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Resumptions and Enhancement Concerning the Trading Discounts within the Context of the New Accounting and Fiscal Regulations in Romania

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ABSTRACT

Within a competitive economy, the trading discounts constitute a frequent practice, whereby the asset and service providers instill loyalty to the current customers or propose themselves to draw new clients. While the economic and legal practice of entities use a diversity of trading discounts, both from the point of view of their name and the complexity of clauses of the trading agreements, the relevant national regulations try to take into account the trading news and innovations. Our study proposes to specify the impact of the last changes in the accounting and fiscal legislation of trading discounts within the context whereby they may generate fiscal vulnerabilities to all the contracting entities, whether they are profit tax payers or micro-enterprise income tax payers.

Introduction

Trading discounts constitute a frequent practice in the business environment, whereby the maintenance of the existence customers, as well as drawing of new clients is followed. Independently of the rigorous analysis achieved on the negotiation of contractual clauses, based upon the observance of applicable trading legislation, the trades developed by the entity must observe the provisions of Fiscal code and Order 1802/2014.

Even though the trading legislation is not sufficiently adapted to the specifics of trades developed on the entities' practice, and the accounting legislation avoids the regulation of many situations in the economic reality, we still have to notice that the latter one suffered a lot of changes over time, the last one being at the end of 2015 year, when, by the Order 4160/2015, issues regarding the trading discounts received after the invoicing of inventories/tangible and intangible assets were introduced. The New Fiscal Code was not subject to changes of substance, the trading discounts being identically treated with respect to the limits and conditions whereby the micro-enterprise taxation of VAT, profit tax or income tax basis must be lowered.

Our study shows an analysis of accounting and fiscal regulations that allows a setup of treatments specific to granted-received trading discounts, the chosen examples having the role of explaining including the fiscal impact over the entities, whether they apply the VAT system to invoicing or VAT to encashment.

Analysis of the main legal provisions

The most trading practices and general trading rules are regulated by the Government Ordinance 99/2000 regarding the trading of market products and services. We shall further show the main issues that must be taken into account for the implementation of accounting and fiscal treatments. The accounting legislation, valid since 01.06.2016, delivers the thematic of trading discounts at points 76 and 77 of the Annex to the Order 1802/2014.

Regarding the accounting treatment

The accounting treatment of trading discounts granted for the invoiced assets/services is registered as a decrease of turnover (the assessment of incomes being made on the net trading value), while the trading discounts granted after the invoicing lead to the distinct recognition of a corrective income (*accounting account 709 „Trade discounts offered” whereof debtor sold is taken into account with minus on the establishment of turnover*).

The accounting treatment of trading discounts received for services that account at the level of net purchased services (for the discounts received even on invoicing), on behalf of the corrective account 609 „Received trading discounts”, respectively, whereof creditor sold is taken into account with minus on the establishment of exploitation expenses.

The accounting treatment of trading discounts received for the assets is stressed depending on the reception time, depending on the kind of procured assets, respectively. For any further details, we recommend you the analysis shown by table 1, as such:

Reception time of trading discount	Inventories	Tangible and intangible assets
Discounts received on the procurement date for the procured assets/services	Inventory procurement cost discount, according to point 76 par. (1) of the Annex to Order 1802/2014.	Procurement cost discount.
	The received discount is not separately shown.	
	Starting with the financial statements of fiscal year 2015, the trading discounts registered on the procurement invoice that entirely covers the equivalent value of purchased inventories - they are recognized as a current income (<i>account 7588 „Other operating revenues”</i>) because these assets must be assessed on their fair value, according to point 76 par. (1 ¹) of the Annex to Order 1802/2014.	In the extent that these discounts entirely cover the equivalent value of tangible and intangible procured assets, the entity will recognize an advance income (<i>account 4758 „Other amounts received in the form of investment subsidies”</i>) that will be staggered on the entire life term of the relevant assets (it will be both recognized an expense for the amortization registered through the account 6811 and a current income in the account 7584 related to the resumption of subsidy).
<p>Remark: Point 76 par. (1¹) of the Annex to Order 1802/2014 only aims, on our opinion, the full discounts granted for the purchased assets. Provided that these discounts are actually granted for other assets/services traded in the past between the parties, we consider that a correction of expenses should be recognized by the accounting account 609, nowise the use of a current income account or deferred incomes.</p>		
Discounts received after the initial invoicing.	<p>Basic treatment:</p> <p>a) Decrease of the inventory cost if (i) the procurement of assets and reception of trading discounts are jointly considered or (ii) if these are still under administration.</p>	<p>Basic treatment:</p> <p>The discounts are recognized in the category of advance incomes (<i>account 4758 „Other amounts received in the form of investment subsidies”</i>), if the entity may prove the asset wherefore</p>

	<p>b) Decrease of expenses (<i>account 609 „Received trading discounts“</i>) in respect of an expense saving if the inventories are not anymore under administration.</p> <p>Alternative treatment:</p> <p>Recognition of expense decrease (<i>account 609 „Received trading discounts“</i>) even if the assets are still on inventory, unless the owned information allows the improvement of inventories (see point 76 par. (2¹) of the Annex to Order 1802/2014.</p>	<p>the discount was received.</p> <p>Alternative treatment:</p> <p>The further discounts are directly recognized in the category of current incomes (<i>account 7588 „Other operating revenues“</i>) from their reception, unless the entity may identify the assets wherefore the trading discount was received.</p>
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Table 1: Minimal accounting treatment for the trading discounts received by the buyer of assets

Regarding the fiscal treatment

The fiscal treatment aims the limits and conditions required by the Fiscal code and attached legislation with respect to the trading discounts negotiated by the parties. Because their granting leads to the decrease of VAT taxation basis, of the corporate tax or of the micro-enterprise income tax, we considered relevant to present the minimal items that must be taken into account on the configuration of fiscal treatments. For any further details, we recommend you the analysis shown by table 2, as such:

Category of interest	Seller/Provider	Buyer/Beneficiary
<p>Value-added tax</p>	<p>An essential condition is that such discounts don't actually represent the remuneration of a service or a delivery. The trading discounts granted on sale lead to the decrease of taxation basis according to Art. 286 par. (4) letter a) of Fiscal code, while the further granted discounts must adjust the VAT basis, according to Art. 287 letter c) of the Fiscal code.</p> <p>The VAT rate applicable to the invoiced discounts is that in force on the date of VAT generating fact. In case of further granted trading discounts, the supplier will apply the rate in force on the basic operation date (the date of initial invoicing of assets and services wherefore the trading discounts are granted). However, provided that the basic operation cannot be identified, the valid rate is the VAT rate on the trading discount granting date.</p> <p>Unless the discounts are registered at the unit price, the supplier is liable to individually mention these discounts by the invoice, according to Art. 319 par. (319) par. (20) letter i) of the Fiscal code.</p>	
	<p>For the seller, the granted discounts either lower the collected VAT or the non-exigible TVA (<i>only if this applies the VAT system on the encashment</i>).</p>	<p>For the buyer, the trading discounts result in the decrease of deductible VAT or non-exigible VAT (<i>if at least one of the partners applies the VAT system on the encashment</i>).</p>
<p>Corporate tax</p>	<p>If the granted trading discounts are related to the economic activity and observe the provisions of trading legislation in force, as well as the contracting clauses, the discount of incomes is fiscally recognized.</p>	<p>The received trading discounts will be taxed depending on the time when these must be recognized as current incomes or as expense discounts.</p>
<p>Micro-business income taxes</p>	<p>The taxation basis takes into account all the duly recognized incomes in the accountancy. The further granted</p>	<p>The taxation basis lowers by the incomes resulted by subsidies for investments of the account 7584 (according to Art. 53</p>

	trading discounts lower the taxation basis according to Art. 53 par. (1) letter j) of Fiscal code.	par. (1) letter d) of the Fiscal code or adjust by the traded discounts received and registered under the law conditions in the accounting account 609 (according to Art. 53 par. (2) letter a) of the Fiscal code) or by the current incomes, periodically recognized (account 7588).
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Table 2: Minimal fiscal treatment for the trading discounts

Case studies

We will explain the accounting treatment related to the trading discounts negotiated for the sold assets, both for the circumstance when these are registered by the sale invoice and if they are invoiced after the sale of assets.

Granted trading discounts on the initial invoicing

A trader sells equipment by 20,000 lei, VAT 20% and spare parts, amounting 5,000 lei, VAT 20%. On the invoicing date, a trading discount of 10% and VAT 20% is individually granted to each asset.

The seller applies the VAT system on invoicing, while the buyer is registered on the Register of taxable persons who apply the VAT system on encashment.

- in the seller's accountancy
- issued invoice registration:

4111	=	%	27,000 lei
„Customers”		707	
		„Sale of goods purchased for resale”	22,500 lei
		4427	
		„Input VAT”	4,500 lei

- encashment registration:

5121	=	4111	27,000 lei
„Cash at bank in lei”		„Customers”	

- in the buyer's accountancy

- the registration of equipment is made on the procurement cost:

%	=	404	21,600 lei
		„Suppliers of non-current assets”	
2131			18,000 lei
„Plant and machinery”			
4428			3,600 lei
„VAT under settlement”			

- spare parts registration:

%	=	401	5,400 lei
		„Suppliers”	
3024			4,500 lei
„Spare parts”			
4428			900 lei
„VAT under settlement”			

- payment registration c/value of equipment:

404	=	5121	21,600 lei
„Suppliers of non-current assets”		„Cash at bank in lei”	

- <i>payment registration c/value of spare parts:</i>			
401	=	5121	
			5,400 lei
„Suppliers”		„Cash at bank in lei”	
- <i>VAT deduction registration on payment (27,000 lei * 20/120):</i>			
4426	=	4428	
			4,500 lei
„Output VAT”		„VAT under settlement”	

Further granted trading discounts

Using the input data of the previous example, we consider that the 10% discount was granted after the issuance of the initial invoice, and the discount takes place after the trading discount.

- *in the seller's accountancy*

- *issued invoice registration:*

4111	=	%	30,000 lei
„Customers”		707	
		„Sale of goods purchased for resale”	25,000 lei
		4427	
		„Input VAT”	5,000 lei

- *discount invoice registration:*

4111	=	%	(3,000) lei
„Customers”		709	
		„Trade discounts offered”	(2,500) lei
		4427	
		„Input VAT”	(500) lei

Remark: The net turnover is 27,000 lei, being included in the taxation basis for the calculation of corporate tax/micro-enterprise income tax, as the case may be.

- *encashment registration:*

5121	=	4111	
„Cash at bank in lei”		„Customers”	27,000 lei

- *in the buyer's accountancy*

- *equipment reception registration:*

%	=	404	24,000 lei
		„Suppliers of non-current assets”	
2131			20,000 lei
„Plant and machinery”			
4428			4,000 lei
„VAT under settlement”			

- *spare parts reception registration:*

%	=	401	6,000 lei
		„Suppliers”	
3024			5,000 lei
„Spare parts”			
4428			1,000 lei
„VAT under settlement”			

- *registration of trading discount reception for the spare parts:*

%	=	401	
609		„Suppliers“	(600) lei
			(500) lei
		„Trade discounts received“	
4428			(100) lei
		„VAT under settlement“	
<hr/>			
<i>- registration of trading discount reception for the equipment:</i>			
404	=	%	
„Suppliers of non-current assets“		4758	2,400 lei
		„Other amounts received in the form of investment subsidies“	2,000 lei
		4428	400 lei
		„VAT under settlement“	

Remark: During the entire life of equipment, the entity will register the amortization (6811 = 2813), concomitantly with the income recall, corresponding to trading discount (4758 = 7584).

<i>- payment registration c/value of equipment:</i>			
404	=	5121	
			21,600 lei
„Suppliers of non-current assets“		„Cash at bank in lei“	
<hr/>			
<i>- payment registration c/value of spare parts:</i>			
401	=	5121	
			5,400 lei
„Suppliers“		„Cash at bank in lei“	
<hr/>			
<i>- VAT deduction registration on payment (27,000 lei * 20/120):</i>			
4426	=	4428	
			4,500 lei
„Output VAT“		„VAT under settlement“	

Conclusions

Any economic entity must design its accounting and fiscal policies starting from its own trading policies and from the specific trading legislation. It must also be taken into account its fiscal vector (*if it is a VAT payer on encashment or invoicing, micro-enterprise corporate tax or income tax payer*).

On our opinion, the current solution proposed by the accounting regulations for the further trading discounts is easier to apply in practice, both regarding the adjustment of expenses if the inventories are still under administration, respectively the registration of procurement cost of assets based upon the initial data, with recognition of further trading discount, either on account of the advance incomes or on account of the current incomes, depending on the identification/assignment of discount for the assets.

According to the new accounting regulations, in the case of trading discounts received by the buyers on the date of procurement of tangible/intangible assets, they must be treated as advance incomes, in the extent that these discounts entirely cover c/value of the relevant assets. However, we consider that the solution proposed by the legislator must be very carefully analyzed, because we consider that it cannot be applied if, although the discount entirely covers c/value of procured assets, we ascertain by the analysis of contractual clauses and of the situation de facto that the trading discount was received for the whole of operations developed in the past between the two partners. This case, the fiscal risk both occurs for the corporate tax payers (*who should charge the full income on the reception of discount*) and for the payers of micro-enterprise income tax (*who cannot benefit anymore of the discount of taxable basis gradually, with the recalling of subsidy to incomes because it should add to the taxation basis the expense saving, even from the reception of discount*).

A special situation is related to the recognition of trading discounts during the period they refer to, independently of the way and time of granting/reception, more specifically the date when the conditions negotiated by the trading agreements for their granting/reception are accomplished. From the accounting point of view, it is required the use of accounts 418 "Clients - invoices to conclude" and 408 "Suppliers - not arrived invoices", respectively. From the fiscal point of view, the instrumentation of this situation is very complex, taking into account the different impact that the discount of taxation basis for both partners, especially in the case of value-added tax treatment, has. As for example, the seller must check at the end of each tax period whether the decrease conditions of taxation basis of incomes and VAT are accomplished and whether he issued or not the invoices during the period referred to for the trading discounts.

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Opinions Regarding the Political Interest and the Economic Reality from the Perspective of the New Fiscal Regulations

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ABSTRACT

The configuration of the politic interest from the fiscal perspective, its impact upon the economic reality and the performance of the feedback by means of the tax payer, remains a field of perpetual controversies. This is the reason for which we considered as being very useful to present, according to our own vision, certain details of the inter-relationship mechanism of the politic interest with the economic reality and the place and role of the tax payer within this process.

Introduction

The development of our proceedings envisages the clarification of certain aspects related to the configuration of the politic interest, with the manner in which the economic reality should be approached from a fiscal point of view, as well as with the identification of the role and place of the tax payer within this context. In this respect, I have structured the work in **three sections**.

The first section highlights the elements which describe the general framework as well as clarifications such as: different political orientations at global and national level, elements which set the economic reality and the position of the tax payer within the process of interference of the politic interest with the economic reality. **In the second section**, I presented some approaches with respect to the effects of inter-relationships of the politic interest with the economic reality, the impact upon the tax payer, but also the tax payer's involvement in the development of the respective process, and in **the third section**, I synthesised the main conclusions resulted from the analysis which was performed.

Literature Review

The field which is subject to the current work has as reference the theoretical and practical elements resulted within this doctoral research, from the point of view of the dysfunctional ties and uncertainties within the accounting – fiscal – management relationship, induced by the current regulations in force.

We mention that the entire process is based on the provisions of the Fiscal Code, of the Fiscal Procedure Code (approved by Law no. 227/2015 and respectively, by Law no. 207/2015) with their subsequent modifications and completions, as well as on the Methodological Norms on

the enforcement of the Fiscal Code (GD no. 1/2016). I took also as reference, some elements related to the micro and macroeconomic indicators, which were presented in the work "Economical and financial analysis", which belongs to the writers: Willi Păvăloaia and Daniel Păvăloaia (Tehnopress Publishing House, Iași, 2009) and I analysed the site of the National Institute of Statistics (www.isse.ro/cms/ro/content/buletine-statistice), which presents by means of its reports the evolution of the Gross Domestic Product (GDP) and of the main macro-economic indicators, as well as the elements which influenced the respective trends.

Scientific Contents

General considerations

The debates related to the fiscal theme within the academic environment but also the debates of the economic and financial analysts, reflected by mass-media, present a common element, which is the positioning of the tax payer in the area of interference between the politic interests with the economic reality. If the economic reality can be configured, in its dynamics, by means of "studying from the point of view of several aspects of the results of the use of human, material and financial resources [...] at micro and macroeconomic level [...]" (Willi Păvăloaia, Daniel Păvăloaia, Economical and financial analysis, Tehnopress Publishing House, Iași, 2009, page 16), the politic interests should be seen, in our opinion, from the point of view of a real fan of politic orientations which are present within a democratic society. So, according to one of the definitions of politics (DEX 2012, page 845) each of them corresponds to the "tactics, strategy, methods and specific means used by the politic leaders for the fulfilment of the objectives which were set", at which we add – based on our own doctrines with respect to the resolution of the state affairs adopted during the period of preparation for taking over authority and effectively applied, after the authority was taken over.

The current political stage within the democratic societies, at global level, is characterised by **3 main trends: left trend, centre trend and right trend**. Besides these three, other smaller size trends are remarked: centre-left trend, centre-right trend, as well as the two extremes, left and right. Each of them aims at achieving its objectives set based on a **specific doctrine**, represented by the „totality of principles of a politic, scientific, religious, etc. system," (DEX 2012, page 325). But the doctrine differences not only make a difference between the politic trends, but represent, in fact, the source of permanent confrontations in the politic, economic and social field. Practically, these confrontations determine different polarisations at social level, which, most of the times, are not expressing themselves only through exercising the right to vote in favour of one or another politic party, as it would be normal in a democratic situation, but in some situations confrontations could actually occur. Such extreme situations are produced, in general, when obscure interests occur (internal, but also external), especially from an economic perspective, but also from political perspective, and lately, more frequently, from a religious perspective. In **Romania** 3 dominant trends are obvious:

- the **centre-left trend (social - democracy)**, which is characterised by a strong social influence, which means that it supports the proceedings for the development and maintenance of a balance between the development and the distribution of the national income, with a focus on the underprivileged members of the society, aspects which imply the use of fiscal measures as an adjustment instrument;
- the **right trend (liberalism)**, which supports the (economic) development from the point of view of individual freedom which implies the following: free manifestation of demand and supply, of the market forces (competitively) and obviously, limitation of the intervention of the state in economy and support of private initiative;
- the **centre-right trend (conservatism)**, which is focused on the support of national initiative and sustains that there is a great error to use important techniques and methods without a strong social support.

Due to the limited space which is at our disposal, we briefly presented, only the three dominant politics trends. However, our politics scene includes also lower extend orientations, which favour frequent **attitude changes**, which consist of the development or the disintegration of different politic alliances. The frequent changes in attitude that we are

talking about generate, in their turn, the fading of the impact of the specific characteristics of the main political trends which dominate a coalition or another, through the acceptance for the sake of an alliance of somebody else's principles, especially in the fiscal domain.

This explains the fact that, in our opinion, **the mixture of principles, right or left trends**, promoted in this period by the main Romanian parties, especially after, at the end of 2015; the technocrat regime took over the political authority. As a result, the fact that at the beginning of 2016, the two main politic parties (social-democrats and liberals), practically, destroyed one another, each of them **assuming its paternity** over the provisions of the new fiscal regulations, out of which, some are specific to the adverse part (examples: unique rate of 16%, general reduction of the VAT rate and of the food products VAT rate, the new procedure for the taxation of natural bodies, the non-taxation of certain salary incomes, the reduction to 5 % of the income related to the dividend distributed to Romanian natural bodies or legal entities, etc.). Also, although the new Fiscal code **was voted almost unanimously**, when the **excessive provisions** are not highlighted, as the case of the contribution of 5.5% of the minimum economy salary, at the contribution related to social security, due by the natural bodies which do not generate incomes, **the discrepancies are more acute**, which indicates the fact that the important element in such situations is always constituted by the political interest and not necessarily the concern related to the underprivileged persons.

Starting from these considerations, we present below our vision related to certain aspects related to the inter-relationship between the politic interest and the economic reality, from the perspective of the new fiscal regulations, among which an important role is played by the tax payer.

Approaches related to the inter-relationship between the politic interests and the economic reality based on the new configuration of the fiscal domain

The current configuration of the Fiscal field in Romania is mainly provided by: Law no. 227/2015 regarding the Fiscal Code, Law no. 207/2015 regarding the Fiscal procedure code, with subsequent modifications and completions, the Methodological norms for the enforcement of the Fiscal code (GD no. 1/2016), at which all the order issued by Ministry of Public Finance and National Authority of Fiscal Administration are added together with the comments and details necessary for their enforcement, and the totality of the connected fiscal regulations. But this configuration Is the **result of the politic will**, generated in its turn from the politic interests of the coalitions with variable composition, which have the authority during 2014 – 2015 and obviously, materialized, from this perspective, by the specialised governmental structures. The fact that all main politic forces **accepted to compromise**, finally, we ended up, as previously indicated, with the approval in the Parliament, with very few amendments and to the enforcement of the regulations which form the actual fiscal field.

In this background, **from the perspective of the politic interest**, a few natural questions related to the new regulations still arise; we have selected some of these regulations:

1. Do they fully correspond to the requests expressed in the argumentation for the issuance of regulations regarding simplification and provision of predictability?
2. Do they contain sufficient elements which lead to the effectiveness of the process related to the stimulation of the development of the economic environment, private and public?
3. Are the aspects related to the discrimination of Romanian investors as compared to the foreign ones in the field of taxation eliminated?
4. Do they contain enough provisions which lead for sure to the significant reduction of fiscal evasion?
5. Do they contain sufficient and significant provisions with a positive social impact, so that they will diminish as much as possible the perception related to which they are a fiscal burden?
6. Was a significant progress accomplished in the process of fulfilling the obligation related to the transposition within the national legislation of the decisions of the EU

Court of Justice and of the amendments brought to the regulations, directives and other communitarian regulations?

It can be noticed that the normality of the questions consist of the fact that each of them includes elements based on the assembly of which even the principles on which the fiscal field should be based on, as they are configured in article 3 of the Fiscal code, can be built.

So, we are talking about the **predictability of the taxation**, which is provided by the stability during an extended period of the fiscal regulations, as well as by the **principle of taxation certainty**, which envisages simplicity, clarity and exclusion of arbitrary interpretations. Then we refer to the **efficiency of taxation**, which implies the accomplishment of an increased rate of taxes, contributions and fees along the entire economic cycle, simultaneously with the efficiency of the adjustment measures at micro and macroeconomic level for the stimulation of the economic development and, implicitly, of the increase of the used taxation base.

The third question envisages the **neutrality of fiscal measures** with respect to different categories of investors and capitals. Also, to the certainty and lawfulness of the taxation we also refer when talking about fiscal evasion, due to the fact that in our opinion, certain interpretations which are not only wrong, but mostly abusive, of the accounting and fiscal regulations, such as their avoidance, are elements with a major negative impact upon the amount of the budget incomes.

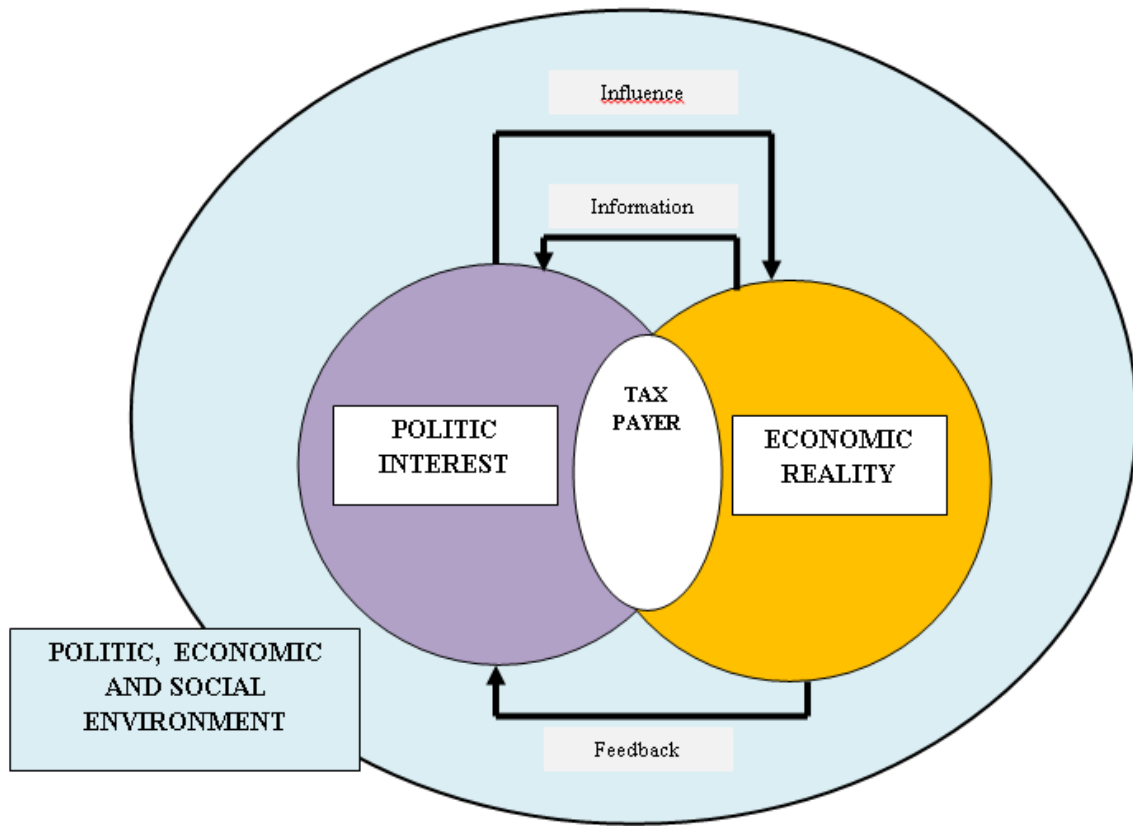
The fifth question envisages **the lawfulness (rightfulness) of the taxation**, by means of which it is necessary to take into consideration the contributively capacity of the tax payers, so that the fiscal task which is related to them will not become an abusive burden.

All the above mentioned aspects must be taken into consideration in the context of full integration of Romania to the European Union, which is not possible without the adequate alignment to its regulations and without a unitary jurisdiction.

We mention that the main purpose of listing the questions consists in the **highlight of the determinant role of the fiscal principles in the configuration of the fiscal field**, as well as of the fact that the central element upon which the fiscal impact is exercised is the tax payer, which is in the position of legal or natural person. From this perspective, the role of determinant factor of providing the state incomes which is related to the potential of the financing sources, represented by all the tax payers (legal and natural bodies) should be highlighted. In this respect we refer effectively to: overall assets, overall incomes, turnover, financial position, and financial performance, macroeconomic and microeconomic indicators, which finally reflect, as a result of a general overview, the economic reality.

Consequently, in our opinion, **the tax payer** must be seen as being the **basic cell** of an extended assembly, which is constituted of the economic reality and is positioned in the area in which the economic reality interferes permanently with the political interest. From this point of view an entire theory can be developed, which exceeds the dimensions of our proceedings, with respect to the role and the place of the tax payer in the **continuous metamorphosis of economic reality**, in its double quality as tax payer to the state income, respectively of economic entity which generates profit or income, as the case may be, or natural body which holds assets and generates incomes. Details indicated in **Figure 1**.

Figure 1: The variant for the representation of the tax payer's position within the politic, economic and social environment



Source: Authors own thinking

The configuration included in Figure 1 was adopted taking into consideration our opinion according to which from the general assembly background comprising of the politic, economic and social environment, we can divide the political interest and the economic reality, as well as the fact that these two elements interfere permanently, and the main vector of the interference being the tax payer. So, the politic interest generated from the doctrine specific to the dominant politic orientation within the governance and legal framework, will determine based on the information provided by the economic reality, the configuration of objectives, strategies, tactics, methods and means of their fulfilment, the final purpose being the amelioration from the point of view of the own governance, of the economic reality. The follow up will be, consequently, the influence of the configuration of economic reality, which, in its turn will generate towards the politic interest an adequate feedback; in our opinion this process is continuous and with a variable dynamics with respect to the intensity on the entire area of economic domains and with an adequate impact upon the social environment. In this entire process we see that the tax payer is in the position of a vector with multiple values. So, as previously demonstrated, we consider it as being the basic cell of the economic reality, its status expressed through the position with respect to the microeconomic indicators, leading in the end, based on certain periodic reports, processed according to a sum of laws, procedures

and specific assessments, to the configuration by the statistic entities of the overall status of the economic reality (at macroeconomic level).

Another mention which we consider important refers to the fact that the entire process that we have talked about, respectively the obtaining of information from the economic environment, the development and enforcement of fiscal measures with economical and financial impact, the occurrence of mutations within the economic reality framework and transmission of feedback, is tributary to inertia. Each of the listed stages needs variable times and dimensions, function of the specific and actual conditions in which they are developed, at which the period of time needed for debates within the professional and public environment, the period of time necessary for the learning and application by the ones involved and. Most important, the period of time needed for producing the effects and manifestation of feedback is added.

An aspect which most of the time is ignored, but which sometimes has devastating effects in the fiscal field, comprises of the **correctness of the reception**, the precision of the assessment of the desired effects for each and every fiscal measure. In this sense, an eloquent example is represented by the controversies within the public debates, before and immediately after the start of the implementation of the new Fiscal code, respectively of the new regulations regarding pensions and minimum economy wage. The central element of the disputes is represented by the sustainability for the support of which at 30 days after the enforcement of the new fiscal legislation nobody has yet presented complete computations or relevant data. In such situations we can talk about the manifestation of arbitral or discretionary methods, favoured by an updated component of the politic interest, which is the electoral interest.

At all aspects mentioned above we have added also the **amateurism**. So, within the debates, both at institutional level (Government, Parliament), of some political parties, but also within the public space, assessments and proposals occur on a frequent basis without any theoretical and practical base consistent enough which sometimes are accepted within the proceedings for the development of certain regulations. From this perspective we reiterate the controversial measures of austerity in 2010, followed by significant external loans, for which, not even now the transparency regarding their real use and impact upon the budget is not manifested. Also, we recall the proposals for the austerity measures, which are currently very popular within this period in the public space. In our opinion, such a mode of approach is outside any scientific base, an affront brought to the academic, professional and business environment.

The approaches presented highlight the special complexity of the processes synthesised in **Figure 1**, the mutual influences of the elements involved, as well as the special difficulties

encountered in the configuration of the effects of the anticipated measures and in the description of the correct and complete proceeding to be followed for the fulfilment of the objectives established by the dominant politic forces within a governance. However, the situation becomes more complicated from the point of view of the fact that the tax payer, in multiple situations, is part of the politic interest through the agreement and effective participation In the fulfilment of some politic objectives related to an orientation or another. On this base, within the politic parties and/or within the Parliament some groups occur which militate for their own interests, succeeding in the confirmation through the regulation of such interests. This thing represents one of the main clauses of the excessive diversification and regulatory modification in certain fields; the impact generated by such modifications is most of the time unpredictable due to the lack of correlation with other regulations in the respective fields, as in the field of fiscal proceedings, of the connected regulations and norms of enforcement. Also, we also highlight the fact that the negative aspects mentioned above are most of the time simplified by the mutations unpredictable in the political and economic environment, as happened with the previous government, which, after a short period of time after the promulgation of the Fiscal code issued an Emergency ordinance by means of which it brought amendments, and then, in a very short period of time, the respective government resigned, placing the new government in the situation in which from the perspective of the own objectives (program), but also of the pressure created through the mass-media, would anticipate amendments of the fiscal framework.

In our opinion, it is confirmed in this way the continuation of a phenomenon expressed by the statement **„another government, another fiscal policy“**. If when the government is a politic one it can be accepted that it promotes its own doctrine in the fiscal field, which is different than the ones of its politic competitors, in the situation of the current government, the argumentation is given as it is stated, by the need to ensure sustainability of the implemented measures and placing them in agreement with their own governing programme. Consequently, if we return to the scheme in **Figure 1** we will be able to state that we are facing a new paradigm with respect to control upon the inter-relationship between the politic interest and the economic reality and to the fact that the main implications are sustained by the tax payer.

Consequently, we notice the development of a **process for the re-assessment of impact** of the new regulations, which envisages mainly the following: the assessment of impact related to the reduction of some taxes and contributions upon the available income and savings and, as a consequence, upon the share capital accumulation rate; the effect of reducing the social contribution for employers upon the occupancy of the work force; the impact upon the consumers' behaviour; sustainability, respectively the identification of elements which produce distortions at micro and macroeconomic level, with harmful effects (the need for massive reduction of expenses, excessive depreciation of the national currency,

sudden increase of the public debt etc.); identification and elimination of unlawful provisions with respect to the contribution capacity etc.

If we accept the fact that the type of measures which were mentioned can have a positive effect of a so called „*sanitation*“ of *fiscal field*, we cannot ignore the fact that one of the basic principles, which is the principle of **predictability**, which is based mainly of the stability of fiscal regulations, is **permanently in danger of not being observed**. In this manner the opinion regarding the positioning of the tax payer in the area of interference between the economic reality and the politic interest, as well as the fact that this is the main actor which **undertakes the impact of precarious predictability** is confirmed.

Conclusions

The analysis of inter-relationship between the politic interest with economic reality and the assessment of the tax payer in their area of interference is a very useful proceeding which is also permanently updated. The results of a correct and complete analysis in this field (*from the point of view of the fiscal domain*), can be the measure of efficiency, of lawful configuration and opportunity of the proceedings undertaken by the politic forces which have authority; these proceedings are obviously developed based on the economic doctrines which are specific to them.

The fiscal field is one of the defining elements of the politic will for exercising authority and in the same time, of the politic interest which derives from it. Also, last but not the least, it should be considered that the **fiscal field** is **one of the important instruments by means of which the sovereignty of a country is exercised**. Consequently, the differentiation of the configuration of politic interest and of the actual manner on which the politic interest will relate with the economic reality, in case of different politic orientations of the ones having authority, can also be the expression of the specifics in the development of the main functions of the fiscal system.

The tax payer is the main **vector for the interference of politic interest with the economic reality**. It is the **basic cell of economic reality**, but it can also be a direct participant to the configuration and fulfilment of politic interest, through the affiliation at one political orientation or another, situations in which we can talk about polarisations of group interests, with consequences which are not always favourable to the society.

The harmonisation from a fiscal perspective of the relationship between politic interests –economic reality, having the tax payer in the position of vector of interference, irrespective of the political orientations of the ones who exercise authority, is a mandatory condition of the **development of fiscal predictability and of the development measures on medium and**

*long term. But this challenge cannot be performed otherwise but through the development of **CONSENT** with respect to the configuration and prevalence of the **NATIONAL INTEREST** upon all politic interests.*

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Study of Stresses and Stress Concentrations in Pressure Vessels

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ABSTRACT

This paper is indented to emphasize the possibilities to show the influence of present standards to improve or change design methods of pressure vessel, in spite of all problems related to recent inspection programs for metallic pressure containment vessels and tanks which have revealed cracking and damage in a considerable number of the vessels inspected.

On the one hand, it identifies and proposes the approach of a new research regarding the decrease of the following phenomena: cracking, stress, stress concentration, faulty Design, corrosion, fatigue, creep, and other serious damage problems.

On the other hand, the paper reflects the important role of good practice, careful operation, regular maintenance, and adherence to the recommendations and guidelines developed for susceptible applications. We investigate how can all of this problems influences future studies. The objectives refer to reviews some of the current developments in the determination of stress concentration factor in pressure vessels. The literature has indicated a growing interest in the field of stress concentration analysis in the pressure vessels. The motivation for this research is to analyze the stress concentration occurring at the openings of the pressure vessels and the means to reduce the effect of the same. Most of the researchers have worked on the stress concentration occurring at circular and radial openings in the shell under internal pressure. Also some of the researchers have worked on holes in the end covers. In this paper the recent developments, theories for estimation of stress concentration are presented and there is also the scope for future studies.

1. INTRODUCTION [24, 31, 32]

The paper highlights how the design and analysis of pressurized structure is covered by Standards [24, 31]. All relevant combinations of structural, thermal, and pressure loading are applicable.

A pressure vessel is a closed container that is designed to contain gases or liquids at a pressure that is much different from the pressure outside of said container. Because of the extreme difference in pressure between the contents in the container and the surrounding atmosphere, the correct design and construction of pressure vessels is an extremely important and high-risk task. With Computer Aided Design, the process of pressure vessel

drawing is becoming more and more accurate, meaning that the vessels themselves are becoming safer and more efficient [31].

Our expectations are:

- show the importance of vessel components and why they are weakened when material is removed to provide openings for nozzles or access;
- demonstrate the differing types of quality tools/techniques attributed to the UK researchers but used by all of us;
- illustrate the applicability of tools and techniques of quality design methods improvement using American models;

Objectives:

1. An appreciation of the failure of pressure vessel which may result in loss of life, health hazards and damage of property;
2. A continual improvement of study about geometric discontinuities alters the stress distribution in the neighborhood of discontinuity so that elementary stress equations no longer prevail. Such discontinuities are called „stress raisers“ and the regions in which they occur are called the areas of stress concentrations [32];
3. An interpretation of the contribution of various researchers in determination of stress concentration at opening in pressure is summarized for design of pressure vessel by using different approaches [32].

2. PRIOR WORK [2, 3, 4, 18, 19, 23, 24, 30, 31, 32]

From the perspective of Design Pressure Vessel Methods Change, we examined the new trend influencing high **stress concentrations** which exist at the opening edge and decrease radially outward from the opening, becoming negligible beyond twice the diameter from the center of the opening.

To avoid failure in the opening area, compensation or reinforcement is required. Some ways in which this can be accomplished are: (a) increase the vessel wall thickness (non-economic measure), (b) increase the wall thickness of the nozzle, or (c) use a combination of extra-shell and nozzle thickness. The Code procedure is to relocate the removed material to an area within an effective boundary around the opening.

Table 1: Code Formulas for Calculation of Vessel Component Thickness [19]

Cylindrical shell	$t = \frac{PR}{SE_j 0.8P}$
Hemispherical head or spherical shell	$t = \frac{PR}{2SE_j 0.2P}$
2:1 ellipsoidal head	$t = \frac{PD}{2SE_j 0.2P}$
Flanged and dished head	$t = \frac{1.77PL}{2SE_j 0.2P}$
Flat head	$t = d \sqrt{\frac{CP}{SE}}$

where

- t = Minimum required thickness (in.)
- P = Design pressure (psi)
- R = Inside radius (in.)
- S = Allowable stress (psi)
- D = Inside diameter (in.)
- L = Inside spherical crown radius (in.)
- E = Weld joint efficiency factor, determined by joint location and degree of examination
- C = Factor depending upon method of head-to-shell attachment

Numerous research studies of Pressure Vessels and Pressurized Components highlight the metallic pressure vessels and pressurized components shall be designed, qualified, and accepted per the requirements of ANSI/AIAA S-080, Space Systems – Metallic Pressure Vessels, Pressurized Structures, and Pressurized Components[23].

ANSI/AIAA S-080 and S-081 shall be tailored such that MDP shall be substituted for all references to maximum expected operating pressure (MEOP) [23].

The design of pressure vessels is an important and practical topic which has been explored for decades. The opening created due to nozzle or other accessories in pressure vessel plays vital role in stress concentration factor. In this paper parametric study of nozzle dimensions on stress concentration factor for static loading has been carried out. Here, the effect of nozzle angle with a vertical vessel on stress concentration factor has also been studied. The model of different nozzle diameter and different angle with vertical vessel has been created in solid modeling software and finite element analysis for the same has been carried out in ANSYS software. The comparison of parametric study results of the stress concentration factor has been shown in the graphical format. For constant diameter of the vessel, sustainable limit dimension for opening size and angle is decided from this study [30].

3. DESIGN/ METHODOLOGY [9,14,20,25,28,30,33,34]

This report presents a map of past, present and future changes to design and conception of pressure vessels as researchers' contributions to the improvement of design methods. Many researchers have already been contributed in this field. Zick [28] described stresses in large horizontal cylindrical pressure vessels on two saddle supports. Deterministic structural and fracture mechanics analysis of reactor pressure vessel for pressurized thermal shock was explained by Carbonari [9,]. You-Hong Liu [14, 30] elaborated pressurized thermal shock analyses of a reactor pressure vessel using critical crack depth diagrams. A model for predicting the influence of warm pre-stressing and strain aging on the cleavage fracture toughness of ferrite steels was illustrated by Thakkar [25]. Heckman [28] described the application of warm pre-stressing effects to fracture mechanics analyses of nuclear reactor vessels during severe thermal shock.

While the design and conception of pressure vessels was traditionally done by hand drafting, in recent decades there has been an almost unanimous push for Computer Aided Design programs to take over for hands when drawing and drafting the vessels. This is largely because of their extreme accuracy and ease of use when compared to physical, hand drawn specs[33].

Reduction of Stresses in Cylindrical Pressure Vessels Using Finite Element Analysis [23,32,34]

In a cylindrical shell weakened by a hole, the stress distribution caused by an internal pressure load applied to the shell will differ considerably from that in an un-weakened shell. The maximum stress will be much larger if there is a circular hole in the shell than in the case where there is no penetration. This causes the rise in the stress distribution around the hole, to study the effect of stress concentration and magnitude of localized stresses, a dimensionless factor called Stress Concentration Factor (SCF), is used to calculate the stress rising around hole[32].

The determination of S.C.F includes basic concept of engineering like maximum stress/strain and nominal stress etc. This factor is ratio between the maximum average stress generated in the critical zone of discontinuity and the stress produce over the cross section of that zone. It as defined by Eq. (1) is used [32]

$$K_t = \frac{\sigma_{max}}{\sigma_{nomi}} \quad (1)$$

The term maximum design pressure (MDP) can be used for design and testing of pressure vessels and related pressure components. The basic difference between MDP and MEOP is the

degree of consideration of potential credible failure within a pressure system and the resultant effects on pressure of the pressure vessel(s) during system operation. MDP is associated with human-rated systems and is based on the worst case combination of two credible system failures. [23]

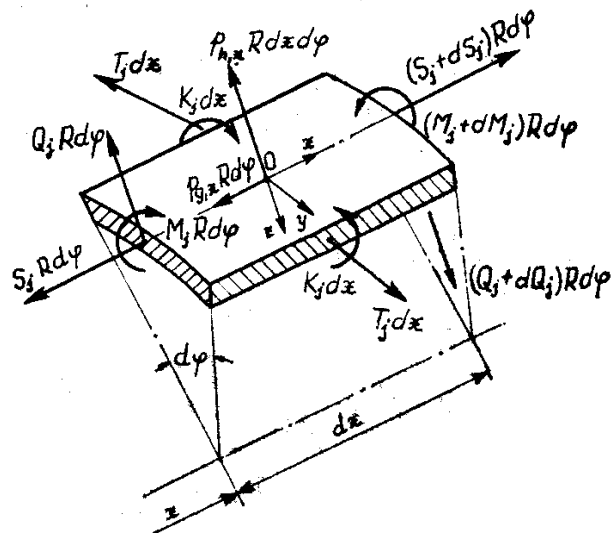


Figure 1: Loading an element in cylindrical shell [5,6]

Causes of pressure vessel failures [34]

The main causes of failure of a pressure vessel are as follows:

- Stress
- Faulty Design
- Operator error or poor maintenance
- Operation above max allowable working pressures
- Change of service condition
- Over temperature
- Safety valve
- Improper installation
- Corrosion
- Cracking
- Welding problems
- Erosion
- Fatigue
- Improper selection of materials or defects
- Low -water condition
- Improper repair of leakage
- Burner failure
- Improper installation Fabrication error
- Over pressurization
- Failure to inspect frequently enough
- Erosion
- Creep
- Embrittlement
- Unsafe modifications or alteration
- Unknown or under investigation

Researches about Creep Damage and Thermo Mechanical Fatigue was developed by author in Creep Damage Calculation for Thermo Mechanical Fatigue. Case Study: Thermo Mechanical Loading in Beveled Area between Two Cylindrical Shells with Different Thicknesses [34].

Every month studies about stress and stress concentration in cylindrical shells was carry out by author in research reports as PHD Candidate.

Stresses in pressure vessels [34]

Stress is the internal resistance or counterforce of a material to the distorting effects of an external force or load, which depends on the direction of applied load as well as on the plane it acts. At a given plane, there are both normal and shear stresses (Engineers Edge 2010). However, there are planes within a structural component subjected to mechanical or thermal loads that contain no shear stress. Such planes are principal planes, the directions normal to those planes are principal directions and the stresses are principal stresses [34].

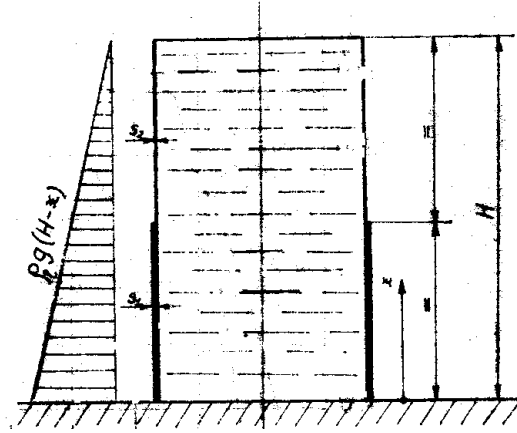


Figure 2: Vertical cylindrical tank with a flat bottom made of two sections of different thickness of metall sheet of execution[5,6].

For a general three-dimensional stress state there are always three principal planes along which the principal stresses. (Spence. J & Tooth.A.S. (1994) [34].

Different types of stresses as stated in Chattopadhyay. S. (2004) are as follows [34]:

- i. Pressure stresses
- ii. Thermal stresses
- iii. Fatigue stresses
- iv. Local stresses
- v. External stresses
- vi. Compressive stresses
- vii. Bending stresses
- viii. Normal stress
- ix. Circumferential stresses
- x. Longitudinal stresses
- xi. Radial stresses
- xii. Tangential stresses
- xiii. Tensile stresses
- xiv. Shear stress
- xv. Bending stress
- xvi. Principal stress [34]

Selection Criteria for Factors of Safety [23]

The appropriate design and test factors for a given mechanical or structural flight hardware element depend on several parameters, such as the materials used, attachment methods (e.g., bonding), and the verification approach (prototype or proto-flight). In addition to the minimum factors of safety specified in this Standard, some structural and mechanical members may be required to meet other more stringent and restrictive performance requirements, such as dimensional stability, pointing accuracy, stiffness/frequency constraints, or safety requirements (e.g., fracture control)[23].

According to D. R. Moss (2004) stresses are generally categorized as primary, secondary or peak stresses. Primary stresses are stresses due to pressure (internal or external), mechanical loads and wind which can result in the rupture or total collapse of a pressure

vessel, they are the most hazardous [34]. Secondary stresses on the other hand are strain-induced stresses, and can be developed at the junction of major components of a pressure vessel (e.g. radial loads on nozzles) because of stresses caused by relieving load or differential thermal expansion. While Peak stresses are the maximum stress concentration point in addition to the primary and secondary stresses present in a region. Peak stresses are only significant in fatigue conditions and are the sources of fatigue cracks, which are applicable to membrane, bending and shear stresses (Rao. K. R. 2002)[34].

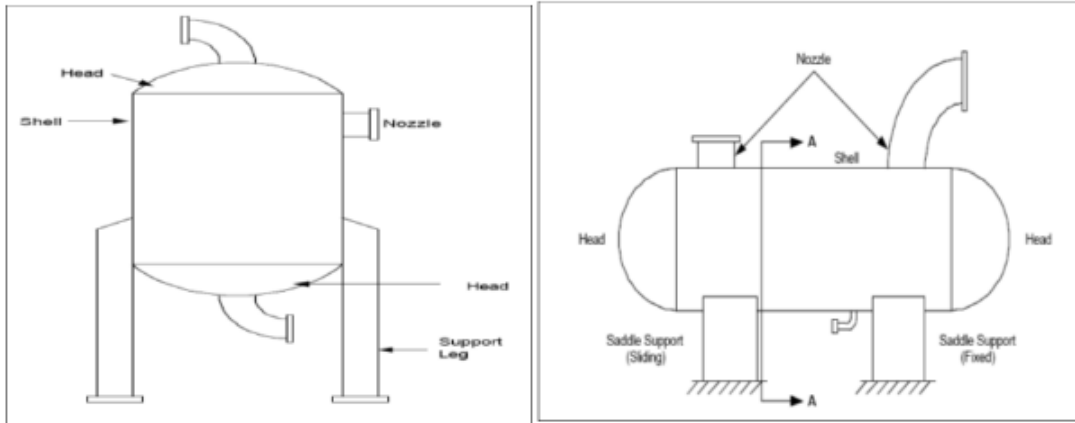


Figure 3: Typical vertical arrangement [34] **Figure 4:** Typical horizontal vessel [34]
Source: Megyesy. E.F (2001)

When a thin-walled cylinder is subjected to internal pressure, three mutually perpendicular principal stresses will be set up in the cylinder material, namely the circumferential or hoop stress, the radial stress and the longitudinal stress, (Sharma. S.C .2010) [34].

Provided that the ratio of thickness to inside diameter of the cylinder is less than 1/20, it is reasonably accurate to assume that the hoop and longitudinal stresses are constant across the wall thickness, and that the magnitude of the radial stress set up is so small in comparison with the hoop and longitudinal stresses that it can be neglected.

This is obviously an approximation since, in practice, it will vary from zero at the outside surface to a value equal to the internal pressure at the inside surface (Hearn.E.J.1998) [34].

Test Verification Criteria [23]

Strength verification tests fall into three basic categories: (1) tests to verify strength of the design (qualification); (2) tests to verify strength models; and (3) tests to screen for workmanship and material defects in the articles (acceptance or proof). Strength verification tests are normally static load tests covering critical load conditions in the three orthogonal axes and, generally, can be classified as prototype or protoflight.

In some cases, alternative test approaches (centrifuge, below resonance sine burst, saw tooth shock, etc.) are more effective in reproducing the critical load or environmental conditions and may be used in lieu of static testing if it can be demonstrated that the resulting loads in the test article are equivalent to or larger than the limit loads multiplied by the test factor.

- a. The strength verification program shall be approved by the responsible Technical Authority.
- b. The magnitude of the static test loads shall be equivalent to limit loads multiplied by the qualification, acceptance, or proof test factor[23].
- c. Strength model verification, if required, shall be accomplished over the entire load range.

Strength model verification is normally performed as part of the strength verification testing. Verification of the strength model over the entire load range is especially important if the response of the test article is expected to be nonlinear.

Strength model verification may not be required if the load path is easily determined and straightforward and the flight loads are well characterized.

- d. The test article shall be instrumented to provide sufficient test data for correlation with the strength model.
- e. Each habitable module, propellant tank, and SRM case shall be proof pressure tested.

f. Departures from test plans and procedures, including failures that occur during testing or are uncovered as part of post-test inspection, shall be documented by a non-conformance report per the approved quality assurance plan[23].

When using the prototype structural verification approach, the minimum ultimate design factors are the same as the required qualification test factors for both metallic and composite/bonded structures, except in the case of discontinuity areas of composite/bonded structures used in safety critical applications.

When using the prototype structural verification approach, metallic structures shall be verified to have no detrimental yielding at yield design load before testing to full qualification load levels [23].

Finite element model of pressure vessels [34]

In order to proceed with the analysis, three Finite element models were designed and denoted as design case one, two and three. A finite element model consists of boundary conditions, mesh of elements and nodes. Each component of pressure vessel analyzed for stress and deformation at the design conditions of 137 MPa and 400 degree C for all the cases.

The pressure vessel model assumed a cylinder with semi ellipsoidal top head and hemispherical bottom head capped. Considering the shell to be mono-bloc and the design rule that the design pressure PD should not exceed the limit set by article KD-251.1 (division 3 of ASME BPVC section 8) given as[34]:

$$P_D = \frac{1}{1.732} (S_y) \ln(Y) \quad (2)$$

$$137 = \frac{1}{1.732} (965) \ln(Y) \quad (3)$$

$$Y = 1.28 \quad (4)$$

Where Y is the ratio of outer diameter (Do) to the inner diameter (Di) of the shell, $Y = D_o/D_i$, and ratio of 2 is assumed for safety. Assumed $D_o = 3048$ mm, $D_i = 1524$ mm, Length = 3 x D_o and flange thickness = 254 mm. The ellipsoidal top head is considered to be fully radiographed like shell, hence $E = 1$. Then using given equation[34]:

$$t = \frac{PDk}{2SE - 0.2P} \quad (4)$$

Where K is the stress intensity factor by the equation below[34]:

$$K = \frac{1}{6} \left[2 + \left(\frac{a}{b} \right)^2 \right] \quad (5)$$

$$t = \frac{137 * 3048 * 1}{2 * 965 * 1 - 0.2 * 137} \quad (6)$$

Thickness = 220 mm [34]

The required thickness of the bottom hemispherical head is normally one-half the thickness of an elliptical or tori spherical head for the same design conditions, material, and diameter which will be 110 mm in this case.

Where r is the inside radius of nozzle, assuming a 1524 mm nozzle, the required thickness comes out to be 254 mm [34].

The CAD model of the pressure vessel is shown below [34]:

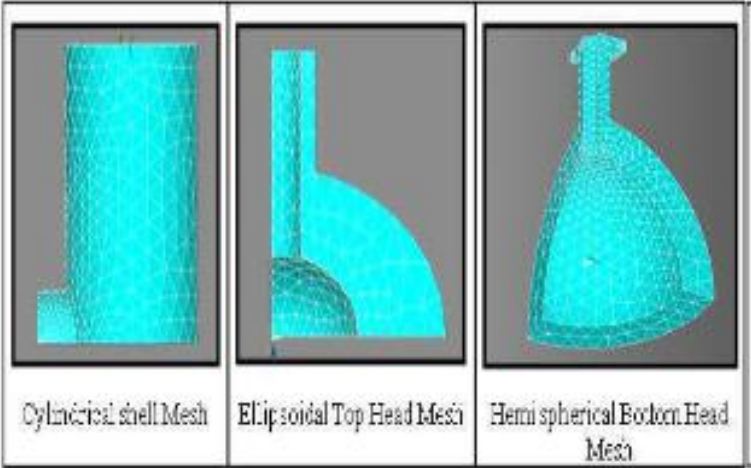


Figure 5: [34]

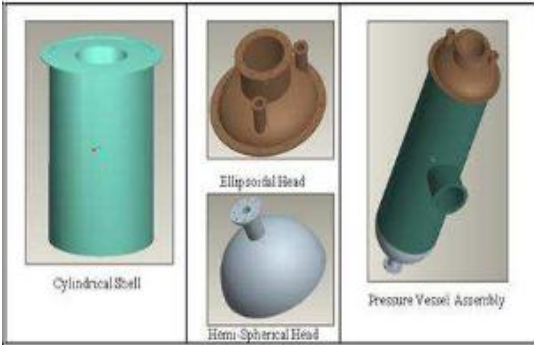


Figure 6: [34]

Sections of Pressure Vessel	1 st Principal Stress	Von Mises	Stress Intensity	Displacement
Cylindrical Shell				
Ellipsoidal Head				
Semi - Hemispherical Head				

Figure 7: [34]

Table 2: [34]

Sections	1 st Principal Stress (MPa)	Von Mises (MPa)	Stress Intensity (MPa)	Displacement (mm)
Cylindrical Shell	2562.59	2541.21	2552.94	0.38605
Ellipsoidal Head	704.35	623.94	720.15	0.09479
Semi Hemispherical Head	726.73	744.73	770.86	0.11313

The Code procedure [2,3,4,18,19] is to relocate the removed material to an area within an effective boundary around the opening. Figure 8 [19] shows the steps necessary to reinforce an opening in a pressure vessel. Numerous assumptions have been made with the intent of simplifying the general approach [19].

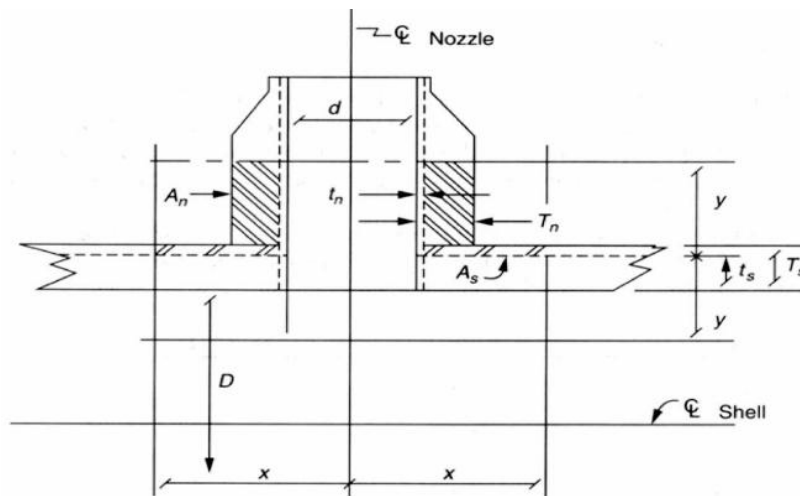


Figure 8: Opening Reinforcement Requirements [19]

- | | |
|---------------------------------------------------------|------------------------------------------------------------|
| $x =$ Larger of d or $R_n + t_n + T_n$ | $A_r =$ Area of required reinforcement (in. ²) |
| $y =$ Smaller of $2\frac{1}{2}T_s$ or $2\frac{1}{2}T_n$ | $A_s =$ Area available in the shell (in. ²) |
| $d =$ Diameter of circular opening (in.) | $A_n =$ Area available in the nozzle (in. ²) |
| $D =$ Inside diameter of shell (in.) | $A_r = (d)(t_s)$ |
| $t_s =$ Required thickness of shell (in.) | $A_s =$ Larger of: $d(T_s - t_s) - 2T_n(T_s - t_s)$ or |
| $T_s =$ Actual thickness of shell (in.) | $2(T_s + t_n)(T_s - t_s) - 2t_n(T_s - t_s)$ |
| $t_n =$ Required thickness of nozzle (in.) | $A_n =$ Smaller of: $2[2\frac{1}{2}(T_s)(T_n - t_n)]$ or |
| $T_n =$ Actual thickness of nozzle (in.) | $2[2\frac{1}{2}(T_n)(T_n - t_n)]$ |
| $R_n =$ Inside radius of nozzle = $d/2$ (in.) | $A_r < (A_s + A_n)$: Acceptable configuration |

Code: The complete rules for construction of pressure vessels as identified in ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Pressure Vessels.

Construction: The complete manufacturing process, including design, fabrication, inspection, examination, hydro test, and certification. Applies to new construction only.

Hoop membrane stress: The average stress in a ring subjected to radial forces uniformly distributed along its circumference.

Longitudinal stress: The average stress acting on a cross section of the vessel.

Pressure vessel: A leak-tight pressure container, usually cylindrical or spherical in shape, with pressure usually varying from 15 psi to 5000 psi.

Stress concentration: Local high stress in the vicinity of a material discontinuity such as a change in thickness or an opening in a shell.

Weld efficiency factor: A factor which reduces the allowable stress [2,3,4,18,19].

Results [23]

There are the follow results:

- to contribute to this vision-building process on ways of addressing emerging competence skills, *When using the prototype structural verification approach, the minimum ultimate design factors are the same as the required qualification test factors for both metallic and composite/bonded structures, except in the case of discontinuity areas of composite/bonded structures used in safety critical applications*[23].

a. When using the prototype structural verification approach, metallic structures shall be verified to have no detrimental yielding at yield design load before testing to full qualification load levels.

b. When using the protoflight structural verification approach, design factors shall be specified to prevent detrimental yielding of the metallic structure or damage to the composite/bonded flight structure during test.

- to contribute to the development of innovative visions and scenarios with stress and stress concentration in pressure vessels[23] ;

- *to increase the design factors of safety* . Some examples of criteria on which to base such an approach are as follows:

- The structural design is simple (e.g., statically determinate) with easily determined load paths; the design has been thoroughly analyzed for all critical load conditions; and there is a high confidence in the magnitude of all significant loading events[23].
- The structure is similar in overall configuration, design detail, build quality, and critical load conditions to a previous structure that was successfully test verified, with good correlation of test results to analytical predictions, and for which the same level of process control has been maintained[23].
- Development and/or component tests have been successfully completed on critical, difficult-to-analyze elements of the structure, and correlation of the analytical model to test results has been demonstrated[23].

1. Effect of nozzle diameter on stress concentration factor (SCF)[20,25,28,30]

In this section study of nozzle diameter on stress concentration factor has been carried out. For that here, different nozzle diameter i.e. 150 mm, 200 mm, 250 mm, 300 mm, 350 mm, 400 mm has been taken for calculation of stress concentration factor. Analytical and numerical method has been adopted to determine of stress concentration factor. Some parameters like internal pressure = 0.32 MPa, vessel diameter = 2400 mm, angle of nozzle with vertical vessel is 90° have been taken as constant in this section. The 3D CAD model of pressure vessel has been created using solid modeling software and the same has been imported into finite element analysis software to determine stress concentration factors.

Modeling and finite element simulation for pressure vessel [30]

The 3D CAD model has been generated using pro-e solid modeling software. The dimensions for the same has been taken as per above conditions. Here, the parametric module of solid modeling technique has been used to reduce time require in 3D modeling. This parametric technique has been used because of only one parameter i.e. diameter of nozzle has been changed with fixed remaining parameters. The CAD files of different models have been converted into a standard da exchange format. All files have been converted into step format due to its ASCII structure which is easy to read with typically one instance per line. The converted files have been imported into the FE simulation software ANSYS mechanical.

The proper material properties have been assigned to geometric files. Models have been discretized into numbers of element which is called meshing. Higher numbers of elements have been taken near about the junction of nozzle and vessel to get more accurate results. The proper boundary and loading conditions have been applied to meshed models. Meshed models with boundary conditions have been solved for static structural analysis to determine maximum equivalent stress value. The CAD model of pressure vessel with 150 mm diameter nozzle and meshed model for the same is shown in figure 9[30].

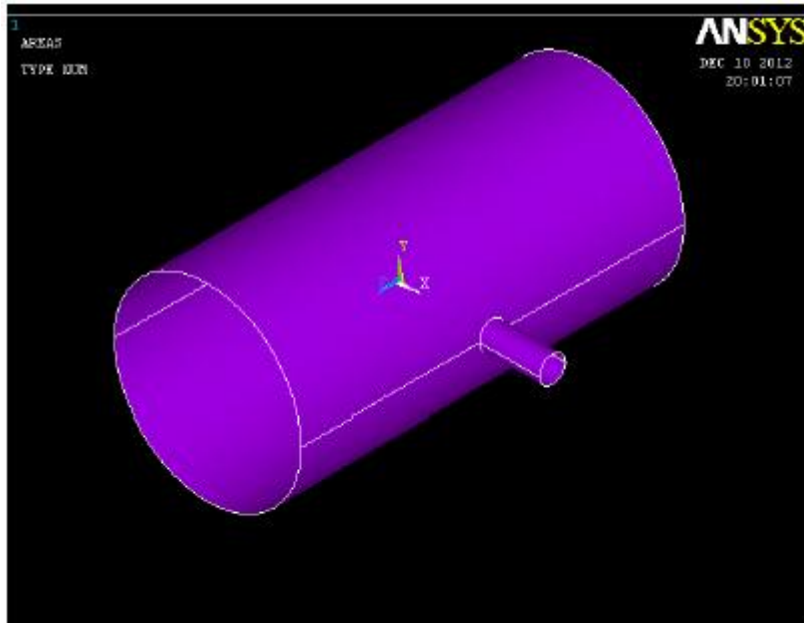


Figure 9: (a) Model of Pressure vessel for nozzle diameter 150 mm; (b) Meshed Pressure vessel for nozzle diameter 150 mm [30]

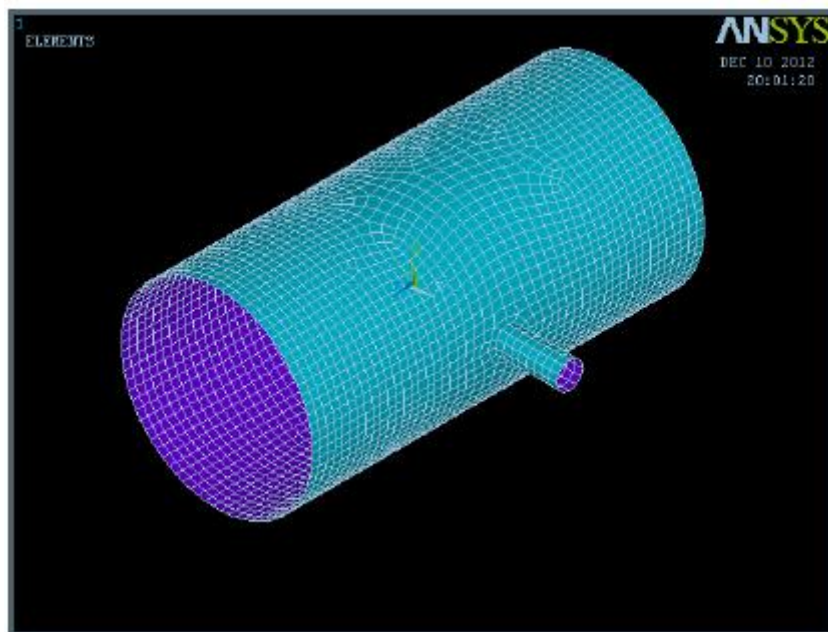


Figure 9: (b) Meshed Pressure vessel for nozzle diameter 150 mm [30]

For nozzle diameter 150 mm, equivalent stress profile has been found using above methodology and the same has been shown in figure 9. The enlarged view of maximum stress profile region has been shown in figure 9 (b). The stress concentration factor for 150 mm nozzle diameter has been calculated analytically using maximum equivalent stress value found by ANSYS. The value of stress concentration factor for the same is $k_t = 2.0707$.

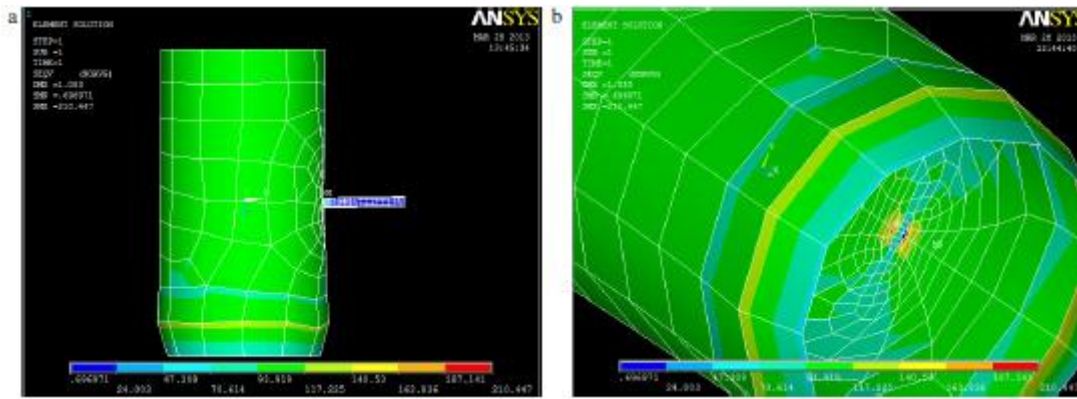


Figure 10: (a) Equivalent stress plot of pressure vessel for $d = 150$ mm; (b) Enlarge view of pressure vessel for $d = 150$ mm [30]

The same procedure has been adopted for 200 mm, 250 mm, 300 mm, 350 mm and 400 mm to determine stress concentration factors. The trend for stress concentration factor has been found to increase as nozzle diameter increases due to the value of equivalent stress increasing. The value of equivalent stress for more than 300 mm nozzle diameter is found very near to the yield stress of the material. So, the chances of failure are high in those cases compared to less than 300 mm nozzle diameter due to a high stress concentration factor [30].

The comparison of the stress concentration factor values for different diameter nozzles has been shown in graphical format in figure 11. In this study, nozzle angle with vertical vessel has been taken constant and is 90° [30].

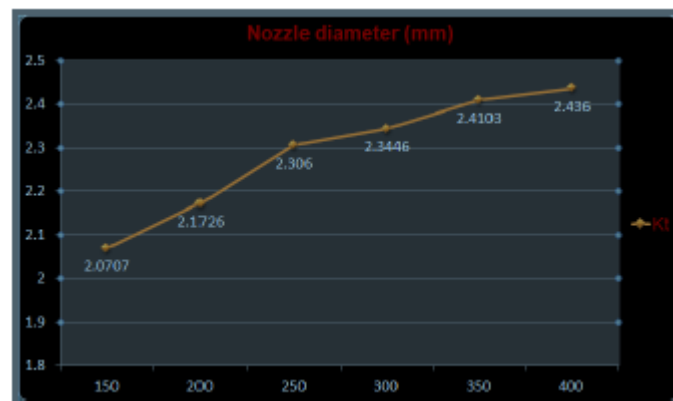


Figure 11: Graph of SCF versus different diameter nozzle with nozzle angle 90° [30]

2. Effect of nozzle angle on stress concentration factor [20,25,28,30]

In this section, study of nozzle angle on stress concentration factor has been carried out. For that here, different nozzle angles with vertical vessel, i.e. 95° , 100° , 105° , 110° have been taken with different nozzle diameters, i.e. 150 mm, 200 mm, 250 mm, 300 mm, 350 mm, 400 mm for calculation of stress concentration factor. The same method has been adopted to determine the stress concentration factor as described in the earlier section.

The comparison of the stress concentration factor values for different diameter nozzles for nozzle angle 95° with vertical vessel has been shown in graphical format in Fig. 4 (a). Similarly, the comparison of the stress concentration factor values for different diameter nozzles for nozzle angles 100° , 105° and 110° with vertical vessel has been shown in graphical format in figure 12 (b), 13 (a) and 13 (b) respectively [30].

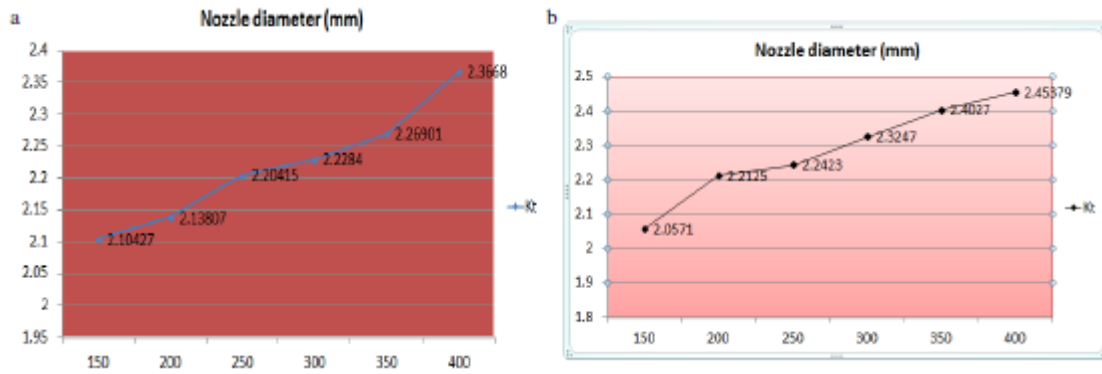


Figure 12: (a) Graph of SCF vs. diameter nozzle with nozzle angle 95°; (b) Graph of SCF vs. diameter nozzle with nozzle angle 100° [30]

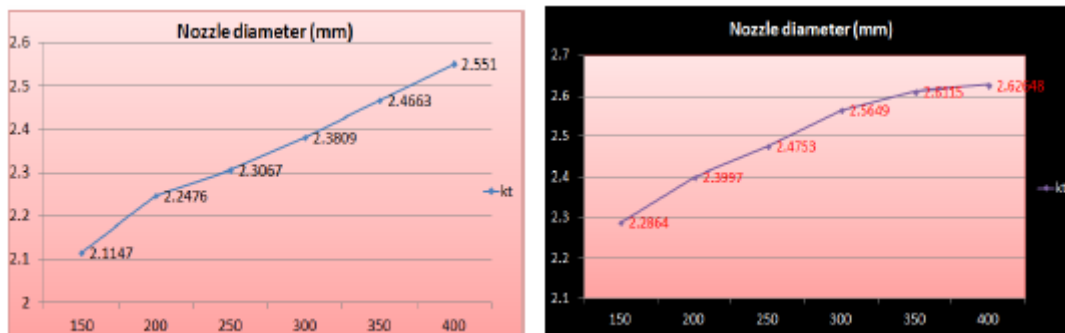


Figure 13: (a) Graph of SCF vs. diameter nozzle with nozzle angle 105°; (b) Graph of SCF vs. diameter nozzle with nozzle angle 110° [30]

To study the effect of nozzle angle on stress concentration factor, different nozzle angles i.e. 90°, 95°, 100°, 105° with different nozzle diameters i.e. 150 mm, 200 mm, 250 mm, 300 mm, 350 mm and 400 mm have been represented in single graph as shown in figure 14. From that it can be observed that as diameter of nozzle increases the stress concentration factor increases and for same diameter, as angle of nozzle increases the stress concentration factor increases [30].

Implications [12,13,23]

New technology based on probabilistic methods must use knowledge (or assumptions) of the statistical variability of the design variables to select design criteria for achieving an overall success confidence level.

a. Any proposed use of probabilistic criteria to supplement or as an alternative to deterministic factors of safety shall be approved by the responsible Technical Authority on an individual-case. The design factors of safety and test factors of this Standard are the minimum required values for NASA spaceflight structures and shall be applied to the limit stress condition, including additive thermal or pressure stresses.

b. If pressure or temperature has a relieving or stabilizing effect on the mode of failure, then for analysis or test of that failure mode, the unfactored stresses induced by temperature or the minimum expected pressure shall be used in conjunction with the factored stresses from all other loads[23].

Calculation of the portion of thermal stress or load which acts to relieve or stabilize stresses due to other applied loads is dependent on assumptions regarding boundary conditions and constraints between structural elements. In cases where a thermal stress or load acts to relieve or stabilize a failure mode, a conservative estimate (i.e., minimum value) of the portion of the thermal stress or load providing relief or stability should be used so as to not overestimate the beneficial effect of temperature.

c. Material selection and derivation of material design allowables shall follow the requirements defined in NASA-STD-6016.

Material allowables are to be chosen to minimize the probability of structural failure due to material variability. Considerations when specifying material design allowables include accounting for degradation of material properties under service environments and performance of sufficient material tests to establish values with an appropriate statistical basis.

d. The factored stresses shall not exceed material allowable stresses (yield and ultimate) under the expected temperature, pressure, and other operating conditions.

e. The hardware shall be designed to preclude any detrimental yielding under limit loads and, where applicable, under protoflight or proof test loads.

f. Applications of design and test factors to the development and verification of a structure shall be accepted by the responsible Technical Authority only when all the constraints and preconditions specified in section 1.3 are met[23].

If the proof test is to be used for fracture control flaw screening, higher factors than those listed here may be required for proof testing.[23]

Table 3: Minimum Design and Test Factors for Metallic Structures [23]

Verification Approach	Ultimate Design Factor	Yield Design Factor	Qualification Test Factor	Proof Test Factor
Prototype	1.4	1.0*	1.4	N/A or 1.05**
Protoflight	1.4	1.25	1.2	N/A or 1.05**

There are next general rules [12, 13]:

Emotional education is key driver of scientific discoveries.

Scientific discoveries are key drivers of economic growth, driving and fueling the economy [12, 13].

Leading engineers and economists have identified technological progress as the single most important determining factor in sustained economic growth. While some technologies can be anticipated, especially those that are improvements or new uses of old technologies, there is such rapid change in fundamentally new areas that it is hard to fully understand the implications [12, 13].

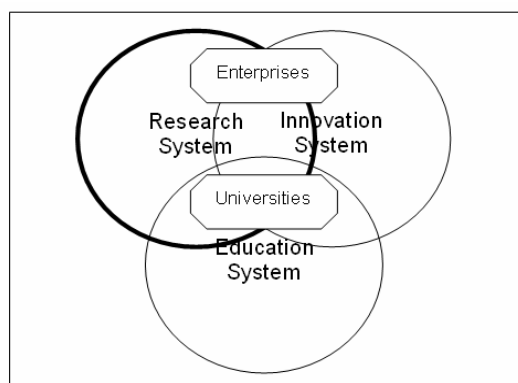


Figure 14: [12]

Example is the explosive changes taking place in Design information technology of pressure vessels.

The geometrical 3D CAD model of pressure vessel has been created considering the ASME code for all different cases [30].

The pressure vessel diameter is 2400 mm and internal pressure is 0.32 MPa taken as a constant parameter. The parametric study for nozzle diameter has been carried out and as a result of that it can be conclude that as diameter of nozzle increases stress concentration factor increases. For the same, limit dimension for the nozzle diameter is 300 mm to avoid catastrophic failure. The parametric study for nozzle angles has also been carried out. From that it can be observed that as diameter of nozzle increases the stress concentration factor increases and for same diameter, as angle of nozzle increases the stress concentration factor increases [30].

4. BACKGROUND [7,8,16,17,29]

4.1 Evaluations of thermal and mechanical stresses in areas with beveled ribs of pressurized cylindrical shells [16].

There are the follow stresses:

$$\begin{aligned}\sigma_{xi}^{(tot)} &= \sigma_{xi}^{(pc)} + \sigma_{xi}^{(\bar{P}_1)} + \sigma_{xi}^{(Q_{\theta i})} + \sigma_{xi}^{(M_{\theta i})}; \\ \sigma_{\theta i}^{(tot)} &= \sigma_{\theta i}^{(pc)} + \sigma_{\theta i}^{(Q_{\theta i})} + \sigma_{\theta i}^{(M_{\theta i})},\end{aligned}\quad (7)$$

$$\sigma_i^{(ech)} = \sqrt{[\sigma_{xi}^{(tot)}]^2 + [\sigma_{\theta i}^{(tot)}]^2 - [\sigma_{xi}^{(tot)}] \cdot [\sigma_{\theta i}^{(tot)}]}. \quad (8)$$

Intensifying stresses coefficients are[16]:

$$\alpha_{xi} = 2 \cdot \sigma_{xi}^{(tot)} \cdot \delta_c / (p_c \cdot r_{mc}); \quad \alpha_{\theta i} = \sigma_{\theta i}^{(tot)} \cdot \delta_c / (p_c \cdot r_{mc}), \quad (9)$$

$$\alpha_i^{(ech)} = \frac{2}{\sqrt{3}} \cdot \delta_c \cdot \sigma_i^{(ech)} / (p_c \cdot r_{mc}), \quad (10)$$

4.2 Thermo Mechanical Loading in Bevelled Area between Two Cylindrical Shells with Different Thicknesses [29]

There is present an original methodology based on the theory of unitary bending moments, characteristic for shells of revolution, respectively shorter structural elements theory. In this sense it pursues, to the present case, the determination of related loads (unitary radial bending moments, cutting efforts) in the separation plans of the structure elements, with transition areas from one thickness to another, with linear variation (the four cases analyzed)[29]. Their values can be used in subsequent works, at the evaluation of the average radial and annular stress, respectively of the maximal equivalent

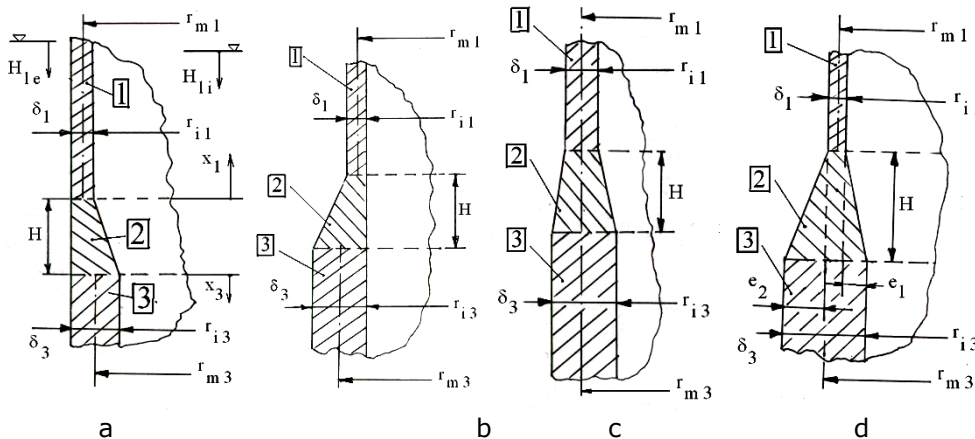


Figure 15: Types of beveled zones between two successive cylindrical shells with different thicknesses: [29]

15a - constant outer radius; 15b - constant inner radius; 15c - constant median radius (symmetrical beveled area); 15d - different medial surfaces (unsymmetrical beveled area) [29]

able to operate or it's necessary to go to specific adaptations: changing the construction material or the geometry used in the study.

An interesting observation is that the above results can be adjusted accordingly, when the switch between two different thicknesses of the shells are made through connections with identical or different geometry [29].

Another paper [29] proposed the evaluation of loading status, in the crossing beveled zone, between two cylindrical shells with different thicknesses (Figure 15). Evaluation was performed based on the theory of bending moments, of revolution shells and of congruence deformations on the one hand, [29], and of method of short structural elements [29], on the other hand. The paper sets out how the deduction of link loads, developed under the action of considered external loads, between shells and short structural elements (type cylindrical shell with length shorter than semi wave length [29], on the one hand, and between mentioned elements [29], on the other hand. Some recognized normative [29], make adequate specifications on the geometry of such beveled zones. Practice cannot meet always such recommendations, and as such it is required an atypical methodology for specific case.

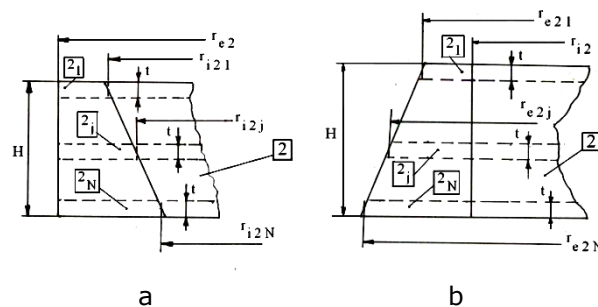


Figure 16

16a- Dividing of beveled shape zone presented in Figure 15.a 16b- Dividing of beveled shape zone presented in Figure 15.b. [29]

In the future we will try to make creep damage calculation in this case study. For achievement of the proposed aim, beveled zones of link are divided (figure 16-17), between the two successive cylindrical shells, in any number of short cylindrical elements (blades). Considering H - the zone height of a mentioned form, the N- the number of the lamellar elements of equal height, t (it is noted that the method also allows separation with different thickness which is accepted by researcher), it is deducted:

$$t = H / N .$$

(11)

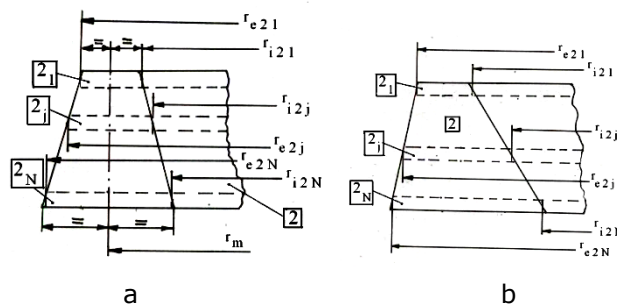


Figure 17: [29]

17a - Dividing of beveled shape zone presented in figure 15.c. 17b - Dividing of beveled shape zone presented in figure 15.d.

4.3 The Cumulative Creep-Fatigue Damage (Tmf/Srp-Damage Coupling) Model [5,6,7,8]

Most applications that involve TMF loading also include complex multilevel cyclic loading patterns, so that cumulative damage effects are also a concern. The model of cumulative creep-fatigue damage, proposed by McGaw, rests on the notion that certain basic damaging modes of cyclic deformation characterize the failure behavior of a material and utilize the SRP method as its basis [7].

A set of damage-curve relations is proposed for the modeling of damage accumulation according to each of the four fundamental deformation and damage modes given in SRP

$$D_{ij} = \left(\frac{n}{N_{ij}} \right)^{N_{ij}^{\alpha_{ij}}} \quad (12)$$

where α_{ij} , $i, j = p, c$ may be considered as material-dependent parameters, and the damage variable, D , possesses a range of 0 (undamaged condition) to 1 (failure) over the domain of the life fraction n/N_{ij} of 0 to 1[7].

When multiple damage modes are operative, an additional set of damage coupling relations is required,

$$D = g_{ij}(D_{ij}) \quad (13)$$

where the functions, g_{ij} , $i, j = p, c$ [where $g_{pp}(D_{pp}) \equiv D_{pp}$] must be determined by experiments.

The coupling relations recognize that what is considered as damage in one context cannot be necessarily regarded as damage in another (e.g., pp-type cycling is associated with trans granular, classical fatigue-type damage, while cp-type cycling is associated with intergranular, creep-type damage). However, the coupling relations do imply that the damage state is relatable. The coupling relations provide a mapping or correspondence between damage modes [7].

To model the more general problem wherein multiple damage modes may be present within a single cycle, one additional relationship must be established—a description of how the various damaging contributions may be synthesized to provide a means of assessing the cumulative damage contribution

$$\frac{n}{N_f} = F_{pp} D_{pp}^{N_{pp}^{-\alpha_{pp}}} + F_{cp} D_{cp}^{N_{cp}^{-\alpha_{cp}}} + F_{pc} D_{pc}^{N_{pc}^{-\alpha_{pc}}} + F_{cc} D_{cc}^{N_{cc}^{-\alpha_{cc}}} \quad (14)$$

This equation describes the cumulative damage behavior of a complex cycle (with life N_f) as life fraction, expressed in terms of the four damage variables, D_{pp} , D_{cp} , D_{pc} , and D_{cc} . The model can be readily extended to treat the case of TMF through the use of the bithermal fatigue approximation to TMF[7]. To address TMF, the life relations, damage-curve equations, and damage-coupling relations can be directly replaced by bithermal counterparts. Experiments consisting of two-level loadings of TMF (both IP and OP) followed by isothermal fatigue to failure were conducted on 316 stainless steel. It was found that the model gave good predictions for the OP two-level tests and provided reasonable bounds for the IP two-level tests [7].

This study is part of a larger study investigating the effects of stresses and stresses concentration in pressure vessels. Since 2012 our small group, involved in educational

process of PHD candidates at Politechnique University of Bucharest has been started to find solutions for improve quality assurance problems in stress, stress concentration, *stress concentration factor*, *Design Pressure Vessels Methods Change*.. We are now trying to open a new folder with many files as design manufacture, and use of pressure vessels [5,6,7,8,17,29].

5. DATA AND METHOD[5,6,7,8,12,13,23,24,29,30,31,32,33,34]

The study was carried out by using the statistical data collected from the Institutes of Technology from USA, UK, India and Romania. We examined to underline the aspects regarding the pressure vessels sector from the studied area, both by outlining the major problems and also by finding adequate solutions for a long-term quality improvement of interdependence within another sectors of activity. We involved the important role of short elements theory to assure best results for design manufacture, and use of pressure vessels process.

The relevant final stage for the study was the analysis and the interpretation of the results obtained, which completed the general image over the design approach indicated by the Code to perform a simple sizing calculation for a typical welded carbon steel vessel. Figure 19 shows a typical shell-nozzle juncture and head-shell juncture which meet the code requirements. Design specifications for the many associated vessel parts such as bolted flanges, external attachments, and saddle supports can be found in the reference materials [19].

Using the statistical data available, we have indicated the important role of Research, Innovation, Enterprises and Universities in developing or change Design Pressure Vessel Methods for good results in improvement stress concentrations studies in pressure vessels [12,13,23,24].

DESIGN SPECIFICATION

Design pressure = 700 psi
Design temperature = 700° F

Material:

Shell SA-516 Gr. 70
Head SA-181 Class 70
Nozzle SA-106 Gr. B

Weld efficiency factor = 1.0 = E
(full radiographic examination)

Shell Thickness

$$t_s = \frac{PR}{SE - 0.6P}$$

$$= \frac{700(30)}{16600(1.0) - 0.6(700)}$$

$$= 1.30 \text{ in. Use } 1\frac{1}{2}'' = T_s$$

P = 700 psi

R = 30 in.

E = 1.0

S = 16 600 psi (SA-516 Gr. 70, Table 9.2)

Hemispherical Head Thickness

$$t_h = \frac{PR}{2SE - 0.2P}$$

$$= \frac{700(30)}{2(16600)(1.0) - 0.2(700)}$$

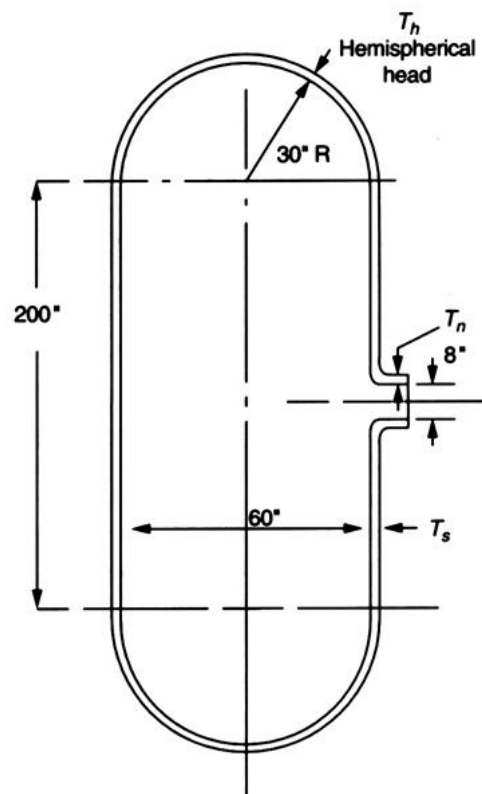


Figure 18: [19]

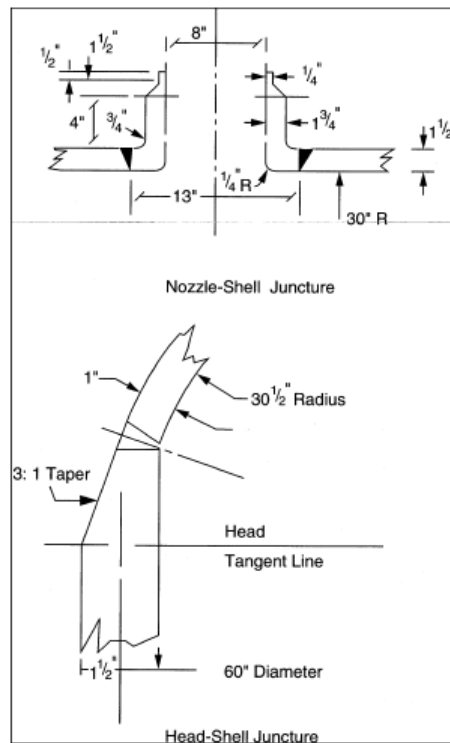


Figure 19: Fabrication details [19]

6. RESULTS AND DISCUSSIONS [7, 34, 35]

On the one hand, the scope of this paper is to present *research regarding the decrease of the following phenomena: cracking, stress, stress concentration, faulty Design, corrosion, fatigue, creep, and other serious damage problems* [7, 34, 35].

On the other hand, we present high results for the cases when pressure vessels are used to store fluid that many undergo a change of state inside in case of the boiler or it may combine with other reagent as in chemical plants [7,8,9,29,34]. The fluid being stored may undergo a change of state inside the pressure vessel as in case of steam boilers or it may combine with other reagents as in a chemical plant. The pressure vessels are designed with great care because the rupture of pressure vessels means an explosion which may cause loss of life and property. The material of pressure vessels may be brittle such that cast iron or ductile such as mild steel [35]. Cylindrical or spherical pressure vessels e.g., hydraulic cylinders, gun barrels, pipes, boilers and tanks are commonly used in the industry to carry both liquids and gases under pressure. When the pressure vessel is exposed to this pressure, the material comprising the vessel is subjected to pressure loading, and hence stresses, from all directions. The normal stresses resulting from this pressure are functions of the radius of the element under consideration, the shape of the pressure vessel i.e., open ended cylinder, closed end cylinder or sphere as well as the applied pressure[35]. Two types of analysis are commonly applied to pressure vessels. The most common method is based on a simple mechanics approach and is applied to thin wall pressure vessels which by definition have a ratio of inner radius to wall thickness i.e., $r/t \geq 10$. The second method is based on elasticity solution and is always applicable regardless of the r/t ratio and can be referred to as the solution for thick wall pressure vessels [7,34,35].

Cylindrical or spherical pressure vessels (e.g., hydraulic cylinders, gun barrels, pipes, boilers and tanks) are commonly used in industry to carry both liquids and gases under pressure [35].

Thin-Walled Pressure Vessels several assumptions are made in this method.

1) Plane sections remain plane

- 2) $r/t \geq 10$ with t being uniform and constant
- 3) The applied pressure, p , is the gage pressure (note that p is the difference between the absolute pressure and the atmospheric pressure)
- 4) Material is linear-elastic, isotropic and homogeneous.
- 5) Stress distributions throughout the wall thickness will not vary
- 6) Element of interest is remote from the end of the cylinder and other geometric discontinuities.
- 7) Working fluid has negligible weight [35]

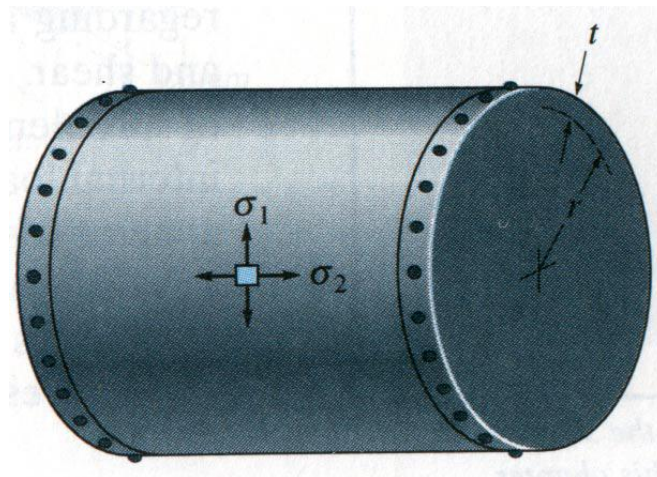


Figure 20: Cylindrical Thin-Walled Pressure Vessels

7. CONCLUSIONS [7,29,30]

This paper aims to present an original methodology based on the theory of unitary bending moments, characteristic for shells of revolution, respectively shorter structural theory. In this sense it pursues, to the present case, the determination of related loads (unitary radial bending moments, cutting efforts) in the separation plans of the structure elements, with transition areas from one thickness to another, with linear variation (the four cases analyzed). Their values can be used in subsequent works, at the evaluation of the average radial and annular stress, respectively of the maximal equivalent stress. Based on its value it can be concluded if the structure is able to operate or it's necessary to go to specific adaptations: changing the construction material or the geometry used in the study [7].

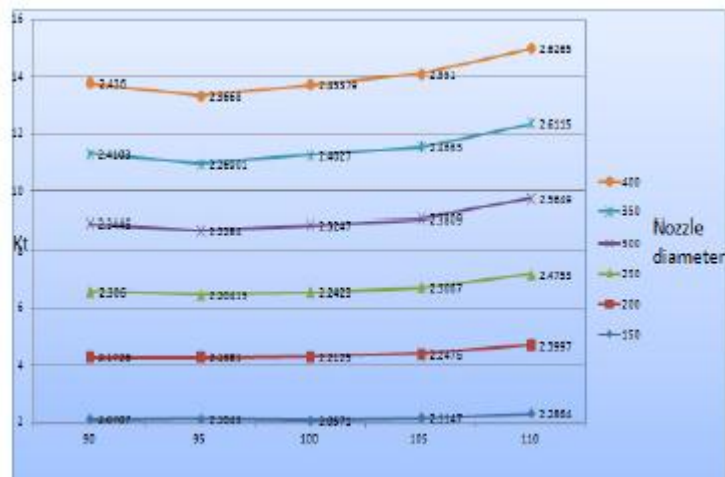


Figure 21: Graph of SCF vs. different nozzle angle for different diameter nozzle [30]

The geometrical 3D CAD model of pressure vessel has been created considering the ASME code for all different cases [30].

The pressure vessel diameter is 2400 mm and internal pressure is 0.32 MPa taken as a constant parameter. The parametric study for nozzle diameter has been carried out and as a result of that it can be conclude that as diameter of nozzle increases stress concentration factor increases. For the same, limit dimension for the nozzle diameter is 300 mm to avoid catastrophic failure. The parametric study for nozzle angles has also been carried out. From that it can be observed that as diameter of nozzle increases the stress concentration factor increases and for same diameter, as angle of nozzle increases the stress concentration factor increases [30].

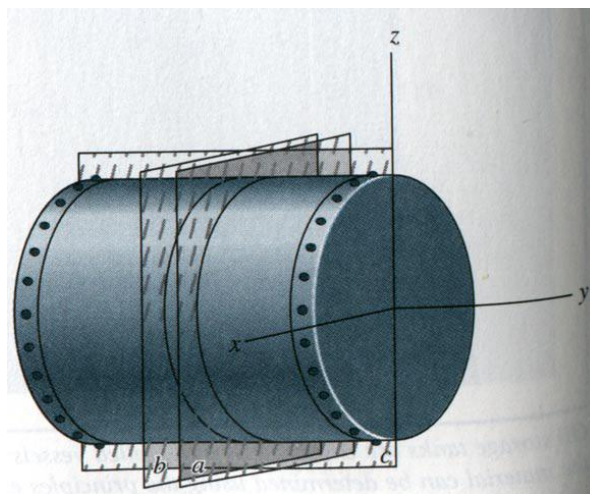


Figure 22: Cylindrical Thin-Walled Pressure Vessel Showing Coordinate Axes and Cutting Planes (a, b, and c) [35]

An interesting observation is that the above results can be adjusted accordingly, when the switch between two different thicknesses of the shells are made through connections with identical or different geometry [7].

Damage modeling under thermo mechanical cyclic loading is still at an early stage. TMF cycling is expected to introduce a multitude of cyclic deformation and damage mechanisms in super alloys, and the influence of these damage mechanisms on the material's fatigue-crack initiation and propagation behavior is not well understood at present. No generally accepted models of TMF fatigue-life prediction are currently available [7].

It is generally recognized that three dominant damage mechanisms (fatigue, oxidation, and creep damage) may occur during TMF loading conditions. Most proposed models of TMF fatigue-life prediction attempt to capture the effects of these damage mechanisms and their interactions. It is not certain if these dominant damage mechanisms operate simultaneously, or if some of them run and others become inoperative during a special TMF loading condition [7].

There are many factors affecting TMF lives, such as materials, maximum and minimum temperatures, temperature range, strain rate, strain range, strain-temperature phase, and

dwel and cycle times. There is a difficulty in that the models quantitatively simulate the interaction of damage mechanisms; at present, views on how to deal with this problem differ. Based on this and the complexity of alloys systems, TMF-life-prediction models are generally time-consuming and expensive [7].

To develop effective TMF life-prediction approaches for super alloys, more experimental work and data collection are necessary on various materials placed under TMF loading conditions, including pressure vessels[7].

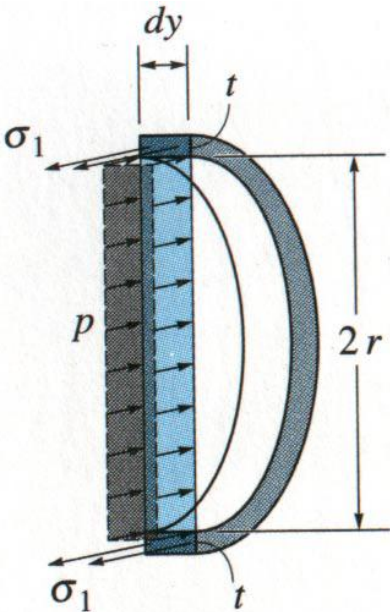


Figure 23: Free-Body Diagram of Segment of Cylindrical Thin-Walled Pressure Vessel Showing Pressure and Internal Hoop Stresses [35]

The opening created due to nozzle or other accessories in pressure vessel plays vital role in stress concentration factor. In this paper parametric study of nozzle dimensions on stress concentration factor for static loading has been carried out[35].

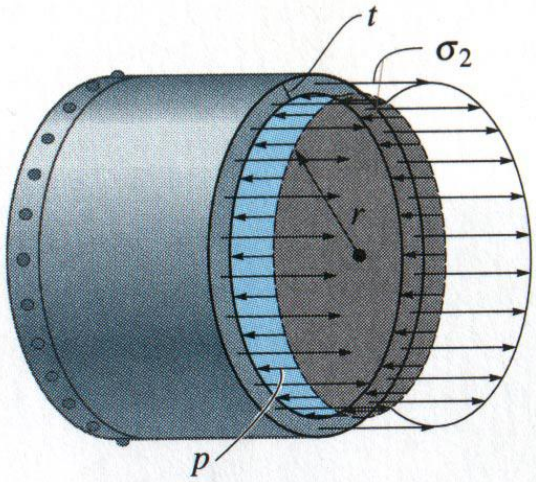


Figure 24: Free-Body Diagram of End Section of Cylindrical Thin-Walled Pressure Vessel Showing Pressure and Internal Axial Stresses [35]

Here, the effect of nozzle angle with a vertical vessel on stress concentration factor has also been studied. The model of different nozzle diameter and different angle with vertical vessel

has been created in solid modeling software and finite element analysis for the same has been carried out in ANSYS software. The comparison of parametric study results of the stress concentration factor has been shown in the graphical format. For constant diameter of the vessel, sustainable limit dimension for opening size and angle is decided from this study [30]. The hoop stress is twice as large as the axial stress. Consequently, when fabricating cylindrical pressure vessels from rolled-formed plates, the longitudinal joints must be designed to carry twice as much stress as the circumferential joints [35]. Our models are inspired by theory often used to describe complex dynamic interactions in engineering systems. As with any metaphor, the model has its limits.

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The Realistic Vision of Professor Ion Nicolae Angelescu about the Part Played by Culture in the Creation of a Modern and Complex Economic Civilisation

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ABSTRACT

As a result of the 1918 Great Union and the formation of Modern Romania, Professor and economist Ion Nicolae Angelescu approached and studied mostly the relationship between economy and culture, namely, civilization. Among the great professors who carried out their activity before the foundation of the Faculty of Commerce, in 1951, we have the great honor to "make room" at "Personalalia" column, for Ion N. Angelescu. Economist, distinguished scholar and neo-liberal politician. He was an associate professor and afterwards a professor at the History of Commerce Department in the Academy of High Commercial and Industrial Sciences. He was a university Professor at the History of Commerce Department and rector of the Academy of High Commercial and Industrial Studies; he had high official positions (member of parliament, chief of the Ministry staff, under-secretary of state, minister), one of the founding president of Romanian Economists' Association, as a professor, rector and economic thinker. Ion N. Angelescu had an outstanding professional experience for an economist from the beginning of 20th century, generally, and for an economist with a modest provenance and limited material possibilities, particularly: Ion N. Angelescu had a Bachelor of Law and a Bachelor of Literature and Philosophy, at the University of Bucharest; a doctor degree in economics at the University of Munich, with Lujo Brentano as a guiding scientific professor, dean of the new historic German school.

He stressed the importance of the organization of an advanced economic educational network aimed at connecting the theoretical approach to every day practice.

Ion Nicolae Angelescu's approach to the role played by culture in the development of socio-economic life as well as to their interdependence brought new ideas and theses to the field of economic culture.

Introduction

The encyclopedic personality of the neoliberal Ion Nicolae Angelescu, is important because he managed, during his short life (1884-1930) to highlight the importance of the inter-wars period throughout his entire theoretical and practical activity.

Among his professional achievements which show the connection between culture and economy mention should be made that he was founder professor of A.I.S.C.I. (currently A.S.E. -the Academy of Economic Sciences)

He was its rector from 1918 to 1926 and then the founder and manager of the Statitic and Economic Annals from 1926 to 1930. He was a co-worker to various Rumanian and foreign journals.

The proper interpretation of the actual economic situation of a country is done with the support of a vast general culture offering the researcher a vast field of study in order to be able to approach present and long term socio-economic issues.

I.N. Angelescu was an active, creative spirit constantly preoccupied to emphasize the indissoluble connection which should exist between cultural development and the economic life of a people, as Maria and Dumitru Mureşan state, that he looks upon economic life „ in its entire complexity and makes it out under numerous aspects”¹.

I.N. Angelescu's approach is that: “the special culture and the genius of a people is a factor for the greatness and spreading of which, people use up a lot of energy and consciousness”².

In another context, I.N. Angelescu states that: “in the course of history no culture was created without thorough economic organisation and a prosperous material life.

When during very civilised stages, the justifying of rivalries and attacks are achieved through tendencies and spreading of culture and the battle is fought on economic field. „After a battle, one acquires goods and favorable economic situations and on the other hands, the enemy's economic defeat is surely followed by the cultural defeat”³.

I.N. Angelescu states that „the past life of the world offers us convincing evidence that everywhere the gathered wealth leads to the creation of a culture, of a political force and of the superior output of feeling and thinking”⁴ and his speeches on the history of trade confirms the fact that in this subject „one has the most appropriate occasion to emphasize the close connection between the economic and the cultural development of a people”⁵, as it offers to each society member the possibility to understand his or her place and use in society and to channel his or her activity in the sense required by society”⁶.

According to I.N. Angelescu's approach, the economic culture which is in the benefit of people having a functionally active part, with a multitude of aspects enabling mostly the revelation, „comprehension and application of economic laws which are scientifically researched and which should be obeyed”⁷. He mentions that laws must be obeyed to the letter without being disobeyed, to make possible the elaboration of a correct economic policy. When speaking about the duties of politicians in the field of economic culture, I.N. Angelescu thinks that:

„The results of scientific research on economic issues must be learnt by politicians just as they learn writing and reading, the basics of law and of natural science”⁸ regardless of the political party to which they belong.

Taking into account that the degree of perception of the purpose of scientific research of the economic field varies from politician to politician, “only a powerful economic culture could determine all of them, in view of logics and honesty, to accept the principles and conclusions of economic science and to act accordingly”⁹.

As the consequent application of the efficient economic policy is concerned, I. N. Angelescu stated that „all is as to a consequent caution of economic policy. I.N. Angelescu stated that „ all the decisive elements of economic life, – as only thus – economic policy is closer to positive science”¹⁰.

¹ Maria and D. Mureşan, *Culture and şii Economii in Prfessor I.N. Angelescu.'s Works introduced at the Professors 'Session, May 1997*, The Romanian-American University, Bucharest, 378.

² I.N. Angelescu, *The Economic and Political Power*, p. 9.

³ Ibidem, p. 10.

⁴ Idem, *The History of Trade*, Bucharest 1915, p. 54-55.

⁵ Idem, *The History of Universal Trade in relation to Economic History and the History of People's Culture*, p. 28.

⁶ Maria and D. Mureşan, op. cit., p. 379.

⁷ I.N. Angelescu, *The Economic History and other Economic Studird, I*, p. 20.

⁸ Idem, *The History of Trade* p. 236.

⁹ Maria and D. Mureşan, op. cit., p. 381.

¹⁰ I.N. Angelescu, *The knowledge and Leadership of the Economic Market*, 1914, p. 5.

I.N. Angelescu also stated that economic culture plays an important part in solving economic, social, political and moral crises which emerge in society, while initial reforms act as „lever or support in order to achieve the legislative frame of order in society”¹¹.

One cannot establish „ social order by means of isolated means or laws. This system is not achieved by simple-minded impressions and mostly by means of passionate drives of hate”¹². I.N. Angelescu underlines that “reforms and laws must be initiated and applied by paying”¹³ much attention to the benefit of everybody, allowing an appropriate orientation of such complex economic issues in order to avoid „man’s falling a victim to existential fight, as well as for man to shape a proper behaviour „the result of our victory regarding the requests leading to a better material status, to a moral uplifting, cultural development conditioned by the economic development”¹⁴.

I.N. Angelescu ascertains that in his effort of having a better life „man prepares his economic and cultural aim, on the other hand, man can bring about economic ruin and cultural burrial”¹⁵.

Finally, the allotment of riches,„ has a crucial influence on the economic, cultural and political development of the people”¹⁶.

„Economic culture with the meaning offered to material life is the result of the spreading of wealth in the town bourgeoisie, as well as of passing land ownership in the hands of the true farmers, either before or after appropriating land to the peasants

People’s natural desire to progress leads to competition.

The competition between the active people leads to technical progress and thus the gathering of wealth by means of ??**mora** ?? and intellectual progress”¹⁷.

The importance of economic scientific culture is emphasised by I.N. Angelescu when he discusses about the foreign capital participation to the economic activities, such as machines and tools, while „the most qualified work to the most upskilled work will be Romanian”¹⁸.

I.N. Angelescu point of view on education related to forming an economic culture was that „ by means of education man is able to live material and moral life more fully ”¹⁹.

As to population and its professional education, I.N. Angelescu stated that,„ It is our generation's duty to try hard to implement at home the most advanced civilisation ”²⁰

Regarding the state role, he states that: „The first duty is the formation of population to emphasize national riches. Up to now, we had almost nothing. The Former Kingdom does not offer us the required elements, while they are theoretical limitations and are not in accordance with our real needs”.

Important production and industrial branches with great commercial perspectives imposed by our relationship with other countries do not have the appropriate educational level. work These branches are dominated by routine and tradition, while technical discoveries are used to convert us into mere blind tools aiming at a purpose which is not ours”²¹

¹¹ Maria și D. Mureșan, op. cit., p. 382.

¹² I.N. Angelescu, *Guide lines in economic and Financial Policy of Romania*, p. 5.

¹³ Ibidem, p 5.

¹⁴ Idem, *The History of Universal Trade in relation to Economic History and the History of People's Culture*, p. 11.

¹⁵ Idem, *The economic and the Political Power* p. 10.

¹⁶ Ibidem, p. 38.

¹⁷ Ibidem, p. 31-32.

¹⁸ Idem, *The Economic Policy of Great Romanian*. 37-38.

¹⁹ Idem, *Social insurance in Modern States*, p. 158.

²⁰ Idem, *The Political economic of Great Romania*, p. 18.

²¹ Ibidem, p. 20.

Regarding the competition between states, I.N. Angelescu states that „in case our national production is not able to sustain competition and we will have to resort to protectionist systems which make consumers' living more difficult, the cause of all that is the lack of an appropriate professional preparation. There must be unity and coordination of forces in our national economy due to a lack of a systematic economic education”²².

Thus „on a professional level, all citizens should have appropriate educational training during their life time; to attain Progress in a certain branch is useful to the national work force”²³.

The state has a leading role, while all people also play an active part, as education „is an issue which concerns the entire population of the country.”²⁴, being a stringent urgency for the young generation.

That is why an immense effort must be made to offer the necessary preparation to young people. “One should devise a ample plan of national education from the very beginning”²⁵

He stated that „ Building all level schools endowed with teachers should be the main preoccupation of a government”²⁶, as well as „the organisation of higher economic education which should be competitive with the European economic higher education. and prepare experts with both ample professional knowledge and culture, by organising university education at the level of the European education.

I.N. Angelescu stated that „workers need higher professional qualification with good and profound cultural background so as to ensure the economic progress of the nation”²⁷.

„Special culture, thorough knowledge in any research field are aimed at spreading to wider circles”²⁸, by the people who „having at their disposal exact methods of research, personally contribute to progress. They have to cope with everyday life issues”²⁹. They have to be very well prepared from the scientific point of view, in order to efficiently solve the economic issues.

The extension of the economic culture both horizontally and vertically, determines the economic behaviour of all society members, becoming a basic component of the economic modern civilisation, requiring complex theoretical and practical preparation which „is able to be put to good use and enrich the requirements of science. This reaffirms that peoples' energy” may be used only with the most advanced technique”³⁰.

CONCLUSIONS

Ion Nicolae Angelescu will be remembered as a prestigious representative of the Rumanian economy and education which he served with abnegation all his life.

The research of various aspects of the role played by the economic culture in determining the economic life, leads to I.N. Angelescu's opportunity to formulate objective considerations regarding the role of the state and of the educational system in the professional and cultural formation of the entire population.

I.N. Angelescu ideas on the role played by culture in the socio-economic life make up a complex and realistic conception with everlasting ideas which can also be a source of

²² Ibidem.

²³ Ibidem.

²⁴ Ibidem, p. 21.

²⁵ Idem, Guide in the *Political and Financial Economy of Great Romania*

²⁶ Ibidem.

²⁷ Idem, *The History of universal Trade its economic History and with the History of People's*, p. 5.

²⁸ Idem, *The History of Trade*, p. 231.

²⁹ Ibidem.

³⁰ Idem, *The Economic Policy of Great Romania* p. 7.

inspiration and meditation about the contemporary situation of our society, in order to shape Romanian economy according to the requirements of the modern market economy.”³¹. His approach emphasizes the connection between economic theory and practice, leading to pertinent conclusions.

Mention must be made that I.N. Angelescu's interest in economic culture results from his intense preoccupation in this field. His approach was internally and internationally affirmed and dwells on an ample process from a scientific point of view as phenomena which amplify during the interwar period.

Nowadays I.N. Angelescu's approach is: “One lives in a period of time in which the usual schemes are not valid any more, people look for a more complex image about themselves. This image must be in accordance with their image in real life ³². The author agrees with Ion Nicolae Angelescu who considered that culture played a decisive part in the making of a modern economic civilisation, able to a rational putting to good use of material and human potency towards successful progress.

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³¹ Maria and D. Mureşan, op. cit., p. 388.

³² Zamfirescu D., History and Culture, Eminescu Publishing House, 1975, p. 8.