

DESIGN SUBMITTAL REVIEW DIFFICULTIES IN OPEN/BRACED CUT CONSTRUCTION

This project involved the construction of a freshwater diversion structure which channeled freshwater from the Mississippi River into freshwater marsh to prevent saltwater migration. To construct this diversion structure, it had to be installed through the river levee and below a state highway and a three-track railroad system which were parallel and downstream from the levee (see Figure 1).

SPECIFIED DESIGN

The plan was to first install concrete culvert Sections C-6 to U-4 by constructing braced cut excavation to the necessary elevation (see Figure 1). The braced cut was specified to handle the highway and railroad loadings in the detoured position. After the installation of the C-6 to U-4 culvert Sections, Sections C-5 to U-1 were to be installed primarily by open cut excavation. The excavation plan was specified to be designed by the contractor.

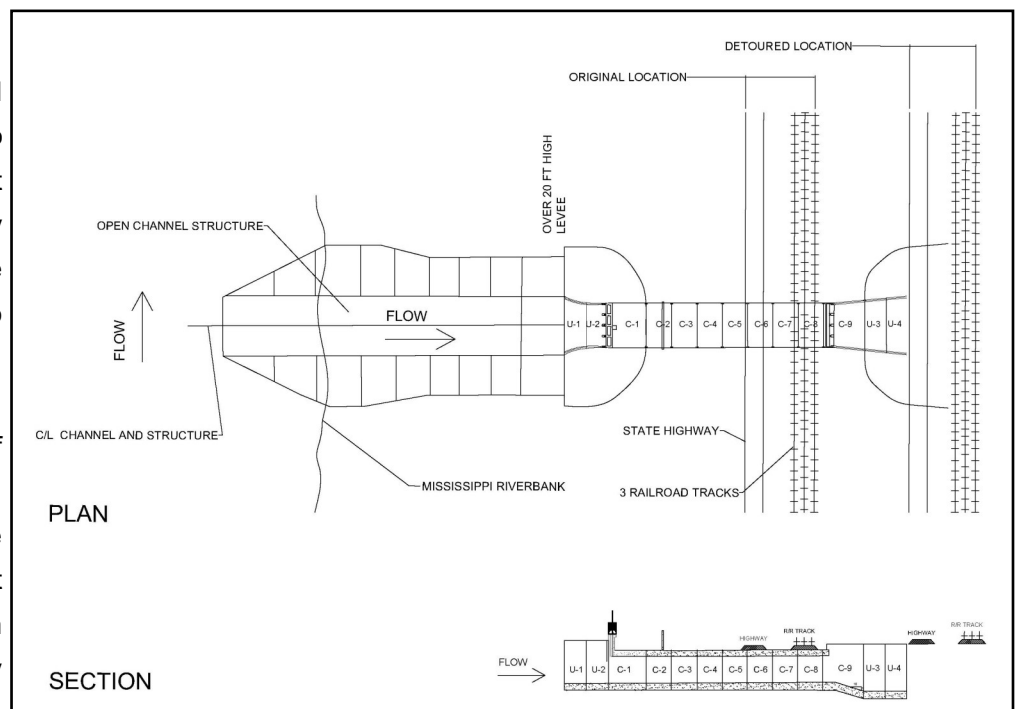


FIGURE 1 PLAN AND CROSS-SECTION OF THE FRESHWATER DIVERSION STRUCTURE

SUBMITTAL PROCESS

The construction of the culvert was significantly delayed when the contractor had difficulty in providing the government with an excavation design and plan that would need to be approved for construction. The contractor had to make 9 design and plan submittals over a span of over 1.5 years in order to receive final approval. While the other submittals were rejected for inappropriate or too liberal design procedures the last design submittal was evaluated by the government as being too conservative.

Without government approval of an appropriate design the contractor decided to construct the cofferdam based on the last submittal. This design called for significant changes from the nature of temporary support outlined in the contract document. Also, because of the delay in the design of cofferdam, the construction sequence had to be changed. Despite the objections of being too conservative, the government finally approved the design and plans.

FINAL DESIGN

In the final design, a two-phased braced excavation was performed with the remaining culvert sections from U-1 to C-8 open cut. (Note: Monoliths C-6 to C-8 were originally planned to be constructed in a braced excavation). With the highway, railroad and associated earth surcharges present in the detoured position, it was determined that there wasn't sufficient bottom and lateral wall stability to construct U-3/U-4 monoliths with a braced excavation without an unacceptable risk of excessive settlement or deformation of the railroad. Therefore, the proposed plan included returning the highway and railroad to their original positions with the construction and backfill of monoliths C-6 to C-9 prior to the sheet pile excavation of U-3/U-4. Still, because of the proximity of railroad to the U-3/U-4 excavation it was found necessary to construct a pile supported relieving platform under the 3 railroad tracks. Figure 2 shows the ongoing construction of the diversion structure.

CAUSE OF SUBMITTAL DIFFICULTIES

For this project, there was an extraordinary effort necessary to provide acceptable design-built plans. Through different professional engineers, various excavation plans were submitted to the government. With the evaluation of each design and plan, new criteria and pertinent information became apparent in the government's design rejection comments. This was the result of insufficient or unknown information that was not provided in the plans and specifications. The specifications were sufficiently ambiguous that they allow for a range of reasonable interpretations which were significantly different than the government's opinion. This resulted in substantial changes in design-built plans. The more salient design difficulties which were encountered were:

- Submittal rejection because sheet pile design methodology was considered not standard despite being successfully utilized internationally for almost 10 years.
- Above methodology was not rejected until its second submittal. Other instances of delay rejection of other design approaches/assumptions also occurred.
- Surface loading requirements contained insufficient definitions this resulted in a wide variation in assumed conditions by different designers resulting in confusion and rejection of some submittals.
- Acceptable slope stability analysis and safety factor unknown until after submittal was rejected.
- Review of design-built by the railroad was not known.



FIGURE 2 AERIAL IMAGE OF CONSTRUCTION OF THE DIVERSION STRUCTURE COMPLETED

LESSONS LEARNED

In preparing plans and specifications for a design-built as the owner's representative on similar projects, one should determine the preferred degree of control of the contractor prepared design, and be specific to that degree. It may be determined that the sequence of construction needs to be completely delineated so that it does not need to be specified at all. Obviously where there exists a question(s) of constructability, a feasibility design is necessary. Full disclosure of this feasibility study should be shared with the bidding contractors for information only. This way, contractors can more intelligently bid and design these more complex projects with at least a viable approach, methodology, and assumptions which are known and allowed. The contractor should not be expected (and don't) to sufficiently design the project before bid. Moreover, the reviewer should not deviate from the specified bid criteria as a result of a bias approach to the problem. Also, when it is discovered from review of the design submittal that some information or criterion is missing,

one should issue an immediate and full disclosure of this necessary data to minimize the cost and delays. A common issue when undisclosed specifications exist is insufficient definition of terminology.

Clearly, in reviewing design submittals, one should always include in its report a thorough description of any erroneous data, assumptions, and analyses that are present to avoid additional and unnecessary delays.

Other MEA Publications that may be of Interest:

[UPDATE #9: Hard Excavation Dispute](#)

[UPDATE #17: Landslide During Land Development](#)

[UPDATE #23: Anatomy of Canal Geo-Construction Difficulties](#)

[UPDATE #37: 500 Ft. Assembly Platform on Concrete Piers Heaves](#)

[UPDATE #47: Improved Methods of Cofferdam Design](#)

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 26 states in the U.S. Our projects primarily have an emphasis on Geotechnical Engineering, however, we also have significant experience in projects involving transportation, subsidence engineering, laboratory testing, training, and geophysical exploration. Gennaro G. Marino, Ph.D., P.E., D.GE is president and principal engineer of Marino Engineering Associates, Inc., and has been a licensed professional engineer since 1984. To obtain additional information on MEA, one can also visit our website at www.meacorporation.com.

FOR MORE INFORMATION: There is a significant amount of additional information that is available on the above subject. For more information, please contact MEA at the address listed below.

All material in this Engineering UPDATE © 2019 Marino Engineering Associates, Inc. All Rights Reserved.

MEA
MARINO ENGINEERING ASSOCIATES, INC.

1370 MCCAUSLAND AVENUE, ST. LOUIS, MISSOURI 63117
PH: 314.833.3189 FAX: 314.833.3448
<http://www.meacorporation.com>