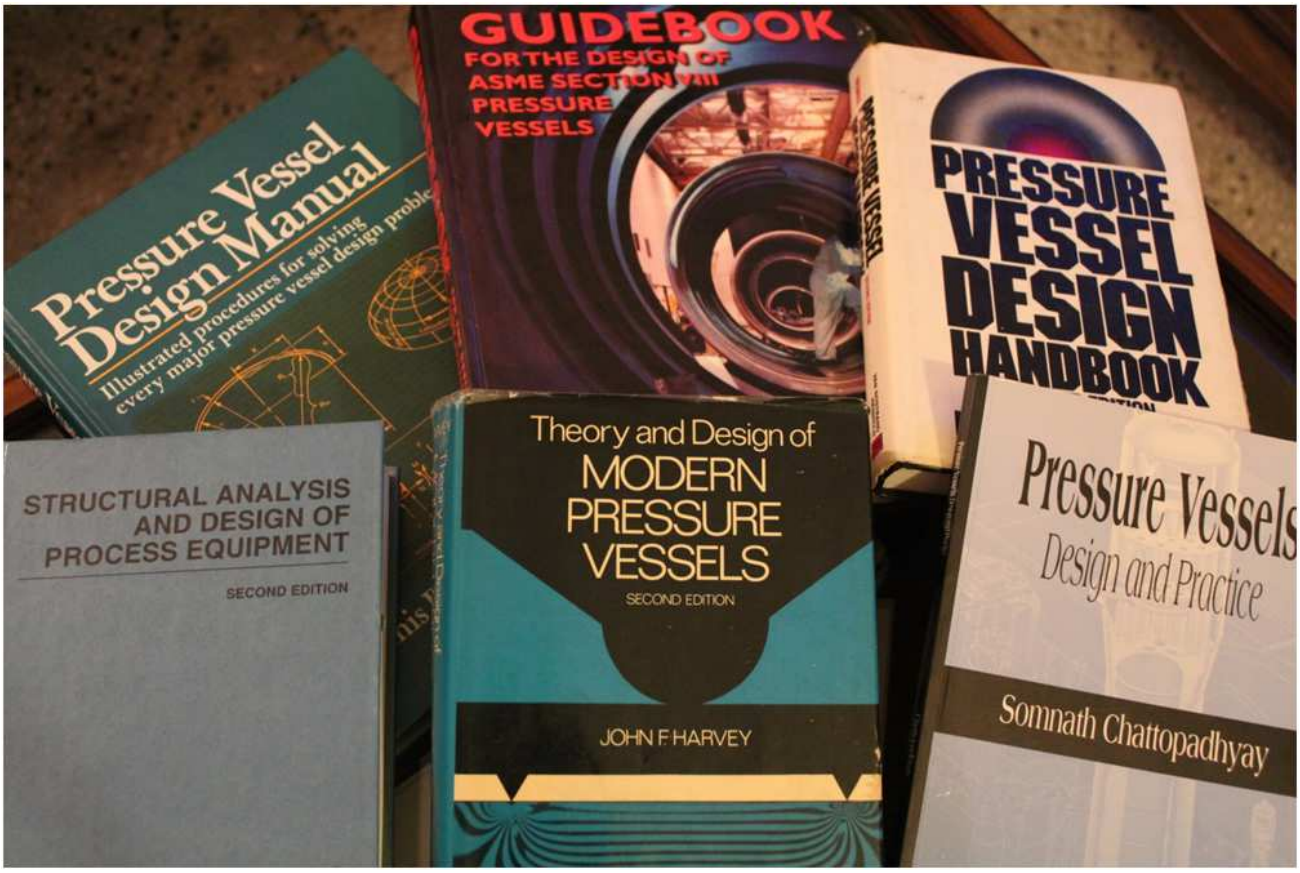
Pressure Vessel Newsletter

Volume 2014, September Issue



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In this issue…

REGULAR FEATURES

For any queries regarding the newsletter, please write to rtiwari123@gmail.com or call at +91 98109 33550

From The Editor's Desk:

The Indian Prime Minister, Mr. NarendraModi, very recently concluded an official visit to Japan. When measured in terms of bringing fresh investments into India from the Japanese industry, the visit was a highly successful one. Energy, infrastructure and environment figure as the key areas for partnership between the two countries.

In the area of energy, the partnership is based on the agreement between India's Petroleum Conservation Research Association and Japan's Energy Conservation Center. In India, oil and gas production is declining as crude oil and coal imports climb. The partnership is likely to increase the Japanese assistance to Indian companies for locating new oil and gas reserves, and purchasing LNG jointly to cut the cost of energy imports.

In the area of infrastructure, Japan is already involved in the Delhi-Mumbai Dedicated Freight Corridor Project. The partnership will extend the economic cooperation to include seawater desalination and gas powered power generation. The cooperation in environment-related field will give a big boost to waste water treatment; air and noise pollution; environmental goods and services; renewable energy and clean energy development mechanism; and carbon abatement technologies.

The increased economic activity as a result of the Indo-Japan cooperation in these areas is likely to give a boost to the pressure vessel and heat exchanger industry as well.

One area where the two countries could not come to an agreement is the Cooperation in Peaceful Uses of Nuclear Energy. Japan's insistence on signing the Nuclear Nonproliferation Treaty and India's refusal to do so remains the big stumbling block. However, in my opinion, this may help India in the long run. I have always believed that all countries, including India, should develop their local resources to meet the energy needs. India has huge reserves of Thorium and she should dedicate her efforts to develop the technology based on Thorium rather than Uranium, a resource that is not available in India and which makes the country dependent on others for its energy needs.

GENERAL DEFINITIONS IN PRESSURE VESSELS

Austenitic Steel: Steel which has a stable austenitic structure at normal (room) temperature.

Carbon Steel: Steel whose major properties depend on carbon content and in which other alloying elements are negligible.

Cast Steel: Any object made by pouring molten steel into molds.

Charpy Test: A test made to determine the notched toughness, or impact strength, of a material. The test gives the energy required to break a standard notched specimen supported at the two ends.

Compressive Strength: Yield – Maximum stress that a compressed metal can withstand without a predefined amount of deformation. Ultimate – Maximum stress a brittle metal can withstand without fracturing when subjected to compression.

Creep: Plastic deformation or flow of metals held for long periods of time at stresses lower than normal yield strength. Especially important if temperature of stressing is near recrystallization temperature of the metal.

Creep Strength: The maximum stress which can be applied to steel at a specified temperature without causing more than a specified percentage increase in length in a specified time.

Ductility: The ability to permit change of shape without fracture. In steel, ductility is usually measured by elongation and reduction of area as determined in a tensile test.

Eddy-Current Test: Nondestructive testing method in which eddy-current flow is induced in the test object. Changes in the flow caused by variations in the object are reflected into a nearby coil or coils for subsequent analysis by suitable instrumentation and techniques.

Elastic Limit: The maximum load per unit of area that may be applied without producing permanent deformation. It is a common practice to apply the load at a constant rate of increase and also measure the increase of length of the specimen at uniform load increments. The point at which the increase in length of the specimen ceases to bear a constant ratio to the increase in load, is called the proportional limit. The elastic limit will usually be equal to or slightly higher than the proportional limit.

Endurance Limit: Maximum dynamic stress to which material may be subjected for an infinite number of times without causing fatigue failure.

Fatigue: The tendency for a metal to break under conditions of repeated cyclic stressing below the ultimate tensile strength.

Heat Treatment: An operation or a combination of operations involving the heating and cooling of steels in the solid state for the purpose of obtaining certain desirable mechanical microstructural or corrosion-resisting properties.

Impact Test: Determines the energy absorbed in fracturing a test bar at high velocity. Test may be in tension or bending, or may be a notch test in which notch creates multi-axial stresses.

Modulus of Elasticity: Within the proportional limit, if the stress is divided by the strain, a value is obtained which is called the modulus of elasticity of the material.

Nominal Dimension: OD, ID or wall thickness of a pipe specified by the buyer, regardless of how the tolerances are expressed.

Normalizing: Heating to about 100^{o}F above the critical temperature and cooling to room temperature in still air. Provision is often made in normalizing for controlled cooling at a slower rate, but when the cooling is prolonged, the term used is annealing.

Quenching: Cooling rapidly by immersion in oil, water, etc.

Radiography: A nondestructive method of internal examination in which metal or other objects are exposed to a beam of x-ray or gamma radiation. Differences in thickness, density or absorption, caused by internal discontinuities, are apparent in the shadow image either on a fluorescent screen or on a photographic film placed behind the object.

Stress Relieving: Reducing residual stresses in a metal by heating to a suitable temperature for a certain time. This method relieves stresses caused by casting, quenching, normalizing, machining, cold working or welding.

Tensile Strength: The maximum load per unit of original cross sectional area obtained before rupture of a tensile specimen.

Work Hardness: Hardness resulting from mechanical working.

Yield Point: The load per unit of original cross sectional area at which a marked increase in the deformation of the specimen occurs without increase in the load. Usually calculated from the load determined by the drop of the beam of the testing machine or by use of dividers.

Yield Strength: The stress at which a material exhibits a specified deviation from proportionality of stress and strain. An offset of 0.2% is used for many metals.

Source: Technical Data Handbook *by The Hartford Steam Boiler Inspection and Insurance Co. – Third Edition*

DISCONTINUITY STRESSES IN PRESSURE VESSELS

Introduction

The principal membrane stresses in a vessel subjected to internal or external pressure are produced as a result of this pressure and remain as long as it is applied. Likewise, the bending stresses in plates subject to pressure or structural loads are produced by these loads and remain as long as these are applied. These are called *primary stresses*.

Primary stresses may be defined as those stresses developed by the imposed loadings which are necessary to satisfy the laws of equilibrium of internal and external forces and moments. The basic characteristic of primary stresses is that they are not self-limiting; hence, when they exceed the yield point of the material they can result in failure or gross distortion. Another example of primary stress is that produced by wind, snow, or other specified live loads. These may produce either tension, compression, or bending, and must be combined with those produced by pressure in determining the total primary stress.

Secondary Stresses, on the other hand, are those stresses developed by the constraint of adjacent parts, or by self-constraint of a structure. The basic characteristic of a secondary stress is that they are self-limiting. Local yielding or minor distortion can satisfy the conditions causing the stress to occur and failure is not expected in one application. Some sources of secondary stresses are:

- All thermal stresses produced by thermal gradients within the structure
- Stresses occurring at the juncture of a cylindrical vessel and its closure head resulting from the differential growth or dilation of these parts under pressure

The effects from secondary stresses are not uniform over the entire vessel, nor are they unrelenting in the sense that the primary membrane stresses are, since they remain as long as the load is applied. In fact, the secondary stresses are relatively local in extent and self-limiting in magnitude since once the differential deflection is satisfied by plastic flow of the material, a more favorable stress distribution results. Although they do not affect the static or bursting strength of the vessel, they are nonetheless important when the vessel is subject to repetitive loading such that high local stresses can seriously limit its fatigue life.

Discontinuity Stresses in Vessels

When a vessel is subjected to internal pressure only, we generally consider the direct tensile stresses, called membrane stresses, occurring over the entire wall thickness. Differential displacements due to membrane stresses of varying magnitudes throughout the vessel can also occur causing bending of the wall. Even though these bending stresses are local in extent, they can sometimes become very high in magnitude. One such location will be at the juncture of the cylindrical shell with its closure head (see Figure 1) where the radial growth of the cylindrical portion of the vessel is not the same as that of the head when the vessel is pressurized. Hence, at the juncture of these parts, local bending takes place to preserve the continuity of the vessel wall. The additional stresses set up at these locations are called *discontinuity stresses*.

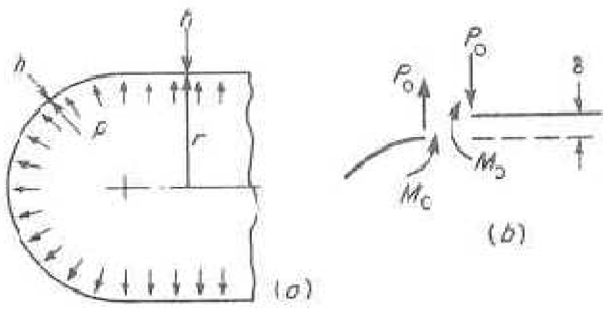

Figure 1: Discontinuity at Hemispherical Head and Cylindrical Shell Juncture

When *h* is small in comparison with *r*, as is the case in thin-walled vessels, the deflection and bending becomes very local in extent and affects the stresses only in the immediate vicinity of the juncture. This narrow zone at the edge of the head can be considered as nearly cylindrical in shape; hence, the equations developed for the cylindrical portion of the vessel can be used for approximate calculations of the deflection in spherical, elliptical, torispherical, or conical shaped heads at the juncture.

Cylindrical Vessels with Hemispherical Heads:

If the cylindrical and spherical portions are disjointed, Figure 1, the difference in the radial growth produced by the membrane stresses in the two portions would be:

$$\delta = \delta_c - \delta_s = \frac{pr^2}{2hE}$$

However, in the actual vessel, the head and cylinder are kept together at this juncture by shearing forces P_o and bending moments M_o per unit length of the circumference. These discontinuity forces produce local bending stresses in the adjacent parts of the vessel. One of the simplest cases which frequently occurs in practice is that in which the cylindrical wall and spherical head are of same thickness. In this case, the deflections and slopes induced at the edges of the cylindrical and spherical parts by the forces P_o are equal; hence the conditions of continuity at the juncture are satisfied if $M_o = 0$ and P_o is of a magnitude to create a deflection at the edge of the cylinder equal to $\frac{\delta}{2}$.

The value of P_o can be found as:

$$P_o = \frac{p}{8\beta}, \text{ where } \qquad \beta = \sqrt[4]{\frac{k}{4EI}}$$

The total longitudinal stress at any distance from the point of juncture of the cylinder and hemisphere is, in the cylinder:

$$\sigma = \frac{pr}{2h} \pm \frac{6}{h^2} \cdot \frac{p}{8\beta^2} \cdot B_{\beta x}$$

The total hoop stress is, in the cylinder:

$$\sigma = \frac{pr}{h} - \frac{pr}{4h} \cdot D_{\beta x} \pm \frac{3}{h^2} \cdot \frac{\mu p}{4\beta^2} \cdot B_{\beta x}$$

Table 1: Functions $A_{\beta x}$, $B_{\beta x}$, $C_{\beta x}$, and $D_{\beta x}$,

β_x	$A_{\beta x}$	$B_{\beta x}$	$C_{\beta x}$	$D_{\beta x}$	β_x	$A_{\beta x}$	$B_{\beta x}$	$C_{\beta x}$	$D_{\beta x}$
0	1.0000	0	1.0000	1.0000	3.6	-0.0366	-0.0121	-0.0124	-0.0250
0.1	0.9907	0.0903	0.8100	0.9003	3.7	-0.0341	-0.0131	-0.0079	-0.0210
0.2	0.9651	0.1627	0.6398	0.8024	3.8	-0.0314	-0.0137	-0.0040	-0.0177
0.3	0.9267	0.2189	0.4888	0.7077	3.9	-0.0286	-0.0140	-0.0008	-0.0147
0.4	0.8784	0.2610	0.3564	0.6174	5π/4	-0.0278	-0.0140	0	-0.0139
0.5	0.8231	0.2908	0.2415	0.5323	4.0	-0.0258	-0.0139	0.0019	-0.0120
0.6	0.7628	0.3009	0.1431	0.4530	4.1	-0.0231	-0.0136	0.0040	-0.0095
0.7	0.6997	0.3199	0.0599	0.3798	4.2	-0.0204	-0.0131	0.0057	-0.0074
π/4	0.6448	0.3224	0	0.3224	4.3	-0.0179	-0.0125	0.0070	-0.0054
0.8	0.6354	0.3223	-0.0093	0.3131	4.4	-0.0155	-0.0117	0.0079	-0.0038
0.9	0.5712	0.3185	-0.0657	0.2527	4.5	-0.0132	-0.0108	0.0085	-0.0023
1.0	0.5083	0.3096	-0.1108	0.1988	4.6	-0.0111	-0.0100	0.0089	-0.0011
1.1	0.4476	0.2967	-0.1457	0.1510	4.7	-0.0092	-0.0091	0.0090	0.0001
1.2	0.3899	0.2807	-0.1716	0.1091	3π/2	-0.0090	-0.0090	0.0090	0
1.3	0.3355	0.2626	-0.1897	0.0729	4.8	-0.0075	-0.0082	0.0089	0.0007

1.4	0.2849	0.2430	-0.2011	0.0419	4.9	-0.0059	-0.0073	0.0087	0.0014
1.5	0.2384	0.2226	-0.2068	0.1580	5.0	-0.0046	-0.0065	0.0084	0.0019
π/2	0.2709	0.2709	-0.2709	0	5.1	-0.0033	-0.0057	0.0080	0.0023
1.6	0.1959	0.2018	-0.2077	-0.0059	5.2	-0.0023	-0.0049	0.0075	0.0026
1.7	0.1576	0.1812	-0.2047	-0.0235	5.3	-0.0014	-0.0042	0.0069	0.0028
1.8	0.1234	0.1610	-0.1985	-0.0376	5.4	-0.0006	-0.0035	0.0064	0.0029
1.9	0.0932	0.1415	-0.1899	-0.0484	7π/4	0	-0.0029	0.0058	0.0029
2.0	0.0667	0.1230	-0.1794	-0.0563	5.5	0.0000	-0.0029	0.0058	0.0029
2.1	0.0439	0.1057	-0.1675	-0.0618	5.6	0.0005	-0.0023	0.0052	0.0029
2.2	0.0244	0.0895	-0.1548	-0.0652	5.7	0.0010	-0.0018	0.0046	0.0028
2.3	0.0080	0.0748	-0.1416	-0.0668	5.8	0.0013	-0.0014	0.0041	0.0027
3π/4	0	0.0671	-0.1342	-0.0671	5.9	0.0015	-0.0010	0.0036	0.0026
2.4	-0.0056	0.0613	-0.1282	-0.0669	6.0	0.0017	-0.0007	0.0031	0.0024
2.5	-0.0166	0.0492	-0.1149	-0.0658	6.1	0.0018	-0.0004	0.0026	0.0022
2.6	-0.0254	0.0383	-0.1019	-0.0636	6.2	0.0019	-0.0002	0.0022	0.0020
2.7	-0.0320	0.0287	-0.0895	-0.0608	2π	0.0019	0	0.0019	0.0019
2.8	-0.0369	0.0204	-0.0777	-0.0573	6.3	0.0019	0.0001	0.0018	0.0018
2.9	-0.0403	0.0132	-0.0666	-0.0534	6.4	0.0018	0.0003	0.0015	0.0017
3.0	-0.0423	0.0070	-0.0563	-0.0493	6.5	0.0018	0.0004	0.0012	0.0015
3.1	-0.0431	0.0019	-0.0469	-0.0450	6.6	0.0017	0.0005	0.0009	0.0013
π	-0.0432	0	-0.0432	-0.0432	6.7	0.0016	0.0006	0.0006	0.0011
3.2	-0.0431	-0.0024	-0.0383	-0.0407	6.8	0.0015	0.0006	0.0004	0.0010
3.3	-0.0422	-0.0058	-0.0306	-0.0364	6.9	0.0014	0.0006	0.0002	0.0008
3.4	-0.0408	-0.0085	-0.0237	-0.0323	7.0	0.0013	0.0006	0.0001	0.0007
3.5	-0.0389	-0.0106	-0.0177	-0.0283	9π/4	0.0012	0.0006	0	0.0006

As an example, the discontinuity stresses in the vessel of Figure 1 for the conditions of p = 300 psi, r = 50 in., h = 1 in., and μ = 0.3 can be found as follows:

Calculate β:

$$\beta = \frac{1.285}{\sqrt{rh}} = \frac{1.285}{\sqrt{50\times1}} = 0.182, \qquad \beta^2 = 0.033$$

Calculate the longitudinal stress in the cylindrical portion:

$$\sigma = \frac{pr}{2h} \pm \frac{6}{h^2}\cdot\frac{p}{8\beta^2}\cdot B_{\beta x}$$

$$\sigma = \frac{300\times50}{2\times1} \pm \frac{6}{1^2}\cdot\frac{300}{8\times0.033}\cdot B_{\beta x}$$

$$\sigma = 7500 \pm 6820 \cdot B_{\beta x}$$

The first quantity in this equation, membrane stress, remains constant along the length of the cylinder, while the second quantity, the bending stress, varies along the length of the vessel reaching a maximum numerical value at βx = π/4 as observed from an inspection of the Table 1. This variation is plotted in Figure 2.

Calculate the hoop stress in the cylindrical portion:

$$\sigma = \frac{pr}{h} - \frac{pr}{4h} \cdot D_{\beta x} \pm \frac{3}{h^2} \cdot \frac{\mu p}{4\beta^2} \cdot B_{\beta x}$$

$$\sigma = \frac{300\times50}{1} - \frac{300\times50}{4\times1} \cdot D_{\beta x} \pm \frac{3}{1^2} \cdot \frac{0.3\times300}{4\times0.033} \cdot B_{\beta x}$$

$$\sigma = 1500 - 3750 \cdot D_{\beta x} \pm 2040 \cdot B_{\beta x}$$

The first quantity in this equation, membrane stress, remains constant along the length of the cylinder, while the direct compression stress due to shortening of a radii and the bending stress varies along the length of the vessel. The variation is shown in the plot of these stresses in Figure 3.

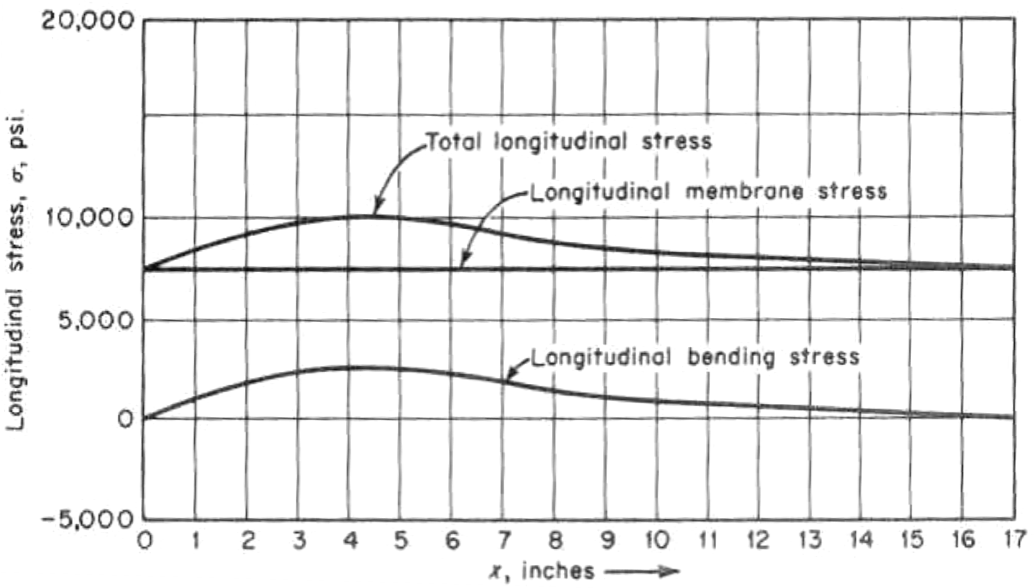

Figure 2: Longitudinal Stresses in the Cylindrical Portion of the Vessel

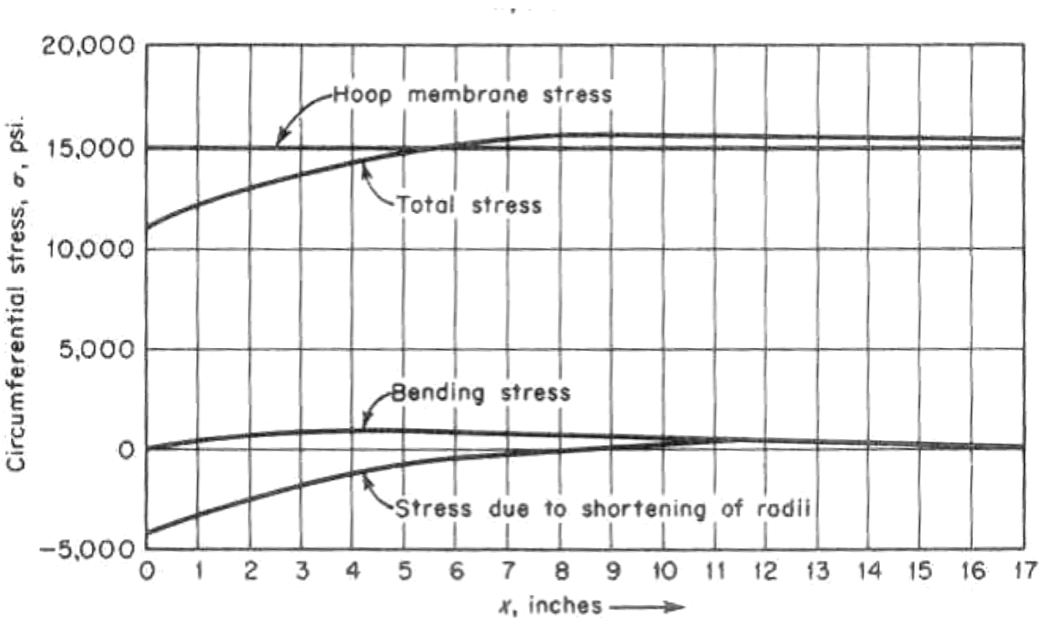

Figure 3: Hoop Stresses in the Cylindrical Portion of the Vessel

This discussion and the example considered the case in which both the thickness and the modulus of elasticity of the head and cylindrical portions were equal. When the head is thinner than the cylindrical portion (as will usually occur in case of hemispherical head), or when the modulus of elasticity is not same for parts joined, there will be both a shearing force P_o and a moment M_o at the juncture.

Source: *Theory and Design of Modern Pressure Vessels* by John F. Harvey.

TRAINING ANNOUNCEMENT

DESIGN & FABRICATION OF PRESSURE VESSELS: ASME SECTION VIII, DIVISION 1

Pressure vessels and heat exchangers are the workhorses for storage and processing applications in the chemical, petroleum, petrochemical, power, pharmaceutical, and food and paper industries. ASME BPV, Section VIII, Div. 1 Code and TEMA standard are used for the design and fabrication of these equipments by most companies around the world.

Wewould like to announcetwo training courses in the month of October and November. First is the ten (10) day training workshop for pressure vessels and heat exchangers in New Delhi. This is a very intensive course generally intended for fresh graduates, and engineers with 10 years' experience or less. The second is the three (3) day training course for "Design and Fabrication of Pressure Vessels: ASME Section VIII, Div. 1" in Mumbai. This course provides the information that will help you understand the ASME requirements for the design and fabrication of pressure vessels, and is based on 2013 edition of the code. It is replete with worked examples covering important aspects of pressure vessel construction. This hands-on learning will allow you to master in 3 days what would otherwise take up to a year or more of on-job training.

New Delhi – October 6-17, 2014

- Introduction to Boiler and Pressure Vessel Code
- Materials of Construction
- Low Temperature Operation
- Joint Efficiencies
- Welding Requirements
- Design of Components
- Openings and Reinforcements
- Fabrication, Inspection and Tests
- Markings and Reports
- Tall Towers and Pressure Vessel Supports
- Nozzle Loads
- Introduction to ASME Section VIII, Division 2
- Introduction to Shell-and-Tube Heat Exchangers
- General Description and Nomenclature
- Construction of Shell and Tube Heat Exchangers
- Codes and Standards
- Mean Temperature Difference
- TEMA Standards
- Thermal Design of Condensers
- Thermal Design of Reboilers
- Examples – Thermal Design
- Mechanical Design Aspects
- Tubesheet Design – Part UHX
- Examples – Mechanical Design
- Flow Induced Vibration
- Heat Exchanger Fouling
- Heat Exchanger Troubleshooting
- Maintenance and Inspection
- Air-cooled Heat Exchangers

Mumbai – November 6-8, 2014

- Introduction to Boiler and Pressure Vessel Code
- Materials of Construction
- Low Temperature Operation
- Joint Efficiencies
- Design of Components
- Openings and Reinforcements
- Fabrication, Inspection and Tests
- Markings and Reports
- Tall Towers and Pressure Vessel Supports
- Nozzle Loads
- Fatigue Analysis
- Introduction to ASME Section VIII, Division 2

Registration Fees

10 day course: Professionals - Rs 52,500; Students - Rs 33,500
3 day course: Professionals - Rs 25,300; Students - Rs 16,000

For the 3-day course only, a discount of 15% is available for group registration of 2 or more participants. Additionally, early bird discount of 15% is available if registration is done on or before October 24th. Registration fee includes training, a collection of articles on design and fabrication of pressurevessels, copy of the presentation, certificate from CoDesign Engineering, and beverages and lunch on all days. It excludes travel to and from the training center, accommodation, and meals and beverages other than those provided during the course.

Mr. Ramesh Tiwari is an ASME member and an internationally recognized specialist in the area of pressure vessels, heat exchangers, solar energy, materials, and codes and standards. He is a registered Professional Engineer in the State of Maryland in the United States. Mr. Tiwari is a member of ASME Boiler & Pressure Vessel, Section VIII Subgroup on Heat Transfer Equipment, and a member of ASME International Working Group on B31.1 for Power Piping in India.

Rajiv Mukherjee is a freelance consultant in unfired heat transfer based in New Delhi, India. He is a member of HTRI and a licensed user of their software. He has over 40 years of experience in the thermal design, revamp and troubleshooting of air-cooled and shell-and-tube heat exchangers, and in the design of heat exchanger networks. His has two books to his credit - "Practical Thermal Design of Shell-and-Tube Heat Exchangers" and "Practical Thermal Design of Air-cooled Heat Exchangers".

We invite you to make nominations. In case of any queries, including the registration process, please email at learning@codesignengg.com, or call at +91 98109 33550.

RUPTURE HAZARD OF PRESSURE VESSELS

Problem

Improperly operated or maintained pressure vesselscan fail catastrophically, kill and injure workers andothers, and cause extensive damage even if thecontents are benign.

Examples of Accidents

Three workers were killed and a number of otherswere injured when a high-pressure vessel containingair and water ruptured. The vessel that ruptured wasoriginally designed with a working pressure of 1740pounds per square inch (psi), but was operatingbetween 2000-3000 psi. After a number of years ofservice, the vessel developed a pin-hole leak. Theleak was repaired but not in adherence withrecognized codes. About a month later, the vesselfailed catastrophically at the weld area. The vesselripped apart and rocketed through the roof. Majorpieces of shrapnel weighed from 1000 to 5000pounds. Some pieces were thrown a half mile away.Fortunately, people on a nearby highway and anearby commuter railway narrowly missed injury.Damage to the plant was extensive and a portion ofthe state was without phone and electrical servicesfor many hours.

Hazard Awareness

This accident demonstrates the potential danger ofpressure vessels if they are not properly designed,constructed, operated, inspected, tested, orrepaired. The higher the operating pressure and thelarger the vessel, the more energy will be released ina rupture and the worse the consequences. It shouldbe emphasized that the danger exists even if thevessel contents are not flammable, reactive, orexplosive. In the case above, a vessel containing onlywater and air ruptured and released great energy.Had the contents of the vessel been flammableand/or toxic, the consequences would probablyhave been magnified.

Factors in Pressure Vessel Failure

The following conditions and factors have played major roles in pressure vessel accidents:

- Operation above the maximum allowable Rupture Hazard of Pressure Vessels working and test pressures.
- Improper sizing or pressure setting of relief devices.
- Improper operation of relief devices due to faulty maintenance and failure to test regularly.
- Failure of the vessel due to fatigue from repeated pressurization, general thinning from corrosion or erosion, localized corrosion, stress corrosion cracking, embrittlement, holes and leaks.
- Failure to inspect frequently enough.
- Improper repair of a leak or other defect involving welding and annealing that embrittles and further weakens the vessel. Hazards posed by a vessel can be worse if repair welds are made without shutting down and de-inventorying the vessel. If a pressure vessel is repaired without removing the water, the quench effect of the water can embrittle the steel.
- Overpressuring and failure of the vessel due to exothermic reaction or polymerization.
- Vessel exposure to fire.

Pressure Vessel Laws

Requirements for pressure vessels vary widely fromcountry to country, and from state to state.in a country Many countries and states have a boiler law, butothers do not. Even for those states that have aboiler law, typical practices (e.g., inspector requirements) for pressure vessels may vary.In the US, stateboiler laws that require general adherence toAmerican Society of Mechanical Engineers (ASME)codes or National Board Inspection Code (NBIC)usually require the following for each pressurevessel:

- Registering with the state boiler and pressurevessel department.

- Designing and constructing in accordancewith Section VIII of the ASME Boiler andPressure Vessel Code (ASME Code), Rules for Construction of Pressure Vessels, Division 1,which covers vessels operating between 15psi and 3000 psi.
- Marking the ASME Code on the vessel with specified information that includes themanufacturer, the serial number, the year built,and the maximum allowable working pressurefor a specific temperature, and any specialsuitability such as for low temperature andpoisonous gases or liquids.
- Having the vessel approved for installation withthe submission of drawings, specifications,welding details and calculations, and having anauthorized inspector be satisfied with thewelding and witness the testing.
- Operating at pressures below the maximumallowable working pressure with pressurerelieving devices set according to the ASMECode; testing at regular intervals.
- Periodically inspecting for corrosion anddefects, and testing according to the NBICManual for Boiler and Pressure Vessel Inspectorsor American Petroleum Institute (API) 510,"Pressure Vessel Inspection Code," for vessels inthe petrochemical industry.
- Repairing or altering only according to a planapproved by an authorized inspector andconducted by test-qualified welders. Theinspector must be satisfied that the repairs areperformed according to NBIC or API 510 andspecify any necessary nondestructive andpressure testing. Increasing the maximumallowable working pressure or temperature isconsidered an alteration whether or notphysical work is done.

Where pressure vessel laws are not mandatory, or they do not exist, good safetypractices require that similar precautions be followedin the design, construction, welding, testing, marking,operation, inspection, and repair of any pressurevessel. The ASME Code should be used for the design,construction, initial testing, and operation of pressurevessels. The NBIC or API 510 should be used formaintenance and inspection and subsequent testing.Boiler and machinery insurance companies, somepressure vessel suppliers, or jurisdiction-licensedindependent contractors can provide authorizedinspectors.

Evaluating potential Explosion Hazard

Facilities, particularly those without formal pressurevessel inspection programs, should survey theirvessels, review pertinent history and data to identifyhazards, and prevent vessel rupture or catastrophicfailure. Among the questions to be asked and answered arethe following:

1) Does the vessel operate above 15 psi, and wasit designed, fabricated, and constructedaccording to the ASME Code or otherapplicable code?

   Is the vessel code labeled or stamped?

   Is the operating pressure and size of the vesselknown?

2) Is the vessel maintained, inspected, andrepaired according to the NBIC and/or API 510?
3) Are the ratings and settings of the relievingdevices appropriate?

   Are the devices tested regularly and how recently?

4) Is the vessel inspected periodically?

   What are the criteria for inspection frequency?

   When was it last inspected externally?

   When was it last inspected internally?

   Did the inspection disclose general thinning ofwalls due to corrosion, localized corrosion, stresscorrosion cracking, embrittlement, holes, leaks,or any other defects that required follow up?

   Were they followed up?

5) Has the vessel been repaired?

Were the plan of repair, welding techniquesand safety tests approved by a certified or authorized inspector?

Was the welding done by a qualified welder?

Were the welding performance qualificationtests approved by an inspector?

Was the vessel tested after the repair wascompleted?

6) Was the vessel down rated and were thenecessary changes in operating conditions andrelief device settings made?

7) Are exothermic reactions carried out in thevessel?

   Does the vessel have an emergency reliefsystem to handle runaway reactions?

Source: This article has been taken from the March – April 2008 issue of the Chemical Emergency Prevention and Planning newsletter published by US Environmental Protection Agency.

TRAINING CALENDAR ANNOUNCEMENT

2014	
October 6-17 ***New***	Ten (10) Day Workshop: Pressure Vessels and Heat Exchangers New Delhi
November 6-8	Design and Fabrication of Pressure Vessels: ASME Section VIII, Division 1 Mumbai
December 11-13	Design and Fabrication of Pressure Vessels: ASME Section VIII, Division 1 Chennai
2015	
TBA	One (1) Day Pressure Vessel Workshop Vadodara
TBA ***New***	Introduction to API 510: Pressure Vessel Inspection New Delhi
TBA	Introduction to ASME Section VIII, Division 2 Bengaluru
TBA	Design and Fabrication of Pressure Vessels: ASME Section VIII, Division 1 Vadodara
TBA ***New***	Introduction to European Code EN 13445 for Unfired Pressure Vessels Mumbai
TBA	Design and Fabrication of Pressure Vessels: ASME Section VIII, Division 1 Chennai
July 16-18	Introduction to ASME Section VIII, Division 2 New Delhi
August 20-22	Design and Fabrication of Pressure Vessels: ASME Section VIII, Division 1 Mumbai
September 7-18	Ten (10) Day Workshop: Pressure Vessels and Heat Exchangers New Delhi
October 15-17 ***New***	Thermal and Mechanical Design for Shell & Tube Heat Exchangers Pune
November 12-14	Design and Fabrication of Pressure Vessels: ASME Section VIII, Division 1 Bengaluru
December 10-12 ***New***	Introduction to Fitness for Service Using API 579/ ASME FFS Mumbai

TBA: Date to be announced at a later date.

NEWS AND EVENTS

2014 Abu Dhabi International Petroleum Exhibition & Conference

November 10-13, 2014
Abu Dhabi, UAE

This event is an opportunity for like-minded professionals to join and contribute to one of the largest industry shows in the Middle East. Providing a first-rate platform for exchanging knowledge and best practices, the conference brings together renowned international speakers, researchers, and experts with a carefully selected mix of technical presentations, executive plenary session, and panel discussions.

FABTECH

November 11-13, 2014
Georgia World Congress Center
Atlanta, GA USA
www.fabtechexpo.com

Get information about FABTECH, which will be conducted at the Gerogia World Congress Center in Atlanta, Georgia from November 11th to November 13th, 2014. The FABTECH web site notes that the exposition will host over 27,000 attendees and 1,400 exhibiting companies. FABTECH is the United States' largest metal forming, fabricating, welding and finishing trade show. People in the pressure vessel manufacturing and fabrication industry along with folks in the steel processing and fabrication industry who attend FABTECH will learn about metal forming, fabricating, welding and finishing products and developments.

September 2, 2014:

SINOPEC Engineering announced that the Company formally entered into an EPCC (engineering, procurement, construction and commissioning) package contract of Project RAPID with PRPC, a subsidiary of Petroliam Nasional Bhd. The total contract value is approximately US$1.329 billion. Located in the region of Pengerang, Johor, Malaysia, Project RAPID is a substantial oil refining and petrochemical integrated engineering project owned by PETRONAS. Project RAPID will contribute towards meeting the growing demands for oil products and chemical material in Southeastern Asia. The work scope of SEG under the Contract includes a 15 million tons per annum ("Mtpa") Crude Distillation Unit, an 8.8 Mtpa Atmospheric Residue Desulphurization Unit, a Hydrogen Collection and Distribution Unit and a Fuel Oil System. The expected contract term is 52 months.

September 6, 2014:

Technip was awarded by Air Products a contract to provide project management, as well as engineering, procurement and construction management (EPCM) services for a new industrial gas complex for Bharat Petroleum Corporation Limited – Kochi Refinery (BPCL-KR) located in the state of Kerala, India. Being built on a "Build-Own-Operate" basis (BOO), the industrial gas complex of Air Products is designed to cater to the requirement of industrial gases (Hydrogen, Nitrogen and Oxygen) of BPCL-KR for its Integrated Refinery Expansion Project (IREP), which will increase BPCL-KR's crude refining capacity from 9.5 million metric tons per annum to 15.5 million metric tons per annum (from 190,000 barrels per day to 310,000 barrels per day) and produce clean transportation fuels to meet Euro IV/V specifications. The BOO project of Air Products includes the following main units: Two trains of hydrogen production unit (based on steam methane reforming) of 8.2 metric tons per hour capacity (approximately 91,000 Nm3/hr), an air separation unit to produce nitrogen and oxygen, steam generation and export to BPCL's manufacturing process, a gas turbine to produce power for the Air Products facility, other utilities required for the BOO facility.

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BUILDING A BETTER TOMMORROW

It is becoming less practical for many companies to maintain in-house engineering staff. That is where we come in – whenever you need us, either for one-time projects, or for recurring engineering services. We understand the codes and standards for pressure vessels, and can offer a range of services related to them.

Training & Development

Consulting Services

CoDesign Engineering

Pressure Vessels ● Heat Exchangers ● Piping Systems ● Welding
Oil & Gas ● Power ● Chemical ● Petrochemical ● Fertilizer ●Solar ● Biogas