# Integrated project Engineering Technology

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# Design of a system for feeding zinc ingots into an existing Dross plant

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Bachelor in Electromechanical Engineering Technology

## Situation

This bachelor thesis is being conducted in collaboration with **ArcelorMittal** located in Genk. ArcelorMittal is a steel company with facilities all over the world. The Genk site comprises an **electrogalvanization line** for the continuous galvanizing of steel sheet. The galvanizing process involves passing the steel sheet through fifteen **galvanizing cells** using rollers. The galvanizing cells are filled with electrolyte, which is prepared by **dissolving zinc in diluted sulphuric acid**. This dissolution of zinc takes place in the **Dross plant** (Figure 1). Currently, the electrolyte is produced by placing large **900 kg zinc blocks** into three dissolution tanks and allowing them to dissolve.

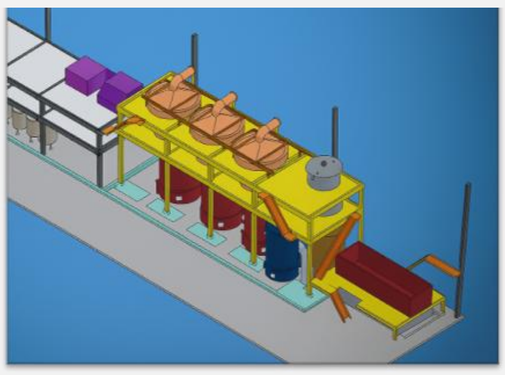


Figure 1: Simplified representation of existing Dross plant.

## Problem

- The large zinc blocks are placed into the dissolution tanks of the Dross plant using a **maintenance crane**. This crane should no longer be used for this purpose because it is intended **solely for maintenance tasks** and should therefore always be available for that purpose.
- In addition, a **worker** is needed to operate the maintenance crane for an entire day. They would like to assign this worker a more **useful task**.

## Goal

The goal is to design a system that can **feed smaller zinc ingots** (Figure 2) into the dissolution tanks without using the maintenance crane and **without the need for manual intervention**.

Figure 2: Pallets of smaller zinc ingots.

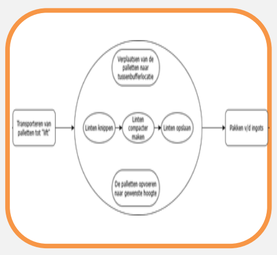
## Methodology

The Van den Kroonenberg model was applied as the methodology for this project.

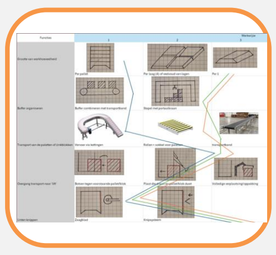
**Requirements**

| Vaste eis | Variabele eis | Wens | |
|---|---|---|---|
| X | | | De installatie moet volledig geautomatiseerd verlopen vanaf het moment dat een zinkpallet op de installatie wordt geplaatst. |
| X | | | De van polyester verpakkingslinten rondom de zinkpaletten moet verwijderd worden. |
| X | | | De herkomde onderhoudskraan mag niet gebruikt worden voor het automatiseren. |
| X | | | Het proces zou volledig gemonitord en uitgebaat moeten worden via een SCADA-systeem. |
| | X | | De installatie mag ondersteun niet meer dan 1 m in breedte uitstekken van de horizontale Dross-installatie. |
| | X | | Idealiter bevat het hele transportsysteem een bufferscapaciteit van 25 ton zink. |
| X | | | Er dienen 25 kg SHG 99,995% zink blokken gebruikt te worden. |
| | X | | Het ontwerp moet een cyclustijd hebben van maximaal 8 uur. |
| X | | | De zinkblokken moeten gelijkmatig verdeeld kunnen worden over de grondoppervlakte van de oplostank en gestapeld tot de vereiste hoeveelheid is bereikt. |
| X | | | De transportcapaciteit moet maximaal 18 ton zink per dag kunnen verwerken. Gemiddeld wordt er 12 ton per dag verwerkt. |
| X | | | Het ontwerp moet voldoen aan de IP-4/5-classificatie (Buitenopstelling, regenbestendig). |
| X | | | De machine moet voldoen aan de 2006/42/EG machinerichtlijn. |
| X | | | Het ontwerp moet voorzien worden van een veer veiligheidsblokbeveik dat voldoet aan de NEN-EN-ISO 14120 norm. |
| | X | | Het bedrijf organiseert 1 groot onderhoud (1 week) per jaar en 1 klein onderhoud (1 dag) per 6 weken. |
| | | X | Het gebruiksniveau mag niet boven het huidige gebruiksniveau (ong. 85 dB) komen. |

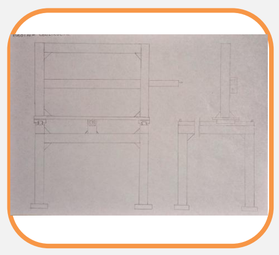
**Function Block Diagram**



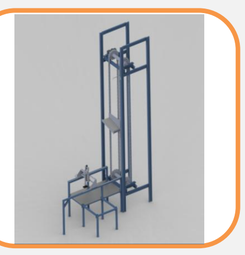

**Morphological overview**



**Concept**



**3D and 2D Drawings**



## Result

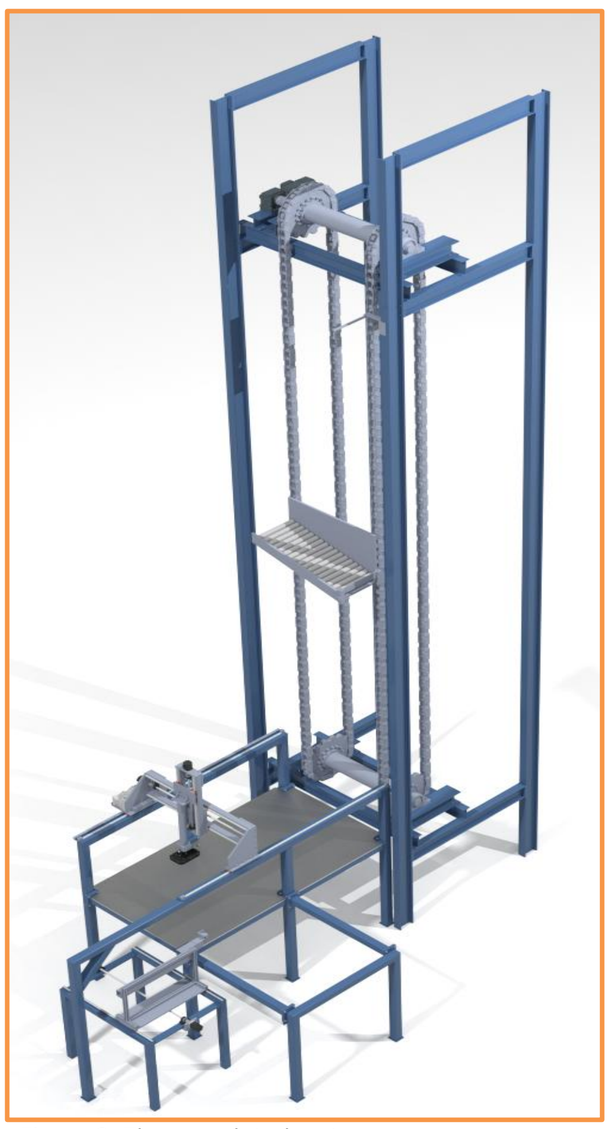


Figure 3: The completed system.

1. A pallet of zinc blocks will be placed on the main construction (Figure 4).
2. Next, a robot will grab the packaging ribbons and cuts them off. It then throws the ribbons into a shredder (Figure 5).
3. The gantry pick and place system will transport the zinc ingots into the bucket of the elevator.
4. The elevator lifts the zinc blocks to the top, where a mechanism causes them to roll off the bucket onto a conveyor belt (Figure 6).

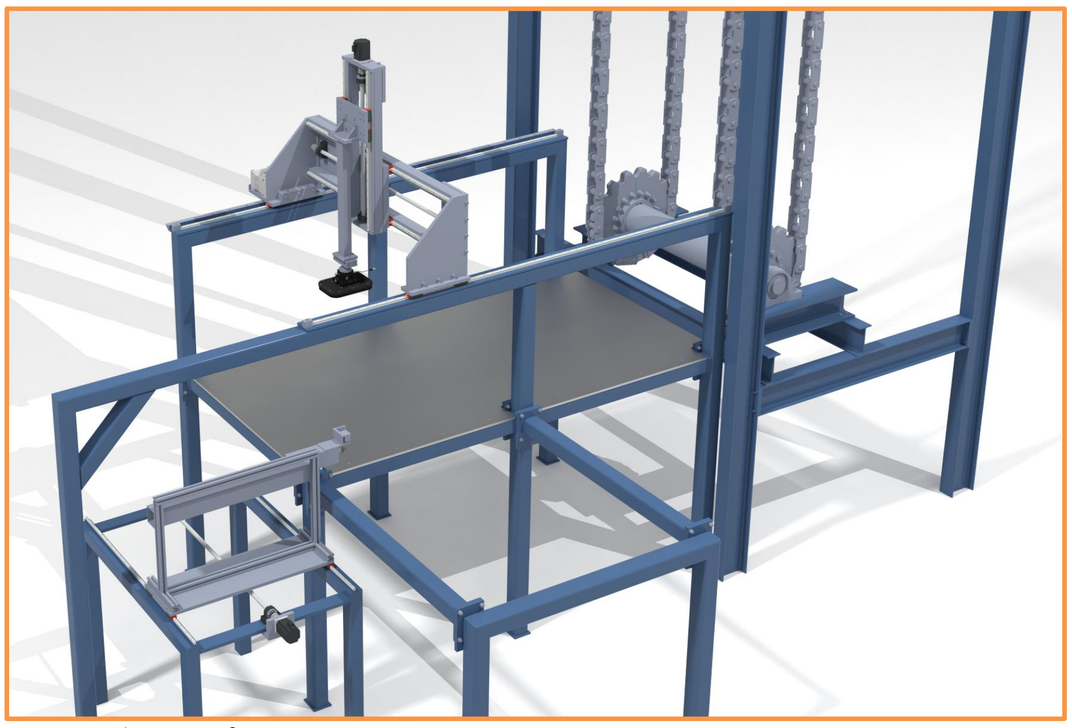


Figure 4: Close-up of main construction.

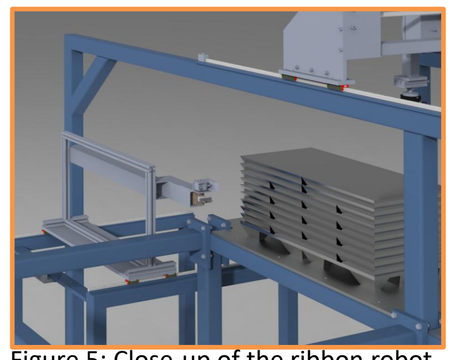


Figure 5: Close-up of the ribbon robot.

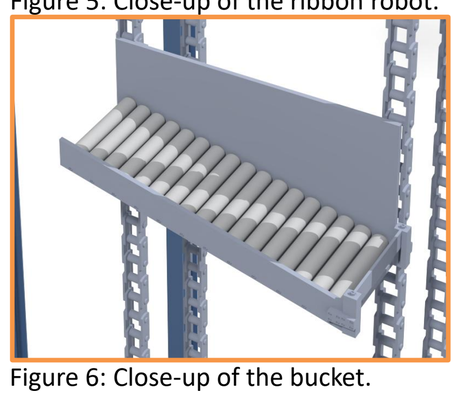


Figure 6: Close-up of the bucket.

## Conclusion

The initial design of the entire system turned out to be very extensive, so only about half of it has been fully developed. Nevertheless, it already includes crucial steps, such as removing the packaging and transferring zinc ingots onto an elevator. The completed system meets most of the important requirements; only guards, electrical sensors, and wiring are still missing.

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