Institute of Piping Engineering & Building Services

CERTIFICATE ONLINE TRAINING COURSE

PIPING FLEXIBILITY & STRESS ANALYSIS

Course Speaker:

Mr. Mohammed Kamal Uddin Ahmed

Pipeline & Pumps Specialist.
Certified Engineer – Saudi Aramco, KSA.
International Trainer & Course Speaker.

ABOUT TRAINING PROGRAM

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.

The **Online Training Course** is developed by the faculty of **IPEBS**, who are International Course Speakers and have more than 22 years work & training experience individually.

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

PROGRAM FEATURES

- ✓ In-depth course content for easy understanding.
- ✓ Blended Learning: Online contact with faculty.
- ✓ Accessibility to Course Faculty & Counseling Services.
- ✓ Job oriented training program.
- ✓ Student will be job ready, after the course.
- ✓ Student will acquire skills and knowledge similar to working professional.

WHO SHOULD ATTEND

- • **Graduating College Students in the following disciplines**

    - ✓ Mechanical Engineers
    - ✓ Chemical Engineers
    - ✓ Petroleum Engineers
    - ✓ Production / Industrial Engineers
    - ✓ Diploma / ITI

- **Working Professionals**

  - ✓ Piping Design / Layout Engineers
  - ✓ Pipeline Engineers
  - ✓ Pipe Stress Engineers
  - ✓ Pipeline Contractor
  - ✓ Mechanical Engineers
  - ✓ Pipeline Operators
  - ✓ Senior Draftsman
  - ✓ Government Regulators
  - ✓ Inspection Engineers
  - ✓ Piping QA / QC Engineers
  - ✓ Piping Supervisors

- **Corporate / Organizations**

  - ✓ EPC Companies
  - ✓ Piping Equipment Manufacturing Companies
  - ✓ Piping Consultants
  - ✓ Piping Contractors
  - ✓ Thermal Power Plants Industry
  - ✓ Ship Building / Marine Industry

COURSE MODULES

- ✓ **Stress World Definitions**
- ✓ **Failure Theories**
- ✓ **Stress Categories**
- ✓ **Classification of Loads & Code Requirements**
- ✓ **Types Of Pipe Loading Conditions**
- ✓ **Methods of Analysis**
- ✓ **Simplified Analysis**
- ✓ **Layout Solutions for Weight, Thermal, Vibration & Wind Loads using Nomo Graphs**

- ✓ **Computer Programs & Analysis Methods**
- ✓ **Supports & Restraints**
- ✓ **Piping Thermal Flexibility**
- ✓ **Sustained & Displacement Load Analysis**
- ✓ **Nozzle Loads – Piping Stresses & Effect of Piping on Equipment**
- ✓ **Expansion Joints**
- ✓ **Piping Vibrations**

DETAILED COURSE MODULES

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

Failure Theories

- Maximum Principal Stress Theory
- Maximum Shear Stress Theory

Stress Categories

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

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

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)

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)

Simplified Analysis

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

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

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

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

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

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.

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

Expansion Joints

- Introduction
- Types, Application & Selection
- Pressure Thrust

Piping Vibrations

- Introduction
- Analyzing Vibrating Pipe
- Required Natural Frequency of Piping, Frequency Calculation

- Pipe Supports for Vibration. Supports for Pulsation Dampeners

Course Fee Details:

Course Title	Fee for Indian Participants	Fee for International Participants
Piping Flexibility & Stress Analysis	INR 25,000/-	USD 500/-

For making e – payment for the course fee please find **IPEBS** Bank account details below.

Account Name	IPEBS
Account Number	03182020005287
Bank Name	HDFC
Branch	ABIDS
RTGS / NEFT / IFSC Code	HDFC0004125
SWIFT Code	HDFCINBB

IPEBS Corporate Training Clients:

Company Name	Location	Company Name	Location
Intergraph Consultants	India	SPPC	Sudan
Port of Sohar	Oman	CFPE Technology Solutions	Malaysia
Uhambiso Consultant	South Africa	Qatar Petroleum Technical Center	Qatar
Newtech Consulting Group	Sudan	Petro Vietnam Marine Shipyard	Vietnam
Yashada Consultant	India	Locus Technologies	India
Telstar Life Science Pvt Ltd	India	RasGas	Qatar
BHEL	India	ICB Technimont	India & Italy
IDC Training House SDN BHD	Malaysia	LG-Digitech	Sudan
Sakhlain Energy	Russia	Infotech Enterprises	India
Aveon Offshore	Nigeria	Petroleum Operating Company	Sudan
BPCL	Bhutan	Dr. Reddy's Labs	India
Saitech Engineers	India	Vasavi Power Services	India
Riyan Architects	Maldives	Siddhi Consulting	India
Oryx GTL	Qatar	Qatar Petroleum	Qatar
WNPOC	Sudan	Centroid Technical Services	Sudan
GNPOC	Sudan	MG – Vowgas Group	Nigeria
Fleming gulf	UAE	DAL Group	Sudan

Terms & conditions:

CANCELLATIONS: IPEBS does not provide refunds for Cancellations done after registration & fee payment. However, credit maybe granted to a later program. This credit will be available for up to one year from the date of issuance.

COURSE MATERIAL AGREEMENT: It is the intention of **IPEBS** that the course text and materials supplied to participants at **IPEBS** courses are prepared and issued for the participants' sole use. Codes and standards constantly change and interpretations are issued by the publishing societies. Information contained in **IPEBS** course materials is based on the best available data obtained by **IPEBS** at the time of publication. **IPEBS** is in no way responsible for subsequent use regardless of intention.

PROGRAM CHANGE POLICY: Please note that instructors and topics were confirmed at the time of publishing this document; however, circumstances beyond the control of the training organizers may necessitate substitutions, alterations or cancellations of the instructors and/or topics. As such, **IPEBS** reserves the right to alter or modify the instructors and/or topics if necessary. Any substitutions or alterations will be updated on our web site.

COURSE CANCELLATION BY IPEBS: IPEBS reserves the right to cancel any course due to circumstances beyond our control. All tuition fees will be refunded in the event of cancellation. **IPEBS** liability is limited to only those tuition fees paid in advance.

FORCE MAJEURE: Except for the obligations to make money payments as outlined hereunder, neither party shall be responsible to the other for delay or failure to perform any of the terms and conditions, or other activities, of this agreement if such delay or failure is caused by strike, war, act of God, or force majeure.

Frequently Asked Questions – FAQ's

Duration of the course?

Ans: Course Duration is 05 Days.

Daily Class Duration?

Ans: Morning 09:00am to 05:30pm with appropriate Lunch & Tea breaks.

Requirement for the course?

Ans: Computer / Laptop with good internet connection, Camera and Mic.

Support from IPEBS?

Ans: Faculty assigned to all registered participant of the course. Faculty not only helps to clear the participant's queries while doing the course but also monitors the progress of the participant to help in successful completion of the course.

Mode of Payment?

Ans: You can make the payment through electronic transfer or at **IPEBS** office.

Issue of Certificate?

E - Certificate will be issued by **IPEBS** only on successful completion of the course & will be sent via email to the participant.

Training Methodology?

Ans: Online streaming of lectures, contact with faculty by email or chat groups.

Training Material?

Ans: Printed Material – Course / Class handouts will be provided in printed format and shipped (within India) to the participants.

Soft Copy Material - Data tables, Charts, Nomographs, Drawings, Concept Theory, Design Calculations and Practice Exercise's will be provided in soft copy.

Demonstration software's and excel spread sheets will be provided.

** International Shipping charges of printed material - course / class handouts to be borne by participants.