Structural Detailed Engineering for Waste Heat Recovery Units

Key Features

Technology:

Bentley Systems STAAD.Pro v8i

Autodesk AutoCAD 2016

Duration:

The project was completed in a period of 10 weeks

Deliverables:

1. Structural Stress Analysis Report
2. Lifting and Transportation Analysis
3. Foundation Load Data
4. Structural Design Drawings
5. Review of Fabrication Drawings

The Client

A large EPC conglomerate based in the UK who has executed Construction projects in a myriad of industries, ranging from Commercial Infrastructure to Heavy Industrial and Energy Sectors.

The Business Need

For the Sao Vanda and Dai Nguyet Development Project, detailed engineering design of Topsides for offshore platform SV CPP was much required. As part of this project Aker Solutions, awarded the order for two Nos. Waste Heat Recovery Units (WHRUs) to our client.

These WHRUs are used for transferring heat from process outputs at high temperature to another part of the process to increase the efficiency of the system.

Rishabh Engineering was responsible for the following:

- Preparation and Collation of all engineering data regarding the design and fabrication of WHRUs.
- Structural analysis of two nos. WHRU using STAAD.Pro v8i.
- Foundation load data calculation and anchor bolt design.
- Structural analysis during a lifting operation of various WHRU components.
- Structural analysis during the transportation operation of various WHRU components.
- Structural analysis for WHRU support and associated pipe supports
- Structural analysis of supporting platform.
- Structural design drawings for WHRU support, pipe supports and supporting platform.
- Carry out a detailed review of fabrication drawings based on structural design drawings.

Rishabh's Solution

Rishabh Engineering was appointed to carry out Structural Detailed Engineering for the Waste Heat Recovery Units (WHRU). With a team of three members (comprising of two structural engineers and one structural designer) listed below were the activities completed for this project;

Structural Stress Analysis

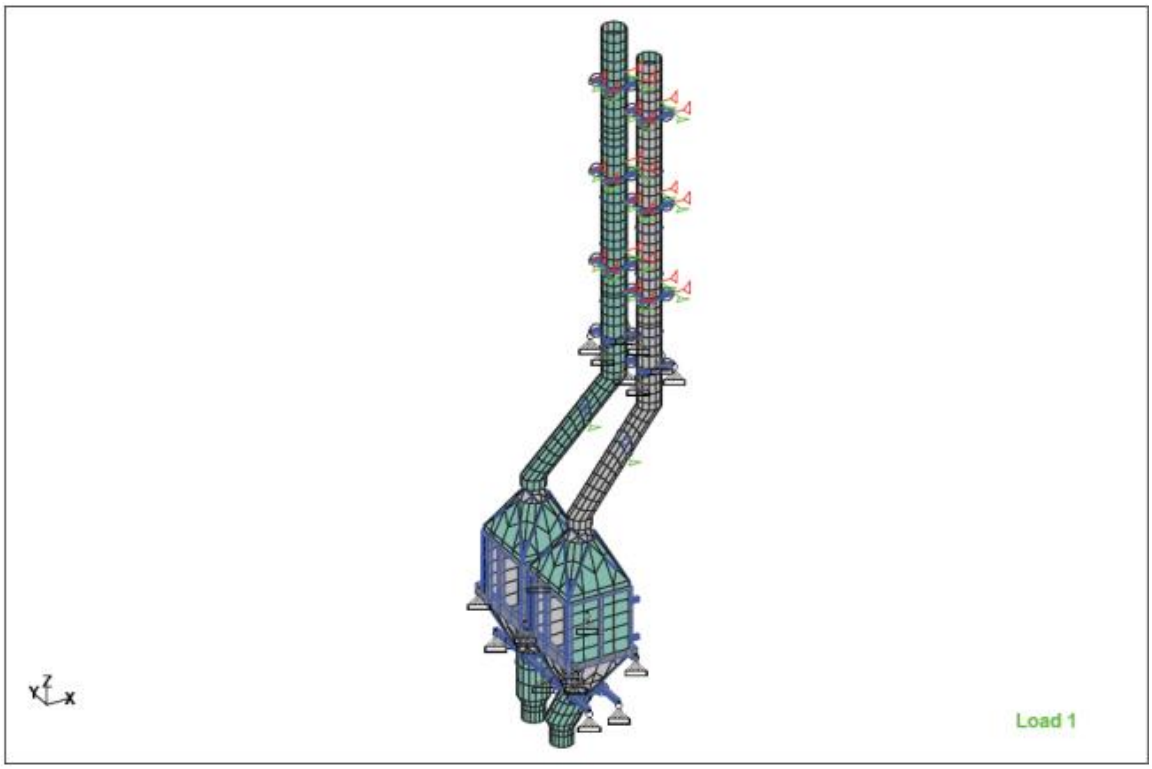
- Preparation of analysis model of WHRU equipment in STAAD.Pro v8i.
- Preparation of analysis model of inlet and outlet stack using plate shell elements in STAAD.Pro v8i.
- Application of load input data for refractory, tubing, tube sheets, pipe supports, and other accessories in WHRU.
- Analysis of temporary structural members required during a lifting operation of various components of WHRU.
- Analysis of temporary structural members required during transportation operation of various components of WHRU.
- Analysis of sea-fastening members required during transportation operation.
- Analysis of splice joints for inlet and outlet stacks.
- Analysis of ring stiffeners for inlet and outlet stacks.

Structural Calculation Documentation

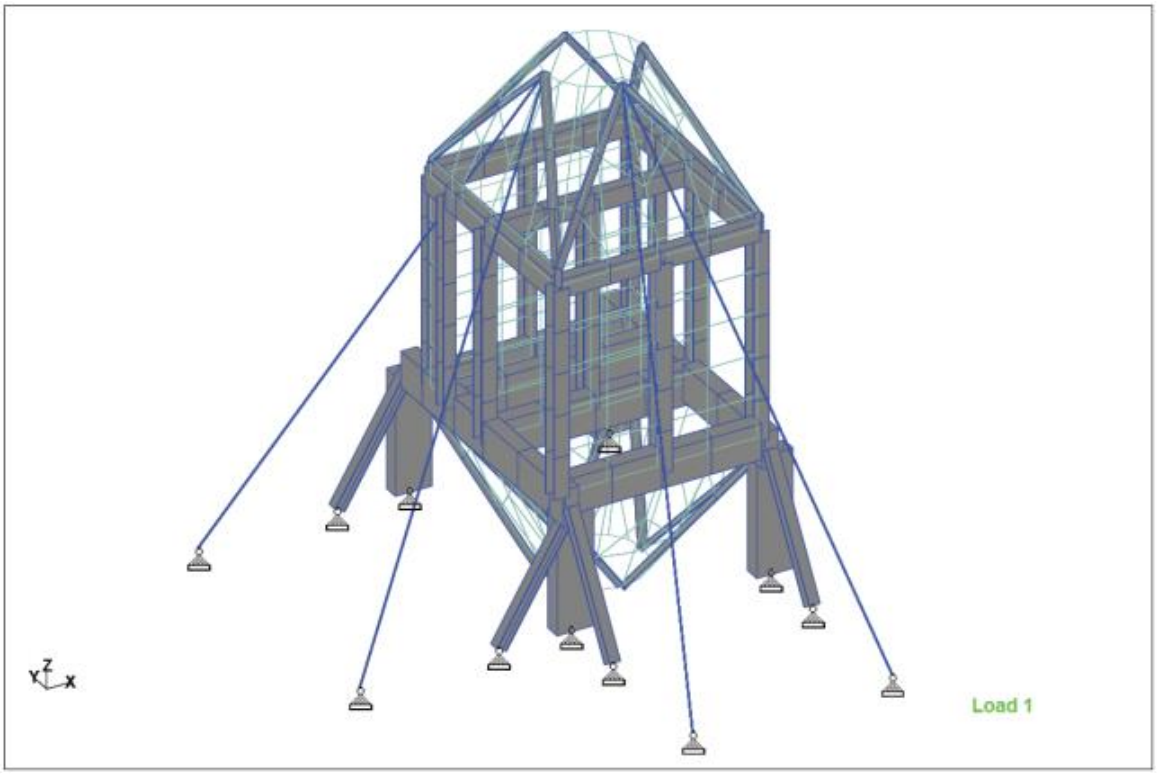
- Calculation report including all design considerations and assumptions.
- Calculation report for WHRU tube sheets comprising of local design checks. These checks were based on tube sheet specifications provided by the client.
- Anchor bolt design.
- Local design check for lifting lug and spreader beam.
- Documentation including foundation load table for operating and transportation conditions.

Structural Design Drawings and Fabrication Drawings

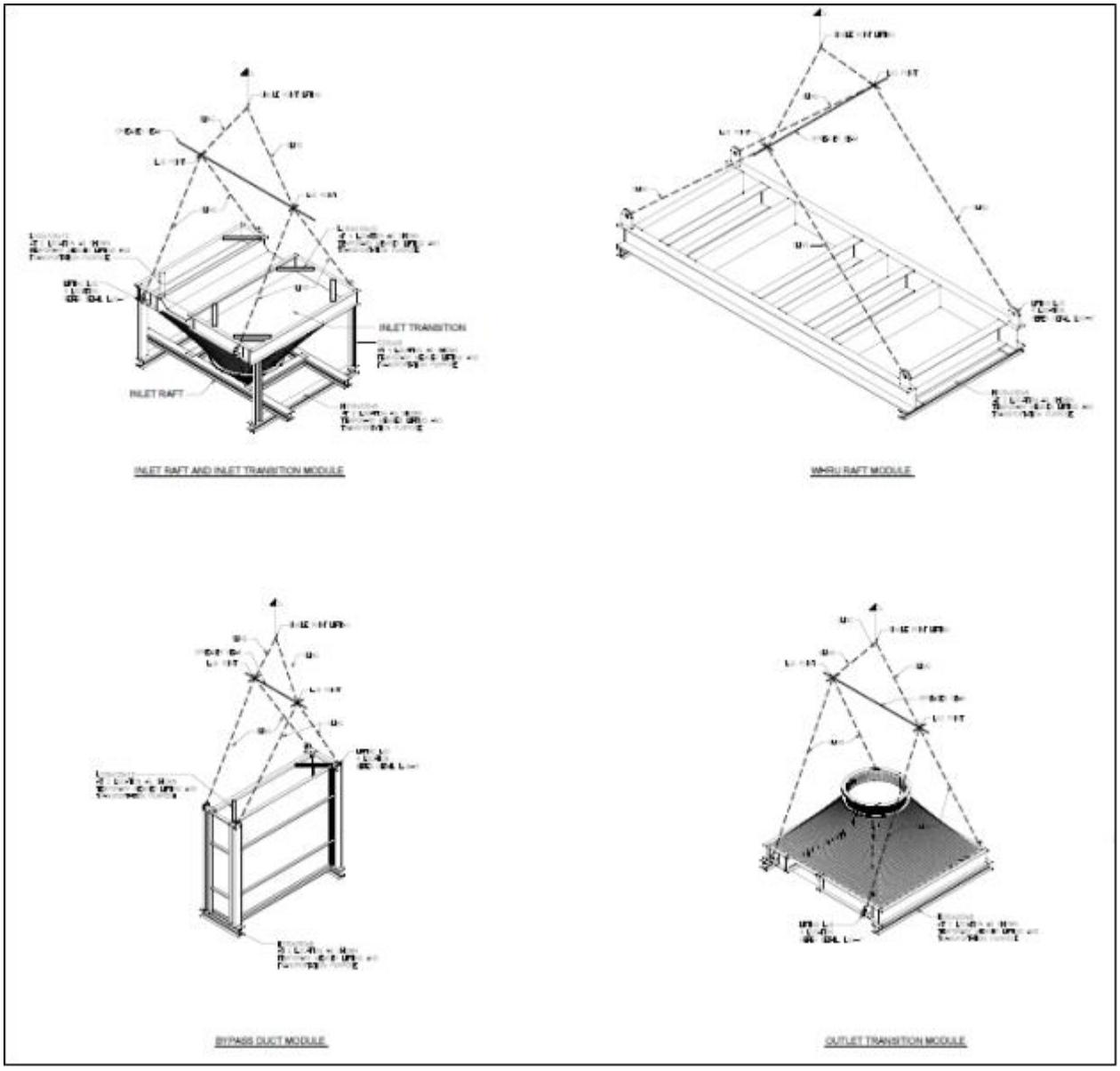
- Structural design drawings for various components of WHRU
- Structural drawings for Convection Box, Bypass Duct, Inlet and Outlet Transitions, Inlet and Outlet Stacks including details for stiffener plates, connection details, and welding symbols
- Structural drawings for supporting platform, including with connection details with WHRU components and topside pancake
- Structural drawings for lifting arrangement, including temporary members, lifting lug details, spreader beam details and lifting slings
- Structural drawings for transportation condition, including sea-fastening details and lugs for sea-fastening.
- Fabrication drawings were prepared by client fabrication office and sent for review to Rishabh.
- Review of fabrication drawings based on structural design drawings



Structural Stress Analysis in Inplace Condition – 2 nos. WHRU



Transportation Analysis for WHRU



Lifting Arrangement for various components of WHRU

Challenges & Approach

Technical Challenge:

- The client had instructed Rishabh Engineering to calculate loads of WHRU internals like piping, tubing and refractory

Our Solution:

- Rishabh Engineering estimated loads of WHRU internals like piping, tubing and refractory using client data sheets and client calculation template sheet, including the calculation for dead loads and operating loads. This data used in STAAD model for operating, lifting and transportation analysis.

Project Execution Methodology

Week 1-2

- Received Inputs from client like Design Basis, data sheets, GA Drawings, Sample documents
- Reviewed the input data
- Calculated load inputs from data sheets and GA Drawings
- Applied loads to STAAD analysis model

Week 3-4

- Updated STAAD analysis model based on structural geometry inputs from client
- Analysis of WHRU structure carried out and preliminary model submitted to client for review
- Performed analysis of tubesheets as per client specific calculation template
- Updated WHRU analysis model
- Prepared foundation load data table based on STAAD analysis

Week 5-8

- Updated WHRU analysis model for transportation condition
- Prepared foundation load data table based on transportation condition
- Started preparation of structural drawings based on client template and structural analysis
- Submitted calculation report for client review
- Submitted preliminary design sketches for client review

WeeK 9-10

- Revision & final submission of calculation report along with foundation load table
- Update and final submission of structural design sketches for client review and preparation of fabrication drawings
- Receipt of Tekla Model based on structural design sketches and review of the same
- Receipt of Fabrication drawings based on Tekla model and structural design sketches and review of the same

Technology Used

- Bentley STAAD.Pro v8i
- Auto CAD 2016

Key Deliverables

- Structural Stress Analysis Report and STAAD.Pro Analysis File
- Structural Calculation of Tubesheets
- Structural Calculations for Lifting analysis
- Structural Calculations for Transportation analysis
- Structural Design Drawings
- Structural Foundation Load Data Table
- Structural Fabrication Drawings
- Review Comments

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