THE ROAD ZIPPER SYSTEM™
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.

BEN FRANKLIN BRIDGE: PHILADELPHIA, PA

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.


IN 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

CONGESTION TRENDS: 1982-2006

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
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.

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.

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 24 ft (7.3 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?**

<table>
<thead>
<tr>
<th>Protection</th>
<th>Tunnel</th>
<th>Bridge</th>
<th>Urban Freeway</th>
<th>Rural Freeway</th>
<th>The Road Zipper System</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Protection</td>
<td>$188M</td>
<td>$88M</td>
<td>$330M</td>
<td>$105M</td>
<td>$10M</td>
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<tr>
<td>Cones</td>
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<td>$71M</td>
<td>$290M</td>
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<td>Traffic Lights</td>
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<td>$61M</td>
<td>$240M</td>
<td>$71M</td>
<td>$20M</td>
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<td>REVERSIBLE LANES USING CONES</td>
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</tr>
<tr>
<td>DO NOTHING (WITH HIGHER DEFERRED COST AT A LATER DATE)</td>
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</tr>
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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 CO2.

Creates dedicated lanes

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

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.

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.
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.

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.

1 Safety and Cost Effectiveness of the Moveable Lane Barrier on the Auckland Harbour Bridge; MJ Leaka, NV Hawkinsb, EP Sansom, and RCM Dunnd.
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.

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

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
Positively separating the work area improves flow, and safeguards work crews and motorists.

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.

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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 zones 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

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.
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 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

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.

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

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.

AVOIDING TUNNEL VISION

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 (2/2 or 3/3 configuration), which is a problem if higher capacity is desired without the budget.

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.

DEREK TALLMAN
TUNNEL, UK: The Road Zipper System used for maintenance and to provide protection.

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. 1

1 http://www.dot.ca.gov/dist11/departments/planning/pdfs/tcs/2012_I_15TCS.pdf
THE ROAD ZIPPER SYSTEM

MOVING PEOPLE.

LOW DEFLECTION
NCHRP 350, TL3
ZERO CROSSOVER fatalS
SAFE
POSITIVE PROTECTION
SAFER
BS EN 1317-2 TL H2
Rapid
operational
Stage Changes
not years
Transfer Time: 1 Mile in 6 minutes
Travel Time
INCREASES
FASTER
accelerates construction
REduces
CONSTRUCTION
Travel Time
INCREASES
FUEL efficiency
Smarter
Improves Air Quality
increases BRT Capacity & usage
SMARTER
Utilizes Existing Capacity
A Fraction of the cost of New Construction
ReusABle ASSET
BS EN 1317-2 TL H2
Positive Protection
NCHRP 350, TL3
Zero Crossover Fatalities
... BETTER.
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.