

**US Army Corps of Engineers  
Supply Chain Management Research  
12 December 2007**

**Executive Summary**

The following items are the US Army Corps of Engineers Supply Chain Management Research:

**Bollards**

- (1) Production Challenge: The assumption made was that about 150 miles of the solid bollard style fences will be required and that 30% percent of this construction effort must start in the March/April time frame. Then the Government and its construction Contractors may require 285,120 bollards in order to complete an estimated 45 miles of border barrier. Industry wide capability to produce round steel structures is about 36 miles per month. Since there is an array of square structures and other customers, assume that about 50% of industry effort could be brought to bear on producing 3/16" 6"X 6" square bollards or 18 miles of barrier per month can be dedicated to fence bollard production. Given these assumptions, two and one half months of production effort are required before the March/April timeframe. Steel mills require about two weeks of lead time to prepare for production additionally, the lead time would be increased to eight weeks for use of weathering steel.
- (2) MATOC Contractor Construction Supplies: Field Project Managers (PMs) have stated that the following supplies are critical to fence construction: concrete, aggregate, lumber, steel and water. Water is especially critical in New Mexico, where water can be difficult obtain to support construction because it is carefully regulated and permitted for specific purposes. PMs also pointed out issues with paper trails that resulted from disconnects between suppliers, trucking companies and MATOCs.
- (3) Square vs. Round Bollards: On the behalf of the Government, Michael Baker Jr, Inc, (Herein after Baker) contacted 11 vendors of Hollow Steel Structures (HSS). After completing this industry analysis, it has been determined that round bollards may be more expensive then square bollards. Baker's research indicated near equal availability of square and round bollards. Since there is little availability of schedule 20 or 3/16" round bollards, in order to maintain schedule, the Government may be required to purchase schedule 40 or .28" round bollards which are generally more expensive than the 3/16" square bollards. Furthermore, preliminary engineering has indicated that square bollards are a better choice for standing up to projected wind or breaching attempt loads. For the same amount of steel, due to the angles (resistance), the square bollard is actually more resistant to tensile and bending failure. Square bollards also provide a better welding base and better support the project from a constructability perspective.
- (4) Rust and Maintenance: Weathering steel initially rusts to a brown patina, and then stops continued corrosion. Weathering Steel costs 12-15% more than straight carbon

steel. The anticipated break even point for the construction and maintenance of weathering steel as opposed to carbon steel will be quickly realized. About 3000 gallons of paint are needed per mile of solid bollard fencing, at \$30 per can plus application fees just the initial painting is costly. Follow-on maintenance costs for additional coatings necessary to care for a carbon steel bollard fence make a good case for an up front investment in weathered steel. Steel mill representatives indicate an 8 week lead time is necessary to initially produce weathered steel. Steel mills typically do not coat or prime bollards, steel plate, I-beams or angle iron. Ultimately the cost and handling of priming and coating and then periodical repainting will far exceed the life cycle advantages of using weathered steel.

- (5) Reinforced Concrete Slugs: Bollard “slugs” are pre-made reinforced concrete fillers for bollards. Rather than mixing concrete at remote work sites, using pre-made slugs to install into bollards was suggested as an alternative. The top of the bollard must be covered to prevent water from ponding inside. If slugs are selected, stacking three to four 5’ long, pre-cast, reinforced concrete slugs in the bollards appears to a better technical solution than manufacturing a 15’ or 20’ slug. It is recommended to place 3-5’ slugs in each bollard, if the bollards are to be reinforced. Fiber is recommended over steel reinforcement, which is just as strong but can be admixed and reduce additional handling and costs. The total is approximately 19,000 slugs per mile of solid bollard fence. A pre-cast company with numerous plants will be necessary to complete this task. An advantage to using pre-cast slugs is the strength of the concrete that can be attained; 5000-8000 PSI can be achieved. Industry capability to produce slugs is still being determined, prompt testing and early production of the slugs will be as important as the production of the bollards.
- (6) Steel/Concrete Interaction: A large problem with bollards filled with concrete is the electrolytic interaction between the two materials will cause rusting of the steel from the inside out which will precipitate fence failure. A recommended solution to this problem is to admixture in the concrete mix which reduces the adsorption of water by the silica in the concrete.

**Wire Mesh**

- (7) Wire Mesh: Wire mesh design considerations include: the use of 8 gauge, 6 gauge, 4 gauge, or a combination thereof.

	8 gauge wire mesh	6 gauge wire mesh	4 gauge wire mesh
Weight	1.97 lbs/sqft	2.77 lbs/sqft	3.82 lbs/sqft
Max shipping dimensions	20’ x 10’	20’ x 10’	20’ x 10’
Max panels per truck	111 panels	80 panels	57 panels

The manufacturers reported that 8 gauge mesh is the industry standard. It was also reported that 4 gauge wire mesh is very hard on the machines that produced it, thus increasing the chances of a breakdown and possible further material delays. 8 gauge and 6 gauge sample mesh arrived at the Fort Worth USACE office on 29 Oct 2007.

2. Beta Fence
3. Bull Moose Tube Company
4. C.E. Shepherd L.P.

## **Conclusion and Recommendations Summary**

1. Expedite Selection of the Fence Types by Segment so we can conclusively determine our supply chain requirements.
2. It may be in the Government's best interest to start stockpiling key materials for the initial construction efforts in March-April 2008. If weathered steel is selected, production may not be able to begin until around February 2008 and it may take 2.5 months to produce materials needed by the first 30% of the RFPs.
3. The sooner potential suppliers have defined requirements, the more successful they will be at meeting the manufacturing timeline.

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