Piping Stress Analysis for Multiple Projects (08 Nos. of Heaters)

Key Features

Technology:

CAESAR-II

Duration:

The project was completed in a period of 3.5 months

Deliverables:

1. Piping Stress Reports
2. Assumptions & considerations & with suggestions reports
3. C2 file
4. Simplified report for support design (Induced forces, moments & displacements at support locations in simplified manner)
5. Isometric Support Markup

The Client

A Texas based multinational energy corporation with 10,000+ employees working on diverse engineering portfolio of integrated businesses like: midstream, chemicals, refining; a petroleum refiner and supplier of petroleum products. They currently own and operate five domestic oil refineries, and related assets; an energy infrastructure company with three main lines of business: Pipelines, Natural Gas and Power Generation.

The Business Need

Rishabh Engineering was appointed by an Original Equipment Manufacturer (OEM) to carry out pipe stress analysis of critical lines for various projects. The OEM is a leader in providing quality heat transfer equipment like Direct fired heaters, Air preheat systems, Water heat recovery systems

The project scope covered to perform Piping Stress analysis for **o8 nos. of heaters** of various units for multiple projects. The scope was to provide piping stress analysis of all critical stress lines connected to the following heaters:

- Vacuum Heater, Large Crude Heater & Splitter Boiler
- Propane Regeneration Unit
- Ethane Regeneration Heater
- FCCU Superheater

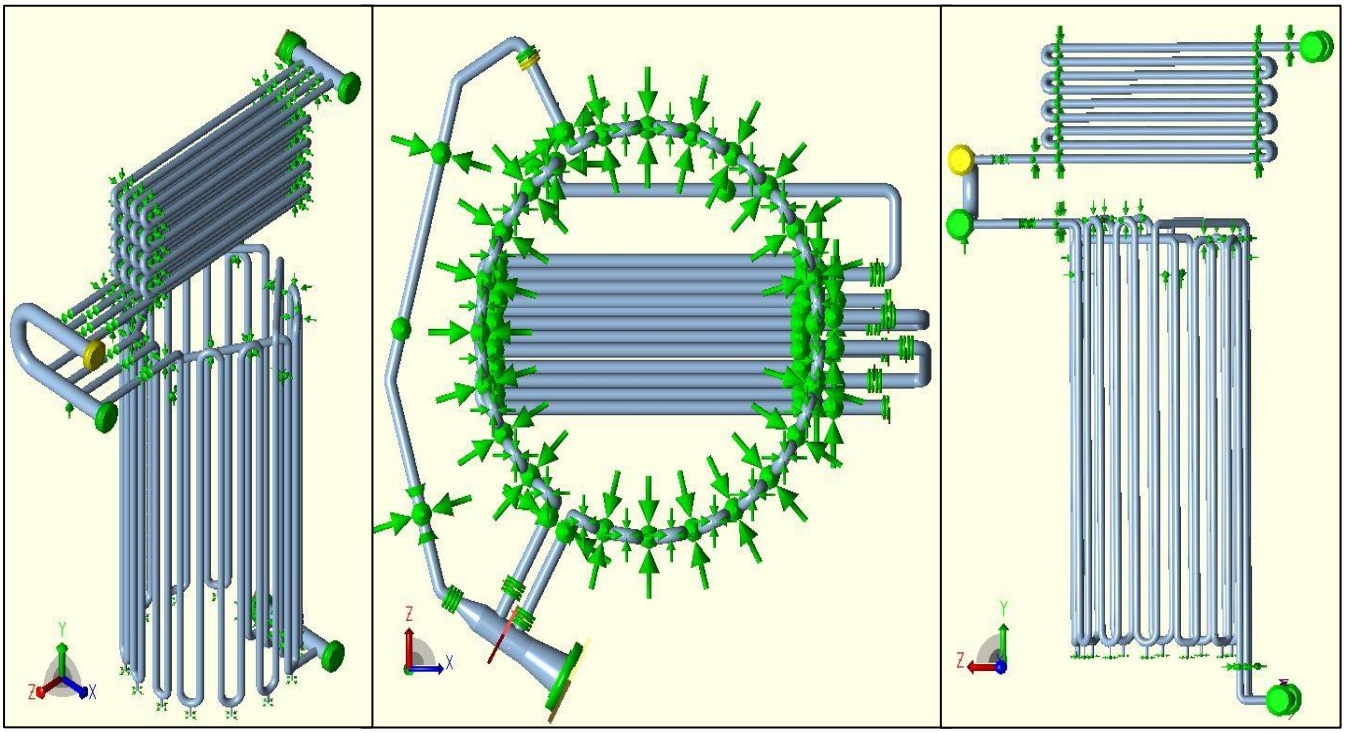
Rishabh's Solution

For Vacuum Heater

- Performed flexibility analysis on the process coil from inlet connections to outlet connections (i.e., Radiant and Convection Process Piping), boiler feed water coil (upper convection) from the inlet manifold to the outlet manifold.
- Provided support for the horizontal radiant single fired tubes in coking service which include an allowance for movement designed to accommodate or restrain lateral movement due to bowing associated with a 300°F temperature differential from tube hot face to tube cold face.
- Performed analysis to evaluate the 5" lower radiant tube for the effects of bowing associated with the temperature differential.

For Horizontal Heater

- The client needed to change the tube metallurgy for operational safety of the system and thus assigned Rishabh Engineering to carry out piping stress analysis to confirm if the coil design is adequate.
- Metallurgy change in the convection section was from 317L to 347 L and the pipe diameter change in the lower radiant section.
- Moreover, installation of a piping anchor at the radiant outlet tubes were required to analyze the force of the thermal expansion into the heater, and take the piping loads off of the transfer piping outside.



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We had completed the piping stress analysis of the heaters within 3.5 months with a team of 06 members (including 1 project coordinator).

Challenges & Approach

Technical Challenge: Route Modification challenge in Cross over Piping:

- Crossover pipe (piping that connects convection section to radiant section of the heater) was compact & congested. Initially, the team recommended a modified route for the crossover pipe. However, the client insisted that we stick to the existing routing. The pipe was reanalyzed by changing dimensions of a few elbows (2-3) from short radius to the Long radius. As a result, the area and flexibility of pipe increased.

Documentation Challenge:

- The coils had multiple passes, i.e., multiple coil layers stacked together. Defining CAESAR node number for the coils was thus difficult due to large number of nodes being congested around the coil bends. For this, nodes were grouped and put under criteria defined by support types.

Project Level Challenges:

- Tight schedules
- Resource Allocation
- Need for scale-up number of licenses (depending upon demand)
- Strict Adherence to International Standards
- Need for seamless and transparent communication with client

There was a need for innovative solutions to reduce the overall time consumption. It was achieved with the help of CAESAR II software.

Unique Achievements for this Assignment:

The client's requirement was to consider BOWING EFFECT* for radiant zone coils only, not for convection zone. The effect of thermal bowing (6-inch displacement in the lateral direction) was required to be considered for radiant coils just to simulate the maximum expected BOWING height for a temperature difference of 300 °F.The analysis was performed for entire coil assembly (convection coils, crossover pipeline, and radiant coils).

(* **Bowing Effect:** Temperature difference between two sides of Pipe because of location & burner/heat exposure causes pipe deflection is called Bowing effect.)

Major Project Facts:

- 30% Man hours saved in entire project
- Productivity improvement by 15%
- Cost Savings by 35%
- 15% Reduced Training efforts
- Design & Modeling accuracy by 70%
- Reduced overall training time by at least 30%
- Color-coded stress graphics and animated explanation saved the time

Technology Used

- CAESAR-II

Key Deliverables

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- C2 file
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- Isometric Support Markup

Contact Details

US Ph : +1-201-484-7302, 1-877-RISHABH (747-4224)
UK Ph : +44-207 993 8162
Email : sales@rishabheng.com
Twitter : www.twitter.com/RishabhEng
Linkedin : www.linkedin.com/company/rishabh-engineering-services

More information about Rishabh Engineering, please visit:
www.rishabheng.com | www.rishabhsoft.com | www.rishabhbpo.com

About Rishabh Engineering

Rishabh Engineering provides multidisciplinary engineering support services to EPC companies in industries like Oil and Gas, Petrochemical, Power and Water treatment. Our parent company, Rishabh Software is a CMMI level-3, ISO9001 and ISO27001 company that provides services in Software Development, Business Process Outsourcing (BPO) and Engineering Services Outsourcing (ESO) to clients globally. Rishabh has offices in USA, UK and India with their main delivery center in Vadodara, India.