594752 (M)
IDC Training House
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PIPING FLEXIBILITY & STRESS ANALYSIS

COURSE DURATION: 5 DAYS

IDC Training House

INTRODUCTION

Pipe Stress Analysis is an intensive five-day course designed to give a **thorough understanding of basic and advanced concepts of process piping stress & flexibility analysis as per ASME B 31.3.** Stress analysis is a critical component of piping design through which important parameters such as piping safety, safety of related components and connected equipment and piping deflection can be addressed. **It needs good understanding & background in piping layouts, ASME Code requirements & piping design.**

Piping Stress Analysis involves examining the flexibility and stiffness of a particular piping system under different loading conditions. Piping stress analysis determines the maximum stresses, displacements, forces & moments at restraints and suggests necessary modifications for satisfying the ASME Code Requirements for limits of sustained, displacement & occasional load allowable stresses.

Stress analysis helps revising the piping layout and its supports to avoid high local stresses. The course will discuss different types of stresses affecting piping flexibility, code criterions, and methods of analysis, including simple & comprehensive methods and computerized methods.

The extensive use of case studies and practical exercises during the course of the discussion ensures as comprehensive coverage of the topic as possible.

All the pipe stress analysis concepts will be examined & demonstrated through pipe modeling using pipe stress analysis software to give a detailed insight into the analysis methods & solutions.

COURSE OBJECTIVES

Upon completion of this course, attendees will be able to:

- ✓ Apply the piping system stress analysis requirements of ASME B31.3 to process plant piping systems
- ✓ Understand how to perform piping flexibility & stress analysis
- ✓ Provide solutions to piping loads
- ✓ Limit piping stresses within the code allowable limits

NOTE

Demonstration software of stress analysis will be given to participants during the training session, thus a LAPTOP is COMPLUSORY

WHO SHOULD ATTEND?

Engineers who are responsible for performing piping stress analysis and others who must have a good understanding of its requirements are invited to attend including

- Piping Design Engineers
- Piping Draftsmen
- Piping Layout Engineers
- Pipe Stress & Flexibility Engineers
- Demonstration software of stress analysis will be given to participants during the training session, thus a LAPTOP is COMPLUSORY

COURSE DURATION

- 5 Days Training

DAILY SCHEDULE

- 8:30am - 5:30pm

ITEMS TO BRING

- Calculator
- Laptop

Stationeries such as pen and highlighter will be provided.

COURSE OUTLINE

MODULE: 1 - STRESS WORLD DEFINITIONS

- Piping Failure Modes
- Why Stress Analysis
- Pipe Stress Engineer Scope of Work
- Force , Moment & Equilibrium
- Different Forces on Piping System
- Stress & Strain
- Stress – Strain Curve (Typical Behavior of Material)
- Modulus of Elasticity, Yield Strength, Ultimate Tensile Strength, Allowable Stress (at "hot" and "cold" conditions, that is, Sh and Sc)
- Code Tables for Allowable Stresses
- Stress (Axial, Shear , Bending, Longitudinal Stress due to pressure, Torsion Stress, Hoop Stress, Displacement Stress, Reaction Force)
- Piping Systems Classification (Hot, Cold & Cryogenic)
- Installed & Operating Temperatures
- Fatigue
- Stress Analysis General Working Procedure

MODULE: 2 - FAILURE THEORIES

- Maximum Principal Stress Theory
- Maximum Shear Stress Theory

MODULE: 3 - STRESS CATEGORIES

- Primary Stresses
- Secondary Stresses
- Peak Stresses
- Basic Stress Intensity Limits

MODULE: 4 - CLASSIFICATION OF LOADS & CODE REQUIREMENTS

- Sustained Loads
- Displacement Loads
- Occasional Loads
- Pipe Loading Chart
- ASME B 31.3 Process Piping Code Requirements – Limits of Stresses due to Sustained Loads, Displacement Loads & Occasional Loads.
- Allowable Stresses (Time Independent & Dependent Stresses)
- Local Stresses
- Basic Solutions to all Piping Loads

MODULE: 5 - TYPES OF PIPE LOADING CONDITIONS

- Internal Pressure Stress
- Axial, Hoops & Radial Stresses
- Weight Stress
- Bending Load due to weight
- Bending Stress & Moments due to weight of pipe
- Hydro Test Load
- Thermal Expansion Loads (Thermal Modes, Free Thermal Expansion, Imposed Thermal Movements, Temperature Decay, Stress Ranges)
- Occasional Loads (Seismic, Relief Valve Discharge, Wind, Steam/Water Hammer)

MODULE: 6 - METHODS OF ANALYSIS

- Simplified Analysis (Check as per ASME B 31.3)
- Comprehensive Methods of Analysis (Charts & Nomographs)
- Computer Analysis (Static & Dynamic Loads & Analysis Types)

MODULE: 7 - SIMPLIFIED ANALYSIS

- Simplified Weight Analysis
- Simplified Thermal Expansion Analysis
- Guided Cantilever Method
- Thermal Movement Calculation
- Simplified Seismic Analysis

MODULE: 8 - LAYOUT SOLUTIONS FOR WEIGHT, THERMAL, VIBRATION & WIND LOADS USING NOMO GRAPHS

- Layout Solution for Weight Stress – Continuously Supported & Branch Pipe Allowable Spans
- Solving Concentrated Loads and Reducing Loads on Equipment Nozzles
- Layout Solutions for Thermal Load using force & Stress Nomographs for Pump and Vessel Piping
- Checking Piping Layout in Pipe Racks
- Checking Piping Layout for Reciprocating Equipment
- Checking Piping Layout for Wind Load

MODULE: 9 - COMPUTER PROGRAMS & ANALYSIS METHODS

- CAESAR –II, CAE PIPE, AUTOPIPE , TRIFLEX
- Capabilities
- Method of Analysis
- Minimum Required Load Cases for Computer Analysis
- Data Required for Stress Analysis

MODULE: 10 - SUPPORTS & RESTRAINTS

- Functions & Selection
- Supports (Rigid & Flexible Support Types)
- Restraints (Different Types)
- Support / Restraint Selection Example
- Hanger Selection Example
- Maximum Support Spacing Based on Weight, Deflection & Natural Frequency Criteria
- Support Spacing Criteria
- Function of each type of Restraints with Example Piping Layouts
- Loads on Supports
- Dynamic Supports (Sway Braces & Snubbers)
- Stress Support Symbols
- Locating Supports
- Standard Pipe Support Spans
- Pipe Span Reduction Factors
- Guide Spacing for Wind Loading

MODULE: 11 - PIPING THERMAL FLEXIBILITY

- Introduction & Purpose of Flexibility
- What are we trying to achieve
- Approach for Piping Flexibility & Support Design
- Formal Analysis Requirements (Guidelines Whether to Perform Thermal Flexibility)
- When Detailed Analysis is Needed
- Critical Line List
- Required Design Conditions for Piping Flexibility Analysis
- Piping Flexibility Temperatures
- Thermal Fatigue and Cyclic Stress Reduction Factor - Number of Cycles to be Considered
- Providing Additional Flexibility
- Cold Spring
- Types of Flexibility (Axial & Bending)
- Piping Displacement Calculation
- Actual & Free Thermal Expansion Calculation
- Temperature Range Examples
- Expansion Stress & Reaction Force Calculations
- Flexibility & Stress Intensity Factors
- SIF Calculations for Piping Components
- Discussion on Effect of SIF on Piping Stress
- Elbow Flexibility
- Expansion Loops (Types , Sizing, Locating Supports)
- Leg Required for Flexibility
- Initial Anchor Movements / Nozzle Thermal Growth Calculations

MODULE: 12 - SUSTAINED & DISPLACEMENT LOAD ANALYSIS

- Sustained Load Analysis (Calculation Methods & Acceptance Criteria)
- Loads & Design Criteria
- Pressure Stress
- Weight Stress
- Weight Bending Moments
- Allowable Stress
- Displacement Load Analysis (Calculation Methods & Acceptance Criteria)
- Loads & Design Criteria
- Effect of Friction
- Displacement Stress Range Calculation
- Allowable Stress Range
- Considerations for Displacement Analysis
- Example Analysis Discussion
- Fixing Problems
- Flexibility Analysis Examples using Kellog Charts, ITT Grinnel Charts.

MODULE: 13 - NOZZLE LOADS – PIPING STRESSES & EFFECT OF PIPING ON EQUIPMENT

- Load Limitation on Equipments (Rotating & Stationary)
- What are Equipment Nozzle Loads
- The Piping Effect
- Factors that Affect Nozzle Loads
- Reducing Loads on Equipment Nozzles
- Typical Piping Layout

MODULE: 14 - EXPANSION JOINTS

- Introduction
- Types, Application & Selection
- Pressure Thrust

MODULE: 15 - PIPING VIBRATIONS

- Introduction
- Analyzing Vibrating Pipe
- Required Natural Frequency of Piping, Frequency Calculation
- Pipe Supports for Vibration. Supports for Pulsation Dampeners

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TRAINER'S PROFILE

MD. KAMAL

Md. Kamal Uddin Ahmed, B.E.(Mechanical Engineering) is a Senior Piping & Pipeline Engineer with 15-20 years of progressive & extensive international experience. He is an expert in Process, Power Piping & Liquid & Gas Transmission Pipelines as per ASME & API standards including ASME B1.1, B31.3, B31.4, B31.8, & API 570.

He is a dynamic speaker & master trainer providing knowledge transfer effectively with interactive style that connects with the audience.

Md. Kamal has designed & presented piping design seminars to piping engineers & designers across India, Qatar & Saudi Arabia. He has trained more than 1500 mechanical, chemical, & petroleum engineers in Piping Engineering, Pipeline Design, HVAC & Plumbing Systems from different countries including India, Qatar, Saudi Arabia, Jordan, Turkey, Sudan, Ghana, Nigeria, Maldives, United Kingdom, & Thailand.

CLIENTS SERVED

Md. Kamal has offered professional training services to many corporate including:

- ORYX GTL Qatar
- ICB Tecnimont, Qatar Petroleum
- RASGAS
- Intergraph Consulting
- Infotech Enterprises
- Petrodar Oil & Gas Operating Co.

EXPERTISE IN

- ✓ Piping Systems Detailed Engineering
- ✓ Pipe Stress Analysis
- ✓ Pipe Hydraulics
- ✓ Process Plant Layout
- ✓ Pipeline Design & Construction
- ✓ Pipe Supports
- ✓ Piping Systems Erection & Testing
- ✓ HVAC Plant Design
- ✓ Plumbing & Fire Water Piping Systems

Throughout his career, Md. Kamal has been providing these expertise for both new and operating process / power plants & facility construction industry using codes / standards, software analysis and field experience in arriving at safe, economical piping designs and solutions to piping problems.

Besides, Md. Kamal has also offered his services such as:

- ✓ Project Management
- ✓ Design / Analysis
- ✓ Construction / Testing / Inspection

in **India & Kingdom Of Saudi Arabia** involving many onshore & offshore projects.

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