2-2-2017

ROAD ZIPPER™

Purdue ECT Team

Construction Engineering & Management, Purdue University, ectinfo@purdue.edu

DOI: 10.5703/1288284316363

Follow this and additional works at: <https://docs.lib.purdue.edu/ectfs>

Part of the [Civil Engineering Commons](#), [Construction Engineering and Management Commons](#), [Engineering Education Commons](#), [Engineering Science and Materials Commons](#), [Environmental Engineering Commons](#), [Geotechnical Engineering Commons](#), [Hydraulic Engineering Commons](#), [Other Civil and Environmental Engineering Commons](#), and the [Transportation Engineering Commons](#)

Recommended Citation

Team, Purdue ECT, "ROAD ZIPPER™" (2017). *ECT Fact Sheets*. Paper 225.
<http://dx.doi.org/10.5703/1288284316363>

ROAD ZIPPER™

THE NEED

Construction work zones are growing in number around the world. The natural aging of existing roadway infrastructure ensures that more and more maintenance and rehabilitation will be required. Work zones, by their very definition, create two major problems that must be addressed in some way: safety and mobility. In the United States, highway work zones are responsible for almost 25% of all non-recurring congestion and 10% of overall congestion. Vehicle accidents are more common in work zones, and traffic congestion through work zones on urban arterials and freeways is often considered to be “unavoidable.” Fortunately, technology is providing new solutions to these problems at an accelerated rate. By combining the best of these new technologies, agencies can effectively reduce injury accidents and mitigate traffic congestion through construction work zones.

In a construction work zone, there must be a balance between the number of lanes that are available for motorists and the space requirements of the contractor. Typically, this is addressed in one of three scenarios:

1. First, to give the maximum number of lanes to traffic, the size of the work zone must be reduced. In this scenario, congestion is minimized, but the work zone is confined and inefficient. This creates a work zone environment that is prone to accidents, and it extends the construction schedule.

FIGURE 1 TRAFFIC IS NOT IMPACTED, BUT THE WORK ZONE IS CONFINED AND INEFFICIENT

2. In the second scenario, the work zone is expanded. This allows for larger, more efficient equipment to accelerate the construction schedule, and more space means a safer work zone. The impact on traffic is seen as the number of vehicle lanes is now minimized, creating congestion and potentially increasing vehicle accident rates. In these first two scenarios, the static, inflexible work zone is optimized for either the motoring public or the contractor, but it cannot be optimized for both. Fortunately, in either of these scenarios we can increase safety by separating vehicles and workers from each other with either steel or concrete barrier. This positive protection virtually eliminates vehicle encroachments into the work zone, which account for a large

percentage of work zone fatalities. Positive barrier protection is a critical safety element, and agencies are often willing to sacrifice mobility and work zone efficiency for the safety of barrier separation.

FIGURE 2 THE WORK ZONE IS SAFE AND EFFICIENT, BUT SEVERE CONGESTION AND USER DELAY COSTS WILL RESULT

3. The third scenario is the most efficient use of the roadway. In this case, the maximum number of lanes is made available to motorists during peak traffic hours, and the road is reconfigured to increase the size of the work zone during off-peak traffic hours. This allows the contractor to create dedicated haul lanes, use larger equipment, accelerate the construction schedule, and create a safer working environment, while maximizing mobility and vehicle throughput for traffic.

FIGURE 3 THE WORK ZONE IS EFFICIENT AND TRAFFIC IS NOT IMPACTED, BUT ENCROACHMENT ACCIDENTS WILL STILL OCCUR

Unfortunately, implementing a flexible divider between vehicle traffic and the construction work zone is traditionally accomplished by using plastic cones, barrels, and flexible delineators that offer no positive protection. Historically, road delineation that can be reconfigured quickly enough to respond to the needs of peak traffic conditions must by definition lack the crashworthy physical attributes of positive protection. This is the essential conflict between safety and mobility: work zone intrusion accidents must be eliminated if safety and mobility are to be optimized together.

Safely Separating Workers from Traffic While Mitigating Traffic Congestion

Long-term and larger work zones provide a greater challenge to enhance safety while mitigating traffic congestion. When arterial or freeway lanes are taken for construction, user delay costs to motorists can easily climb to millions of dollars. Additionally, the longer the work zone is in place, the more likely that there will be an intrusion accident, or accidents related to changes in the road configuration. One solution that meets both challenges is moveable concrete barrier. Moveable barrier technology mitigates traffic congestion by quickly reconfiguring the roadway under traffic, and the positive protection of concrete barrier provides the safety that is not available with plastic delineation. This creates a crashworthy lane separator that provides more lanes for peak traffic and expands the work zone to accelerate the construction process. Vehicle mobility is maximized without compromising the safety of positive protection.

FIGURE 4 MOVEABLE BARRIER RECONFIGURES THE ROADWAY IN REAL TIME WITH POSITIVE BARRIER PROTECTION

FIGURE 5 MOVEABLE BARRIER IS USED TO EXPAND THE WORK ZONE AND/OR PROVIDE MORE LANES FOR PEAK TRAFFIC

THE TECHNOLOGY

Moveable barrier is a two-part system. The first part consists of one-meter sections of highly reinforced concrete that 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 transfer machine. The second part of the system is a Barrier Transfer Machine (BTM), which lifts the barrier and passes it through a conveyor system, transferring the barrier from 8 to 24 feet (2.4 m to 7.3 m) in one pass at speeds up to 16km/h (1km can be reconfigured in four minutes). When necessary, the ends of the barrier are protected with a water-filled crash cushion that can articulate through the transfer machine for seamless operation.

Shoulder / Median Work

For shoulder and median work, the barrier can be stored at the edge of the road and moved out during off-peak traffic periods to increase the size of the work zone. The barrier is returned to the stored position during peak traffic periods to give the maximum number of lanes to traffic. The barrier can be moved many times per day to meet the needs of both construction crews and motorists.

FIGURE 6 THE BARRIER CAN BE STORED AT THE EDGE OF THE ROAD AND MOVED OUT DURING OFF-PEAK TRAFFIC PERIODS TO INCREASE THE SIZE OF THE WORK ZONE IN ORDER TO FACILITATE SHOULDER AND MEDIAN WORK

Partial Closures

During partial closure construction, one side of the road is completely shut down for construction and all traffic is diverted to the other side. Moveable barrier is used as a “moveable median,” shifting multiple times per day to reconfigure the road and give more lanes to the peak traffic direction.

FIGURE 6 ONE SIDE OF THE ROAD IS COMPLETELY CLOSED FOR CONSTRUCTION WHILE TRAFFIC IS MANAGED ON THE OTHER SIDE

FIGURE 7 TRAFFIC LANES ARE RECONFIGURED UNDER TRAFFIC IN REAL TIME DURING A PARTIAL CLOSURE

THE BENEFITS

The following case study explain the concepts and the benefits derived from using moveable barrier in a real world situation.

3500 South, Salt Lake City, UT USA (Shoulder / Median Work)

3500 South is a busy arterial in Salt Lake City, Utah. The first phase of the reconstruction called for two traffic lanes to be open for traffic in each direction, and plastic barrels were used to separate directional traffic and to delineate the work zone. The work zone area was confined and restricted, and it lacked positive protection, which created dangerous conditions as confused motorists occasionally turned into the work zone. For the second phase of the project, it was decided that a moveable barrier system would be used to create a larger work zone, while minimizing the impact on traffic and limiting left-hand turns.

It was determined that moveable barrier could keep two lanes open to traffic in the peak direction by using a total of only three lanes. This would give the contractor an extra lane to expand the work zone, keeping workers safe and accelerating construction. The barrier was moved multiple times daily to create a 1/2, 2/1 traffic pattern.

- Project was completed seven months early & saved one construction season
- Savings from early completion were estimated at US \$1.3 to \$1.4 million
- Reduced user delay costs
- US \$1 million in accident cost reductions
- Total moveable barrier benefits estimated at US \$2.4 million
- Moveable barrier benefit/cost ratio estimated between 4:1 and 10:1.

FIGURE 8 MOVEABLE BARRIER HAS MAJOR BENEFITS ON BOTH HIGHWAYS AND ARTERIALS

STATUS

The concept for the Road Zipper has been around for 30 years, but the technology is not necessarily well known in the industry. DOTs are quick to see the benefits in time and dollars saved as well as safety, but contractors tend to rely on techniques such as temporary asphalt and additional stages due to their familiarity with these better known methods.

BARRIERS

Moveable barrier is a tool best used where space is limited and the contractor and motorists can all benefit from additional space. If the construction work zone is already open and efficient with dedicated haul lanes and no impact on traffic, moveable barrier would not be an appropriate choice. Moveable barrier saves contractors time and money when the work zone is confined and inefficient, and can benefit from being expanded one or more lanes as traffic permits. If an expanded work zone does not affect peak traffic flow when opposing traffic lanes have a static positive barrier between them, then using moveable barrier between opposing traffic lanes will not have any additional benefits.

POINTS OF CONTACT

Laura Huizinga, Regional Manager

Tel: +1 (606) 994-2389, Email: Laura.Huizinga@lindsay.com

REFERENCES

1. Utah Department of Transportation (2010). *Evaluation of Moveable Barriers in Construction Work Zones*.

REVIEWERS

Peer reviewed as an emerging construction technology

DISCLAIMER

Purdue University does not endorse this technology or represents that the information presented can be relied upon without further investigation.

PUBLISHER

Emerging Construction Technologies, Division of Construction Engineering and Management, Purdue University, West Lafayette, Indiana