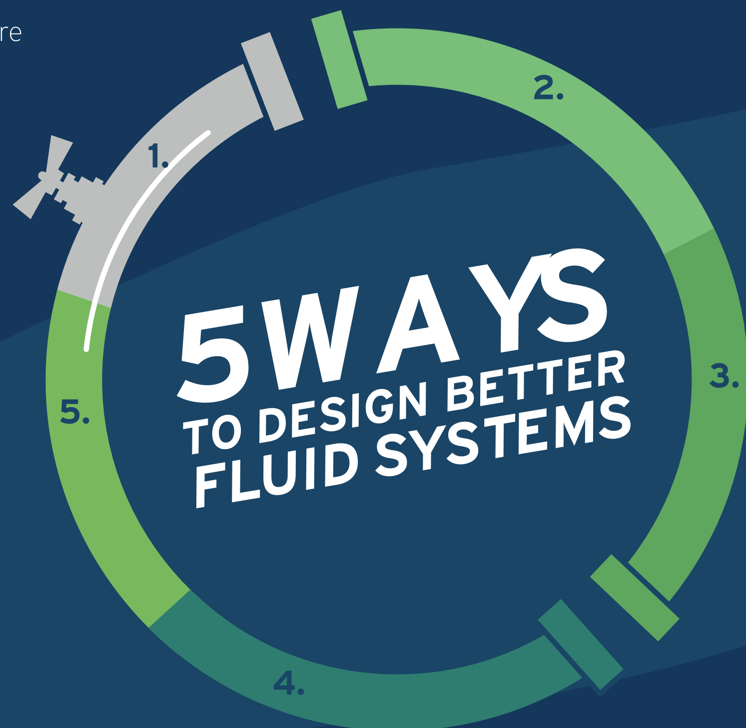
5 WAYS TO DESIGN BETTER FLUID SYSTEMS



Mirror Your System
Uncertainty is a certainty in engineering design. Reduce uncertainty by mirroring your physical system in software, easily calibrating a model to field data to ensure your recommendations will work in the built system.

Standardize the Workflow
A custom tool or process that is intuitive to one engineer may be completely foreign to another engineer. A standardized software suite establishes a shared modeling foundation, allowing engineers to easily interpret, troubleshoot, analyze, and modify each other's models.

Analyze Alternatives
Time is an engineer's most precious resource. The ideal software package allows an engineer to focus on the analysis of the system, testing and comparing alternatives to consider impacts to operation.

Upgrade your System Operation
Software allows engineers to meet and exceed design expectations. A robust software package enables engineers to quickly compare design options on the efficiency and reliability metrics that matter to realize cost and energy saving opportunities.

Start Smarter
Juggling data from different sources can be daunting in the design phase. Let software centralize databases of fluid, component, and pipe information to build systems confidently and quickly.

The engineering design process is constantly driven toward faster, better, and lower-cost designs without sacrificing accuracy, operational flexibility, and safety. For systems which handle fluids, this means meeting pressure and flowrate requirements while minimizing both the capital and operating costs of a system. Like any engineering design, however, these simple goals are easier said than done.

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Case Study:

Underdog Resolved Refinery Flooding $25MM under Competitor Scope

Hydrus Works
Houston, Texas USA

Problem

- Frequent refinery process area flooding during storms from undersized lift stations
- Larger incumbent firm quoted resolution at $70MM

Tool

- AFT Fathom model was calibrated from 160,000 data points using design factors and Goal Seek and Control Module
- Design alternatives at different expidenture levels developed

Solution

- Resulting 505-pipe model matched to within 3% accuracy of field results
- Flow capacity could be increased by 151% at highest expenditure level, at 35% below competitor's $70MM proposal

"Once the model calibrated, any configuration of the system could be tested to explore improvements and cost-saving opportunities"

Full case study can be found here:
https://bit.ly/3dCOo2t

5 Ways to Design Better Fluid Systems Faster

Engineers often face large uncertainty during the design of their system, inheriting cryptic tools from other engineers which require as much effort to troubleshoot the tool as to troubleshoot the system. This sink-in time and margin for inaccuracy restricts the design alternatives engineers can evaluate. Engineers are forced to settle for an inefficient design certain to work rather than an optimized, flexible solution.

Software to model fluid handling systems resolves many of these pain points, allowing engineers to model, troubleshoot, and design better systems more efficiently. Here are 5 ways software helps design better fluid systems faster.

1. Mirror Your System

Uncertainty is a certainty in engineering design. Uncertainty may be introduced from simplifying assumptions of ideal conditions, from vague requirements of a design, or it may be introduced by human error or oversight. This uncertainty can create several issues for a fluid system. For one, to maintain a safe and operable system, systems are often over-designed with excessive design margins which lead to high costs during construction and operation of the system. Uncertainty may also cause concern when updating or troubleshooting a faulty system. If an engineer is not confident in the quality of their initial results, how can they be confident in the problem they are solving or in their recommended resolution?

The digital twin philosophy has made its way into many facets of engineering, including in fluid handling systems. A model that reflects a physical system or accurately captures the non-idealities of a proposed design creates significant confidence for an engineer. Especially when working on an existing system, precise calibration of a model to field data establishes a strong engineering foundation, ensuring tests in the model will be accurately reflected in the physical system. Calibrating to a dataset by goal-seeking variables like design factors, scaled pipe diameters, and additional friction losses enable engineers to design confidently, even when the state of the physical system introduces uncertainty.

2. Standardize the Workflow

Engineers accumulate a lot of knowledge about how to solve very particular problems. However, a tool or process that is intuitive to one engineer may be completely foreign to another engineer. Anyone who has inherited a spreadsheet from a long-gone colleague understands these struggles. Often these tools are not robust and difficult to troubleshoot, without any documentation on how to use the tool or the methodology behind the calculations. These tools may be project-specific, requiring tinkering and modification to expand its scope of application. While custom solutions may meet an internal need effectively, it is often outweighed by the cost to develop and maintain this 'perfect' tool.

Establish a shared modeling foundation. Engineers' shared experience allows them to easily interpret, troubleshoot, analyze, and modify another engineer's model.

Relying on a standardized software suite resolves many of the issues caused by custom engineering tools. By establishing a shared modeling foundation, engineers' shared experience allows them to easily interpret, troubleshoot, analyze, and modify another engineer's model. With other standardization features like fluid, component, and pipe material databases, engineers are also confident in the source of the information integral to the model's results. An industry-accepted software package will also have the resources and documentation to bring a new user up to speed or help an experienced user to understand the underlying methodology. No more scratching your head at 10-year-old spreadsheet calculations.

3. Analyze Alternatives

Time is an engineer's most precious resource. In that sense, the less time spent doing a task on a project the better. However, often engineers lose time troubleshooting re-purposed or inflexible tools instead of analyzing their system. The tools may make it difficult to perform the necessary analysis for a robust system. While engineers may want to consider additional operating circumstances, a system's capacity for an expansion, or how an aging system will impact its operation, engineers may be happy to barely finish their assigned work before the end of the day.

The ideal software allows an engineer to step out of the way of the tool to instead focus on the analysis of their system. Even something as simple as organizing operational options and design iterations in a single file can save hours of engineering time. This scenario-based structure creates a flexibility for engineers to follow their natural curiosity and consider other impacts to operation. From a productivity standpoint, it also allows rapid alternative comparison to find an ideal design. Engineers can then test their design against changes in operation, its capacity for future expansion, or how age will impact system operation. ***A model lets engineers explore at the speed of their curiosity instead of getting tangled in managing their tools.***

4. Upgrade System Operation

Priority number one is ensuring a fluid system meets design requirements. Whether that system is efficient is a secondary consideration, often leading to missed energy and cost savings opportunities due to the limited options an engineer can consider. Systems also operate across a range of operating conditions, creating other opportunities for inefficient operation an engineer should consider in their limited time. While pump standards have required more and more efficient components, placing an efficient pump in an ineffective system creates as many issues as an inefficient pump. Ineffective design leads to more downtime, reduced reliability, and shorter lifespans for major components.

Software allows engineers to meet and exceed design expectations for efficiency and reliability. Engineers can find the best pump by evaluating its proximity to its Best Efficiency Point (BEP), its Net Positive Suction Head (NPSH) margin, as well as its capital and operating cost. These factors be compared across different pumps across multiple operating conditions. For new systems or expansions, engineers can similarly consider how pipe size, layout, and other component choices impact the cost and operation of the system. With a robust and flexible software package, engineers can quickly evaluate design alternatives on the metrics that matter.

5. Start Smarter

Collecting, organizing, and centralizing data is a major part of engineering design. Juggling standard pipe diameters, roughness, cost, and everything to connect these pipes is a daunting task by itself. Not to mention there are also fluid properties, component losses, system layout, and pump curve alternatives to consider. While handbook data provides a first approximation of system losses, it still requires manual look-up and entry which is prone to error and challenging to document.

Centralize databases of common information, reporting fluid information like ASME Steam Tables or standard pipe diameters to easily pull from while modeling.

Software approaches this issue by centralizing databases of common information, reporting fluid information like ASME Steam Tables or standard pipe diameters to easily pull from while modeling. Not only does this save an engineer the steps of finding and entering handbook data, but it also avoids the potential errors introduced by manual specification. During the initial design phase, much of the system is uncertain without exact component data. Databases of fittings and losses allow engineers to build a precise model without investing significant time or effort, guiding their engineering process as details are gradually refined.

Case Study:

Petrochemical Plant Cooling Water Capacity Restored

Ingenero Technologies Pvt Ltd. Thane, India

Problem

- Cooling water system unable to meet design requirements
- Restricted cooling limited plant capacity, reducing plant profitability

Tool

- AFT Fathom model built and calibrated to field data
- Team performed sensitivity analysis on configuration changes for:
  - Valve Position
  - Replacing Components
  - Pump Operation

Solution

- Replaced troublesome consumer group
- Found fewer parallel pumps improved operation and reduced operating costs

"The plant validation simulation in AFT Fathom opened up avenues for possible improvements which were inconceivable solely based on plant data analysis."

Full case study can be found here:
https://bit.ly/3jD8NZo

Examples in this document used **AFT Fathom™ Flow Analysis Software.**

AFT Fathom is a fluid dynamic simulation software used to calculate pressure drop and pipe flow distribution in liquid and low-velocity gas piping and ducting systems.

"With AFT Fathom, all combinations were modeled in a single system & analyzed easily, where it is near impossible to do this by manual methods and get accurate results"

- M. Arunkumar, Larsen & Toubro

From Theory to Application

Software enables engineers to mirror their system accurately, flexibly test design alternatives to improve system operation, and rely on centralized resources to standardize their workflow. Effectively combining these facets of software open many possibilities outdated tools cannot compete with. Let's explore some of these possibilities across a few real-life examples.

Example #1 comes from a small firm competing with a larger incumbent firm to resolve storm-water flooding issues at a Gulf Coast refinery. The firm was tasked with increasing storm-water capacity at a range of expenditure tiers. The firm was able to calibrate a 505-pipe model of the existing infrastructure to within 3% of field data results. This calibrated foundation enabled the firm to create and compare design alternatives within the various cost limitations. At the highest expenditure tier, the firm's proposal underbid their competition by $25MM, more than 35% savings over the competitor's $70MM scope.

Example #2 came from a case study which isolated problematic components in an under-performing system. A cooling water system in a petrochemical plant was limiting plant capacity. A model was calibrated to field data, revealing issues with the plant's flow measurement devices and indicating consumers with five times more pressure loss than designed. The team used sensitivity analysis on their model to consider valve position, replacing components, and adjusting pump operation to resolve the issues.

Not only did the team resolve the capacity issue, but their changes also reduced power consumption by running one less pump in parallel. The team put it best: plant validation simulation revealed improvements inconceivable based on plant data analysis alone.

Software opens many possible improvements in the design of fluid handling systems.

With flexible, accurate, standardized models, engineers can design better fluid systems faster without compromising the safety, reliability, and efficiency required by modern engineering design.

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