Reversible express lanes

A most unique toll road, Tampa's Crosstown Expressway reversible express lanes (REL) opened to motorists in July 2006. It is developed, owned, and operated by Tampa-Hillsborough County Expressway Authority. REL is a common-sense transportation solution that addresses urban congestion by combining the innovations of concrete segmental bridges, reversible express lanes, cashless open-road tolling, and full electronic controls. The revolutionary "six lanes in six feet" freeway was constructed within the existing right-of-way of the Lee Roy Selmon Crosstown Expressway (**Fig. 1**). It provides three lanes toward Tampa in the morning peak and three lanes out of Tampa and into the rapidly growing suburb of Brandon in the afternoon peak. During midday, a central segment is closed and the Tampa and Brandon segments operate independently on a direction that optimizes local traffic circulation. Only cars and buses are allowed on the REL. A $1.50 toll was charged in 2007, but entry is unimpeded because tolls are collected electronically via in-vehicle transponders or with license-plate recognition. REL has provided a major reduction in congestion. Before-speeds of less than 15 mi/h (24 km/h) in the peak hours rose to free-flow speeds of about 60 mi/h (100 km/h), which translates to up to a full hour of round-trip travel-time savings for many commuters. In addition, REL was constructed at a record low cost per mile, had minimal environmental impacts, created a minimal disruption to adjacent traffic, and spurred development growth in both Tampa and Brandon. Actual traffic volumes have exceeded forecasts by 25%.

The growth of traffic from 13.1 million tolling transactions in 1982 to 30.2 million transactions in 2002 resulted in severe congestion for thousands of daily Crosstown Expressway motorists. The Expressway is also a classic commuter toll road, with directional percentage splits of more than 75/25 during the peak hours. In the morning, more than 75% of the traffic is Tampa bound; the reverse is true in the afternoon. Almost 80% of all of the daily traffic occurs during the morning and afternoon commuting peak periods.

The Authority's solution to relieve peak-hour congestion was to build 10 mi (16 km) of reversible express toll lanes between Interstate 75 and downtown Tampa. Like many urban areas, purchasing the necessary additional land in this corridor for typical highway widening was neither physically nor financially feasible. To minimize the footprint, most of the project was constructed as a concrete segmental bridge using only 6 ft (1.8 m) of space within the existing median (Fig. 1). This resulted in an aesthetically pleasing structure, lower project costs, and reduced impacts to the community and the environment. The shape of the box that supports the deck and transfers loads to the pier limits the view of the underside of the bridge to only half of the structure, providing light and limiting the structure's visual impact. The resultant perception is that of an overpass instead of a "double-decker" structure.

Technological innovations include cashless three-lane-wide open road tolling at free-flow speeds supplemented by a unique approach to video toll collection for motorists without transponders as well as a centralized traffic management center with state-of-the-art software to control the reversible lane operations and provide multiple safeguards to preclude vehicles from entering the expressway in the wrong direction.

Terminal gateways. The Brandon and downtown gateways to REL were planned by engaging the public in the design process. This resulted in highly positive community acceptance and support at both ends of the project.

In addition to their value as transportation projects, these gateways were major investments in urban architecture, landscaping, and public facilities that have been a catalyst for new private investment. They are a case study on the integration of major highway infrastructure into existing communities. They are also a case study of flexible traffic operations since REL is able to operate in six modes, including all eastbound, all westbound, and four combinations of directional operation of the Brandon and Tampa gateways.

The Brandon Parkway end of REL includes scenic landscaping, a winding off-road recreational trail for walking and cycling, and numerous sites for resting, relaxing, and enjoying the environment. The Parkway has become the prime location for construction, with over $100 million of new restaurants, shopping, residential, and private leisure activities. During off-peak travel periods, the Parkway functions as a set of internal circulation roads, facilitating local trips to shopping areas, public services, and restaurants.

In downtown Tampa, REL descends to Meridian Avenue. It has transformed a former narrow

Fig. 1. Elevated bridge on a 6-ft-wide (1.8-m) pier provides the equivalent of six lanes of peak commuting period capacity.

Fig. 2. Electronic tolling structure (gantry) collects tolls at free traffic flow speeds.

two-lane street through an aging industrial district into a modern six-lane urban thoroughfare. Representing a $50 million investment in downtown Tampa, the gateway includes custom-designed urban architecture and offers a visually exciting and pedestrian-friendly environment, which has been the primary catalyst for almost $1 billion of new residential and commercial development.

Traffic improvement. Before opening REL, the traffic on the existing four-lane divided toll facility was at level of service (LOS) F during the peak hours of operation. LOS is a grading scheme for representing the quality of traffic operations; it ranges from A (best) to F (worst). Of the total 115,000 average trips during a weekday, more than 75,000 occurred between I-75 and downtown Tampa on the east end of the highway. The trip time from the east averaged 30–40 min during the morning commute.

Fig. 3. Match casting, where each new segment is cast against the previously completed one to ensure that all the pieces fit together properly. The curved shape of segments was one of the bridge's aesthetic features.

REL opened on a limited basis in mid-2006 and fully in January 2007. Since then, it has provided motorists a trip time of 10 min or less for their morning and afternoon commute into and out of Tampa. This has yielded a time savings of 20–30 min for each of the peak-hour directions, thus delivering a time savings of up to 1 h per day at a cost of $3.

Travel time was not only substantially shortened, it became more reliable due to the safe conditions resulting from the express lane design and the elimination of vehicle conflicts caused by large trucks and numerous entrance and exit ramps. The reduced trip time also is responsible for enhanced public transit service from suburban Brandon to downtown Tampa. Within weeks of opening the REL, public transit ridership was up by over 40% on two express bus routes.

It is noteworthy that the REL is ahead of traffic forecasts. The forecast entries for the first year of operation was 12,500 vehicles per day. In February 2007, REL carried 15,960 vehicles.

Tolling system innovations. REL is the first transportation project in Florida to employ a totally cashless toll collection method known as "open road tolling," and it is the first implementation of free-flow tolling in a configuration wider than two lanes for the SUNPASS™ statewide electronic toll collection system (**Fig. 2**). In addition, video toll collection was added to ensure open access to all users, with or without a transponder.

The toll-by-plate program creates a unique video toll account (VTA) for occasional users who may call a special toll-free number in advance of using the REL, or up to 72 h after use, to register for a VTA. By providing their license plate number and a credit card, motorists may register for either a limited time use of the facility or for an on-going VTA, which only requires a minimum $5 balance in a prepaid account.

The toll system has been made more customer friendly by changing the overall philosophy of identifying violators. Under normal business practices for electronic tolls in the United States, violators are identified as those vehicles without a transponder or an ETC account. By providing multiple payment options, motorists can enter and pay later. A violation is registered only when "failure-to-pay" occurs. Not only is this a more user-friendly approach to toll collection, it also has reduced mistaken violations and increased net revenues for the agency, while allowing the organization to focus its violation enforcement resources on those who intentionally and repeatedly refuse to pay tolls. *See* ELECTRONIC TOLL COLLECTION.

Construction and cost. The three-lane post-tensioned and steel-reinforced concrete bridge was constructed in 9-ft (2.7-m) segments (**Fig. 3**) at an off-site casting yard, delivered to the Crosstown Expressway, and then assembled in the median of the existing roadway, virtually eliminating any impacts to adjacent land uses, the surrounding community, or the environment.

The construction started with the installation of cast-in-place piers in the median. Subsequently, a steel truss designed for REL was placed between the piers to temporarily support the segments while they were being assembled, allowing much of the work to be performed from above, therefore minimizing impacts to the traffic on the existing Crosstown Expressway lanes below. All segments were match-cast at the casting yard, so the on-site assembly was rapid, the resultant geometry flawless, and assembly was expedient.

Weighing about 70 tons each, the 59-ft-wide (18-m) segments were delivered to the expressway on 13-axle flatbed trucks designed for the project. The segments were then assembled during off-peak times. After the segments were lowered onto the truss, they were pulled together with post-tensioned steel cables inside the bridge.

Concrete segmental bridge construction is most efficient for longer structures and the efficiency increases as the length of the project increases. With more than 3000 segments, REL took advantage of the "cookie cutter" approach to bridge development. The total contract cost for the project was approximately $300 million in year 2004 terms. This includes all of the planning, design, right-of-way, construction, and construction management and inspection for the reversible express lanes and the two gateways. The cost also includes the electronic control and safety systems required to operate the lanes and the new three-story traffic management center.

The actual contract price for the 17.5 lane miles of bridge structure was just over $100 million. At approximately $120 million, the deck cost for the segmental bridge portion of the project was approximately $65 per square foot, far below the average cost for structures in Florida during the past 20 years. The average cost per lane mile for the reversible bridge is approximately $7 million and is among the lowest for bridges constructed in the United States.

The bulk of the construction funding for the REL was provided through a combination of revenue bonds and loans. One of the most interesting financing components was a unique loan from the State of Florida. In 1999, based on an endorsement from the Florida Transportation Commission which called the REL project "... a unique demonstration of innovative ideas, new technology and the beneficial impact of transportation on economic development and urban revitalization," Florida loaned the Expressway Authority $25 million in order to accelerate construction.

Worldwide applicability. Several of the concepts employed on REL have direct application to urban transportation needs worldwide. The concept of increasing the capacity of transportation corridors through innovative design and maximizing the use of existing public rights-of-way is directly applicable to traffic congestion problems in all urban areas (tolled or not). The tolling technology, payment, and enforcement programs are applicable to other express toll lanes, high-occupancy-toll (HOT) lanes, and open road tolling facilities everywhere.

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For background information *see* HIGHWAY ENGINEERING; PRECAST CONCRETE; TRANSPORTATION ENGINEERING; HIGHWAY BRIDGE in the McGraw-Hill Encyclopedia of Science & Technology.

Panos D. Prevedouros; Martin Stone

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