# EXPEDITED CONCRETE BOX GIRDER BRIDGE REMOVALS OVER THE INTERSTATE IN ONE-NIGHT INTERSTATE CLOSURES

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**ANTHONY BOWER**
**FHWA – IOWA DIVISION**

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# EXECUTIVE SUMMARY

As part of the I-235 reconstruction project, the East 9th St. and Cottage Grove Bridges over I-235 needed to be removed. The concrete box girder structures could not be removed effectively during the normally allotted 20-minute Interstate closures. A special provision was developed to allow I-235 to be closed for one night for the complete demolition and removal of the bridges. One lane in each direction was to be open the next morning with the entire Interstate open early the following morning.

Detours were established using city streets to route traffic around the construction site. The Des Moines Police Department (DMPD) had officers stationed at the major intersections to help keep traffic running smoothly. Traffic lights were set to flash to allow the officers to properly control the traffic. Both permanent and movable Changeable Message Signs (CMS's) were used on the Interstate to communicate the Interstate closure to the traveling public. A close relationship with the media also helped to inform the public of the closures.

The E 9th Bridge was removed the night of April 13, 2002, using a mechanical, cutting/shearing method of removal. Four excavators with hammer attachments along with two large end loaders and dump trucks were used to break apart the bridge and haul away the rubble. Operators worked throughout the night to tear down the bridge. There were several breakdowns of the excavators, but the contractor was prepared for them. Repairs were made efficiently, and the machines were able to continue working.

The excavators began by cutting the top deck between the girders. Upon completion of the deck for the center span, a larger excavator began hammering at the outside girder web from below. It continued across the center span removing one girder at a time. The center span took approximately four hours to tear down. The smaller excavators were continuing their work on the deck in spans two and four of the five-span bridge. The entire structure was down early Sunday morning with the outside lane in each direction of traffic open by the 11 a.m. deadline. The entire mainline, including the Pennsylvania Ave. ramp, was re-opened Sunday evening.

The Cottage Grove Bridges were removed using the blasting method. The first was taken down June 1, 2002, with the other to follow one week later, June 8. Explosives were strategically located in the girders, abutments, pier caps and columns to implode the structure. Excavators with a hammer attachment worked to break apart the decks that were mostly intact, as an end loader filled dump trucks to haul away the rubble.

The morning deadline for opening a lane of traffic was not met for the first demolition. A westbound lane was opened two hours late while an eastbound lane was opened four hours after the deadline. The Iowa Department of Transportation (IowaDOT) is considering liquidated damages for the general contractor for failure to meet the deadline established in the contract.

Information learned from the first implosion was used the following weekend on the other Cottage Grove Bridge. Fewer explosives were used on the second bridge and more mechanical equipment was brought to the site. The lanes were easily opened by the afternoon deadline. This showed that as experience is gained in the removal process, more

effective use of time allows the contractor a better chance to complete the implosion by the stated time.

The removals were for the most part a success. The structures were removed safely without any major incidents. Improvements can be made to both methods to more effectively remove the remaining bridges on the I-235 corridor.

# MECHANICAL METHOD/EAST 9th BRIDGE

## PREPARATION

### DECISION

It was decided that the E 9th Concrete Box Girder Bridge could not be safely taken down in sections. The entire structure needed to be removed during one closure instead of during 20-minute temporary closures. The special provision, Attachment A, developed for this removal allowed the contractor the opportunity to close the Interstate for an entire night if he requested it. Work could begin on a Saturday night no earlier than 9 p.m. and would have to have at least one lane in each direction open by 11 a.m. Sunday morning.

### COORDINATION

The special provision for removal of concrete box girder bridges (Attachment A) indicates that the removal plan should be submitted to the IowaDOT no less than 30 days in advance of the removal.

A meeting was held a few days before the removal to discuss the entire process. The prime contractor along with the traffic control and the bridge removal sub-contractors discussed with IowaDOT and FHWA staff the process that would be used to remove the bridge. A final removal plan was submitted at this meeting to the IowaDOT bridge engineers to finalize the procedure. The DMPD attended this meeting to help coordinate traffic control with the contractors. A detour route was finalized and all questions were clarified. A test run of the detour was set up to practice the closure and to handle any problems that arise. This is discussed further in the Detour section below.

This meeting was a vital component in the success of the demolition. It was the only opportunity for both sides to meet and discuss the plan and special provisions. There were a few items that needed to be clarified such as the use of roadway protection. The contractor did not intend to use protection, but was reminded there was a note in the special provisions that required it. This is covered in detail in the Roadway Protection section below.

### PREPARATION OF THE BRIDGE

The contractor began working on the bridge a few days before the actual removal. This work was done on the bridge while traffic was still allowed on the Interstate below. Two-foot square openings were cut in the deck to allow access into the box girders to remove wooden forms that were left in place during construction (Attachments 1 and 2). These holes also provided an opportunity for the contractor to locate the girders and diaphragms to make sure the initial slotting of the top deck did not damage these elements. The metal handrail was also removed.

The contractor had the option to remove the protective chain-link fencing, traffic signs for the Interstate, and a light pole that stood on the bridge. They opted to leave these in place, and they were easily removed by the excavators at the beginning of the demolition.

## TRAFFIC CONTROL

INTERSTATE CLOSURE

I-235 needed to be closed for the removal of the bridge for the safety of both the traveling public and the construction workers. During the workweek, the traffic volume can exceed 5000 VPH in one direction for short periods of time. The traffic volume at 9 p.m. on Saturday drops to 3000 VPH total for both directions. During the overnight hours, the volume on the Interstate drops to the range of 200-800 VPH. Sunday morning was determined to have the lowest morning traffic volume that lasted furthest into the morning. This information led to the determination that the safest time to close I-235 would be Saturday night and into Sunday morning. The Interstate was closed at 9 p.m. Saturday night. The special provisions required one lane in each direction to be open by 11 a.m. Sunday morning and all lanes open including the ramps by 6 a.m. Monday morning.

Changeable Message Signs were used in advance of the Greater Des Moines area as well as closer to the work zone to notify the traveling public of the closure. Figure 1 below indicates where the permanent CMS's are located. The signs stated the point of the closure and suggested through traffic use the alternate route, I-35/80.

The contractor was allowed to close a few of the ramps early, but was not able to begin the closing process on the mainline until 9 p.m. Construction began as soon as the Interstate was completely cleared at 9:25 p.m.

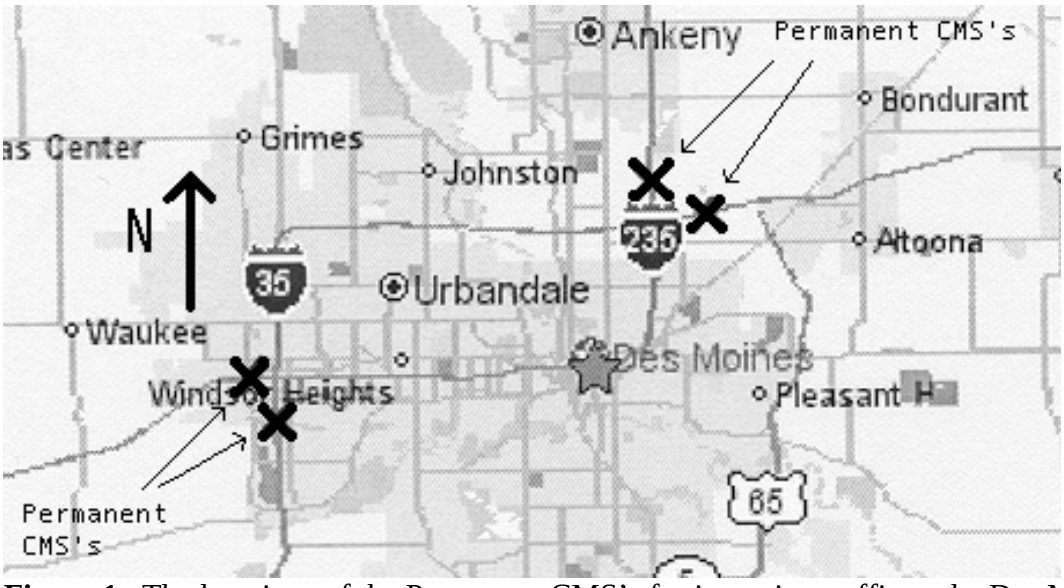



**Figure 1.** The locations of the Permanent CMS's for incoming traffic to the Des Moines area. The star indicates the location of the E 9th Bridge removed on I-235.

There were a few vehicles that accidently entered the work zone, but were safely directed out of the closed area.

DETOUR

The detour took Interstate traffic through local city streets and back onto the Interstate. Traffic signals along the detours were switched to flash allowing the DMPD officers to direct traffic and have it flow more efficiently. Figure 2 shows the detour path for the Interstate traffic during the closure.

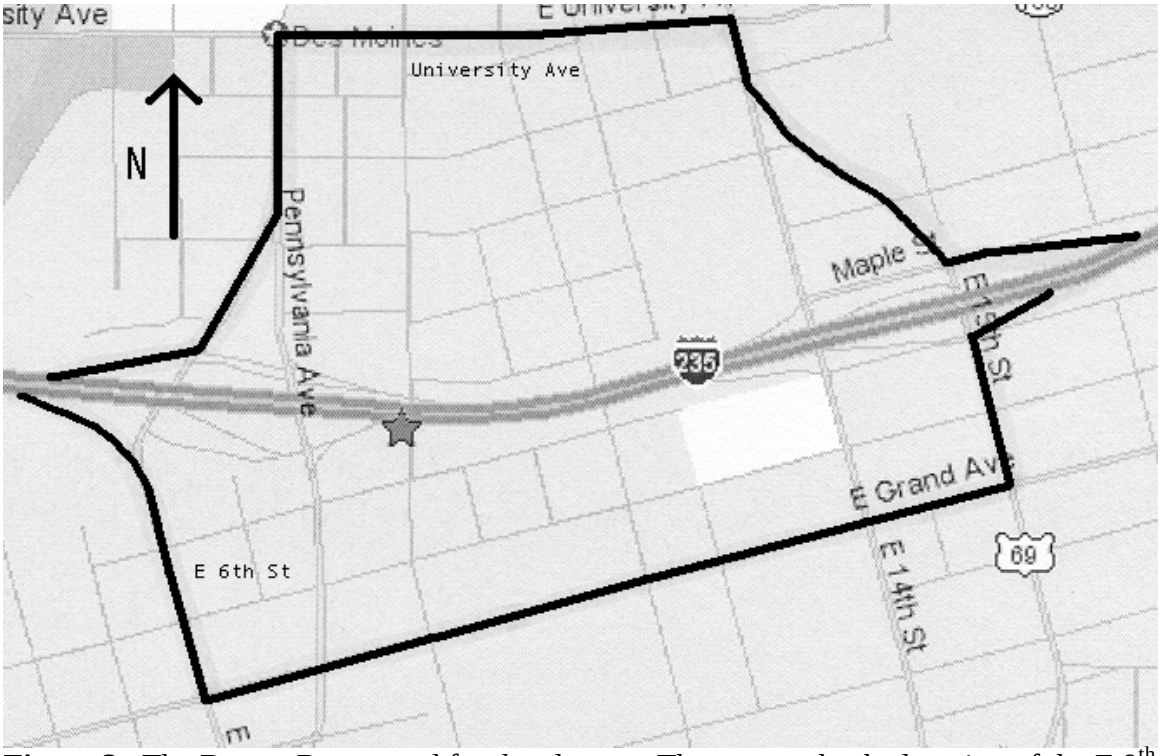



**Figure 2.** The Detour Route used for the closure. The star marks the location of the E 9th Bridge.

There was a sign truss that was an obstruction to the contractor and needed to be taken down before the work on the bridge could begin. This presented the contractor with an opportunity to close the eastbound lanes for a few hours as a practice run to see if the detour plan would be effective. It took approximately 1.5 hours to completely close the one direction of traffic. This was much longer than expected. In order to speed up the process for the bridge removal, the contractor was allowed to close the ramps in the area before the closure. The practice closure allowed these details to be resolved before the night of the demolition.

Reports from the DMPD stated that there were no accidents caused by the detour. The only problem was that the traffic volume leaving downtown at 9 p.m. caused a backup of vehicles from the exit back into downtown. It was proposed that on similar future projects the closure is delayed until later at night.

RE-OPENING OF INTERSTATE

The deadlines were met. One lane of traffic in each direction was re-opened by 11 a.m. Sunday. Attachment 3 is a view, looking north, of the construction site at approximately 1

p.m. Sunday afternoon. This photo shows the traffic passing through the single open lane in each direction through the work zone. Traffic was slightly backed up at this point in time, but moving reasonably quickly through the work zone.

By 4 p.m. Sunday afternoon, the mainline was open in both directions. The contractor was still working on the abutments, but all work requiring equipment to be on the mainline was complete. The westbound Penn Ave. exit ramp, which passed through span four, remained closed to allow easier access to the north abutment. This ramp was opened Sunday evening.

## BRIDGE REMOVAL

### EQUIPMENT

The sub-contractor for the bridge removal was the Penhall Company, a California-based business. They used four hydraulic excavators with hammer attachments to break apart the bridge. Two end loaders worked to place the gravel protection and clear the concrete rubble. There was a skid loader and a backhoe on site to perform minor tasks. Thirteen dump trucks were used to bring gravel to the site and to haul debris away from the site.

### REMOVAL PLAN

A removal plan was required to be submitted thirty days before the demolition. The contractor was required to have a licensed engineer design the removal. The engineer worked with the engineers in the Office of Bridges and Structures of the Iowa DOT to design a method that met all special provisions. Revisions were being done up until two days before the demolition.

The contractor chose Tomitich Engineering Inc. of Boone, Iowa, to design the demolition. The removal plan submitted included notes on pre-demolition work, a sequence of the demolition, and equipment descriptions. The sequence of demolition included directions for removing the superstructure followed by the substructure. Special notes were added to instruct the contractor for depth of the removal for each of the footings.

### TECHNIQUE

Two of the smaller excavators began by slotting the center span of the top deck as shown in Attachment 4. They cut openings as wide as 3.5 feet longitudinally between the girders. The excavators removed the chain-link fence, barrier rail, light pole, and metal Interstate signs at this time. Attachment 5 shows one of the excavators hammering at the barrier rail. The contractor's removal plan indicated that the tracks of the excavators needed to be kept on a girder during removal, and that no two tracks could be on the same girder line for the entire length of the bridge. It was noted that the excavators were on the same girder line on different spans for extended periods of time during the demolition with no adverse consequence. Attachment B is a typical cross-section of a concrete box girder showing the tracks of the excavator remaining over the girders.

Once the machines on top completed the middle span, a larger excavator started to work from below. It began by taking out the web of the outside beam and continued on to remove

the bottom and what remained of the top deck rather easily. The excavator continued to proceed transversely through the bridge until the entire span had been removed. The first span was completely down by 1:30, approximately four hours into the demolition.

The concrete fell in small pieces for the most part. The contractor mentioned at the pre-demolition meeting that they could take down the structure in pieces no larger than a basketball. During the removal larger pieces did fall, but there was protection below that allowed this to occur without damaging the roadway. If there were no protection below, it is likely they could have kept large sections from falling.

The excavators were able to separate most of the rebar while breaking up the concrete. As much of the steel as possible was hauled to a separate rubble pile as shown in Attachment 6. The end loaders loaded the concrete rubble onto the dump trucks that hauled it away. The operators of the end loaders appeared to clear enough of the rubble to keep the site workable without removing an excessive amount of the gravel protection.

## ROADWAY PROTECTION

The special provisions for this removal required some type of protection be placed on the roadway. One-inch thick steel or two feet of dirt were recommended in the plans, but the decision was left to the contractor. The area of the protection was required to extend four feet outside the footprint of the bridge.

At the coordination meeting mentioned above, the sub-contractor said he felt the protection was not needed. It would only slow the process. The IowaDOT and FHWA worked together deciding how to handle the situation. It was decided that if the contractor offered a sufficient refund and would take responsibility for any damage to the roadway, they would allow the project to go without protection. No agreement was reached between the state and the contractor, therefore the protection was required.

In future projects, this protection requirement could be reviewed. It may be an opportunity to save funds to eliminate the protection or reduce the thickness of the layer if the contractor feels he can avoid damaging the roadway. As long as the concrete is broken into small pieces before it is dropped, it should not cause significant damage to the pavement below. If the protection requirement is kept, it might be valuable to extend the protection more than four feet outside the footprint. Debris was seen falling outside this limit. It was stated at the post-removal meeting, mentioned below, that protection will be required on the next bridge removal project.

## DUST CONTROL

As with any construction project in an urban area, the neighborhood and its residents should be considered during the process. The removal of the bridge created a significant amount of dust in the air. A strong wind at times blew this dust onto the property of the nearby residents. One resident complained that the dust covered virtually everything in her yard.

Further evaluation is necessary to determine a solution to the dust control issue. A specification to mitigate the dust problem for future bridge removals of this type is being evaluated.

COST

The removal of existing structures was a bid item in the contract for the construction of the E 9th St. Bridge. The cost of the removal was bid at $280,000. This number is significantly higher than the cost to remove beam bridges in the same corridor, which have averaged approximately $85,000 for similar sized structures. These structures do not face the same restrictions as the box girder bridges since they can be removed in stages instead of a complete removal in a one-night Interstate closure.

## POST-REMOVAL MEETING

A de-briefing meeting was held April 17, 2002, at the I-235 Construction Office to discuss the removal process. Members of the IowaDOT met with the contractors to discuss the project and improvements for the next bridge removal.

The state inspector suggested several issues to discuss. The dust control issue was mentioned. The contractor did not feel wetting the area would work. Further discussion will be required for this issue.

There was not enough safety fencing surrounding the construction site. The local citizens who came to watch the removal were too close. One possibility to keep them back would be to put bleachers far enough back for them to be safe.

Issues were raised about the CMS's. The DMPD did not feel they were left on long enough. One of them did not work for the first two hours of the closure, which caused a traffic jam in the downtown area.

Re-painting of the roadway after the removal should be in the next plan before all the lanes are opened. The construction equipment and the debris caused enough wear on the road that re-painting will be required at each bridge. It should be scheduled in advance.

The DMPD recommended that the closure be pushed back two hours and begin at 11 p.m. There was too much traffic to shut the Interstate down at 9p.m. If the morning deadline were pushed back two hours, they felt the public would be able to follow the detour easier in the daytime.

It was also stated by the Resident Construction Engineer that the roadway protection would be required on future projects. The concrete pieces that were falling were large enough to cause damage to the roadway if left unprotected.

# BLASTING METHOD/COTTAGE GROVE BRIDGES

## PREPARATION

### DECISION

The Cottage Grove Bridges located over Interstate 235 in Des Moines needed to be removed as part of the reconstruction project. The contractor was given the option to choose between the same two methods of removal as mentioned above, either the mechanical method or the blasting method. The closure of the Interstate would begin at 12 midnight Saturday. One lane in each direction would have to be open by 2 p.m. Sunday afternoo,n and the entire Interstate open by 6 a.m. Monday morning.

The contractor chose to blast the bridges. This involved the use of explosives to drop the existing structures to the ground leaving the remaining intact pieces to be broken apart using hydraulic excavators. Special provisions require that a pre- and post-blasting property survey be performed for all properties in close proximity to the bridge. The continuous use of a seismograph by a trained operator for ground vibration monitoring purposes occurred during all blasting activities, which is discussed further in the Seismic Monitoring section below. A blasting plan was to be submitted thirty days before the removal.

### COORDINATION

Several meetings were held in an attempt to better coordinate this effort. Discussions between IowaDOT and FHWA bridge engineers and the contractors responsible for the implosion, removal, and traffic control processes proved to be beneficial to all sides. The DMPD also attended these meetings to help coordinate traffic control with the contractors. The explosives sub-contractor was able to coordinate his process with the Des Moines Fire Department's Explosives Personnel to ensure both parties knew what was expected of them. He explained his implosion process, and the state and federal engineers were able to ask questions about the event.

### PREPARATION OF THE BRIDGES

The Cottage Grove Bridges were closed approximately one month prior to the removal due to the nearby construction of the new bridge and ramps. This allowed plenty of time for the contractor to perform the work needed to prepare the bridge for the removal. This section discusses the work done on the bridge while traffic was still allowed on the Interstate below.

Approximately 800 holes were drilled into the top deck of the first bridge beginning one week before the demolition. These holes were about 2 inches in diameter and extended 20 inches down into the center of the girders as shown in Attachment 9. These holes were plugged with tar and a piece of geotextile to prevent debris from entering them. They were later filled with explosives on the day of the demolition.

The structure needed to be wrapped with a geotextile fabric and chain link fencing to help prevent debris from the implosion from leaving the project site. The top deck was covered and the columns were wrapped during the days leading up to the implosion (Attachment 10).

Once the Interstate was closed, the fabric and fencing were thrown over the side of the bridge and tied underneath to completely wrap the structure.

The rails and pedestrian fence were also removed prior to the closure.

The information gathered from the first implosion was adapted for use on the second bridge, which was removed one week later. The only parts of the second bridge to be loaded were over the pier diaphragms and along the sidewalk. The bridge was only wrapped with the fabric and fencing where charges were placed, Attachment 11. Longitudinal cuts were made along the top deck. These cuts, shown in Attachment 12, are intended to help the bridge break apart when it hits the ground. This was also in the plan for the first bridge, but the contractor did not have enough time to perform the saw cuts.

### TEST BLAST

The sub-contractor responsible for the implosion of the bridge, Controlled Demolitions Incorporated, CDI, usually performs a test blast on the structure before the actual demolition. This involves setting off a few charges in non-critical areas of the bridge several days in advance of the removal. The sub-contractor uses the information from the test blast to determine more specific requirements for the explosives. The bridge remains standing and in a condition allowing normal Interstate traffic to safely pass beneath the bridge. The bridge remains closed to traffic.

Due to coordination conflicts with CDI and the difficulty they had finding an engineer licensed in the state of Iowa that would approve a demolition plan that included a test blast, it was not done. Tom Dowd of the CDI Company felt it was not required for this bridge type. His company had sufficient experience to determine the amount of explosives needed to complete the demolition without performing a test blast.

## TRAFFIC CONTROL

### INTERSTATE CLOSURE

The DMPD requested the closure of the Interstate for removing structures be delayed until 12 midnight Saturday. They felt traffic volume on the Interstate was too high at 9 p.m. The Police Department thought it would be safer and easier for the traveling public to follow the detour route signs during the daylight on Sunday afternoon rather than on Saturday night. The contractor was still given the same amount of time to remove the bridge, therefore he would not be required to have a lane open until 2 p.m., but still needed to open all mainline lanes by 6 a.m. Monday morning.

Both permanent and portable CMS's were used to help communicate with the traveling public. Permanent CMS's located on incoming traffic lanes to the Des Moines area on I-35 and I-80, as shown in Figure 1 above, were used to notify the public of the closure.

Portable CMS's were located on the Interstate nearer the closure. Double-lane closures were used to shift the traffic into the right lane ahead of the closure and direct them off the

Interstate at the appropriate exit ramp. The double-lane closures began at 9 p.m. Saturday night.

The start of the eastbound detour occurred at the Cottage Grove exit, which was within the 1000-foot blasting range that needed to be vacated during the implosion. This presented a problem of how to handle the Interstate traffic during the few minutes required for the implosion. A rolling roadblock was used. DMPD positioned patrol cars with lights flashing in each lane of traffic to slow down all vehicles at the appropriate time. They would slow down as they approached the vacated area and stop the traffic if it was needed to keep everyone at least 1000 feet away. Once the demolition occurred, the exit ramp was the first part of the roadway inspected. As soon as it was safe, the police vehicles allowed the traffic to resume using the detour. The rolling roadblock was an effective method for temporarily closing the detour without re-routing traffic or using a more permanent closure method.

DETOUR

The detour directed Interstate traffic through local city streets and back onto the Interstate. DMPD officers directed traffic at critical intersections. Figure 3 shows the detour path for the Interstate traffic during the closure.

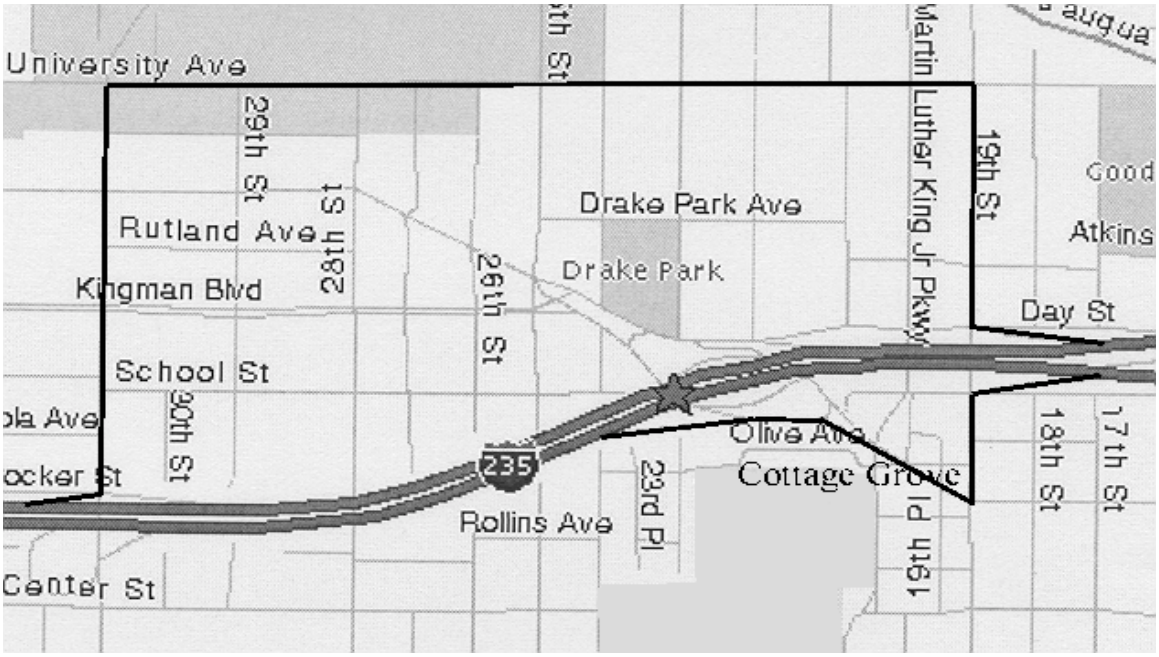



**Figure 3.** The Detour Route used for the closure. The star shows the location of the first bridge removed. The second bridge is located just east of the first.

Certain high-traffic intersections experienced congestion during the detour. Airport traffic often uses these streets to commute to the Interstate. The western part of downtown Des Moines is also located a few miles south of this area of the Interstate. It was decided for the second demolition, signs would be posted on high-traffic streets to restrict traffic through the corridor to local traffic only. This plan should reduce the amount of interference to the flow of Interstate traffic.

The original plan was to test the detour route during the test blast described above. The Interstate would have been closed long enough to detect any issues with the detour. Since the test blast was not performed, there was no opportunity for a practice-run for the detour. A test blast on future projects or similar type of short-term closure presents a good opportunity to use the detour to work out any unforeseen issues that might occur.

Reports from the IowaDOT and DMPD stated that there were no reported accidents caused by the detour either night. The later closure appeared to relieve some of the congestion experienced during the E 9th Bridge removal. The IowaDOT plans to continue closing the Interstate at 12 midnight.

RE-OPENING OF INTERSTATE

The sub-contractor responsible for the removal of the bridge expected the structure to come down in much smaller pieces. They did not appear to be expecting to break apart as much rubble as was required. It took them longer than expected to get the Interstate cleared. As a result, the Interstate was not opened by the deadline of 2 p.m. An eastbound lane was not opened until 4 p.m., two hours late, and a westbound lane was opened around 6 p.m.

The sub-contractor was better prepared for the second implosion. Additional equipment was brought to the site to break apart and haul away the rubble. The contractor had a lane open in each direction by the 2 p.m. deadline and the entire mainline open well before Monday morning.

## BRIDGE REMOVAL

EQUIPMENT/EXPLOSIVES

Metro Wrecking was responsible for the removal of the bridge. They brought in one excavator with a hammer attachment intended to perform minimal breaking of the concrete. Two smaller excavators were responsible for separating the rebar. One had a pincher attachment, the other a grabble attachment. One end loader was used to apply the roadway blanket and load debris into dump trucks that were used for hauling material to and from the site. A backhoe was used to load debris as well.

Additional equipment was brought to the site for the second implosion. Three additional excavators and an extra end loader allowed the Interstate to be cleared much quicker. The excavator with the pincher attachment was exchanged for a second grabble attachment.

The CDI Company was hired by Metro to implode the bridge. An electronic detonation device was used to begin the implosion. Thin primer chord ran from the device to the first row of holes on the south abutment. Each row was connected to the next row in two places by primer chord and a 20-millisecond delay fuse. This was done to create a rolling action across the bridge to assist in breaking up the decks and girders. Each transverse row of holes was connected with light primer chord. Each hole was loaded with a half stick of dynamite and 18-24 inches of a 400-grain-per-foot blasting chord of gunpowder placed in a plastic tube. Sand was placed above the explosives to act as an insulator. A three-second

delay fuse was placed in each hole to allow all the fuses to be lit before the first explosives ignited. This prevented the first explosion from interfering with the detonation of others.

## REMOVAL PLAN

Special provisions for the bridge removal require that the contractor's removal plan should be submitted thirty days in advance of the demolition. An engineer licensed in the state of Iowa was required to review the plan to ensure the removal would be completed safely. Special provisions also required that the engineer be on site during all implosion activities.

## TECHNIQUE

On the first Cottage Grove Bridge, explosives were placed in each concrete girder every 4 feet for the length of bridge. Approximately 800 holes were vertically drilled down into the girders through the top deck. Eighteen-inch diameter holes were cut as necessary into the top deck to check the location of the girders as shown in Attachment 13. They were smaller than the holes in the deck of the E 9$^{th}$ Bridge. These holes did not cause any damage to the structural integrity of the bridge. For the second Cottage Grove Bridge, only approximately 300 holes were loaded with explosives near the pier diaphragms and sidewalk.

Explosives were also placed in the pier columns. Holes were drilled horizontally into the columns for placing charges. The depths of the holes were more than half the diameter of the column. One concrete face of each column was chipped out to allow access to the spiral rebar reinforcement. Attachment 14 shows a column before it was wrapped with the fabric and fencing. All of the horizontal rebar was cut to weaken the reinforcement before the implosion as shown in Attachment 15.

Most of the initial planning and coordinating for this project discussed the implosion, but once the bridge was brought down, it needed to be hauled away. The explosives did not completely break apart the decks and pier caps. Approximately 60 – 75% of the girders and columns were blown out, but the top and bottom decks remained relatively intact. Attachment 16 shows a view of the web of the outside girder after the implosion. Attachment 17 shows the interior girders once the outside girder was removed. The bridge removal sub-contractor had to use a hydraulic excavator with a hammer attachment to break apart the concrete and steel rebar reinforcement. The debris from the bridge and the concrete protective mat was hauled away using an end loader to fill the dump trucks.

The sub-contractor responsible for the removal and the sub-contractor responsible for the explosives did not appear to have the same expectations for the implosion. It appeared that the removal contractor did not have enough equipment on site to handle the amount of concrete breaking that remained after the implosion. The explosives contractor felt that the implosion was a success. He got what he expected from the demolition. This is another example of how critical communication is between all participants in a project of this type. The lack of equipment could have been one of the major causes for the Interstate not being opened on time. When more equipment was available on the second bridge, the removal was completed on schedule.

### SEISMIC MONITORING AND PROPERTY SURVEY

Special provisions required that seismic monitoring be performed during all implosion activities. This required the contractor to supply seismographs and employ a trained operator to monitor ground vibration to analyze potential damage to surrounding properties. Restrictions to the maximum vibration allowed to leave the construction zone are specified in the Special Provision included as Attachment A. These limitations were lower than the threshold to crack plaster.

Special provisions also required that all possibly affected properties receive a pre- and post-blast survey. The contractor should arrange to meet with property owners to investigate their property both inside and outside. It is required that documentation of these surveys should be reported to the IowaDOT within 30 days of the blasting.

### ROADWAY PROTECTION

The special provisions for this project required some type of protection be placed on the roadway. One-inch-thick steel or two feet of dirt were recommended in the plans, but the decision was left to the contractor. The area of the protection extended four feet outside the footprint of the bridge.

The contractor chose to apply a 2 foot layer of broken concrete and sand to protect the roadway. This appeared to be sufficient. There was a small area of roadway that was damaged during the demolition. The Resident Construction Engineer believed that heavy equipment, not the bridge implosion, caused the damage. The contractor repaired the damage at his expense.

If this process is part of the critical path, it might be an area where some time could be saved. If the contractor began applying the protection during the lane closures allowed to begin at 9 p.m., it would require less time to complete the process once the Interstate is closed.

### COST

The removal of existing structures was a bid item included in the contract for nearby road reconstruction that included Cottage Grove Avenue. The cost of the removal for both bridges was bid at $400,000, slightly lower than the price for the cutting/shearing method of $280,000 for one bridge. This number is still significantly higher than the cost to remove beam bridges in the same corridor that use a more conventional method of removal.

## POST-REMOVAL MEETING

The blasting of the second Cottage Grove Bridge occurred a week after the first demolition. Improvements to the removal process were discussed during the post-removal meeting of the first bridge. Changes needed to be made to guarantee the Interstate would be opened on

time. The IowaDOT discussed the possibility of liquidated damages being assessed to the general contractor for failure to reopen I-235 as established in the special provision for the removal of a concrete box girder bridge. The possibility of including a liquidated damage clause in the special provision to encourage the contractor to meet the deadline was discussed.

More preparation was done before the actual closure of the Interstate for the second bridge. The implosion was scheduled to occur at 2 a.m., one hour earlier than the first bridge. The top deck was longitudinally saw cut. More attention was given by the explosives contractor to the pier caps and abutments to make sure they were sufficiently broken apart. The deck did not have any explosives in it. The deck was slightly broken up by the impact of it hitting the ground, but for the most part hydraulic excavators were used to break it apart once it was on the ground.

The bridge removal contractor supplied more equipment to be better prepared for the amount of concrete breaking work that will be required after the implosion. Three additional hydraulic excavators were used as well as an additional end loader. A second shift of operators was brought in to relieve the initial crew.

An attempt was made on the first bridge to keep the involvement of the public to a minimum. Announcements on the news tried to downplay the event and told the public to stay home and watch it on television. This did not work. Hundreds of people turned out to see the implosion. It was decided that a public viewing area would be set up on the mainline roadway for the second implosion. Barrels and ropes were used to create a viewing area maintained by uniformed officers to prevent anyone from negatively affecting the demolition work. This viewing area provided a safe place for spectators to see the implosion without interfering.

As with any construction project, weather can also cause issues. A strong thunderstorm passed through the area in the middle of the night. The planning of future similar projects should include working around inclement weather.

## CONCLUSION

There was a large amount of information learned about bridge removals on these projects. The information covered in this report will be used on future I-235 projects as well as other similar bridges. Coordination, preparation, and communication are keys to the success of projects of this magnitude. The preparation of the detour allowed traffic to flow smoothly and safely around the work zone. Des Moines Police reported no accidents during the Interstate closures. The bridges were successfully removed without any major incidents. The special provisions for concrete box girder bridge removals will be updated to include information learned on the first few bridges that will be used on future projects.

Attachment 1 – E 9th – Evening Before Demolition

Attachment 2 – Access Holes On Deck To Remove Wooden Forms

Attachment 3 – View of E 9th Bridge Removal at 1:00 PM Sunday afternoon

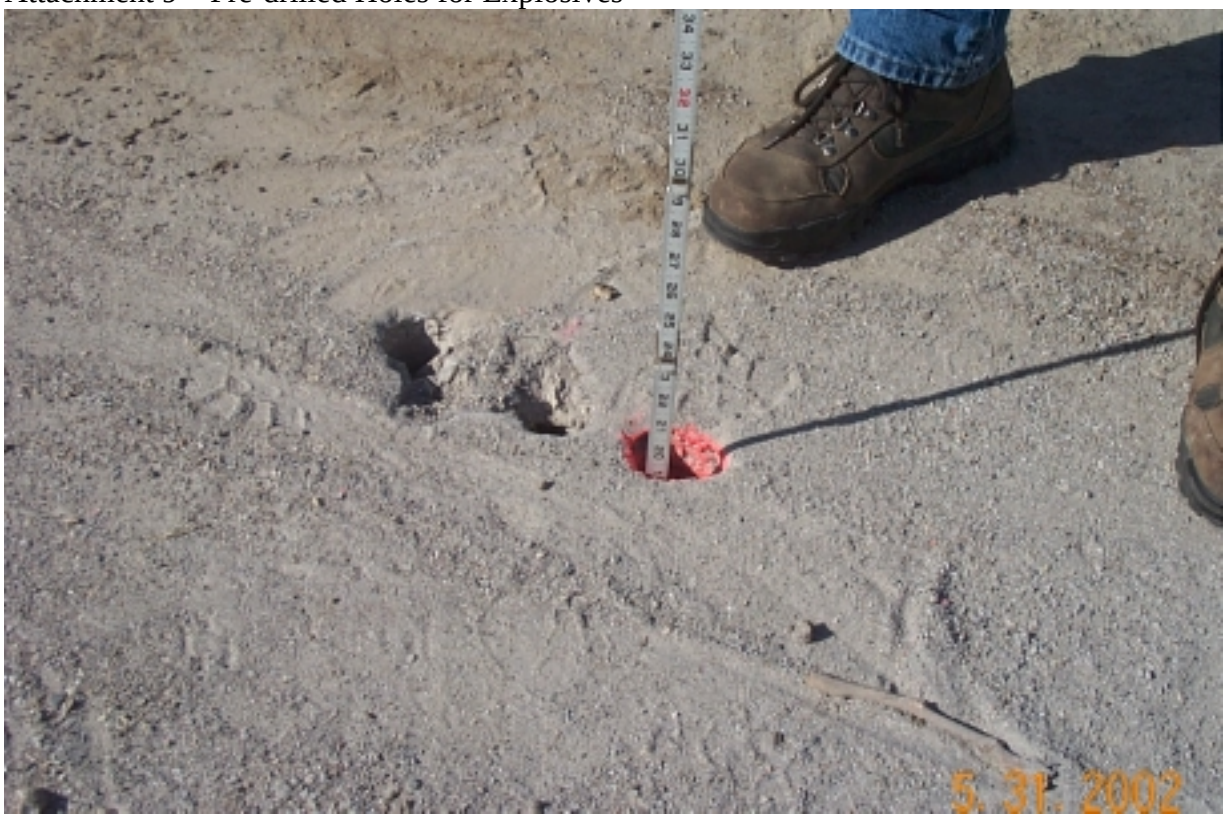

Attachment 4 – Slotted Top Deck

Attachment 5 – Excavator Hammering at the Barrier Rail

Attachment 6 – Separate Debris Pile for Steel Rebar

Attachments 7 & 8 – Damage to roadway caused by equipment


Attachment 9 – Pre-drilled Holes for Explosives




Attachment 10 – Columns wrapped with fencing and fabric

Attachment 11 – Deck Wrapped only over Pier Caps and Sidewalk


Attachment 12 – Longitudinal saw cuts in the deck

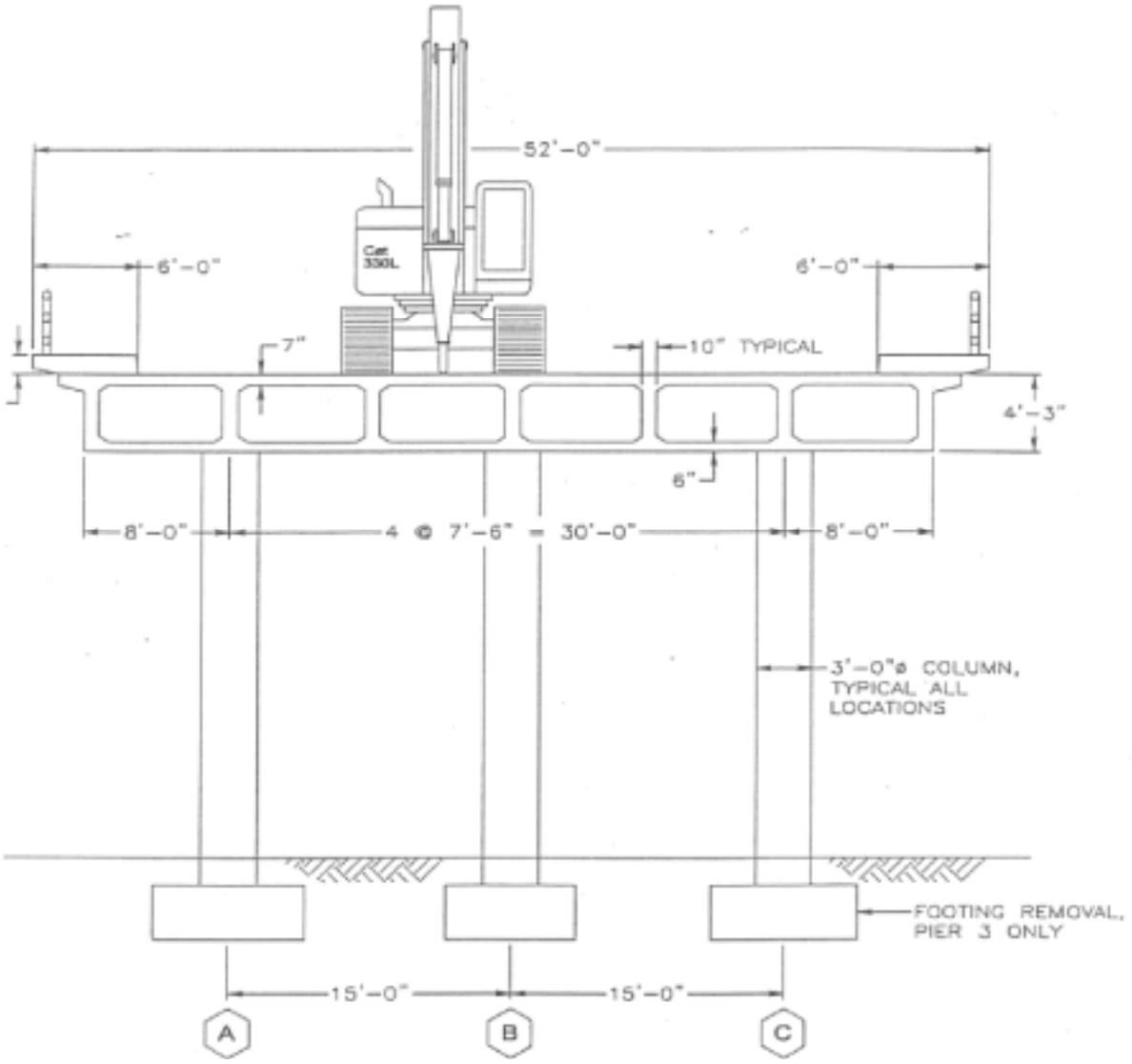
Attachment 13 – 18” Holes drilled into the Deck


Attachment 14 - Columns Before Wrapped


Attachment 15 – Cut Horizontal Rebar

Attachment 16 – An outside girder after the implosion

Attachment 17 – An inside girder after the implosion once outside girder was removed




| PIER 3 APPROXIMATE FOOTING DIM'S | | | |
|---|---|---|---|
| COLUMN | LENGTH | WIDTH | HEIGHT |
| A & C | 9'-0" | 8'-0" | 3'-0" |
| B | 8'-0" | 7'-0" | 3'-0" |

MONTHLY SUMMARY OF TRAFFIC RECORDER DATA — PAGE 370

P1531340
DATE 03/05/2002

FEBRUARY 2002

RECORDER NO. 70070 STATION NUMBER 700 ROUTE 0235 SYSTEM 01 COUNTY NO. 77 DIRECTION WEST
LOCATION I 235 WB AT PENNSYLVANIA AVE DES MOINES

HOUR PERIODS 24 HOUR CLOCK USED

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 225 | 202 | 161 | 170 | 299 | 757 | 2248 | 3767 | 3042 | 1796 | 1767 | 1850 | 2183 | 2254 | 2384 | 2666 | 2651 | 2445 | 2398 | 2071 | 1208 | 1027 | 951 | 741 | 39263 | F | 01 |
| 454 | 375 | 285 | 186 | 212 | 321 | 723 | 1061 | 1323 | 1762 | 2185 | 2341 | 2419 | 2309 | 2299 | 2328 | 2231 | 2141 | 2056 | 1579 | 1099 | 1050 | 912 | 734 | 32380 | S | 02 |
| 439 | 352 | 263 | 204 | 190 | 216 | 457 | 519 | 738 | 1069 | 1363 | 1700 | 2008 | 1926 | 1985 | 2007 | 2002 | 1489 | 1023 | 982 | 744 | 1211 | 880 | 451 | 24195 | S | 03 |
| 257 | 182 | 144 | 164 | 256 | 898 | 2971 | 5341 | 3377 | 2144 | 1986 | 2057 | 2223 | 2291 | 2387 | 2807 | 2560 | 2388 | 1951 | 1335 | 1125 | 868 | 728 | 456 | 40954 | M | 04 |
| 247 | 159 | 151 | 161 | 297 | 961 | 3157 | 5451 | 3594 | 2471 | 2160 | 2163 | 2310 | 2251 | 2403 | 2738 | 2545 | 2487 | 2003 | 1378 | 1120 | 1050 | 736 | 489 | 42489 | T | 05 |
| 316 | 165 | 180 | 165 | 291 | 932 | 3189 | 4419 | 3804 | 2601 | 2264 | 2341 | 2409 | 2266 | 2390 | 2744 | 2578 | 2504 | 2162 | 1487 | 1164 | 1004 | 796 | 467 | 42534 | W | 06 |
| 341 | 178 | 177 | 177 | 314 | 962 | 3196 | 5428 | 3569 | 2495 | 2232 | 2245 | 2391 | 2273 | 2388 | 2845 | 2703 | 2428 | 2205 | 1557 | 1134 | 1086 | 892 | 521 | 43738 | T | 07 |
| 371 | 223 | 218 | 201 | 304 | 922 | 3091 | 5361 | 3488 | 2283 | 2115 | 2309 | 2470 | 2469 | 2675 | 3000 | 2855 | 2704 | 2859 | 1885 | 1402 | 1306 | 1078 | 770 | 46159 | F | 08 |
| 519 | 389 | 312 | 214 | 213 | 363 | 677 | 1152 | 1407 | 1836 | 2294 | 2484 | 2504 | 2583 | 2306 | 2275 | 2161 | 2001 | 1853 | 1416 | 1058 | 849 | 786 | 555 | 32207 | S | 09 |
| 388 | 327 | 262 | 166 | 158 | 196 | 366 | 592 | 858 | 769 | 1039 | 1397 | 1747 | 1926 | 1968 | 1901 | 1926 | 1706 | 1576 | 1241 | 976 | 809 | 821 | 413 | 22918 | S | 10 |
| 200 | 149 | 145 | 164 | 289 | 918 | 3124 | 5541 | 3404 | 2660 | 2097 | 2235 | 2323 | 2342 | 2434 | 2858 | 2620 | 2474 | 2124 | 1468 | 1100 | 961 | 745 | 423 | 42190 | M | 11 |
| 318 | 158 | 151 | 160 | 333 | 1007 | 3228 | 5569 | 3411 | 2216 | 1992 | 2170 | 2315 | 2278 | 2469 | 2817 | 2700 | 2572 | 2283 | 1490 | 1180 | 1034 | 752 | 464 | 43067 | T | 12 |
| 304 | 206 | 144 | 189 | 383 | 952 | 3229 | 4751 | 3628 | 2216 | 2101 | 2301 | 2275 | 2372 | 2551 | 2801 | 2813 | 2565 | 2426 | 1434 | 1373 | 1117 | 941 | 535 | 43527 | W | 13 |
| 298 | 216 | 177 | 183 | 325 | 994 | 3210 | 5554 | 3462 | 2221 | 2079 | 2400 | 2559 | 2496 | 2539 | 2858 | 2927 | 2776 | 2444 | 1766 | 1417 | 1207 | 897 | 609 | 45519 | T | 14 |
| 401 | 235 | 191 | 180 | 321 | 918 | 3135 | 5277 | 3314 | 2285 | 2312 | 2641 | 2678 | 2584 | 2797 | 3222 | 3148 | 2984 | 2877 | 2235 | 1585 | 1464 | 1103 | 744 | 48694 | F | 15 |
| 605 | 413 | 280 | 195 | 242 | 365 | 709 | 1228 | 1621 | 2354 | 2749 | 2991 | 2925 | 2822 | 2758 | 2932 | 2885 | 2718 | 2765 | 1959 | 1804 | 1364 | 1040 | 833 | 46295 | S | 16 |
| 552 | 369 | 336 | 228 | 156 | 234 | 435 | 512 | 841 | 1342 | 1915 | 2178 | 2367 | 2554 | 2398 | 2185 | 2228 | 2101 | 1858 | 1525 | 1051 | 919 | 851 | 463 | 29338 | S | 17 |
| 261 | 196 | 184 | 158 | 283 | 921 | 3045 | 5216 | 3434 | 2236 | 2137 | 2306 | 2325 | 2356 | 2445 | 2886 | 2574 | 2378 | 1943 | 1389 | 1040 | 859 | 678 | 433 | 41588 | M | 18 |
| 274 | 174 | 158 | 180 | 311 | 997 | 3280 | 5495 | 3503 | 2204 | 1980 | 2200 | 2274 | 2348 | 2335 | 2719 | 2598 | 2399 | 2028 | 1378 | 1134 | 1036 | 743 | 469 | 42177 | T | 19 |
| 290 | 174 | 148 | 176 | 304 | 949 | 3200 | 5281 | 3566 | 2210 | 2063 | 2157 | 2188 | 2273 | 2453 | 2719 | 2693 | 2440 | 2145 | 1456 | 1312 | 1011 | 827 | 513 | 42482 | W | 20 |
| 304 | 235 | 171 | 177 | 320 | 777 | 831 | 4088 | 3723 | 3031 | 2398 | 2622 | 2965 | 2506 | 2593 | 2849 | 2866 | 3083 | 2587 | 1607 | 1329 | 1147 | 886 | 636 | 43757 | T | 21 |
| 387 | 211 | 185 | 200 | 344 | 899 | 3043 | 5077 | 3683 | 2746 | 2743 | 2774 | 2724 | 2949 | 2909 | 3041 | 3039 | 3016 | 2945 | 2218 | 1670 | 1403 | 1168 | 795 | 50164 | F | 22 |
| 557 | 405 | 304 | 223 | 248 | 380 | 759 | 1180 | 1530 | 1825 | 2675 | 2769 | 2867 | 2628 | 2344 | 2515 | 2514 | 2558 | 2429 | 1859 | 1298 | 1315 | 1092 | 778 | 36862 | S | 23 |
| 567 | 431 | 315 | 248 | 202 | 214 | 479 | 553 | 751 | 1076 | 1435 | 1781 | 2030 | 2088 | 2223 | 1983 | 2071 | 1875 | 1612 | 1329 | 1041 | 843 | 649 | 422 | 26216 | S | 24 |
| 228 | 169 | 138 | 157 | 286 | 972 | 3159 | 5445 | 3330 | 2175 | 2015 | 2145 | 2239 | 2176 | 2406 | 2793 | 2552 | 2367 | 1921 | 1286 | 1010 | 795 | 605 | 393 | 40753 | M | 25 |
| 256 | 166 | 127 | 168 | 286 | 932 | 2855 | 4705 | 3454 | 2002 | 1775 | 1994 | 1984 | 2164 | 2278 | 2458 | 2345 | 2266 | 1779 | 1299 | 1280 | 982 | 686 | 428 | 38669 | T | 26 |
| 279 | 191 | 144 | 199 | 271 | 934 | 3139 | 5164 | 3324 | 2199 | 2001 | 2286 | 2185 | 2196 | 2405 | 2800 | 2510 | 2413 | 2129 | 1477 | 1371 | 955 | 848 | 535 | 41755 | W | 27 |
| 359 | 234 | 166 | 188 | 327 | 981 | 3198 | 5021 | 3452 | 2299 | 2111 | 2216 | 2380 | 2298 | 2490 | 2713 | 2642 | 2550 | 2251 | 1499 | 1364 | 1123 | 911 | 527 | 43290 | T | 28 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10035 | 5604 | 7881 | 64123 | 78341 | 57983 | 68012 | 68023 | 71823 | 60565 | 34169 | 23586 | | | | | | | | | | | | | | | |
| 6846 | 5182 | 20868 | 108544 | 57963 | 63055 | 65882 | 74257 | 67886 | 43520 | 29805 | 15537 | | | | | | | | | | | | | | | |

| | SUN | MON | TUE | WED | THU | FRI | SAT | | |
|---|---|---|---|---|---|---|---|---|---|
| TOTALS | 102667 | 165505 | 166402 | 170298 | 176304 | 184280 | 141744 | TOTAL FOR MONTH | 1107280 |
| | | | | | | | | ADT | 39546 |
| NUMBER OF DAYS | 4 | 4 | 4 | 4 | 4 | 4 | 4 | TOTAL MON - THU | 678589 |
| AVERAGE | 25666 | 41376 | 41600 | 42574 | 44076 | 46070 | 35436 | 4 DAY AVERAGE | 42411 |

FEBRUARY 2002

MONTHLY SUMMARY OF TRAFFIC RECORDER DATA PAGE 366

P1531340
DATE 03/05/2002

FEBRUARY 2002

RECORDER NO. 70030 STATION NUMBER 700 ROUTE 0235 SYSTEM 01 COUNTY NO. 77 DIRECTION EAST
LOCATION I 235 EB AT PENNSYLVANIA AVE DES MOINES

HOUR PERIODS 24 HOUR CLOCK USED

| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 394 | 284 | 239 | 191 | 194 | 433 | 1198 | 1503 | 1326 | 1233 | 1446 | 1818 | 2197 | 2359 | 2741 | 3698 | 4285 | 3857 | 2343 | 1705 | 1539 | 1559 | 1631 | 1003 | 39176 | * | 01 |
| 651 | 524 | 335 | 214 | 202 | 292 | 538 | 854 | 1170 | 1519 | 1863 | 2132 | 2304 | 2362 | 2229 | 2476 | 2217 | 2164 | 1830 | 1589 | 1375 | 1501 | 1186 | 1148 | 32675 | * | 02 |
| 672 | 537 | 439 | 250 | 168 | 191 | 310 | 471 | 740 | 1191 | 1484 | 1640 | 1916 | 1888 | 1978 | 2133 | 2136 | 2006 | 1682 | 1398 | 1093 | 929 | 731 | 540 | 26523 | * | 03 |
| 408 | 242 | 188 | 186 | 228 | 597 | 1717 | 2119 | 1756 | 1813 | 1879 | 2316 | 2363 | 2474 | 2848 | 3944 | 4900 | 4245 | 2456 | 1766 | 1503 | 1432 | 896 | 589 | 42865 | M | 04 |
| 492 | 257 | 218 | 188 | 239 | 620 | 1730 | 2288 | 1859 | 1875 | 1985 | 2192 | 2383 | 2391 | 2938 | 3917 | 5008 | 4330 | 2569 | 1824 | 1593 | 1451 | 1003 | 734 | 44094 | T | 05 |
| 476 | 261 | 223 | 202 | 234 | 657 | 1678 | 2260 | 1891 | 1822 | 1899 | 2326 | 2554 | 2530 | 2901 | 3911 | 5039 | 4437 | 2637 | 1793 | 1570 | 1514 | 1006 | 799 | 44620 | W | 06 |
| 527 | 309 | 253 | 212 | 234 | 676 | 1780 | 2159 | 1857 | 1912 | 2011 | 2308 | 2513 | 2570 | 3012 | 4305 | 3822 | 4139 | 2842 | 1834 | 1707 | 1601 | 1051 | 808 | 44442 | T | 07 |
| 464 | 300 | 227 | 181 | 229 | 549 | 1563 | 2441 | 1955 | 1821 | 2037 | 2516 | 2826 | 2831 | 3233 | 4338 | 5073 | 4370 | 2872 | 2018 | 1751 | 1701 | 1330 | 980 | 47606 | F | 08 |
| 627 | 454 | 412 | 211 | 164 | 270 | 504 | 934 | 1286 | 1587 | 2030 | 2498 | 2518 | 2480 | 2544 | 2463 | 2414 | 1935 | 1620 | 1321 | 1075 | 1081 | 1166 | 757 | 32351 | S | 09 |
| 557 | 464 | 370 | 187 | 137 | 154 | 305 | 433 | 556 | 853 | 1124 | 1395 | 1781 | 1880 | 1972 | 2039 | 2021 | 1900 | 1616 | 1344 | 987 | 866 | 657 | 502 | 24100 | S | 10 |
| 252 | 166 | 163 | 146 | 208 | 587 | 1655 | 2469 | 1924 | 1783 | 1994 | 2231 | 2400 | 2355 | 2800 | 3971 | 5065 | 4380 | 2577 | 1753 | 1561 | 1471 | 897 | 672 | 43480 | M | 11 |
| 368 | 229 | 159 | 164 | 208 | 576 | 1625 | 2434 | 1961 | 1862 | 1914 | 2290 | 2251 | 2433 | 2925 | 3997 | 5025 | 4358 | 2655 | 1877 | 1682 | 1495 | 921 | 940 | 44349 | T | 12 |
| 465 | 241 | 212 | 155 | 213 | 524 | 1648 | 2411 | 2097 | 1828 | 1963 | 2324 | 2505 | 2686 | 2929 | 3933 | 5153 | 4448 | 2759 | 2066 | 1910 | 1778 | 944 | 795 | 45987 | W | 13 |
| 429 | 262 | 226 | 183 | 195 | 566 | 1682 | 2542 | 2013 | 1950 | 1955 | 2461 | 2634 | 2856 | 3072 | 3962 | 5257 | 4522 | 2935 | 1996 | 1845 | 1619 | 1151 | 850 | 47163 | T | 14 |
| 501 | 317 | 225 | 204 | 215 | 565 | 1650 | 2590 | 2067 | 1855 | 2181 | 2614 | 2737 | 3018 | 3400 | 4598 | 5172 | 4430 | 2853 | 2227 | 1991 | 2040 | 1516 | 1025 | 49991 | F | 15 |
| 654 | 552 | 352 | 234 | 208 | 310 | 602 | 1068 | 1468 | 1939 | 2151 | 2709 | 2778 | 2740 | 2975 | 3029 | 2963 | 2564 | 2528 | 2008 | 1858 | 1702 | 1433 | 1090 | 39915 | S | 16 |
| 918 | 598 | 425 | 234 | 179 | 253 | 416 | 678 | 1069 | 1442 | 1741 | 2007 | 2421 | 2398 | 2454 | 2612 | 2566 | 2262 | 1915 | 1472 | 1216 | 1280 | 780 | 509 | 31845 | S | 17 |
| 290 | 250 | 143 | 151 | 215 | 549 | 1618 | 2449 | 1954 | 1833 | 1956 | 2310 | 2380 | 2442 | 2901 | 4034 | 4916 | 4105 | 2291 | 1712 | 1455 | 1286 | 876 | 632 | 42748 | M | 18 |
| 343 | 228 | 162 | 151 | 236 | 553 | 1694 | 2456 | 1915 | 1891 | 1933 | 2241 | 2388 | 2421 | 2847 | 3888 | 4809 | 4302 | 2555 | 1760 | 1633 | 1466 | 874 | 711 | 43455 | T | 19 |
| 412 | 207 | 154 | 168 | 196 | 548 | 1681 | 2471 | 1952 | 1754 | 1935 | 2280 | 2357 | 2404 | 2937 | 4035 | 5165 | 4257 | 2600 | 1866 | 1737 | 1451 | 957 | 715 | 44219 | W | 20 |
| 427 | 254 | 210 | 182 | 218 | 529 | 1186 | 1992 | 1755 | 1649 | 1898 | 2218 | 2619 | 2957 | 3232 | 4395 | 4198 | 3730 | 2765 | 2028 | 2134 | 2331 | 1053 | 864 | 44824 | T | 21 |
| 524 | 394 | 245 | 177 | 227 | 554 | 1561 | 2330 | 1952 | 1915 | 2251 | 2834 | 2908 | 3238 | 3579 | 4568 | 5457 | 4069 | 2742 | 2303 | 2018 | 2231 | 2142 | 1106 | 51325 | F | 22 |
| 713 | 551 | 410 | 240 | 176 | 279 | 566 | 1001 | 1332 | 1894 | 2199 | 2554 | 2647 | 2502 | 2971 | 2766 | 2659 | 2394 | 2060 | 1688 | 1541 | 1833 | 2235 | 1307 | 38518 | S | 23 |
| 721 | 603 | 418 | 245 | 165 | 187 | 383 | 573 | 820 | 1437 | 1753 | 1978 | 2152 | 2020 | 2166 | 2202 | 2353 | 2025 | 1735 | 1370 | 1020 | 893 | 671 | 471 | 28361 | S | 24 |
| 247 | 163 | 154 | 139 | 199 | 567 | 1741 | 2435 | 1896 | 1777 | 1976 | 2236 | 2308 | 2323 | 2886 | 4150 | 5042 | 4150 | 2331 | 1652 | 1453 | 1245 | 754 | 593 | 42417 | M | 25 |
| 315 | 206 | 162 | 151 | 203 | 544 | 1573 | 2139 | 1891 | 1638 | 1715 | 2404 | 2748 | 2802 | 2769 | 3854 | 4748 | 4106 | 2446 | 1738 | 1466 | 1285 | 858 | 609 | 42370 | T | 26 |
| 363 | 212 | 166 | 148 | 200 | 550 | 1566 | 2032 | 2028 | 1805 | 1980 | 2431 | 2402 | 2471 | 2688 | 3853 | 4850 | 4340 | 2713 | 1889 | 1670 | 1465 | 886 | 698 | 43406 | W | 27 |
| 393 | 281 | 196 | 182 | 245 | 614 | 1651 | 2166 | 1808 | 1845 | 2012 | 2324 | 2502 | 2612 | 2936 | 4121 | 4988 | 4421 | 2727 | 1851 | 1796 | 1569 | 1013 | 724 | 44977 | T | 28 |

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13603 | | 7086 | | 5735 | | 35821 | | 46298 | | 53265 | | 68492 | | 78863 | | 117301 | | 67654 | | 44179 | | 30618 | | | | |
| | 9346 | | 5276 | | 13294 | | 51698 | | 47723 | | 63567 | | 70443 | | 101190 | | 102246 | | 49848 | | 42085 | | 22171 | | | |

| | SUN | MON | TUE | WED | THU | FRI | SAT |
|---|---|---|---|---|---|---|---|
| TOTALS | 110829 | 171510 | 174268 | 178232 | 181406 | 188098 | 143459 |
| NUMBER OF DAYS | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| AVERAGE | 27707 | 42877 | 43567 | 44558 | 45351 | 47024 | 35864 |

TOTAL FOR MONTH 1147802
ADT 40993
TOTAL MON - THU 705416
4 DAY AVERAGE 44088

FEBRUARY 2002

# Special Provision
# For
# Removal of Concrete Box Girder Bridges

Polk County

IM-235-2(330)9--13-77
October 2, 2001

## 1. DESCRIPTION OF WORK

This item shall consist of removal from the project of all portions of an existing structure, except the portions that may be required or permitted to be left in place. Unless otherwise provided, all structures or parts of structures to be removed shall become the property of the Contractor.
Work shall be performed in accordance with these special provisions, or as directed by the Engineer, and Section 2401 of the Standard Specifications.

## 2. BRIDGE REMOVAL

The Contractor shall submit a complete bridge removal plan to the Engineer detailing procedures and sequence for removing portions of the bridge, including all features necessary to remove the bridge in a safe and controlled manner. The removal plans, indicating detailed sequences of operations, shall be submitted to the Engineer, at least, thirty (30) calendar days prior to start of removal operations of the existing bridge. The bridge removal plan shall include the following:

A. The bridge removal sequence for the entire structure, including staging of bridge removal;
B. Equipment locations on the structure during removal operations;
C. Temporary support shoring or temporary bracing if required;
D. Locations where work is to be performed over traffic; and
E. Details and locations of protective covers or other measures to assure that bridge removal will not endanger the public.

The following additional requirements apply to the removal of portions of the existing bridge that are over or adjacent to roadways that may be closed to public traffic for only brief periods of time:

A. The closure of roadways to public traffic shall conform to the Traffic Control Plan.
B. Prior to closing of a roadway to traffic to accommodate bridge removal operations, the Contractor shall have all necessary workers, materials, and equipment at the site as needed to proceed with the removal work in expeditious manner. While the roadway is closed to public traffic, work shall be pursued promptly and without interruption until the roadway is reopened to public traffic.

C. All removal operations shall be performed during periods of time that the roadway is closed to the public traffic except as specified herein for preliminary work.
D. Preliminary work shall be limited to operations that will not reduce the structural strength or stability of the bridge, or any element thereof, to a level that in the judgement of the Engineer would constitute a hazard to the public. Such preliminary work shall also be limited to operations that cannot cause debris or any other material to fall onto the roadway. Protective covers may be used to perform preliminary work such as chipping or cutting the superstructure into segments, provided the covers are of sufficient strength to support all loads and are sufficiently tight to prevent dust and fine material from sifting down onto the traveled way. Protective covers shall extend at least 1.2m beyond the limit of the work underway. Bottom slabs of box girders may be considered to be protective covers for preliminary work performed on the top slab inside the limits of the exterior girders.
E. Temporary support shoring, temporary bracing, and protective covers shall not encroach closer than 2.4m horizontally from the edge or 4.6m vertically above any traffic lane or shoulder that is open to public traffic.
F. During periods when the roadway is closed to public traffic, debris from bridge removal operations may be allowed to fall directly onto the lower roadway provided adequate protection is furnished for all highway facilities. The minimum protection for paved areas shall be a 0.6-m thick earthen pad or a 25-mm thick steel plate placed over the area where debris can fall. Prior to reopening the roadway to public traffic, all debris, protective pads, and devices shall be removed and the roadway swept clean with wet power sweepers or equivalent methods.
G. The removal operations shall be conducted in such a manner that the portion of the structure not yet removed remains in a stable condition at all times.

Concrete superstructures may be removed by any means consistent with regulations regarding safety and protection of adjacent property. Where portions of existing substructures lie wholly or in part within limits for a new structure, they shall be removed as necessary to accommodate construction of the proposed structure.

The Contractor shall submit working drawings, with design calculations, to the Engineer for the proposed bridge removal plan. The bridge removal plan shall be prepared by a Professional Engineer registered in the State of Iowa. The design calculations shall be adequate to demonstrate the stability of the structure during all stages of the removal operations. Calculations shall be provided for each stage of bridge removal and shall include dead and live load values assumed in the design of protective covers. At a minimum, a stage will be considered to be partial removal of the top slab, the sidewalk, or portions of the superstructure, in any span; or bent caps, or columns at support locations.

The Contractor's registered engineer shall be present at all times when bridge susperstructure removal operations are in progress. The Contractor's registered engineer shall inspect the bridge removal operation and the status of the remaining structure. Should an unplanned event occur, the Contractor's registered engineer shall submit immediately to the Engineer for approval, the procedure of operation proposed to correct or remedy the occurrence.

Full compensation for conforming to requirements of this special provision shall be considered as included in the contract lump sum price paid for bridge removal and no additional compensation will be allowed.

3. REMOVAL METHODS

A. Cutting / Shearing: Existing bridge superstructure and pier columns may be reduced into smaller sections to allow for partial removal. Smaller sections may be lifted by cranes or dropped on the pavement below provided that all the requirements of this Special Provision are met.

B. Blasting: The Contractor may be permitted to use explosive provided the requirements outlined in this Special Provision are satisfied.

C. Other Approved Methods

4. USE OF EXPLOSIVES

The following requirements shall apply:

A. Pre-blast Crack and Damage Survey

## Description

The Contractor shall arrange with property owners affected by the project the rights-of-entry to their properties in order to engage in a pre-blast and post-blast property damage survey. The locations of the affected properties are included in the estimate reference information of the bridge plans. The Contractor shall submit written reports to the Iowa DOT District 1 Engineer to confirm a visual investigation of the buildings on these properties.

## Investigation Methods

The investigation shall consist of visually inspecting and recording all existing defects in the structures. The structures shall be thoroughly inspected from top to bottom, inside and out. The report shall include names of inspectors, date of inspections, and descriptions and locations of defects. In addition, the Contractor shall mark existing cracks in such a way that future observations would indicate whether cracks continue to open or spread. Photographs shall be used in verifying written descriptions of damaged areas. The Contractor shall arrange for professional photography capable of producing sharp, grain-free, high-contrast pictures with good shadow details for construction monitoring at the properties.

Before any blasting operations for demolition, the Contractor shall have record photographs taken of the portions of all the buildings affected by the proposed bridge demolition.

Photographs shall be taken and developed so that details of the buildings will be clear and well defined. The intent is to procure a record of the general physical condition of the buildings' exterior walls and foundations. Camera location shall be changed for each of the photographs and shall be varied so that all portions of the buildings' exterior surfaces will be covered by the view.

Each photograph shall contain the following information:

I-235, Polk County
IM-235-2(330)9--13-77
View _____
Looking _____
Date _____
Photographer _____

Photographs shall be eight by ten inches, black and white glossy, mounted on paper with a flap for binding. Three prints of each view and the negatives shall be supplied to the Iowa DOT District 1 Engineer within two weeks after the exposure has been made. Rights for subsequent use shall become the property of the Iowa DOT.

The Contractor shall conduct a second inspection of each affected property once blasting is complete. He shall visually inspect and photograph each structure to verify the post-blast condition. The Contractor shall follow the same inspection procedures as outlined herein before for the pre-blast survey.

The final written report of each property shall be typed on bond paper and be in text form, headings, indexed, etc., and shall become the property of the Iowa DOT.

B. Seismograph

## Description

Work under this item shall consist of furnishing a seismograph and employing a trained operator to continuously monitor ground vibration near buildings during controlled blasting. The purpose of the monitoring is to assess potential damages to adjacent structures due to blasting activities.

## Equipments

The seismograph shall be a continuous monitoring instrument capable of producing a continuous strip recording of the seismic readings, or a continuous dated report of all seismic events exceeding a predetermined threshold. The seismograph shall be supplied with all accessories necessary for making seismographic observations.

## Monitoring Procedures

The Contractor, in the presence of the Iowa DOT District 1 Engineer, or his representative, shall take seismograph readings prior to blasting to establish an ambient index.

The seismograph shall be placed to continuously monitor all blasting activities or as directed by the Engineer. Attentive observation of the seismographic readings shall be made during all blasting operations. If blast activities generate ground vibration with maximum peak particle velocity of greater than 12.7 mm (0.50 inch) per second at frequencies below 40 Hz,

or 50.8 mm (2.0 inches) per second at frequencies greater than 40 Hz; or alternatively, a maximum of 12.7 mm (0.50 inch) per second peak particle velocity below 10 Hz, and a maximum of 50.8 mm (2.0 inches) per second above 40 Hz, and a maximum of 0.20 mm (0.008 inch) displacement between 10 and 40 Hz, the Contractor shall stop the operation in progress and adjust explosive quantities and/or type or other methods to reduce vibrations to allowable levels.

Ground vibration shall be measured as the particle velocity. Particle velocity shall be recorded in three mutually perpendicular directions. The maximum allowable peak particle velocity shall apply to each of the three measurements.

The final recorded seismograph charts and/or reports shall become the property of the Iowa DOT.

## 5. ROAD CLOSURE LIMITS

Depending on the method of removal employed, the Contractor will be allowed to close I-235 to traffic using one of the following traffic control schemes outlined below:

A. The Contractor will be allowed to close I-235 to traffic between 9 PM Saturday and 11 AM Sunday to allow for complete superstructure removal over the traveled way. Additional one lane closure may be allowed between 11 AM Sunday and 7 AM Monday to complete the bridge removal operation; during this period the Contractor will be limited to performing debris removal and clean up.
B. The Contractor will be allowed to close I-235 to traffic between 9 PM and 6 AM weekdays to allow for partial removal of the structure.

## 6. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Removal of all material from the bridge, including removal in stages, will be measured as a single lump sum. No measurement will be made of individual items on the bridge.

The lump sum price bid for “Removal of Existing Structures” shall be full compensation for furnishing all material, equipment, and labor and for performance of all work including removal plans as required, safety and protective measures, cleanup, and disposal of non-salvaged materials.

If explosive is used, the following items should be considered incidental: surveying each property twice, providing the written report, providing three mounted black and white glossy prints and the negative for each view photographed, furnishing a seismograph, an operator, accessories, and for furnishing all labor, equipment and incidentals necessary to complete the work.