# WORK ZONE SAFETY AND MOBILITY ISSUES: A CASE STUDY ON DAN RYAN RECONSTRUCTION PROJECT

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## ABSTRACT

Due to the significance of the Dan Ryan reconstruction project with a total cost close to $1 billion and its proximity to downtown Chicago and the densely populated suburbs; IDOT has taken some extra measures to ensue safety and mobility during the construction of the project. The main objectives of this study are to review and document information pertaining to the reconstruction project; review work zone safety practices, safety programs, and implementation of transportation management plans; analyze the roles and responsibilities of various parties involved in the project; and assess the work zone impact on safety and mobility of the transportation network. Based on our interviews and collected information, the project has been very successful without any worker fatality; fewer crashes are recorded in the work zones; and its impact on the mobility of the transportation network in the Chicago area is minimal.

Our observation shows that construction worker safety is a concern. Contractors take a sole responsibility of their workers' safety. Worker injury data is not reported. Two areas are recommended for improvement for the purpose of continuous work zone safety and mobility enhancement: 1) enhancing vehicle crash and worker injury data collection, and 2) establishing training programs for safety inspectors and supervisors.

## INTRODUCTION

Work zone safety is a big concern in the United States. On average, over 1,000 fatalities and 40,000 injuries are reported every year due to work zone crashes. In the meantime, the growth in highway miles and system capacity expansion are falling far behind the increase of traffic demand. In many places, highway congestion has been increasing in at alarming rates. On the other hand, many of the nation's highways have passed their useful design lives and more frequent reconstruction or repairs are needed. As a result, more and more work zones appear in the highway network. With construction and repairs taking place while growing traffic continues to pass through the work zones, it imposes greater pressure to contractors to compress schedules, reduce construction duration, and perform work at night while maintaining safety and quality. Mobility, often referred to as duration and reliability of travel time, is a key factor associated with work zones as travelers get frustrated with excessive delays and unexpected road conditions caused by work zones. This is particularly a concern to road users when a project is in progress but no work appears to be going on, yet congestion and delays continue to occur (Huebschman et al., 2003).

Highway construction workers are at risk for fatal and serious injuries when working next to passing motorists, construction vehicles, and equipment. For the period 1995-2002, 844 workers were killed while working at road construction sites. More than four-fifths of occupational fatalities that occurred at road construction sites were caused by transportation incidents. Most prevalent cause was workers struck by vehicles or mobile equipment, which accounted for approximately 60 percent of all fatal work injuries that occurred at road construction sites. The state of Illinois had 36 out of the 844 fatal incidents during 1995-2002 (Pegula, 2004). For Laborers' International Union of North America (LIUNA) members with over 38 percent of its members being employed in road construction activities, employment is hazardous. An internal survey of death certificates for LIUNA members who died on the job showed an overwhelming 73 percent of on-the-job fatalities occurred in road and highway construction (LHSFNA, 1998).

Historically, efforts to reduce vehicle-related worker injuries focused on improving traffic control devices and work zone configurations to minimize confusion of motorists passing through the work zone and to limit collisions involving motorists. The premise has been that by minimizing vehicle collisions in work zones, worker injuries are minimized. However, fatality data indicate that workers being struck by motorists passing through the work zone account for only half the vehicle-related fatalities among highway workers (NIOSH, 2001).

This case study aims at reviewing and documenting information pertaining to the reconstruction project; reviewing work zone safety practices, safety programs, and implementation and transportation management plans; analyzing the roles and responsibilities of various parties involved in the project; and assessing the impact of the work zones on safety and mobility of the transportation network.

## BACKGROUND OF THE DAN RYAN EXPRESSWAY

The Dan Ryan expressway (I90/94) was first designed and built during 1961-1963. It runs from the downtown circle interchange with I-290 through the south side of Chicago to the I-57/I-94 interchange. In the year 1963, just over 150,000 vehicles traveled on the expressway each day. The traffic volume on the Dan Ryan reached 320,000 vehicles per day before its reconstruction, making it one of the busiest highways in the nation. Its intended design life has also been surpassed by more than 20 years (IDOT, 2006[2]).

As the busiest expressway in the region and at 40 plus years of age, the Dan Ryan was in dire need of reconstruction. As shown in Table 1, the number of work zone crashes including fatalities and injuries on this 9-mile segment of the interstate highway exponentially increased in the last three years prior to the mainline reconstruction starting in 2006. The data for 2006 was not available at the time when the paper was written.

**TABLE 1 Summary of the Work Zone Fatalities, Injuries, and Crashes on Dan Ryan Expressway before the Mainline Reconstruction**

| Year | | 2003 | 2004 | 2005 |
|---|---|---|---|---|
| No. of Fatalities/Fatal Crashes | | 0/0 | 2/2 | 11/9 |
| No. of Injuries | | 28 | 136 | 520 |
| No. of Crashes | No. of Fixed Object Crashes | 2 | 28 | 51 |
| | No. of Rear End Crashes | 14 | 105 | 442 |
| | No. of Sideswipe Crashes | 2 | 49 | 325 |
| | No. of Others Crashes | 5 | 21 | 43 |
| | Total No. of Crashes | 23 | 203 | 861 |

There were a total of eleven (11) fatal crashes with 13 fatalities occurred in the three-year period. It is worthwhile to point out that nine out of the 11 fatal crashes concentrated at two sites as shown in Figure 1. The detailed map of Site 1 (not included due to space) shows the lane configuration of the crash site: a curved segment on Dan Ryan with no-lane change allowed until the end of the segment, merging from I55, and beginning of express lanes which force quick lane changing before the separation of the express lanes and the local lanes. These factors may have jointly contributed to the five crashes. Site 2 with four fatal crashes as shown in Figure 1 is the separation of I90 (Chicago Skyway) and I94. Drivers' confusion and last minute lane changing to their desired directions may have contributed to those severe crashes.

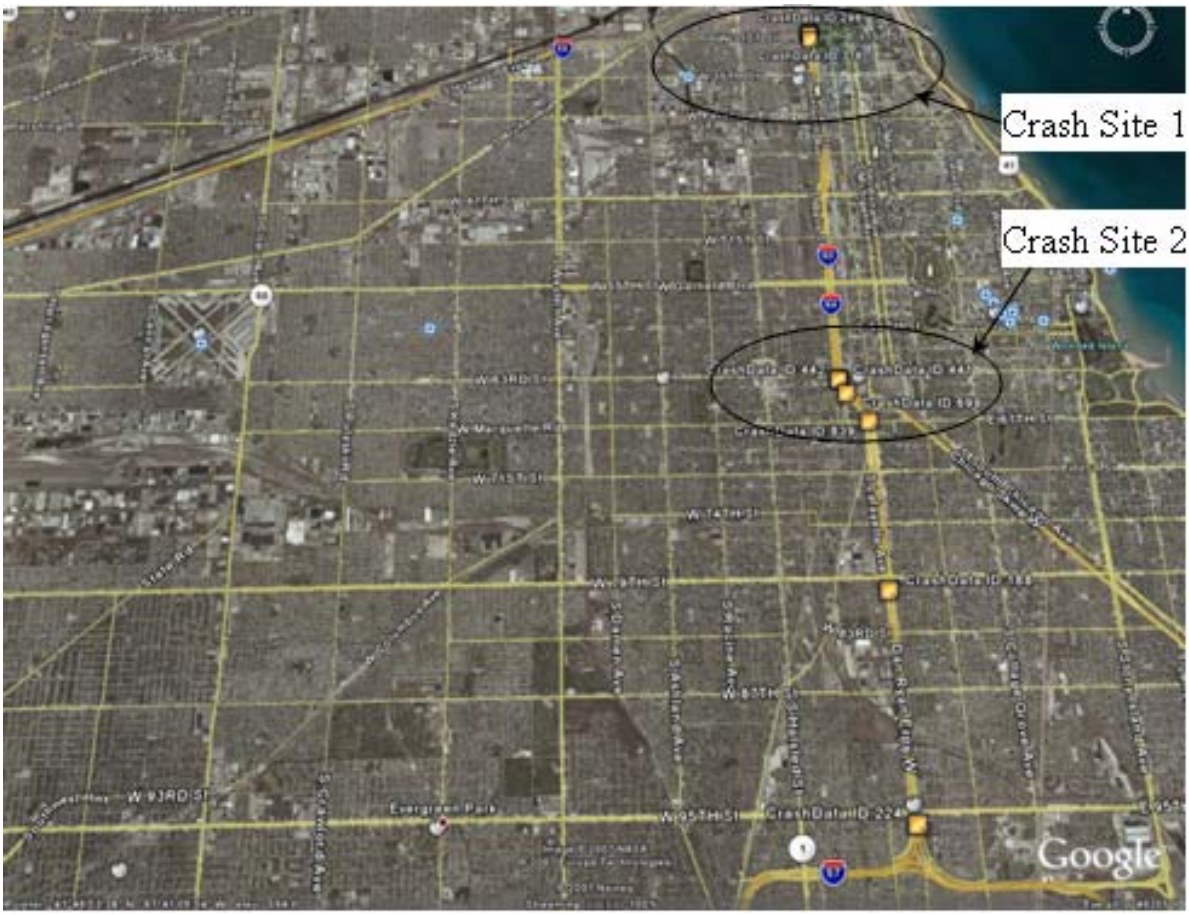



**Figure 1 All 11 fatal crashes marked on the map**

High crash rates and growing traffic volumes warranted a modern design and roadway expansion to help south side Chicagoans and Interstate travelers pass through this traffic bottleneck faster. Upon completion of this project, road users will enjoy safer driving conditions with increased capacity and an enhanced aesthetics. The improved geometric design will reduce crash frequencies and eliminate bottlenecks in traffic flow.

Dan Ryan mainline reconstruction started in 2006 and will be completed by the end of 2007. The project will rebuild the deteriorating pavement and add a lane in each direction, reconfigure many exit and entrance ramps to reduce crash rates, improve drainage to eliminate flooding, and improve the Skyway interchange (IDOT, 2006[2]). The project scope is shown in Figure 2 with an estimated cost close to $1 billion.

## WORK ZONE SAFETY MANUALS, GUIDELINES, AND PROGRAMS

The Federal Highway Administration (FHWA)'s Manual on Uniform Traffic Control Devices defines a work zone as an area of highway with construction, maintenance, or utility work activities. Signs, channelizing devices, barriers, pavement markings, and/or work vehicles typically mark a work zone. A highway work zone presents hazardous conditions to both drivers and construction workers. The presence of workers, construction machinery, roadside construction barriers, and other paraphernalia associated with the work zone create

high degree of conflict that leads to hazardous driving conditions (Khattak et al., 2002). Temporary traffic control intends to provide safe and efficient movement of vehicles, bicyclists, and pedestrians through and around work zones and, in the meantime, to protect construction workers and equipment.


**Figure 2 Scope of the Dan Ryan Reconstruction Project**

In the Dan Ryan reconstruction project, the work zone design must incorporate the need of different road users, such as vehicles, bicyclists, and pedestrians. It is also important to consider the activity area, additional surrounding ramps, and frontage roads when the temporary traffic control plans are designed and implemented.

## The Configuration of a Work Zone

A work zone or temporary traffic control zone includes the entire section of a roadway between the first advance warning sign through the last traffic control device, where traffic returns to its normal path and conditions. According to the Manual on Uniform Traffic Control Devices (MUTCD), a work zone is divided into four areas as shown in Figure 3: 1) advance warning area, 2) transition area, 3) activity area, and 4) termination area. Each of these areas has a specific function and may change in size and location depending on the specifics of the work zone (FHWA, 2003). The functions of the four areas are described as follows:

*a. Advance Warning Area*. In this area, drivers are informed of what to expect. The advance warning may vary from a single sign or flashing lights on a vehicle to a series of signs in advance of the temporary traffic control zone transition area.

*b. Transition Area.* The transition area is the taper or area in which the traffic must be channelized from the normal path to a new path through a series of channelizing devices or pavement markings positioned to move traffic out of or into its normal driving path.

*c. Activity Area*. The activity area is the area of the work zone where the actual maintenance or construction takes place. It is composed of the work space, traffic space, and often one or more buffer spaces. The work space is that portion of the roadway closed to traffic and set aside for workers, equipment, and material. Long-term work spaces are usually delineated by channelizing devices or shielded by barriers to exclude traffic and pedestrians. The traffic space is the portion of the roadway in which the traffic is routed through the activity area. The buffer space is the optional feature in the activity area that separates traffic flow from the work activity or any potential hazard and provides recovery space for errant vehicles. No activity nor equipment or vehicles is allowed in this space.

*d. Termination Area*. The termination area is used to return traffic to the normal traffic path. The termination area extends from the downstream end of the work area to the END ROAD WORK signs.

### Manual on Uniform Traffic Control Devices

The MUTCD defines the standards used by road professionals nationwide to design, install and maintain traffic control devices on all streets and highways (FHWA, 2003). It is the major safety reference and guide book for all parties that have a stake in roadways such as insurance industry, law enforcement agencies, academic institutions, private road construction and engineering industry, and public transportation agencies. It should be noted that MUTCD provides only the minimum requirements for work zone traffic control. Like the state of Illinois, many state agencies adapt additional or supplemental MUTCD Standards.

In the Dan Ryan Reconstruction Project, the design consultants extensively used MUTCD for developing traffic control and maintenance plans. The contractors must fully comply, implement, and maintain the ‘traffic control devices’ per the transportation management plans. The Dan Ryan project is staffed with 24-hour Traffic Control Personnel on-site to make sure all traffic control devices in working conditions.

## MAJOR PARTIES AND RESPONSIBILITIES IN THE DAN RYAN PROJECT

The participants of the Dan Ryan reconstruction project can be divided into three groups: the owner, the consultants, and the contractors. Their roles and safety practices are described in this section.

### IDOT’s Role and Responsibility

*General Safety Practices*

Highway infrastructure owners (i.e. the Federal, state, and local governments) must take responsibility for ensuring that workers and motorists are protected from construction hazards in a work zone. IDOT requires specific safety provisions and practices in contractors’ bids on how to protect workers and motorists by including the following items (Huebschman et al., 2003): 1)

Show evidence of effective road construction safety and health programs; 2) Ensure training in both traffic and non-traffic hazards for workers; 3) Use appropriate personal protection equipment (PPE) such as high visibility apparel and head protection; 4) Use traffic protection barrier systems for workers such as truck mounted attenuators, moveable concrete barriers, portable water-filled barriers and other systems that positively separate workers from traffic. Tools like saws require guards to protect fingers and limbs, yet workers on roadways are often exposed to tons of vehicular metal moving at speeds greater than 70 mph with only a few plastic cones for a guard; and 5) Use collision avoidance technologies on construction vehicles to prevent dump trucks, earthmovers and paving equipment from backing or running over people and other objects in work zones.

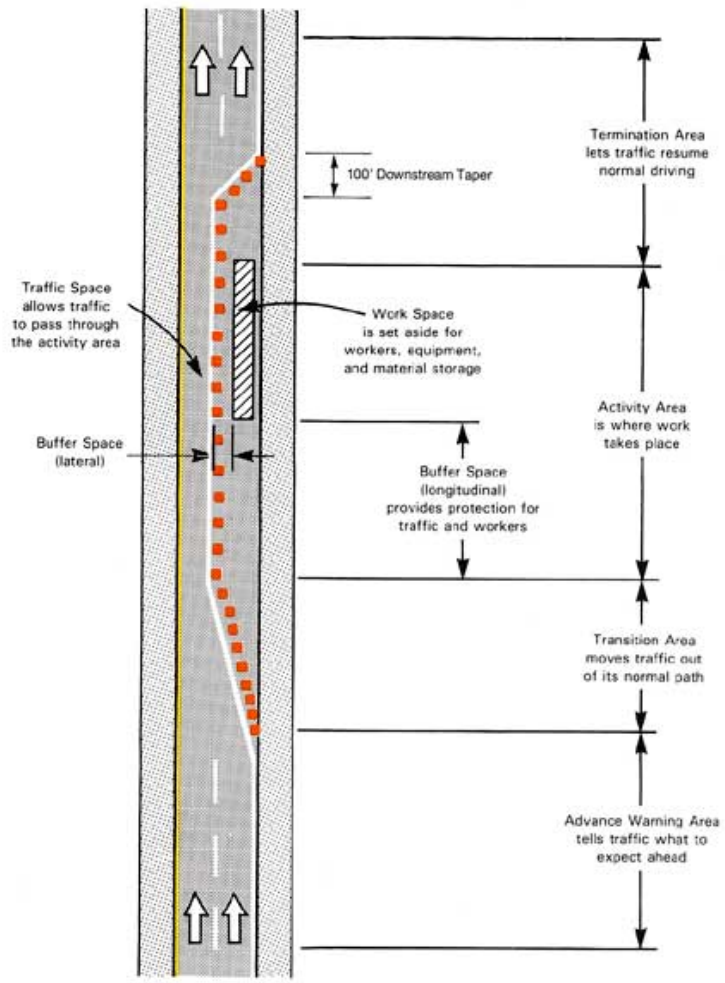



**Figure 3 Configuration of a temporary traffic control zone**

*Best Practices*

Work zones may result in inconsistency in queue lengths in a roadway system. Such inconsistency is especially dangerous because it can surprise motorists and cause rear-end collisions. This type of incident tends to occur most frequently on interstate patching projects (IDOT, 2006[1]). IDOT has taken note of a pattern of severe crashes when queues are formed due

to work zones. Several practices have been taken to improve safety and traffic flow in and around work zones as follows (IDOT, 2006[1]):

- In order to provide sufficient traffic capacity, a busy work zone would maintain at least two operational lanes in each direction during construction by utilizing the shoulders;
- IDOT engineers use the average daily traffic (ADT) to predict when queues may develop. When ADT on a roadway exceeds 20,000, traffic would be slow and long queues would form during construction. A greater than usual effort is required for traffic maintenance plans;
- New technologies, such as the Dynamic Lane Merge System, are used or are under consideration for use to direct drivers to merge safer and faster at a taper;
- Vertical barricades (Type II) and 42" cones are used to replace barrels. Barrels make drivers feel uneasy and lead them to slow down and result in queues. The improved barricades provide a safer driving condition;
- IDOT has worked with contractors to change some construction procedures to reduce the frequency of lane closures on the same roadway;
- Various signs, such as flashing amber and variable messages, are used to alert motorists of a work zone in advance.

*Special Measures on the Dan Ryan Project*

Due to the proximity of the project to the downtown Chicago area as well as the surrounding communities, several special safety measures, mandated by IDOT, have been implemented specific to this project during the construction period.

Emergency Traffic Patrol (ETP), a branch of IDOT, hosts monthly safety meetings three months before actual lane closure. Attendants of the monthly safety meetings include ETP, contractors (Walsh Construction and its subcontractors), IDOT representatives (project managers, engineers, traffic control engineers), Chicago Police Department, Chicago Fire Department, Illinois State Police, and the Consulting Engineers. The purpose of the monthly safety meetings is to discuss the upcoming lane closures, ramp closures, construction staging, and potential impacts of these actions and feasible solutions, emergency traffic routes and procedures. These meetings provide the opportunity for all relevant parties to preplan their course of action and check their readiness to accommodate the impact of anticipated lane closure and construction activity to traffic and the community.

In addition to the monthly safety meetings, each IDOT construction team (including an IDOT resident engineer, consultant engineers, contractors, design team) has its weekly coordination meetings to review upcoming scheduled work and to discuss any corresponding traffic issues.

In addition to safety meetings, several hard safety measures are actively in place. IDOT resident engineers spend about one-third of their daily time on safety inspections and solve relevant problems. They conduct two drive-thru inspections every day one in the early morning and the other in the evening to inspect both worker's safety and the transportation management plans. ETP maintains a daily 24-hour presence on the Dan Ryan.

**Consulting Engineers' Role and Responsibility**

Consulting engineers working with IDOT are divided into two teams:

- Design Team: Designers prepare transportation management plans based on MUTCD requirements and IDOT supplementary safety requirements.
- Construction Management Team (CM): CM is responsible for managing the construction of the project.

The consultant considers the following points during design: 1) decrease the need and use of work zones through the design effort; 2) reduce the traffic/ worker interface through positive separation; 3) maintain traffic flow through work zones; 4) review products and practices to encourage state of the art best practices; 5) continue to learn from active work zones through successes and near misses; and 6) bring to resolution work zone issues of statewide interest (WADOT, 2006).

The duty of the CM is to make sure that the contractors are in full compliance with the transportation management plans and actual implementation of the plans. The CM sends its safety engineer/inspector twice a day to drive through the work zone area and inform the general contractor if any discrepancy is discovered in the field. The field inspector fills out an IDOT traffic inspection form and turns it to the resident engineer/ assistant resident engineer twice a day (Morning/Evening).

**Contractors' Role and Responsibility**

Statistics revealed that one third of the worker fatalities are caused by struck-by traffic vehicles, or by being involved in vehicle crashes themselves as drivers or riders in vehicles on public roadways. The remaining two-thirds of the worker fatalities are largely due to incidents that happen inside work zones such as being run over by moving construction equipment, equipment rollovers, contact with utilities, and employees being struck by tools, materials and trees during the construction process. We found that the most common causes of non-fatal injuries involve back strains and other ergonomic issues, falls, and being struck by construction tools, materials, and trees.

The general contractor in the Dan Ryan Project does not have any formal safety training programs for its workers. Instead, they use safety programs/training offered by other sources, such as the Roadway Work Zone Safety Coalition Signatories, American Road and Transportation Builders Association (ARTBA), International Union of Operating Engineers (IUOE), LIUNA, National Asphalt Pavement Association (NAPA), and NIOSH.

On the Dan Ryan project, the general contractor has its full time safety engineers driving around in the work zone area to ensure traffic flow and safety. The general contractor hires a subcontractor for traffic maintaining services. The sub must file traffic control surveillance report daily and is responsible for maintaining traffic control devices up to the MUTCD standards. If there are any noted deficiencies from the MOT Plans, the traffic control subcontractor is immediately notified. The traffic control subcontractor typically has 24 hours to correct any major deficiencies, and 2-4 hours to correct any minor deficiencies, such as barricade realignment or sign relocation. If any deficiency in traffic control devices is not corrected in a timely fashion, IDOT has the right to impose a fine.

The traffic control subcontractor must also maintain a 24-hour presence on the job-site. The subcontractor must provide three contacts, available 24 hours a day, to the IDOT resident engineer and consulting engineers. The traffic control subcontractor must submit a Traffic Control Surveillance Report every 4 hours, detailing any deficiencies that need and were corrected.

## WORKER SAFETY

It has been noted that many specific measures have been taken to improve traffic planning, control and safety. These measures and compliances are transparent and accountable. As the project owner, IDOT is the major driver of these safety measures. In contrast, the responsibility for construction worker safety mainly relies on the general contractor. The other parties including IDOT and its safety consultants have very little to do, such as checking for compliance with regulations and correcting unsafe operations. This section describes worker safety issues based on our observations and interviews of the site personnel.

### Worker Safety for IDOT and Its Consulting Engineers

IDOT requires all resident engineers, assistant resident engineers, and its consulting engineers to take the 10-hour OSHA Safety Training Course. There was only one consulting engineer injured on the jobsite last year. The incident was reported, fully investigated by the police, and properly recorded. The incident occurred when a surveyor was trying to stop a thief from stealing a piece of surveying equipment on the site.

### Construction Safety Inspection by IDOT and Its Inspectors

*Recording Unsafe Operations*

All consulting inspectors are required to report on the contractor's unsafe performance in their daily reports. The office engineer also records any unsafe incidents in the Master Daily Diary and reports to the IDOT resident engineer. When an inspector sees an unsafe operation, she/he informs the contractor's foreman of the unsafe practice and the act of documenting the incident. IDOT may issue a no-compliance notification to the contractor and demand changes to be made to its operations.

This seems a major concern for the IDOT resident engineers and the inspectors. The only legal option for them to intervene an unsafe operation is to threaten not to pay the contractor for that non-compliant portion of the work. In reality, these threats usually cannot be materialized. Delicate legal issues are involved including time, money, and liability because the contractor may claim damages for work stoppage due to instructions given by the inspector. Inspectors are often afraid of threatening the contractor with a no-pay threat because a threat is always contested by the contractor. At the contest, the inspector, often young and inexperience, is faced with the contractor's seasoned and experienced project manager. This makes it difficult for any 'No Pay' threats to win a contest. Therefore, contractors usually don't take no-pay threats seriously.

*Reporting Repetitive Unsafe Operations to OSHA*

OSHA Regulations allow anyone to file a complaint of any safety concern, such as from employees, media referrals (Police or Fire Departments), or a passer-by individual who visually sees a possible safety violation. When a complaint reaches the area director or a compliance

safety and health officer, the complaint is documented and a referral number is assigned. The area director or the compliance safety and health officer then determines if the complaint presents a potential safety violation, and schedules a site inspection as soon as practical. The inspection shall not be limited to the matters referred to in the complaint.

The procedure for reporting a complaint by an employee is summarized in the following: Any employee or representative of an employee who believes that a violation of the Act exists in any workplace may request an inspection by giving notice to the area director or to a compliance safety and health officer. Any such notice shall be given in written with reasonable particularity about the grounds of the notice, and shall be signed by the employee or representative of the employee. A copy shall then be handed over to the employer no later than at the time of inspection. Upon receipt of a notification, a compliance safety and health officer determines whether a reasonable ground exists to warrant an inspection.

The report of an unsafe operation documented by IDOT resident engineers and consultant engineers does not go to OSHA office directly. Unless no corrective action is taken after non-compliance notification, the IDOT Construction Team may choose to file a complaint to OHSA. This practice indeed happened in the project.

**OSHA's Role**

*Routine Inspections*

OSHA makes 4-5 inspection visits a year to the project site. The general practice is that the OSHA compliance officer does not give any advance warning but to show up on the site and introduce himself/herself to the contractor's foreman, who then contacts the necessary contractor personnel for the Officer to inspect any questionable operations. Check-in at the contractor's site trailer is optional. The compliance officer does not have to give any advance notice to the workers. This eliminates any last minute efforts for non-compliance issues to be corrected and consequently not seen by the OSHA compliance officer. The compliance safety and health officer may consult with employees concerning matters of occupational safety and health to the extent they deem necessary for the conduct of an effective and thorough inspection. During an inspection, any employee shall be afforded an opportunity to bring any violation of the act in the workplace to the attention of the compliance safety and health officer.

*Citations*

Once a compliance safety and health officer observes safety violations, she/he can issue citations to impose a fine to the contractor. We found two serious citations: 1926.0652 A01 Requirements for Protective Systems and 1926.0651 C02 Specific Excavation Requirements. The first violation was cited with a Willful-Type Violation because the contractor previously knew the violation and did not correct it for the standard that requires each employee in an excavation to be protected from cave-ins with an adequate protective system designed in accordance with this standard and that a stairway, ladder, ramp or other safe means of egress shall be located in a trench excavation if it is 4 feet or deeper so that no more than 25 feet of lateral travel for workers to get out of the trench. In the second case, a utility contractor was cited for not providing adequate means of egress from the trench excavation, resulted in a Repeat Type Violation because the offending company had a history of previous violations of this standard.

### Construction Worker Injury Data

The general contractor collects detailed worker injury data. However, the data is not reported to any government agency. The OSHA office in Illinois mandates reporting of fatalities and any serious incidents involving at least three workers. We checked with the OSHA district office and found no worker injury record for the Dan Ryan project. We attempted to get the worker injury data from the contractor, but was unsuccessful. IDOT cannot force the general contractor to release such information.

## DAN RYAN MOBILITY IMPACT ANALYSIS

Dan Ryan expressway (I90/94) is one of the busiest roadways in the country with over 320,000 traveled vehicles every day. Locally, it right crosses downtown Chicago and goes to the second busiest airport in the nation- O'Hare International Airport. It is the one of the main corridors connecting the states of Illinois, Indiana, Michigan, and Wisconsin. If not planned properly, the work zones could have significant impacts on the local and regional transportation network. Prior to the commencement of reconstruction, the particular section of the Dan Ryan had six traffic lanes (three express lanes and three local lanes) on each direction. The phased construction closed down three express lanes for reconstruction and the three local lanes remained open to traffic.

Before the closure of the mainline for construction, many channels were used to announce the expected reconstruction activity including news papers and a project website (http://www.danryanexpressway.com/). IDOT encouraged local commuters to take public transportation. Alternate routes were also designated with proper detour signs. Auto users were encouraged to take alternate roads and trucks were advised to stay on.

The efforts seem have worked well. Commuters followed the instructions. The IDOT's Traffic Systems Center recorded a maximum 46 percent reduction in the ADT volume for inbound and a 36 percent reduction in ADT for outbound. The ADT detector was installed at 31$^{st}$ and I90/94 next to IIT campus. These reductions in traffic volumes on the Dan Ryan had a significant influence on the local artillery routes.

As shown in Figure 4, the Dan Ryan Mobility Impact Map clearly indicates significant increases of traffic volumes on several major alternate routes parallel to Dan Ryan. IDOT designated two re-routes: Ashland Avenue and Stony Island, which registered 83 percent and 11 percent increases in ADT, respectively. South Lake Shore Drive also showed an increase in both inbound and outbound traffic volumes. As shown in Table 2, the morning inbound and outbound travel times increased by 21 percent and 22 percent, respectively; the evening inbound and outbound travel time increased by 13 percent and 5 percent, respectively. The largest increase in travel time was 7 minutes, which indicated not a significant impact on the corridor transportation network. Since travel times on local alternate roads were not collected, we were unable to assess Dan Ryan's impact on the local transportation network. Nevertheless, we can conclude that the traffic control plan has successfully re-routed almost half of the normal traffic volume on I90/94 to the local alternate routes and has minimized the impact of the major reconstruction project on the regional/corridor transportation network.

**Table 2 Comparison of Travel Times on Dan Ryan Before and During Mainline Reconstruction (95th Street to Roosevelt Road)**

| Travel times (in minutes) | 7:00-9:00 AM North Bound | 7:00-9:00 AM South Bound | 3:00-7:00 PM North Bound | 3:00-7:00 PM South Bound |
|---|---|---|---|---|
| Construction Average | 32 | 18 | 29 | 32 |
| 2005 Historical Average | 25 | 14 | 25 | 30 |
| % Change | 21% | 22% | 13% | 5% |

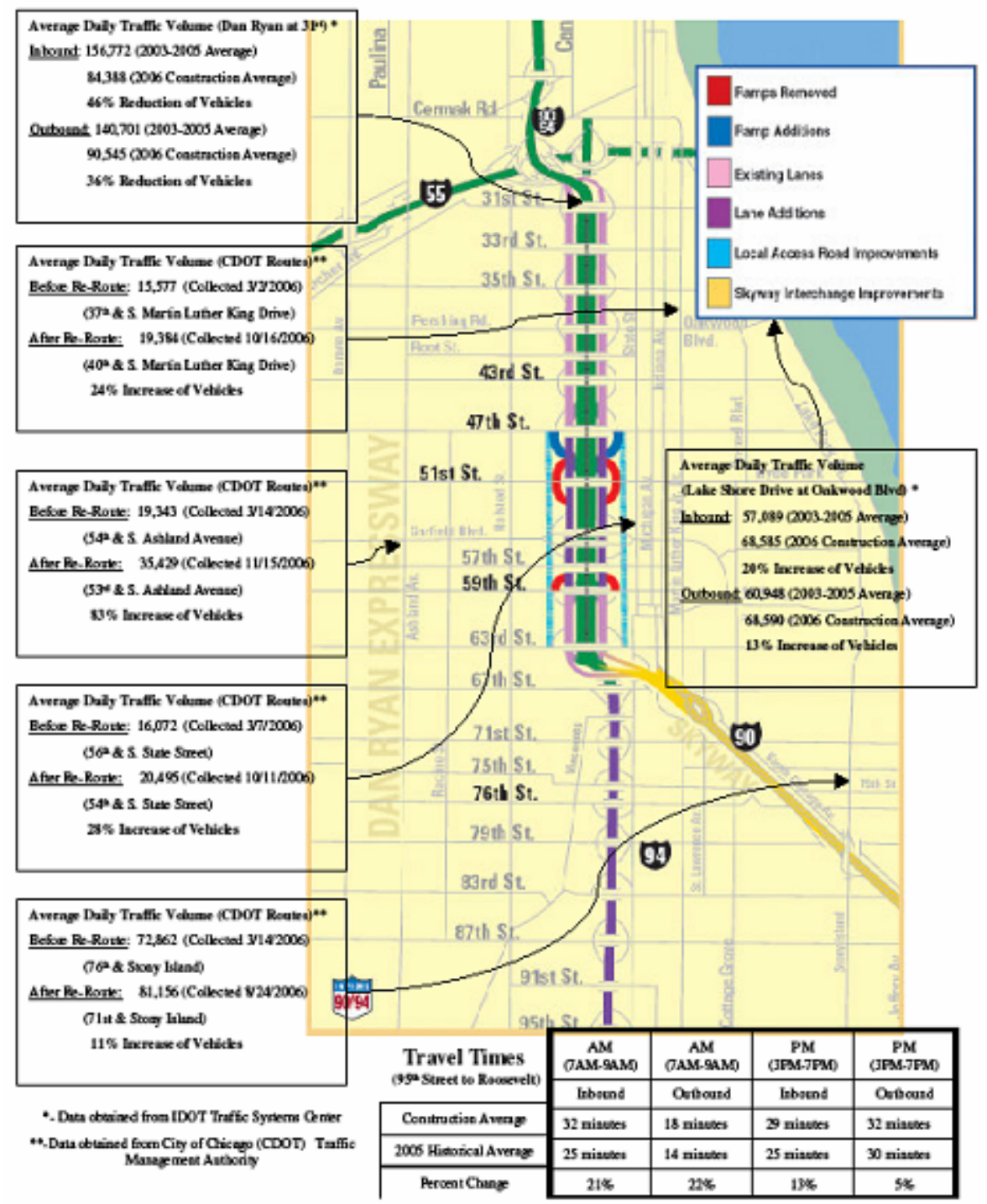
## CONCLUSIONS AND RECOMMENDATIONS

Due to its magnitude with a total construction cost close to $1 billion and its proximity to the downtown Chicago area as well as the surrounding communities, the Dan Ryan Reconstruction project has taken some special measures to ensue its safety and mobility. Based on our interviews and collected information, the project has been very successful without any worker fatality; the work zones recorded less crashes; its impact on mobility is materialized at an increase in travel time in the range between 5 to 22 percent depending on the time of travel during the day. Our major observations are as follows:

- *Proactive Pre-planning*. Pre-construction planning is effective for improving traffic safety and work zone mobility. As early as three months before an actual lane closure, the monthly incident management meetings hosted by the ETP started to coordinate various parties to come up with detailed traffic control plans and emergency response plans, to assess potential impacts on the roadway system, and to seek answers for traffic-related questions.
- *Worker Safety is a Concern*. Several reasons lead us to this conclusion: 1) the contractors take a sole responsibility of worker safety; 2) IDOT and its consultants have little to do for the purpose of improving worker safety; 3) worker injury data essential for analyzing a contractor's safety performance is not available; 4) besides the contractor's internal programs and OSHA's site inspections every 2-3 months, no other forceful measures are in place for ensuring worker safety; and 5) worker safety is not used as a criterion to encourage the contractor to improve its safety performance.

This case study has identified two potential areas for improvement as the continuous efforts for enhancing work zone safety and mobility:

- *Vehicle Crash and Worker Injury Data Collection*. Quality traffic and worker injury data is essential for analyzing the performance of a work zone and for exploring ways to improve performance in future work zones. Work zone crash data usually cannot be made available weeks or even months after the work zone has changed its status. On the other hand, contractors are usually reluctant to release their worker injury data. There is no effective measure to force a contractor to release such information.
- *Training Programs for Assistant/Resident Engineers and Safety Inspectors*. When a resident engineer and safety inspector are responsible for inspecting and documenting a contractor's safety performance, more safety and legal knowledge is needed to empower them with the ability to identify unsafe operations and with legal means available to guide the contractor to comply with the OSHA regulations.




**Travel Times**
(95th Street to Roosevelt)

| | AM (7AM-9AM) | AM (7AM-9AM) | PM (3PM-7PM) | PM (3PM-7PM) |
|---|---|---|---|---|
| | Inbound | Outbound | Inbound | Outbound |
| Construction Average | 32 minutes | 18 minutes | 29 minutes | 32 minutes |
| 2005 Historical Average | 25 minutes | 14 minutes | 25 minutes | 30 minutes |
| Percent Change | 21% | 22% | 13% | 5% |

**Figure 4 Dan Ryan mobility impact map**

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Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the Author(s) and do not necessarily reflect the view of the Federal Highway Administration.

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