

## PROCESS PIPING ENGINEERING & DESIGN – ASME B 31.3

### Program Description

This program is designed to present all major topics relevant to the Detailed Engineering and Layout Design of Piping Systems, Mechanical, Pressure and Hydraulic Design of Process Piping Systems. And it covers elementary topics in fabrication, installation, integrity assessment and maintenance of piping systems.

The program is full time Instructor based and focused on concept theory, problem solving, system design, drafting and exposure to Industry Leading Software.

This is both the Best and most Exclusive Training Program in Nigeria on the subject that is comprehensive and suitable for both beginners and intermediate level engineers; believing that professionalism is acquired on the job.

### COURSE OUTLINE

#### 1. Piping Fundamentals

- Introduction to Process Plants
- Scope of Piping in Projects
- Plant Piping Systems and Transportation Pipelines
- Definition & Application of Pipe
- Pipe Designators – NPS , IPS , NB, Pipe Wall Thickness & Schedule, Pipe
- Weights, Lengths, Grades, Ends, Joining Methods, Methods of Manufacture, Pipe Ratings, Pipe Symbols.

#### 2. ASME Codes & Standards

- Introduction to ASME Pressure Piping Design Codes.
- ASME Standards for Common Piping Elements.
- API Codes
- Other Codes & Standards

#### 3. Pipe Fittings – ASME Standards, Selection, Application, Drawing Symbols & Dimensioning.

- Types of Fittings – Butt Weld, Screwed & Socket Weld.
- Elbow – 90 degree (LR & SR), 45 degree, Reducing Elbow
- Pipe Bends – Miter Bends, 180 degree Return.
- Branch Connections – Weld Straight & Reducing Tee, Cross & Lateral.
- Fabricated Branch Connections – Stub In & Stub On, Welding Minimums for Stub In,
- Branch Reinforcements – Reinforcing Pad, Welding Saddle & Olets
- O-let Fittings – Weldolets, Sockolets, Threadolets, Latrolets, Elbolets & Sweepolets.
- Reducers – Concentric & Eccentric, Reducer Offsets.
- Types of Couplings, Weld Cap.
- Fitting Makeup – Dimensioning, Minimum Pipe Length Requirements,
- Placement of Dimensions
- Screwed & Socket Weld Fittings – Union, Plug, Coupling, Types of Swages.
- Manufacturing methods of and markings on fittings
- Dimensioning Exercises

#### 4. Pipe Flanges – ASME Standards, Symbols, Selection & Application.

- Definition of Flange
- Types of Flanges based on Face and Application, P-T. Ratings – Forged
- Steel and Cast Iron Flanges.
- Flange Facings – Flat Face, Raised Face, RTJ, & Male - Female, Tongue &
- Groove, Flange Face Finish

- Weld Neck, Slip On, Threaded, Socket Weld, Lap-Joint, Reducing, Blind &
- Orifice Flanges.
- Gaskets – Types, Thickness, Bolts & Nuts
- Dimensioning Exercises

#### 5. Valves – ASME/API Standards, Symbols, Selection & Application

- Definition.
- Valve Functions, Locations & End Connections.
- Valve Types – Gate, Globe, Ball, Check, Butterfly, Angle, PRV/PSV, & Plugs etc.
- Control Valve Manifold. – Layout Representation & Requirements.
- Valve Operators.
- Valve Layout Considerations
- Valve Data Sheets
- Valve Selection
- Dimensioning Exercises

#### 6. Piping Special Elements

- Strainers
- Bellows/Expansion Joints
- Rupture Disc
- Spectacle Blind
- Blanks
- Spacers
- Spray Nozzles
- Steam Traps
- Flame Arrestor
- Vortex Breaker
- Hose

#### 7. Mechanical Equipment - API Standards, Symbols, & Application.

- Static – Horizontal Vessels, Vertical Vessels, Storage Tanks, Heat Exchanger & Reboiler
- Rotary – Pumps, Compressor, Fans, & Steam Turbines.

#### 8. Flow Diagrams

- Process Flow Diagram – PFD
- Piping & Instrumentation Diagram – P & ID.
  - 1) Line Numbering
  - 2) P& ID Requirements
  - 3) Print Reading Exercise
  - 4) Line Number
  - 5) Flow Diagram Vs Piping Drawings.
  - 6) Flow Diagram Exercises.
  - 7) Symbols & Abbreviations.
- Instrument Types & Symbols – Flow, Temp, and Pressure & Level
- Utility Flow Diagram – UFD

#### 9. Piping Specifications

- Piping Specifications
- Material Selection
- P-T ratings
- Valve Data Sheets

#### 10. Plot Plan, Equipment Layout, & Piping GA Drawings.

- Plot Plan Development & Requirements.
- Equipment Layout Terminology, Control Point & Battery Limits.
- Preparation of Equipment Layout
- Piping GA Drawing Requirements and Layout Procedure
- Pump GA Drawing and Layout Consideration
- Tank & Vessel Layout Consideration
- GA - Print Reading Exercise

#### 11. Piping Isometrics

- Definition
- Drawing Piping Isometrics
- Isometric Dimensions, Notes & Callouts
- Isometric Offsets.

- Print Reading Exercises.
- Exercises on Creation of Isometrics from Piping Plans and Sections

## 12. Piping Spools

- Definition
- Types of Spool Drawings.
- Guidelines to Prepare Spool Drawings
- Print Reading Exercises
- Exercises on Creation of Piping Spool from Piping Isometrics
- Preparation of BOQ /MTO

## 13. Pipe Supports

- Classification of Supports
- Primary & Secondary
- Anchors
- Pipe Guides
- Limit Stops
- Pipe Shoe
- Dummy Leg / Trunion
- Field Support / Base Support
- Rigid Hangers – Rod & Clevis, Trapeze
- Flexible Hangers – Variable & Constant
- Pipe Rack Design – Types, Height & Width Calculations, Pipe Arrangements
- Control Station & Utility Station on Pipe Racks

Numerous Exercises are carried out to illustrate application to Piping Systems, Detailed Engineering, Layout Engineering and Pipe Drafting

## Piping Systems Design

### 1. Hydraulic Design of Liquid Piping Systems & Pipelines

- Pipe Sizing calculations
- Velocity Variation in Pipes
- Typical Velocities for Water Piping & Other Liquids
- Pressure Drop due to Friction
- Hazen Williams Equation and Darcy Weisbach Equation
- Friction Factor, Reynolds Number, Colebrook White Equation and Moody Diagram
- Minor Losses in Pipe Fittings – Equivalent Length Method & K Factor method.
- Total Pressure Required – Friction Head, Elevation Head, Minimum Delivery Pressure
- Elements of Total Dynamic Head – Static Head, Pressure Head, Velocity Head, Friction Head
- Pump Horse Power Required.
- Cavitation in Pumps
- NPSH Required & NPSH Available for Pumps.

Numerous Examples are covered to illustrate application of Pipe Hydraulics

### 2. Pressure Design of Process Piping Systems – ASME B 31.3

- Scope of ASME B 31.3,
- ASME B 31.3 Fluid Service Categories
- Design Pressure & Design Temperature for Piping Systems
- P-T Ratings of Flanges, Butt-weld Fittings & Socket Weld Fittings
- Pressure Design of Straight Pipe under Internal Pressure – Wall thickness Calculations
- MDP – Maximum Design Pressure for Piping Systems
- Branch Reinforcements – Reinforcement Pad Calculations
- Pipeline Wall thickness Calculations – B 31.4 / B 31.8
- MAOP – Maximum Allowable Operating Pressure for Pipelines.
- Piping Material Selection per ASME Code.

#### ADDITIONAL TOPICS:

#### Piping System Fabrication, Maintenance & Integrity Assessment Procedures

*Note: These are elementary / introductory topics for beginners on the subjects*

1. Fabrication Procedures
  - Pipe preparation for welding
  - Pipe Fitting and Welding procedures
  - Pipe Spooling
  - Fabrication and Installation
2. Hot Tapping & Line Stopping
  - What is Hot Tapping & Why Hot Tapping?
  - Hot Tapping Set Up, Operations & Procedure
  - Line Stopping Procedure
3. Pipeline Pigging Operations
  - Definition and uses of Pigs
  - Types of Pigs
  - Pigging operation's procedure

#### Who Should Attend

- Mechanical, Chemical, Petroleum and Material Engineers
- Technicians, Fitters and Welders
- Draftsmen

#### What You Will Learn

How to perform Detailed Engineering, Design, Drafting and layout design of Chemical plant, Petroleum refinery, Gas Processing plant, Petrochemical, Pharmaceutical, Textile, Paper, Semiconductor & Cryogenic Plants in line with the requirements of ASME B 31.3

#### Materials- (Your Take Home)

Training Manuals, Software, Piping Engineering & Design eBooks, Design Charts & Tables and we Guarantee Knowledge transfer.

#### What You Should Bring

Participants should bring a Laptop computer (if you have one), a scientific calculator, sketch pad, pen and a note book.

**Duration:** Required minimum duration – 6 days @ 7 hours daily or 10 days @ 4 hours daily

**Course Fee:** Contact us for an invoice

#### Training Features

- Instructor lead hands-on training
- Assessment quiz and certificate at completion.
- Conducive training environment
- Excellent Material Provided
- Industry Leading Software used in Training
- Individual Attention & Placement Guidance

*We look forward to welcoming you on one of our training sessions....*

## PIPE STRESS ANALYSIS & CAESAR II – ASME B31.3

### Program Description

This course is aimed at exposing the participants to the calculations that address the stresses that piping systems are subjected to. It covers the types of loads on the systems and stresses caused by the loads, methods of resolving these stresses, layout solutions, flexibility analysis, support span calculations and the use of industry standard software for piping stress analysis.

### COURSE OUTLINE

#### Introduction

- Objectives & Definition of Stress Analysis
- Critical Line List
- Information Required for Stress Analysis
- Piping Loads – Static & Dynamic
- Static & Dynamic Analysis
- Forces, Moment & Stress Calculations.
- Requirements of ASME B 31.3 Code – Sustained Loads, Thermal Expansion & Occasional Loads.
- Classification of Loads
- Solutions for Piping Loads.

#### Pipe Span Calculations

- Span limitations based on Stress, Deflection & Natural Frequency.
- Allowable Pipe Span Calculations
- Suggested Pipe Support Spacing
- Pipe Span Reduction Factor for Elbows, Concentrated Loads etc.
- Selection of Supports.
- Location of Supports and Restraints.

#### Flexibility Analysis – Expansion Loops & Expansion Joints

- Concept of Thermal Expansion.
- Providing Flexibility in Piping

- Minimum Leg Required to Absorb Thermal Expansion
- Types of Expansion Loops
- Expansion Loop Sizing for Hot Piping
- Expansion Joints – Types, Application & Selection.
- Bellow Materials, Hydrostatic Test Pressure for Bellows
- Guide Spacing for Expansion Joints.

#### Layout Solutions for Weight, Thermal, Vibration and Wind Loads.

- Causes of Pipe Stress
- Layout Solution for Weight Stress – Continuously Supported & Branch Pipe Allowable Spans
- Solving Concentrated Loads and Reducing Loads on Equipment Nozzles.
- Equipment Nozzle Load Qualifications.
- Layout Solutions for Thermal Load using force & Stress

# CAESAR II – Pipe Stress Analysis Software

- Introduction to CAESAR II
- Piping Input Spreadsheet.
- Modeling of Piping Isometrics – Bends, Reducers, Tees, Valves, Flanges, and Loops etc.
- Modeling supports and restraints
- Performing Static Analysis
- Modifying Load Cases
- Hanger Selection
- Set up of Wind Load Cases.
- Set up of SUS, OPE, EXP, HYD, HGR, & OCC loads.
- Load Case Editor
- Viewing Reports
- Practical Examples – Input, Analysis & Redesign

## What You Should Bring

Participants should bring a Laptop computer, a scientific calculator, sketch pad, pen and a note book.

***N/B Laptops will be provided for those who do not have, it is however preferred that participants come with theirs as assignment on CAD software will require practice at home for perfection.***

## What You Will Learn

Calculations addressing Stresses (manually and using software) pertaining to piping systems in Chemical plant, Petroleum refinery, Gas Processing plant, Petrochemical, Pharmaceutical, Textile, Paper, Semiconductor & Cryogenic Plants in line with the requirements of ASME B 31.3

## Who Should Attend

- Mechanical/ Chemical/Petroleum Engineers
- Technicians
- Draftsmen

## Materials- (Your Take Home)

Training Manuals, Software (fully installed on your system), eBooks, Charts & Tables and we Guarantee Knowledge transfer.

**Duration: Required minimum duration – 3 days @7 hours daily or 4 days @ 4 hours daily**

**Course Fee: Contact us for an invoice**

## Training Features

- Instructor lead hands-on training
- Assessment quiz and certificate at completion.
- Conducive training environment
- Excellent Material will be Provided
- Industry Leading Software (CAESAR II) used in Training
- Individual Attention

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# 3D Modeling with PDMS 12.0

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## Plant Design Management System

### Program Description

PDMS is industry standard software for 3D plant modeling. The software is equipped with vast capabilities including Equipment modeling, Pipe work modeling, Isometrics, MTO, Drafting etc.

Participants of this training will be exposed to the practical use of the software during the training, as they design a unit in a refinery operation.

### COURSE OUTLINE

#### Introduction to PDMS

- Logging onto PDMS
- Use of the mouse in PDMS
- PDMS Modules and Applications
- Design Explorer
- Navigate Tools

#### Equipment Application

- Overview of PDMS
- Equipment Application & Hierarchy
- Equipment Modeling Options (Use of Primitives and Standard)
- Creating Equipment using Primitives
- Model Editor for Equipment
- Obstruction Volumes
- Negative Primitives
- Creating Nozzles
- Create Equipment using Standard Templates
- Explicit Positioning, Rotate, Move command

#### Pipework Application

- Piping Application & Hierarchy
- Piping Specifications
- Pipe creation form
- Pipe modification form
- Pipe component creation form
- Model Editor & Settings
- Head & Tail attributes
- Piping component creation and Assembling
- Component selection/reselection
- Data Consistency
- Changing Specifications
- Generating Piping Isometrics
- Generating MTO
- Use of Tool bars, short cuts and PDMS Commands

#### Structures

- Structure Application overview & Hierarchy

#### Beams & Columns Application

- Specification setting
- Setting Storage Areas
- Fittings & Joints
- Section nodes & Panels
- Creating Straight & Curved Sections

#### Panels & Plates

- Specification setting
- Setting Storage Areas
- Create panels and plates
- Creating penetrations

#### Walls & Floors Application

- Specification setting
- Setting Storage Areas
- Creating walls
- Negative Extrusions & Panel Fittings
- Modifying Structural Sections
- Bracing configurations
- Splitting & Connecting Split Sections

#### Access ways, Stairs & Ladders

- Platforms – Rectangular, Circular And Hexagonal Platforms
- Creating platform openings
- Modifying openings
- Handrails
- Editing handrail

#### PDMS Draft

- Overview of Draft
- Automatic Drawing Production (ADP)
- Draft annotation

#### What You Should Bring

Participants should bring a Laptop computer, a scientific calculator, sketch pad, pen and a note book.

**N/B** *Laptops will be provided for those who do not have, it is however preferred that participants come with theirs as assignment on CAD software will require practice at home for perfection.*

#### Who Should Attend

- Mechanical/ Chemical/Petroleum Engineers
- Technicians
- Draftsmen

#### Materials- (Your Take Home)

Software (fully installed on your system), eBooks, and we guarantee Knowledge transfer.

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