KNIGHTHAWK TECH NOTES

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"Experience – Does it Still Count?"

Open up any engineering magazine today and you will see countless advertisements concerning engineering tools. The tools are predominately computational fluid dynamics (CFD), finite element analysis (FEA), data acquisition, process analysis, rotating equipment, and pressure containment equipment software. Most articles do not reference the limitations of the software. In fact, great emphasis is placed on "user friendly" software. Frequently, no reference is placed on the qualifications of the individual using it, or their experience level. Unfortunately, most software vendors suggest you do not have to worry about the internal numerical engines or methodology about solving the physical problem. Many of the cheaper software packages offer little information concerning the theory and limitations of the software. Most of the numerical methods employed to solve the problems, have many options concerning numerical controls to solve the problem. Most engineers that graduate from the institutions are highly computer literate and have had at least one course in numerical methods. They are all "gung-ho" and ready to be the "jet-jockey" of the software tools. There are a few things wrong with this picture. Consider the following:

1. No analysis can be more accurate than the data going into it. Many times in simulations, loads or process conditions at best are an estimate. If that is the case it is impossible for any simulation to be anything more than an estimate.
2. The solution methodology must be validated by some manor, either through testing or modeling a known solution. Any numerical method, utilizing an iterative procedure, can converge to a false solution. The simulation involves the solution of partial differential equations. The solution is complex. Although, with each year the solution methodologies are advancing, there are still problems with false solutions. Unfortunately, some of the converged solutions with the new numerical engines that are false, would have diverged with the old numerical engines. Sometimes "user friendly" can bite you like a "snake".
3. The boundary conditions calculated or assumed for the model, are more important than the simulation itself. Many times the software tool that is being used requires boundary conditions that are calculated by hand or with other simulation packages. These boundary conditions affect the results.
4. Software tools have disclaimers that relieve them of all responsibility if there are errors or false solutions obtained for a problem. Ultimately the engineer is responsible for the solution, not the software vendor. Federal, state, and local courts and agencies do not listen to the excuse "the program calculated it wrong". If an engineer uses a tool in a critical situation he or she is the responsible party.
5. Experience of the physical situation is required to determine the correct control volume for the analysis of the physical system. The problem with many solutions is just determining how much to model.
6. Experience is required for finite element, finite volume, and finite difference modeling to determine the correct mesh or grid density to adequately model the response. Once the control volume is defined it is important that the grid or mesh be defined properly to obtain good results.
7. Experience is required to interpret the validity and accuracy of the results. Engineering judgement is required to assess the results. The more gray-hair on the individual the better for this step.

In the aerospace industry many critical analyses are run in parallel with several different software packages performing the same task. They cannot afford a failure due to false convergence or an inaccurate converged solution. The aerospace industry has been aware of the limitations and the best way to insure an accurate solution for many years now. In fact most all of today's high-end software originated from the aerospace industry.

So what is the best way to protect your company's interest? The first thing to do is to realize that all of the simulation packages are tools for competent engineers to use, who have a background in numerical methods and have an appropriate understanding of the theory behind the program. The first thing is there is ***nothing that beats experience***. An experienced individual should review all numerical solutions to see if the results make sense. Many times in facilities the most experienced engineers are not computer literate and it's not worth the time for them to spend learning the program. Sometimes a good team is a rookie engineer and an experienced engineer working together.

Regarding experience, does it really count? You bet it does – in a big way. Any inexperienced engineer in a particular area should review over their solutions with experienced engineers.

Cliff's Notes:

Unfortunately, on more than one occasion, KnightHawk has worked large failures only to determine a design issue due to a simulation that was in error. One in particular, had incorrect boundary conditions that led to failure in a high temperature high pressure vessel. It costs our client millions of dollars, but they did save on the cheap engineering on the front end of the project. Another one was a programing error in a control system that caused the plant to operate in a dangerous mode and the plant experienced a very costly explosion.

What has been so positive for KnightHawk is the fact that we are a multidiscipline company that looks at all aspects of the problem. Our company also can perform field data acquisition and we have a metallurgical and materials lab. We are a one stop shop to get the job done.

I hope everyone had a wonderful holiday weekend and reflected on all of those who gave their lives for freedom in this Country.

Take care and God Bless,

Cliff Knight

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KnightHawk Project Update

- Rotordynamics of a centrifugal compressor
- Steam Turbine Failure Analysis
- Failed tank investigation
- Finite Element Analysis of reactor jacket
- Check Valve Testing
- Thermal Oxidizer Feed Mixing CFD
- Rail Car Pressure Containment FFS
- Heat Exchanger Rerate Analysis
- Furnace Ethane Feed Optimization
- Pipe stress analysis of large bore piping system
- Coker Furnace Outlet Piping Non-Linear Creep Stress Analysis
- Vessel Code Calculations
- Heat Exchanger Diaphragm Failure
- Storage Rack System FFS
- Fan Vibration Field Services
- Reverse Engineering of Medical Devise
- PMI and Materials Consulting
- Boiler Tube Failure Analysis
- Silo Rerate Analysis
- Brittle Fracture Analysis