Accelerated Bridge Construction (ABC) Guidelines

# 1.1 General

Accelerated Bridge Construction (ABC) is defined as the use of Prefabricated Bridge Elements and Systems (PBES) or the use of bridge movement techniques and equipment to set complete superstructures into place built at offsite locations in addition to other contract means in order to rapidly replace or renew a highway bridge structure with less disruption to traffic. The use of ABC techniques should be investigated where appropriate and following these guidelines. The Division of Structural Design has allocated space at their website dedicated to sample details and notes approved for ABC projects. The Federal Highway Administration (FHWA), Transportation Research Board (TRB), and many other state departments of transportation have websites with excellent resources such as the Strategic Highway Research Program’s (SHRP2) Innovative Bridge Designs for Rapid Renewal Toolkit, <http://www.trb.org/Main/Blurbs/168046.aspx> and [www.FHWA.dot.gov/bridge/abc](http://www.fhwa.dot.gov/bridge/abc). The use of details and notes outside of the Kentucky Transportation Cabinet (KYTC), Division of Structural Design’s own website should be coordinated with the division director. Many of these techniques are new, untested, and their use should be carefully thought out. A bridge designer should also consider provisions for long term preservation where rapid renewal techniques are warranted. These provisions may include concrete sealers, corrosion inhibiting admixtures, additional clearance to rebar, and the use of premium corrosion resistant rebar such as stainless steel. The intent is for these guidelines to evolve as the Cabinet gains experience and knowledge with ABC projects. A designer should check the website periodically for updates or subscribe to the news and updates page of our site for automatic email notification of changes.

# 1.2 Decision Making

The cost of using ABC technology can be considerably higher than the use of conventional construction and contract methods. So the decision to use these techniques should be carefully weighed in order for the travelling public to obtain full benefit from these extra expenditures in the form of less construction traffic congestion or having to use lengthy substandard detours. While there are formal decision making processes using flowcharts, analytical matrices, and computer software; the KYTC chooses to use a more simplified approach at this time. That doesn’t mean that we discount the importance of this step. We need time to evaluate and implement other, more structured methods. We do have a simple spreadsheet that can be downloaded from the website to aid the Project Team in their decision and for documentation.

The decision to use ABC technology should be made by the Project Team at the Preliminary Line and Grade Stage. Primary factors to consider are bridge site conditions, traffic volume, detour routes, and structure cost estimates. Other factors to consider would be user costs, economy of scale, and environmental impacts. The Project Team will decide how much weight to give each factor or if certain factors should be considered at all. A representative of the Division of Structural Design should be consulted or be present during the discussion. The discussion and decision should be well documented either in the Preliminary Line and Grade meeting minutes or in a separate report.

## 1.2.1 Bridge Site Conditions

The bridge site conditions should be considered when evaluating the use of ABC. Bridge sites conducive to ABC methods should be easily accessible by trucks delivering PBES or have a staging area where elements could be cast on site. The ease of constructing a diversion at the site should be considered as well. The cost of additional right-of-way for staging area or savings in not having to use a diversion will be elements of this factor. A bridge replacement site that is conducive to phase construction may be better suited for conventional construction. The skew of the bridge should be considered. Skews of 30° or more could cause design difficulties in the connection details and also have constructability issues due to stability concerns. Consider lengthening a span in order to eliminate any skew for practical ABC. Span lengths should also be considered. Limit consideration to spans under 70 feet. Until such time as the KYTC evaluates the technology for pier substructures, we will not use PBES on multiple span bridges unless the existing piers can be reused. For wet crossings the Project Team should look for the potential of scour and stream migration. Scour can be detrimental to any type of construction, but extremely risky to some forms of ABC such as Geosynthetic Reinforced Soil Integrated Bridge Systems (GRS-IBS).

## 1.2.2 Traffic Volume

Bridge replacement projects with high traffic volumes should be considered for ABC. Higher traffic volume would relate to higher congestion issues. The Project Team should carefully consider how much weight to give this issue. Projects with low average daily traffic (ADT) may still warrant the use of ABC due to other factors such as emergency replacements or no alternate access routes for traffic.

## 1.2.3 Detour Routes

Replacements where it is necessary to close the road and detour traffic should be considered for ABC. The Project Team should give weight to the length of detour and road class. Substandard alternate routes even at shorter distances may warrant ABC. All detour routes in excess of 25 miles should be given heavy weight toward ABC.

## 1.2.4 Structure Costs

Cost comparisons between ABC and conventional construction can be difficult as contractors and fabricators are still sorting out the additional costs for PBES. The Division of Structural Design is tracking the data and can help the Project Team with cost figures. Although costs of ABC can be prohibitive, in cases of no alternate routes or emergency replacement, it may still be a prudent choice.

## 1.2.5 Schedule

The Project Team should consider the project’s construction schedule when evaluating for ABC. A project with extensive roadwork may place the bridge off of the critical path and therefore make ABC not necessary. New routes across country should have a low priority for ABC. Projects that are primarily bridge or superstructure replacements may have a high priority for ABC, but still carefully weighed against other factors.

## 1.2.6 Other Factors

Other factors that the Project Team may consider and weigh appropriately are user costs, economy of scale, avoidance of right-of-way, and environmental impacts. If user costs information is known, it should factor into the decision. The Project Team may wish to calculate or seek out user cost information to aid in the decision. Economy of scale could help bring the higher costs of PBES down. More elements of the bridge that can be repeated in fabrication and installation could factor into the decision to use ABC. This may also be considered to help reduce costs on future projects. The use of PBES may help to avoid the acquisition of right-of-way. A superstructure replacement using ABC methods will likely not require any right-of-way funds. This should factor into the decision. Not only can ABC reduce traffic impacts, it can help to reduce impacts to the environment. The use of PBES may enable contractors to avoid disturbing areas during construction and reduce the amount of time any slight disturbance occurs.

# 1.3 Technology

For the purpose of these guidelines ABC technologies will be broken down into three groups: substructures, superstructures, and contract methods. While there are many different types of ABC technology available to use for each of these categories, these guidelines will only discuss those the KYTC Division of Structural Design will be using at this time. Again, as the division becomes more familiar with and has time to try out and evaluate other technologies this document will be updated. As a Department policy, lightweight concrete should not be used in any ABC technology at this time.

## 1.3.1 Substructures

For bridge replacement or renewal projects the ultimate ABC technology for substructures would be to reuse the existing. In many cases the existing substructures are in sufficient shape to receive a new superstructure with minimal or no repairs. In some cases abutments can be modified to receive a wider superstructure than the existing. The KYTC has successfully reused substructures using both ABC and conventional construction for the superstructure and in many instances replacing the superstructure multiple times on the same original abutments. The district bridge inspection staff should be consulted on the decision to reuse substructures. Scour and stream migration should be carefully evaluated in the decision to reuse substructures.

The use of precast pile end bents has been successful on many ABC projects. The designer should consult the KYTC ABC webpage for details and photos. Pile end bents can be cast into manageable pieces and linked together to form any length of bent with closure pours. The designer should give careful consideration to the connection details.

A Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS) will be acceptable for use in the proper location. The proper location should be a single short span dry or wet crossing in order translate to low bearing values. A wet crossing should be stable with low stream velocity and no evidence of stream migration. These types of systems could be susceptible to scour, so the project team should carefully evaluate the location and use the GRS-IBS only at a proper site. Our division’s Geotechnical Branch should be consulted for the suitability of GRS-IBS at any particular site.

## 1.3.2 Superstructures

Side-by-side box beams have been in use for many years and should be considered as an ABC technology. The designer should avoid using side-by-side box beams without some form of wearing surface. The preferred wearing surface is a five inch cast-in-place concrete deck, although this might not be technically ABC. As the slab is cast directly onto the girders with no form work required, construction could go relatively quick. If construction time or the situation does not allow for a cast-in-place deck, the designer should next consider an asphalt wearing surface over a waterproof membrane. Only consider using the side-by-side box beams with no wearing surface in extreme cases such as an emergency replacement.

Precast slab bridges are acceptable for use in Kentucky for ABC. The designer may use the slab bridge from the standard drawings and note for precasting or design to suit a particular situation. Slabs should be cast into sections that can be lifted by common construction cranes. The designer should give consideration to lift locations within the slab and provide reinforcement to allow for lifting. Notes about lifting should be clearly indicated in the plans. Shear transfer offset techniques should be used longitudinally between adjacent slabs along with connecting hardware as shown in the sample details.

Designers may also consider slabs precast onto rolled steel girders for use in superstructure ABC. Consider transport and weight when determining the size and the number of girders to use in a single section. Generally, no welding will be required on these girders, so the fabrication shop won’t need any type of certification. The designer may state in the plans that the contractor is to address lifting provisions rather than designing devices for these types of superstructures. Careful consideration should be given to the connection details. Follow details as provided on the KYTC ABC website. The railing system should be in place before the sections are installed onto the bridge in order to save time during construction.

Other superstructure ABC technologies may be considered on a case-by-case basis. A designer should consult the Division of Structural design to use a different technology as discussed in these guidelines or on the KYTC ABC website. Other technologies may include precast deck panels, slide-in technology of entire superstructures, or the use of self propelled modular transport vehicles to lift partial or entire superstructures into place.

## 1.3.3 Contract Methods

The simple use of certain contract methods can reduce the time of construction. These methods should be considered in conjunction with ABC, but can also be used to lessen the time contractors spend on conventional construction. Some of these methods are a simple accelerated completion date and A + B bidding. Other methods may be discussed and weighed by the project team, but their use should be coordinated with the Division of Construction Procurement.

The simplest way to achieve accelerated construction is to accelerate the completion date. Contractors can be innovative and find ways to meet dates, whether it is by adding workforce or diminishing lead times for materials. PBES may be a part of this equation or not. The project team may want to consider if this should be the only ABC technology to use on some projects. If the time frame is the only consideration, then it may be appropriate for the project to be let with conventional construction techniques and then let the contractor decide to propose the use of PBES to meet deadlines. Alternate PBES techniques may be allowed for in the contract documents of normal conventional construction.

A + B bidding is a mechanism that combines the normal project costs, the “A” component, with a time element, the “B” component. The time element is a number of days to complete construction or to reopen a road or bridge location, bid by the contractor, times a dollar amount based on the road user delay costs. The project team should give careful consideration to the road user delay costs as this can be used for an incentive to reward the contractor for coming in under the numbers of days bid and also to use as a penalty for going over the number of days . The contract documents should also limit the maximum number of days to be bid on for the “B” component. The details of the A + B bidding should be carefully noted in the contract documents. An example A + B bidding contract note is included on the KYTC ABC website.

Other contract methods that the project team may consider are lane rentals, continuity of construction, interim completion date incentives, accepted for traffic incentives, and no excuse incentives. These techniques have had limited or no use in the KYTC, so the decision to use any should be carefully coordinated with the Division of Construction Procurement. The decision to use these or any of the procedures described in this section should be well documented and carefully described in the contract documents.