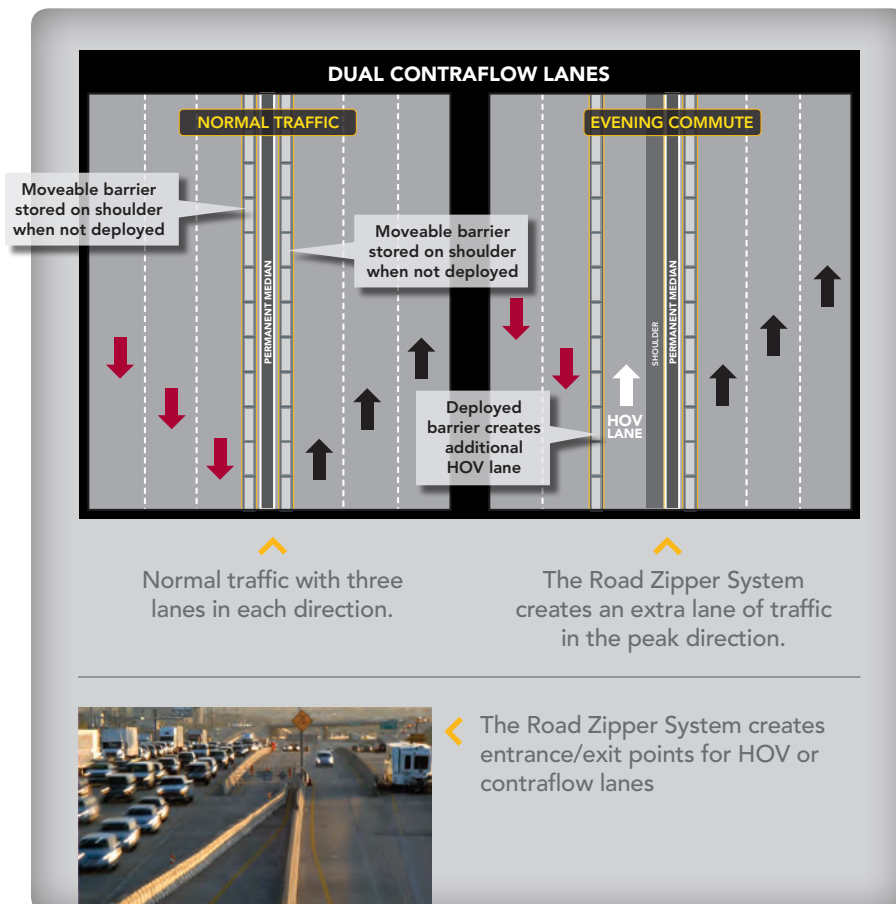
### THE SOLUTION:

- The addition of a commuter lane using The Road Zipper System was faster and less expensive than alternative
- Cost of widening deferred to a later date

### THE RESULT:

- Saves 14 minutes per trip = 1 million hours per year
- Creates a benefit/cost ratio: 6.5 to 1
- Increases vehicle occupancy from 1.1 (U.S. average) in HOV lane to 2.9
- Offers expansion capabilities
- Improves air quality\*

\* Expansion funded by air quality dollars.



**BEFORE:** The East R.L. Thornton Freeway, opened in 1966, is a major eight-lane radial freeway that primarily serves commuters destined for the Dallas central business district. It was experiencing recurring congestion during both peak commute periods. Average speeds were falling below 30 mph (48 km/h) for extended periods of time in the morning and evening commute.

**AFTER:** Once The Road Zipper System was implemented, average peak hour main lane speeds increased by 86%, from 22 to 41 mph (35 to 65 km/h). Bus passenger volumes increased by 38% in the I-30 corridor and carpools increased by 300% in the morning peak hour from 600 to 1,800 cars.



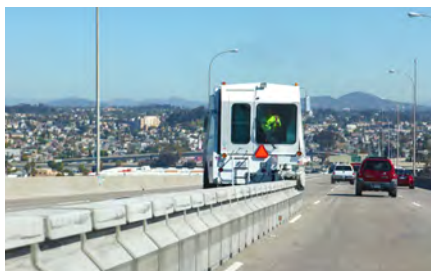
# BRIDGES

As the daily traffic on a bridge increases over time, bridge authorities must find a way to increase the capacity of the bridge to match the traffic flow. New construction is extremely expensive, and can be delayed for decades due to planning and funding.

The cost-effective and expedited method of increasing bridge capacity is to create managed lanes using The Road Zipper System where the lane configuration of the bridge is flexible and additional lanes are made available to the peak traffic direction. Other methods can be used, such as cones and overhead lights, but crossover accidents will occur, causing serious injuries and fatalities.

In addition to the clear benefits that The Road Zipper System provides for managed lanes, the system also addresses some of the challenges faced in bridge repair projects. Limited space for vehicles, equipment, and workers results in an increase in the number of construction stages, prolonging the job and raising the cost of construction.

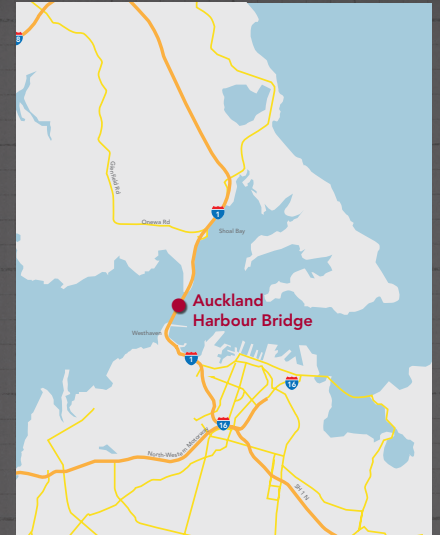
Safety is also compromised if all work must be performed in a confined work zone, and bridge work zones that create a flexible work space by utilizing cones and barrels are inherently dangerous to workers and motorists.



▲ ABOVE: Coronado Bridge, CA



▲ TOP: Golden Gate Bridge, CA  
▲ BOTTOM: Ben Franklin Bridge, PA



## AUCKLAND HARBOUR BRIDGE AUCKLAND, NEW ZEALAND

In operation since 1990

### THE PROBLEM:

- Tidal flow increased from 26 million passenger vehicles per year in 1980 to 42 million passenger vehicles in 1990
- 120,000+ vehicles per day
- Increased speed limit = increased crossover accidents and fatalities

### THE ALTERNATIVE:

- Lights for reversible lane were already implemented, and created more accidents while failing to provide safety
- Bridge was previously expanded to broadest width
- Build another bridge

### THE SOLUTION:

- Implementation of The Road Zipper System as moveable median for reversible lane situation
- Positive barrier separation at a cost of \$5.4 million (USD) in 1990

### THE RESULT:

- Improved operation of managed lanes
- Increased use of center lanes
- Created a benefit/cost ratio of 6.8 to 1
- Net amortized accident savings of \$59.1 million (USD)
- Superior accident containment and extremely low deflection
- Expanded use of The Road Zipper System beyond bridge into downtown area
- Zero crossover fatalities



**BEFORE:** The bridge was opened as a four lane steel truss bridge in 1959. In 1969, two 2-lane steel box extension structures were added, one structure along each side of the original bridge.

As traffic flows increased, overhead lane signals were installed to provide tidal flow operation during morning and evening peaks: five lanes of traffic traveling in the peak direction and three lanes in the off-peak direction.

**AFTER:** The Road Zipper System was the first in the world to be used on a significant grade (5%) and horizontal curvature. Currently, it provides physical separation for over 120,000 vehicles per day. Head-on fatal accidents have been eliminated.<sup>1</sup>

<sup>1</sup> Safety and Cost Effectiveness of the Moveable Lane Barrier on the Auckland Harbour Bridge; MJ Leak, NV Hawkins, EP Sansom, and RCM Dunn.



# CONSTRUCTION

The Road Zipper System is designed to create a flexible, positive traffic barrier between opposing lanes of traffic, or between motorists and construction work zones while managing congestion.

The system can create additional work zone space for construction crews, and provides more lanes to the peak traffic direction to mitigate congestion and accelerate the construction process.

## Improves safety

Workers and motorists have positive barrier protection at all times.

## Reduces congestion

Allows more lanes to be open for peak traffic by reconfiguring the roadway in real time.

## Speeds construction

By combining or eliminating stages due to the larger work space, contractors can save months or even entire construction seasons.

## Creates efficiencies and increases quality

Dedicated haul lanes create safer, more efficient deliveries and material staging. More work zone space allows contractors to use larger, more efficient equipment, resulting in better quality repairs that last years longer.

## Allows for rapid stage changes

Moveable barrier reconfigures the road in minutes. It can take days to reposition miles of temporary concrete barrier.



↗ The Road Zipper System accelerates safe construction in a shoulder work zone while creating room for large equipment.

↖ Construction of the 3500 South Arterial in Salt Lake City, UT using The Road Zipper System.



## PESIO BRIDGE, A6 MOTORWAY

ITALY

In operation 2006

**Bridge Reconstruction**  
**Project Length: 1.3 mi (2 km)**

### THE PROBLEM:

During construction, the 2/2 lane configuration was reduced to a 1/1 with buffer zone using lane delineators. Heavy weekend traffic resulted in 6-mile long queue.

### THE ALTERNATIVE:

1/2 configuration using cones caused extended backup on Fridays and Sundays and did not provide positive protection.

### THE SOLUTION:

- Phase 2 construction with The Road Zipper - 2/1, 1/2 configuration
- No closures necessary

### THE RESULT:

- No traffic queues
- Positive protection

## CONSTRUCTION APPLICATIONS

The Road Zipper System creates a safe, flexible work zone that allows contractors to:

- Compensate for missing lanes
- Expand the work zone during off peak traffic hours, and reduce or even close the work zone during peak traffic hours to maximize traffic flow
- Use larger, more efficient construction equipment in the expanded work zone
- Combine or eliminate stages, allowing many projects to be completed in one construction season rather than two

**BEFORE:** Half of the bridge was 50 years old and required complete rebuilding, and would remain closed for the duration of the project. A buffer zone was striped on the available bridge span during Phase 1 of construction. Lane delineators were used to create one lane in each direction. The result was massive traffic queues up to 6 miles (10 km) on Fridays and Sundays. A new solution was necessary.

**AFTER:** During Phase 2, The Road Zipper System was installed for a 2/1, 1/2 configuration. Traffic queues vanished and motorists also benefited from positive protection.



## PARTIAL WIDTH

For partial width construction, one side of the road can be completely closed for construction while all traffic is diverted to the other side, with a moveable median reconfiguring the roadway in real time to provide more lanes in the peak direction.



## MEDIAN

Narrow median reconstruction using traditional methods usually requires taking traffic lanes for the duration of the project. Moveable barrier allows all traffic lanes to be open during peak hours, and the work zone is expanded during off-peak.



## OUTSIDE SHOULDER

The Road Zipper System increases the size of the work zone to create dedicated haul lanes and allow the use of larger equipment.

# THE ADVANTAGES OF FUTURE FLEXIBILITY

The Road Zipper System is one of the few options on the market that provides superior flexibility – now and in the future.

For example, by planning to include just **one extra meter** of lane/shoulder width in the design phase for bridges, viaducts and tunnels, The Road Zipper System provides simpler and faster maintenance work while creating future capacity in confined spaces.

Bridge authorities are beginning to emphasize cost-effective proactive strategies during the planning stages.

The Road Zipper System solution creates more flexible options for BRT and emergency evacuation, compared to a permanent median, and will meet the demands of ever-increasing traffic flow.

The system is a proactive approach, rather than a reactive approach to future needs.

## INTERSTATE 15 SAN DIEGO, CALIFORNIA

In full operation since 2012

**Express Lanes Project**  
Project Length: 20 mi (32.18 km)

### THE PROBLEM:

- Increased demand added 30-45 minutes to travel time
- 380,000 daily trips projected by 2020 – resulting in delays of 80-90 minutes

### THE ALTERNATIVE:

- Limited reliable and convenient transportation choices
- Costly continuous arterial route parallel to I-15<sup>1</sup>

### THE SOLUTION:

- The Road Zipper system provided express lanes for BRT
- Created direct access ramps with intermediate access points
- Maximized capacity with use of dynamic lanes configured by The Road Zipper to handle peak traffic

### DESIRED OUTCOME:

Once completed, the new express lanes will improve travel times and mobility, and connect to new Bus Rapid Transit centers and Park & Ride lots. Together, these improvements will provide travelers with more reliable and convenient transportation choices.

<sup>1</sup> [http://www.dot.ca.gov/dist11/departments/planning/pdfs/tcs/2012\\_I\\_15TCS.pdf](http://www.dot.ca.gov/dist11/departments/planning/pdfs/tcs/2012_I_15TCS.pdf)

## C-16 TUNNEL: BERGA-BAGA, SPAIN (PROPOSED PROJECT)



### THE PROBLEM:

- 21 km of 3-lane roads reducing to 2 lanes through 5 consecutive tunnels in mountainous terrain
- High directional traffic on weekends requires 2 lanes in 1 direction

### THE ALTERNATIVE:

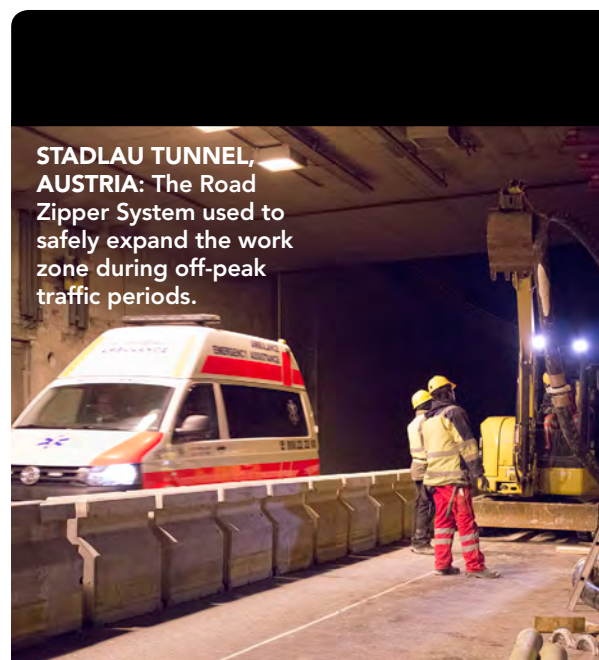
- Widen entire road to 4 lanes, including through tunnels
- Estimated cost of \$700M euros

### THE PROPOSED SOLUTION:

- Widen tunnels to 3 reversible lanes using The Road Zipper System during peak traffic
- Will save \$600M euros
- The Road Zipper System will complete entire route in 2 hours without interrupting traffic



[http://premsa.gencat.cat/pres\\_fsvp/AppJava/notapremasvwi/detail.do?id=233352](http://premsa.gencat.cat/pres_fsvp/AppJava/notapremasvwi/detail.do?id=233352)



**STADLAU TUNNEL, AUSTRIA:** The Road Zipper System used to safely expand the work zone during off-peak traffic periods.

**FREEWAY WITHIN A FREEWAY:** One of the most progressive transportation agencies in the world, Caltrans District 11, and SANDAG (Metropolitan Planning Organization) developed a revolutionary plan to meet current and future traffic needs. Without The Road Zipper System, this plan would not have been possible.

The I-15 Express Lanes feature four center lanes with a moveable barrier for maximum flexibility, multiple access points to the general purpose highway lanes, and direct access ramps for high-frequency BRT service. The managed lanes were developed with the latest technologies that maintain proper flow rates, sense problems, make adjustments at necessary locations and keep travelers informed of their choices.<sup>1</sup>



Drop ramp for buses and rideshare

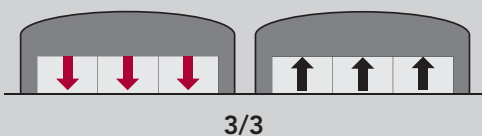
Dynamic highway using a moveable median

Bus Rapid Transit (BRT) station

Park & Ride lot

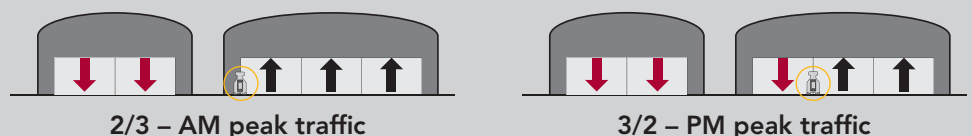
## AVOIDING TUNNEL VISION

### TRADITIONAL



Due to limited space, very high costs, and extensive planning, tunnels require forward-thinking design. Traditional designs typically utilize an even number of lanes in each tunnel (3/3 configuration), which is a problem if higher capacity is desired without the budget.

### FUTURE PLAN



If funds are available for a 2/3 lane tunnel configuration, road authorities can implement The Road Zipper System to gain the equivalent of six lanes of tidal flow capacity at the cost of five lane construction.

# MOVING PEOPLE.

LOW DEFLECTION  
NCHRP 350, TL3

**SAFER**

**ZERO** CROSSOVER FATALITIES

BS EN 1317-2 TL H2

**POSITIVE PROTECTION**

**RAPID** STAGE CHANGES

OPERATIONAL IN MONTHS, NOT YEARS

**REDUCES TRAVEL TIME**

**FASTER**

ACCELERATES CONSTRUCTION

**TRANSFER TIME: 1 MILE IN 6 MINUTES**

INCREASES FUEL EFFICIENCY

**SMARTER**

REUSABLE **ASSET**

UTILIZES EXISTING CAPACITY

A FRACTION OF THE COST OF NEW CONSTRUCTION


**IMPROVES AIR QUALITY**

INCREASES **BRT** CAPACITY & USAGE



... BETTER.

# SERVING CUSTOMERS AROUND THE WORLD



Lindsay Transportation Solutions is the world's leading manufacturer of moveable barrier technology for both managed lanes and construction applications. Lindsay Transportation Solutions also offers a full line of road safety products, including the Universal TAU-II®, ABSORB 350®, and X-TENUator® Crash Cushions, ArmorGuard™ Safety Barriers and Gate systems, Safe-T-Curve™, X-Tension™, X-LITE® and X-MAS® End Terminal Systems, U-MAD TMAs and various safety accessories and specialty barrier products.



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