

FACT SHEET

Advanced Piping Stress & Flexibility Analysis



Fundamentals of Flexibility Analysis: Basic concepts, stress fundamentals, simplified analysis, degrees of freedom and calculation tools.

Who Should Attend?

This course is intended for **graduates (or soon to be), designers, freelancers, technicians and engineers** involved in: calculation, design, selection, manufacturing, safety, quality and maintenance of systems and equipment in industrial processes.

Previous knowledge of this subject is not required to attend to the course.

Training Objectives

The main objective of this course is to **transfer to participants the theoretical and practical skills required in projects**, obtained from experience and sound engineering practices.

What to Expect?

Acquire the vocabulary and the fundamentals of piping stress analysis.

Examine the main stress analysis methods.

Express or identify the importance of constraints and boundary conditions in piping systems.

Determine the tensional status of piping systems under displacement loads.

Course Duration

Full Course: 120 hs; to be completed in 90 days. The Virtual Campus will be open for 365 days (flexibility).

Methodology

At your own pace

Available 24/7, Self-paced course

“Learn by doing” concept

Non-scheduled sessions

Included in the course

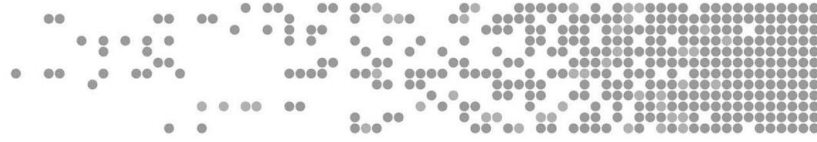
Study Notes

Introductory Videos

Assimilation Test Questions

Case studies to solve with software

Resolution of case studies



Part I: Fundamentals (60 hs)

L1. Mechanic of materials

What is the mechanics of materials?

Basic concepts

Definition of loads and their types

Definition of stresses

Materials mechanics

Deformation

Stiffness

Hooke's law

Tests & Case studies

- *Assimilation questions*

L2. Stress/strain fundamentals

Stress-strain

Engineering stress-strain vs. true stress-strain

Properties obtained by means of a stress-strain curve

Types of stresses

Failure modes

Stress concentrators

Photoelasticity and Thermoelasticity

Tests & Case studies

- *Assimilation questions*

L3. Introduction to stress analysis

Piping systems

Classification of piping systems

Dimensional characteristics of pipes

Common joining methods

Piping Materials

Main piping organizations and codes

Differences between piping codes

Stress and flexibility analysis in piping systems

Challenges of piping stress analysis

Why a stress and flexibility analysis in piping systems?

Stresses in piping systems

Primary, secondary, tertiary stresses in piping systems

Stress intensification factors in piping systems.

In plane and Out plane

Criteria for estimating stresses in piping systems

Stress limits in piping systems according to codes

Combination of loads and stresses in piping systems

Tests & Case studies

- *Assimilation questions*

L4. Stress & flexibility analysis

Stress and flexibility analysis in piping systems

How do you increase flexibility in a piping system?

Stages in a stress and flexibility analysis

Thermal expansion in pipes

Force induced by thermal expansion

Induced stresses and strains

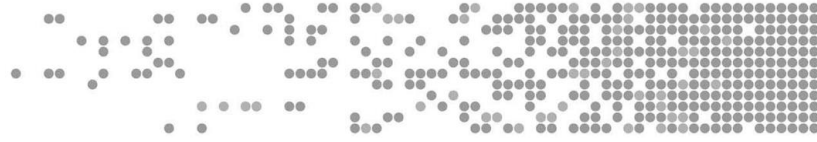
Allowable stresses according to codes

Simplified analytical calculations

Stress and flexibility analysis with computers

Tests & Case studies

- *Assimilation questions*



L5. Considerations for the analysis

Modelling considerations when performing stress and flexibility analysis

Degrees of freedom

Restrictions

Mathematical and physical considerations of a calculation software

Boundary conditions used in analysis

Numerical methods

Types of elements used in mathematical type simulations

Tests & Case studies

- *Assimilation questions*

L6. Stress analysis with computers

Stress and flexibility analysis with computers

Commercial software

Considerations regarding the use of software

Complementary calculations to stress and flexibility analysis

Other software or tools used.

Tests & Case studies

- *Assimilation questions*



Part II: Case studies (60 hs)

Case studies to be solved with software.

L1. Introduction

The objective of this lesson is to provide the necessary tools to solve the proposed cases of the following lessons.

Introduction

Software overview

Main codes contained in the software

Loading the main inputs in the software

Definition of operating scenarios and load cases

Analysis and visualization of results

Tests & Case studies

- *Assimilation questions*
- *Case study*

L2. Loads, stiffness and flexibility

The objective of this lesson is that participants put into practice the concepts acquired, giving flexibility to rigid systems to keep the stress levels within allowable values.

Introduction

Loads and deformation

Flexibility in piping systems

Gain flexibility or decrease stiffness

Tests & Case studies

- *Assimilation questions*
- *Case studies to increase flexibility in piping systems*

L3. Movement, stiffness & loads

The objective of this lesson is for participants to analyse the stress state of a piping system whose routing has been previously defined, comparing the induced stresses against the code allowable stresses.

Introduction

Different load types in piping systems

Movements at terminal points (Edge/border)

Stiffness and associated movements in boundary conditions

Tests & Case studies

- *Assimilation questions*
- *Case studies: evaluation of stress levels of different piping systems*

L4. Nozzle movements

The objective of this lesson is to obtain the stresses induced in nozzles/equipment connections, later comparing them with the code allowable values.

In those cases where the loads induce greater than allowable stresses, ways of reducing them must be considered.

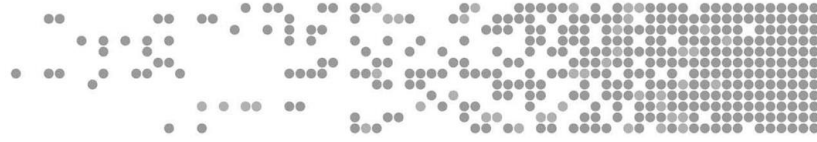
Introduction

Displacement, local and global stiffness, rigid elements

Other types of stiffness

Tests & Case studies

- *Assimilation questions*
- *Case studies: evaluation of loads in a centrifugal pump*



L5. Additional considerations

The objective of this lesson is to consider the additional considerations in the case studies presented for different piping systems.

This analysis includes the stress verification of the systems, the verification of deformations and the location of restrictions.

Introduction

Unexpected or underestimated movements

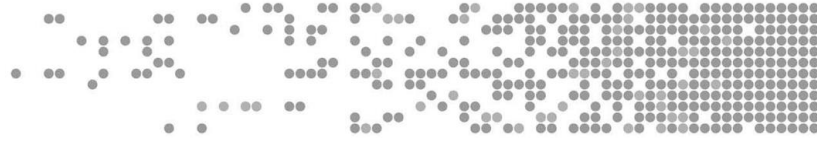
Simulation of characteristic rigid elements

Special considerations for restrictions in elbows

Local stresses at trunnions

Tests & Case studies

- *Assimilation questions*
- *Case studies for improving stress levels in piping systems.*



Instructor

Senior Mechanical Engineer and graduate in management. **More than 31 years of experience in the design, calculation and manufacturing of piping systems and equipment.**

Duties of the above-mentioned positions cover the entire cycle of an equipment, **from the very conception, drawings, design and calculation, technical specifications, technical requisitions, vendor drawings, to the manufacturing phase and installation assistance.**

Among the developed projects, clients such as SHELL, EXXON, REPSOL, CHEVRON, GALP, CEPESA, TUPRAS and SAUDI ARAMCO can be found.

Vast experience providing specific training sessions in both classroom and online approaches. More than 50 training courses carried out in different institutions and in-company, courses oriented to graduates, designers, engineers and experienced professionals.

Tailored Training

The most effective training is one that satisfies the needs of each company's business focus and deliverables. **We adapt our training programs to each specific requirement, offering bespoke solutions for each need.** The result, 100% tailored programs, developed to maximize the time investment and deliver tangible and intangible returns to the work teams.

After assessment phase, a tailored training plan is designed jointly with the client. This plan is specifically tailored to meet the client's needs, focusing on effectively enhancing the capabilities of the work team. **We provide practical, dynamic and hands-on training,** making available the best instructors in each subject.

Arveng Training

Arveng Training has developed effective and practical courses for the needs of today's industrial challenges by delivering specific and high-quality engineering training courses utilizing all three approaches: **classroom, on-line and tailored training.** We are proud to have imparted more than 250 classroom courses, 1800 online courses and over 200 in-company sessions. Our training activities has benefited over 6000 professionals. Our greatest pride is in the letters of recommendation we receive from so many of our customers in this area.

We consider the time of our students as the most valuable. For this reason, all our courses have been designed with the main objective of quickly the professional skills of the participants, through our expert instructors in different disciplines. **We stimulate creativity, innovation and initiative to make the participants inquisitive to bring good engineering practices and lessons learned to the field that benefits their employers in the long term.**

Our Company

Arveng Training & Engineering SL is a leading company providing Training and Engineering services based in **Madrid, Spain.** Our mission and vision are to be a leading training and engineering services company. We are a team of highly motivated, talented high qualified professionals with more than 20 years of experience. Our main goal is to provide our clients, the best training and engineering services and to exceed their expectations in all their spheres of industrial activity, through our renowned services which are based on efficient, innovative, cost-effective and transparent principles.

Established in July 2010, mainly oriented to the industrial sector, from the very beginning Arveng has always worked with closeness, responsibility and commitment in the different areas of activity.