
VIVA
ENGINEERING
VIVA ENGINEERING
AZMET REACTORS

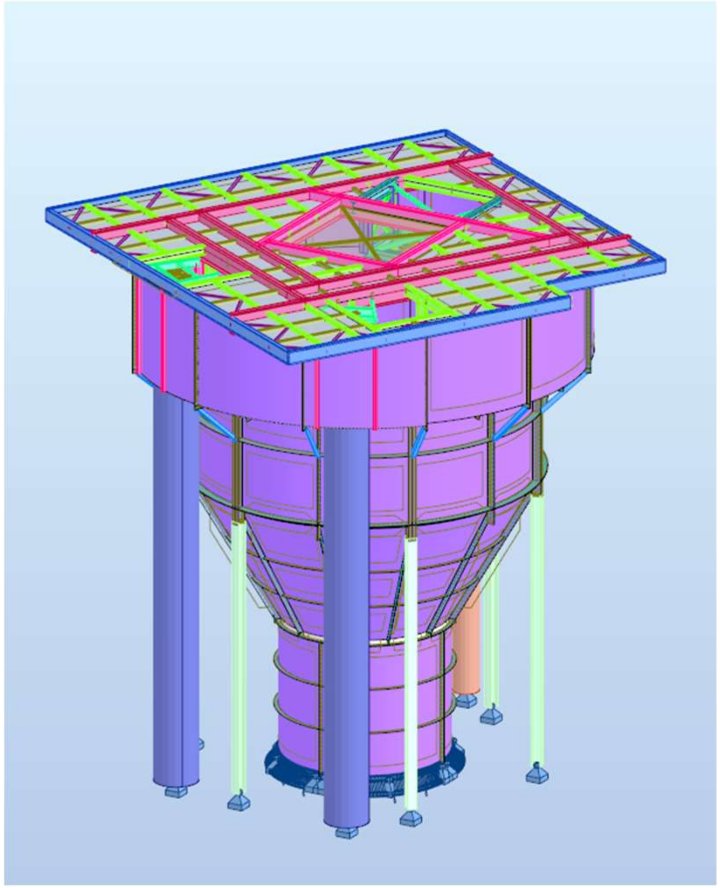
THE PROJECT BRIEF

CLIENT: AZMET TECNOLOGY & PROJECTS

STRUCTURAL ENGINEERING: RMCE

MAIN CONTRACTOR: VIVA ENGINEERING

ENGINEERS MODEL

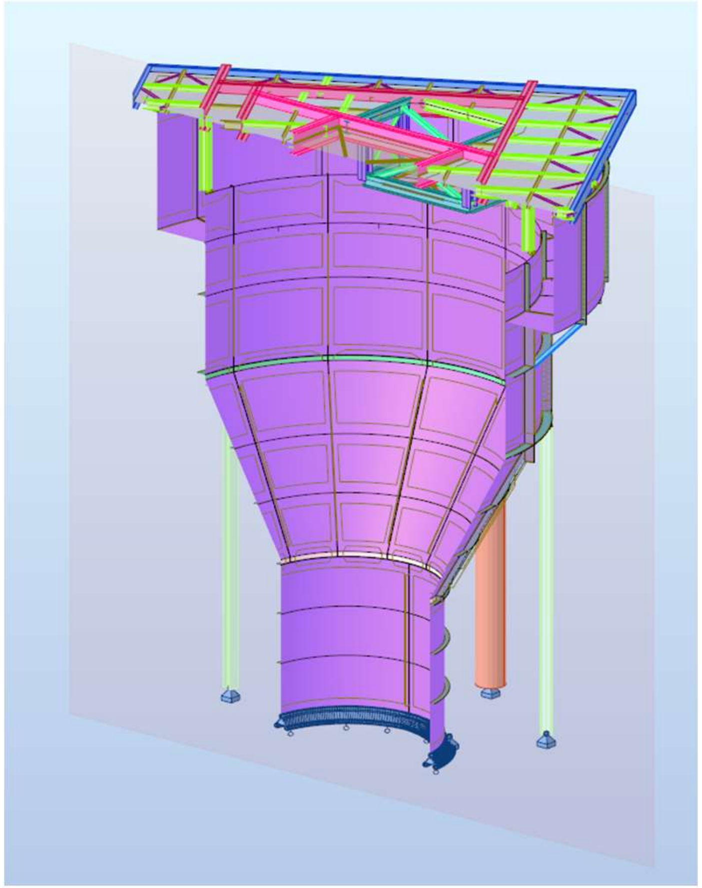


PROJECT OBJECTIVE & REQUIREMENTS

- To design a 320 m^3 capacity CRP Vessel to process fluid with a bulk density of 1800 kg/m^3
- To design the vessel as a bolted structure to ensure transport and erection constraints were met.
- Geometry to support platform above and all mechanical equipment including agitator and pumps.

ENGINEERING CONSIDERATIONS

- Design of the vessel considered permanent loads, material loads, wind loads as well as loads due to equipment.
- Due to the nature of the spliced connections these had to all be modelled in detail, including all the bolts.
- Since the vessel was to be transported and erected piece by piece and due to the size of each piece, a lifting study had to be performed.
- Some of the engineering considerations included in the lift study were:
  - Selecting the most appropriate lifting methodology
  - Analysis of the larger launder elements in the lifting/suspended arrangement.



The splices or connections between each piece of the structure also form the stiffeners required for out of plane forces due to the geometry (such as at the transition points between cylindrical and conical forms) and externally applied loads (such as the supported platform, wind and equipment loads).

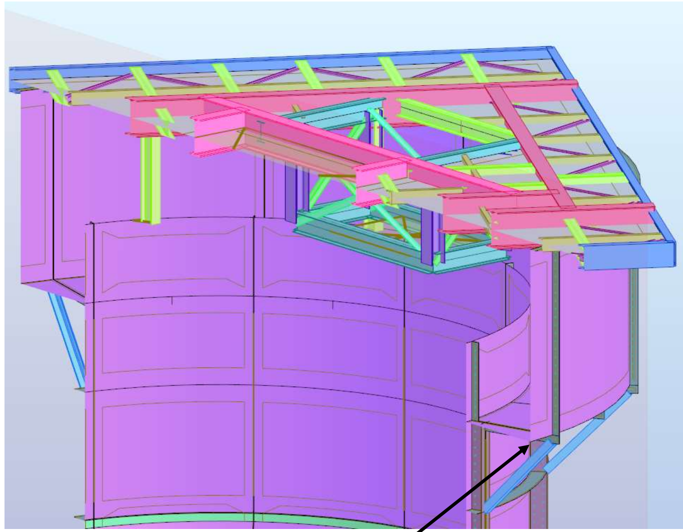
Major areas of stress such as the transition points therefore had two plates forming the stiffener as these were also splice locations. This allowed for significant reinforcement which adequately reduced stresses.

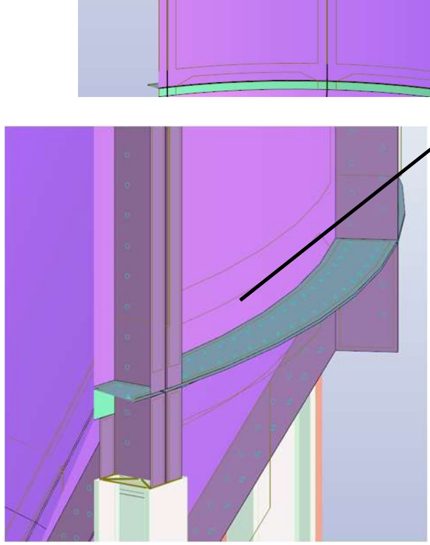
The integrated launder is supported directly off the main vessel structure and the cantilever is supported by a series of knee braces tying it back to the main vessel walls. An additional ring of stiffeners are provided at this level to reinforce the main vessel walls against this out of plane load.

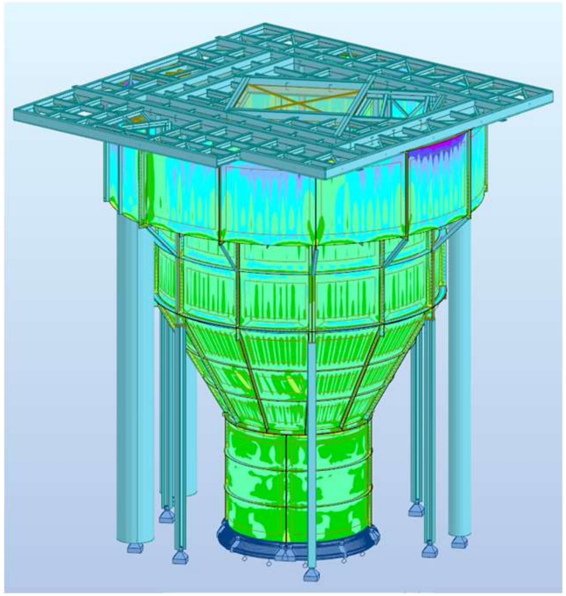
The ring of columns at the top transition point reduces the load from the launder and supported platform on the lower portion of the vessel. This allows the vessel to carry the fluid loads more economically where they are at their maximum.

These columns were aligned to the vertical splice and stiffener locations to adequately carry and distribute the stresses into the vessel shell.

The vertical pipes coming off the launder were modelled as loads only and did not support the structure.







THE PROJECT OVERVIEW

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STRUCTURAL STEELWORK

Project Completion: December 2023
Steelwork Completed: August 2023
Tonnage: 650T (Total Project), 280T (Reactor Portion)

PROJECT OVERVIEW

STRUCTURAL STEELWORK

Structural Engineer: RMCE
Steelwork Contractor: VIVA ENGINEERING
Steel Detailer: AZMET
Steel Merchant/s: VARIOUS

FABRICATION

STEELWORK CONTRACTOR: VIVA ENGINEERING

Viva Engineering's scope included :

- Structural design
- Shop detailing
- Fabrication
- Rubber lining
- Corrosion protection

Rubber lining and corrosion protection was undertaken prior to delivery to the site in the DRC

Six Reactor tanks each 9.9m in diameter and 11.6m high were fabricated and supplied to the project

Platework is 8mm thick with 20mm thick flanges and stiffeners

Each Reactor weighs 44 tonnes comprising of :

- 1393 assemblies
- 3265 parts
- 26900 bolts

Due to the remote location of the mine in the DRC, careful consideration was given to the constructability of the project.

The logistical challenge of transporting components of the Reactor that could fit onto normal trucks required careful planning. This impacted on the detailed analysis and design of bolted connections as well as shop detailing such that the assembled components fitted perfectly.

An added complication was to accommodate continuity of the rubber lining between the bolted faces of each component.

The first Reactor was trial assembled to prove that the jigs and manufacturing was correct.

All six rubber lined Reactors were installed without a single flange hole out of place.

Rubber lining is continuous on the bolted faces. This required that the shop details incorporated the lining thickness and during fabrication that spacer plates were inserted in the connections to simulate the lining.

Corrosion Protection was applied to the external surfaces of the component.

Planning of truck loads for transport to the site was challenging.

Individual components were fitted on cradles designed to optimise the transport deck space, minimise the number of loads and ensure the integrity of the items (including rubber linings and paintwork) during transportation to the site.

Transport jigs were designed and built to brace the components and reduce vibration during the trip.

Careful load packing optimized weight distribution on the truck for the long trip to the DRC

Bureau Veritas Certification and pre-clearing ensured that there were no customs delays at the South African, Zimbabwean and DRC border crossings

Load optimisation with
transport frames

Load optimisation
with transport frames


CRATE
#7

ZA
80
DNP826 FS

In addition to the six Reactors, many other complex tanks and platework was designed and fabricated, which included the plant buildings

ERECTION / CONSTRUCTION / INSTALLATION

CONTRACTOR: AZMET

The foundation and surface bed concrete works were prepared for erection of the Reactors.

Limited space was available within the existing plant for deployment of cranes and laydown areas for components to be lifted into position.

The building structure required to be built over the Reactors due to their size.

The Reactors were first erected before the adjacent Plant Building could be built over the Reactor laydown area.

Access and working platforms from the Plant Building onto the Reactors were installed with the equipment and piping

CHALLENGES AND SOLUTIONS

Transport

Due to the remote location of the mine in the DRC no abnormal transport was possible.

The logistics of normal truck loads required detailed design consideration of component size and the location of bolted joints in the Reactors before the structural modelling, analysis and design commenced and long before any trucks started rolling to site

Packing

Each Reactor is 9.9m in diameter and 11.6m high with 3265 parts. All the components of each Reactor required to be packed so that upon arrival at site the Reactor could be assembled from the designated package.

The Reactor components and small parts had to be carefully packed in specially designed cradles to optimise each load and minimise the number of loads to site

THE BENEFITS OF STEEL IN THIS APPLICATION

The complexity of the Reactor geometry is best suited to fabrication in steel. Construction of the Reactors insitu in concrete would not be viable due to the complexity of formwork and deployment of plant onto the site of limited size.

The benefit of steel for this application is a relatively lightweight structure (compared to concrete), which can be preassembled and trial erected before being transported to site. This allows for fast and accurate erection in the final location.

On site fabrication of the Reactors would take too long and requires establishment of a substantial design office, fabrication works and skilled artisan team that is not available in the DRC.

Furthermore, fabrication of the Reactors at an established Workshop in Gauteng in a controlled and safe environment enabled the site civil works to be constructed concurrently.

The workshop environment allows better control and quality assurance than a site fabricated tank where manufacturing process can be monitored closely to ensure that all materials used in the construction are of the specified quality and workmanship is to the required standard.

WHAT WE'RE PROUD OF

We are proud of :

- Fabrication, transport of the six Reactor tanks 9.9m in diameter and 11.6m high and erection of 3265 parts fitting perfectly

- The workshop jigs were designed to ensure repeatability for the various components achieving site installation of 26 900 bolt without a single bolt hole out of place

- The detailed design of complex geometry with FEM modelling and integrated support frame and platform

- The quality of workmanship and design of the Reactors satisfied the specifications

- The project was completed within the project programme