2011 Discretionary Grant Programs
Highways for Life (HfL) Application
Pecos Street over I-70 ML

Part I. Applicant Information

Application for:	FY 2011
Application date:	June 3, 2011
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State Highway Department:	Colorado Department of Transportation (CDOT)

Part II. Project Information

Project Description (location, purpose and scope)

This application requests supplemental funding to support the reconstruction of Bridge E-16-FW located in Denver, Colorado (see Figure 1, Key Map) where Pecos Street crosses over Interstate Highway I-70. The bridge is located in the heart of the Denver metropolitan area; approximately one-mile west of the largest and most-complex interchange in the entire state with the crossing of I-70 (major east-west route through the state) over Interstate Highway I-25 (major north-south route through the state).

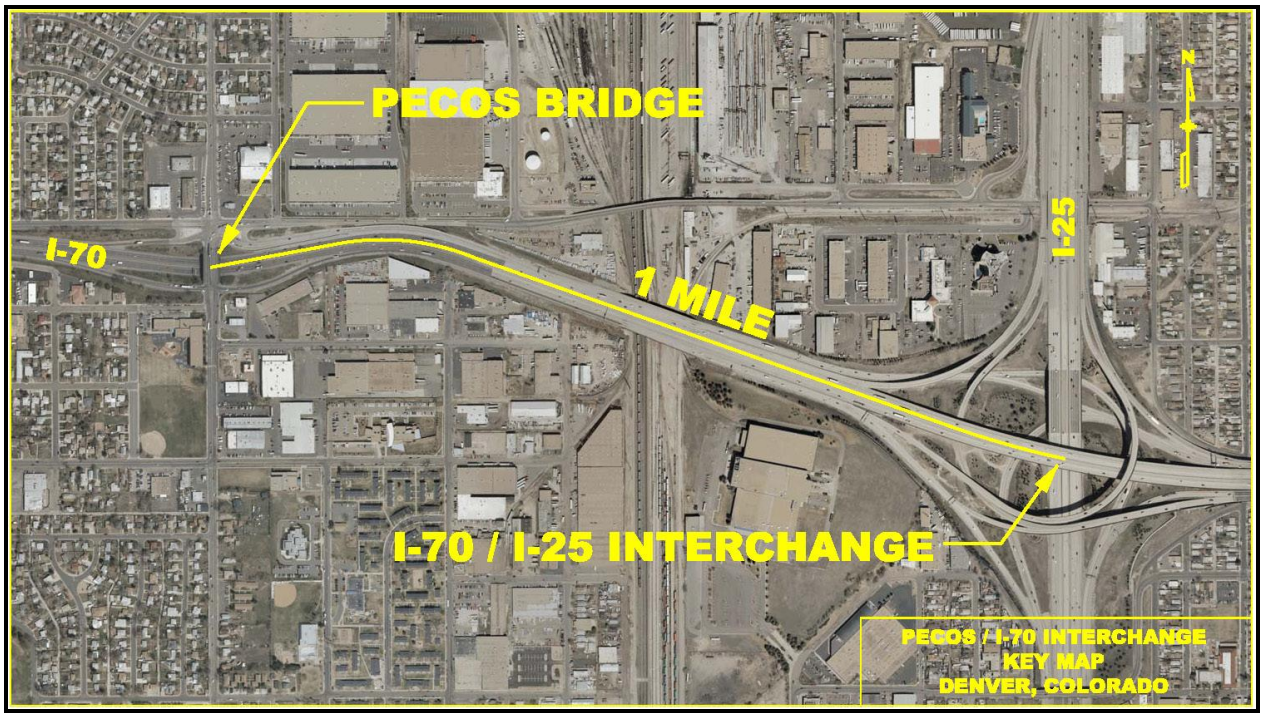

Figure 1 – Key Map

The I-70 and I-25 interchange carries cumulatively in excess of 340,000 trips per day (ADT). I-70 carries approximately 123,000 trips per day (ADT) west of Pecos and 118,000 trips per day (ADT east of Pecos. Eastbound I-70 serves as one of the primary access routes to the Denver downtown business district and Denver International Airport to the east. Westbound I-70 serves as the primary route for the local communities, cities and mountains to the west. Pecos Street which crosses over I-70 carries approximately 19,150 trips per day (ADT) (see Figure 2, Site Map).

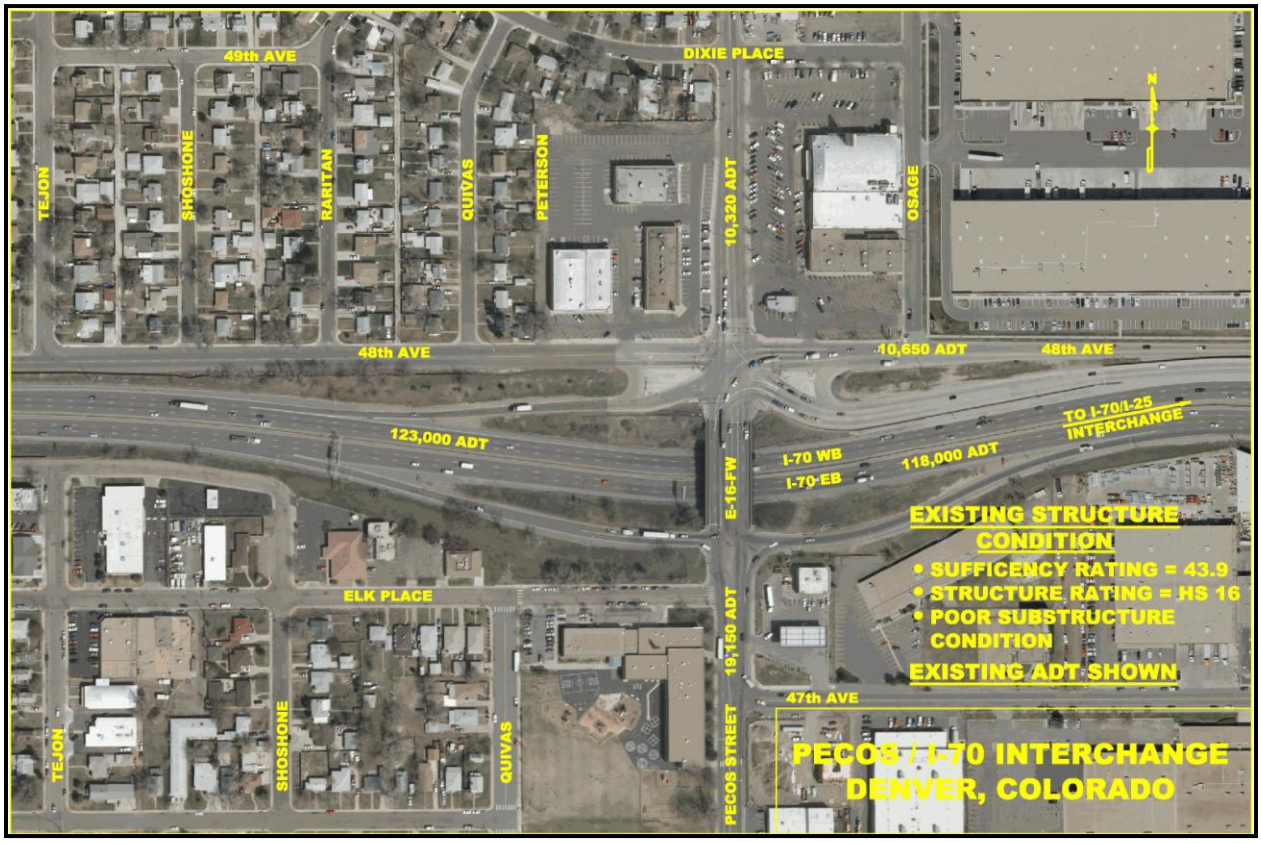

Figure 2 – Site Map

According to the Denver Regional Council of Governments (DRCOG), traffic along I-70 is expected to increase by over 20% in the next 25 years. Furthermore, both I-70 and I-25 are among 19 strategic corridors in the Denver metro area recently identified for funding priority by CDOT, RTD (the regional transit provider), and DRCOG (the regional MPO).

The current Pecos Street bridge is a cast-in-place concrete slab and girder structure originally constructed in 1965 (see Figure 3). The bridge has been classified as structurally deficient with a 43.9 sufficiency rating, and is rated as the 60th worst bridge in the state (out of approximately 3,300 on-system CDOT bridges). The low sufficiency rating and "poor" condition of the substructure is due to deterioration, cracking, and spalling of the columns and abutments (see Figure 4).

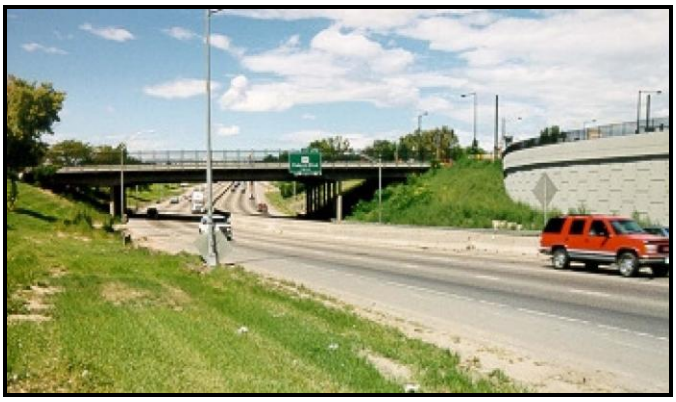

Figure 3 – Looking West under Pecos Street

Figure 4 – Spalling of Columns

The most significant challenge of this project is how to reconstruct the bridge and limit disruptions to traffic along I-70 and Pecos Street for any significant length of time. The application of traditional construction techniques, with lengthy undesirable construction schedules, potential road detours, multiple and complicated construction phasing and sequencing, all negatively impact the traveling public. The traditional construction approach also presents increasingly safety-related concerns not only to the traveling public but also to the contractor work-force constructing a replacement structure (in-place) along-side active traffic all within a congested and restricted work area.

As such, CDOT has committed to deployment of innovation via accelerated bridge construction (ABC) techniques, and an alternative contract delivery methodology (specifically Construction Management / General Contractor [CM/GC]). The goal is to reduce the overall construction schedule thereby minimizing construction related traffic delays and limited shut-downs or closures to traffic along I-70. Furthermore, the deployment of innovative ABC techniques (such as a "slide-in or a launched" bridge) and utilization of CM/GC as the contract delivery are consistent with FHWA every-day-count initiatives and the combination (construction innovation and CM/GC contract delivery) has not been utilized on a CDOT transportation project to date. Both concepts are discussed in further detail in Section IV – Innovative Features of this application.

Anticipated FHWA construction authorization date:
May 2012.

Construction duration time:
A comparative analysis of estimated construction durations associated with traditional construction techniques to potential ABC techniques has been presented in Section VI Construction Congestion. As previously noted, CDOT has committed to the (1) deployment of ABC techniques, and (2) utilization of a CM/GC contracting delivery. CDOT's plan is to allow the design consultant and CM/GC to work collaboratively and select the most cost effective / best suited bridge application for this situation consistent with predetermined goals established for the project. One of these goals benefitting the traveling public could be limited and short-term closures to I-70 (with the proper approvals) e.g., a 50-hour weekend total closure from Friday

evening through Monday morning rather than lengthy (minimum one-year), repetitive construction delays and detours resulting from traditional construction techniques.

Partnerships:
This project is supported by numerous stakeholders including: DRCOG (the MPO for the region), City and County of Denver, and Colorado Bridge Enterprise (government-owned business entity within CDOT providing project funding). DRCOG's approval is evidenced by their recent approval of funding in support of this critical project in the regional TIP (Transportation Improvement Plan).

Anticipated Total Project Costs:
The current project estimate is approximately $18.8 million which includes both pre-construction and construction costs.

Part III Highways for Life Funding

Amount of Grant Application:
This application requests $2 million in funding to implement and streamline CM/GC contracting methodology and implement ABC techniques.

Amount or Percentage requested to be adjusted by increasing the Federal share by using other apportioned Federal-aid funds:
Receipt of any HfL funding (any dollar amount) will not increase the apportionment of Federal-aid dollars assigned to the project. The apportionment of Federal-aid dollars as an overall percentage of estimated projected cost will remain the same but the dollar value amount will decrease. Any required matching funds shall be reimbursed by the Colorado Bridge Enterprise.

Part IV Innovative Features

An "innovation", as defined here, must be one that the State has never before or rarely used. Innovations used on emergency or unique projects are exceptions. The proposed innovations must be available and ready for use. They should not require further development or test and evaluation. The innovations must have (as appropriate) standards, specifications, test procedures, training and operations guidance to support the application of the innovation in routine highway design and construction. Further, the innovations have been used successfully in the U.S. or internationally and documentation or sufficient evidence of the benefits must also be available.

Three innovative features will be used: **CM/GC Contracting, Accelerated Bridge Construction (ABC),** and constructing a **Roundabout Interchange.** These are summarized as follows:

1. **CM/GC Contracting:**

    a. CM/GC contracting method has never done before for a CDOT Highway project.

b. CM/GC allows contractor input during design which will reduce project risks and optimize utilization of accelerated bridge construction techniques. Contractor input is desired to address a more advanced accelerated bridge construction (ABC) method (not used by CDOT before) and challenging phasing issues associated with roundabout design.
c. Project will develop valuable CM/GC experience to use for future CDOT projects.

2. Advanced ABC methods:

a. Purpose is to minimize delays and reduce user costs on I-70 and I-70/I-25 Interchange by minimizing the number of months traffic will be impacted on I-70.
b. Project will develop valuable advanced ABC experience to use on future CDOT projects.
c. CDOT has used some ABC techniques, but the goal on this project is to use advanced techniques to replace superstructure in less than 50 hours.

The existing Pecos Bridge layout is ideal for using more advanced ABC methods where the traffic delays for the interstate are reduced to a weekend closure. The concept sketch below illustrates the new bridge layout. In essence, the substructure will be constructed outside of the existing I-70 shoulders and will be built underneath the existing bridge (see Figure 5).

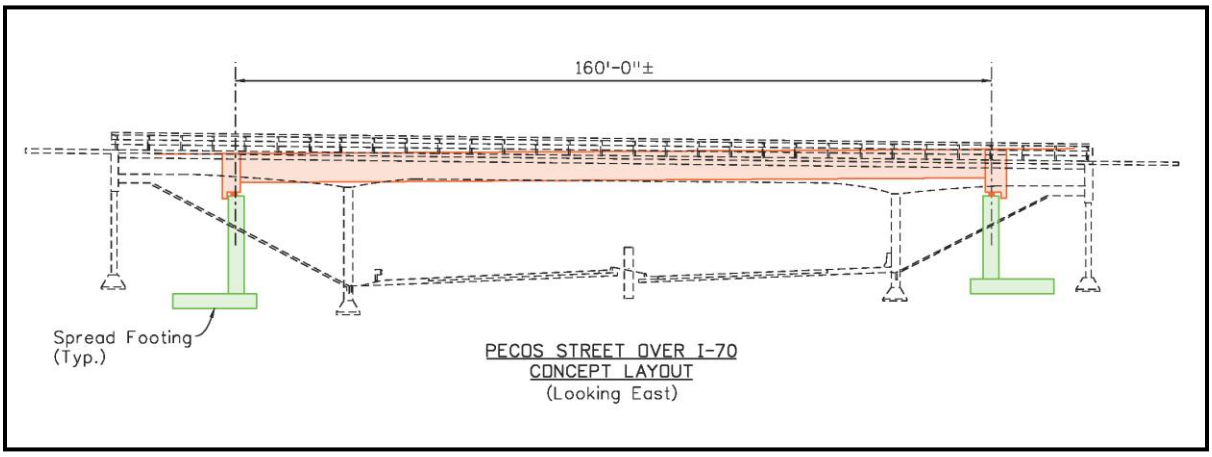

Figure 5 – Bridge Concept Elevation

The superstructure replacement has at least two options; construct the superstructure offsite at a staging area and then transport to final location using self propelled motorized transport vehicles (SPMT), or construct the new superstructure adjacent to the existing bridge on temporary abutments and then slide into position once the existing bridge is removed. In either scenario, the

removal of the existing bridge and installation of the new superstructure can occur in less than 50 hours (see Figure 6).

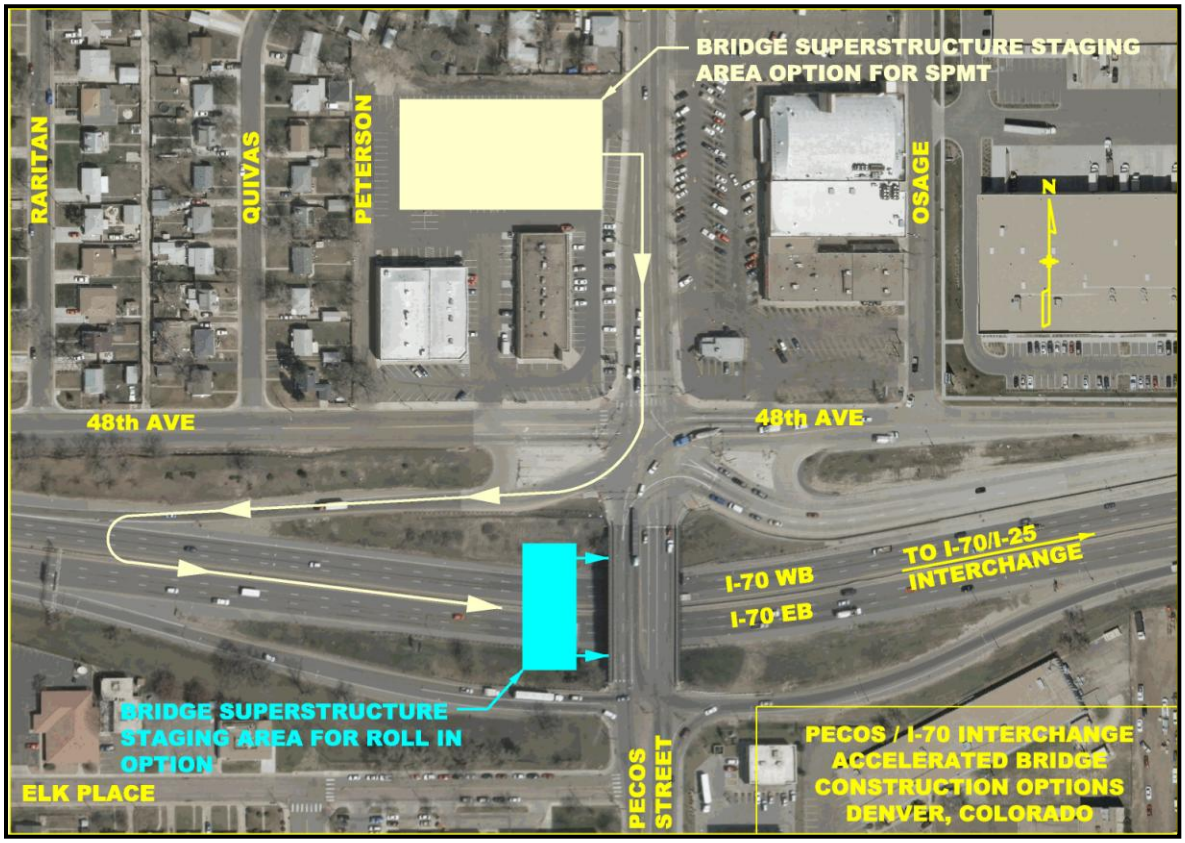

Figure 6 – ABC Construction Options

Recent examples of this advanced ABC method transporting or sliding the superstructure have been successfully completed in Utah as illustrated by pictures below (see Figures 7, 8, and 9).

(Figure #'s left to right)

Figure 7 – Substructure Construction under Existing Bridge
Figure 8 – Slide-in Superstructure
Figure 9 – Superstructure on SPMT's

3. **Roundabout Interchange Design (see Figure 10):**

    a. Roundabout Interchanges are rarely used on the interstate system in Colorado and first application in the Denver urban area on the interstate system.
    b. This interchange concept was found to be the best alternative to solve problems created by proximity of 48th Avenue at ramp termini and minimize ROW and environmental impacts.
    c. Reduces the size of the bridge, compared to the existing interchange, resulting in lower construction costs and maintenance costs in the future.

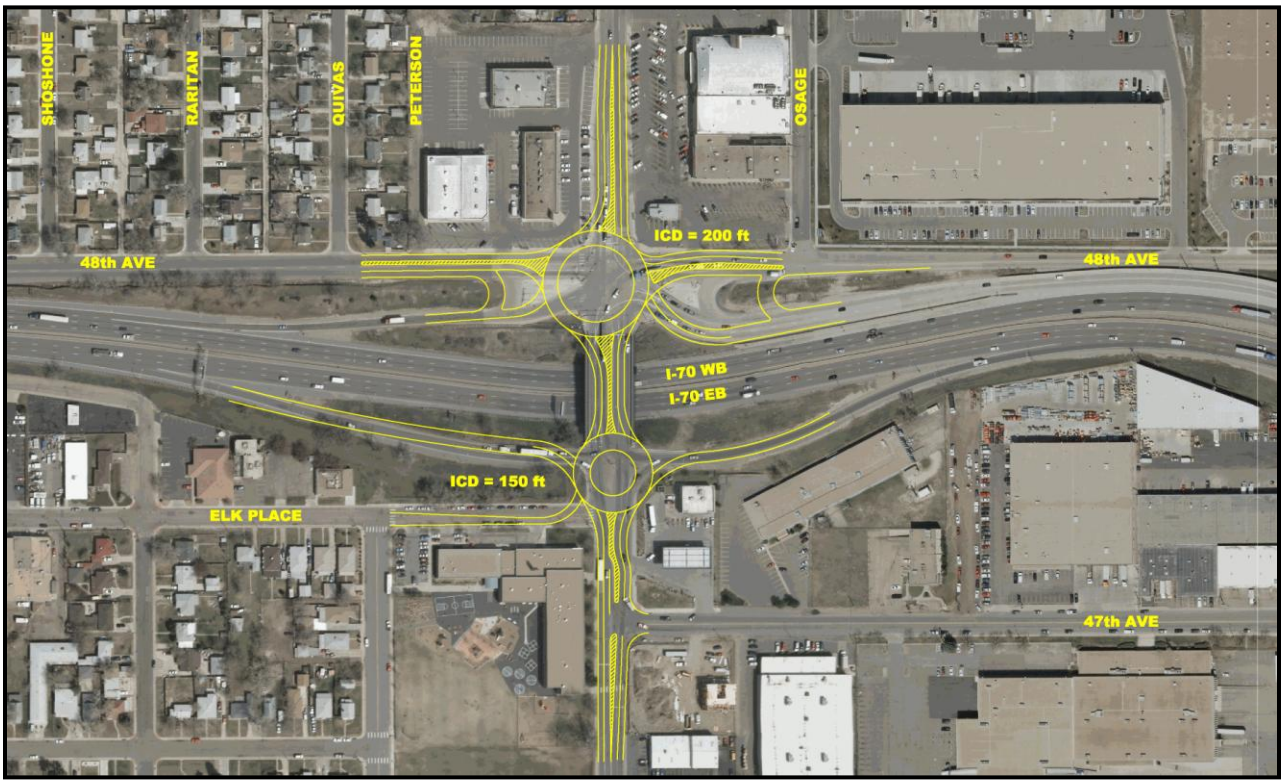

Figure 10 – Roundabout Interchange Concept

Part V Safety

Criteria: Describe the proposed innovations that will be used in meeting the HfL performance goal of achieving a work zone crash rate equal to or less than the existing condition. If your goal is different from the HfL goal please provide an explanation of your goal. Include in your discussion the current crash data for the project location.

CDOT performed a Safety Study and found that during a five year time period between 2005 and 2009; there were 367 accidents in the project area. Of these, there were 42 injury accidents, and 2 fatalities.

The CDOT Roadway Management Core Services Fiscal Year 2007 Action Plan has an overall goal of over the next 5 years of reducing worker accidents by 15 % per year with 2004 being the base year. This project will adhere to this overall objective. Relevant experience from the south I-25 TREX project and from the FHWA Work Zone guidance will be applied including:

- Detailed development of **traffic control plans** and integration of input from local jurisdictions to begin and end traffic management actions prior to entry or exit on the highway facility.

- Contractor interface and **definition of appropriate hours of construction activity to coincide with periods of lower traffic volumes** depending upon time of day and location within the corridor.

- Extensive use of traveler **information concerning traffic management changes** and alternative travel strategies to reduce overall volumes. Information will be made available through the media, CDOT's website and 511 system, as well as through changeable message signs along the corridor.

- Development of a **project safety management plan**. Through this safety plan, which is required by CDOT for all construction projects, the contractor must designate a responsible safety officer to conduct regular safety meetings and reviews, to ensure that proper safety equipment and attire is being used by all personnel on the job site, and to report on all safety conditions or violations. Limited project data is available to evaluate the program's effectiveness. This project will add to the information available on the program to assist in evaluating its impact.

- Development of **Safety Critical Specs**. In December of 2006, CDOT finalized its guidance on safety critical specifications which require CDOT staff to identify all especially hazardous aspects of a construction project and to implement a safety plan for managing the risk on those activities. Again, while this is a CDOT requirement, limited data are available. This project will add to the data available to evaluate its effectiveness by minimizing time of lane closures and maximize lane widths during construction.

CDOT has consistently emphasized safety in the work-zone for both the traveling public and the workers. This safety ethic is prevalent in Colorado contractors. CDOT inspectors are trained in part 6 of the Manual of Uniform Traffic Control Devices.

Criteria: Describe the proposed innovations that will be used in meeting the HfL performance goal of achieving an incident rate for worker injuries to be less than 4.0 based on the OSHA 300 rate. If your goal is different from the HfL goal please provide an explanation of your goal.

Safety is a core value of CDOT's mission statement with a commitment and dedication to "**SAFETY – We work and live safely!** We protect human life, preserve property, and put employee [contractor] safety before production!" Overall, CDOT's goal over the next 5 years is to reduce worker accidents by 15 % per year annually.

To ensure that the future contractor satisfies the above noted goal, CDOT shall deploy the H&S requirements outlined below intended to develop the requisite Health and Safety culture thereby resulting in minimal worker-related accidents and incidents.

- CDOT intends to utilize a best value selection process to select the CM/GC. Selection criteria will include: (1) evaluation of past safety performance, (2) confirmation that contractor already has an in-house H&S program, (3) qualification of proposed on-site H&S professional, and (4) utilization of drug and alcohol testing of employees.
- The CDOT Standard Specifications for Road and Bridge Construction manual has several elements designed to enhance safety on projects. The most prevalent are the Project Safety Management Plan, the Erection of Steel Structures Plan, and the Environmental, Health and Safety Management Plan all briefly discussed below.
- The project-specific Safety Management Plan outlines 13 steps designed to identify hazards, mitigate the hazards, and bring all contracted and sub-contracted employees the awareness to meet an accident free workplace.
- The Erection of Steel Structures Plan requires that equipment, qualified operators and competent persons, and materials be identified. It is a highly-detailed Job Safety Analysis of this process to ensure that bridge girder accidents are eliminated.
- The Environmental Health and Safety Management Plan focuses on environmental hazards and employee exposures to materials that are either naturally occurring or introduced to the area at some previous point.
- Development of Safety Critical Specifications which provide guidance on safety critical specifications to identify all especially hazardous aspects of a construction project and to implement a safety plan for managing the risk on those activities.

In addition by using ABC techniques for this project, CDOT believes that it **will reduce the potential exposure for worker injuries** by limiting the exposures workers have to live traffic by either constructing the superstructure away from traffic (SPMT Method), or constructing the superstructure in a much shorter single-phase (roll-in method). In the case of the SMPT method, work is adjacent to a low speed facility compared to an interstate facility. In addition, using ABC techniques will allow significantly more day work versus necessary night work required using conventional methods.

Furthermore, incorporating the contractor input allowed by CM/GC will focus on adding worker safety features.

Criteria: Describe the proposed innovations that will contribute to a 20% reduction in fatalities and injuries as reflected in a 3-year average crash rate, using pre-construction rates as a baseline.

According to "Roundabouts: An Informational Guide" published by FHWA:

1. Roundabouts improve the safety of intersections by eliminating or altering conflict types, by reducing speed differentials at intersections, and by forcing drivers to decrease speeds as they proceed into and through the intersection.
2. Experiences in the United States show a reduction of crashes after building a roundabout of about 37% for all crashes and 51% for injury crashes.

Part VI Construction Congestion

Criteria: Describe the proposed innovations that will be used in meeting the HfL performance goal of a 50% reduction, compared to traditional methods, in the duration that highway users are impacted. If your goal is different from the HfL goal please provide an explanation of your goal. Include in your discussion a baseline of how long the highway users would have been impacted if traditional methods were used.

Using conventional bridge construction, it is necessary to construct the superstructure in three phases, requiring at least twelve months. A 50% or more reduction in the time that I-70 travelers will be impacted by construction delays will be achieved by using the innovative advanced ABC techniques describe above. The duration that I-70 will be impacted is shown below:

- 3-Phase Construction: Minimum 12 months
- ABC (roll-in method): Approx. 3 months plus 50 hours superstructure roll-in
- ABC (SPMT methods): Less than 50 hours to install superstructure

CDOT options include but are not limited to: (1) construct the new superstructure off-site in a nearby staging area or (2) in one phase adjacent to existing bridge and roll into place. Other methods will be explored with contractor through the CMGC contracting method.

Additional Criteria: Describe the proposed innovations that will be used in meeting the HfL performance goal for trip time or queue length during construction. The trip time goal is less than 10% increase in trip time during construction as compared to the average pre-construction time using 100% sampling. The queue length goal is a moving queue length less than 1/2 mile (travel speed 20% less than posted speed) in a rural area OR a moving queue length less than 1 1/2 mile (travel speed 20% less than posted speed) in an urban area. If your goal is different from the HfL goal please provide an explanation of your goal. Include in your discussion a baseline on what the trip time or queue length would be if traditional methods were used.

To meet this criteria the project will allow lane closures only at night in accordance with CDOT's Lane Closure Policy. The allowable lane closures times are established to minimize delays (queue lengths).

During the 50 hour maximum allowed to install the new superstructure, I-70 will be closed and traffic will be diverted to other major highways. This highway closure will be on selected weekends to minimize delays (queue lengths).

Part VII Quality

Criteria: Does the project include the HfL performance goal of International Roughness Index (IRI) of less than 48 in/mi? If your goal is different from the HfL goal please provide an explanation of your goal. Include in your discussion a baseline of what the existing minimum acceptable IRI is for the project and the method used in achieving the HfL goal.

The majority of this project is a bridge reconstruction where IRI standards do not apply. However, CDOT is committed to achieving this goal for all pavement reconstruction that will be completed on the bridge approaches.

CDOT's current practice on highway projects is to utilize specifications regarding smoothness that allow for incentives/disincentives and also corrective work.

Criteria: Does the project include the HfL performance goal of achieving tire-pavement noise measurement of less than 96.0 decibels using the On Board Sound Intensity (OBSI)* test method? This is the tire to pavement noise and not the noise measured for a noise sensitive area or receptor noise. If your goal is different from the HfL goal please provide an explanation of your goal. Include in your discussion if this is a standard noise measurement for your State. (* This is a revision from the FY06 performance goal which identified using the Close Proximity (CPX) test method.)

The project does not construct any substantial length of highway or arterial pavement that would substantially influence tire-pavement noise, so this criteria is not applicable.

Criteria: Describe any other proposed innovations that will improve the durability and quality of work performed in fabrication and construction.

Using ABC techniques:

1. The superstructure is constructed in one phase eliminating longitudinal joints in the deck which reduces potential corrosion of concrete and reinforcing steel.
2. Construction of superstructure in a more controlled environmental improves product quality by allowing longer cure times and better quality control.
3. If the superstructure is built off-site, and not above I-70 traffic, it will be safer and better working conditions with less constraints, typically during daylight working hours.

Criteria: Describe any advanced material that will be used to prolong the life of the infrastructure (i.e. roadway and bridge). Provide justification for selecting its use.

Although we have not identified any materials that differ from CDOT specifications that already proven to prolong the life of the infrastructure, we will work with the CM/GC contractor to identify any potential materials that could improve on the specifications.

One of the advantages of ABC construction is that un-tested, innovative materials are not needed to accelerate bridge construction to minimize impacts to traffic.

Criteria: Identify equipment innovations that will improve quality and describe the functionality of the equipment.

Although we have not identified any equipment that differs from CDOT specifications, that already proven to prolong the life of the infrastructure, we will work with the CM/GC contractor to identify any potential equipment that could improve on the specifications.

Part VIII User Satisfaction

Criteria: Does the project include the HfL performance goal of 4+ on the Likert scale for the following questions (1) How satisfied the user is with the new facility, compared with its previous condition, and (2) How satisfied the user is with the approach used to construct the new facility in terms of minimizing disruption?

Due to the location of the project site, I-70 travel route with high ADT's, and anticipated public interest from the local community and adjacent stakeholders, CDOT intends to implement a public relations / public outreach prior to and through project acceptance. CDOT recognizes the need and is committed to soliciting and measuring public satisfaction associated with this project.

At the completion of the project, CDOT shall develop a survey to measure (or grade) the public satisfaction associated with: (1) the new facility [or bridge] compared to previous condition, (2) approach to construct the new facility, and (3) disruptions to the traveling public during bridge construction.

The survey shall be based upon a 5-point Likert scale intended to "grade" CDOT's performance from 0 – 4; whereas an "F" (defined as the lowest score or worst performance) is assigned 0 points, and an "A" (defined as the highest score or best performance) is assigned 4 points. The survey shall be web-based where the local community, adjacent stakeholders and traveling public can go online and complete the survey. Survey results shall be compiled and published for public consumption, and lessons learned shall be identified to be deployed on future projects.

Grade F	Grade D	Grade C	Grade B	Grade A
0	1	2	3	4

Part IX Summary

Provide a brief summary on how this demonstration project can impact the future practices of the industry and the DOT. The potential for adopting the identified innovations as standard practice and the benefits to be derived for motorists and the program. Describe the techniques and tools your agency plans to use to communicate the various aspects of the project with highway users and community. (i.e. media relations, surveys, news releases, special events, newsletters, etc.)

Throughout this project, CDOT will be gaining important and necessary knowledge and experience using CM/GC and ABC techniques that will aid in identifying when these techniques can provide cost, quality, schedule, and other benefits in the future. The potential for adopting

these standards is very high. The project will work closely with the Colorado Bridge Enterprise and CDOT's Innovated Contracting Advisory Committee (ICAC) to develop the decision making processes to incorporate these techniques in the future.

CDOT will incorporate an intensive public relations campaign to help inform motorists of changing roadway conditions. CDOT requires that contractors develop and employ a public involvement plan for projects over $1.0 million. This program has helped to develop understanding on the part of the public concerning traffic changes and the timing of when construction activities will take place. The program also is used to communicate about other impacts such as noise, nighttime lighting and construction-related dust and debris. The model program that has provided examples of successful applications is the recently completed TREX project along south I-25. The successful applications used on that project will be evaluated and applied to this bridge reconstruction project as appropriate.

Due to the high level of innovation on this project, CDOT will supplement the contractor's plan with media relations and social media during all phases of the project, but especially during the installation of the bridge's superstructure.

Thank you again for the opportunity to apply for funding from the Highways for Life program.