“Lift-Off” Pipe Supports

Date: 3/20/2018

White Paper on Development, Manufacturing, and Installation

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1. History

Pipe supports in general are primary support elements that carry piping to ensure that the pipe spans and connections to equipment are not unduly overstressed or overloaded causing failure.

There are many types of pipe supports used in the industry; hangers, struts, pickups, springs, beams, etc,

Pipe supports are a fundamental component in any plant and without them; no plant would be able to operate.

Failures: Piping and the related equipment often fail, not necessarily due to upset conditions, but due to the supporting elements excessive deflection allowing forces and moments to be transferred to critical components.

2. Types of failures

Corroded supports: Where the original structural steel has corroded to such an extent that the support has a negative effect on the load characteristics of the structural components.

Excessive structural deflection: Where the beams or columns do not carry the loads and the line/lines bend and transfer loads and moments onto equipment. Often the cases where relief valve inlet and discharge line are not adequately supported.

Wall thickness degradation: This occurs where the line expands and contracts over a wear plate and eventually the wall fails resulting in uncontrollable events.

Vibration and oscillations: This occurs when the line oscillations create material stress fractures. The oscillations may be caused by rotating machinery, product flow, environmental (wind), etc., to set up the vibration.

Pipe Support failures: Where the pipe support elements have been incorrectly specified and degrade due to environmental and operating conditions. This can be attributed to slide plate

failure, line stops tearing off the piping/beams, guides being too slender, beams overloaded, pipe rack loading beams and columns undersized, etc.,

Process: Process conditions not adequately addressed during design. I.e. slug flow, etc., not evaluated.

Installation: Pipe supports not installed correctly, especially the case with spring supports and struts/shock absorbers.

Subsidence: Supports have subsided and supports are not adjusted to cater for this.

This by no means a complete list and each situation needs careful evaluation.

3. Requirements

In order to address the pipe support issues confronting most engineers, certain requirements need to be fulfilled to ensure that failure is eliminated in the early stages of the design exercise. They are (not a complete list as conditions change):

Process conditions: Design temperatures and pressures and any extraneous conditions such as, slug flow, regeneration, etc.,

Climatic conditions: Hurricane strength wind, seismic activity, corrosive atmosphere, etc.,

Noise and acoustic requirements: May need additional insulation due to proximity to urban developments, etc., Pipe racks might have to be acoustically insulated.

Cathodic isolation: are there requirements for electrical/cathodic isolation due to either corrosive soils or lightning conditions. In these cases the lines must be isolated from support steelwork to prevent current from penetration the pipe wall instead of using the specified grounding path.

Fire: The supports must be able to withstand fire and must not contribute to this event.

Types: Must be able to be installed at guides, line stops, spring supports, etc.,

Corrosion: Must be able to withstand high corrosive atmospheres.

Cryogenic: Must be able to withstand high and low (cryogenic) temperatures.

Materials: Must be able to be manufactured from a large variety of materials.

Draining: Must be able to drain liquid away from the support contact points without damaging the corrosion coating where applicable i.e. corrosive atmospheric conditions.

Shock and Upset Loads: Must be designed, manufactured, and tested to withstand forces, moments as well as shock loads as specified or on-site measured.

Codes and Standards: Must comply to piping requirements and codes.

4. Development

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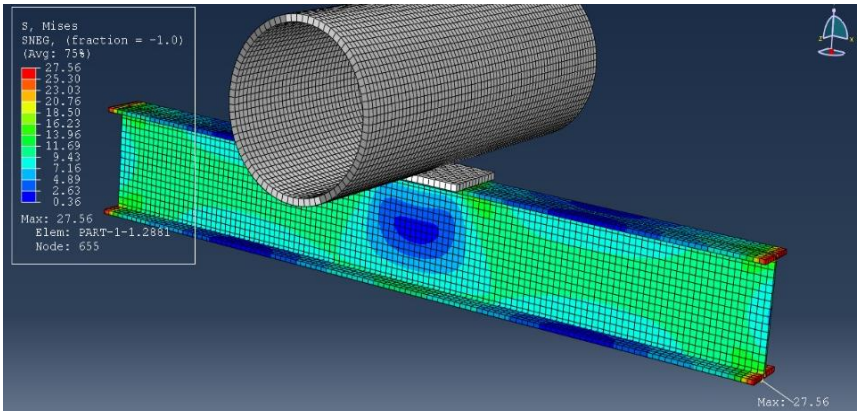
In the early stages of our pipe support development, we researched materials, latest manufacturing techniques, standards, codes, and compliance regulations as well as manpower availability to ensure that the products we produce are the to the highest standards.

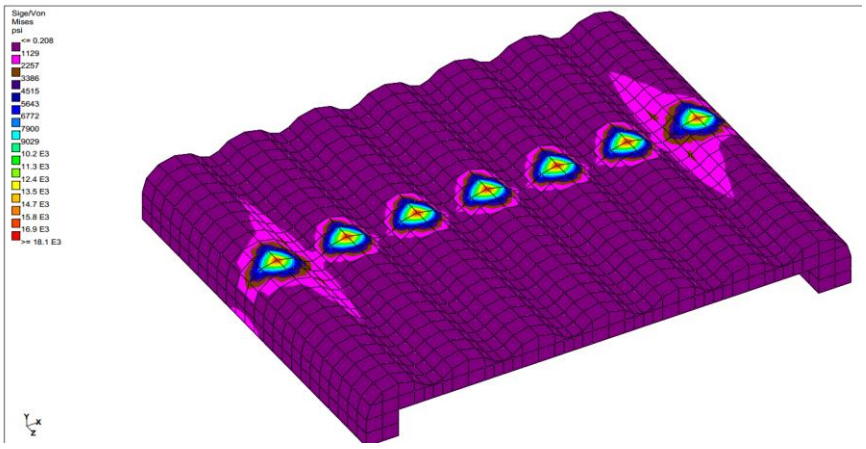
Our models showed that most support failures occur when the pipe loads occur towards the edge of the beam flanges, where some supports exert eccentric loads. So, we had to ensure that the pipe load had to be on the full beam flange width. One simulation we observed that **supporting on the flange back-marks (or eccentric to the neutral axis) resulted on a stress load increase of more that 100% compared to full flange width loading.** A single point load eccentric to the beam neutral axis produced much higher resultant stresses.



Other aspects during the development showed that the support friction between the pipe and the support beam had to be addressed. We developed a non-slide compound to ensure that the longitudinal pipe load exerted during pipe expansion and contraction did not add to excessive flange/beam rotation.

We achieved a friction factor of between 0.05 and 0.2 (μ). This also ensures that no screws, epoxy, and other forms of fixing is required which might add to beam corrosion and failure. We do however recognize that U-Bolts are used in many instances, but generally the holes are made and adequately galvanized prior to installation. Our supports need to be narrow enough to slide in between the U-bolts and only address the contact point of the pipe and the beam.

Many models, process and FEA (finite element analysis) studies were conducted to ensure that we are not overlooking points that could be problematic in future.



Our LOV (Lift-Off Vertical) as well as the LOR (Lift-Off Rest) supports performed well and each lobe can comfortably carry 250lbs, we tested them to 550lbs and they did not show defects. Our base design proved effective and suitability was confirmed for our polymer supports.

We also developed a composite resin to resist not only the loading, corrosion resistance, Ultra Violet rays, but also the fire-resistant aspect. This was a breakthrough as well as the shrinkage was minimal during manufacturing with very little finishing required.

Our supports are also made from High Carbon Steels, Low and High Alloy steels, as well as many other materials, such as Double Duplex, etc.,

5. Manufacturing

We manufacture our polymer supports in house, with all the safety and quality control measures in place. Our manufacturing capability stands at 100 supports per day, which can be easily improved on.

Our facilities are ideally located in Lake Charles, Louisiana, with proximity to the Gulf of Mexico, where the bulk of the United States Oil and Gas industry operates.

We test each support batch and is duly recorded in our quality program.

6. Installation

Prior to any installation we ensure that our clients full understand the risk involved with installing pipe supports, especially on live plant.

All necessary permits and safety precautions are to be taken.

We also undertake training of the tradesmen/contractors to ensure that incidents are avoided.

7. Conclusion

We have manufactured and installed our polymer LOR supports with very good results.

A new development, we will be manufacturing our LOR to withstand the temperature range, from **minus (-) 270F** to **plus (+)450F**, with intermittent temperature spikes up to 550F.

This material is UV and corrosion resistant as well as having the inherent strength requirement.

Beam carrying capacity has been substantially increased due to the flange loading being evenly distributed and not concentrated on back mark offsets.