# Cascade Steel Scrap Yard


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## Background

The objective for this George Fox University Senior Design team, was to conduct a redesign of Cascade Steel's scrap yard. The redesign was prompted by the deterioration of gantry cranes currently used to manage and move material within the scrap yard. Additionally, Cascade's melt shop has the potential to process material at a faster rate than the scrap yard can put it out. The ultimate goal of this project was to create a new system for scrap handling that may be more cost or time efficient in the long run.


**Figure 1. Cascade Steel Scrap Yard overview**

## Design Goals

- Redesign Cascade's material handling scheme to move material at an increased rate and/or more cost effective method.
- Scrap yard must be capable of loading charge buckets at or above the rate at which the melt shop can process material.
- Minimize Operational Cost
- Consolidate separate scrap yards.

## Research

Observational research was conducted to determine how other steel mills move material within their yard. Steel mills identified across the country (Figure 2) were analyzed using satellite images and evaluated on the criteria of space efficiency normalized to yearly finished product output. It was determined that Cascade already had an extremely space efficient yard; what this meant it that Cascade required a unique solution not used by any other US steel mills. Other areas of research delved into railway design and trucking standards. From this research, seven conceptual redesigns were created. With further input from the client, two conceptual designs were selected to undergo a full detailed design and be included in the final deliverables.


**Figure 2. Map of Steel Mills in North America**

## Final Designs

**Dedicated Sennebogen Scrap Yard**

The Dedicated Sennebogen Design (Figure 3) is a relatively noninvasive design which allows for the current method of loading the charge bucket to still be employed. The gantry cranes would be removed, commodity bins re-configured, and an additional sennebogen (Figure 4) would be added to Cascade's fleet. The main goal of this design is to maintain existing structures and handling practices while removing the surrounding waste.

**E-Crane Design**

The design features a massive elevated crane (Figure 4) which would travel down the length of the yard on rails and be able to reach many commodities from a single position (Figure 5). This design, while costly, would provide a highly effective method of delivering scrap to the charge buckets. The massive reach and high lifting capacity of the equipment allow for much flexibility in yard design and commodity placement.

**Basic & Hybrid Layout**

The "Hybrid" design refers to a possible variation on the two main designs where buildings directly south of the yard would be removed. This would allow for self-dumping delivery trucks to access the southern commodity bins without excessive "jockeying." The removal of these buildings is entirely dependent on whether Cascade wants self-dumping trucks to have access to both the north and south bins.

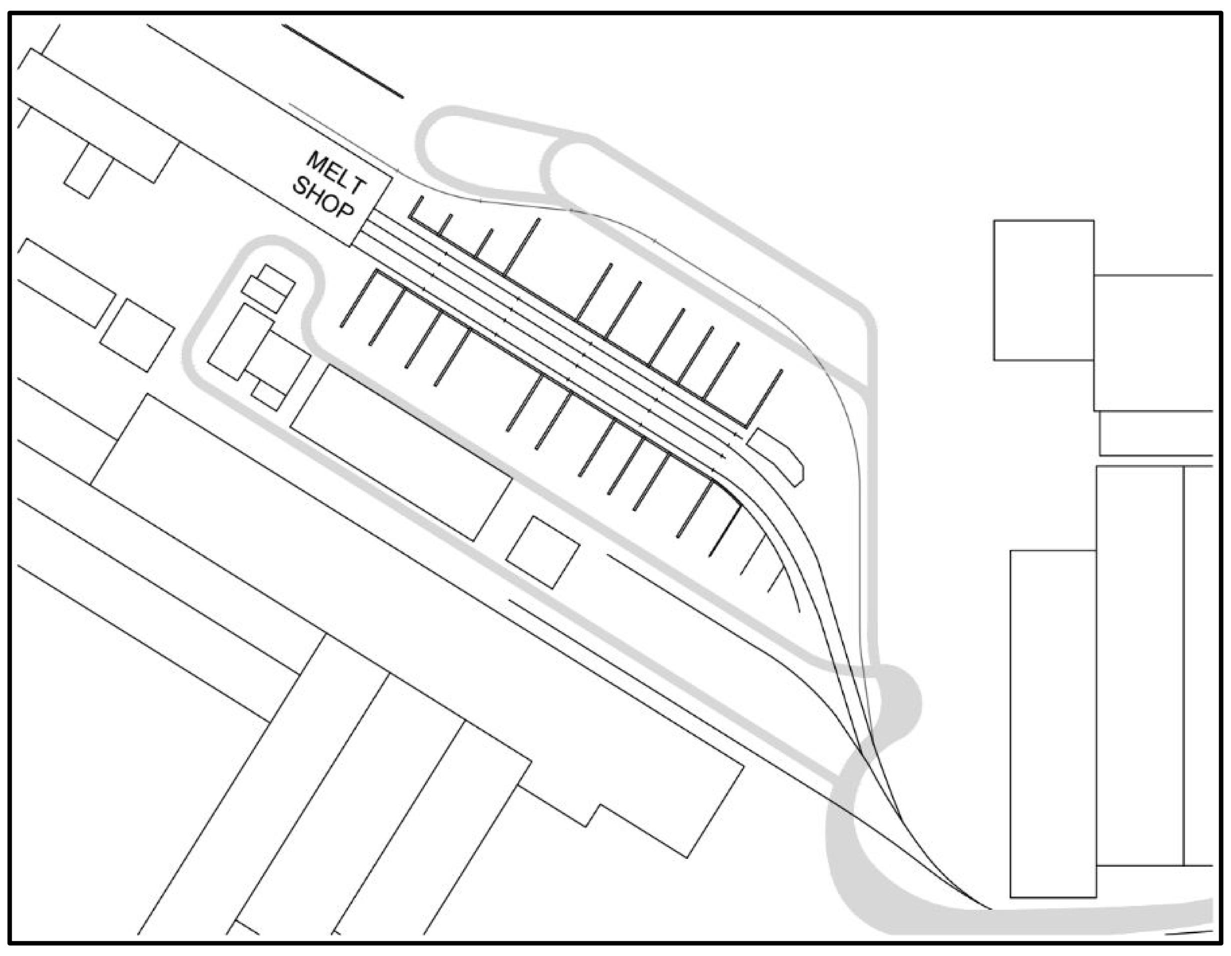


**Figure 3. Dedicated Sennebogen - Basic**

**Figure 4. E-Crane (Left) ; Sennebogen (Right)**

**From Left to Right:** Quinton P., Jacob W., Jacob C., David P., Michael H.

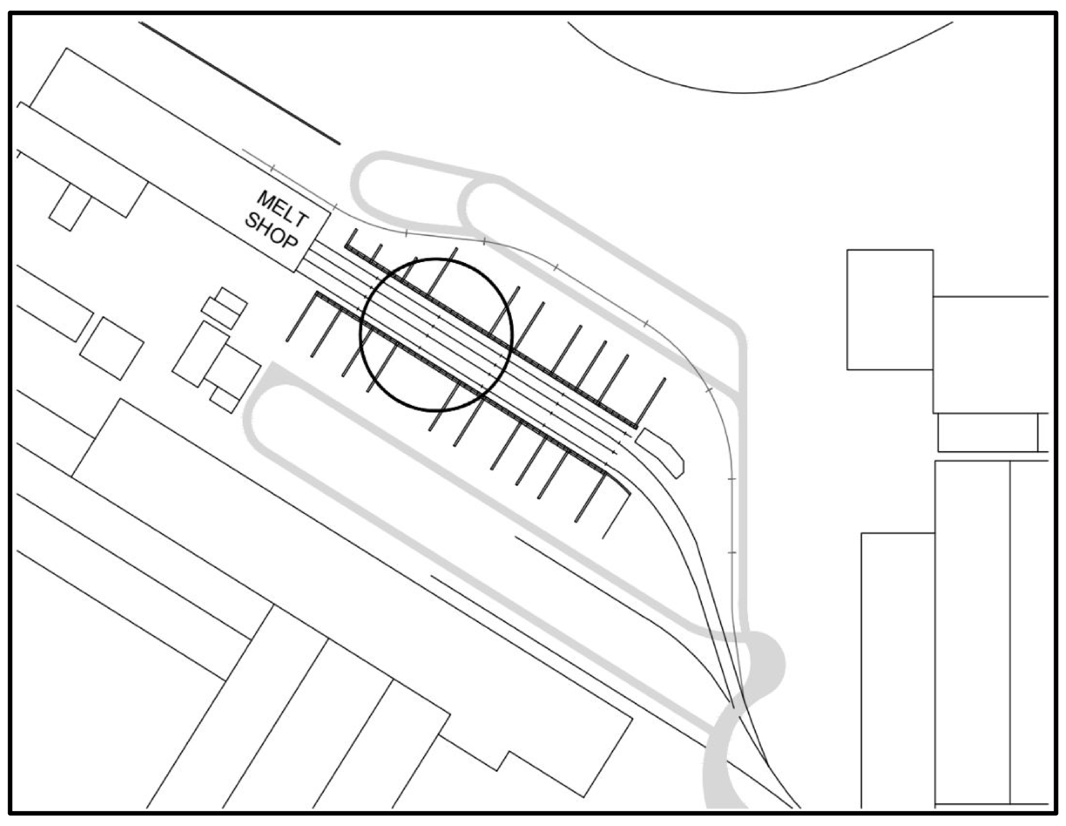


**Figure 5. E-Crane - Hybrid**

## Justifications

Based on video from the plant's current operations, a baseline time study was developed and compared to theoretical time studies for each redesign (Table 1 and Table 2). In addition, cost projections for each redesign were gathered into a comparison matrix (Table 3). Based on these factors, the recommended redesign is the E-Crane design. While it will cost more to implement, it will provide greater productivity with increased longevity and lower operational cost.

**Table 1. Dedicated Sennebogen Time Study**

| Time Study Statistics: | Current Layout | | Modified Grapple (>20% volume increase) | | Modified Sennebogen* | |
|---|---|---|---|---|---|---|
| | 50 ton Charge | 70 ton Charge | 50 ton Charge | 70 ton Charge | 50 ton Charge | 70 ton Charge |
| Scoops to fill: | 25 | 36 | 22 | 32 | 25 | 36 |
| Charge bucket load times: | 16:58 | 19:01 | 15:59 | 18:01 | 15:32 | 17:55 |
| Maximum Scrap Throughput Potential: | 135 tons/hour | | 139 tons/hour | | 141 tons/hour | |

**Table 2. E-Crane Time Study**

| Time Study Statistics: | Current Layout | | Elevated Crane Layout | |
|---|---|---|---|---|
| | 50 ton Charge | 70 ton Charge | 50 ton Charge | 70 ton Charge |
| Scoops to fill: | 25 | 36 | 24 | 32 |
| Charge bucket load times: | 16:58 | 19:01 | 14:56 | 15:17 |
| Maximum Scrap Throughput Potential: | 135 tons/hour | | 145 tons/hour | |

**Table 3. Cost Comparison Matrix**

| Cost Comparison | Sennebogen | Overhead Crane |
|---|---|---|
| Commodity Bin Walls | $77,000 | $77,000 |
| Commodity Bin Base | $417,000 | $417,000 |
| Lime Rail Line | $225,000 | $225,000 |
| 1 Sennebogen | $900,000 | x |
| Elevated Rail | x | $275,000 |
| 1 Elevated Rail Crane | x | $1,200,000-$1,700,000 |
| **Total** | **$1,620,000** | **$2,195,000-$2,695,000** |

## Deliverables

- Proposed Site Maps
- Equipment List
- Inventory of Changes
- Time Study Comparison
- Capital Cost Estimation



Image for *Figure 2* found from: http://www.steel.org/making-steel/where-its-made/steel-plants-of-north-america.aspx