

The logo consists of a stylized 'K' made of black squares, followed by an ampersand and a 'W'.

# K&W

## K-TEK & WILLIAMS

### Plant Inspection & Engineering Analysis Specialists

HRSG Integrity Management Services  
High Energy Piping Assessments  
Piping Stress & Flexibility Analyses  
Fitness for Service & Remaining Life Evaluations  
Vibration & Field Measurements  
Finite Element Analysis





## WHO WE ARE

**K-TEK & WILLIAMS (K&W)** brings a total plant inspection and engineering services package to customers in the power-generation, refinery and petrochemical industries.

### FIELD SERVICES

HRSB Inspections & Assessments  
High Energy Piping Assessments  
Technical Advisory & Consulting

### ENGINEERING SERVICES

Failure & Root Cause Analysis  
Fitness-for-Service Evaluation  
Remaining Life Evaluation  
Finite Element Analysis  
Computational Fluid Dynamics  
Vibration Analysis

### PROCUREMENT SERVICES

Inventory Management  
Equipment & Parts Supply

### DEDICATED TEAM OF SUBJECT MATTER EXPERTS

K&W is an experienced team of engineers that don't mind getting dirty and strongly believe in continuously working to bring value added innovative services and proven solution techniques to our customers ensuring a lasting business and technical relationship. These technologies have been employed by our staff on projects within refinery units; petrochemical facilities; fossil, HRSB combined cycle, solar, and nuclear power plant facilities.

K&W's 43+ years of experience, training, and educational credentials allow us to provide timely and practical solutions to our customers within the framework defined by existing plant parameters, without sacrificing the accuracy of the engineering mechanics computations. It is always K&W's goal to interface seamlessly with our customers to produce expedient, optimal solutions to your technical challenges, while utilizing the most current mechanics and simulation tools.

### PROACTIVE MANAGEMENT

K&W is committed to understanding and meeting our customer's needs for proactive management and risk mitigation. Our world-class service is all about proactively working with customers to ensure safety, reliability, and performance by providing direct access to our repository of expertise and experience.

### SINGLE POINT OF CONTACT

K&W is your streamlined access to comprehensive range of value-added expert services. We bring a total solutions offering to our customers.

### ACTIVE WORLD-WIDE

K&W can be on-site anywhere our customer is located. Distance does not keep our team of experts from doing what K&W does best. Services have been provided in the USA, Mexico, Brazil, Dominican Republic, Colombia, Korea, etc.





## A TOTAL SOLUTIONS PROVIDER

Committed Team Working for You

### CONNECTING YOUR INDUSTRY TO THE INSPECTION AND ENGINEERING RESOURCES YOU NEED TODAY

Many important technical questions can best be answered by developing complex numerical simulations and properly interpreting the calculated results. K&W has the expertise, the staff, and the experience to work with our customers to find fast, effective answers to difficult questions. Our professional staff has evolved from an international leader in the design, testing, inspection, fabrication, and analysis of piping and component supports and restraints that have been utilized in extreme industrial settings. K&W's engineering mechanics expertise is further intensified by the coordination with K&W's engineering field services and inspection specialists and its highly experienced HRSG and boiler technicians and engineers.

K&W's senior and highly experienced staff has combined the theoretical and textbook solutions with some of the most advanced computational techniques available today. These include both FEA and CFD simulations, allowing K&W to provide realistic solutions to a multitude of clients in the refinery, petrochemical, power, and process industries. Evidence of these realistic solutions may be found in over 100 peer reviewed publications authored by our staff members, several of whom are Fellows in the American Society of Mechanical Engineers.

K&W's team of engineers carefully selects the analysis software best suited for each specific engineering task. Our toolset includes the use of ANSYS, STAAD.Pro, Flotran, PTC Mathcad, CAESAR-II, AutoPIPE, and OpenFOAM. We know the strengths and weaknesses of the computational tools that we employ and are able to expertly exploit this knowledge for our clients.



Plant Inspection & Engineering Analysis Specialists





## OUR CAPABILITIES

Inspection and Engineering Services Working for You

### INSPECTION & FIELD SERVICES

K&W's experienced team of engineers are knowledgeable by education and experience and are proficient in performing inspections and gathering necessary field data for condition assessments or engineering analyses. These types of inspections and field services can be employed for any number of major equipment or systems such as the following:

- Heat Recovery Steam Generators
- High Energy Piping Systems



### FINITE ELEMENT ANALYSIS

- Structural Static (linear & non-linear)
- Modal & Natural Frequencies
- Harmonic Response
- Transient Dynamic
- Spectrum (Including Seismic Response)
- Buckling & Instability
- Nonlinear (Material & Geometric)
- Material Response Curve Fitting
- Interface & Delamination Simulation
- Fracture Mechanics
- Composite Modeling
- Fatigue
- Steady State Thermal
- Fluid Sloshing
- Transient Thermal
- Radiation Heat Transfer
- Explicit Dynamics

### COMPUTATIONAL FLUID DYNAMICS

- Laminar Flow Analysis
- Turbulent Flow Analysis
- Thermal Analysis
- Compressible Flow Analysis
- Non-Newtonian Flow Analysis
- Multiple Species Transport Analysis

### PIPING & PRESSURE VESSEL ANALYSIS

Piping stress and flexibility analyses are performed in accordance with a multitude of recognized national consensus Codes and Standards including ASME B31.1, B31.3, B31.4, B31.8, and ASME Section III, Division 1. Likewise, pressure vessels are analyzed in accordance with ASME Section VIII, Divisions 1, 2 and 3. More rigorous techniques are utilized when required due to high temperature creep (ASME Section III, subsection NH) or Fitness-for-Service considerations utilizing API-579.



### VIBRATION & FIELD MEASUREMENTS

Displacements, velocities, and acceleration measurements of undesirable vibrations are often employed in the diagnosis of rotating equipment problems, FIV, and cyclic life assessments. Field data may then be coupled with computer simulations to define appropriate system modifications.



## BRIDGING REAL INDUSTRY PROBLEMS WITH INGENUOUS SOLUTIONS

Power of Computational Mechanics

### **COKER UNIT WITHIN A MAJOR REFINERY: EXCESSIVE VIBRATION**

One of the primary causes of premature piping supports and restraints failures can be attributed to cyclic displacements that result from low frequency, large displacement vibrations. Furthermore, in tall outdoor structures, unwanted displacements are often accentuated the higher in the structure equipment or personnel are located.

K&W's staff inspected the large bore piping connecting the coker reactor to the furnace noting the severity of the unwanted displacements at each working level within the coker structure. A K&W senior staff member developed a methodology employing replacement of the existing piping support and restraint system while "tuning" the revised injection and transfer lines to a threshold natural frequency, resulting in mitigation of the undesirable vibrational displacements to the maximum extent possible.



### **BELLOWS FAILURE IN A FLEXIBLE HOSE**

A catastrophic failure of a flexible hose utilized in piping connection was investigated to determine the failure mechanism. The issues associated with the instability of the metal u-shaped bellows, from which the hose derives its overall flexibility and nomenclature, were reviewed and a structural model was created using a commercially available finite element analysis code. The proximate cause of failure was determined to be a result of column buckling of the bellows (i.e., "squirm") and not solely a result of excessive internal pressure. The FEA results allowed the client to assess both its direct and indirect losses and to be compensated accordingly by the offending party.







## BRIDGING REAL INDUSTRY PROBLEMS WITH INGENUOUS SOLUTIONS

### Power of Computational Mechanics

#### HEAT RECOVERY STEAM GENERATOR CONDITION ASSESSMENT

Regular visual inspections to proactively assess the condition and mitigate risk is a critical part of a HRSG life time management program. K&W's staff is experienced in assessing heat recovery steam generators and noting severe deviations from original design, prioritizing findings by risk-factor, assessing potential causes, and providing recommendations based on accumulated design and operation knowledge and years of global inspection and service experience. Two HRSG units were assessed by K&W staff at a 480 megawatt, natural gas combined cycle power electric generating facility to advise plant's new ownership of an HRSG management program for the remaining life of the units. Specialized inspection plans were developed tailored to plant data and operating history. Part of the assessment program included analysis and detailed engineering evaluation to determine remaining life of the critical components.

#### HIGH TEMPERATURE PIPING STRESS AND STEAM HAMMER ANALYSES

K&W's staff engineers have designed, analyzed, and provided fabrication support for a wide variety of high temperature piping systems for the refinery, petrochemical, and power industries. While there are several recognized piping analysis tools available on the market, detailed and rigorous analyses of piping attachments (including, but not limited to lugs and trunnions) are one of our fortes. Additionally, K&W's staff has analyzed the high energy piping for a recently designed 828 megawatt, dual fueled, combined cycle electric Generating facility in the US. Part of the specialized evaluations included both the application of finite element analysis (FEA) of welded pipe attachments and computational fluid dynamics (CFD) to address the potential for steam hammer events within judiciously selected regions of the System. These specialized tools were selected to augment the more traditional piping stress analyses conducted in accordance with the ASME B31.1 Power Piping Code.







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