

CASE STUDY: CONSTRUCTABILITY REVIEW PROCESS OF A LARGE PUBLIC TRANSPORTATION AGENCY

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Constructability is the optimum use of construction knowledge and experience to plan, design, procure, and manage field operations to achieve project objectives. Although there are many benefits to conducting constructability reviews (CRs) such as reduced cost and schedules, and fewer claims and change orders, current CRs still lack effectiveness in meeting industry demands for delivering construction contract documents promoting buildable projects. In the highway sector, transportation agencies have applied CRs at various levels, starting from the involvement of their own project team to soliciting external input from contractors before the project is even bid out. The objective of this paper is to investigate effective practices used by an agency in soliciting constructability input from contractors, given administrative and legal constraints. This was achieved through a comprehensive literature review of existing CR practices, followed by a case study of a transportation agency that has been implementing CRs involving contractor's input, as well as content analysis of documents, forms, and tools used during their CR process. The interviews entailed personnel working in various departments, such as preconstruction, program management, construction, and environmental. It also included consultants and contractors working for the agency. The major conclusions drawn are that the Florida Department of Transportation (FDOT) lives up to its reputation of a de-centralized agency in the area of Constructability; FDOT does not routinely customize its CR Process to the details of each project; and FDOT is not one of the more progressive DOTs in the US in the area of Constructability.

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1 INTRODUCTION

The Florida Department of Transportation (FDOT) has enjoyed a reputation as one of the most progressive public transportation agencies in the United States for the last two decades. The agency was one of the first to react when important research in the early 1990s identified a problem in American highway and bridge construction, gave it the name “constructability”, and developed a method for mitigating the effects of the problem (Jergeas and Put 2001). This method was later given the name “Constructability Review Process (CRP)”, and the problem that had long plagued the US was temporarily mostly solved for those agencies that adopted the process (Gibson 1996).

The problem had been that, due to a number of things, especially the practice of designing a project with the goal of gaining a permit instead of the goal of creating a buildable set of plans, contractors were receiving contract documents that could not be constructed in the field (Arditi *et al.* 2002). The problem seemed to be under control until two developments converged to make

constructability an issue again. Those two issues were the environmental movement, with its associated regulations and permits; and integrated construction project delivery, with its attendant need for speed and contractor input. The way the new problems have most manifested themselves is when a contractor develops ideas that will lower project cost, shorten project duration, or increase project quality, the idea is often ignored by the agency because to act on the idea would cause the owner to repeat the National Environmental Policy Act (NEPA) processes (Karkkainen 2002).

This Case Study is the result of several interviews conducted with personnel who work for the FDOT and non-FDOT employees from the Planning, Construction, Design, and Environmental sectors. FDOT employees interviewed included people from Districts 2, 5, 6, 7, and the Central Office. Non-FDOT employees including Construction Engineering and Inspection (CEI) and design consultants were interviewed, as well as construction contractors.

FDOT is a decentralized agency with eight districts, and at times appears to be eight separate DOTs, because each district enjoys a large measure of autonomy in most matters, including the CRP. The NEPA process, being a federal mandate, however, is more uniform throughout the state. As a NEPA-Assigned state, Florida NEPA policy is controlled by a NEPA Office within FDOT's own Central Environmental Office. Even so, there is some latitude given the districts; and this central NEPA Office, after setting policy, generally acts in only an advisory role.

2 NEPA

It took two years to get Florida law changed to allow Florida to handle its own NEPA procedure. The main concern held by the Florida Legislature was that FDOT would take on all the legal liability for the NEPA process that had rested before with the Federal Highway Administration (FHWA) (Buccino 2003). At the time of publication, Florida was one of eight states with their own NEPA Assignment. So far, the new arrangement seems to be going well. FDOT has had NEPA responsibility for less than a year, but so far it looks like this process should allow for Alternative Construction Methods (ACMs) to be implemented in a more streamlined manner.

FDOT's District-6 (D-6) is headquartered in Miami, and serves extreme southeast Florida. Those interviewed in this district believe that one result of Florida's NEPA Assignment is that the concept of Federal Cooperating Agencies, long allowed and encouraged by the FHWA, is now being more utilized. In this process, all federal agencies that are parties to the planning of the project meet regularly, and sign a letter stating they agree to any design changes. If a federal agency is invited to participate in this process, they almost always comply. It is frowned upon for one to decline after buying in.

District-2 (D-2) is located in the northeast corner of the state, and contains Jacksonville. Regardless of whether under the old NEPA system or the recently instituted FDOT NEPA Assignment, D-2 never considered NEPA a problem for the CRP on DBB jobs, only for D-B jobs. These requests must be completed by the Design-Builder for changes made to specified other projects also. D-2 helps the Design-Builder with this task – “holds their hands”, you might say. Any idea must be equal or better to get approval, and the FHWA is usually brought onboard if the project is federally funded. Typically, the IAR causes a longer delay than a NEPA Re-evaluation. Generally, if a proposed change does not require additional right-of-way (ROW), the district will gladly go through the NEPA process again (a re-evaluation) for a contractor's change request. If the change requires more ROW, this is a problem, due to the time required to procure ROW (typically two years). NEPA is a rather quick process (typically two months) compared to ROW procurement or the IAR process.

District-5 (D-5) serves the central part of the state, and includes Orlando. D-5 personnel agreed it is too soon to tell whether or not the NEPA Assignment is helping the process at all, much less

the CRP. They do report an improvement in how the different sections work together as a team. The Statewide Environmental Project Tracker (SWEPT) is a new computer-based tracking program that is very popular so far. It is through the SWEPT software that the district submits their documents to the Central Office for the NEPA process. The new system is quick and provides a great permanent record of the process.

District-7 (D-7) covers the Tampa Bay area of the state and extends for many miles down the west coast of Florida's peninsular. Those interviewed in D-7 think that, on the whole, the NEPA Assignment is no different than when the FHWA ran NEPA, and it is not intended to be. SWEPT may be the exception, because its use forces district personnel to be a little more proactive in getting things into a digital format. This district claims never to have done a NEPA Re-Evaluation on a D-B project. Generally, they reject a change because the change would require a NEPA Re-Evaluation if they judge that the delay risk posed by a NEPA Re-Evaluation is unacceptable.

The Central Office of FDOT is located in Tallahassee. Personnel in this office are further removed from the actual construction projects, so they provide a more "big picture", or policy, perspective. On DBB jobs, FDOT executes the NEPA process before the bid which necessarily precludes industry input. According to the Central NEPA Office, the Value Engineering Change Proposal (VECP) process is the same as when the FHWA did it, only faster. The Central NEPA Office (and so FDOT) has no problem executing a NEPA Re-evaluation, but they let each district administer their projects as they see fit, as long as FHWA rules for the NEPA process are followed.

The Central NEPA Office explained that to have the NEPA process executed, a project must be able to "stand on its own". In other words, a NEPA process would not be done for a portion of a project that, if completed, could not fully function if suddenly the rest of the project could not be built for some reason. On D-B jobs, the risk to the Design-Builder is such that they often decide not to go forward with re-evaluation. In fact, the Central NEPA Office believes that the overwhelming majority of contractors are not willing to take the risks inherent with the delay to the project brought on by a NEPA Re-evaluation. Any NEPA Re-evaluation should always be done before construction commences, if possible.

In the experience of the Central Structures Design Office, most Design-Builders elect to take the risk and pursue a NEPA re-evaluation prior to construction starting. This conflicts with what was said by most of the rest of the offices. They believe that the reward of getting the job as they bid it is worth the risk to the Design-Builder. This office further submits they have "never seen a case where a design-builder (or a contractor on a DBB job) submits a good idea and it is turned down for the purpose of avoiding a NEPA Re-evaluation". However, they agree that they may deny a good idea if it requires new ROW and a two-year delay in the project to procure the ROW would not be in the public's best interest, even if the contractor is willing to take the risk.

3 CONSTRUCTABILITY REVIEW PROCESS

D-6 thinks that NEPA should not be a problem for the CRP in a D-B project because the Design-Builder should know the NEPA status (situation) when they bid the job, and when they are awarded the job. This district performs a CR on every project, no matter the delivery system. They have two full-time FDOT employees who do nothing but CRs, and two full-time consultants who do nothing but CRs. The Resident Construction Office of each project participates in CRs for jobs under their jurisdiction. They review all projects for constructability at 60%, 90%, and 100%.

The D-6 Plans Review Engineer reviews all Supplemental Agreements and Work Orders, and the District Construction Office is happy with the level of involvement the CR Team has in the design process. On D-B projects, the district hires an "Owner's Rep". This consulting firm is different than the firm hired as CEI, if there is a CEI on the project.

Transferring knowledge is the biggest problem D-6 has in the CRP. To mitigate this problem, the district has implemented quarterly Lessons Learned Meetings. In these meetings, the agenda is confined to those issues that have been a problem in the preceding 90 days. Cooperation from the Production side of the district is essential. The District Design Engineer is present at all meetings.

The D-6 officials interviewed could not understand why the CRP would ever conflict with NEPA. It seems the reason D-6 has experienced no problems with NEPA and their CRP conflicting is that they don't start their CRP or their permitting process until the 60% plans completion milestone. Without contractor input to the design, there is little chance of a design change that would trigger the need for a NEPA Re-evaluation.

D-2 answers requests from outside sources for changes to the design quickly in most cases with a "yes" or "no". They are usually able to provide an answer at the initial meeting. When a Design-Builder makes a change request (usually through an Alternative Technical Concept (ATC)), a meeting is held to listen to the proposal, with 10-15 section heads in attendance. Sometimes there is a quick "no", sometimes a quick "yes". Sometimes, there is a "maybe", which includes recommendations and suggestions on how to alter the idea to make it more likely to gain acceptance, and more likely to result in the best product possible. If they go forward, it will likely result in a NEPA Re-evaluation and/or an IAR.

The district takes the view that it is the contractor's risk. If they have a plan that will improve the product for the same or less money, or will save money in achieving the project objectives, the district will go through all the processes with them – not just "being there for them", but holding their hands. The district "never rejects any idea to avoid a NEPA Re-evaluation". They contend if it ever appears that they are rejecting an idea because they do not want to perform a NEPA Re-evaluation, the reality is one of two things: either the delay costs inherent with a Re-evaluation frightened the contractor, and it was the contractor who chose not to proceed; or the delay costs inherent with a Re-evaluation were such that D-2 decided any advantages brought on by the new idea were not worth enough to offset the disadvantages brought on by the delay.

For all change requests, there is a group within D-2 that reviews each request. This group includes the District Design Engineer, the District Construction Engineer, the District Planning and Design Engineer, and the Urban Planning Office Head (this individual is not included because of his position, but because of his unique set of knowledge and experience. In his career, he has been District PD&E, Engineer, District Consultant Project Management Engineer, and District Permitting Engineer).

D-2 also uses the CRP to "build our people – grow young engineers". They try to always have a new engineer assigned to every CRP, but these teams do not do a true CRP on D-B projects. The District Design Engineer explained their lack of a CRP for D-B jobs, "I am paying the D-B to design and build the job. I am not going to spend any time telling him how to build it. As long as his design meets all the design criteria and codes, fits inside the ROW, and conforms to our NEPA plan, we don't get involved at all from a constructability standpoint."

If there is enough benefit to the idea, D-5 might "partner" with them. They might entertain a contract extension to allow the procurement of the ROW, permits, NEPA, etc., or they might reject an idea just because its implementation would lead to a NEPA Re-evaluation. If they know a change would all but guarantee the NEPA process or environmental-permitting process would be unsuccessful; or if the delay that such a Re-evaluation would cause would be prohibitive for that particular project/situation, they would have to reject the request for a NEPA Re-evaluation or to re-execute the environmental-permitting process. That said, the district tries very hard to work with the contractor or Design-Builder. The D-5 motto is, "Find a way to 'yes'."

Like D-2, D-5 does not perform a real CR on D-B jobs. That is what they are paying the Design-Builder for. There is a CR process performed on all bridges by the Central Bridge Design

Office, but this does not involve D-5 employees. That does not mean constructability problems are never pointed out to D-5 Design-Builders. They will point out to the Design-Builder anything that seems strange from a constructability standpoint that they see in a routine design review – but they won't make them change anything unless their design would cause a Maintenance of Traffic (MOT) problem where the phasing would cause danger to people.

After the award, if the contractor or Design-Builder requests a design change that requires a NEPA Re-evaluation or re-doing the permitting process, the contractor is responsible for filing the paperwork and for paying all expenses for any new contract documents. The district will help them in any case, but if they are “partnering” with them, they might also use their influence (“if we have any”) with the permitting agency. All monetary expense for the change is borne by the contractor or Design-Builder in any case.

The District Design office has a full-time CR team within a Constructability Review and Design Services Unit. This team operates under the District Roadway Design Engineer, and performs CR and Bidability Reviews (BR). Just prior to 60% Plans completion they also perform a CR and an MOT Review. This is done on every project and is a very intense meeting that could last many hours. The district has resisted the development of a checklist because they feel this could lead reviewers not to look at everything due to the variability of projects and review needs.

Electronic Review Comments (ERC) meetings are held to review 60%, 90%, 100% on occasion. These are assigned to one of their two Quality Assurance Review (QAR) consultants for review. Described by one designer as “a godsend”, this process keeps everyone moving forward because one of the functions of the software is to send everyone involved periodic reminders of what is due in the future and when it is due.

The primary purpose of the Plans in Hand Field Review is to perform a “boots on the ground” field review of the 60% plans. This review provides more insight into potential conflicts and “tie back” or harmonization concerns, allowing reviewers to visually interpret the plans’ intent while in the field, seeing what the contractor sees, not just Google Earth and a 2D plan set. Attendees are the EOR, the Consultant PM, the Consultant Utilities PM, the D-5 PM, the D-5 Constructability Manager, the D-5 Senior Roadway Design Engineer, D-5 District Construction Office representative, a Utilities representative, and a D-5 Construction Field Office representative.

On occasion, there is a QAR special assignment, where the district identifies projects where the estimate becomes volatile or there are changing conditions, or where multiple projects impact the same area – or just a project with a perceived high risk. On these occasions, an independent review separate from their normal ERC review is performed. The Quarterly Quality Forums are popular and enjoy great attendance from top DOT personnel and top design consultants. Some of the issues overlap with the six issues from the Internal Construction-Design Meeting, but this is coincidence and not policy. Lessons Learned are always shared. There are some recurring themes and the issues are not limited to the preceding 90 days.

The Internal Construction-Design Meeting, held quarterly, is limited to District Construction and Design personnel, to discuss six issues. Most issues are large and stay on the agenda from quarter to quarter. The Construction Office contributes three issues to the meeting agenda, and the Design Office brings three issues. Often these meetings are held early in the life of a project, and at the time of the meeting, attendees do not always know whether a project is going to be let D-B or DBB. This meeting often discusses 30% Conceptual Plans for a D-B project.

D-7 typically commences their CRP on DBB projects at the 60% plans milestone, but don't do a typical CR on D-B jobs. The risk is on the contractor, and the district looks only for fatal flaws, design-standards discrepancies, and conformance to the RFP. This process grades the constructability of the bid package, after the project has been completed. Forms filled with questions are completed by Construction and Design personnel. They do not claim to have a direct

metric to measure the effectiveness of their CRP as a whole, but the Assistant District Construction Engineer sends out a list of “Avoidable Issues”, based on bad things that happened on recent construction projects. The list is sent to 400-500 design consultants who have done business with D-7 over the years. In-house designers get a copy of the list also.

The Central Structures Design Office performs a CR on all DBB bridge or tunnel projects that are designed through the Central Office. On a D-B project, they must provide a set of “Preliminary” Plans for inclusion in the RFP. These are essentially 30% “Concept Plans” and must describe all restrictions for the Design-Builders. The “Concept Plans” provided by the Central Structures Design Office are non-binding, and most contractors “re-design everything”. However, if they change the design by five feet or more horizontally or vertically, they have to pitch their idea through the ATC process. If they come up with a good idea later (after commencement of construction), they must pitch the idea through the CSI process. The Central Structures Design Office claims to perform a new CR for every ATC and CSI.

4 CONCLUSIONS

This Florida Case Study was part of a research project that involved case studies focusing on five state DOTs. This research found FDOT’s CRP to be the least formal, and least rigid of the five DOTs. This is mainly due to the fact that so many districts do not commence the CRP until so late in the project delivery process. While other states report conflicts between the CRP and the NEPA and environmental permitting processes, Florida is nearly free from these conflicts. This is because FDOT waits until so late in the process (often 60% plans) to start its CRP, any input from the contractor or other outside sources has little chance of becoming part of the process, thus eliminating the chance for any conflict.

FDOT is a de-centralized state transportation agency, and nowhere is the independence of each district more evident than in the area of Constructability Reviews. One example of this is in the attitudes of the districts when it comes to working with the contractor, CM, or design-builder through the NEPA and environmental permitting processes as part of the CRP. D-6 thinks that NEPA should not be a problem for the CRP in a D-B project because the Design-Builder should know the NEPA status (situation) when they bid the job, and when they are awarded the job. D-2, on the other hand, takes the view that it is the contractor’s risk. If they have a plan that will improve the product for the same or less money, they will go through all the processes with them – not just “being there for them” but holding their hands.

It is obvious from the fact that the nation-wide eight-person panel that oversaw this research contained two FDOT Construction officials, that FDOT wants to improve its CRP. Perhaps an increased measure of uniformity would help.

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