Engineering
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# IMPROVED METHODS OF COFFERDAM DESIGN

Cofferdams are used to conduct construction in the dry when the project area is submerged by a body of water. To accomplish this, a water barrier enclosure is constructed to isolate the project area which is then dewatered. The cofferdam typically involves the use of sheet pile driven deep enough into the soil to provide safe working conditions against underseepage and external water and soil pressure against the wall (see Figure 1). A cantilever design is used where no interior lateral support is used and the soil embedment of the sheet system is solely relied upon. Where the lateral support is augmented by internal support a braced system is utilized. Often times, when cost effective, additional lateral support is provided against this external pressure in some form of lateral bracing. The lateral bracing can consist of horizontal (struts) to angled steel members (steel rakers or batter piles) perpendicular to the wall which are connected to a horizontal steel beam (whaler) which directly distributes the lateral support onto the sheet pile (see Figure 2). For circular cofferdams no struts or rakers may be needed as the lateral support is provided by the circular whaler (ring beam) alone. Where applicable, a circular design allows for greater accessibility to the specified construction, which is not afforded when horizontal struts are present in one or both directions.

Where the external loads are quite large, a cellular cofferdam must be used, and is outside the scope of this UPDATE.

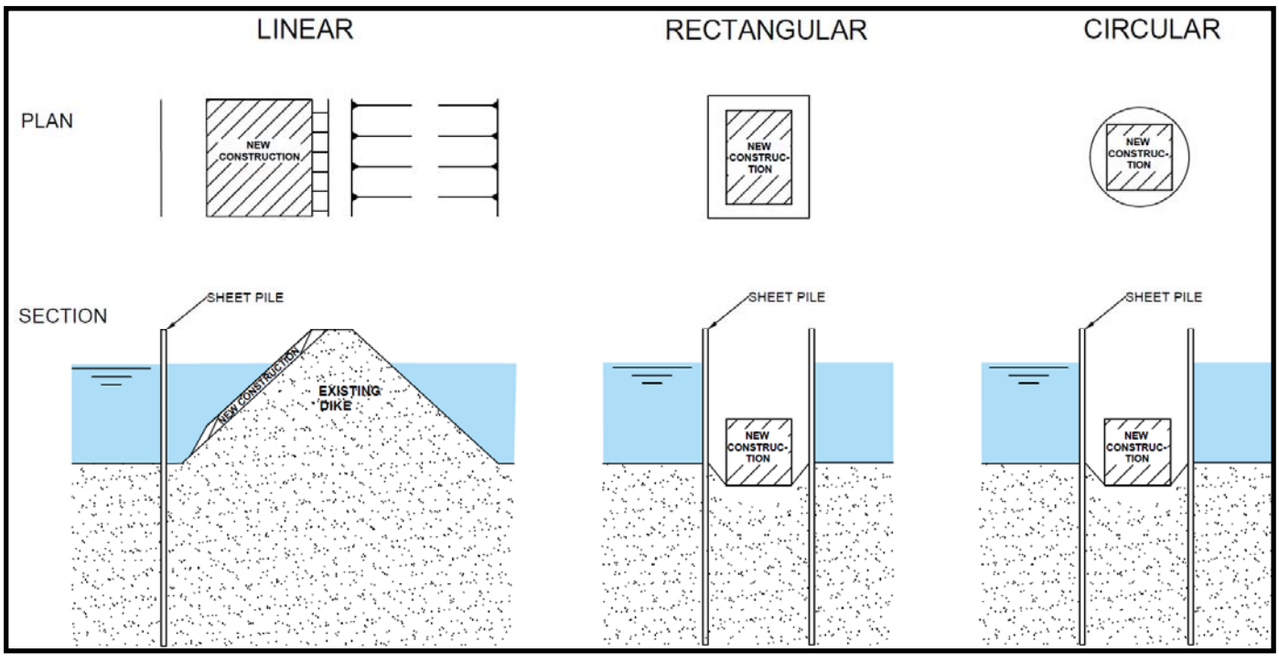


FIGURE 1 MORE COMMON FORMS OF FREE STANDING (CANTILEVER) COFFERDAMS

## STATUS QUO

The vast majority of the designs of cofferdams are considered part of the means and methods of the construction contractor (i.e. design-built construction) and are designed by an outside consultant(s). Conventional methods used to design the cofferdam construction can only approximately account for the varied site conditions and load and are thus overly conservative in their design requirements. Many of the commercially available software that provide calculations used in cofferdam design utilize these conventional methods.

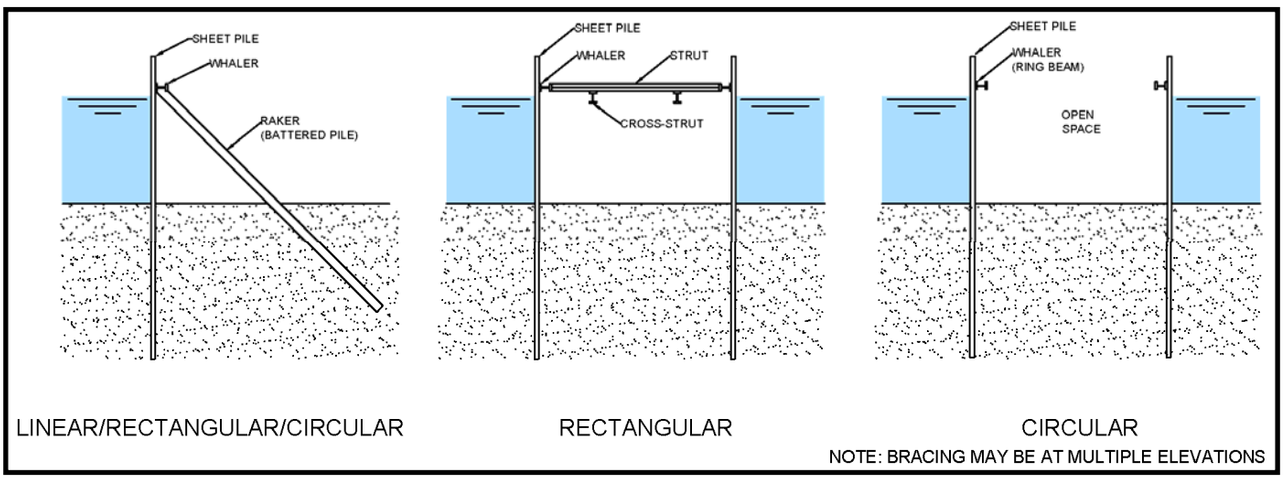


FIGURE 2 TYPICAL LATERAL SUPPORT BRACING COFFERDAM

## NUMERICAL METHODS

Current numerical software is user friendly and can be efficiently utilized as a design tool when using engineering judgment. Moreover, numerical methods, in lieu of conventional design methodology, provide a more accurate depiction of the expected performance of the proposed design and therefore result in a more cost-efficient design. Such analyses allow for better accounting of all the important conditions peculiar to the project. These include:

- Retained water level
- Soil embedment and sheet pile properties
- Actual topographic conditions
- Seepage effects on stability, lateral stiffness, and piping considering different dewatering scenarios
- Lateral soil stiffness considering varied soil strata
- Lateral deflection of sheet pile wall with and without a bracing system
- Load distribution

## CONCLUSIONS

The use of numerical calculations provides a more realistic and thus cost-effective approach to the design of the cofferdam. For example, it has been our experience that the calculated requirement bracing force can be 25% of that determined by conventional methods when numerically accounting for all the relevant conditions in the model. Consequently, where underseepage is not of issue, less sheet pile embedment may be required with less inward deflection of the sheet pile wall. In other words, the use of numerical model can result in reducing the required size and length of the sheet pile needed.

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**Other MEA Publications that may be of Interest:**

UPDATE #39: Using Reinforced Soil for Construction of Retaining Structures and Earth Slopes

UPDATE #42: Advantages of Reinforced Earth over Other Retainage Systems

MEA Blog: What are Cofferdams?

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**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.



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