CONSTRUCTIBILITY REVIEW BEST PRACTICES GUIDE



~ August 2000 ~

AASHTO SUBCOMMITTEE ON CONSTRUCTION

INTRODUCTION

In order for a transportation agency to receive the best price for any project, the plans and specifications for the project must be both "biddable" and "buildable". In recent years, there has been increasing concern among transportation officials, contractors and design professionals that the plans and specifications do not always allow the project to be constructed as detailed. When this occurs, projects are delayed, project costs increase, and frequently costly construction claims develop. Of equal concern are the delays and disruptions to motorists that occur, and the impact of delayed transportation projects on the economy in the area of the work and the agency's public image.

As a result of the concern for constructible plans and specifications, a National Cooperative Highway Research Program (NCHRP) study was conducted in the mid-1990s. The study findings and recommendations were published in 1997 as NCHRP Report 390. Report 390 identified many of the issues related to constructibility review practices, or the lack of them, and defined a recommended constructibility review process. While parts of the recommended review process have been adopted by several agencies, there is no indication that any agency has fully adopted the recommended process. Several agencies have indicated that the process defined in NCHRP Report 390 is comprehensive in nature, but these agencies are concerned that the recommended program in NCHRP Report 390 is too resource intensive for full implementation. NCHRP Report 390 does, however, provide some valuable information for any agency to consider as they adopt a constructibility review program that meets their needs.

The American Association of State Highway and Transportation Officials (AASHTO) is concerned with the costs and delays associated with construction plans that cannot be built as detailed. As a result of this concern, the AASHTO Standing Committee on Highways addressed this issue in its November 1998 Strategic Plan. Strategy 5-4 calls for AASHTO to "Identify and advocate cost savings associated with constructibility reviews between designers and construction personnel and encourage participation by contractors and suppliers during design."

The AASHTO Subcommittee on Construction was assigned responsibility for developing the implementation plan for Strategy 5-4. As a part of the strategic planning process, in 1999 the Subcommittee on Construction performed a survey of the AASHTO agencies to determine the status of the constructibility review process throughout the country. That survey revealed that only 26 percent of the AASHTO members have a constructibility review process of some type, but only eight states have formalized the process with written procedures.

The development of a Constructibility Review Best Practices Guide, that could be utilized by transportation agencies to establish constructibility review procedures, was determined to be essential to the implementation of Strategy 5-4 of the AASHTO Strategic Plan. With the development of a Best Practices Guide, the AASHTO Subcommittee on Construction could then

begin the process of encouraging transportation agencies to begin a constructibility review process that would include design, contractor, supplier and other groups in an effort to provide contract plans that are both buildable and biddable.

Before a constructibility review process can be developed and implemented, it is important to understand the definition of constructibility review. The AASHTO Subcommittee on Construction has defined "Constructibility Review" as "a process that utilizes construction personnel with extensive construction knowledge **early in the design stages** of projects to ensure that the projects are buildable, while also being cost-effective, biddable, and maintainable."

It is important to note in the definition that construction personnel should conduct the constructibility review **early in the design stages**. Many states, as a part of their design process, routinely conduct reviews of the plans and specifications at or near the completion of the design phase of a project. Conducting plan reviews with construction personnel late in the design process is not effective since, by this time, significant costs have been incurred in developing the design. Plan changes at this late stage are costly to implement, have a significant effect on the project schedule, may conflict with already approved permits and commitments, and will be perceived by many involved in the process as an attack on their credibility. On the other hand, when construction personnel are involved early in the design stages, a sense of teamwork is developed, which should continue through the construction phase.

An effective constructibility review process will accomplish several goals that are important to any transportation agency. The constructibility review process should assure that:

1. The project, as detailed in the plans and specifications, can be constructed using standard construction methods, materials and techniques;

2. The plans and specifications provide the contractor with clear, concise information that can be utilized to prepare a competitive, cost-effective bid; and

3. The work when constructed in accordance with the plans and specifications will result in a project that can be maintained in a cost-effective manner by the agency over the life of the project.

This "**Best Practices Guide**" has been developed to provide information to the AASHTO member states that can be used to develop a constructibility review process that will meet the needs of their individual transportation agency. The guide is not meant to detail a specific constructibility process. Rather, the guide has been developed to assist state agencies in developing a constructibility review process that will meet the needs of the agency. In establishing the constructibility review process, each state must determine the appropriate level of resources that it desires to commit to the process. Likewise, agencies must consider the frequency and timing of constructibility reviews and the processes that will work given the

unique characteristics of the agency, its employees, and the external participants that are to be utilized in implementing the process.

In developing this guide and reviewing the processes that exist in the eight states that have documented constructibility review programs, one aspect stands out. All of the successful programs have established a "Champion" for the constructibility process. This individual, or perhaps a group of individuals, is invariably at the senior management level and provides the leadership and the corporate commitment to the constructibility review process. It is believed that every successful program must have a senior official(s) who takes responsibility of and sets the direction for the constructibility review process within the agency and with the agencies external partners as well.

The "**Best Practices Guide**" will describe the elements that are a part of the successful constructibility practices that are currently being employed by state transportation agencies. In cases where there are different methods of implementing the elements in the programs, a discussion of the varying methods will be provided so an agency can decide the appropriate method to meet its needs. An appendix is provided at the end of the guide listing the states that have developed a constructibility review program along with the name, phone number and e-mail address of a contact person who can provide additional information regarding the particular state's program.

DEVELOPING THE PROGRAM

Champion: Although each agency has its own unique organizational structure, strengths and needs, it is essential for an individual near the top of the organizational pyramid, such as the Chief Engineer, State Construction Engineer, State Design Engineer or other Senior Manager, to set the tone or goal for the agency's constructibility program and also be its Champion. This individual would have to clearly specify that all contract plans generated by the agency are to be constructible. The Champion should emphasize the team concept to ensure that all units cooperate and that communication flows freely, both vertically and horizontally through the organization.

It may be necessary for the Champion to authorize the Design units to redo plans and specifications when a constructibility review uncovers a significant problem. This should not be considered a criticism, but rather an improvement, or refinement, in design.

The Champion should also realize that constructibility reviews are dynamic. The level of effort will change over time as staff levels fluctuate, workloads vary, and hopefully the Design process becomes more sensitive to and aware of constructibility issues.

Team Composition: This is usually established at the design concept stage of the project. Most agencies have the Design Project Manager responsible for arranging Constructibility Reviews. Other agencies have found it valuable to have the Construction Office coordinate the review. A few states have a separate constructibility team in place who are responsible for the coordination. New Jersey, for example, has developed a separate Constructibility Unit.

When developing the constructibility review team, it is vitally important to keep the group as small as possible while at the same time providing for the required expertise for the type of project to be reviewed. The constructibility review should be focused on the critical project issues, as much as possible. As a project design evolves, it may become apparent that some original team members may not be required or, conversely, that additional expertise is required to assure that the project critical issues are addressed.

Most agencies favor team meetings over independent and separate reviews, as this provides a forum for the various disciplines to interact and gain from each other's experience and point of view. An independent review, followed by the team meeting to discuss and refine the comments, is a viable option. The designer should participate in the constructibility review, and may perform an independent review as part of a QC review or check of their design. The designer,

however, should not be the sole participant in a constructibility review of their own project design.

If an agency decides to have a dedicated team that only performs constructibility reviews, they need to ensure that the members stay abreast of the changing problems and technologies, which may effect the designs being reviewed. This may be accomplished by staggering and rotating the terms of the team members from the participating units.

The review team may be comprised of the following:

1. Internal: Many agencies have their constructibility review teams comprised of a minimum of design and construction unit representatives. Additional specialty or support units are brought in as needed, or on a predetermined basis.

   While internal agency construction staff is well versed in construction practices and procedures, it is recommended that agencies consider the use of construction industry personnel to supplement the experience of the agency staff.

   Florida's constructibility reviews are performed solely by internal construction office staff who also determines contract time during what they call a "biddability review."

   Other states that utilize agency only staff for their constructibility reviews include California, New Jersey and Washington. Some states, such as Connecticut, utilize internal agency staff for the majority of their reviews and invite industry participation for selected constructibility reviews.

2. Construction Professionals: Some states have chosen to utilize representatives from the construction industry to assist in the constructibility review process. The North Carolina Department of Transportation states the advantages of using construction professionals in their "Pre-Bid Constructibility Reviews" as:

   > "While our construction people tend to be very knowledgeable about many of the aspects of construction, they are not familiar with equipment requirements, production issues, material deliveries, the intricate economics of many items of work or innovative or unfamiliar construction techniques. Members of the industry, for obvious reasons, are. Also, "contractors, when given the option, will most likely find the most economical method of building a project." If we can take advantage of this in the design stages, then we can provide the highest quality project at the most economical cost."

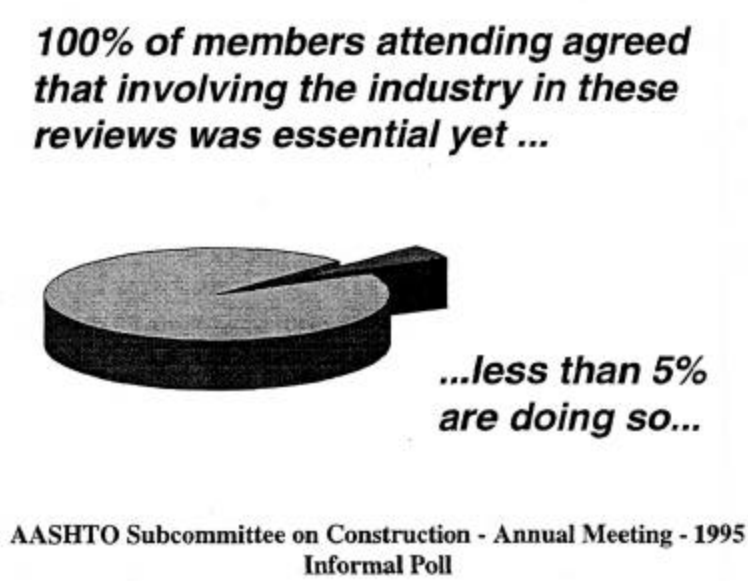
   The Connecticut Department of Transportation (ConnDOT) has been working jointly with the Connecticut Road Builders section of the Connecticut Construction Industries Association (CCIA) for several years. The CCIA offered its members to assist ConnDOT in performing Constructibility Reviews on selected projects. ConnDOT announces the projects, selected jointly by ConnDOT and CCIA, to all bidders on the agency's bid list and also by CCIA via their newsletter. In addition to contractors, consulting engineers who are not

involved with the project have also participated. Generally, the reviews are conducted on site with the presentation of project features given by the Designer and comments submitted both orally and in written format. Contractors are not compensated and there are no restrictions on subsequent bidding. ConnDOT is also increasing both the frequency and level of constructibility reviews by utilizing its construction engineers in both its headquarters and district offices.

Pennsylvania has employed a retired contractor to perform their constructibility reviews.

Kansas utilizes a joint task force comprised of representatives from the Kansas Contractors Association, the Heavy Constructors Association, and the Kansas DOT.

Maine DOT also involves representatives of the construction community in selected constructibility reviews.



AASHTO Subcommittee on Construction - Annual Meeting - 1995
Informal Poll

The use of contractor personnel as a part of the constructibility review team is highly recommended. While agency and consultant construction personnel are very knowledgeable in the construction process, contractor personnel have a unique perspective that will be invaluable to the constructibility review process. This would be particularly important for projects involving non-standard construction activities and techniques that could have a major impact on the progress of the construction project. While it may not be feasible to include contractor personnel on every constructibility review team, agencies should develop a guideline for when contractors will be included in the constructibility review process. Agencies should seek the assistance of the local contractor's association(s) in developing the guidelines and determining the availability of contractor personnel to participate in the constructibility review process. Contractor participation in the development of the guidelines

will assure that the construction industry "buys in" to the constructibility process and will support the process as it proceeds.

3. Consultants: State highway agencies may wish to use consultants for constructibility reviews. States may retain consultants on either a project by project basis or use an "on-call" consultant for multiple assignments. It is strongly recommended that consultants not do a constructibility review on their own designs. States electing to use the services of an on-call consultant may find it desirable to have two or more consultants available for constructibility reviews to preclude the possibility of having a consultant review their own work. This does not mean that a Design Consultant should not participate in a Constructibility Review; only that the Design Consultant should not be the lead entity if a consultant engineer is retained to perform a Constructibility Review.

   The Pennsylvania Department of Transportation (PennDOT) has utilized consultants for providing constructibility reviews throughout their state. A sample constructibility Scope of Work provided from PennDOT is as follows:

   - Site logistics and constraints,
   - Environmental impacts of proposed construction methods,
   - Clarity of documents,
   - Technical constructibility,
   - Compatibility of contract plans, specifications, and applicable standards,
   - Subsurface soil data,
   - Scheduling requirements,
   - Construction phasing,
   - Erosion and sedimentation control,
   - Maintenance and protection of traffic (MPT),
   - Construction site access for each phase of MPT, including material delivery and specialized equipment needs,
   - Local event conflicts,
   - Material acquisition,
   - Utility clearances for constructibility and project schedule,
   - Property/business owner access and pedestrian safety/access, and
   - Full-scale structural analysis of bridge designs will not be completed as part of the scope of work.

   The constructibility reviews will establish project duration, milestone dates, and applicable construction restrictions.

   In conjunction with the constructibility review, a Critical Path Method (CPM) Schedule will also be developed. The CPM schedule should be compatible with the Department's specifications.

   When Washington State DOT uses consultants, they are compensated under a design agreement with the Department.

If it is determined that consultants will be utilized to assist an agency in performing constructibility reviews, care must be taken in selecting the appropriate consultant. The selected consultant(s) must have personnel with extensive, current experience in construction practices, equipment and methodology.

4. Regulatory: Representatives of federal, state, or local regulatory agencies may be invited to the key review meetings.

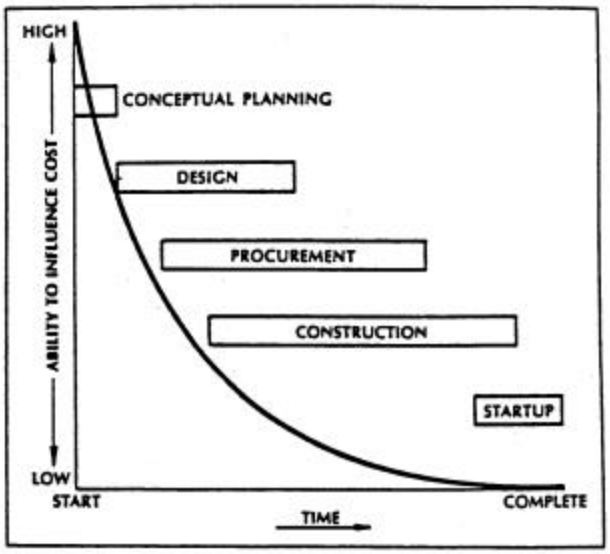
5. Utilities: Representatives of the effected utility companies may be invited to the group meetings. There may be issues concerning relocation or replacement of the utilities' facilities that are best addressed by the utilities' representatives.

6. Railroad: Representatives of the effected railroad companies may be invited to the group meetings. There may be issues concerning relocation or replacement of the railroad's facilities that are best addressed by the railroad's representatives.

7. Material Suppliers: On projects where non-standard materials are to be utilized, attendance from material suppliers may provide information that is critical for the successful use of the materials and completion of the project.

The constructibility review team should include the necessary expertise to address the major issues related to a project, but at the same time should not be so large that it will preclude effective discussion and resolution of the issues. The agency should determine a guideline for the maximum size of the constructibility review team (ten to twenty members may be appropriate) and strive to keep the team within the determined size limitations. Larger groups tend to be less productive and may not be able to resolve the constructibility issues.

Frequency of Reviews: In determining the frequency of reviews, the agency must consider available agency resources, benefits to be achieved, external organizations that may provide input and the stage(s) of plan development when reviews should be conducted. All agencies currently performing constructibility reviews recommend that the reviews be conducted during the early stages of a project design. Reviews conducted early in the design process have the best potential for providing meaningful benefits without having an adverse affect on project schedules. Performing the first constructibility review at the 90-95 percent plan completion is not recommended. At this stage, plan changes will without a doubt, result in costly schedule delays.



Ability to Influence Final Cost Over Project Life

(Courtesy of Construction Industry Institute)

The agency should establish a schedule or procedure for selecting projects to be reviewed. This may vary from allowing the lead designer to determine if a constructibility review is necessary, up to rigidly defining a frequency and extent of review for every project.

Adequate time should be allocated to the reviewers. Most agencies give a minimum two week period prior to the group meeting for participants to review the design.

Agencies may wish to develop a minimum number, or percentage, of major, intermediate and minor projects for annual, or periodic reviews (frequency determined by the agency), so that the agency may stay current with the various issues that may impact the constructibility of their designs/projects. Typical categories may include: major intersection reconstruction, minor intersection reconstruction, new construction in virgin land, bridge construction, bridge rehabilitation, signal projects, rail upgrades, illumination, resurfacing, safety improvements, facility expansions, etc.

Additional reviews may be warranted even if they do not fit the typical definitions or frequency outlined in the agencies' constructibility review process on high profile projects, typical "trouble spots," or when new or seldom used designs are utilized.

California, for example, has developed a three-level process, which is applied to all projects. Each level has a predetermined review schedule that are defined as:

> "A "Level 1" Constructibility Review, which includes reviews at the Project Initiation Document (PID) stage and 30%, 60%, and 95% design stages is appropriate for the following types of projects:

- Large, complex roadway/facility improvements (including new construction, widening, or realignment projects with significant staging and traffic handling requirements).
- Complex interchange construction or modifications.
- Large rehabilitation projects that include widening, major replacements of structures/drainage features, or significant utility involvement.

A "Level 2" Constructibility Review, which includes a PID stage and 30% and 95% design stages is appropriate for the following types of projects.

- Less complex roadway/facility projects (including widening projects with minimal staging/traffic handling requirements.
- Less complex structure or interchange projects.
- Most rehabilitation projects which include structure rehabilitation, minor widening, drainage, or safety improvements.

A "Level 3" Constructibility Review, which includes a PID stage and 95% design review is appropriate for other simple projects such as:

- Capital Preventative Maintenance (CAPM) overlay projects.
- Most non-complex Soundwall projects."

Florida incorporates their "Constructibility Reviews" and "Biddability Reviews" into their 30% and 60% design review procedures when performed by their construction staff.

Connecticut schedules constructibility reviews at 30-50% plan completion. At this stage of design, the plans have been sufficiently developed to provide general layout and design concept, but details have not yet been developed. This provides ample time to implement required revisions without major schedule and redesign impacts.

Location of Reviews: It is desirable to have the constructibility review on site, so that all concerned may see the site conditions. If this cannot be accomplished, participants should be encouraged to visit the site, as their schedules permit, prior to the constructibility review meeting. Some agencies may prefer this second option, as there may be less of a public relations issue that may be a concern with large gatherings of agency officials at a particular site.

Other options available to agencies would be the use of photos, videos, or other media tools that are available for the participants to familiarize themselves with the site. It may be beneficial to highlight or show the participants seasonal conditions through this method.

Consideration can be given to the use of nearby public facilities (i.e.: state highway garage, school, municipal office, agricultural extension office, library conference room, etc.) for a review meeting site. This allows for a combination of a site review and a team meeting. Some agencies have also indicated an increased use of technology to reduce travel/time requirements by using telephone or internet meetings.

Resources: This subject will probably be a major concern for any agency either currently utilizing or planning to formalize Constructibility Reviews. Time, funding and personnel must be allocated by each agency in a balance with their needs and resources. California's Constructibility Review Process addresses this concern:

> "To assure that functional unit staff are available to conduct these constructibility reviews, the Project Manager negotiates with each Functional Manager at the PID stage and includes sufficient time and resources in the project work plan. This means that more resources may need to be expended during the early stages of the project development process. However the resources required to conduct the Constructibility Reviews should be more than offset by the savings in capital support resource which are currently going towards negotiating Contract Change Orders (CCOs) and resolving claims."

Washington State DOT utilizes a complex multi-disciplinary team approach. Their teams are typically comprised of a mix of reviewers and managers familiar with the project, along with others who can provide objectivity and independent thought to the process. Their team is lead by the design project engineer and includes a minimum of construction managers, inspection staff, maintenance managers and maintenance staff. The additional members vary depending on the size and complexity of the project, and may vary from all department design disciplines to just a few select disciplines.

Other states, such as Connecticut, perform a majority of their reviews utilizing internal district construction staff except for major, complex and/or unique projects. For this small number of projects, Connecticut invites external participation from utilities, the construction industry, regulatory agencies and others that may have the ability to affect the project outcome.

Agencies need to tailor their constructibility review program to fit their goals, which may include improving designs and reducing costs associated delays, claims and change orders. The following variables will also affect the program: manpower levels, workload, and type of organizational structure (i.e.: centralized, regional, etc.).

Manpower: More resources may be required in the early phases than the later ones.

Funding: Savings from reduced change orders and claims will typically offset possible additional funding earlier in the project schedule.

Time: The review process may impact some project schedules and need to be factored into both the design schedule and into the constructibility review process. Typically though, any time lost in the design phase will typically be made up for in the construction phase due to a more constructible and maintainable project.

In developing the constructibility process, agencies should avoid creating a process that is complex and resource intensive. The ideal constructibility process will be simple to implement

and should focus on the major issues involved in the project. The constructibility review team should not be so large that it creates a mass meeting forum where the participants are reluctant, or do not have the opportunity to express their concerns and comments related to the project design and its ability to be constructed as intended.

REVIEW PROCESS

Type and Length of Review Meeting: The agency's constructibility review plan should be developed to provide all participants with guidance on the purpose of the constructibility review process, the desired outcomes, the responsibilities of the constructibility review team members, the format for meetings and reviews, and a methodology for resolving issues raised during the review process. It is essential for the plan to be written so that all parties can become familiar with what is expected and the desired outcomes of the constructibility reviews.

Some states have found that a highly structured review process is desirable. As an example, the Washington State DOT constructibility review plan provides the following:

> "Meetings are generally most effective when an agenda has been prepared and sent to the invited participants before the meeting. The agenda should include specific items of discussion and time allocations. The project engineer should allow a reasonable amount of time for discussion and problem solving. In addition, the agenda should be arranged in such a manner that the most serious items of discussion do not use up the meeting time, or the meeting time runs out before the serious issues have been thoroughly discussed.
>
> The project engineer of design is responsible for creating and circulating a meeting agenda in a timely manner before the review meeting. In addition, the appropriate CRP checklist and review documents should be provided with the agenda to the relevant functions to allow them sufficient time to prepare for the meeting. The project engineer is also responsible for managing the meeting, including ensuring the meeting starts and ends on time, strictly adhering to the agenda, and monitoring the time allocated for items of discussion. Frequent references to the agenda, during the meeting, should aid in keeping the meeting on track."

The agenda must be timed in order to complete the Constructibility Review in one meeting. The agenda should include specific items of concern to the design office and allot time for discussion and resolution of issues. In addition, time should be used to reflect back on previous decisions and determine whether the project is on track with respect to scope, schedule, and cost. The agenda should also incorporate items of concern identified by the appropriate checklist. A title, meeting date, starting and ending times and location should also be shown on the agenda. These items give the attendees a sense of purpose and the ability to plan other activities on the meeting date.

When planning the constructibility review meeting, the agency must consider the time demands that are placed on internal agency staff and outside participants in the process. It is easy for an

agency to commit its own staff for lengthy review meetings. External participants, however, may not be able to commit to a substantial amount of time for constructibility review meetings. It is therefore important for the agency to assure that the constructibility review meetings are efficiently run and accomplish the goals that are set for the meeting in the shortest possible time frame. In general, it is recommended that the constructibility review meeting be limited to a half a day or less wherever possible to accommodate the needs of the external participants in the process.

Checklists: In developing a constructibility plan, agencies should consider including checklists to guide the constructibility process. Reviewing plans for constructibility is not something that comes naturally to all engineers, inspectors, contractors, etc. Many agencies have found that it is imperative that certain guidelines and/or checklists be developed for the reviewers to follow. The guide/checklists do not need to be stringently adhered to but should serve as a means for the reviewers to focus on the areas and issues of concern.

Checklists are one component of a constructibility review. Agencies must use caution that they do not rely solely on checklists for their review procedure. Checklists do not always cover all aspects of the work and may not be applicable to possible areas of concern particular to the specific design or site at hand.

Some agencies have found that checklists listing general subjects to be considered are appropriate. On the other hand, a number of agencies have developed detailed checklists comprising ten or more pages of items that have historically caused constructibility problems, project delays and cost overruns.

States with general checklists include New Jersey and Pennsylvania, while California, Connecticut and Florida use detailed checklists. Examples of portions of these checklists are included in the appendix.

Each agency should consider whether general or detailed checklists are appropriate for their plan. Regardless of the type of list decided upon, it is important for agencies to understand that the checklists should be reviewed periodically to assure that they continue to meet the agency's needs and plan goals.

Agencies need to develop checklists as a guide, and update them periodically so that they remain relevant and useful to the participants.

Responsibility for Review Follow Through: It is recommended that the constructibility review plan include a mechanism for follow through on the comments produced during the review. Most agencies have the lead person, typically a project manager, review comments and

reply back to the reviewers with what was or was not included in the design. The comments should include reasons that reviewer's comments/suggestions were not included.

It is also recommended that the plan have a resolution procedure detailed that assigns responsibility for deciding whether review comments will be incorporated into the project design. The resolution procedure should document whom, or at what level, the decision is made to change or choose a design or alternate design. The agency may assign the responsibility for making the final determination to the project engineer responsible for the project. California uses this approach for comment resolution. The California plan requires that:

> "All comments are discussed at the Constructibility Review meeting, which may take up to four hours for each Constructibility Review level. The goal is to resolve all comments during the meeting. Any comments which cannot be resolved during the meeting are assigned to a review team member who is responsible for prompt follow up by a specific date. The Project Engineer and/or Project Manager has the overall responsibility to assure that all comments are adequately addressed."

On the other hand, some agencies, such as Washington State DOT, have written procedures that establish a multi level resolution process, described as follows:

> "Assuming that some items or issues might remain unresolved at the conclusion of a review meeting, an appeal describing them would be prepared by the team leader and submitted to the Region Arbitration Committee for a decision. The Region Arbitration Committee is comprised of the Assistant Administrators for Project Development, Construction, Traffic, Maintenance, and, if a bridge issue is involved, an appropriate level of Bridge Management.
>
> The Appeals Report should describe the issue, impacts to the project (scope, scheduling, and cost), and why an impasse was reached. The report is then used by the Region Arbitration Committee to resolve the issue. Issues that are statewide or that cannot be resolved at the regional level should be forwarded to Olympia for final resolution. The transmittal letter to Olympia should include any recommendations or concerns identified by the Region Arbitration Committee. If resolution still can not be attained, the issue should be submitted to the State Design Engineer, who would promptly process the resolution."

Agencies may find that a multi-level review process such as Washington State's is complicated to establish and administer. In keeping with a concept of simplicity, agencies may want to consider a more streamlined approach to resolving conflicts

Several states (North Carolina and Connecticut among them) have a more simplified issue resolution process. In these states, engineering and construction supervisors communicate and resolve the matter jointly. In Connecticut, issues that cannot be resolved between the engineering and construction supervisors are then referred to the Chief Engineer for a final determination.

Dissemination of Review Comments: This is an important area that needs to be improved upon. If there is any benefit from the constructibility review process, it needs to be brought back to the agency, its designers, and support staff. State agencies (DOTs) may also find it beneficial to share the information learned with county and municipal agencies. This would be particularly important in states where the local governmental agency prepares project plans that are then bid and administered by the state transportation agency.

Washington and Maine store their lessons learned for future reference by designers/agency staff. Maine also posts their results on their internet home page.

Agencies may already be performing some form of constructibility review, although under another name: Partnering, Value Engineering, Constructibility, Biddability, Maintainability, Buildable, Plan Review, Post-construction Review or Peer Review. All of these are variations to the same general goal of improving the design of a particular project and, at large, all similar projects. The key component to all of these programs are that they are all dependent upon the continued education of the team (designers, staff, etc.) and the open communication and sharing of the lessons learned from the various participants' experiences and expertise.

MEASURING CONSTRUCTIBILITY REVIEW RESULTS

When an agency is contemplating adding a procedure or process to its standard practices, the cost and benefits of the process is always a consideration. The constructibility review process is no exception. Unfortunately, however, to date there has not been an effective measure developed to determine the costs to an agency of conducting constructibility reviews. Likewise, measuring the benefits of constructibility reviews, other than through anecdotal results, has been an issue.

The constructibility review survey of state agencies conducted by the AASHTO Subcommittee on Construction in 1999 found that of the twelve states that routinely conduct constructibility reviews, only two states have documented the costs of performing the reviews (Florida and Georgia). The survey also revealed that measuring the benefits of the constructibility reviews also is not generally performed.

A review of the constructibility procedures of those state agencies that have written plans reveals that few have developed a methodology for measuring the results of the constructibility review process. The Washington State DOT (WSDOT) Manual of Instruction for Implementation of the Constructibility Review Process contains a section on the monitoring of constructibility review results. The WSDOT procedure sets performance goals in the areas of contract addenda, contract change orders, advertising delays, scope change, construction schedule change and project budget. It is reported that WSDOT has not implemented the monitoring procedures that are outlined in their Manual of Instruction.

The AASHTO Subcommittee on Construction has concerns that there appear to be no viable methods developed to date to provide a measure of the success of constructibility review programs. Due to the lack of a method to measure the benefits of performing constructibility reviews, the Subcommittee has requested that research be performed under the NCHRP program to develop a method for determining the costs and benefits of performing constructibility reviews on a regular basis. It is anticipated that the research for this study will begin in FY 2001, and the results and recommendations for measuring the success of constructibility review programs will be incorporated into future editions of the Best Practices Guide.

POST-CONSTRUCTION REVIEWS

Another tool for the constructibility review toolbox is the post-construction review of completed construction projects. Fifty-nine percent of the state transportation agencies responding to the AASHTO Constructibility Questionnaire indicated that they perform some type of post-construction review. Of those responding, twenty three percent conduct post-construction reviews on all projects, forty-two percent on major projects only, and fifteen percent only on projects that had many problems during construction.

Post-construction reviews are considered to be beneficial to state agencies and to the construction process. Conducting post-construction reviews allows the agency to eliminate repeated mistakes that increase costs and affect project schedules. Post-construction reviews provide feedback to design about project issues that can be addressed on future projects and should be considered as an educational process for all of the parties involved in the construction of transportation facilities. Post-construction reviews lead to increased communication between the parties to the construction process and can lead to improvements in project plans and specifications.

Like pre-construction constructibility reviews, it is important for an agency to identify a Champion for the post-construction review process. A well-planned post-construction review process will invariably involve many offices within an agency and a Champion will provide the needed emphasis to assure that all agency offices participate in the process as required. In many cases this Champion could be the same person who is also responsible for the constructibility review process within the agency.

Many of the agencies conducting post-construction reviews have an informal process that involves agency staff only. While an internal program does provide some benefit to the agency, it is recommended that the post-construction process also include external representatives who are familiar with the projects and the issues that arose during the construction of the projects. Agencies should consider participation by members of the following organizations (as applicable) in their post-construction reviews:

Agency Staff	External Staff
Highway Design	Contractor Superintendent
Bridge Design	Contractor Estimator
Soils, Hydraulics	Key Subcontractors
Construction Inspector(s)	Utility Companies
Environmental Office	Environmental Regulatory Agency
Traffic Engineers	Railroads
Maintenance Personnel	Local Municipality

This list should not be considered as all-inclusive; there may be other internal and external participation that is desirable depending on the project type and the issues that occurred during the construction phase of the work.

The post-construction review should be conducted near the end of a project while the personnel who will be involved in the review are still readily available to attend the review. This is also the best time to assure that participants' memories will still recall the details of issues that developed during the course of the work. Where possible, the post-construction review should be held at the project site so participants can see the conditions that led to the problems discussed as well as the final outcome of the solution to the problems.

In developing a post-construction review program, the agency must determine the level of effort it would like to expend on the effort. While the typical post-construction review should be able to be conducted in less than half a day, the agency must be cognizant of the resource needs of the external agencies participating in the review process. Many of the external agencies may be willing to participate in some post-construction reviews, but if they become frequent and involve substantial resources, the agencies may not agree to participate on a continuing basis. ConnDOT had this concern when it began conducting its post-construction review process and established a program to conduct twelve reviews annually. As a result, ConnDOT has had good representation from external agencies at all of its post-construction reviews. The resource issue is also a concern for internal agency staff, and the more reviews conducted obviously impacts an agencies ability to perform other work utilizing the same staff.

As with the constructibility review process, it is recommended that an agency develop a written plan for the post-construction review process. The written plan should detail the purpose of the post-construction review process, attendees at the reviews, the frequency of conducting the reviews, the person(s) responsible for scheduling and conducting the reviews and the subjects to be covered by the review. An agenda should be developed for each of the reviews which details what will be discussed and the duration of the post-construction review meetings should be provided to participants in advance of the meeting. Every effort should be made to conduct the review within the time frame stipulated in the agenda so the participants can plan their time appropriately. The appendix contains samples of the agenda used by ConnDOT, along with a copy of the report of meeting that is generated at the conclusion of the reviews.

If an agency determines that it will conduct post-construction reviews, it should also develop a mechanism for distributing and sharing the review comments with all parties involved in the plan development and construction process. Distribution of the results of the post-construction review should be made not only to those participating in the project review, but agencies should assure wide distribution so that all agency engineers and support staff have the benefit of the lessons learned on the particular project. Agencies that utilize consultants during the design phase of its program should also consider a mechanism for distributing the results of the post-construction reviews among consultant staff also. A cooperative effort with the engineering association within the state may be a good way to accomplish this result.

In developing the “Best Practices Guide”, the Subcommittee was not able to obtain much information regarding the practices utilized by states in conducting their post-construction

reviews. Rather than delay publication of the guide, the Subcommittee determined that it would distribute the basic information on post-construction reviews that it had available. The Subcommittee will investigate the post-construction review practices in the country further and will provide additional information in future updates of the Best Practices Guide.

CONCLUSIONS AND FUTURE ACTIVITIES

Agencies should consider implementing a Constructibility Review Process to assure that the best possible plans and specifications are utilized in their construction programs. As stated in the Arizona Constructibility Guide, reviews will enhance early planning, minimize scope changes, reduce design related change orders, improve contractor productivity, develop construction friendly specifications, enhance quality, reduce delays, meet schedules, improve public image of the industry, promote public/work zone safety, reduce conflicts, disputes and claims, and decrease construction and maintenance costs.

Constructibility Reviews are but one of many tools that are available to public agencies that will help to improve the constructed transportation project. When used judiciously, constructibility reviews have the real potential to provide benefits to the agency, the contractor and, most importantly to our customers, the travelling public. Constructibility Reviews must be a cooperative effort involving agency engineering, construction and maintenance staff, consultants (where applicable), contractors, and other external entities that may have positive input to the development of a biddable and constructible set of contract documents.

This Best Practices Guide is the first step in developing a program to encourage agencies to begin the process of developing constructibility review programs. It is intended to submit copies of this guide to the AASHTO Subcommittee on Design for additional input. In addition, the guide will also be distributed to the national contractors associations for review and input by their members in an attempt to refine the practices and encourage participation by these key players in the construction process. It is intended to update the guide on a periodic basis so that it becomes a living document that reflects the best constructibility practices available in the country.

Future activities planned by the Subcommittee in the areas of constructibility reviews and post-construction reviews will include continuing work on the development of a methodology to measure the cost benefits of the two processes. In addition, the Subcommittee intends to develop an action plan in conjunction with the AASHTO Subcommittee on Design, FHWA, and our industry contractor and consultant partners to educate agencies in the need for and benefits of constructibility and post-construction reviews. The Subcommittee also plans to continue the process of gathering information on the "best practices" in these areas and disseminating that information through periodic updates of the Best Practices Guide.

Users of this Guide are encouraged to provide feed back to the Subcommittee on Construction regarding the usefulness of the information provided, practices that they have found work (or those that don't work), issues related to constructibility reviews and post-construction reviews, and suggestions for improvements to the Guide. A comment form is provided in the appendix for use in providing feed back to the Subcommittee.

APPENDIX

I. List of States with Constructibility Review Programs

II. Subcommittee Constructibility Survey

III. Sample Checklists

IV. Sample Agendas

V. Post Construction Review Sample

VI. Constructibility Best Practices Guide Comment Form

APPENDIX I

LIST OF STATES WITH CONSTRUCTIBILITY REVIEW PROGRAMS

The following states responded to the 1999 Survey for the AASHTO Subcommittee on Construction that they utilize a Constructibility Review Program. The states in bold type have indicated that they have a written procedure. The states marked with an asterisk have indicated that they utilize contractors in their constructibility review process.

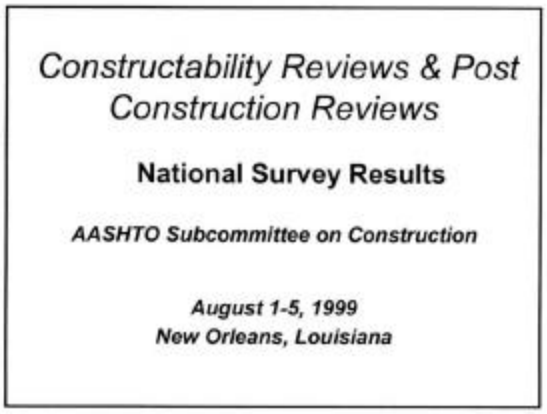
STATE	CONTACT NAME	TELEPHONE NUMBER	E-MAIL
Arkansas	Phil McConnell	(501) 569-2336	
***California**	Joe Dobrowolski	(916) 654-4352	joe_dobrowolski@dot.ca.gov
*Connecticut	Art Gruhn	(860) 594-2680	arthur.gruhn@po.state.ct.us
*Delaware	Vasuki Hiraesane	(302) 760-2188	
Florida	John Shriner	(850) 414-4150	john.shriner@dot.state.fl.us
*Indiana	Tim Bertram	(317) 232-5502	tbertram@indot.state.in.us
*Iowa	John Smythe	(515) 239-1503	jsmythe@max.state.ia.us
Kansas	Dean Testa	(785) 296-3576	dean@ksdot.org
***Kentucky**	Steve Waddle	(502) 564-4780	
Louisiana	Rick Holm	(225) 379-1505	rickholm@dotd.state.la.us
***Maine**	James Tukey	(207) 287-2759	james.tukey@state.me.us
Maryland	Robert Harrison	(410) 545-0072	rharrison@sha.state.md.us
Michigan	Phillip Lynwood	(517) 373-2302	lynwoodp@mdot.state.mi.us
Missouri	Ken Fryer	(573) 751-2806	fryerk@mail.modot.state.mo.us
*Nevada	Ruedy Edgington	(775) 888-7440	redington@dot.state.nv.us

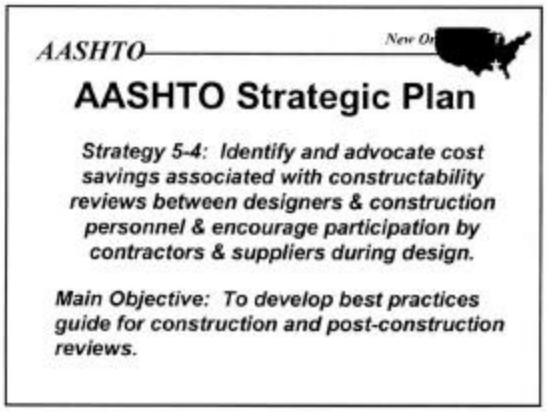
New Jersey	Michael W. Gross	(609) 530-5500	mgross@cpm.dot.state.nj.us
***North Carolina**	Steven DeWitt	(919) 733-2210	sdewitt@dot.state.nc.us
*Ohio	Gary Angles	(614) 466-3598	gary.angles@dot.state.oh.us
*Oregon	Ken Stoneman	(503) 986-3023	kenneth.l.stoneman@odot.state.or.us
Pennsylvania	Tony Pitone	(814) 765-0627	
South Carolina	Charles Matthews	(803) 737-1490	
*South Dakota	Larry Weis	(605) 773-3174	
Texas	Thomas Bohuselor		tbohusl@mailgw.dot.state.tx.us
*Virginia	Frank Gee	(804) 786-2783	gee_cf@vdot.state.va.us
Washington	Dick Albin	(360) 705-7269	albind@wsdot.wa.gov
Wisconsin	Gary Whited	(608) 266-3707	

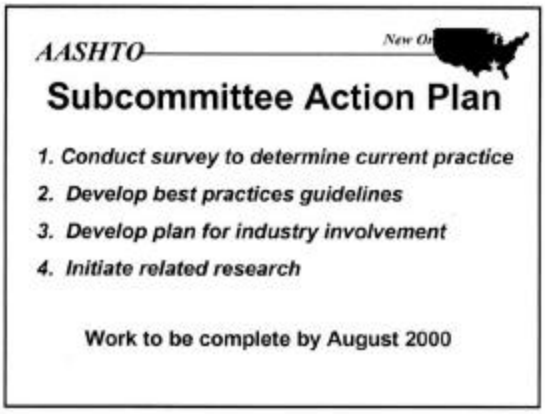
APPENDIX II

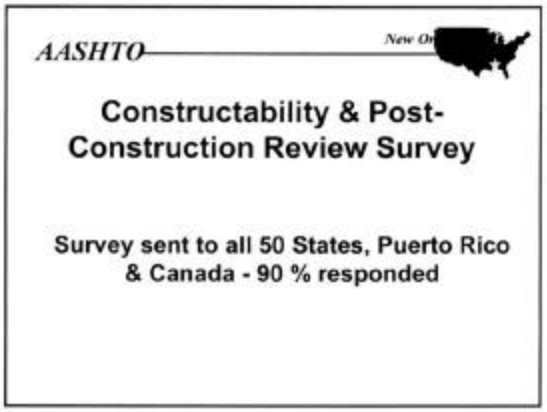
SUBCOMMITTEE CONSTRUCTIBILITY SURVEY

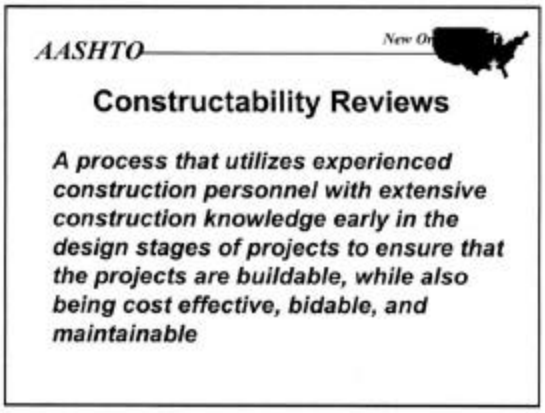
The Constructibility Reviews and Post Construction – National Survey Results presentation, which was presented to the AASHTO Subcommittee on Construction by Mr. Steven D. DeWitt, PE, North Carolina Department of Transportation, is in Figure A.II-1.











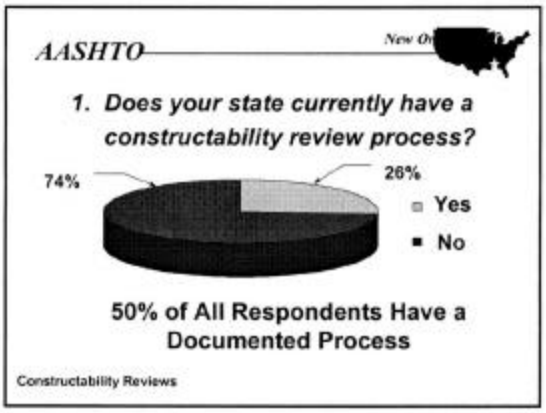
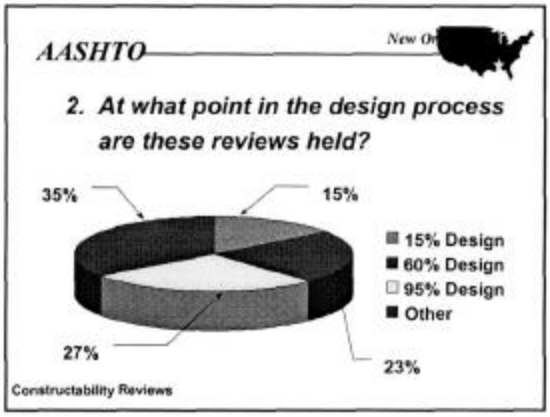
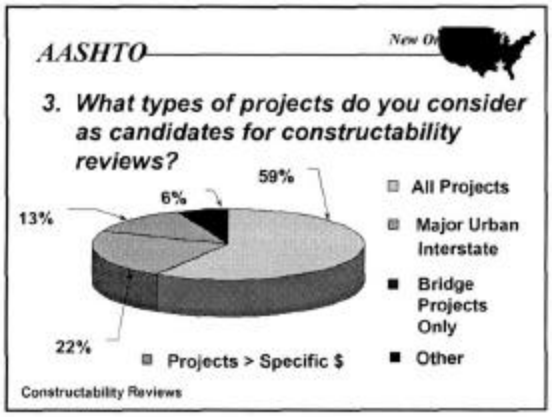
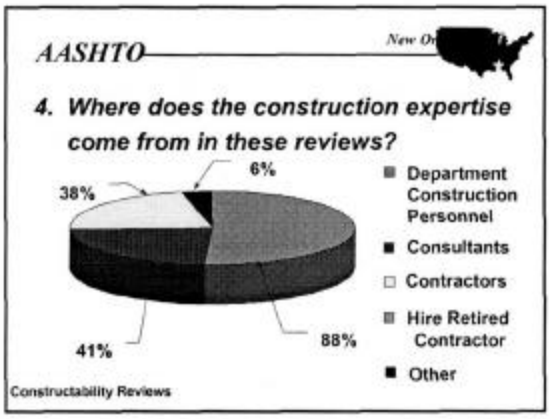
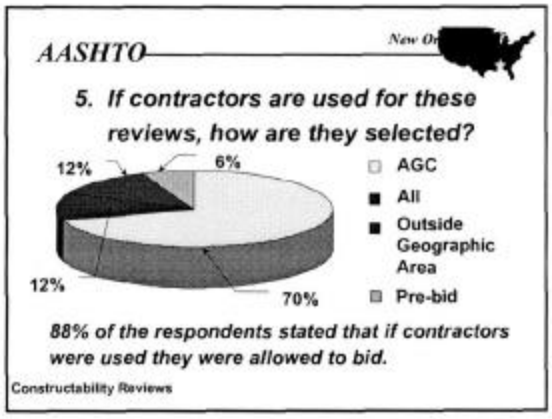


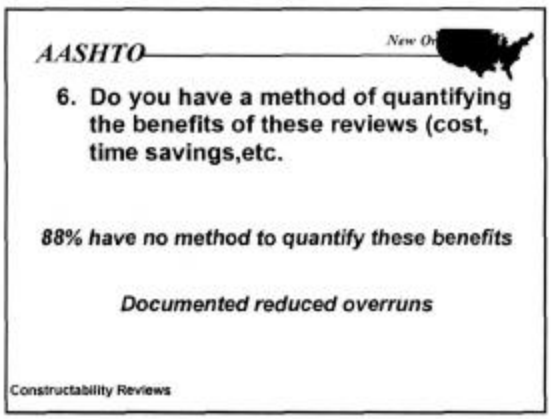
Figure A.II-1: National Survey Results presentation.











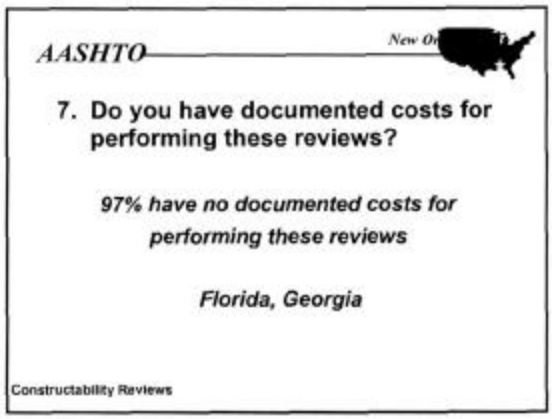
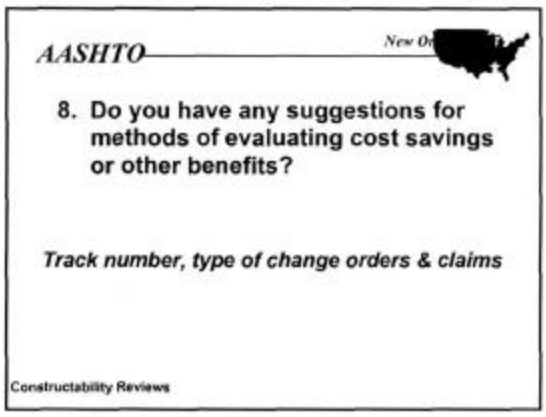
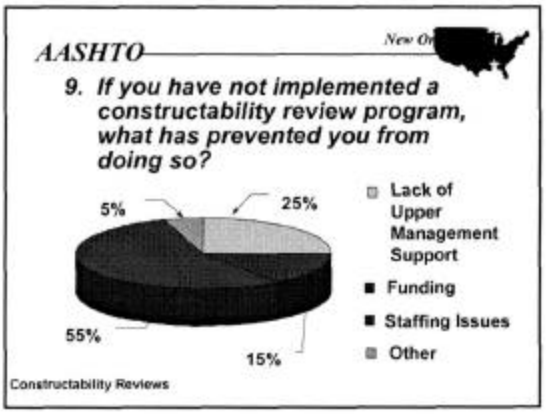
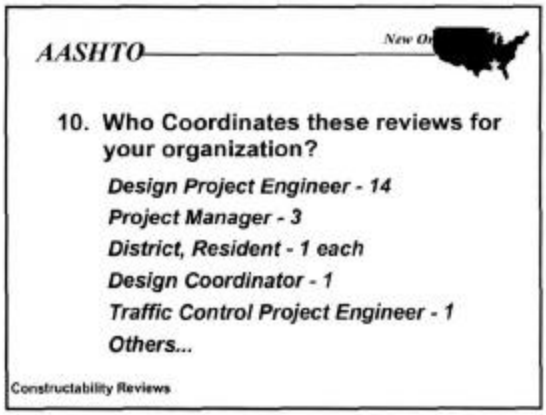
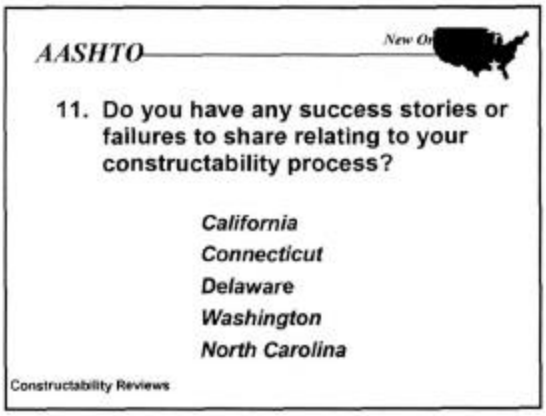


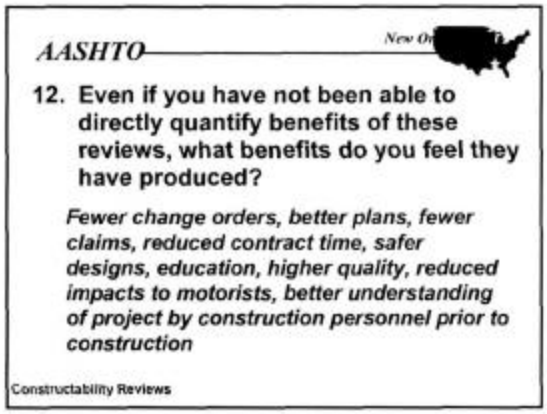
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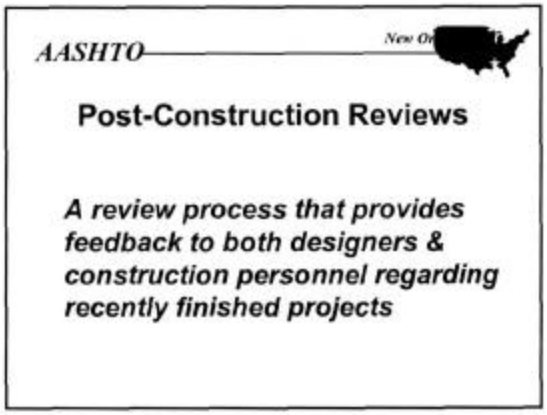
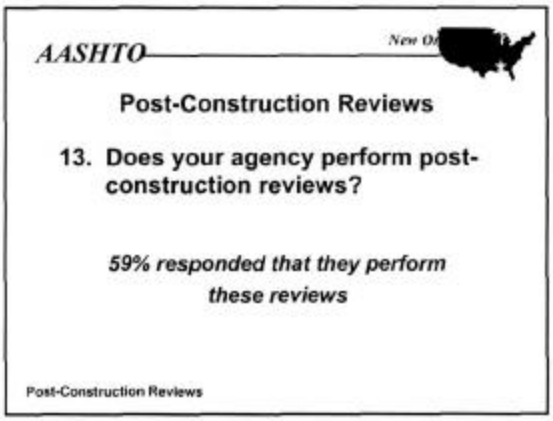
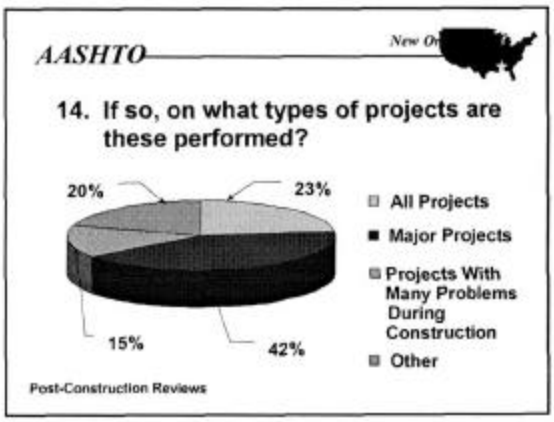
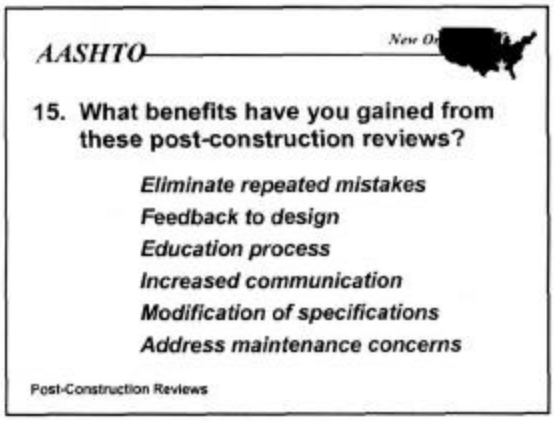
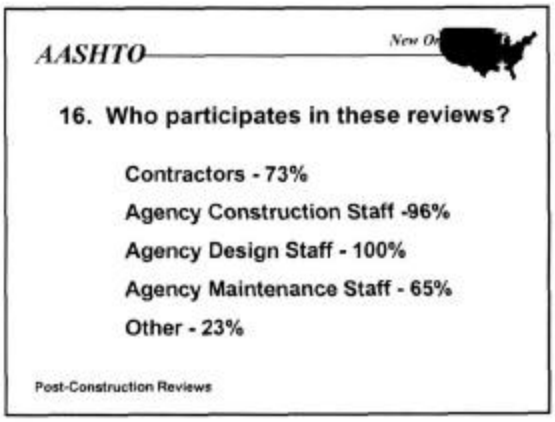


Figure A.II-1 (Cont'd.): National Survey Results presentation.









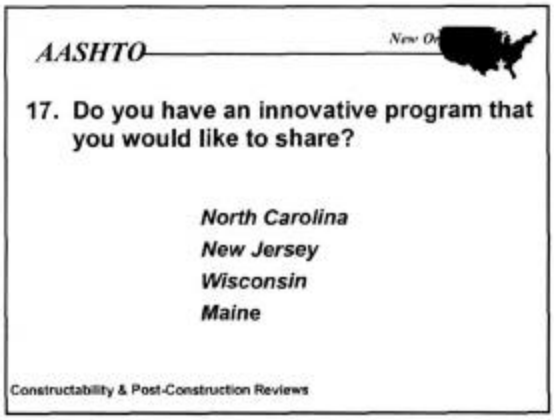




Figure A.II-1 (Cont'd.): National Survey Results presentation.

APPENDIX III

SAMPLE CHECKLISTS

This Appendix contains samples checklists from the following agencies:

California (CALTRANS) has developed Constructibility Review checklists that cover the following areas:

Design	Traffic Operations/Management
Traffic Design/Electrical Design	Construction
District Office Engineer	Landscape Architecture
Materials & Geotechnical	Environmental
Maintenance	Hazardous Waste
Hydraulics	Hydrology
Right-of-way	Surveys

A sample of the CALTRANS District Office Engineer checklist is provided in Figure A.III-1.

Connecticut (ConnDOT) has developed Constructibility Review checklists that cover the following areas:

Roadway	Utilities
Environmental	Drainage
Structures	Maintenance and Protection of Traffic
Illumination, Signing and Signalization	General
Rails	Survey

Samples of the ConnDOT Roadway and Structures checklists are provided in Figure A.III-2.

Florida (FDOT) has developed Constructibility Review checklists that cover the following areas:

Clearing/Grubbing/Excavation	Site Survey/Plan/Profile
Removal/Demolition	Structures
Utilities	Drainage
Maintenance of Traffic	Signalization
Schedule/Phasing/Access	Nature & Environment Protection
Reconstructibility	

Samples of the FDOT Roadway and Structures checklists are provided in Figure A.III-3.

Maryland DOT has developed Constructibility Review checklists that cover the following areas:

MOT Items	Storm-Water Management
Problems with Phasing	New Structures
Hours for Lane Closures	Structure Rehabilitation
Detour Routes	Traffic / Lighting
Impact on Existing Signals	Pedestrians
Impact on Existing Signs	Signage
Impact on Traffic on Sight Distance	Landscaping
Utilities	Soundwalls
Sediment & Erosion Controls	Right of Way
Drainage: Existing & Proposed	Pay Items
Typical Sections (Roadway)	

Samples of the Maryland constructibility review checklists are provided in Figure A.III-4.

New York State DOT (NYSDOT) has developed Constructibility Review checklists that cover the following areas:

Biddability	Construction Staging
Buildability	M&PT / Traffic Control
Site Investigation	Schedule
Right of Way	Special Materials / Conditions

Samples of the NYSDOT Construction Issues checklist are provided in Figure A.III-5.

Pennsylvania (PennDOT) has developed Constructibility Review checklists that cover the following areas:

Roadway	Plan Content
Specification Content	Drainage
Structures	Construction Issues

A sample of the PennDOT Construction Issues checklist is provided in Figure A.III-6.

CALTRANS PS&E/CONSTRUCTABILITY REVIEW CHECKLIST

Project Information: - Co.-Rte.-KP: _____ District/EA: _____
Reviewed By: _____ Date: _____ Functional Unit: **DISTRICT OFFICE ENGR.**
I certify that a thorough and complete constructability review has been performed by my staff:

_____ _____
Signature of Functional Manager Date

Key Constructability Issues	PS&E Milestone 30%	60%	95%
All items of work shown on Plans specified in SSPs and match pay items in BEES. Description and unit of measure are consistent in PS&E.			X
Railroad involvement on plans resolved.		X	X
Cross sections are developed as required.			X
Standard Plans Lists are complete and accurate.			X
Typical cross sections includes existing conditions.	X	X	X
First Layout sheet contains legends, symbols abbreviations not shown on Standard Plans. All necessary exist facilities shown in dropout.			X
Construction Details are complete.			X
Drainage profiles included as required. Alternative pipe culvert table included.			X
Detours, Traffic Handling plans and stage construction plans are included as required.		X	X
Summary of Quantities are tabulated & summarized correctly.			X
Utility Plans complete & high risk utilities identified & located on plans.	X	X	X
Log of Test Borings included for all retaining and soundwall projects.			X
Number of working days sufficient for the type of work.			X
Liquidated damages calculated per project's complexity.			X
Lane closure charts are included.			X
SSPs specify all work to be done in Plans & contract pay items in BEES.			X
All SSPs have necessary measurement and payment clauses			X
All SSPs related to obstructions (including high risk facilities) are incl.			X
Railroad clauses provided.			X
All permits are obtained & requirements needed are incorporated in the PS&E.	X	X	X
Supplemental Funds for Maintain Traffic included.			X
Environmentally Sensitive Areas (ESAs) are identified on plans and included in SSPs.	X	X	X
Storm Water Pollution Prevention Plan (SWPPP) issues addressed		X	X
Previous suggestions/corrections addressed	X	X	X

Figure A.III-1: Sample CALTRANS Constructibility Review Checklist.

1. ROADWAY

PD	SF	FPFR	DESCRIPTION
			Is general topography of area as indicated on plans?
			Any subdivisions or commercial/industrial areas not indicated?
			Is there sufficient geometry, horizontal and vertical to properly locate and construct project? Are baseline ties shown? Benchmarks?
			If survey baseline and centerline are different and test pits taken, are they plotted correctly?
			Are sufficient control points and curve data shown?
			Do we need additional right-of-way to construct?
			Are widths and grade of reconstructed driveways reasonable?
			Is point of application of grade being changed? If so, have proper sections been developed?
			Existing pavement conditions - Are replacements required? Condition of concrete or bituminous. Are appropriate specifications included?
			If shoulders are required to carry traffic during stage, are they structurally adequate or should reconstruction be required?
			Does existing pavement have concrete base not shown?
			Is transition from structure sufficient? Is pavement overlay keyed into existing? Are details provided?
			Are paving limits shown? Pavement composition? Joint sealing? Do specs address over filling joint on sealing item and cleaning and sealing joints and cracks item. Saw Cutting?
			If pressure relief joints are to be constructed, are they wide enough? ie: 10' minimum.
			Have existing overlays been taken into consideration?
			Are temporary roadways or pavements required to complete the construction? If so, details are required.
			On overlay projects, are leveling courses required in some areas to correct existing problems?
			Plans or specifications must indicate no longitudinal joints allowed at completion of days paving.

Figure A.III-2: Sample ConnDOT Constructibility Review Checklists.

5. STRUCTURES

STS	SL/D	FPFR	DESCRIPTION
			Are all as-builts of existing structure available and referenced in the specifications?
			Have all subsurface or underwater investigations been performed to verify existing conditions?
			Is sufficient boring data available? Were borings taken at locations of temporary and permanent sheet piling, piles and structures?
			If piles or sheeting are required, can they be driven or do conflicts exist, additional borings may be required. Are necessary permits in place?
			Are railroad requirements and Coast Guard regulations in place? Allowable time frames?
			Any salvageable material? If so, is it noted? Ensure if maintenance or stores has a need for it.
			Are provisions and items in contract to maintain not only the lighting on and under the bridge, but also the circuits running through the parapets during deck replacements and/or jacking, etc.? Are there provisions for temporary lighting, if existing is to be removed and new lighting does not get installed until the latter stages of the project.
			Ensure that when cofferdam and pumping is an item in the contract, structure excavation is also an item. Is underwater (tremie) concrete required?
			Is an index sheet included? This is required for projects with more than one structure.
			Is a summary of quantities sheet included for each structure?
			Ensure that the structure reference numbers are correct.
			Is hydrologic data shown for waterway structures?
			Is minimum vertical clearance shown on the plans?
			If structure is on Merritt Parkway, does it conform to parkway guidelines? (ie: replication of original).
			If cofferdams required, is size and location shown on plans and allowed by permit?
			Do we have sufficient unassigned quantity of repair work items to cover unforeseen conditions?
			If existing structures nearby, are they on timber mats? This is prevalent along the shoreline.
			Are abutments and piers in sound condition? If not, are proper repair procedures in place?
			Are deck grades furnished on replacement project? Are deflections of existing beams shown?
			If structure is structural steel, are replacement members required? If so, is replacement procedure in place and is it adequate? Are additional members deteriorated to a point of replacement and not noted?

Figure A.III-2 (Cont'd): Sample ConnDOT Constructibility Review Checklists.

STS	SL/D	FPFR	DESCRIPTION
			Are bearings to remain? If so, are they in good condition? If not, is there a suggested jacking procedure along with associated quantities? Is jacking acceptable under live load? If yes, are parameters established?
			Are bearing pads sound or do they display deterioration or cracking? If so, are repair procedures in place? Access available for elevated structures?
			If structure is prestressed, are units in good shape?
			Does the contract require a suggested erection sequence? Particular attention should be given to structures with curved girders or tubs, and skewed abutments for differential deflection and/or rotation.
			All Fracture Critical Members (FCM) should be indicated with requirements for fabrication.
			Condition of Paint - Adhesion Tests and Toxicity Tests must be performed. Are current containment, cleaning, and disposal specifications in place? Does contract contain latest LHPP Specifications?
			Will containment cause height restrictions (ie: waterway, railroad)?
			Are painting specifications complete and current? Note any special problems (access, environmental)?
			Have all structures been properly evaluated for superstructure replacement vs. painting? Prestressed Concrete vs. Steel Beams.
			Has the substructure been examined for scour?
			Underside of deck, are map cracking, efflorescence or chlorides visible?
			Are "pop-outs" evident on underside of deck? If so, are they addressed in repair procedures?
			Condition of deck surface - is deck overlaid? If so, is type known?
			If deck exposed, what is it's condition? Are partial and/or full depth patches required? Are specifications in place? Check removal procedures.
			If stage construction, will deck have cantilevered sections that require support? If so, is support concept noted on plans and criteria as to when required given for both existing and new decks?
			Type of deck joints/headers-can they be constructed in fashion to eliminate "Bumps"? If not, recommend possible solution.
			How is wearing surface to be removed? Item provided?
			Does deck have existing membrane waterproofing? If so, is type known?
			If at all possible, new bridge decks on existing roadways should be raised to meet the new roadway profile created by an overlay.

Figure A.III-2 (Cont'd): Sample ConnDOT Constructibility Review Checklists.

STS	SL/D	FPFR	DESCRIPTION
			Is transition, roadway to bridge, sufficient?
			Have provisions been made to maintain navigational lighting throughout construction?
			If bridge is to be closed, are there enough safety barriers and protection in place?
			Protective Compound - is preferred material indicated (not linseed oil)?
			Bridge rail (protective fence) is it properly indicated? If over railroad, is latest railroad specification utilized? If on moveable span, is kickplate required?
			Do specifications contain an item for protective sealing/coating for completed structures? This item is no longer required.
			If temporary structures are specified, responsibilities for design and appropriate details should be furnished.
			Are existing utilities under structure or in parapets? If so, how are they maintained throughout contract period? Are items provided to maintain them?
			Note the presence of incident management conduit and/or signs.
			If span is moveable, can stage construction work?
			Is all repair work noted on the plans or as-built?
			For box culvert installations, the sequence of installation should be from outlet to inlet.

Figure A.III-2 (Cont'd.): Sample ConnDOT Constructibility Review Checklists.

5. UTILITIES

Item No.	Feature to be Checked	Ok	Not Ok	N/A
5-1.	List of all utility owners and contact numbers.			
5-2.	Existing utility location marked in the plan.			
5-3.	Utility conflicts and their relocation indicated in design.			
5-4.	Disruptions of other utilities and provisions for restoration.			
5-5.	Responsibility to relocate utility and provisions.			
5-6.	Verification of new utilities connecting with existing.			
5-7.	Adequate description of connection and reconnection points.			
5-8.	Availability of indicated existing utility ducts and their proximity to highway facility and traffic.			
5-9.	Other utilities which new underground ducts intersect or traverse.			
5-10.	Utility crossings resolved via scheduling restrictions (i.e., weekends, after hours) or temporary structures.			
5-11.	Overhead utilities, guy wires for potential conflict with operations and access of large equipment.			
5-12.	Utilities required for construction operation and field offices.			
5-13.	Sewer lines below water mains and gas lines above other utilities.			
5-14.	Space between R/W line and drainage structure to allow for construction.			
5-15.	Utility conflicts with drainage.			

Suggested Changes: (to be completed for items checked "NOT OK")

Item No.	Description of Change
Designer's	
Comments	
Designer's	
Comments	
Designer's	
Comments	

Figure A.III-3: Sample FDOT Constructibility Review Checklists.

7. MAINTENANCE OF TRAFFIC

Item No.	Feature to be Checked	Ok	Not Ok	N/A
7-1.	TCP (Traffic Control Plan) clear, complete, approved and conform to FDOT Standard Index.			
7-2.	Temporary safety devices requirement and provision (i.e., guard rail, attenuators, earth mounds, etc.)			
7-3.	Location of traffic control signs, warning devices and barricades. Check if they are encroaching on lanes.			
7-4.	Detour facility, if any, and maintenance of traffic. Traffic addressed on side streets as per Index 600 of Standard Index.			
7-5.	Traffic operation requirements properly addressed (i.e., signing, pavement markings, signal, etc.).			
7-6.	Relocation item for barrier wall or fence.			
7-7.	Location of flashing arrow boards, if needed, at appropriate places.			
7-8.	Lanes on which traffic is to be maintained compatible to local conditions and intended to be paved.			
7-9.	Is there sufficient clearance within the work zone for the operation (such as crane swing room)?			
7-10.	Adequate accommodations for intersecting and crossing traffic.			
7-11.	Address pedestrian and bicycle accommodations.			
7-11.	Are exits and entrances to the work zone adequate and safe?			
7-12.	Method of containing bridge slopes during phased construction (at end bent) and approach grade separations.			
7-13.	Restrictions (e.g., lane closure, general construction or peak-hour restrictions in urban areas) indicated in plan.			
7-14.	Note covering traffic signal modifications for phased construction.			
7-15.	Note covering pay for traffic control items.			

Suggested Changes: (to be completed for items checked "NOT OK")

Item No.	Description of Change
Designer's	
Comments	
Designer's	
Comments	

Figure A.III-3 (Cont'd.): Sample FDOT Constructibility Review Checklists.

11. RECONSTRUCTIBILITY

When this project needs to be reconstructed, (i.e., repaving, widening, utility/drainage work, etc.) in the future, which of the following project components, as designed, will facilitate reconstruction?

Item No.	Feature to be Checked	Ok	Not Ok	N/A
11-1.	Earthwork design (e.g., "temporary" borrow, "additional excess," detour material, embankment, etc.).			
11-2.	Right-of-way acquisition (e.g., for signal and lighting foundations, redesigned radii of drainage structures, utility relocation, construction easements, adequate work space, desirable clear zone, etc.).			
11-3.	Geometrics and roadway alignment (e.g. curve data, sight distance, vertical datum, centerline, etc.).			
11-4.	Utilities (e.g., accuracy of location, proposed relocation, conflicts with other structures, future MOT impact, etc.).			
11-5.	Pavement (e.g., design criteria, flexibility to change, material alternatives, etc.).			
11-6.	Drainage structures (e.g., new and standardized structures, size of pipe, low head piping, interim drainage).			
11-7.	Lighting and signs (e.g., conduit size, service point locations, design of structures, compatibility, power source, etc.).			
11-8.	Other structures (e.g., mix design, strength, pile information, finishes, concrete and steel requirements, etc.).			

Item No.	Comments

Figure A.III-3 (Cont'd.): Sample FDOT Constructibility Review Checklists.

A. **MOT ITEMS**

1. Are quantities sufficient for lane markings, both tape and paint (multiple HMA lifts, MOT phases); Traffic Manager; flagger hours; drums; concrete barriers, MOT asphalt; signs; VMS and arrow panels, etc.
2. Will project go through winter? How will this affect quantities if duration is longer then scheduled?
3. Is there enough room for sand cushions at the actual roadway speed, or should GREAT systems be utilized?
4. Have appropriate types & quantities of temporary connections of traffic barrier been identified ?
5. Have minimum numbers of lanes & widths of lanes been shown on both MOT plans & x-sections & typical sections? Do they match?
6. Have MOT & temporary widenings been calculated into excavation quantities? Will borrow have to be brought in & cause a waste of material at end of job?
7. Have replacement items been setup for items such as drums, attenuators, barrier, etc.?
8. Is there an indication that the RCE worked time through phases of construction?
9. Was the project Value Engineered?
10. Can embankment materials be accessed from Class 1 or is traffic being maintained on top of it?
11. Can work be accessed safely? (median work especially)

Figure A.III-4: Sample Maryland Constructibility Review Checklists.

12. Is clearance sufficient under bridges to allow MOT before final work phases?

B. **PROBLEMS WITH PHASING**

1. How do you get from one phase into the next? Are there any safety issues between phasing?
2. Are there drainage problems between phases? Can water get to inlets or drainage structures while changing phases and during each phase?
3. Can driveways & entrances be used by residents & customers safety? Are tie-ins reasonable? Are they too steep or will water lay in them?
4. Are drop-offs adequately protected?

C. **HOURS FOR LANE CLOSURES**

1. Are hours on project & location on project specific? Has consideration been given to shopping centers & malls, churches, schools, military installations, seasonal traffic constraints, sports arenas & events, etc.?
2. Do work hour restrictions allow time to perform work?
3. Can hours be determined based on directional traffic flow?

D. **DETOUR ROUTES**

1. Have they been approved by the appropriate jurisdiction?
2. Has duration of detours been identified? Will it run through winter? If so, has plowing of snow or maintenance of detour

Figure A.III-4 (Cont'd.): Sample Maryland Constructibility Review Checklists.

CHECKLIST
FOR
CONSTRUCTABILITY REVIEW

PIN # _____ Reviewer(s) _____
D# _____ _____
Designer _____ _____
Projected Letting Date _____ _____
Date Review Started_____ _____
Date Review Completed_____ _____

The following is a checklist of project items (if applicable to the project) that need to be reviewed during a Constructability Review :

	Description	YES	NO	NA	MORE INFO NEEDED
I.	**BIDDABILITY**				
	The clarity of the final plan and proposal to the bidders so that they may submit a fair and accurate bid.				
1	Are bidders unnecessarily restricted in their bids, or has the appropriate degree of flexibility been included in the bidding documents?				
2	Information sufficient to avoid major field changes?				
3	Coordination and agreements with appropriate agencies/parties?				
4	Permits been identified and sufficient time allowed to secure?				
5	MP&T plans adequate and complete?				
6	MP&T plans too restrictive?				
7	Items appropriate?				
8	Items omitted?				
9	Cross referencing between various contract documents consistent?				

1

Figure A.III-5: Sample NYSDOT Constructibility Review Checklists.

CHECKLIST
FOR
CONSTRUCTABILITY REVIEW

	Description	YES	NO	NA	MORE INFO NEEDED
II.	**BUILDABILITY**				
	The accuracy and completeness of the contract plans so that the design as shown on the final plans can be built.				
A.	**Site Investigation**				
1	Sufficient field investigation been done to ascertain that contract work can be performed as shown on plans?				
2	Current site survey (horizontal & vertical controls)?				
3	Subsurface exploration?				
4	Utility investigation?				
5	Current traffic counts?				
6	Structural inspection?				
7	Emergency/interim structural repairs been considered?				
B.	**Right of Way**				
1	Sufficient R.O.W. available for all operations				
2	Equipment, material and hazardous waste storage?				
3	Staging?				
4	Field Office?				
5	Access requirements?				
6	Access to work areas?				
C.	**Construction Staging**				
1	Phased to provide minimum number of stages and reasonable work areas and access?				
2	Are there areas with restricted access?				
3	Are widths of work zones and travel lanes adequate?				

2

Figure A.III-5 (Cont'd.): Sample NYSDOT Constructibility Review Checklists.

Constructability Review Checklist						
Construction Issues (circle most appropriate description)						
Traffic						
	Staging	very complex		Average		Simple
	Impact on construction activities	High		Average		Low
	Volumes	High		Average		Low
Materials						
	Procurement Time	Inadequate	Poor	Average	Good	Excellent
	Galvanized steel products	Inadequate	Poor	Average	Good	Excellent
	Fabricated steel products	Inadequate	Poor	Average	Good	Excellent
Space						
	On Site storage areas	Inadequate	Poor	Average	Good	Excellent
	Off-site storage areas	Inadequate	Poor	Average	Good	Excellent
	Staging areas	Inadequate	Poor	Average	Good	Excellent
	Shared storage	Inadequate	Poor	Average	Good	Excellent
	Access to the work	Inadequate	Poor	Average	Good	Excellent
	Disposal of Material	Inadequate	Poor	Average	Good	Excellent
Equipment						
	Availablity	Inadequate	Poor	Average	Good	Excellent
	Security	Inadequate	Poor	Average	Good	Excellent
	Access to work area	Inadequate	Poor	Average	Good	Excellent
Time						
	Risk of delays	High		Average		Low
	Need for specialty subcontractors	High		Average		Low
Utilities						
	Probability of delays	High		Average		Low
	Need for close cooperation	High		Average		Low
	Number of conflicts	High		Average		Low
Labor						
	Availability of skilled labor	Low		Average		High
Other:						
	Risk of Geotechnical Problems: Sink holes Mines Unsuitable materialsHighHigh	High		Average		Low
	Environmental Obligations	High		Average		Low
	Location: Weather sensitive	High		Average		Low

Figure A.III-6: Sample PennDOT Constructibility Review Checklist.

Appendix IV

Sample Agendas

PROJECT: _____
PROJECT NO.: _____ **DATE:** _____
MEETING LOCATION: _____

AGENDA ITEM	SPEAKER	TIME FRAME

I Introduction

II Traffic
- A. Design office specific items of concern
- B. Traffic office specific issues of concern

III Environmental
- A. Design office specific items of concern
- B. Env. office specific issues of concern

IV Hydraulics/Utilities
- A. Design office specific items of concern
- B. Hydraulic/Utilities specific issue of concern

V Structures/Geotechnical
- A. Design office specific items of concern
- B. Structures/Geo. specific issues of concern

VI Right-of-Way
- A. Design office specific items of concern
- B. Right-of-Way specific issues of concern

VII Traffic Control
- A. Design office specific items of concern
- B. Traffic control specific issues of concern

VIII Construction/Maintenance
- A. Design office specific items of concern
- B. Const./Main. specific issues of concern

IX Recap of issues
- A. Issues
- B. Responsible Parties for Resolution
- C. Deadline dates for resolution

Figure A.IV-1: WSDOT Sample Agenda 1.

PROJECT: _____

PROJECT NO.: _____ **DATE:** _____

MEETING LOCATION: _____

ITEM	SPEAKER	TIME
1. Meeting Overview		
2. Roadway Sections		
3. Geometrics		
4. Earthwork, Geotechnical/Soils Report, Foundation Survey		
5. Retaining Walls/Noise Walls		
6. Shoring		
LUNCH		
7. Drainage		
8. Bridges		
9. Utilities Involvement		
10. Agreements		
11. Coordination with Other Agencies		
12. Construction Schedule/Sequence		
13. Stage Construction Plans		
14. Special Traffic Control Plans unique to the Project		
15. Environmental		
16. Erosion Control/Storm Water Site Plans		
17. Maintenance Issues		
18. Right of Way		
19. Real Estate Services		
20. Signing		
Recap of issues & assigning responsible parties		

ADDITIONAL INFORMATION
Observers:
Resource persons:

Figure A.IV-2: WSDOT Sample Agenda 2.

DESIGN ISSUES		Time:
Discussion:		
Considerations:		
Conclusions:		
Action Items:	Responsible Person:	Deadline:

DESIGN ISSUES		Time:
Discussion:		
Considerations:		
Conclusions:		
Action Items:	Responsible Person:	Deadline:

DESIGN ISSUES		Time:
Discussion:		
Considerations:		
Conclusions:		
Action Items:	Responsible Person:	Deadline:

Figure A.IV-2 (Cont'd): WSDOT Sample Agenda 2.

APPENDIX V

POST CONSTRUCTION REVIEW SAMPLE

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

memorandum

subject: Post Construction Project Review

date: March 24, 1999

to: Leon M. Alford – Dist. I
Charles Panteleakos – Dist. II
Joseph DeMarco – Dist. III
Wayne Blair – Dist. IV

Bureau of Engineering and
Highway Operations

from: Arthur W. Gruhn
Construction Administrator

ARTHUR W. GRUHN

Bureau of Engineering and
Highway Operations

In a continuing effort to improve the quality of plans, specifications and the constructed project, the Office of Construction has conducted Post Construction Project Reviews in all districts.

These reviews have been well received and all participants have benefited from the process. Beginning in April, the districts will be in charge of conducting the Post Construction Project Reviews. District I will conduct the reviews in April, August and December 1999, District II in May and September, District III in June and October and District IV in July and November on a continuous rotating basis. If possible, the reviews should be held in the field.

The projects selected should be completed or will be completed within six months. They should not have a claim or anticipated to have a claim. The types of projects selected should be diverse such as bridge replacement, resurfacing, signalization, intersection improvement, etc.

When scheduling each post construction review meeting, the District liaison, Manager of Construction Operations and Construction Administrator should be notified so they may attend if possible.

A "Report of Meeting" should be done listing the major project issues, project positives, project negatives and suggestions for improvements (sample copy attached)

Also, attached for your use is a sample letter to a contractor, suggested agenda for the Post Construction Project Review and a list of suggested attendees.

Bill Colacrai is the Office of Construction's coordinator for post construction reviews. Please provide him with your intended schedule and selected projects for the remainder of the year by April 15, 1999.

William A. Colacrai
cc: Arthur W. Gruhn – L. Brian Castler
William A. Colacrai – James P. Connery – Robert P. Pettinicchi

Figure A.V-1: ConnDOT Post Construction – Review Cover Memo.

(860) 594-2680

December 8, 1997

Mr. Mark Spazzarini
Spazzarini Construction Co., Inc.
50 Post Office Road
Enfield, CT 06082

Dear Mr. Spazzarini:

Subject: Post Construction Project Review

In a continuing effort to improve the quality of plans, specifications and the constructed project, the Department and the Connecticut Engineers in Private Practice have established a trial "Post Construction Project Review" program. By conducting post construction reviews, we hope that all parties involved in the project and its future maintenance will benefit from both the project successes and failures. Using these "lessons learned" will help to provide better plans, specifications and end products in the future.

Project 132-118, Drainage - Route 194 in the Town of South Windsor, has been selected as one of the trial projects. It is requested that appropriate staff from your organization participate in the post construction review. A list of the suggested participants is enclosed for your guidance. If you feel additional staff from your organization would provide valuable input, please feel free to add them to the process. Participation in this process is on a voluntary basis and we believe all participants will benefit from the process.

An agenda for the Post Construction Review meeting is provided. You may wish to visit the completed project before the Post Construction Review to review the quality of the finished product.

The Post Construction Review will be held on December 30, 1997 at 10:00 a.m. at the Project Field Office on Route 194 in South Windsor.

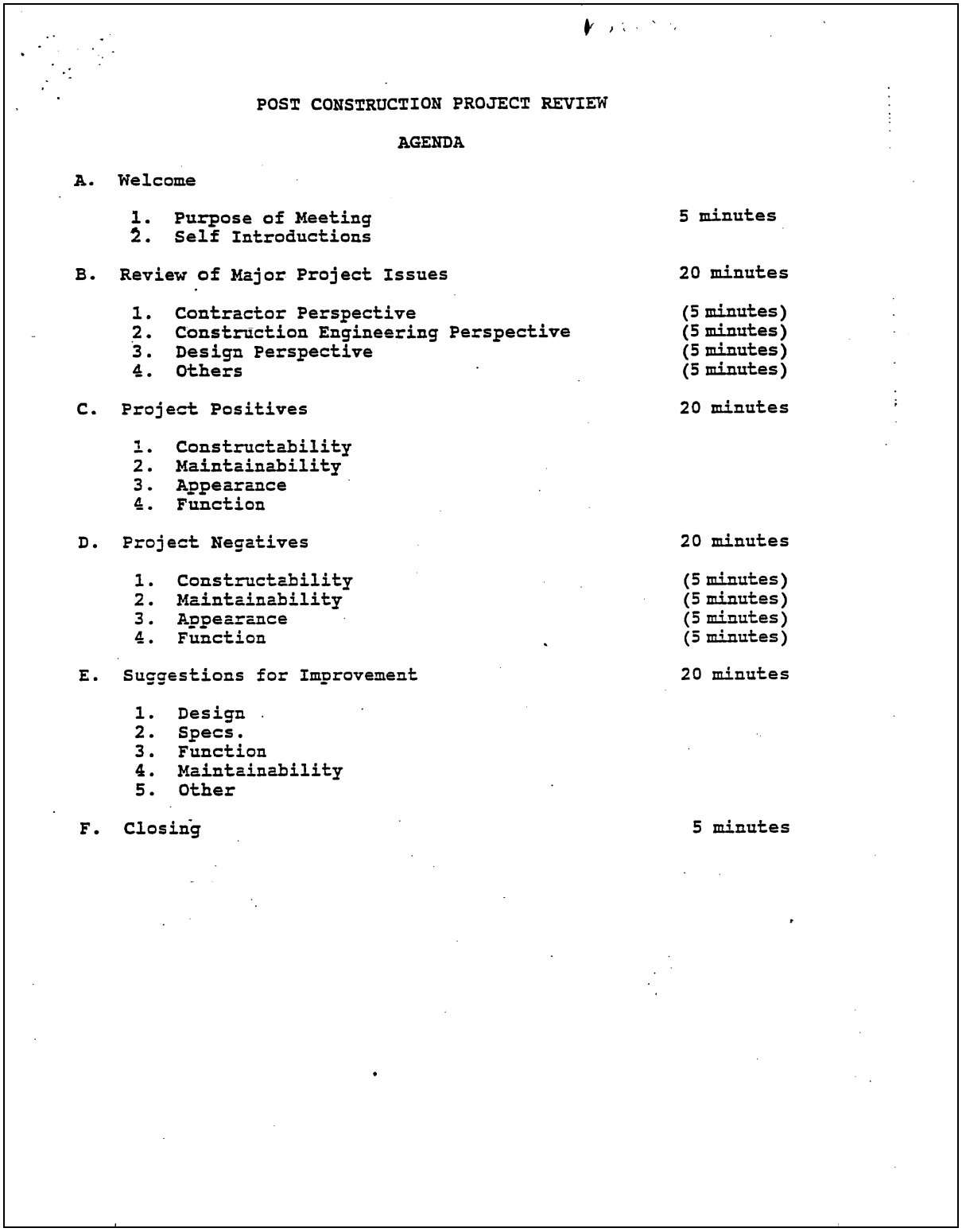
Please contact Mr. William Colacrai at (860) 594-2667 to confirm your attendance at this review.

Very truly yours,

Arthur W. Gruhn, P.E.
Construction Administrator
Bureau of Engineering and
Highway Operations

Enclosures
William A. Colacrai\pad
bcc: James F. Byrnes, Jr. - Robbin L. Cabelus
Louis R. Malerba - Please be represented.
Walter Coughlin - Bradley J. Smith - Please be represented.
Arthur W. Gruhn - L. Brian Cashel - William A. Colacrai
Leon M. Alford - Please be represented.
a:132-118(6)

Figure A.V-2: ConnDOT Post Construction Review – Sample Letter to Contractor.



POST CONSTRUCTION PROJECT REVIEW

AGENDA

A. Welcome	
1. Purpose of Meeting	5 minutes
2. Self Introductions	
B. Review of Major Project Issues	20 minutes
1. Contractor Perspective	(5 minutes)
2. Construction Engineering Perspective	(5 minutes)
3. Design Perspective	(5 minutes)
4. Others	(5 minutes)
C. Project Positives	20 minutes
1. Constructability	
2. Maintainability	
3. Appearance	
4. Function	
D. Project Negatives	20 minutes
1. Constructability	(5 minutes)
2. Maintainability	(5 minutes)
3. Appearance	(5 minutes)
4. Function	(5 minutes)
E. Suggestions for Improvement	20 minutes
1. Design	
2. Specs.	
3. Function	
4. Maintainability	
5. Other	
F. Closing	5 minutes

Figure A.V-3: ConnDOT Post Construction Review – Suggested Agenda.

POST CONSTRUCTION REVIEW

SUGGESTED ATTENDEES

CONTRACTOR	SUPERINTENDENT, PROJECT MANAGER/ENGINEER
CONNDOT	OFFICE OF CONSTRUCTION, OFFICE OF MAINTENANCE, STATE DESIGN, CONSULTANT DESIGN, DIVISION OF TRAFFIC ENGINEERING (SIGNALS, M&PT), MANAGER OF DESIGN SERVICES, OFFICE OF ENVIRONMENTAL PLANNING
CONNDOT DISTRICT	DISTRICT ENGINEER OR ASSISTANT DISTRICT ENGINEER, SUPERVISING ENGINEER, PROJECT ENGINEER
DESIGNER	PROJECT MANAGER, DESIGNERS, (CONSULTANT OR STATE DESIGN
CONSTRUCTION ENGINEER	RESIDENT ENGINEER/CHIEF INSPECTOR, SENIOR INSPECTOR

Figure A.V-4: ConnDOT Post Construction Review – Suggested List of Attendees.

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

OFFICE OF CONSTRUCTION
BUREAU OF ENGINEERING
& HIGHWAY OPERATIONS
UNIT 501

REPORT OF MEETING

Project No. 46-113
Route/Town: 140, East Windsor
Date of Meeting: June 6, 1997
Location: Project Field Office
Subject of Meeting: Post Construction Project Review

IN ATTENDANCE: See Attached Sheet

WELCOME

Bill Colacrai stated the purpose of the meeting was to determine what was good and bad about the design and construction to get a better end product and better plans and specifications.

MAJOR PROJECT ISSUES

-Difficult project (27 changes) due to unforseen problems. Productivity affected
-Limits on plans a problem. Cross-sections were every 20 meters should have been every 10 or 15 meters.
-Grading plan a bust. CB 3' too high.
-Had to use processed instead of gravel to run traffic on.
-All utility locations not known.

PROJECT POSITIVES

-Using processed to run traffic on.
-Breaking out the utility work prior to construction start.
-Relationship with property and business owners was good.
-Intersection functions better.
-No injuries.

PROJECT NEGATIVES

Figure A.V-5: ConnDOT Post Construction Review – Sample Report of Meeting.

-Night work was difficult, day work would have been much better.

-More borings needed, there was more clay less rock than anticipated.
-Do not reuse precast concrete curbing, most were chipped.
-Mill and pave all in one operation.
-utility pole in curb line.
-Many hidden utility locations

SUGGESTIONS FOR IMPROVEMENT

-Use processed to run traffic on.
-Cross sections every 15 meters.
-Survey should go farther back along private drives to avoid conflicts.
-Perform work during day if possible.
-Hold monthly meetings.
-Lower speed limit through work zone by signs and with enforcment to avoid damage to vehicles.
-Need quicker decisions.

Submitted by: William A. Colacrai Date: June 12, 1997

Figure A.V-5 (Cont'd.): ConnDOT Post Construction Review – Sample Report of Meeting.

APPENDIX VI

CONSTRUCTIBILITY BEST PRACTICES GUIDE COMMENT FORM

Please utilize the attached form to provide the Subcommittee on Construction with comments and suggestions regarding the Constructibility Review Best Practices Guide. It is the intent of the Subcommittee on Construction to update this Guide on a periodic basis (maximum every two years, annually if sufficient new information is available).

Return comments and form to:

Mr. Arthur W. Gruhn, P.E.
Construction Administrator
Connecticut Department of Transportation
2800 Berlin Turnpike
P. O. Box 317546
Newington, Connecticut 06131-7546
Phone: (860) 594-2680
FAX: (860) 594-2678
E-mail: arthur.gruhn@po.state.ct.us

AASHTO CONSTRUCTIBILITY REVIEW
BEST PRACTICE GUIDE 2000
COMMENT FORM

Agency or Firm Name:
_____
Name of Commentator:
_____
Phone No. _____ FAX No. _____ e-mail_____

Comments on the 2000 Edition of the Guide

This Guide is: ___ Very Useful ___ Some What Useful ___ Not Useful

I have the following suggestions for improving the Guide:
_____
_____
_____
_____

Our Agency/Firm has constructibility review practices that may be of interest to guide users:

___ Yes ___ No If yes, please provide a copy of the written practices.

Additional information on the following topics would be helpful in future Guides:
_____
_____
_____
_____

Implementation Efforts by Agency or Firm

My Agency or firm is interested in implementing constructibility review practices:
___ Yes ___ No If no, please provide reasons for not implementing constructibility reviews.

Anticipated time frame for implementation:

___ 1 year ___ 2-3 years ___ 3-5 years ___ >5 years

We plan to incorporate the following in our constructibility review program: (Circle)

Champion Written Program Constructibility Checklists

Industry Involvement Other Highlighted Areas in Guide

We plan to involve the following in our constructibility review teams: (Circle)

Agency Design Personnel Agency Construction Personnel

Consultant Design Personnel Consultant Construction Personnel

Contractors Railroads

Permitting Agencies Utilities

Other - Please list:

Other Comments/Suggestions:

_____
_____
_____
_____

Please return this form to:

Mr. Arthur W. Gruhn, P.E.
Construction Administrator
Connecticut Department of Transportation
2800 Berlin Turnpike
P. O. Box 317546
Newington, Connecticut 06131-7546
Phone: (860) 594-2680
FAX: (860) 594-2678
E-mail: arthur.gruhn@po.state.ct.us