"Moving Advancements into Practice"

MAP Brief Winter 2025

Best practices and promising technologies that can be used now to enhance concrete paving

Accelerated Delivery of Concrete Paving Projects

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PROJECT TITLE
Accelerated Delivery of Concrete Paving Projects

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Introduction

It is essential to deliver highway improvement projects in a cost-effective and time-efficient manner. Demands on state highway agencies (SHA) continue to increase, and a variety of factors make it a challenge for agencies to meet these demands, including the deteriorating condition of the national highway network, increased traffic levels, a diminishing pool of technical staff, and expectations from the public to minimize disruption. At the same time, inadequate investment in the maintenance of our nation's roads and bridges at all levels of government has created a resource gap, incentivizing SHAs to deliver roadway improvements as efficiently and cost-effectively as possible. Strategies can be applied throughout the project delivery process—including during planning, design, construction, and opening—to deliver concrete paving projects in an efficient manner that saves time and money without compromising quality or safety.

The Winter 2025 MAP Brief provides a summary of the recently published *Accelerated Delivery of Concrete Paving Projects* (Cackler et al. 2024). That document explores a number of project delivery strategies with the aim of helping SHAs become more proficient at accelerating the delivery of concrete paving projects. The discussion is informed by practical and effective ideas on accelerated delivery drawn from numerous contractors, SHAs, and industry leaders. Case studies illustrating the successful application of a number of these strategies are provided to demonstrate the value of accelerated project delivery in specific concrete pavement project situations.

Benefits of Accelerated Delivery

The following are benefits to accelerating the delivery of concrete projects for SHAs, contractors, and the traveling public.

Increased Efficiency in Project Development

An efficient project delivery process will result in time and cost savings for the agency. The earlier in the development of a project that acceleration goals are identified, the greater the opportunity to accelerate the project. Efficient project delivery includes the development of a well-defined scope of work and project schedule as well as effective communication between all members of the development team, whether the design is completed within the agency or outsourced to consultants.

Flexibility in Concepting

Often a concrete pavement overlay, inlay, or rehabilitation can extend the life of an existing pavement in a time-saving and cost-effective manner while still providing the long service life normally associated with a new pavement. Alternatives to full pavement replacement, in addition to reducing cost, can also result in many opportunities to shorten the delivery time of the completed improvement.

Minimized Disruption to the Public

Once a project gets to the construction phase, completing the project quickly generally results in reduced road user impacts and costs, fewer impacts to businesses, and higher public satisfaction. For concrete paving projects, there are multiple options for getting traffic back on the roadway more quickly than traditional methods. In addition to advancing traffic restoration, solutions are expected to deliver longer project service life than traditional methods.

Improved Safety

In general, the less time the traveling public is exposed to construction activities, the safer it will be for workers and motorists. In addition, reduced construction time typically results in cost savings due to fewer traffic control operations.

Increased Competition and Innovation through Alternative Concrete Solutions

Competition between paving industries as well as an examination of the full range of available concrete solutions will result in cost savings for the agency. During the design process for traditional projects, the results of a life-cycle cost analysis (LCCA) should be considered when selecting the pavement type.

Improved Credibility and Confidence with the Public

Advertising an upcoming project provides advance notice and can improve relations between the agency and general public. Figure 1 is a public relations example communicating an anticipated project. Furthermore, consistently delivering completed projects on schedule and within budget builds agency credibility.

Brett Trautman, Missouri DOT, used with permission

Figure 1. Public relations example

Creation of an Efficient Project Delivery Process

Accelerating the delivery of a single priority project is different from being positioned to consistently deliver concrete paving projects in an expedited manner. There are many advantages to SHAs for delivering their transportation improvement plan (TIP) as efficiently as possible, including the following:

- The ability to quickly turn a need into a completed project builds credibility with the public.
- Long-life solutions that can be delivered in a streamlined manner are safer and more economical than frequent traffic disruptions caused by ongoing maintenance.
- An efficient project delivery process that minimizes rework, allows parallel work activities to occur, and incorporates the latest technologies and transportation innovations allows more to be accomplished with the talent available within the SHA.

This section offers concepts for consideration that some agencies have found to be helpful in creating an efficient delivery system.

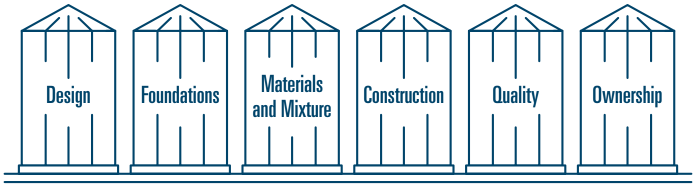
Organizational Strategies

Core Competency Supplemented with Outside Services as Needed

Some SHAs may not have enough internal agency staff to deliver their TIPs. It is important to keep a core level of technical competency within the agency for all facets of the project development process. These internal resources, however, can be supplemented with outside services on an as-needed basis.

Communication

Communication between the members of the project development team is the most important and impactful item an agency can focus on. Regardless of the organizational structure, projects cannot be delivered successfully without effective communication throughout the delivery process. Many SHAs have a “siloed” organizational structure with a linear workflow from one technical area to another (Figure 2). Efficiency is often gained by having concurrent activities proceed during project development, which requires effective communication between the members of the development team.



CP Tech Center

Figure 2. Silos representing development teams

Planning and Scoping

Developing the project concept is arguably the most impactful decision regarding project complexity, cost, and duration of construction. Because of the importance of this decision, it is beneficial to have experts from across project planning, right-of-way (ROW), utilities, design, and operations involved in the process. Often a long-life solution with a low traffic impact is available if those involved in developing the project concept understand the available options. Rehabilitating existing pavements with concrete overlays and inlays can address pavement condition needs effectively without triggering the need for additional ROW and utility considerations.

When utilities and railroads are involved in a project, it is important for the project team to address concerns related to those entities early. Early and frequent communication between utility owners, railroad entities, and the design team will help reduce delays during ROW clearance and construction. Another item that can help streamline the development and construction of a project is to allow the existing ROW to be accessible to the contractor for borrow and waste disposal. Project needs accommodated in this way can simplify the environmental clearance process and eliminate or reduce additional ROW needs.

Traffic management impacts how the project will be designed, the need for staging, and how fast a project can be completed. When a feasible detour is available, allowing the contractor unrestricted access to the work site can often be the optimal choice for minimizing impacts on the traveling public.

Design Considerations

The design should be developed with constructability in mind. Simplifying the design and minimizing staging will speed up construction activities and reduce costs. Uniform pavement widths or a jointing plan to maximize the use of a slip-form paver will also aid in constructability and maximize productivity during construction. There are several opportunities during the design process to evaluate what will have an effect on the project schedule. Examples include innovative survey technologies, earthwork, and plan development.

Innovative Survey Technologies

Survey methods that use scanning technology continue to evolve. Lidar can provide a more complete data set than conventional survey methods. The latest generation of scanning technology offers a reduction in survey cost and time and less disruption for the traveling public, which in turn improves safety compared to conventional survey methods. Although scanning technologies require additional office time working with large data sets, it is anticipated that their use will continue to grow, offering overall time and cost savings. Refer to *Implementation Manual: 3D Engineered Models for Highway Construction; The Iowa Experience* for more information about scanning technologies for surveying (Reeder and Nelson 2015).

Earthwork

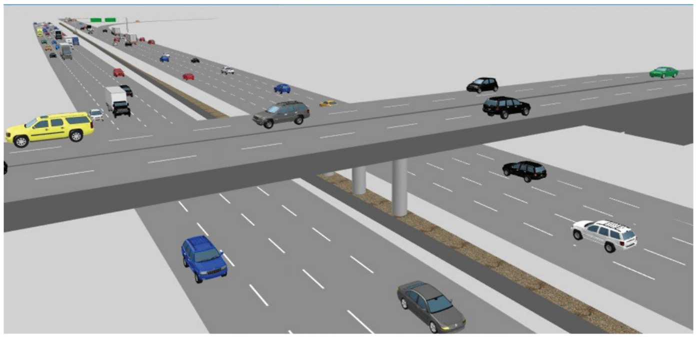
Mixing a chemical stabilizing material such as cement or fly ash into the subgrade soil will accelerate the preparation of excessively wet or unstable soils to allow placement of the subbase foundation. Geotextiles in combination with granular materials will also stabilize weak subgrade areas and may prove more cost-effective than coring out weak material and replacing it with select soil. Subgrade improvement through either chemical or geotextile stabilization is typically quicker than discing and drying an excessively wet subgrade.

Plan Development

The project's construction drawings should include the joint layout for sections that are not typical, including intersections, roundabouts, acceleration lanes, deceleration lanes, and turning lanes.

The design should provide a reasonable phasing and maintenance of traffic option to ensure that the design is constructible. The SHA will also benefit from being especially open to contractor input in this area. Contractors may offer ideas on how to efficiently construct the work that are achievable within their production capabilities. The engineer should consider providing the contractor with digital design files and three-dimensional (3D) models developed during the project design. Many contractors are now utilizing automated machine guidance (AMG) for various operations, and having these files available will increase efficiencies during construction. The 3D engineered model can be used by the contractor to construct a project with increased accuracy in a short timeframe (Reeder and Nelson 2015).

Figure 3 shows an image of a 3D model.



Reeder and Nelson 2015

Figure 3. 3D model

When the design is performed by outside consultants, a formalized agency-consultant joint meeting schedule to address design-related questions and assign tasks to both the designer and the agency will help minimize delays by keeping each team member on task.

Procurement/Letting

SHAs may benefit from the use of alternative contracting methods (ACMs) for some projects because these can reduce the overall time needed to get the facility in place. In a comparison of ACMs against traditional letting strategies (Figure 4), the Federal Highway Administration (FHWA) reported that "agencies are saving substantial time in project delivery, with 40% to 60% savings" (FHWA 2018).

Incentives/Disincentives

SHAs routinely incorporate incentive and disincentive provisions into contracts to encourage contractors to achieve project-critical objectives, such as material quality, pavement thickness, and ride quality, and schedule milestones.

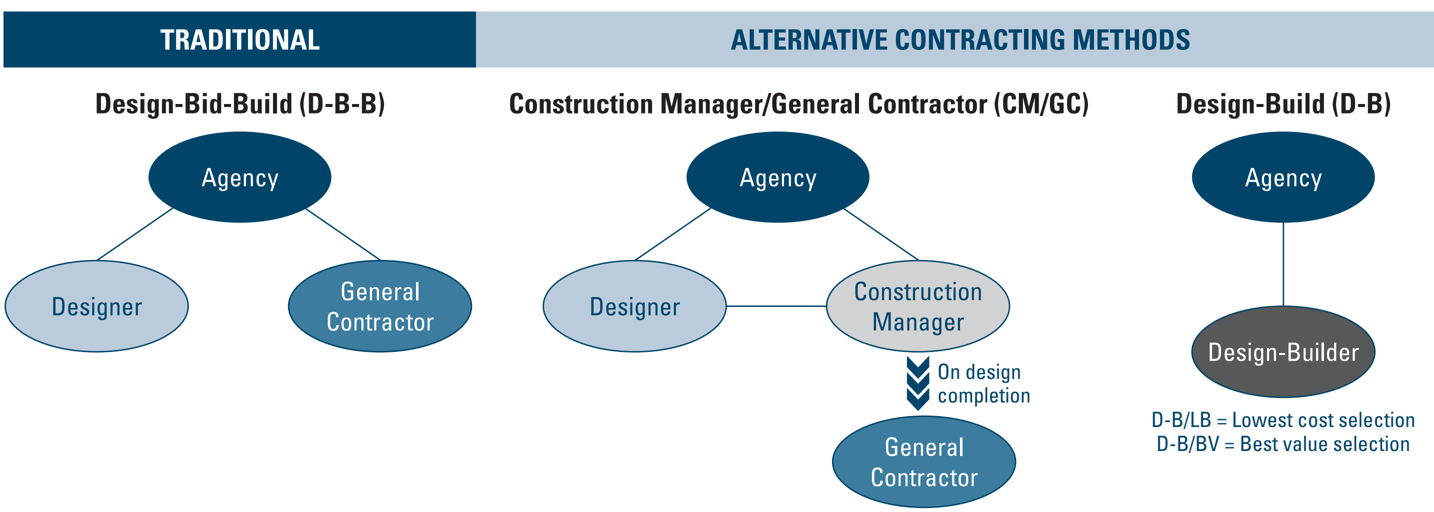
Time incentives are also commonly used to reward the accomplishment of project milestones.

When considering the use of incentives, realize that incentivized projects may become the priority for the contractor, and other projects may be negatively impacted. Incentives are normally best reserved for higher-volume roadways where meeting intermediate milestones and project completion is critical. It is also important to make the incentive payment large enough to cause acceleration but not so large that unreasonable risk is introduced.

Scheduling

Construction firms offer the following scheduling recommendations:

- Select the letting schedule to avoid conflicts with surrounding states' lettings as much as possible.
- Advertise projects well in advance to obtain good competition. Depending upon the project complexity, three to four weeks is the minimum desired for normal projects, and six weeks is desired if a pre-bid meeting is required.
- Advertise design-build projects six months or more in advance because the bid development process takes much longer.
- Provide flexibility between the bid award and the start date to allow the contractor to coordinate the project with other work and to obtain the best bid and most competition.



Recreated from FHWA 2018

Figure 4. Traditional and alternative contracting methods

Special Considerations

Competitive bidding is in the public interest and results in the best use of public funds. An SHA can help ensure competition by routinely undertaking both concrete and asphalt pavement projects and by having a predictable program so that contractors will make the investment to work in a certain market area.

The following points have been shown to be helpful in obtaining competitive project bids:

- Use pre-bid meetings for complex projects.
- Set a cut-off date of two to three days before the letting on addenda to avoid last minute changes.
- When setting the contract start date, allow time for aggregate production if a large volume of material is required.
- Specialty item procurement might require a long lead time. State-furnished materials can be an option for furnishing specialty items if the project must be completed before the normal procurement times would allow.
- Use incentives to achieve key milestones and project completion. The incentive amount should be appropriate for the acceleration requested.

Acceleration of Concrete Pavement Construction

General Strategies

The contractor brings expertise as well as a unique perspective on how the project can be built most efficiently. Contractors can be especially good at identifying more efficient ways to handle traffic and staging requirements. Many if not all SHAs have provisions for value engineering and/or alternative technical concepts. The SHA will benefit from a culture promoting openness to contractor innovations and encouraging creative solutions to be brought forward for consideration.

Contractor use of stringless paving can reduce the schedule of concrete paving operations. Stringless paving produces significant savings in terms of the time and labor needed to establish and maintain the guidance system, while the elimination of stringline-related tripping hazards and reductions in the required width of operating space for the paver are beneficial (Snyder 2019).

Contractor use of early-entry saws reduces the construction schedule by allowing sawing operations to begin earlier than in conventional sawing. With typical paving mixes, early-entry sawing can often begin an hour or two after paving. Figure 5 is an image of an early-entry saw.

Iowa DOT, used with permission

Figure 5. Early-entry saw

SHAs should review their specifications to ensure that they are incorporating advancements in testing technologies that are appropriate for their projects. An example is maturity monitoring, which enables new pavements to be opened to traffic based on strength, not an arbitrary curing time.

The maturity monitoring procedure is described in AASHTO T 413, Estimating the Early Opening Strength of Concrete Pavements by Maturity Tests, which is a modification to the original maturity monitoring standard, AASHTO T 325. The newer standard focuses on early strength development and can be implemented at the start of paving. Within the first three to four days of production, the maturity curve can be developed. The newer method allows for flexibility in using beams or cylinders, with the requirement that the first test be taken between 18 and 24 hours after casting. With the focus on early strength gain, a maturity curve no longer needs to be established months in advance of the project. Use of the newer testing method allows for early prediction of concrete strength and enables the contractor to open the pavement to traffic earlier than under the conventional method. Figure 6 illustrates a sample maturity curve from AASHTO T 413.

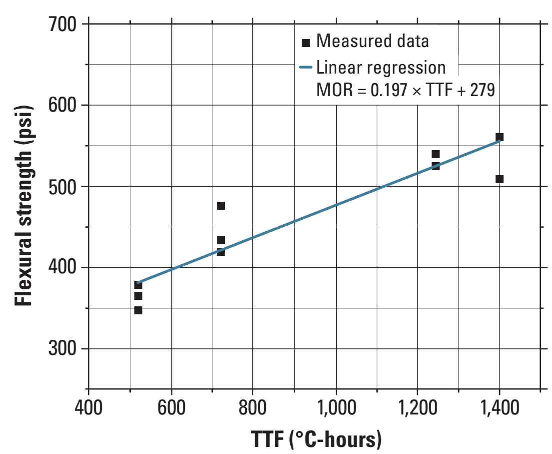


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Figure 6. Maturity curve

The National Concrete Pavement Technology Center has issued a recent research report as well as a technical brief on optimizing concrete pavement opening to traffic (Delatte et al. 2023, Delatte 2021). Tools such as the maturity method (AASHTO T 413) can be used to provide guidance on when a newly placed pavement can be opened to light vehicles or construction traffic.

Other tools are available to predict the real-time strength of concrete, including PITT/IRISE software and piezoelectric sensors. For more information, refer to Khazanovich et al. (2021) and Su et al. (2020).

Pavement thickness measurements can now be conducted using nondestructive methods. In lieu of physically coring the pavement to verify pavement thickness, an MIT-SCAN-T2 or MIT-SCAN-T3 gauge can be used to perform thickness measurements. The MIT-SCAN-T3 is the latest model and has Global Positioning System (GPS) capabilities. Figure 7 illustrates a metal target and an MIT-SCAN-T3 device. For more information, refer to FHWA (2017a).

Jagan M Gudimettla, ATI Inc. for the FHWA Mobile Concrete Technology Center, used with permission

Figure 7. Metal target and MIT-SCAN-T3 scanner

Placement of load transfer devices can also be confirmed with nondestructive methods. The MIT-Dowel-Scan device can be utilized to locate dowel bars and confirm proper location and alignment. For more information, refer to FHWA (2017b).

For a comprehensive list of accelerated concrete paving techniques, refer to Table 1 in *Accelerated Delivery of Concrete Paving Projects* (Cackler et al. 2024).

Strategies Specific to Rehabilitation and Preservation Projects

Most deteriorated pavements can be improved with concrete rehabilitation and preservation solutions. There are several options available depending on the extent of the repair needed, service life goals, and available funding. When properly concepted and designed, concrete pavement preservation and rehabilitation solutions are cost-effective, have long service lives, and can be rapidly constructed while minimizing disruptions to traffic.

Since rehabilitation and preservation needs arise due to a broad range of conditions, guidance includes: (1) major pavement replacement and inlays and (2) minor rehabilitation and overlays.

Major Pavement Replacement and Inlays

The difference between a major pavement replacement and a pavement inlay lies in how the existing shoulders and base materials are addressed and whether the existing roadway cross section can be reused without significant grading. An inlay can be as straightforward as replacing the existing pavement while leaving one or both existing shoulders in place. A major pavement replacement typically involves removing both shoulders, perhaps improving the base layers, and often making some minor adjustments to the profile grade through regrading.

Minor Rehabilitation/Preservation and Overlays

Work in this category includes pavement patching, dowel bar retrofitting, pavement grinding, joint resealing, and concrete overlays. These types of repairs extend the service life of the existing pavement and, since the contractor is only minimally affected by weather, can typically be constructed fairly quickly.

FHWA has recognized that concrete overlays are classified as accelerated construction and has developed many resources under its Targeted Overlay Pavement Solutions (TOPS) program, developed as part of Every Day Counts, Round 6 (EDC-6) (FHWA 2024).

Figure 8 shows a concrete on concrete–unbonded (COC–U) overlay in Buchanan County, Iowa, where the overlay was extended in width to include paved shoulders.

Snyder and Associates, Inc., used with permission

Figure 8. COC–U overlay

Project Staging, Local Access, and Options for Through Traffic

Concrete overlays can be built efficiently one lane at a time, but additional efficiency can be obtained by closing the project to through traffic. In 2022, the Iowa Department of Transportation (Iowa DOT) demonstrated accelerated construction by implementing unique staging requirements for a 6 in. thick concrete overlay on Iowa Highway 3 between Le Mars and Remsen. By closing segments of the corridor at a time, the nearly 10 mi project was able to be constructed in 25 calendar days. More information is available in King et al. 2024.

Pavement Design and Material Selection

The use of alternative cementitious materials for concrete pavement restoration can allow for early opening to traffic in rehabilitation projects. There are many types of alternative cementitious materials that have high early strength with minimal shrinkage. Burris et al. (2015) evaluated the early-age and long-term material properties as well as the durability of common alternative cementitious materials, including calcium aluminate cement (CAC), calcium sulfoaluminate (CSA), calcium sulfoaluminate belite (CSAB), magnesium phosphate cement (MPC), and alkali-activated binders.

Accelerated Construction

The opening strength requirements for partial-depth patches are lower than full-depth patches, and concrete overlays may have lower opening strength requirements than full-depth pavements depending on their thickness. Preservation projects should allow the contractor the option of field monitoring concrete strength development using the maturity method or other real-time strength monitoring methods.

Strategies Specific to Emergency Projects

Each state has specific legislative language for the SHA regarding procurement and bidding during emergency situations which can speed up delivery of the project. In addition, emergency declarations by the state's governor enable the SHA to use its resources in ways not normally allowed. It is recommended that an SHA review its authority to address emergency situations and, if needed, work through the state's legislative process to modernize the authority to meet anticipated needs and establish procedures that allow for rapid response to emergencies impacting the transportation system.

For example, the Tennessee Department of Transportation Commissioner has the authority to enter into contracts "narrowly tailored to remedy the actual or imminent failure or other emergency" in the event of a transportation system failure, the imminent threat of a failure, or other emergency presenting a hazard to the traveling public or a significant delay in transportation.

The Code of Federal Regulations makes provisions for emergency relief funding in 23 C.F.R. § 688. The purpose of the emergency relief program, as stated in 23 C.F.R. § 688.101, is to provide guidance for the administration of emergency funds for the repair or reconstruction of federal-aid highways that have suffered serious damage by natural disasters over a wide area or serious damage from catastrophic failures.

Case Studies

Concrete pavement solutions can be used effectively on projects where accelerated delivery is important. In *Accelerated Delivery of Concrete Paving Projects* (Cackler et al. 2024), eight case study examples are presented to show the versatility of applications where portland cement concrete (PCC) pavements can be used.

Resource Materials

A number of excellent resources are available that can help agencies and contractors become proficient with accelerated concrete pavement solutions. Several key resources are available in *Accelerated Delivery of Concrete Paving Projects* (Cackler et al. 2024) on a variety of topics, including accelerated construction, concept development, contracting, design, specifications, and utilities and railroads.

Conclusion

Concrete pavement solutions can be developed and delivered efficiently to meet a wide range of new pavement and pavement repair needs. Numerous actions can be taken throughout the project development and construction processes that will enable projects to be completed rapidly without compromising safety or quality. SHAs and ultimately the public will benefit from agencies' technical proficiency with concrete pavement solutions and a focus on opportunities to reduce delivery times to meet project needs.

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