Acceptable Risk: A day in the life of John-Paul Schmidt, Piping Stress Leader at Dow Chemical

Managing Aging Plants had the pleasure of speaking to John-Paul Schmidt, Piping Stress Leader at Dow Chemical, about working with clients to design projects, calculating risk and common challenges with equipment, as well as the best and most challenging aspects of the job.

By Jody Hewitt

Raised in the small chemical plant town of Mont Belvieu, Texas, where nearly everyone in town worked in the plant, John-Paul Schmidt was exposed to the industry at a young age, quickly discovering a passion for engineering and "creating something useful out of something worthless". After obtaining his BSc in Chemical Engineering from Lamar University and an MBA with a focus on Project Management, Procurement and Project Finance from the University of Houston, Schmidt recently obtained his PE license — considered the highest standard of competence in the engineering profession.

Today, Schmidt works in a mechanical engineering capacity at Dow Chemical, but has prior experience working in a variety of roles in both capital and maintenance projects. After graduating during a downturn in the market, Schmidt was able to use one of his hobbies, computer animation, as a jumping point into drafting, where he worked for several years before moving into a process engineering role, and then into piping engineering.

In his current role, Schmidt works out of the Dow Houston office, where he guides the day-to-day activities of a handful of designers and engineers and coordinates their training and performance reviews. He also helps a variety of clients with capital and maintenance projects.

"The designers create a proposed design," he explains, "and the pipe stress engineers review that design to make sure that the physics involved are safe. After the designer has proposed a routing, we check the thermal growth, weight and flow phenomena like transient flow, water hammer, flow-induced vibration, acoustically- induced vibration and all the different rigors that we put the pipes through to make sure that there are absolutely no unplanned events."

"Unplanned events are unacceptable," Schmidt tells Pump Engineer. "Dow plans to be safe, to protect the environment, to ensure the health of the community and to make a profit. Hurricanes, ice and other natural phenomena are no excuse to deviate from the plan." It is up to Schmidt and his team to predict the risks associated with piping and to help the owner manage them.

Acceptable risk

To make his calculations, Schmidt draws from a wealth of information already documented and known in the industry, taking the concepts of materials engineering and applying them to the industrial world. The risk of an earthquake, for example, can be calculated in several different ways, some of which are very complex — but the team is usually able to find a more simplified method, one in which the pipe is never pushed "to the ragged edge of danger".

"In any business or engineering endeavor, we have to take risks," explains Schmidt. "My goal is to take intelligent risks. For example, a designer will attempt to apply a design to a situation and I evaluate the risks associated with that design in that situation and, of course, I try to limit those as much as possible."

"In some cases," he continues, "with the accuracy of the calculations involved, it is better to err on the side of safety — say, 20 percent or even 30 percent, as opposed to trying to save a few pennies and then shaving it down to a 1–3 percent margin of error."

Sometimes, an owner's consulting engineer will recommend an expensive solution to what they perceive to be a credible risk to the operating plan. When the owner disagrees with the proposal or the risk assessment, Schmidt's team will be called in for a second opinion. Many times, the key conflict is on risk tolerance and deciding the best engineering model to apply to a design. Negotiating this conflict resolution can be challenging both technically and socially.

"Schedule delays on large projects can mean large financing charges. Delaying a 300-million-dollar project 6 weeks costs 3 million at a reasonable project's borrowing cost," says Schmidt. "The capital costs can be huge, but the time to market, and the cost of a deployed construction team not being productive, may surpass them."

John-Paul Schmidt is the Piping Stress Leader at Dow Chemical.

Mentorship

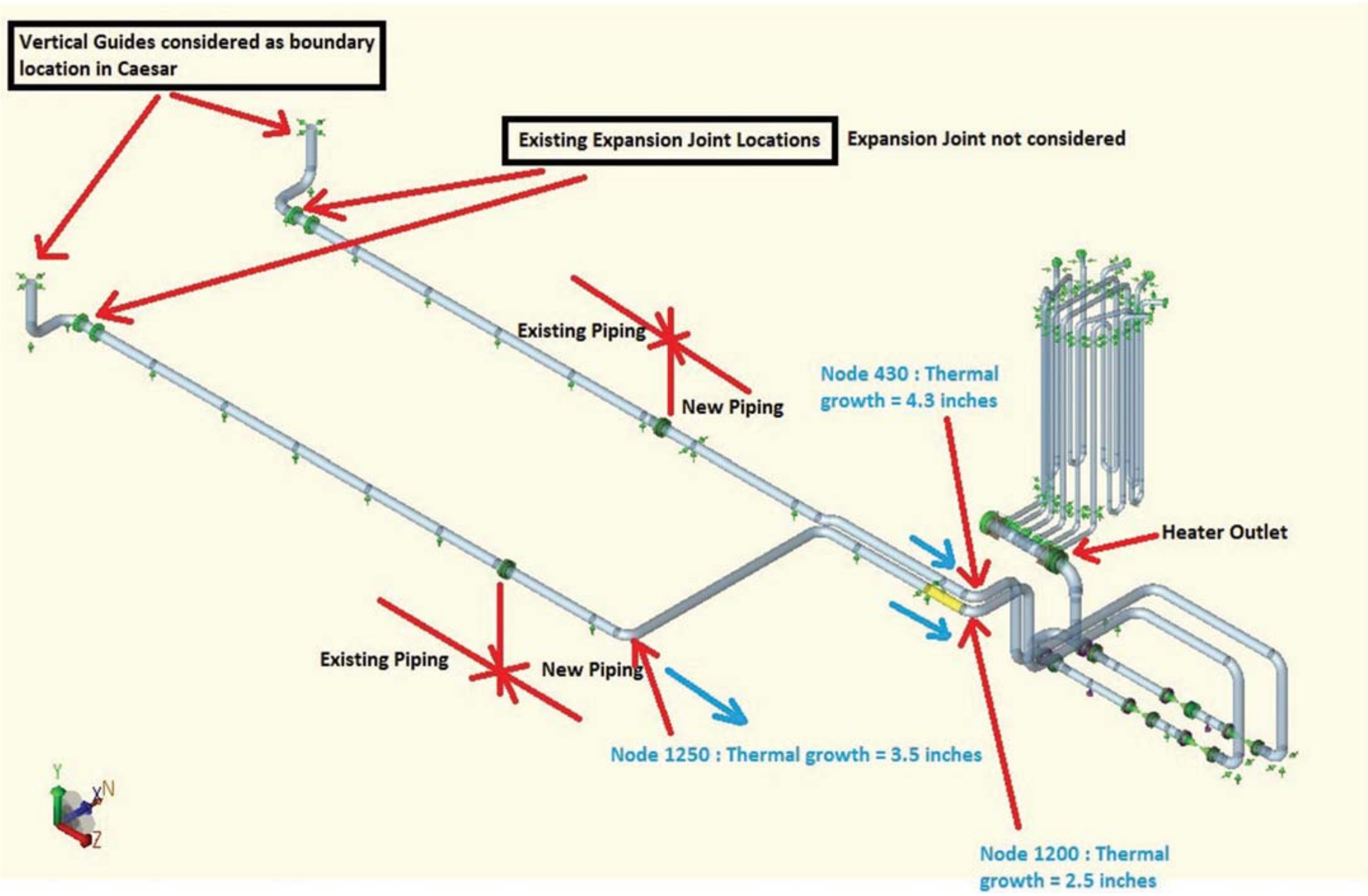
Dow has a strong mentoring program focused on skill development, employee engagement and strengthening best practices. Mentorship programs are a long-term investment and can make

Is the vertical part of this line installed in a way that may cause an unplanned event? A variety of tools exist for the piping engineer to use; non-destructive testing and the experiences shared through the ASME code.

a real difference in the dynamics of an organization, though not all companies in the industry embrace mentorship and knowledge transfer, which deepens the learning curve for new employees.
"At Dow, we are able to leverage the talent we have with our mentors," explains Schmidt, "while mentees bring fresh ideas. The mentor-mentee relationship is effective in helping to accelerate the growth of the mentee and to provide unique insights for the mentor. It's really a win-win situation."
Another advantage of a mentor program, Schmidt points out, is that by training mentees, he is sometimes alerted to gaps in his own knowledge.
"I noticed, during training sessions with my mentees, I became more aware of what I didn't know. It turned into an opportunity for me to learn new things and fill those gaps in my own understanding. I have definitely found that the best way to continuously learn and to find holes in an established process is to train somebody new."
Schmidt himself was mentored by his predecessor, Scott Allen, who guided him into the world of pipe stress engineering.
"Being mentored helped me accelerate my own learning and expertise and gave me opportunities to succeed," he says. "The sustainability of the industry as a whole depends on this relationship, and I believe that everyone must do their part."

Equipment

In his role, Schmidt works with a variety of equipment, including valves, pumps, expansion joints and hoses.
While plant technicians generally take care of any hose issues, Schmidt is very hands-on with the company's many expansion joints, which require a higher level of technical expertise.
"With expansion joints, I get involved pretty quickly," Schmidt says. "They can get quite complicated. Expansion joints are typically used in places where you are trying to isolate vibration, where



This is a screenshot from the finite element analysis software, Caesar, appended with notes from the designer. Large movements in the piping downstream of furnaces often require expansion joints to safely install. This is to accommodate space-constrained existing facilities.

there is some usual movement (like settlements) or where there is a delicate nozzle that needs to be taken care of. For example, we have a lot of glass-lined reactors at Dow Chemical, which are great for reducing corrosion or product contamination. These reactors have a glass nozzle, which is obviously quite delicate, so we often use expansion joints to protect those."

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He also works with many different types of pumps — including positive displacement and centripetal compressors — and says that one of the biggest challenges he sees in terms of safe pump installation has to do with the vendor. "If vendors don't have a clear idea of the allowable load, that can make safe installation a challenge."

He continues: "When installing the pump, I am interested in making sure that the forces on the inlet and outlet are low enough that it is going to work reliably. A pump that is getting too much force on its connections will suffer case deformation or coupling misalignment. If that happens, you are going to have difficulty getting that pump to work; you might have seals failing early and general reliability issues, which translate to downtime in your plant."

As the group leader for process safety valve installation, Schmidt is also no stranger to relief devices, and spends a good deal of time working with

The insulated hemispherical head of the reactor is shown installed with a hose to accommodate the downward thermal growth on a line connected to a pump. The hose protects the pump as well as improves the performance of the weight cells on the reactor.

pressure safety valves (PSVs), rupture discs and many other types. Generally, Schmidt is less concerned with the inner-working of the relief devices and more concerned with how they relate to the pipe assembly.

One of the first things he asks the process engineers on a site is whether a valve is fast opening or closing. It turns out that this is critical information for a man whose primary responsibility is predicting the unpredictable.

Fluid hammer

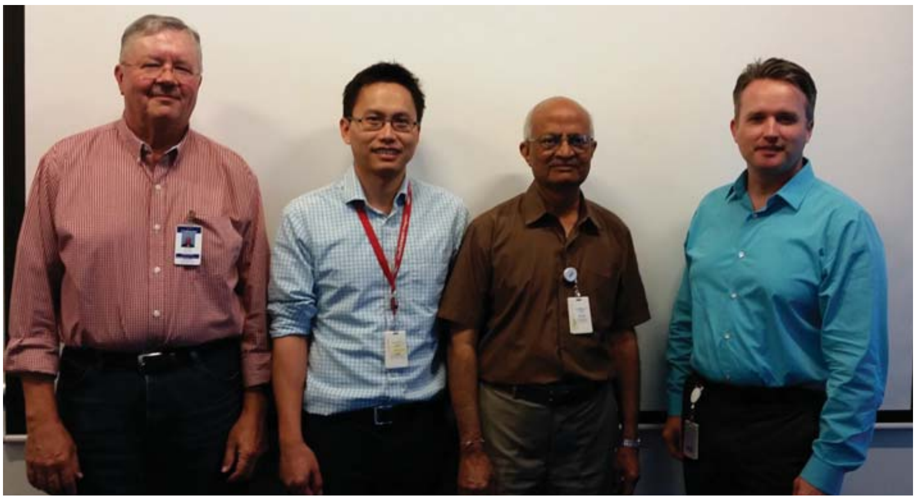
Fluid hammer, also called water hammer or hydraulic shock, is a pressure surge or wave caused when a fluid in motion is forced to stop or change direction suddenly. It often occurs when a valve closes suddenly at an end of a pipeline

There are many factors that can contribute to fluid hammer — the examples below are a few of the most common causes:

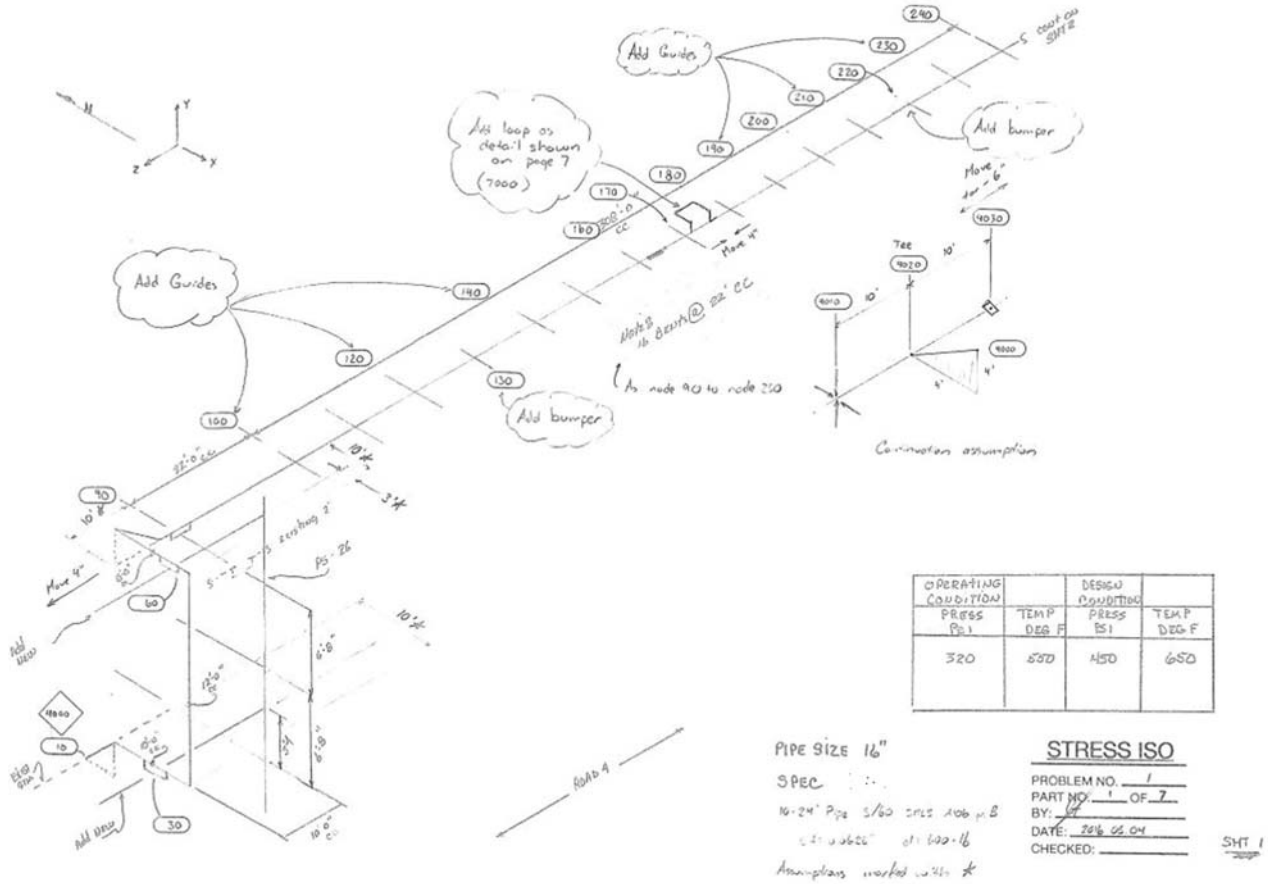
Steam flow water hammer, or two-phase flow, can occur if condensate accumulates in low sections of steam and condensate piping. The steam creates ripples on the surface of the water in a pipe and if the water level is high enough for the ripples to fill the pipe, they are transformed into a slug of water the steam carries down the pipe at upwards of hundreds of feet per second.

Condensation-induced water hammer is caused either by steam entering a piping system that contains water (cooled condensate) or by the injection of water into a piping system containing steam. This type of fluid hammer is caused by a four-step sequence which involves: rapid condensation, a sudden void caused by the steam changing to liquid form and a dramatic drop in pressure in the pipe, producing a local pressurized pulse of fluid shooting down the pipe.

Water-flow water hammer is a sudden decrease or stop of flow velocity that can occur in any water system. It is s caused by a similar mechanism described in the steam flow water hammer.



This is a picture of my current stress team in Houston. From Left to right: Scott Allen (PE), Si Vo, Ashok Patel, John Schmidt (PE)



A hand drawn pipe isometric proposes a new design. Here are notes showing movements and clouded directions from the pipe stress engineer.

system, when steam from one pipe mixes with condensate from another or two-phase flow occurs, producing a pressure wave in the pipe. This pressure wave can cause major problems, from noise and vibration to pipe rupture.

"The equipment is never designed to handle fluid hammer — neither is the pipe. It is unpredictable and dangerous," explains Schmidt. "Fluid hammer can cause the pipe to fail, the pump to fail and it can destroy the surrounding steel and damage the internals of valves."

A properly designed, operated and maintained steam system rarely, if ever, suffers a fluid hammer event — however, by its very nature, it is impossible to plan for it. Avoiding fluid hammer requires both a thorough understanding of its causes and contributing factors and following good design, operations and maintenance protocol. Other strategies for reducing the effects of fluid hammer pulses include accumulators, expansion tanks, surge tanks and pressure relief valves.

"My primary job is to make sure there are no unplanned events," he adds, "to make sure the designs our designers create are safe. Fluid hammer is unpredictable and we try to avoid it, but if it is going to happen, we want to be as safe as we can and put in extra support."

The human factor

As the reader can imagine, coordinating a team of 18 engineers, consulting on capital projects and providing on-site support is no easy feat. Of all his daily responsibilities, Schmidt says the most challenging are the human factors: understanding how to communicate with and align to the goals of his co-workers. Coordinating, training and motivating people is an amazingly difficult thing to do in any profession, but Schmidt believes in the importance of counterpoints: alternate points of view and people who will challenge our ideas and inspire us to work hard and make progress.

"I need my co-workers, even though sometimes it is difficult to deal with them," he laughs. "But without people to challenge us, we stagnate."

For Schmidt, the best parts of the job are the freedom to learn new technical information and the opportunity to interact with peers, inside and out of the company. "I interact with ASME professionals and professors, read technical journals, etc. I have been given a lot of leeway to collect a vast sphere of knowledge and then apply it to real world problems, which is exciting and gratifying."

One of his favorite experiences while working with Dow was being called out to a job site at 2 o'clock in the morning on a Sunday. "When I arrived, there were about a dozen very angry pipefitters who had encountered an unforeseen problem with the design of a maintenance project. When I left two hours later, they were smiling because they had a clear solution. Helping people find a solution to a problem is gratifying. The next morning, I had an encouraging email from the group leader waiting for me, which I still have pinned to my wall today."

"I'm proud to say that I work for a safety-conscious company," concludes Schmidt. "I admire this company and what it stands for. The employees can hold a capital project or maintenance operation if they feel that something is unsafe. Safety is our primary concern at Dow, but in an unplanned event, we're motivated to get the plant up and running or the project back on schedule."