Analysis 3: Stainless Steel Bollard Detail

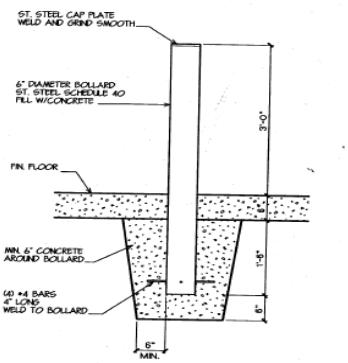
Background

The Production Area contains fifty-six 6" stainless steel bollards that are set in 2' of concrete below a 6" slab-on-grade with #4 bars welded to the bottom of the bollard. These bollards are located sporadically throughout the first floor level of the Production Area for protection of equipment, doors, and entrances for when a forklift is moving around the area.

Problem

In order to place these bollards per the detail below with a 6" slab-on-grade in 2' of concrete with #4 bars welded to the bottom of them, they need to be installed before the slab-on-grade is poured. Therefore, you are trying to layout the exact location of these bollards before the equipment, doors, and entrances are located or placed. Additionally, you don't even have a concrete slab to place marks on and chalk lines down. Hence, you are left trying to layout these bollards in the gravel base of the slab while working around the underground rough-in: conduit, pipes, drains, etc. Even then, if you are able to locate and place them correctly the first time, once the slab-on-grade is poured and all of the walls, equipment and doors are being installed hopefully there was not a change that relocated any of them because the amount of work necessary to remove one of these bollards and place it even a couple inches to the side is tremendous. It is my initial hypothesis that the bollards were structurally over designed to meet the requirements of withstanding a "fork-lift carrying milk cartons at 1mph" *(a logical guess)*.

Refer to the figure to the right to view the bollard design detail:



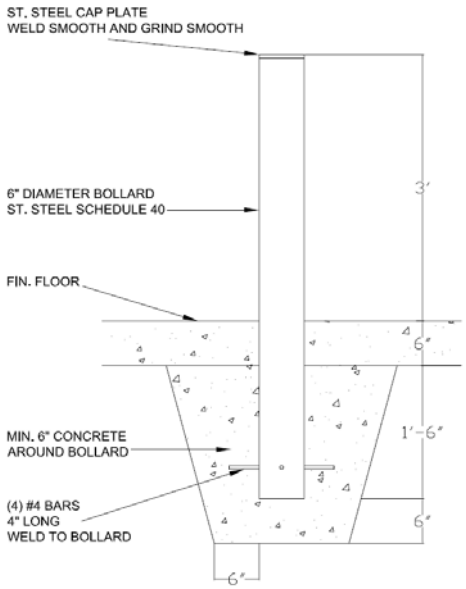
11 / A8.6 Typical Bollard
1 1/2"=1'-0"

Proposal

The redesign of a bollard detail that is less complex. A design that is more easily installed while maintaining the necessary structural requirements would allow for a more feasible installation detail. Intern, this would provide easier installation during construction while maintaining the necessary structural requirements. The proposed solutions will offer value engineering to the project by providing the same quality with a simpler installation that may result in a cost savings on labor to the project. Also, this would help to expedite the schedule during this phase of the project.

Analysis

I began my investigation into the bollard detail by first talking with the architect and engineer. The first question asked was why the need for such a complex and structurally solid bollard detail. The answers received were astonishing. The engineer had not even seen the bollard detail. The complex structural detail was not even approved by the structural engineer on the project. The architect used a typical detail found from some place not known to even them. Through the course of the interview I found that the architect did not even give any serious consideration to the detail which was one of the most difficult on the project for sequencing and constructability.



Current Bollard Detail

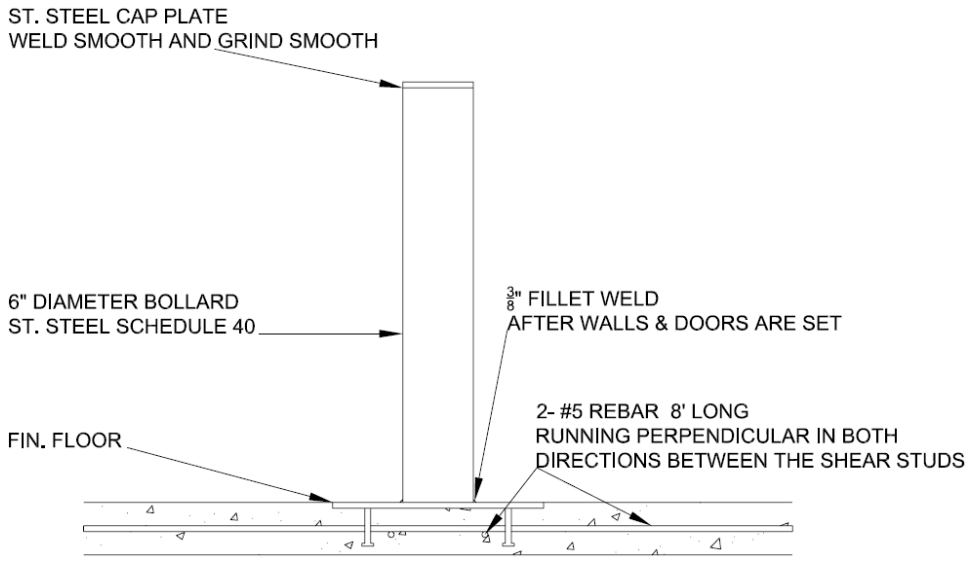
The next part of the investigation was to determine the load the bollard needs to resist to provide an acceptable redesign. Even this question raised some interesting discoveries. The architect, whom designed the detail, did not know what resistance it would have to withstand. The engineer however, even though he was not asked to review the detail, was helpful in this matter. After speaking with a few of his colleagues he found that there is not always a good way to design a bollard. Typically, an engineer would have an understanding of where the

bollards where going to be located on the project and what there intended use was for. Using this information, a logical engineering judgment is made to base the design upon.

From these results the next step was to go to the user group of the Production Area and review their needs. The information found here was invaluable. It was discovered, through an extremely easy conversation with the Production Facility Manager, what their desired needs were in the area with regards to the bollards.

During our walk, through the on going construction in the Produciton Area, it was determined that for the most part the facility has no desire to drive a fork-lift through the Production Area. Standing there and looking at all the equipment set and piping run it would be almost impossible to get a fork lift through there. Likewise the facility never had a desire to run a fork lift through the area, mainly the only thing the fork-lift will be used for is to get product form the loading dock to the storage areas and to move product in and out of the coolers and freezers. In the Production Area itself everything is manageable by hand and a small hand truck or pallet lift.

Therefore, through simple investigation and questioning it was determined the requirements for the bollards in the Production Area were considerably less than originally perceived. A detail was later issued by the engineer, whom worked considerably with the construction manager to provide a better detail, which was used for the installation of the last 10 bollards. This detail is shown below:



Proposed Bollard Detail

Conclusion

The new proposed bollard detail should be used in place of the current detail at all locations. The new proposed detail allows for the 12" x 12" stainless steel plate w/ shear studs to be imbedded and set in the concrete with the adequate reinforcing during the concrete pour. With the flexibility of now having a 12" x 12" area to weld the bollard to later will allow for more accurate placement. This is due to the fact that the plates can be set then all other work in the area can be done; including walls, doors, equipment, etc. The bollards can then be welded onto the plate in there exact locations.

In addition, now because the first floor level will be a cast-in-place structure the layout of the plates can be placed more accurately by laying-out off of the plywood as a work surface. The required 8 ft. long #5 bars was decided upon so that if the bollard is hit the force is distributed to two joists in the slab, regardless of its placement.

The new proposed design will ultimately provide a better finish with a considerable amount of ease added to the constructability of the design. In addition, the good judgment engineering reasoning behind the design provided a value engineering idea that will not increase the cost.