A

THESIS REPORT

ON

STRESS ANALYSIS OF PIPELINE USING CAESAR II

A thesis is submitted in partial fulfillment of the requirement for the degree of

MASTER OF TECHNOLOGY
IN
PIPELINE ENGINEERING

BY

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Under the Guidance of

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College of Engineering Studies
University of Petroleum & Energy Studies
Dehradun

May, 2011

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Approved

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01st April 2011

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. Anurag Dixit, student of University of Petroleum & Energy Studies, Dehradun, has completed his project assignment in our organization from 24th January 2011 to 01st April 2011.

The topic of his project was *"Stress Analysis of Pipeline Using CAESAR II"*

We found Anurag Dixit hardworking and sincere person who carried out his work diligently. We wish him all the very best.

Yours truly,
for **Larsen & Toubro Limited**

Anshul Sharma
Asstt. Manager- Human Resources

CERTIFICATE

This is to certify that the work contained in this thesis titled " **STRESS ANALYSIS OF PIPELINE USING CAESAR II** " has been successfully carried out by **ANURAG DIXIT (R150209004)** student of **M.Tech. Pipeline Engineering** in **University of Petroleum & Energy Studies**, Dehradun, under my supervision and has not been submitted elsewhere for a degree.

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ABSTRACT

Stress analysis is a term applied to calculations, which address the static and dynamic loading resulting from the effects of gravity, temperature changes, internal and external pressures, changes in fluid flow rate and seismic activity. Codes and standards establish the minimum requirements of stress analysis.

Pipelines used for oil & gas transportation are buried for below the ground surface for aesthetic and environmental reasons to avoid damage from external activities and to provide thermal insulation. The soil cover also provide resistance to upward movement of the pipe caused by thermally induced axial loading, phenomenon known as upheaval buckling. Buried pipelines are subjected to various static and dynamic loads.

The designer is required to appropriately combine the effects of concurrent loads when evaluating the adequacy of the buried pipeline. Pipelines are designed to have sufficient flexibility to prevent expansion or contraction from causing excessive stresses in the pipe material, excessive bending moments at joints, or excessive force or moments at points of connection to equipment or at anchorage or guide points.

The purpose of this thesis is to demonstrate evaluation of the integrity of buried pipeline system subjected to static loading due to internal pressure, thermal expansion, dead loads, buoyancy, relative pipe-soil displacements and movement at pipe bends. The provisions contained in this thesis apply to carbon steel, welded pipelines designed, fabricated and tested in accordance with ASME B 31.4 for liquid hydrocarbon pipelines.

TABLE OF CONTENT

Content **PAGE**

LIST OF TABLES

LIST OF FIGURES

NOMENCLATURE

A	=	Corrosion plus any other allowances
D	=	Outside diameter of the pipe
Pi	=	Design internal pressure
T	=	Pressure design wall thickness
SMYS	=	Specified Minimum Yield Strength
P_y	=	Yield Pressure at Collapse
S	=	SMYS
t	=	Wall thickness
D	=	Nominal outer diameter
P_e	=	Elastic Collapse Pressure
E_s	=	Young Modulus of steel, in kPa
υs	=	Poisson's ratio of steel
Es	=	Young's Modulus
R	=	Pipe Radius
r	=	Radius of curvature of pipeline
F_{AF}	=	Anchor force
t_{nom}	=	Nominal wall thickness of pipe
S_E	=	Elastic section modulus of pipe
α_T	=	Linear coefficient of thermal expansion of steel
T_1-T_2	=	Temperature difference between operating and installation temperatures
A_s	=	Area of pipe cross section
A	=	Point of virtual anchor
B	=	Free end
A_m	=	Pipe metal area, m2
F_s	=	soil resistance, kg/m
L_0	=	Transition length of pipeline from starting to point of non-movement
σ_L	=	Longitudinal stress

ε_B = Net Longitudinal Strain

σ_H = Hoop Stress

δ = Displacement at free end

W_p = Net downward pipe weight including coating, N/m

W_1 = Steel pipe Weight, N/m

W_2 = Fusion Bonded Epoxy Coating Weight, N/m

W_3 = PUF Coating weight, N/m

W_4 = CS Heating tubes weight, N/m

W_5 = HDPE Coating weight, N/m

W_6 = Concrete Coating weight, N/m

K_{He} = Stiffness factor for earth load

B_e = Burial factor for earth load

E_e = Excavation factor for earth load

G = Soil unit weight, kN/m^3

D = Pipe outside diameter, m

μ = Friction coefficient

S_u = Unstrained shear strength

D = Pipe diameter

ρ_s = Soil density

H = Buried depth to the top of pipe

ρ_p = Pipe density

t = Pipe nominal wall thickness

ρ_f = Fluid density

φ = Angle of internal friction

CHAPTER – I

INTRODUCTION

1.1. Introduction

This project is the part of final semester (IV Semester) course curriculum. I choose my project STRESS ANALYSIS OF PIPELINE USING CAESAR II software as my major project and I got an opportunity to do this project in L&T Valdel Engineering Ltd.. Faridabad campus. There were several projects running in both onshore & offshore of different pipelines (companies). I was there under the Pipeline Department headed by Mr. Vishal Modgil. Mr. Modgil decided to give me an onshore underground pipeline project and provided me a mentor Mr. Vikas Gupta, who has good experience in the pipeline field. In the starting of the project they provided me necessary data and documents to study. These were very helpful to understand the project and their scope. They also provided the software CAESAR II to do the stress analysis. The detail of the project is attached in the report.

Pipeline is the medium of transporting oil & gas from any onshore/offshore terminal to other onshore/ offshore terminal. It is a safe, economical and fast method of transporting hydrocarbon. Before laying a pipeline the stress analysis of the critical section of pipeline is carried out by using commercially available software(s) like CAESAR & Auto PIPE.

2. Project Background

A new crude oil export pipeline is being planned from the central processing facility (CPF) at the Station -1 to Station -2.

The crude oil contains significant long chain paraffin components. The crude oil is expected to get at temperatures below 50°C and the design calls for heating on the pipeline to prevent gelling and to reduce the crude oil viscosity.

The design considers the transportation of stabilized crude oil from the central processing facility (CPF) near Station -1, to the potential receiving centers at Station -2. Since the crude oil in the pipeline is to be heated to around 73°C, the design temperature was fixed at 93°C.

1.3. Objective of the project

1. Prevention of pipeline from stress failure.
2. Decide the safe minimum burial depth with construction point of view.
3. Insertion of cold bends & hot bends to suit the pipeline profile.

1.4. Scope Of Project

The scope of this project is to take the experience of real pipeline projects and face the challenges occur during the design phase of any pipeline project. The scope of this project report is to prevent the pipeline failure due to stresses generated due to

1. Pressure
2. Temperature
3. Environmental factors like temperature at which pipeline are installed below ground level.
4. Hydrostatic testing etc.

The analysis has been carried out for one Highway Crossing and for one Nala Crossing.

CHAPTER – II

LITERATURE REVIEW

2.1. Stress Analysis

Stress analysis is a term applied to calculations. which address the static and dynamic loading resulting from the effects of gravity, temperature changes, internal and external pressures. changes in fluid flow rate and seismic activity. Codes and standards establish the minimum requirements of stress analysis.

Pipelines used for oil & gas transportation are buried / below the ground surface for aesthetic and environmental reasons to avoid damage from external activities and to provide thermal insulation. The soil cover also provide resistance to upward movement of the pipe caused by thermally induced axial loading, phenomenon known as upheaval buckling. Buried pipelines are subjected to various static and dynamic loads due to:

- Internal Pressure
- Thermal Expansion
- Vertical earth loads
- Surface live loads
- Surface Impact loads
- Weight of pipe, coating, insulation, components and the liquid transported.
- Buoyancy.
- Relative pipe soil Displacement.
- Movement at pipe bends.
- Earthquake.
- Effect of nearby blasting.
- Friction forces due to transient fluid..

The designer is required to appropriately combine the effects of concurrent loads when evaluating the adequacy of the buried pipeline. Pipelines are designed to have sufficient flexibility to prevent expansion (or contraction) from causing excessive stresses in the pipe material, excessive bending moments at joints, or excessive force or moments at points of connection to equipment or at anchorage or guide points.

2.2. Requirement Of Stress Analysis

The stress analyses of buried pipeline have been done with the consideration of the critical crossing locations such as River or Highway or Railroad crossing. Profile of the ground also plays a vital role in the stress analysis.

Analyzing an underground pipeline is quite difficult from analyzing plant piping. Special problems are involved because of the unique characteristics of a pipeline, code requirements and techniques required in analysis. Elements of analysis include pipe movement, anchorage force and soil-pipe interaction.

2.3. Code Requirement

Pipelines normally are designed constructed, inspected and operated according to the ANSI B31.4, "Liquid Petroleum Transportation Piping Systems," and ANSI B 31.8, "Gas Transmission and distribution Piping Systems."

Because it is more economical to ship the gas at the lowest temperature possible, the thermal stresses are less severe than that in an oil line. According to the ANSI B 31.4, the minimum burial depth required from the ground to the top of pipe is 1.0m for soily as well as rocky area also but this burial will increase in case of the crossing locations. In case of coated pipe, burial cover shall be measured from top of coated pipe.

2.4. Crossing

- Intersection between a pipeline crossing and the railroad and highway to be crossed should be as near to 90°. In no case it should be less than 30°.
- Crossing in wet or rock terrain and where deep cuts are required should be avoided as far as possible.
- Where casing pipe is installed, it should extend a minimum of 2 Feet (0.6m) beyond the toe of the slope or base grade, or 3 Feet (0.9m) beyond the bottom of the drainage ditch, whichever is the greater.

2.4.1. Types of crossing

1. Uncased crossing
2. Cased crossing

2.4.2. Uncased crossing

It must be predicated on careful consideration of the stresses imposed on uncased pipeline, as well as the potential difficulties associated with protecting cased pipeline from corrosion. In uncased crossing-

- Carrier should be straight and have uniform soil support for the entire length of the crossing.
- Carrier pipe shall be welded in accordance of API Standard 1104 and ASME B31.4.

2.4.3 Cased crossing

- The relevant specifications for selecting minimal wall thickness in casing under railroads are given by the American railway engineering association.
- Design practices suitable for casing beneath railroads and highways are provided by the American Society of Civil Engineers (ASCE) and American Society of Mechanical Engineers (ASME)
- Carrier pipe for cased crossing should conform to the material and design requirements of the ASMEB31.4.
- Casing may be coated or bare.

2.4.3.1. Casing for crossings

Suitable material for casings are new or used of same pipe material, mill reject pipe or other available steel tubular goods including longitudinally split casings.

2.4.3.2. <u>Minimum internal diameter of casing</u>

- The inside diameter of casing pipe should be large enough to facilitate installation of the carrier pipe to provide proper insulation for maintenance of Cathodic Protection (CP) and to prevent transmission of external loads from the casing to carrier pipe.
- The casing pipe should be at least two nominal pipe size larger than the carrier pipe.

2.4.3.3. <u>Casing pipe</u>

- Casing pipe should be free of internal obstruction
- It should be as straight as practicable.
- It should have uniform bedding for the entire length of the crossing.
- Casing pipe should be installed with an overbore as small as possible so as to minimize the void between the pipe and the adjacent soil.
- Steel casing pipe should be joined completely to ensure a continuous casing from end to end.

2.4.3.4. <u>Installation</u>

Carrier pipe installed in a casing should be held clear of the casing pipe by properly designed supports , insulators, or other devices, and installed so that no external load will be transmitted to the carrier pipe.

This also may be accomplished by building up a ring of layers of coating and outer wrap, or by a concrete jacket, where manufactured insulators are used; they should be uniformly spaced and securely fastened to the carrier pipe.

2.4.3.5. <u>Insulators</u>

Insulators electrically isolate the carrier pipe from the casing by providing a circular enclosure that prevents direct contact between the two.

The insulators should be designed to promote minimal bearing pressure between the insulator and carrier coating.

2.5. Coating of the Pipeline

To maintain the pipeline service life the prevention from corrosion is the necessary requirement of any pipeline. To protect the pipeline from corrosion, coating and cathodic protection system is used. For the design and stress analysis the coating of pipeline is the important part of consideration.

2.5.1. Types of Coating

1. Fusion Bonded Epoxy (FBE)
2. Poly Urethane Foam (PU Foam)
3. High Density Poly Ethylene (HDPE)

2.5.2. Fusion Bonded Epoxy

The FBE is an electro statically changed powder, which is pneumatically sprayed on to the hot pipe & contains excellent passive corrosion protection properties. Thickness of FBE is 350-500 microns.

FBE is of two types: Single layer
Double layer

Single layer FBE is for protection of pipeline operating at elevated temperature where coating adhesion & resistance to soil stresses cathodic disbondment are required.

Double layer FBE is a two component powder coating designed to provide long term corrosion resistance and mechanical protection to steel pipe. The system was principally developed for Road/ River Crossing and HDD application where resistant to abrasion and gauging is considered important. It consist of

(a) Primary layer of thermosetting epoxy resin powder as the corrosion barrier by electro static charge to a preheated pipe.

(b) A secondary layer of abrasion and impact resistant epoxy resin powder to provide mechanical protection.

2.5.3. <u>High Density Poly Ethylene</u>

Material:

- Polyethylene compound
- Epoxy powder
- Adhesive

Process:

- **Surface preparation** – Pipes are preheated to 65°C and to 85°C for removal of any moisture, raising of silvers, laminations etc.
- **Coating Application** – the external surface of the pipe shall be heated to about 190°C followed by application of 3-layer.

1. Electrostatic application of epoxy powder with the thickness of 100-175 micrometer.
2. Crystalline co-polymer adhesive applied by extrusion within the 15 seconds of FBE powder application and before the solidification of FBE with the thickness of minimum 0.2mm.
3. Polyethylene coating by extrusion

- The coated pipe is subsequently quenched.

CHAPTER – III

PROJECT REVIEW

3.1. Introduction

It's a onshore underground crude oil pipeline project starting from location 1 and end at location 2. To lay the pipeline from station 1 to station 2 there are various highways, railway tracks, rivers, canals and nalas are on the ROW of pipeline. The pipeline way is known as ROW (Right of Way). The objective of this project is to prevent the pipeline from stress failure caused by static and dynamic loading, temperature changes, internal and external pressure, change in fluid flow rate and some other environmental factors. This report consists of one Highway Crossing and One Nala Crossing segment of pipeline which is about 800meter before the State Highway Crossing and 800 meter after the Nala Crossing.

To achieve this objective the pipeline profile is generated in AutoCAD software, calculation of bend angles and bend radius, development of model, generation of soil models or calculation of stiffness for different burial depth to the top of the pipe is followed. The initial data are calculated according to the codes and standards given in the API and ASME B31.4. Before going for stress analysis the standard data and calculations used for the pipeline are given below in the design data section.

3.2. Design Data

3.2.1. Design Life

The pipeline shall be designed for an operating life of 25 years.

3.2.2. Oil Export Pipeline Design Information

Grade	:	API 5L Gr. X-65 PSL2
		SMYS : 448 N/mm^2
		UTS (min) : 531 N/mm^2
Pipeline Diameter	:	24 inch (609.6 mm)
Pipeline Wall Thickness	:	10.6 mm (pipeline) / 11.9 mm (at crossings)
Pipeline Wall Thickness (Cold Bend)	:	10.6 mm

Pipeline Wall Thickness (Hot Bend)	:	14.3 mm / 15.9 mm (if failure in previous case)
Corrosion Allowance	:	0
Pipeline Service	:	transporting highly waxy crude
Maximum flow rate	:	150,000 bpd (23848 m^3 /day)
Design pressure	:	95 barg
Operating pressure (Max)	:	9.5 MPa
Design temperature	:	93°C (For heated lines)
Temperature-operational	:	75°C
Installation	:	15°C (minimum design temperature for buried : lines)
Hydrotest pressure	:	1.25 x Design Pressure
Hydrotest Duration	:	The test pressure shall be maintained for a period of 24 hours after temperature stabilization & stabilization of surges from pressuring operation.
Design factor	:	0.72 (pipeline) / 0.6 (uncased crossing)
Design factor for above ground pipeline	:	0.72
Outer HDPE Coating	:	5.0 mm
Insulation	:	90 mm (confirmed by SEHMS Vendor)
FBE Coating	:	0.5 mm
Line pipe manufacturing Process	:	Longitudinal submerged Arc Welding (LSAW)
Pipeline alignment	:	As per alignment sheets

Welding shall be as per API 1104.

3.3. Pipeline Design

3.3.1. Wall Thickness Calculation

The pipeline wall thickness is selected on the following consideration:

- Pressure confinement criteria
- Hydrotest criteria

- Collapse criteria
- Seismic design criteria
- Longitudinal stress criteria
- Overburden loads and live loads for highway and railway

Table: 3.1

ALLOWABLE STRESSES				
	Class	**Hydrotest**	**Longitudinal**	**Hoop**
Crude Line	1	403 MPa / Cl.4.3.1.2 API- 1111	403 MPa / Cl.419.6.4 ASME B31.4	322 MPa / Cl.402.3.2(a) ASME B31.4
Gas Line	1	347 MPa / Cl.855.1 ASME B31.8	347 MPa / Cl.833.3 ASME B31.8	278 MPa / Cl.841.11 ASME B31.4
Gas Line	2	347 MPa / Cl.855.1 ASME B31.8	347 MPa / Cl.833.3 ASME B31.8	231 MPa / Cl.841.11 ASME B31.4
Gas Line	3	347 MPa / Cl.855.1 ASME B31.8	347 MPa / Cl.833.3 ASME B31.8	193 MPa / Cl.841.11 ASME B31.4

3.3.1.1. Pressure Confinement Criteria

The nominal wall thickness 't_n' for a given design pressure for the crude pipeline will be determined as below

$$t_n = t + A$$ *(As per ASME B31.4 Cl.404.1.1)*

$$t = P_i D / 2S$$ *(As per ASME B31.4 Cl.404.1.2)*

Where,

A = Corrosion plus any other allowances

D = Outside diameter of the pipe

Pi = Design internal pressure

S	=	0.72 x SMYS (for pipeline) OR 0.6 x SMYS (for river crossing)
T	=	Pressure design wall thickness
SMYS	=	Specified Minimum Yield Strength
	=	448 N/mm^2

Selected pipe wall thickness will be nearest higher nominal wall thickness as per API 5L.

3.3.1.2. Hydrotest Criteria

For crude pipeline Hydrotest is to be carried out at 1.25 times the Design Pressure. However the maximum test pressure at the lowest point of the test section or the section with least wall thickness shall be limited to hoop stress resulting in 95% of SMYS.

3.3.1.3. Collapse criteria

-For crude and gas pipeline

Minimum wall thickness required to prevent the pipeline wall thickness collapse to be carried out as per API-RP-1111.

$$P_c = \textbf{Collapse Pressure} = P_y * P_e / (P_y^2 + P_e^2)^{1/2}$$

Where,

P_y	=	Yield Pressure at Collapse	=	$2S * (t/D)$
S	=	SMYS		
t	=	Wall thickness		
D	=	Nominal outer diameter		
P_e	=	Elastic Collapse Pressure		
	=	$2E_s (t/D)^3 / (1-\upsilon_s^2)$		

Where,

E_s	=	Young Modulus of steel, in kPa
υs	=	Poisson's ratio of steel
P_c	=	$P_{e\,max} / f_0$

3.3.1.4. Tensile load criteria

The pipeline wall thickness will be designed for maximum installation pull load.

Pulling Stress = (Static Friction Coefficient x Length x Weight/Length) /Area of steel

$$\textbf{Bending Stress} = E_s\, r / R$$

Where,

Es = Young's Modulus

= 2.07×10^5 MPa

R = Pipe Radius

r = Radius of curvature of pipeline

Combined Longitudinal Stress = Pulling Stress + Bending Stress < 90%SMYS

3.3.1.5. Longitudinal Stress Criteria

As per ASME B31.4 Cl.419.6.4 (b)

For restrained lines the net longitudinal compressive stress due to the combined effects of temperature rise and fluid pressure shall be computed from the equation.

$$S_L = E_s\, \alpha_T (T_2 - T_1) - \upsilon_s S_H \leq 0.9SMYS$$

3.3.2. Anchor Force Calculation

Stresses and deflection occur in pipelines at the transition from the below ground (fully-restrained) to the above ground (unrestrained) condition. The stresses and deflections in transition areas, resulting from internal pressure and temperature changes are worked ot to determine anchor block requirements. The forces required to maintain the pipe in a fully restrained condition are then used to size the anchor block. The resultant force on the anchor is given by:

$$F_{AF} = [\{(P_i D / 2\, t_{nom})(1/2 - V_s)\} + \{S_E * \alpha_T (T_1 - T_2)\}] * A_s$$

(Ref: Pipeline Rules of Thumb, Handbook by E.W. Mc Allister)

Where,

F_{AF}	=	Anchor force
t_{nom}	=	Nominal wall thickness of pipe
S_E	=	Elastic section modulus of pipe
α_T	=	Linear coefficient of thermal expansion of steel
T_1-T_2	=	Temperature difference between operating and installation temperatures
A_s	=	Area of pipe cross section

3.3.3. Virtual Anchor Length

In order to establish the length L0 over which the transition occurs, the longitudinal resistance of the soil needs to be known. It is assumed that any tendency to move will be counteracted by constant and opposite soil force. Wilbur has recommended a design value for average soil of

$$F_s = 80[D/12]^2 \text{ lbf / ft}$$

OR

$$F_s = 80[D/12]^2 \times 1.49 \text{ kgf/m}$$

(Ref: Pipeline Rules of Thumb, Handbook by E.W. Mc Allister)

Between A & B equilibrium of forces exists and therefore,

$$F_s L_0 = A_m(\sigma_{LB} - \sigma_{LA})$$

From which,

$$L_0 = [A_m(\sigma_{LB} - \sigma_{LA})] / F_s$$

Where,

A	=	Point of virtual anchor
B	=	Free end
A_m	=	Pipe metal area, m2
F_s	=	soil resistance, kg/m
L_0	=	Transition length of pipeline from starting to point of non-movement
σ_L	=	Longitudinal stress

3.3.4. Displacement at Free End

The net longitudinal strain at point B will therefore be,

$$\varepsilon_B = \alpha_T (T_1 - T_2) + (\sigma_H / S_E) * (1/2 - V_s)$$

Total movement of B will be average strain between A and B over length L_0

$$\delta = (\varepsilon_B / 2) * (12 L_0)$$

Where,

ε_B = Net Longitudinal Strain

σ_H = Hoop Stress

δ = Displacement at free end

3.4. Stability Analysis

3.4.1. Concrete Coating

3.4.1.1. Weight of pipe

Concrete Coating thickness will be calculated based on the following by an excel spreadsheet.

$$W_p = W_1 + W_2 + W_3 + W_4 + W_5 + W_6 \text{ N/m}$$

Where,

W_p = Net downward pipe weight including coating, N/m

W_1 = Steel pipe Weight, N/m

W_2 = Fusion Bonded Epoxy Coating Weight, N/m

W_3 = PUF Coating weight, N/m

W_4 = CS Heating tubes weight, N/m

W_5 = HDPE Coating weight, N/m

W_6 = Concrete Coating weight, N/m

3.4.2. Burial Depth (Minimum)

Buried depth from ground to top of the pipe	: 1.0 m (for soil) 1.0 m (for rocky area)
Buried depth for crossings	
Major River	: 2.5 m below max scour depth (normal soil) : 1.5 m below max scour depth (rocky soil)
NH / SH & Other roads	: 1.2 m
Lined canal	: 1.5 m
Unlined canal	: 2.5 m (Built up)
Railroads	: 1.8 m from base of rail or 1.2 m (minimum) from bottom of drainage ditch

Notes:

- Burial over shall be measured from top of coated pipe.
- Sand bedding to provided only where rock is encountered at trench bottom.

3.4.3. Bend Radius

Minimum radius of field cold bends for 24 inch crude line 136.7D (as per OISD-141) or as per the approved bend procedure as per the upheaval buckling report.

3.5. Stress Due To Earth Load

The circumferential stress at the pipeline invert caused by earth load. S_{He} (kPa) is determined as follows:

$$S_{He} = K_{He} B_e E_e \gamma D$$

Where,

K_{He} = Stiffness factor for earth load

B_e = Burial factor for earth load

E_e = Excavation factor for earth load

G = Soil unit weight, kN/m^3

D = Pipe outside diameter, m

The earth load K_{He} depends on the pipe wall thickness to diameter ratio, t_w/D, and modulus of soil reaction, E'. E' shall be chosen from table A-1 (refer Annexure- API RP 1102) depends upon soil strata at specific crossing location. From figure 3 stiffness factor for the earth load circumferential stress, the value of K_{He} is determined.

The burial factor be is presented as a function of the ratio of bored diameter H/B_d for various soil conditions as shown in fig 4.

The excavation factor, Ee is presented as a function of the ratio of bored diameter to pipe diameter, B_p/D in figure 5.

Note: Burial cover shall be measured from the top of coated pipe.

3.6. Cathodic Protection

No cathodic protection shall be provided foe crude oil pipeline.

3.7. Pipe-Soil Interaction

In the present analysis, analyst used soil models to define pipe-soil stiffness for each variation in the burial depth of pipeline. Soil model allows the user to specify soil data for **CAESAR II** to use in generating one or more soil restraint systems. The following procedures for estimating soil distributed stiffness and ultimate loads should be used only when the analyst does not have better data or methods suited to the particular site and problem. Soil supports are modeled as bi-linear springs having an initial stiffness, an ultimate load, and yield stiffness. The yield stiffness is typically set close to zero, i.e. once the ultimate load on the soil is reached there is no further increase in load even though the displacement may continue. The two basic ultimate loads that must be calculated to analyze buried pipe are the axial and transverse ultimate loads.

Valid soil model numbers start with 2 in CAESAR II. Soil model number 1 is reserved for user defined soil stiffness. Up to 15 different soil models may be entered for a single job.

The soil restraint equations use these soil properties to generate restraint ultimate loads and stiffness. (The temperature change is optional. If entered the thermal strain is used to compute and print the theoretical "virtual anchor length.")

These equations are:

- **Axial Ultimate Load (F_{ax})**

$$F_{ax} = \mu D\ [(2\ \rho_s H) + (\Pi\ \rho_p t) + (\Pi\ \rho_f)(D / 4)]$$

Where:

μ = Friction coefficient, typical values are:

0 .4 for silt

0 .5 for sand

0 .6 for gravel

0.6 for clay or Su/600

S_u = Unstrained shear strength

D = Pipe diameter

ρ_s = Soil density

H = Buried depth to the top of pipe

ρ_p = Pipe density

t = Pipe nominal wall thickness

ρ_f = Fluid density

- **Transverse Ultimate Load (F_{tr})**

$$F_{tr} = (0.5)\,(\rho_s)\,(H+D)^2\,[\tan(45+\varphi/2)]^2 * OCM$$

Where:

φ = Angle of internal friction, typical values are:

27-45 for sand

26-35 for silt

0 for clay

OCM = Overburden Compaction Multiplier

Common practice has been to reduce it (from its default of 8) to values from 5 to 7, depending on the degree of compaction of the backfill. Backfill efficiency can be approximated by the Proctor Number. (The Proctor Number is a ratio of unit weights.) The standard practice when the Proctor Number is known, is to multiply the default value 8 by the Proctor Number. This result should then be used as the compaction multiplier.

- **Yield Displacement (yd):**

$$y_d = \text{Yield Displacement Factor} \times (H+D)$$

The Yield Displacement Factor defaults to 0.015.

CHAPTER – IV

PROJECT DETAIL

4.1. Model Description

The pipeline is modeled considering the State Highway Crossing at CH: 133+323. An 800m pipeline is modeled before the State Highway Crossing and an 800m pipeline after the Nala Crossing as a virtual anchor length. The present analysis includes State Highway Crossing with 26 vertical bends of 136.7D bending radius & wall thickness of 10.6mm. 2 vertical bends of 10D radius and wall thickness of 13.44mm. Analysis also includes 3 horizontal bend of 10D radius & wall thickness of 13.44mm, and 1 horizontal bend of 136.7D radius & 10.6mm thickness. The complete details are given in the bend data listing in table 4.4. The pipeline is generally having 1.5m burial depth to the top of pipe from the bottom of ditch to the State Highway Crossing.

The carrier pipeline is protected at State Highway Crossing location by a casing pipe. The casing pipe is provided for the full ROW of State Highway Crossing and extends beyond ROW by 600 mm both side. The casing dimensions are NPS 40, IS 3589, thickness 10.6mm.

The CAESAR II model is shown in the report

4.2. Pipeline Stress Analysis

Buried pipeline stress analysis for crude oil pipeline is carried out using the software – CAESAR II as per ASME-B31.4.

The analysis included in this document pertains to approximately 1800 m length of the pipeline.

Changes in the direction along the pipeline route have been considered in the model. Minor undulations of the ground profile were ignored. The pipe properties are given in the table.

The friction factor 0.6 has been considered between HDPE coating and soil.

Table: 4.1 Pipe Properties

Description	**Value**
Pipeline outside diameter	610mm
Bend outside diameter	610mm
Hot bend radius	6100mm
Hot bend thickness	14.3mm*

Cold bend radius	83387mm
Material grade	API 5L – X65, PSL2
Modulus of elasticity	2.07×10^{5} MPa
Poisson's ratio	0.3
Coefficient of thermal expansion	11.7×10^{-5} mm/mm/°C

*** Hot bends considered in model with 6% thinning as advised by Client.**

Table: 4.2 Coating Details

Description	Thickness, mm	Density, kg/m³
FBE	0.5	1400
PU Foam for line pipe	90	60
PU Foam for bends	90	160
HDPE	5.0	944

Table : 4.3 Functional Parameters

Description	Value
Internal Design Pressure	9.5 MPa
Installation temperature	93 °C
Service	Oil
Content density	850 kg/m³

Table : 4.4 Soil Properties

Description	Value
Density of soil	1750 kg/m³
Cohesion	0 kg/m²
Angle of internal friction	25

The isometric profile of pipeline is attached in the report

4.3. Calculation for Virtual Anchor Length

$t = 10.6$ mm $= 0.417$ inch

$P = 9.5$ N/mm² $= 1377.86$ psig

$D_o = 801$ mm $= 31.5354$ inch

$D_i = 588.4$ mm $= 23.1654$ inch

$E = 2.07*10^6$ N/mm^2 = $29*10^6$ psi

$\alpha = 11.7*10^{-5}$ mm/mm-°C = $6.5*10^{-6}$ inch/inch-°F

ΔT = (75-15)°C = 140 °F

υ = 0.3

F_S = 80* (31.5354/12)^2

= 552.4896962 lbf/ft

σ_H = (P*D$_i$)/(2*t)

= 38271.79622 psi

σ_{LB} = (σ_H/2)

= (38271.79622/2)

= 19135.89811 psi

σ_{LA} = (υ*σ_H) – (E*α*ΔT)

= (0.3*38271.79622) – ($29*10^6*6.5*10^{-6}*140$)

= -14908.46113 psi

A_m = π (D_o- t)*t

= 3.14159*(31.5354-0.417)*0.417

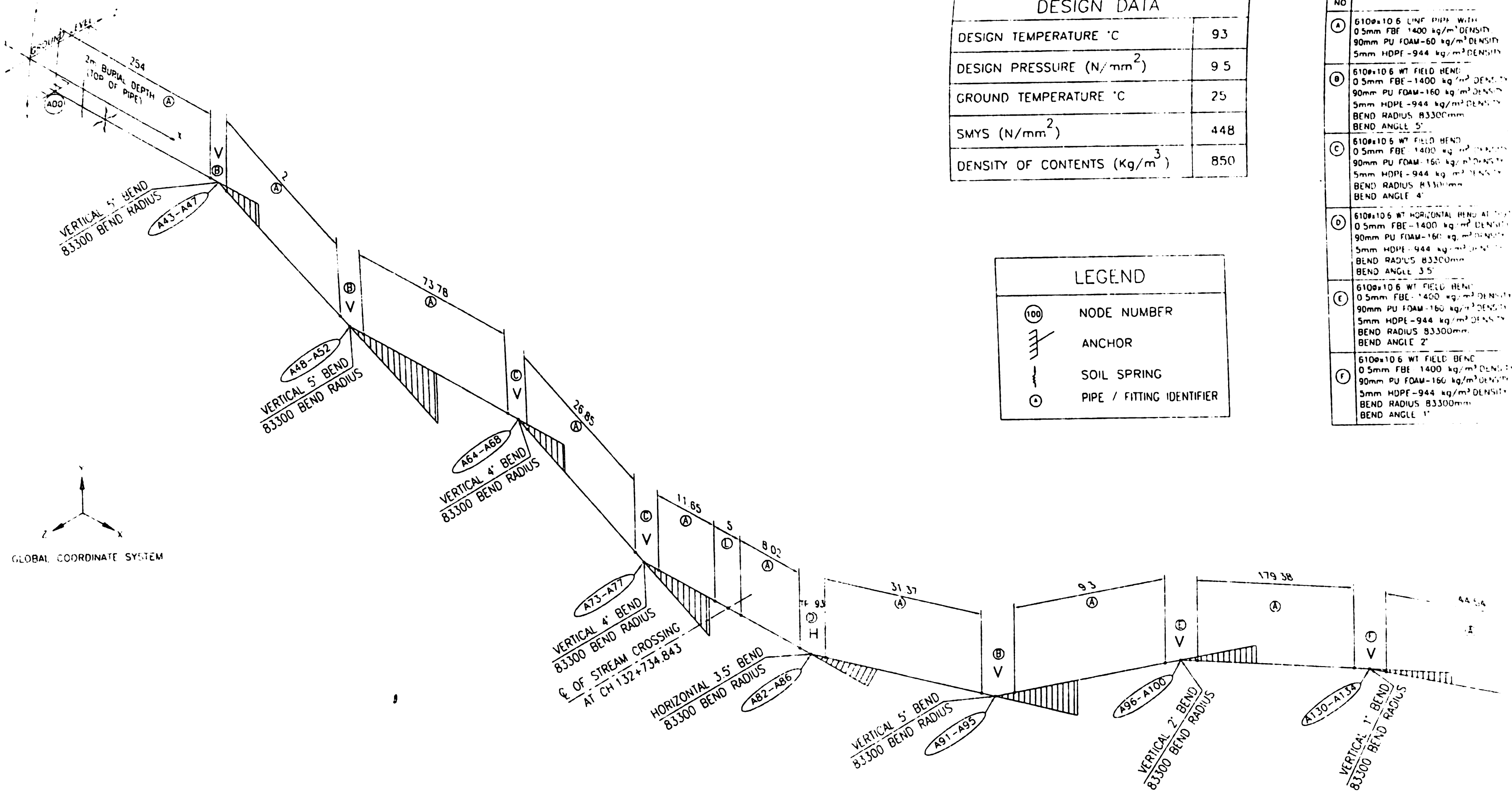
= 40.766 inch^2

Lo = [40.766*{(19135.89811)-(-14908.46113)}]/552.4896962

= 2511.9968 $\approx$ 2512 ft

= 765 m

The Virtual Anchor Length is 765 m. For the analysis of crossing the Virtual Anchor Length will take as 800 m both side of the crossing.



DESIGN DATA

DESIGN TEMPERATURE °C	93
DESIGN PRESSURE (N/mm^2)	9.5
GROUND TEMPERATURE °C	25
SMYS (N/mm^2)	448
DENSITY OF CONTENTS (Kg/m^3)	850

LEGEND

(100)	NODE NUMBER
	ANCHOR
	SOIL SPRING
⊙	PIPE / FITTING IDENTIFIER

MATERIAL SCHEDULE (CARRIER PIPE)

SL NO	DESCRIPTION			REMARK
A	610ø×10.6 LINE PIPE WITH 0.5mm FBE 1400 kg/m^3 DENSITY 90mm PU FOAM-60 kg/m^3 DENSITY 5mm HDPE-944 kg/m^3 DENSITY			
B	610ø×10.6 WT FIELD BEND 0.5mm FBE-1400 kg/m^3 DENSITY 90mm PU FOAM-160 kg/m^3 DENSITY 5mm HDPE-944 kg/m^3 DENSITY BEND RADIUS 83300mm BEND ANGLE 5°			
C	610ø×10.6 WT FIELD BEND 0.5mm FBE 1400 kg/m^3 DENSITY 90mm PU FOAM-160 kg/m^3 DENSITY 5mm HDPE-944 kg/m^3 DENSITY BEND RADIUS 83300mm BEND ANGLE 4°			
D	610ø×10.6 WT HORIZONTAL BEND AT [illegible] 0.5mm FBE-1400 kg/m^3 DENSITY 90mm PU FOAM-160 kg/m^3 DENSITY 5mm HDPE-944 kg/m^3 DENSITY BEND RADIUS 83300mm BEND ANGLE 3.5°			
E	610ø×10.6 WT FIELD BEND 0.5mm FBE-1400 kg/m^3 DENSITY 90mm PU FOAM-160 kg/m^3 DENSITY 5mm HDPE-944 kg/m^3 DENSITY BEND RADIUS 83300mm BEND ANGLE 2°			
F	610ø×10.6 WT FIELD BEND 0.5mm FBE 1400 kg/m^3 DENSITY 90mm PU FOAM-160 kg/m^3 DENSITY 5mm HDPE-944 kg/m^3 DENSITY BEND RADIUS 83300mm BEND ANGLE 1°			

ALL HOT BENDS CONSIDERED SHALL HAVE 6% THINNING AS ADVISED BY CEIL.
ALL DIMENSIONS ARE IN METRES

REV.	DATE	DESCRIPTION	DRAWN BY	CHKD. BY	APPROVED BY

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EPC CONTRACTOR	OWNER
ENGINEERING CONTRACTOR	PROJECT
ENGINEERING SUB CONTRACTOR	

TITLE: 24" CRUDE OIL PIPELINE MODEL FOR RDX & RVX

ORIGINAL FEED DRAWING NO:	CAIRN DRAWING NO.	
--	--	
DRAWN BY	PROJECT NO.	CAD FILE NAME

MATERIAL SCHEDULE (CARRIER PIPE)

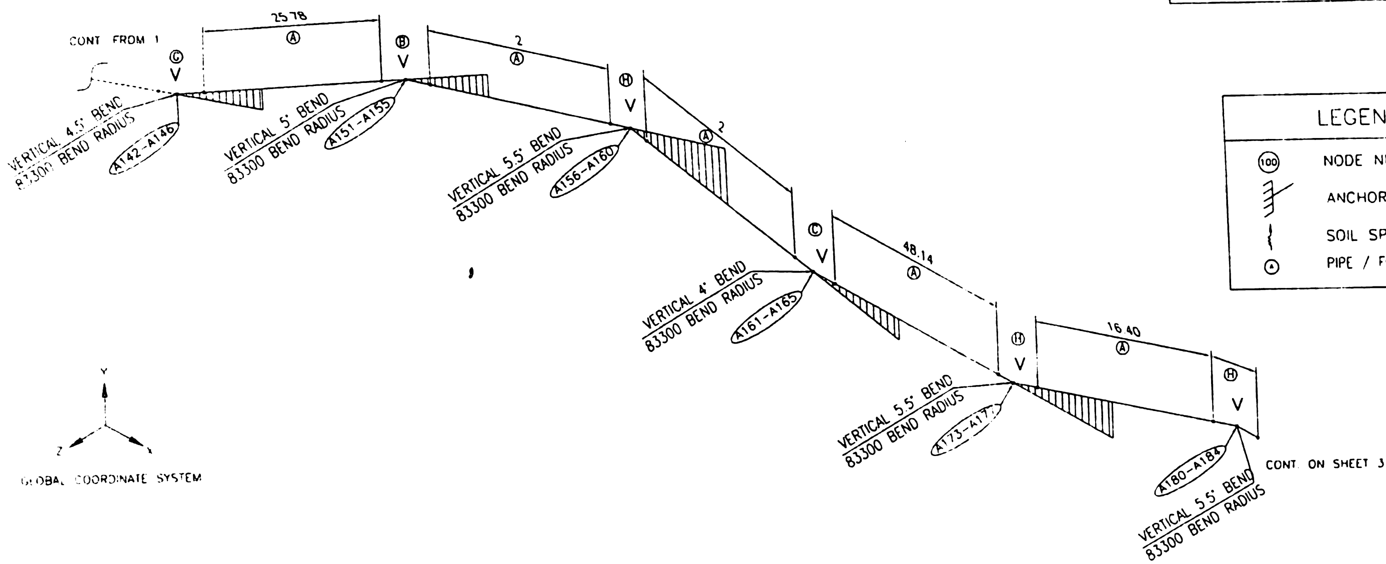
SL NO	DESCRIPTION			REMARKS
A	610ø×10.6 LINE PIPE WITH 0.5mm FBE-1400 kg/m³ DENSITY 90mm PU FOAM-60 kg/m³ DENSITY 5mm HDPE-944 kg/m³ DENSITY			
G	610ø×10.6 WT FIELD BAND 0.5mm FBE-1400 kg/m³ DENSITY 90mm PU FOAM-160 kg/m³ DENSITY 5mm HDPE-944 kg/m³ DENSITY BEND RADIUS 83300mm BEND ANGLE 4.5°			
B	610ø×10.6 WT FIELD BAND 0.5mm FBE-1400 kg/m³ DENSITY 90mm PU FOAM-160 kg/m³ DENSITY 5mm HDPE-944 kg/m³ DENSITY BEND RADIUS 83300mm BEND ANGLE 5°			
C	610ø×10.6 WT FIELD BAND 0.5mm FBE-1400 kg/m³ DENSITY 90mm PU FOAM-160 kg/m³ DENSITY 5mm HDPE-944 kg/m³ DENSITY BEND RADIUS 83300mm BEND ANGLE 4°			
H	610ø×10.6 WT FIELD BAND 0.5mm FBE 1400 kg/m³ DENSITY 90mm PU FOAM-160 kg/m³ DENSITY 5mm HDPE-944 kg/m³ DENSITY BEND RADIUS 83300mm BEND ANGLE 5.5°			

DESIGN DATA

DESIGN TEMPERATURE °C	93
DESIGN PRESSURE (N/mm^2)	9.5
GROUND TEMPERATURE °C	25
SMYS (N/mm^2)	448
DENSITY OF CONTENTS (Kg/m^3)	850

LEGEND

- (100) NODE NUMBER
- ANCHOR
- SOIL SPRING
- ⊙ PIPE / FITTING IDENTIFIER



1. ALL HOT BENDS CONSIDERED SHALL HAVE 6% THINING AS ADVISED BY CEIL.
2. ALL DIMENSIONS ARE IN METRES

REV.	DATE	DESCRIPTION	DRAWN BY	CHKD. BY	APPROVED BY

EPC CONTRACTOR | OWNER:

ENGINEERING CONTRACTOR | PROJECT:

ENGINEERING SUB CONTRACTOR

TITLE : 24" CRUDE OIL PIPELINE MODEL FOR RDX & RVX

ORIGINAL FEED DRAWING NO: | CAIRN DRAWING NO:

DRAWN BY | PROJECT NO: | CAD FILE NAME

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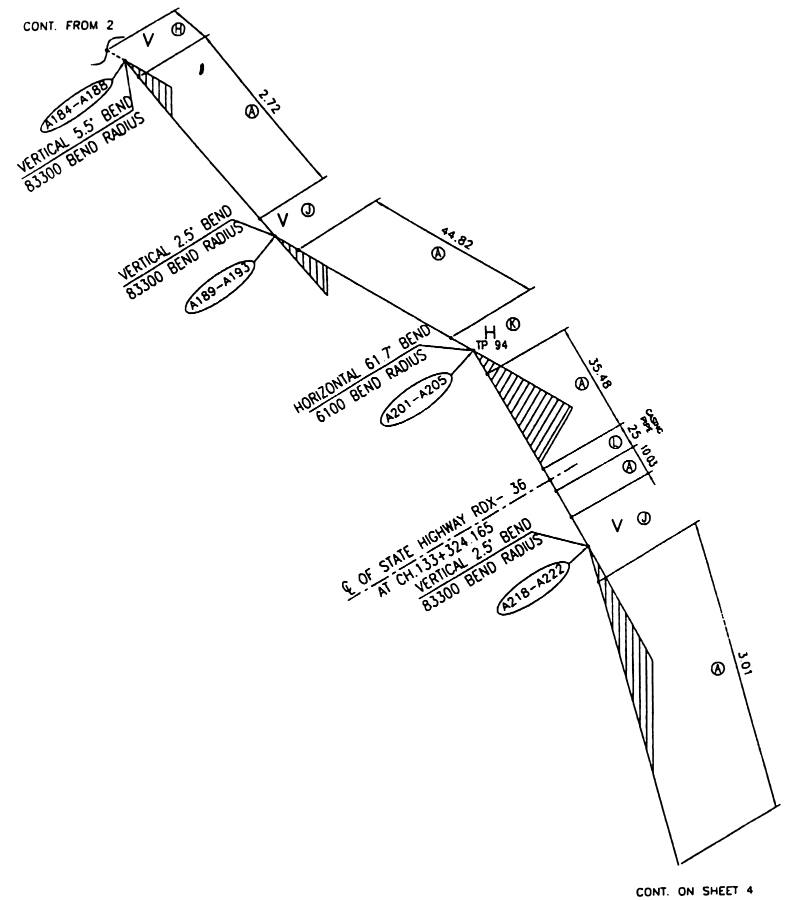

DESIGN DATA

DESIGN TEMPERATURE °C	93
DESIGN PRESSURE (N/mm^2)	9.5
GROUND TEMPERATURE °C	25
SMYS (N/mm^2)	448
DENSITY OF CONTENTS (Kg/m^3)	850

LEGEND

(100)	NODE NUMBER
	ANCHOR
	SOIL SPRING
ⓐ	PIPE / FITTING IDENTIFIER

MATERIAL SCHEDULE (CARRIER PIPE)

SL NO.	DESCRIPTION	QUANTITY	APPROX LENGTH(m)	REMARK
Ⓐ	610Ø×10.6 LINE PIPE WITH 0.5mm FBE-1400 kg/m^3 DENSITY, 90mm PU FOAM-60 kg/m^3 DENSITY, 5mm HDPE-944 kg/m^3 DENSITY.	-	96.06	-
Ⓗ	610Ø×10.6 WT FIELD BAND 0.5mm FBE-1400 kg/m^3 DENSITY, 90mm PU FOAM-160 kg/m^3 DENSITY, 5mm HDPE-944 kg/m^3 DENSITY, BEND RADIUS 83300mm BEND ANGLE 5.5°	1	-	
Ⓙ	610Ø×10.6 WT FIELD BAND 0.5mm FBE-1400 kg/m^3 DENSITY, 90mm PU FOAM-160 kg/m^3 DENSITY, 5mm HDPE-944 kg/m^3 DENSITY, BEND RADIUS 83300mm BEND ANGLE 2.5°	2	-	
Ⓚ	610Ø×14.3 WT HOT BEND AT TP 94 0.5mm FBE-1400 kg/m^3 DENSITY, 90mm PU FOAM-160 kg/m^3 DENSITY, 5mm HDPE-944 kg/m^3 DENSITY, BEND RADIUS 6100mm BEND ANGLE 61.7°	1	-	
Ⓛ	610Ø×11.9 WT LINE PIPE WITH 0.5mm FBE-1400 kg/m DENSITY, 90mm PU FOAM-60 kg/m DENSITY, 5mm HDPE-944 kg/m DENSITY.	-	25	

MATERIAL SCHEDULE (CARRIER PIPE)

CASING PIPE	NPS 40 AS PER IS 3589 GR Fe 410 10.3 mm WALL THICKNESS	-	25	

NOTE -
1. ALL HOT BENDS CONSIDERED SHALL HAVE 6% THINING AS ADVISED BY CEIL.
2. ALL DIMENSIONS ARE IN METRES

REV.	DATE	DESCRIPTION	DRAWN BY	CHKD. BY	APPROVED BY

EPC CONTRACTOR	OWNER:
ENGINEERING CONTRACTOR	PROJECT:
ENGINEERING SUB CONTRACTOR	

TITLE : 24" CRUDE OIL PIPELINE MODEL FOR RDX & RVX

ORIGINAL FEED DRAWING NO:	CAIRN DRAWING NO:	SCALE	SHEET 003 OF 006
DRAWN BY:	PROJECT NO:	CAD FILE NAME:	REV.

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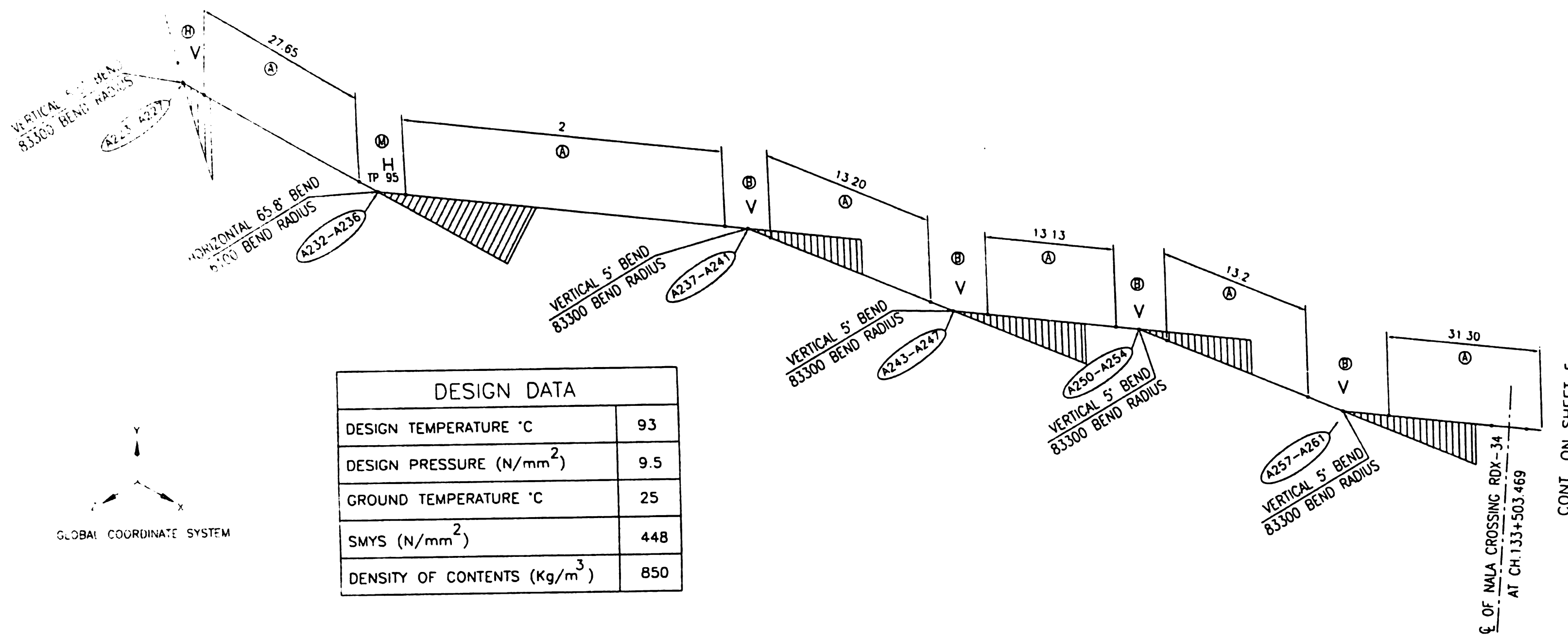
MATERIAL SCHEDULE (CARRIER PIPE)

SL. NO	DESCRIPTION	QUANTITY	APPROX LENGTH(m)	REMARK
A	610ø×10.6 LINE PIPE WITH 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-60 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY.	-	100.48	
H	610ø×10.6 WT FIELD BAND 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-160 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY, BEND RADIUS 83300mm BEND ANGLE 5.5°	1	-	
B	610ø×10.6 WT FIELD BAND 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-160 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY, BEND RADIUS 83300mm BEND ANGLE 5°	4	-	
M	610ø×14.3 WT HOT BEND AT TP95 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-160 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY, BEND RADIUS 6100mm BEND ANGLE 65.8°	1	-	



GLOBAL COORDINATE SYSTEM

DESIGN DATA

DESIGN TEMPERATURE °C	93
DESIGN PRESSURE (N/mm^2)	9.5
GROUND TEMPERATURE °C	25
SMYS (N/mm^2)	448
DENSITY OF CONTENTS (Kg/m^3)	850

LEGEND

(100)	NODE NUMBER
	ANCHOR
	SOIL SPRING
(A)	PIPE / FITTING IDENTIFIER

NOTE -

1. ALL HOT BENDS CONSIDERED SHALL HAVE 6% THINING AS ADVISED BY CEIL.
2. ALL DIMENSIONS ARE IN METRES

REV.	DATE	DESCRIPTION	DRAWN BY	CHKD. BY	APPROVED BY

EPC CONTRACTOR	OWNER:
ENGINEERING CONTRACTOR	PROJECT:
ENGINEERING SUB CONTRACTOR	

TITLE : 24" CRUDE OIL PIPELINE MODEL FOR RDX & RVX

ORIGINAL FEED DRAWING NO:	CAIRN DRAWING NO:		SCALE	SHEET 004 OF 006
DRAWN BY:	PROJECT NO:	CAD FILE NAME:		REV

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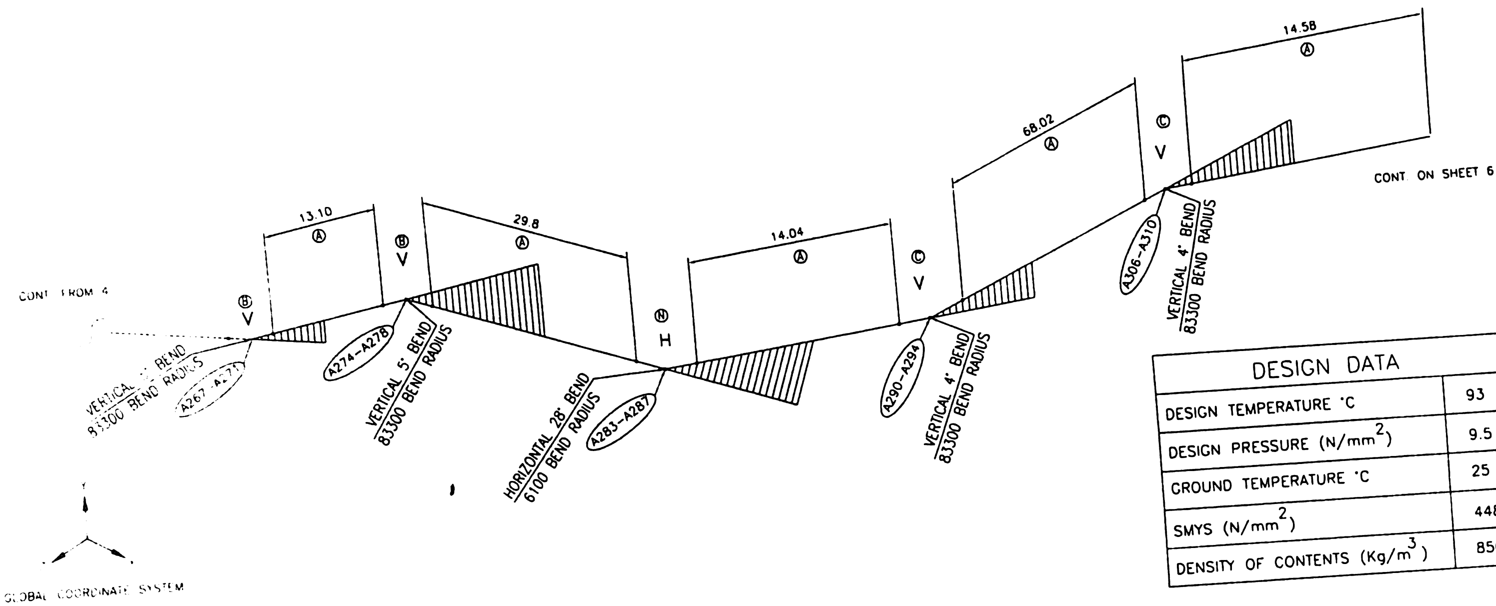
MATERIAL SCHEDULE (CARRIER ...)

SL NO	DESCRIPTION	QUANTITY	APPROX LENGTH(m)	REMARK
A	610ø×10.6 LINE PIPE WITH 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-60 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY.	--	139.54	
B	610ø×10.6 WT VERTICAL FIELD BEND 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-160 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY, BEND RADIUS 83300mm BEND ANGLE 5°	2	-	
C	610ø×10.6 WT VERTICAL FIELD BEND 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-160 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY, BEND RADIUS 83300mm BEND ANGLE 4°	2	-	
N	610ø×14.3 WT HOT BEND AT TP96 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-160 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY, BEND RADIUS 6100mm BEND ANGLE 28°	.	-	



DESIGN DATA	
DESIGN TEMPERATURE °C	93
DESIGN PRESSURE (N/mm²)	9.5
GROUND TEMPERATURE °C	25
SMYS (N/mm²)	448
DENSITY OF CONTENTS (Kg/m³)	850

LEGEND

- (100) NODE NUMBER
- ANCHOR
- SOIL SPRING
- PIPE / FITTING IDENTIFIER

NOTE:
1. ALL HOT BENDS CONSIDERED SHALL HAVE 6% THINNING AS ADVISED BY CEIL.
2. ALL DIMENSIONS ARE IN METRES

REV.	DATE	DESCRIPTION	DRAWN BY	CHKD. BY	APPROVED BY

EPC CONTRACTOR | OWNER:

ENGINEERING CONTRACTOR | PROJECT:

ENGINEERING SUB CONTRACTOR

TITLE : 24" CRUDE OIL PIPELINE MODEL FOR RDX & RVX

SCALE | SHEET 005 OF 006 | REV

ORIGINAL FEED DRAWING NO: | CAIRN DRAWING NO:

DRAWN BY: | PROJECT NO: | CAD FILE NAME:

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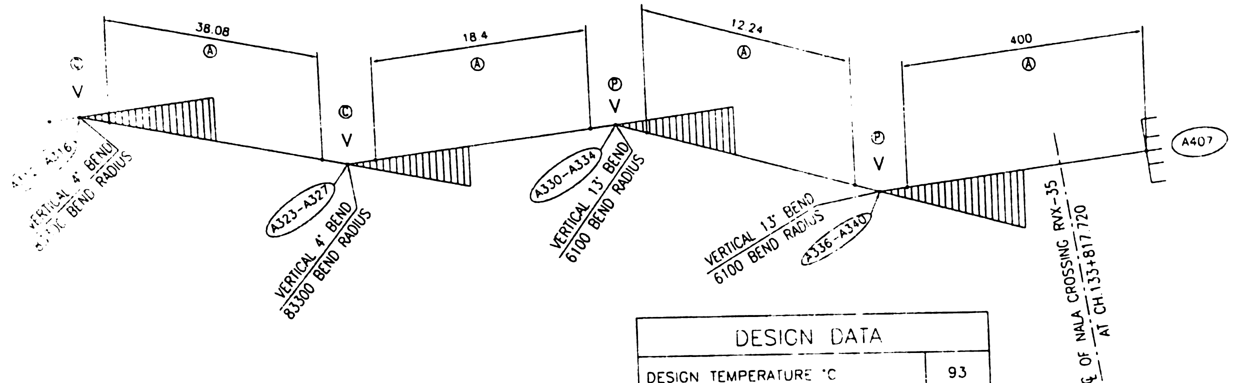
MATERIAL SCHEDULE (CARRIER PIPE)

SL NO	DESCRIPTION	QUANTITY	APPROX LENGTH(m)	REMARKS
(P)	610Ø x 10.6 LINE PIPE WITH 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-60 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY.	-	468.72	
(C)	610Ø x 10.6 WT VERTICAL FIELD BEND 0.5mm FBE-1400 kg/m³ DENSITY, 90mm PU FOAM-160 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY, BEND RADIUS 83300mm BEND ANGLE 4°	2		
(P)	610Ø x 14.3 WT HOT BEND 0.5mm FBE-1400 kg/m³ DENSITY 90mm PU FOAM-160 kg/m³ DENSITY, 5mm HDPE-944 kg/m³ DENSITY, BEND RADIUS 6100mm BEND ANGLE 13°	2		



DESIGN DATA

DESIGN TEMPERATURE °C	93
DESIGN PRESSURE (N/mm^2)	9.5
GROUND TEMPERATURE °C	25
SMYS (N/mm^2)	448
DENSITY OF CONTENTS (Kg/m^3)	850

LEGEND

(100) NODE NUMBER
ANCHOR
SOIL SPRING
PIPE / FITTING IDENTIFIER

... CONSIDERED SHALL HAVE 6% THINNING AS ADVISED BY CEIL.
ALL DIMENSIONS ARE IN METRES

REV.	DATE	DESCRIPTION	DRAWN BY	CHKD. BY	APPROVED BY

EPC CONTRACTOR
OWNER:
ENGINEERING CONTRACTOR
PROJECT:
ENGINEERING SUB CONTRACTOR

TITLE : 24" CRUDE OIL PIPELINE MODEL FOR RDX & RVX

ORIGINAL FEED DRAWING NO: | CAIRN DRAWING NO: | SCALE | SHEET 006 OF 006
DRAWN BY: | PROJECT NO: | CAD FILE NAME | REV.

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4.4. <u>Bend Data</u>

Table: 4.5

Sr. No.	bend angle (Degree)	bend radius (mm)	wall thickness (mm)	hot/cold	PUF Density (kg/m^3)
1	5.0	83387	10.6	Cold	160
2	5.0	83387	10.6	Cold	160
3	4.0	83387	10.6	Cold	160
4	4.0	83387	10.6	Cold	160
5	3.5	83387	10.6	Cold	160
6	5.0	83387	10.6	Cold	160
7	2.0	83387	10.6	Cold	160
8	1.0	83387	10.6	Cold	160
9	4.5	83387	10.6	Cold	160
10	5.0	83387	10.6	Cold	160
11	5.5	83387	10.6	Cold	160
12	4.0	83387	10.6	Cold	160
13	5.5	83387	10.6	Cold	160
14	5.5	83387	10.6	Cold	160
15	2.5	83387	10.6	Cold	160
16	61.7	6100	13.44	Hot	160
17	2.5	83387	10.6	Cold	160
18	5.5	83387	10.6	Cold	160
19	65.8	6100	13.44	Hot	160
20	5.0	83387	10.6	Cold	160
21	5.0	83387	10.6	Cold	160
22	5.0	83387	10.6	Cold	160
23	5.0	83387	10.6	Cold	160
24	5.0	83387	10.6	Cold	160
25	5.0	83387	10.6	Cold	160
26	28.0	6100	13.44	Hot	160
27	4.0	83387	10.6	Cold	160
28	4.0	83387	10.6	Cold	160
29	4.0	83387	10.6	Cold	160
30	4.0	83387	10.6	Cold	160
31	13.0	6100	13.44	Hot	160
32	13.0	6100	13.44	Hot	160

4.5. Coating Equivalent Density Calculations

Table: 4.6

L&T-VALDEL ENGINEERING LTD	COATING EQUIVALENT DENSITY CALCULATION		PAGE No.: CONTRACT NO:	
			SHEET 1 OF 1	
PROJECT: BARMER TO SALAYA PIPELINE PROJECT				
PIPELINE PROPERTIES	UNIT	PIPELINE	Field Bend	Hot Bend	ROAD CROSSING
OUTER DIA OF STEEL PIPE	mm	610	610	610	610
OUTER DIA OF CASING PIPE	mm	0	0	0	1016
WALL THICKNESS OF PIPE	mm	10.6	10.6	13.44	11.9
WALL THICKNESS OF CASING	mm	0	0	0	10.6
THICKNESS OF FBE	mm	0.5	0.5	0.5	0.5
THICKNESS OF PU Foam	mm	90	90	90	90
THICKNESS OF HDPE	mm	5	5	5	5
THICKNESS OF CONCRETE	mm	0	0	0	97.19
EQUIVALENT THICKNESS OF COATING	mm	95.5	95.5	95.5	203.29
DENSITY OF STEEL PIPE	kg/m^3	7850	7850	7850	7850
DENSITY OF CASING PIPE	kg/m^3	7850	7850	7850	7850
DENSITY OF PU Foam	kg/m^3	60	160	160	60
DENSITY OF FBE	kg/m^3	1400	1400	1400	1400
DENSITY OF HDPE	kg/m^3	944	944	944	944

DENSITY OF CONCRETE	kg/m^3	2400	2400	2400	2400
Wt. OF FBE	kg/m	1.34	1.34	1.34	1.34
Wt. OF PU Foam	kg/m	11.89	31.71	31.71	11.89
Wt. OF HDPE	kg/m	11.80	11.80	11.80	11.80
Wt. OF CONCRETE	kg/m	0.00	0.00	0.00	658.19
Wt. OF CASING PIPE	kg/m	0.00	0.00	0.00	262.98
EQUIVALENT DENSITY OF COATING	kg/m^3	118.29	211.93	211.93	1821.68
EQUIVALENT DENSITY OF COATING	kg/cm^3	0.00012	0.00021	0.00021	0.00182
CONTENT DENSITY	kg/cm^3	0.00085			
Notes :Thickness of Hot Bend taken is after 6% thinning as advised by client					

4.6. Pipe-Soil Model

The different soil- models and the entered values in the respective models are given in the following tables.

Table: 4.7

Description	**Value**
Model No.	**2**
Burial depth to top of the pipe	1000mm
Yield displacement factor*	0.015
Model No.	**3**
Burial depth to top of the pipe	1200mm
Yield displacement factor*	0.018
Model No.	**4**
Burial depth to top of the pipe	1500mm
Yield displacement factor*	0.0225

Model No.	5
Burial depth to top of the pipe	2000mm
Yield displacement factor*	0.03

***Its value is 1.5% of burial depth (in meter)**

Table: 4.8*

Description	**Value**
Friction coefficient	0.5
Soil density	1750 kg/m^3
Friction angle	25
Overburden Compaction Multiplier (OCM)**	7
Thermal Expansion Coefficient	11.41N/mm/mm
Temperature change (installation-operating)	68

***These values are same for all soil models.**

****Proctor No. taken is 0.9.**

CHAPTER – V

CAESAR II V4.5 PIPELINE MODEL

5.1. Input Shape of Pipeline

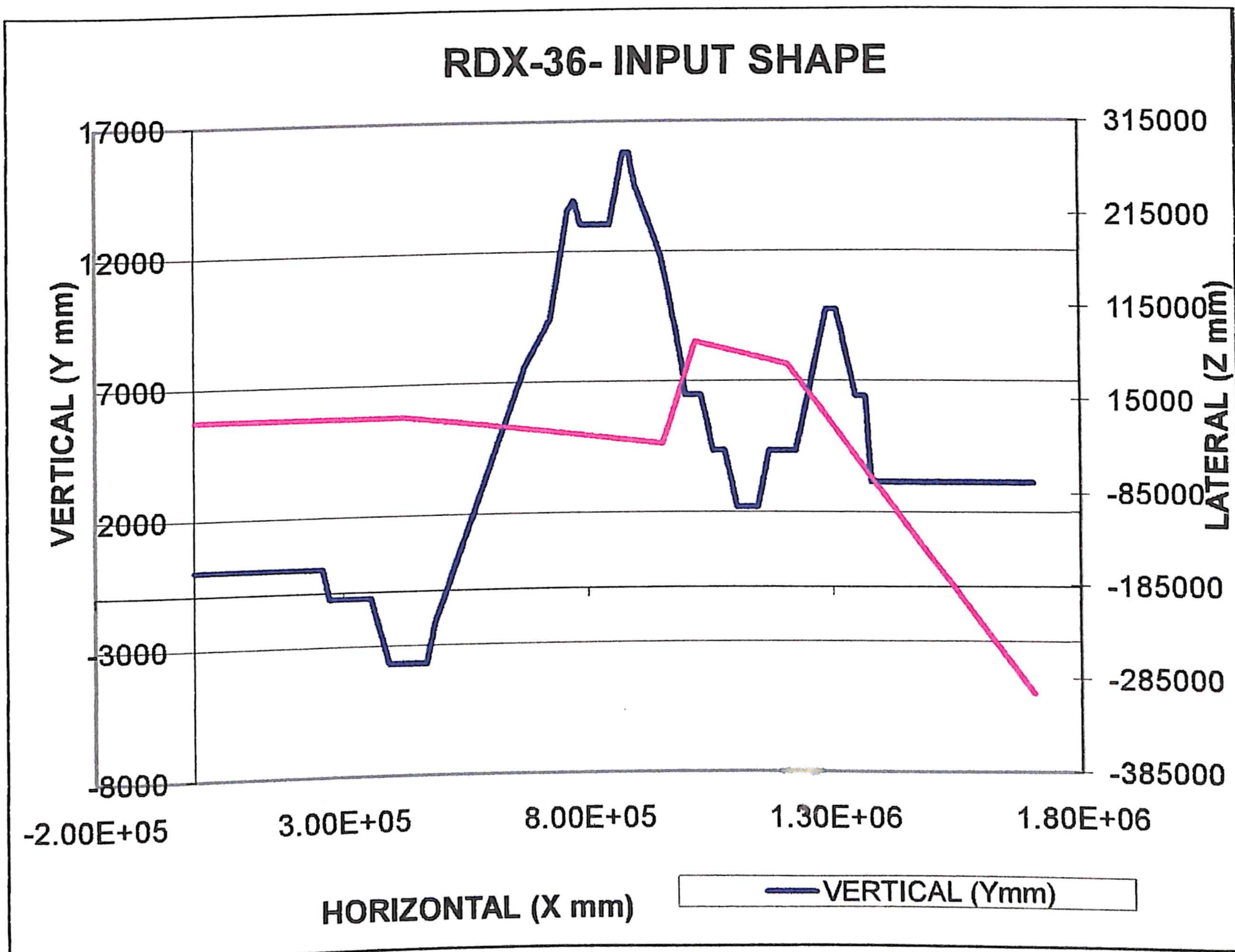
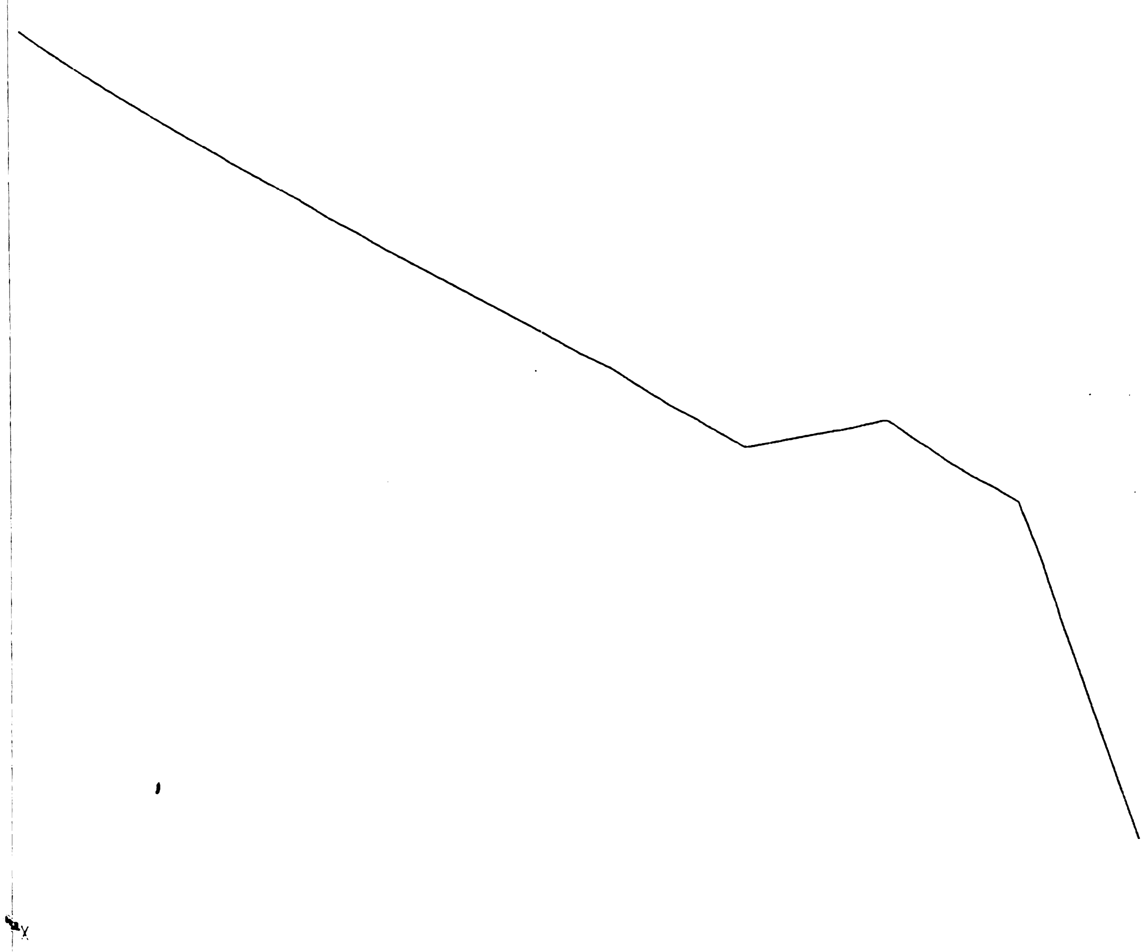


Fig: 5.1



ted: 02/15/11 20:05:33 model: C:\ANURAG\BSPL-NEWB

CHAPTER – VI

CAESAR II V4.5 PIPELINE MODEL STRESS ANALYSIS OUTPUT

RT, Stresses on Elements
W-T1-P1

AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	Stresses (N./sq.mm.)						Stress (N./sq.mm.)		

... CODE STRESS CHECK PASSED
PIPING CODE: B31.4 -2002, October 4, 2002

HIGHEST STRESSES: (N./sq.mm.)

CODE STRESS %:	98.4	@NODE	2340	STRESS:	396.7	ALLOWABLE:	403.
BENDING STRESS:	122.3	@NODE	2722				
TORSIONAL STRESS:	0.3	@NODE	2341				
AXIAL STRESS:	32.4	@NODE	4009				
HOOP STRESS:	273.3	@NODE	20				
VON MISES STRESS:	148.5	@NODE	2340				

-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
-32.33	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
-32.33	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
-32.33	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
-32.33	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
-32.33	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
-32.33	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.25	403.33	88.
-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.25	403.33	88.
-32.31	0.00	0.00	273.35	136.83	1.000	1.000	353.25	403.33	88.
-32.31	0.00	0.00	273.35	136.83	1.000	1.000	353.25	403.33	88.
-32.31	0.00	0.00	273.35	136.83	1.000	1.000	353.24	403.33	88.
-32.31	0.00	0.00	273.35	136.83	1.000	1.000	353.24	403.33	88.
32.31	0.00	[illegible]	273.35	136.83	[illegible]	1.000	353.24	403.33	88.
32.31	0.00	[illegible]	273.35	136.83	[illegible]	[illegible]	353.24	403.33	88.
[illegible]	[illegible]	[illegible]	273.35	136.83	[illegible]	[illegible]	353.24	403.33	88.
-32.30	0.00	0.00	273.35	136.83	[illegible]	[illegible]	353.24	403.33	88.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32.29	[illegible]	[illegible]	273.35	136.83	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32.29	[illegible]	[illegible]	273.35	136.83	[illegible]	[illegible]	353.23	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REPORT, Stresses on Elements
[illegible]OPE, W+T1+P1

[illegible]	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	---------Stresses(N./sq.mm.)---------							----Stress(N./sq.mm.)----		
30	-32.27	0.00	0.00	273.35	136.82	1.000	1.000	353.21	403.33	88.
90	-32.27	0.00	0.00	273.35	136.82	1.000	1.000	353.21	403.33	88.
90	-32.27	0.00	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
00	-32.27	0.00	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
00	-32.26	0.00	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
10	-32.26	0.00	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
10	-32.25	0.00	0.00	273.35	136.81	1.000	1.000	353.19	403.33	88.
20	-32.25	0.00	0.00	273.35	136.81	1.000	1.000	353.19	403.33	88.
20	-32.25	0.00	0.00	273.35	136.81	1.000	1.000	353.18	403.33	88.
30	-32.25	0.00	0.00	273.35	136.81	1.000	1.000	353.18	403.33	88.
30	-32.24	0.00	0.00	273.35	136.81	1.000	1.000	353.17	403.33	88.
40	-32.24	0.00	0.00	273.35	136.81	1.000	1.000	353.17	403.33	88.
40	-32.23	0.00	0.00	273.35	136.81	1.000	1.000	353.16	403.33	88.
50	-32.23	0.00	0.00	273.35	136.81	1.000	1.000	353.16	403.33	88.
50	-32.22	0.00	0.00	273.35	136.81	1.000	1.000	353.16	403.33	88.
60	-32.22	0.00	0.00	273.35	136.81	1.000	1.000	353.16	403.33	88.
60	-32.21	0.00	0.00	273.35	136.80	1.000	1.000	353.15	403.33	88.
70	-32.21	0.00	0.00	273.35	136.80	1.000	1.000	353.15	403.33	88.
70	-32.20	0.00	0.00	273.35	136.80	1.000	1.000	353.14	403.33	88.
80	-32.20	0.00	0.00	273.35	136.80	1.000	1.000	353.14	403.33	88.
80	-32.19	0.00	0.00	273.35	136.80	1.000	1.000	353.13	403.33	88.
90	-32.19	0.00	0.00	273.35	136.80	1.000	1.000	353.13	403.33	88.
90	-32.18	0.00	0.00	273.35	136.80	1.000	1.000	353.12	403.33	88.
00	-32.18	0.00	0.00	273.35	136.80	1.000	1.000	353.12	403.33	88.
00	-32.17	0.00	0.00	273.35	136.79	1.000	1.000	353.10	403.33	88.
10	-32.17	0.00	0.00	273.35	136.79	1.000	1.000	353.10	403.33	88.
10	-32.16	0.00	0.00	273.35	136.79	1.000	1.000	353.09	403.33	88.
20	-32.16	0.00	0.00	273.35	136.79	1.000	1.000	353.09	403.33	88.
20	-32.14	0.00	0.00	273.35	136.79	1.000	1.000	353.08	403.33	88.
30	-32.14	0.00	0.00	273.35	136.79	1.000	1.000	353.08	403.33	88.
30	-32.13	0.00	0.00	273.35	136.78	1.000	1.000	353.07	403.33	88.
40	-32.13	0.00	0.00	273.35	136.78	1.000	1.000	353.07	403.33	88.
40	-32.12	0.00	0.00	273.35	136.78	1.000	1.000	353.05	403.33	88.
50	-32.12	0.00	0.00	273.35	136.78	1.000	1.000	353.05	403.33	88.
'50	-32.10	0.00	0.00	273.35	136.78	1.000	1.000	353.04	403.33	88.
'60	-32.10	0.00	0.00	273.35	136.78	1.000	1.000	353.04	403.33	88.
'60	-32.09	0.00	0.00	273.35	136.77	1.000	1.000	353.02	403.33	88.
'70	-32.09	0.01	0.00	273.35	136.77	1.000	1.000	353.03	403.33	88.
'70	-32.07	0.01	0.00	273.35	136.77	1.000	1.000	353.02	403.33	88.
'80	-32.07	0.01	0.00	273.35	136.77	1.000	1.000	353.01	403.33	88.
'80	-32.06	0.01	0.00	273.35	136.76	1.000	1.000	353.00	403.33	88.
'90	-32.06	0.45	0.00	273.35	136.88	1.000	1.000	353.44	403.33	88.
'90	-32.04	0.45	0.00	273.35	136.87	1.000	1.000	353.42	403.33	88.
i00	-32.04	1.17	0.00	273.35	137.06	1.000	1.000	354.15	403.33	88.
i00	-32.02	1.17	0.00	273.35	137.05	1.000	1.000	354.13	403.33	88.
i10	-32.02	9.80	0.00	273.35	139.29	1.000	1.000	362.76	403.33	90.
i10	-32.01	9.80	0.00	273.35	139.28	1.000	1.000	362.74	403.33	90.
i11	-32.01	1.57	0.00	273.35	137.15	1.000	1.000	354.51	403.33	88.
i11	-32.00	1.57	0.00	273.35	137.15	1.000	1.000	354.51	403.33	88.
i12	-32.02	7.32	0.00	273.35	138.64	1.000	1.000	360.28	403.33	89.
i12	-32.01	7.32	0.00	273.35	138.64	1.000	1.000	360.27	403.33	89.
i13	-32.01	8.57	0.00	273.35	138.96	1.000	1.000	361.52	403.33	90.
[illegible]	-32.01	8.57	0.00	273.35	138.96	1.000	1.000	361.51	403.33	90.
[illegible]	-32.01	[illegible].64	[illegible]	273.35	138.72	1.000	1.000	360.59	403.33	89.
[illegible]	-32.01	[illegible].64	[illegible]	273.35	13[illegible].72	1.000	1.000	360.59	403.33	[illegible]
[illegible]	-31.99	[illegible].22	[illegible]	273.35	136.8[illegible]	1.000	1.[illegible]	353.14	403.33	[illegible]
[illegible]	-31.99	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible].14	[illegible]	[illegible]
[illegible]	-31.99	2.7[illegible]	[illegible]	273.35	[illegible].4[illegible]	1.00[illegible]	[illegible]	355.69	[illegible]	[illegible]
[illegible]	-31.99	2.7[illegible]	[illegible]	273.35	[illegible].4[illegible]	1.00[illegible]	1.[illegible]	355.69	[illegible]	[illegible]
[illegible]	-31.99	[illegible].51	[illegible]	273.35	136.94	1.000	1.[illegible]	353.44	[illegible]	[illegible]
[illegible]	-31.99	[illegible].51	0.[illegible]	273.35	[illegible]	1.[illegible]	1.[illegible]	353.44	[illegible]	[illegible]
[illegible]	-31.99	1.8[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REPORT, Stresses on Elements
OPE) W-T1+P1

ENT ES	Stresses (N./sq.mm.) AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	OUT-PLANE	----Stress (N./sq.mm.)---- STRESS	ALLOWABLE STRESS	%
51	-31.99	0.57	0.00	273.35	136.89	1.000	1.000	353.49	403.33	88.
51	-31.99	0.57	0.00	273.35	136.89	1.000	1.000	353.49	403.33	88.
52	-32.00	6.98	0.00	273.35	138.54	1.000	1.000	359.91	403.33	89.
52	-32.00	6.98	0.00	273.35	138.54	1.000	1.000	359.91	403.33	89.
53	-32.00	7.71	0.00	273.35	138.73	1.000	1.000	360.64	403.33	89.
53	-32.00	7.71	0.00	273.35	138.73	1.000	1.000	360.64	403.33	89.
54	-32.00	6.84	0.00	273.35	138.51	1.000	1.000	359.77	403.33	89.
54	-32.00	6.84	0.00	273.35	138.51	1.000	1.000	359.78	403.33	89.
50	-31.99	1.54	0.00	273.35	137.14	1.000	1.000	354.46	403.33	88.
50	-31.99	1.54	0.00	273.35	137.14	1.000	1.000	354.47	403.33	88.
70	-31.99	10.00	0.00	273.35	139.33	1.000	1.000	362.93	403.33	90.
70	-32.00	10.00	0.00	273.35	139.34	1.000	1.000	362.94	403.33	90.
80	-32.00	0.57	0.00	273.35	136.89	1.000	1.000	353.51	403.33	88.
80	-32.02	0.57	0.00	273.35	136.90	1.000	1.000	353.52	403.33	88.
90	-32.02	0.15	0.00	273.35	136.79	1.000	1.000	353.11	403.33	88.
90	-32.04	0.15	0.00	273.35	136.80	1.000	1.000	353.12	403.33	88.
00	-32.04	0.03	0.00	273.35	136.77	1.000	1.000	353.00	403.33	88.
00	-32.05	0.03	0.00	273.35	136.77	1.000	1.000	353.01	403.33	88.
10	-32.05	0.00	0.00	273.35	136.76	1.000	1.000	352.98	403.33	88.
10	-32.06	0.00	0.00	273.35	136.76	1.000	1.000	353.00	403.33	88.
20	-32.06	0.00	0.00	273.35	136.76	1.000	1.000	353.00	403.33	88.
20	-32.07	0.00	0.00	273.35	136.77	1.000	1.000	353.01	403.33	88.
30	-32.07	0.00	0.00	273.35	136.77	1.000	1.000	353.01	403.33	88.
30	-32.08	0.00	0.00	273.35	136.77	1.000	1.000	353.02	403.33	88.
40	-32.08	0.00	0.00	273.35	136.77	1.000	1.000	353.02	403.33	88.
40	-32.09	0.00	0.00	273.35	136.77	1.000	1.000	353.02	403.33	88.
50	-32.09	0.00	0.00	273.35	136.77	1.000	1.000	353.02	403.33	88.
50	-32.10	0.00	0.00	273.35	136.77	1.000	1.000	353.03	403.33	88.
60	-32.10	0.00	0.00	273.35	136.77	1.000	1.000	353.03	403.33	88.
60	-32.10	0.00	0.00	273.35	136.78	1.000	1.000	353.04	403.33	88.
70	-32.10	0.00	0.00	273.35	136.78	1.000	1.000	353.04	403.33	88.
70	-32.10	0.00	0.00	273.35	136.78	1.000	1.000	353.04	403.33	88.
80	-32.10	0.01	0.00	273.35	136.78	1.000	1.000	353.05	403.33	88.
80	-32.11	0.01	0.00	273.35	136.78	1.000	1.000	353.05	403.33	88.
90	-32.11	0.02	0.00	273.35	136.78	1.000	1.000	353.07	403.33	88.
90	-32.11	0.02	0.00	273.35	136.78	1.000	1.000	353.07	403.33	88.
700	-32.11	0.42	0.00	273.35	136.88	1.000	1.000	353.47	403.33	88.
700	-32.11	0.42	0.00	273.35	136.88	1.000	1.000	353.47	403.33	88.
710	-32.11	1.21	0.00	273.35	137.08	1.000	1.000	354.25	403.33	88.
710	-32.11	1.21	0.00	273.35	137.08	1.000	1.000	354.25	403.33	88.
720	-32.11	9.33	0.00	273.35	139.19	1.000	1.000	362.37	403.33	90.
720	-32.11	9.33	0.00	273.35	139.19	1.000	1.000	362.37	403.33	90.
721	-32.11	0.15	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
721	-32.11	0.15	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
722	-32.13	9.61	0.00	273.35	139.26	1.000	1.000	362.67	403.33	90.
722	-32.13	9.61	0.00	273.35	139.27	1.000	1.000	362.67	403.33	90.
723	-32.13	9.69	0.00	273.35	139.29	1.000	1.000	362.76	403.33	90.
723	-32.13	9.69	0.00	273.35	139.29	1.000	1.000	362.76	403.33	90.
730	-32.11	0.03	0.00	273.35	136.78	1.000	1.000	353.07	403.33	88.
730	-32.12	0.03	0.00	273.35	136.79	1.000	1.000	353.08	403.33	88.
740	-32.12	9.41	0.00	273.35	139.21	1.000	1.000	362.47	403.33	90.
740	-32.13	9.41	0.00	273.35	139.21	1.000	1.000	362.47	403.33	90.
7[illegible]	-32.13	0.21	0.00	273.35	136.83	1.000	1.000	353.27	403.33	88.
7[illegible]	-32.14	0.21	[illegible]	273.35	136.84	[illegible]	[illegible]	353.28	403.33	[illegible]
7[illegible]	[illegible]	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	353.31	403.33	[illegible]
7[illegible]	[illegible]	0.24	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7[illegible]	[illegible]	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7[illegible]	[illegible]	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7[illegible]	[illegible]	[illegible]	[illegible]	273.35	[illegible]	1.000	[illegible]	353.59	403.33	[illegible]
7[illegible]	[illegible]	5.67	[illegible]	273.35	[illegible]	1.000	[illegible]	[illegible]	[illegible]	[illegible]
7[illegible]	[illegible]	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REPORT, Stresses on Elements

OPE' W-T1+P1

ELEMENT S	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	------------- Stresses (N./sq.mm.)							---- Stress (N./sq.mm.)		----
)0	-32.18	7.45	0.00	273.35	[illegible]	1.000	1.000	360.56	403.33	89.
)1	-32.18	0.06	0.00	273.35	136.81	1.000	1.000	353.17	403.33	88.
)1	-32.18	0.06	0.00	273.35	136.81	1.000	1.000	353.17	403.33	88.
)2	-32.19	9.35	0.00	273.35	139.22	1.000	1.000	362.48	403.33	90.
)2	-32.20	9.35	0.00	273.35	139.22	1.000	1.000	362.49	403.33	90.
)3	-32.20	9.47	0.00	273.35	139.25	1.000	1.000	362.61	403.33	90.
)3	-32.21	9.47	0.00	273.35	139.25	1.000	1.000	362.61	403.33	90.
10	-32.19	0.07	0.00	273.35	136.82	1.000	1.000	353.19	403.33	88.
10	-32.20	0.07	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
20	-32.20	9.42	0.00	273.35	139.24	1.000	1.000	362.55	403.33	90.
20	-32.21	9.42	0.00	273.35	139.24	1.000	1.000	362.57	403.33	90.
30	-32.21	0.23	0.00	273.35	136.86	1.000	1.000	353.37	403.33	88.
30	-32.23	0.23	0.00	273.35	136.87	1.000	1.000	353.39	403.33	88.
40	-32.23	0.21	0.00	273.35	136.86	1.000	1.000	353.38	403.33	88.
40	-32.25	0.21	0.00	273.35	136.87	1.000	1.000	353.39	403.33	88.
50	-32.25	0.18	0.00	273.35	136.86	1.000	1.000	353.36	403.33	88.
50	-29.82	0.16	0.00	243.49	122.18	1.000	1.000	315.08	403.33	78.
60	-29.82	0.43	0.00	243.49	122.24	1.000	1.000	315.35	403.33	78.
60	-32.23	0.48	0.00	273.35	136.93	1.000	1.000	353.64	403.33	88.
70	-32.23	7.01	0.00	273.35	138.61	1.000	1.000	360.18	403.33	89.
70	-32.21	7.01	0.00	273.35	138.61	1.000	1.000	360.15	403.33	89.
80	-32.21	0.06	0.00	273.35	136.82	1.000	1.000	353.21	403.33	88.
80	-32.20	0.06	0.00	273.35	136.82	1.000	1.000	353.19	403.33	88.
81	-32.22	10.68	0.00	273.35	139.57	1.000	1.000	363.83	403.33	90.
81	-32.21	10.68	0.00	273.35	139.57	1.000	1.000	363.83	403.33	90.
82	-32.21	10.57	0.00	273.35	139.54	1.000	1.000	363.71	403.33	90.
82	-32.20	10.57	0.00	273.35	139.54	1.000	1.000	363.71	403.33	90.
90	-32.18	0.63	0.00	273.35	136.96	1.000	1.000	353.75	403.33	88.
90	-32.18	0.63	0.00	273.35	136.96	1.000	1.000	353.74	403.33	88.
00	-32.18	5.84	0.00	273.35	138.29	1.000	1.000	358.95	403.33	89.
00	-32.17	5.84	0.00	273.35	138.29	1.000	1.000	358.94	403.33	89.
10	-32.17	2.45	0.00	273.35	137.42	1.000	1.000	355.56	403.33	88.
10	-32.15	2.45	0.00	273.35	137.41	1.000	1.000	355.54	403.33	88.
20	-32.15	0.38	0.00	273.35	136.89	1.000	1.000	353.47	403.33	88.
20	-32.13	0.38	0.00	273.35	136.88	1.000	1.000	353.45	403.33	88.
30	-32.13	0.04	0.00	273.35	136.79	1.000	1.000	353.11	403.33	88.
30	-32.11	0.04	0.00	273.35	136.79	1.000	1.000	353.08	403.33	88.
40	-32.11	0.09	0.00	273.35	136.80	1.000	1.000	353.14	403.33	88.
40	-32.09	0.09	0.00	273.35	136.79	1.000	1.000	353.12	403.33	88.
50	-32.09	0.83	0.00	273.35	136.98	1.000	1.000	353.86	403.33	88.
50	-32.07	0.83	0.00	273.35	136.98	1.000	1.000	353.84	403.33	88.
60	-32.07	6.82	0.00	273.35	138.52	1.000	1.000	359.83	403.33	89.
60	-32.06	6.82	0.00	273.35	138.52	1.000	1.000	359.82	403.33	89.
70	-32.06	7.61	0.00	273.35	138.72	1.000	1.000	360.60	403.33	89.
70	-32.05	7.61	0.00	273.35	138.72	1.000	1.000	360.59	403.33	89.
71	-32.05	1.20	0.00	273.35	137.07	1.000	1.000	354.19	403.33	88.
71	-32.04	1.20	0.00	273.35	137.06	1.000	1.000	354.18	403.33	88.
72	-32.05	6.91	0.00	273.35	138.54	1.000	1.000	359.89	403.33	89.
72	-32.05	6.91	0.00	273.35	138.54	1.000	1.000	359.89	403.33	89.
73	-32.05	8.03	0.00	273.35	138.83	1.000	1.000	361.01	403.33	90.
73	-32.04	8.03	0.00	273.35	138.83	1.000	1.000	361.00	403.33	90.
74	-32.04	7.00	0.00	273.35	138.56	1.000	1.000	359.97	403.33	89.
74	-32.04	7.00	0.00	273.35	138.56	1.000	1.000	359.97	403.33	89.
8[illegible]	-32.02	1.59	0.00	273.35	137.16	1.000	1.000	354.54	403.33	88.
8	32.02	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	354.54	[illegible]	[illegible]
9	32.02	[illegible]	[illegible]	[illegible]	139.[illegible]	[illegible]	[illegible]	362.84	403.33	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]4.23	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]4.23	[illegible]	[illegible]
[illegible]	-32.01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	358.95	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	32.01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

EPORT, Stresses on Elements
OPE) W+T1+P1

NT	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	OUT-PLANE	STRESS	ALLOWABLE STRESS	*
	------------Stresses (N./sq.mm.) ------------							----Stress (N./sq.mm.) ----		
[illegible]	-32.02	12.46	0.00	273.35	139.99	1.000	1.000	365.41	403.33	91.
[illegible]	-32.00	5.29	0.00	273.35	138.10	1.000	1.000	358.23	403.33	89.
0	-32.00	5.29	0.00	273.35	138.10	1.000	1.000	358.23	403.33	89.
0	-32.00	6.03	0.00	273.35	138.30	1.000	1.000	358.97	403.33	89.
0	-32.00	6.03	0.00	273.35	138.30	1.000	1.000	358.97	403.33	89.
C	-32.00	0.32	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
0	-31.99	0.32	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
0	-31.99	0.18	0.00	273.35	136.79	1.000	1.000	353.11	403.33	88.
0	-31.99	0.18	0.00	273.35	136.79	1.000	1.000	353.10	403.33	88.
0	-31.99	0.01	0.00	273.35	136.75	1.000	1.000	352.93	403.33	88.
0	-31.98	0.01	0.00	273.35	136.75	1.000	1.000	352.92	403.33	88.
0	-31.98	0.00	0.00	273.35	136.74	1.000	1.000	352.92	403.33	88.
70	-31.97	0.00	0.00	273.35	136.74	1.000	1.000	352.91	403.33	87.
70	-31.97	0.00	0.00	273.35	136.74	1.000	1.000	352.91	403.33	87.
30	-31.96	0.00	0.00	273.35	136.74	1.000	1.000	352.90	403.33	87.
90	-31.96	0.00	0.00	273.35	136.74	1.000	1.000	352.90	403.33	87.
90	-31.95	0.00	0.00	273.35	136.74	1.000	1.000	352.88	403.33	87.
00	-31.95	0.00	0.00	273.35	136.74	1.000	1.000	352.88	403.33	87.
00	-31.94	0.00	0.00	273.35	136.73	1.000	1.000	352.87	403.33	87.
10	-31.94	0.00	0.00	273.35	136.73	1.000	1.000	352.87	403.33	87.
10	-31.92	0.00	0.00	273.35	136.73	1.000	1.000	352.86	403.33	87.
20	-31.92	0.00	0.00	273.35	136.73	1.000	1.000	352.86	403.33	87.
20	-31.91	0.00	0.00	273.35	136.72	1.000	1.000	352.84	403.33	87.
30	-31.91	0.00	0.00	273.35	136.72	1.000	1.000	352.84	403.33	87.
30	-31.89	0.00	0.00	273.35	136.72	1.000	1.000	352.83	403.33	87.
40	-31.89	0.00	0.00	273.35	136.72	1.000	1.000	352.83	403.33	87.
40	-31.87	0.00	0.00	273.35	136.71	1.000	1.000	352.81	403.33	87.
50	-31.87	0.00	0.00	273.35	136.71	1.000	1.000	352.81	403.33	87.
50	-31.85	0.00	0.00	273.35	136.71	1.000	1.000	352.79	403.33	87.
60	-31.85	0.00	0.00	273.35	136.71	1.000	1.000	352.79	403.33	87.
60	-31.83	0.00	0.00	273.35	136.70	1.000	1.000	352.77	403.33	87.
70	-31.83	0.00	0.00	273.35	136.70	1.000	1.000	352.77	403.33	87.
70	-31.81	0.00	0.00	273.35	136.70	1.000	1.000	352.74	403.33	87.
80	-31.81	0.00	0.00	273.35	136.70	1.000	1.000	352.74	403.33	87.
80	-31.78	0.00	0.00	273.35	136.69	1.000	1.000	352.72	403.33	87.
90	-31.78	0.00	0.00	273.35	136.69	1.000	1.000	352.72	403.33	87.
90	-31.76	0.00	0.00	273.35	136.68	1.000	1.000	352.69	403.33	87.
200	-31.76	0.00	0.00	273.35	136.68	1.000	1.000	352.69	403.33	87.
200	-31.73	0.00	0.00	273.35	136.68	1.000	1.000	352.66	403.33	87.
210	-31.73	0.00	0.00	273.35	136.68	1.000	1.000	352.66	403.33	87.
210	-31.70	0.00	0.00	273.35	136.67	1.000	1.000	352.63	403.33	87.
220	-31.70	0.00	0.00	273.35	136.67	1.000	1.000	352.63	403.33	87.
220	-31.66	0.00	0.00	273.35	136.66	1.000	1.000	352.60	403.33	87.
230	-31.66	0.00	0.00	273.35	136.66	1.000	1.000	352.60	403.33	87.
230	-31.63	0.00	0.00	273.35	136.65	1.000	1.000	352.57	403.33	87.
240	-31.63	0.00	0.00	273.35	136.65	1.000	1.000	352.57	403.33	87.
240	-31.59	0.00	0.00	273.35	136.64	1.000	1.000	352.53	403.33	87.
250	-31.59	0.00	0.00	273.35	136.64	1.000	1.000	352.53	403.33	87.
250	-31.55	0.00	0.00	273.35	136.63	1.000	1.000	352.49	403.33	87.
260	-31.55	0.00	0.00	273.35	136.63	1.000	1.000	352.49	403.33	87.
260	-31.51	0.00	0.00	273.35	136.62	1.000	1.000	352.45	403.33	87.
2[illegible]	-31.51	0.00	0.00	273.35	136.62	1.000	1.000	352.45	403.33	87.
2[illegible]	-31.47	0.00	0.00	273.35	136.61	1.000	1.000	352.40	403.33	8[illegible].
2[illegible]	-31.47	[illegible]	[illegible]	273.35	136.61	1.000	1.000	352.40	403.33	8[illegible].
2[illegible]	[illegible]31.42	[illegible]	[illegible]	273.35	136.60	1.000	1.000	352.36	403.33	[illegible]
2[illegible]	[illegible]31.42	[illegible]	[illegible]	273.35	136.60	1.[illegible]	1.[illegible]	352.36	403.33	[illegible]
2[illegible]	[illegible]31.37	[illegible]	[illegible]	[illegible]	136.5[illegible]	[illegible]	[illegible]	352.31	403.33	[illegible]
3[illegible]	-31.37	[illegible]	[illegible]	[illegible]	136.5[illegible]	1.000	1.000	352.31	403.33	[illegible]
3[illegible]	[illegible]31.32	[illegible]	[illegible]	[illegible]	136.57	1.000	1.000	352.26	403.33	[illegible]
3[illegible]	-31.32	[illegible]	[illegible]	273.35	136.57	1.000	[illegible]	352.26	403.33	[illegible]
3[illegible]	-31.2[illegible]	[illegible]	[illegible]	273.35	136.56	1.000	[illegible]	352.2[illegible]	403.33	[illegible]
3[illegible]	[illegible]31.2[illegible]	[illegible]	[illegible]	[illegible]	136.56	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REPORT, STRESSES ON ELEMENTS
(OPE) W+T1+P1

ELEMENT NODES	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	V. Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	----Stress(N./sq.mm.)---- STRESS	ALLOWABLE STRESS	%
	------------Stresses (N./sq.mm.)------------									
30	-31.21	0.00	0.00	273.35	136.54	1.000	1.000	352.14	403.33	87.
30	-31.15	0.00	0.00	273.35	136.53	1.000	1.000	352.08	403.33	87.
40	-31.15	0.00	0.00	273.35	136.53	1.000	1.000	352.08	403.33	87.
40	-31.08	0.00	0.00	273.35	136.51	1.000	1.000	352.02	403.33	87.
50	-31.08	0.00	0.00	273.35	136.51	1.000	1.000	352.02	403.33	87.
50	-31.01	0.00	0.00	273.35	136.49	1.000	1.000	351.95	403.33	87.
60	-31.01	0.01	0.00	273.35	136.49	1.000	1.000	351.95	403.33	87.
60	-30.94	0.01	0.00	273.35	136.47	1.000	1.000	351.88	403.33	87.
70	-30.94	0.15	0.00	273.35	136.51	1.000	1.000	352.02	403.33	87.
70	-30.86	0.15	0.00	273.35	136.49	1.000	1.000	351.95	403.33	87.
80	-30.86	0.80	0.00	273.35	136.65	1.000	1.000	352.60	403.33	87.
80	-30.79	0.80	0.00	273.35	136.63	1.000	1.000	352.52	403.33	87.
90	-30.79	2.55	0.00	273.35	137.08	1.000	1.000	354.28	403.33	88.
90	-30.73	2.55	0.00	273.35	137.06	1.000	1.000	354.22	403.33	88.
91	-30.73	5.88	0.00	273.35	137.92	1.000	1.000	357.55	403.33	89.
91	-30.71	5.88	0.00	273.35	137.91	1.000	1.000	357.52	403.33	89.
92	-30.72	8.44	0.00	273.35	138.58	1.000	1.000	360.09	403.33	89.
92	-30.70	8.44	0.00	273.35	138.57	1.000	1.000	360.07	403.33	89.
100	-30.70	5.77	0.00	273.35	137.88	1.000	1.000	357.41	403.33	89.
100	-30.67	5.77	0.00	273.35	137.87	1.000	1.000	357.38	403.33	89.
110	-30.67	2.89	0.00	273.35	137.13	1.000	1.000	354.50	403.33	88.
110	-30.61	2.89	0.00	273.35	137.12	1.000	1.000	354.44	403.33	88.
120	-30.61	0.44	0.00	273.35	136.50	1.000	1.000	351.98	403.33	87.
120	-30.52	0.44	0.00	273.35	136.47	1.000	1.000	351.89	403.33	87.
130	-30.52	0.11	0.00	273.35	136.39	1.000	1.000	351.57	403.33	87.
130	-30.42	0.11	0.00	273.35	136.36	1.000	1.000	351.47	403.33	87.
140	-30.42	0.00	0.00	273.35	136.33	1.000	1.000	351.36	403.33	87.
140	-30.32	0.00	0.00	273.35	136.31	1.000	1.000	351.25	403.33	87.
150	-30.32	0.00	0.00	273.35	136.31	1.000	1.000	351.25	403.33	87.
150	-30.21	0.00	0.00	273.35	136.28	1.000	1.000	351.14	403.33	87.
160	-30.21	0.01	0.00	273.35	136.28	1.000	1.000	351.15	403.33	87.
160	-30.09	0.01	0.00	273.35	136.25	1.000	1.000	351.03	403.33	87.
170	-30.09	0.02	0.00	273.35	136.25	1.000	1.000	351.05	403.33	87.
170	-29.97	0.02	0.00	273.35	136.22	1.000	1.000	350.92	403.33	87.
180	-29.97	0.28	0.00	273.35	136.29	1.000	1.000	351.19	403.33	87.
180	-29.84	0.28	0.00	273.35	136.25	1.000	1.000	351.06	403.33	87.
490	-29.84	0.26	0.00	273.35	136.25	1.000	1.000	351.04	403.33	87.
490	-29.71	0.26	0.00	273.35	136.22	1.000	1.000	350.91	403.33	87.
500	-29.71	9.13	0.00	273.35	138.48	1.000	1.000	359.77	403.33	89.
500	-29.61	9.13	0.00	273.35	138.46	1.000	1.000	359.67	403.33	89.
501	-29.61	0.50	0.00	273.35	136.25	1.000	1.000	351.05	403.33	87.
501	-29.56	0.50	0.00	273.35	136.24	1.000	1.000	351.00	403.33	87.
502	-29.58	8.48	0.00	273.35	138.28	1.000	1.000	358.99	403.33	89.
502	-29.53	8.48	0.00	273.35	138.27	1.000	1.000	358.95	403.33	89.
503	-29.53	10.16	0.00	273.35	138.71	1.000	1.000	360.63	403.33	89.
503	-29.49	10.16	0.00	273.35	138.69	1.000	1.000	360.58	403.33	89.
504	-29.48	8.30	0.00	273.35	138.21	1.000	1.000	358.72	403.33	89.
504	-29.44	8.30	0.00	273.35	138.20	1.000	1.000	358.67	403.33	89.
510	-29.42	0.83	0.00	273.35	136.28	1.000	1.000	351.19	403.33	87.
510	-29.37	0.83	0.00	273.35	136.27	1.000	1.000	351.14	403.33	87.
520	-29.37	9.47	0.00	273.35	138.48	1.000	1.000	359.78	403.33	89.
5[illegible]	-29.27	9.47	0.00	273.35	138.46	1.000	1.000	359.68	403.33	89.
5[illegible]	-29.27	0.29	0.00	273.35	136.11	1.000	1.000	350.49	403.33	87.
5[illegible]	-29.12	0.2[illegible]	0.00	273.35	136.0[illegible]	1.000	1.000	350.34	403.33	87.
5[illegible]	-29.12	[illegible].24	[illegible]	273.35	13[illegible].[illegible]6	[illegible]	1.[illegible]	350.29	403.33	8[illegible].
5[illegible]	[illegible]	[illegible].24	0.00	273.35	136.01	[illegible]	[illegible]	35[illegible]	403.33	[illegible]
5[illegible]	[illegible]	[illegible]	[illegible]	273.35	135.99	[illegible]	[illegible]	[illegible]	403.33	[illegible]
5[illegible]	[illegible]	[illegible]	[illegible]	273.35	135.95	[illegible]	[illegible]	34[illegible]	[illegible]	[illegible]
5[illegible]	[illegible]	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5[illegible]	-28.61	[illegible]	0.00	273.35	13[illegible]	[illegible]	[illegible]	35[illegible]	403.33	[illegible]
5[illegible]	-28.61	[illegible]	[illegible]	273.35	13[illegible]	[illegible]	[illegible]	[illegible]	403.33	[illegible]
5[illegible]	-28.5[illegible]	[illegible]	[illegible]	273.35	13[illegible]	[illegible]	[illegible]	[illegible]	403.33	[illegible]
5[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REPORT, Stresses on Elements
(CFE: W-T1-P1

ELEMENT NODES	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	Stresses (N./sq.mm.)							Stress (N./sq.mm.)		
30	-28.45	7.52	0.00	273.35	137.73	1.000	1.000	356.90	403.33	88.
31	-28.45	0.71	0.00	273.35	136.00	1.000	1.000	350.09	403.33	87.
31	-28.37	0.71	0.00	273.35	135.98	1.000	1.000	350.01	403.33	87.
32	-28.39	7.15	0.00	273.35	137.62	1.000	1.000	356.47	403.33	88.
92	-28.31	7.15	0.00	273.35	137.60	1.000	1.000	356.40	403.33	88.
93	-28.32	7.86	0.00	273.35	137.78	1.000	1.000	357.11	403.33	89.
83	-28.24	7.86	0.00	273.35	137.76	1.000	1.000	357.04	403.33	89.
84	-28.24	6.08	0.00	273.35	137.30	1.000	1.000	355.25	403.33	88.
84	-28.17	6.08	0.00	273.35	137.29	1.000	1.000	355.18	403.33	88.
90	-28.15	3.54	0.00	273.35	136.64	1.000	1.000	352.63	403.33	87.
90	-28.08	3.54	0.00	273.35	136.62	1.000	1.000	352.56	403.33	87.
00	-28.08	12.79	0.00	273.35	139.00	1.000	1.000	361.80	403.33	90.
00	-28.02	12.79	0.00	273.35	138.98	1.000	1.000	361.74	403.33	90.
10	-28.02	13.69	0.00	273.35	139.22	1.000	1.000	362.65	403.33	90.
10	-27.98	13.69	0.00	273.35	139.21	1.000	1.000	362.61	403.33	90.
20	-27.98	12.73	0.00	273.35	138.96	1.000	1.000	361.65	403.33	90.
20	-27.92	12.73	0.00	273.35	138.94	1.000	1.000	361.59	403.33	90.
21	-27.92	3.60	0.00	273.35	136.59	1.000	1.000	352.45	403.33	87.
21	-27.84	3.60	0.00	273.35	136.57	1.000	1.000	352.37	403.33	87.
22	-27.85	4.85	0.00	273.35	136.89	1.000	1.000	353.64	403.33	88.
22	-27.76	4.85	0.00	273.35	136.87	1.000	1.000	353.55	403.33	88.
23	-27.76	5.34	0.00	273.35	136.99	1.000	1.000	354.04	403.33	88.
23	-27.68	5.34	0.00	273.35	136.97	1.000	1.000	353.95	403.33	88.
24	-27.68	5.29	0.00	273.35	136.96	1.000	1.000	353.91	403.33	88.
24	-27.60	5.29	0.00	273.35	136.93	1.000	1.000	353.83	403.33	88.
30	-27.59	0.27	0.00	273.35	135.67	1.000	1.000	348.79	403.33	86.
30	-27.51	0.27	0.00	273.35	135.65	1.000	1.000	348.71	403.33	86.
40	-27.51	2.45	0.00	273.35	136.19	1.000	1.000	350.89	403.33	87.
540	-27.44	2.45	0.00	273.35	136.18	1.000	1.000	350.83	403.33	87.
550	-27.44	0.39	0.00	273.35	135.66	1.000	1.000	348.77	403.33	86.
550	-27.40	0.39	0.00	273.35	135.65	1.000	1.000	348.72	403.33	86.
560	-27.40	1.49	0.00	273.35	135.92	1.000	1.000	349.83	403.33	87.
560	-27.34	1.49	0.00	273.35	135.91	1.000	1.000	349.76	403.33	87.
561	-27.34	2.13	0.00	273.35	136.07	1.000	1.000	350.40	403.33	87.
561	-27.25	2.13	0.00	273.35	136.04	1.000	1.000	350.31	403.33	87.
562	-27.26	9.27	0.00	273.35	137.86	1.000	1.000	357.46	403.33	89.
562	-27.17	9.27	0.00	273.35	137.84	1.000	1.000	357.38	403.33	89.
563	-27.17	8.76	0.00	273.35	137.71	1.000	1.000	356.87	403.33	88.
563	-27.09	8.76	0.00	273.35	137.69	1.000	1.000	356.78	403.33	88.
570	-27.07	0.65	0.00	273.35	135.63	1.000	1.000	348.65	403.33	86.
570	-26.98	0.65	0.00	273.35	135.61	1.000	1.000	348.56	403.33	86.
580	-26.98	9.76	0.00	273.35	137.92	1.000	1.000	357.68	403.33	89.
580	-26.78	9.76	0.00	273.35	137.86	1.000	1.000	357.47	403.33	89.
590	-26.78	0.48	0.00	273.35	135.51	1.000	1.000	348.20	403.33	86.
690	-26.45	0.48	0.00	273.35	135.43	1.000	1.000	347.87	403.33	86.
700	-26.45	0.16	0.00	273.35	135.35	1.000	1.000	347.54	403.33	86.
700	-26.10	0.16	0.00	273.35	135.26	1.000	1.000	347.19	403.33	86.
710	-26.10	0.03	0.00	273.35	135.23	1.000	1.000	347.06	403.33	86.
710	-25.72	0.03	0.00	273.35	135.13	1.000	1.000	346.69	403.33	86.
720	-25.72	0.00	0.00	273.35	135.12	1.000	1.000	346.66	403.33	86.
720	-25.32	0.00	0.00	273.35	135.02	1.000	1.000	346.26	403.33	86.
730	-25.32	0.00	0.00	273.35	135.02	1.000	1.000	346.26	403.33	86.
7[illegible]	24.90	0.00	0.00	273.35	134.91	1.000	1.000	345.83	403.33	86.
74	24.90	0.01	0.00	273.35	134.91	1.000	1.000	345.84	403.33	86.
74	-24.44	0.01	0.00	273.35	134.80	1.000	1.000	345.[illegible]	403.33	86.
7[illegible]	-24.44	0.02	0.00	273.35	134.80	1.000	1.000	345.39	403.33	86.
7[illegible]	23.46	0.02	[illegible]	273.35	13[illegible].6[illegible]	1.000	[illegible]	344.9[illegible]	403.33	86.
7[illegible]	23.46	0.04	[illegible]	273.35	13[illegible]	1.00[illegible]	[illegible]	345.4[illegible]	403.33	86.
7[illegible]	-23.44	0.54	0.[illegible]	273.35	134.6[illegible]	1.000	1.[illegible]	344.[illegible]	403.33	86.
7[illegible]	-23.44	2.09	0.00	273.35	13[illegible]	1.000	1.000	346.[illegible]	403.33	86.
[illegible]	-23.[illegible]	2.09	0.[illegible]	273.35	134.94	1.000	1.[illegible]	346.[illegible]	403.33	86.
7[illegible]	-23.[illegible]	8.38	0.[illegible]	273.35	13[illegible]	1.000	1.000	352.31	403.33	8[illegible].
[illegible]	[illegible]	[illegible].38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

EPORT, Stresses on Elements
OPE: W+T1+P1

NODE	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	------------- Stresses (N./sq.mm.)	-------------						----Stress (N./sq.mm.)	----	
1	-22.56	1.35	0.00	273.35	134.65	1.000	1.000	344.85	403.33	86.
2	-22.58	5.60	0.00	273.35	135.70	1.000	1.000	349.11	403.33	87.
2	-22.40	5.60	0.00	273.35	135.66	1.000	1.000	348.94	403.33	87.
3	-22.40	5.67	0.00	273.35	135.67	1.000	1.000	349.00	403.33	87.
3	-22.22	5.67	0.00	273.35	135.63	1.000	1.000	348.82	403.33	86.
4	-22.22	5.12	0.00	273.35	135.49	1.000	1.000	348.28	403.33	86.
4	-22.04	5.12	0.00	273.35	135.45	1.000	1.000	348.10	403.33	86.
0	-22.03	2.45	0.00	273.35	134.78	1.000	1.000	345.41	403.33	86.
0	-21.85	2.45	0.00	273.35	134.74	1.000	1.000	345.23	403.33	86.
0	-21.85	9.82	0.00	273.35	136.57	1.000	1.000	352.60	403.33	87.
0	-21.44	9.82	0.00	273.35	136.46	1.000	1.000	352.19	403.33	87.
0	-21.44	0.60	0.00	273.35	134.18	1.000	1.000	342.97	403.33	85.
0	-20.77	0.60	0.00	273.35	134.02	1.000	1.000	342.30	403.33	85.
0	-20.77	0.69	0.00	273.35	134.04	1.000	1.000	342.40	403.33	85.
0	-20.06	0.69	0.00	273.35	133.86	1.000	1.000	341.68	403.33	85.
0	-20.06	6.01	0.00	273.35	135.16	1.000	1.000	347.00	403.33	86.
0	-19.57	6.01	0.00	273.35	135.03	1.000	1.000	346.52	403.33	86.
0	-19.57	6.78	0.00	273.35	135.22	1.000	1.000	347.29	403.33	86.
10	-19.35	6.78	0.00	273.35	135.17	1.000	1.000	347.07	403.33	86.
11	-19.35	0.79	0.00	273.35	133.71	1.000	1.000	341.08	403.33	85.
11	-19.12	0.79	0.00	273.35	133.65	1.000	1.000	340.84	403.33	85.
12	-19.13	5.31	0.00	273.35	134.75	1.000	1.000	345.38	403.33	86.
12	-18.89	5.31	0.00	273.35	134.69	1.000	1.000	345.14	403.33	86.
13	-18.89	4.89	0.00	273.35	134.59	1.000	1.000	344.72	403.33	85.
13	-18.65	4.89	0.00	273.35	134.52	1.000	1.000	344.47	403.33	85.
14	-18.65	4.31	0.00	273.35	134.38	1.000	1.000	343.89	403.33	85.
14	-18.40	4.31	0.00	273.35	134.32	1.000	1.000	343.65	403.33	85.
50	-18.39	1.67	0.00	273.35	133.68	1.000	1.000	341.00	403.33	85.
50	-18.14	1.67	0.00	273.35	133.62	1.000	1.000	340.75	403.33	84.
50	-18.14	4.29	0.00	273.35	134.25	1.000	1.000	343.36	403.33	85.
50	-17.95	4.29	0.00	273.35	134.20	1.000	1.000	343.17	403.33	85.
70	-17.95	2.44	0.00	273.35	133.75	1.000	1.000	341.32	403.33	85.
70	-17.82	2.44	0.00	273.35	133.72	1.000	1.000	341.19	403.33	85.
30	-17.82	0.37	0.00	273.35	133.23	1.000	1.000	339.12	403.33	84.
30	-17.71	0.37	0.00	273.35	133.20	1.000	1.000	339.01	403.33	84.
90	-17.71	0.21	0.00	273.35	133.16	1.000	1.000	338.86	403.33	84.
90	-17.53	0.21	0.00	273.35	133.12	1.000	1.000	338.68	403.33	84.
91	-17.53	5.44	0.00	273.35	134.38	1.000	1.000	343.91	403.33	85.
91	-17.27	5.44	0.00	273.35	134.31	1.000	1.000	343.65	403.33	85.
92	-17.28	11.20	0.00	273.35	135.73	1.000	1.000	349.41	403.33	87.
92	-17.03	11.20	0.00	273.35	135.66	1.000	1.000	349.16	403.33	87.
00	-17.01	2.22	0.00	273.35	133.47	1.000	1.000	340.17	403.33	84.
00	-16.74	2.22	0.00	273.35	133.40	1.000	1.000	339.90	403.33	84.
10	-16.74	7.92	0.00	273.35	134.78	1.000	1.000	345.60	403.33	86.
10	-16.12	7.92	0.00	273.35	134.62	1.000	1.000	344.97	403.33	86.
20	-16.12	0.18	0.00	273.35	132.76	1.000	1.000	337.23	403.33	84.
20	-15.09	0.18	0.00	273.35	132.51	1.000	1.000	336.20	403.33	83.
30	-15.09	0.15	0.00	273.35	132.51	1.000	1.000	336.18	403.33	83.
30	-14.00	0.15	0.00	273.35	132.24	1.000	1.000	335.08	403.33	83.
40	-14.00	0.02	0.00	273.35	132.21	1.000	1.000	334.95	403.33	83.
40	-12.84	0.02	0.00	273.35	131.94	1.000	1.000	333.80	403.33	83.
5	12.84	0.02	0.00	273.35	131.93	1.000	1.000	333.79	403.33	83.
9	-11.61	[illegible]	0.00	[illegible]	131.64	1.000	1.000	332.56	[illegible]	82.
9	-11.61	[illegible]	0.00	[illegible]	[illegible]	1.000	1.000	332.67	[illegible]	82.
9	10.30	[illegible]	0.00	[illegible]	[illegible]	[illegible]	1.000	331.36	[illegible]	82.
9	10.30	0.15	0.00	[illegible]	[illegible]	[illegible]	[illegible]	331.59	[illegible]	82.
9	8.91	[illegible]	0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	8.91	[illegible]	0.00	[illegible]	[illegible]	[illegible]	1.000	[illegible]	[illegible]	[illegible]
9	[illegible]	6.69	0.00	[illegible]	[illegible]	[illegible]	1.000	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	0.00	[illegible]	[illegible]	1.000	1.000	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

EPORT, Stresses on Elements
OPE: W+T1-P1

NT	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	----Stresses (N./sq.mm.)----							----Stress (N./sq.mm.)----		
	-6.62	62.47	0.00	215.59	119.59	1.000	1.000	320.72	403.33	80.
	-6.11	62.47	0.00	215.59	119.43	1.000	1.000	320.22	403.33	79.
	-6.11	1.17	0.00	215.59	103.39	1.000	1.000	258.92	403.33	64.
	-5.57	1.17	0.00	215.59	103.26	1.000	1.000	258.35	403.33	64.
	-7.21	69.69	0.00	215.59	121.94	1.000	1.000	328.54	403.33	81.
1	-6.91	69.69	0.00	215.59	121.85	1.000	1.000	328.23	403.33	81.
5	-7.10	77.71	0.00	215.59	124.37	1.000	1.000	336.44	403.33	83.
5	-7.02	77.71	0.00	215.59	124.35	1.000	1.000	336.36	403.33	83.
5	-6.69	64.05	0.00	215.59	120.08	1.000	1.000	322.38	403.33	80.
5	-6.84	64.05	0.00	215.59	120.13	1.000	1.000	322.52	403.33	80.
0	-5.11	8.18	0.00	215.59	104.74	1.000	1.000	264.93	403.33	66.
0	-5.47	8.18	0.00	215.59	104.82	1.000	1.000	265.29	403.33	66.
1	-5.47	68.22	0.00	215.59	120.95	1.000	1.000	325.33	403.33	81.
1	-5.81	68.22	0.00	215.59	121.05	1.000	1.000	325.66	403.33	81.
2	-5.81	48.99	0.00	215.59	115.44	1.000	1.000	306.43	403.33	76.
2	-6.09	48.99	0.00	215.59	115.52	1.000	1.000	306.71	403.33	76.
0	-6.09	20.13	0.00	215.59	107.84	1.000	1.000	277.85	403.33	69.
0	-5.84	25.16	0.00	273.35	136.26	1.000	1.000	351.94	403.33	87.
0	-5.84	6.51	0.00	273.35	131.76	1.000	1.000	333.28	403.33	83.
0	-6.70	6.51	0.00	273.35	131.97	1.000	1.000	334.15	403.33	83.
0	-6.70	0.20	0.00	273.35	130.53	1.000	1.000	327.84	403.33	81.
0	-7.47	0.20	0.00	273.35	130.71	1.000	1.000	328.61	403.33	81.
0	-7.47	0.12	0.00	273.35	130.69	1.000	1.000	328.53	403.33	81.
0	-8.15	0.12	0.00	273.35	130.85	1.000	1.000	329.21	403.33	82.
0	-8.15	0.02	0.00	273.35	130.82	1.000	1.000	329.11	403.33	82.
0	-8.74	0.02	0.00	273.35	130.96	1.000	1.000	329.69	403.33	82.
0	-8.74	0.00	0.00	273.35	130.96	1.000	1.000	329.68	403.33	82.
0	-9.24	0.00	0.00	273.35	131.08	1.000	1.000	330.18	403.33	82.
0	-9.24	0.00	0.00	273.35	131.08	1.000	1.000	330.18	403.33	82.
0	-9.47	0.00	0.00	273.35	131.13	1.000	1.000	330.41	403.33	82.
0	-9.47	0.00	0.00	273.35	131.13	1.000	1.000	330.41	403.33	82.
0	-9.68	0.00	0.00	243.49	117.11	1.000	1.000	294.79	403.33	73.
0	-9.68	0.00	0.00	243.49	117.11	1.000	1.000	294.78	403.33	73.
0	-9.92	0.00	0.00	243.49	117.16	1.000	1.000	295.03	403.33	73.
0	-9.92	0.00	0.00	243.49	117.16	1.000	1.000	295.03	403.33	73.
0	-10.04	0.00	0.00	243.49	117.19	1.000	1.000	295.15	403.33	73.
10	-10.04	0.00	0.00	243.49	117.19	1.000	1.000	295.15	403.33	73.
10	-10.04	0.00	0.00	243.49	117.19	1.000	1.000	295.15	403.33	73.
20	-10.04	0.01	0.00	243.49	117.19	1.000	1.000	295.16	403.33	73.
20	-9.91	0.01	0.00	243.49	117.16	1.000	1.000	295.03	403.33	73.
30	-9.91	0.12	0.00	243.49	117.19	1.000	1.000	295.14	403.33	73.
30	-9.70	0.14	0.00	273.35	131.21	1.000	1.000	330.77	403.33	82.
40	-9.70	0.03	0.00	273.35	131.19	1.000	1.000	330.67	403.33	82.
40	-9.38	0.03	0.00	273.35	131.12	1.000	1.000	330.35	403.33	82.
50	-9.38	5.81	0.00	273.35	132.45	1.000	1.000	336.13	403.33	83.
50	-9.19	5.81	0.00	273.35	132.40	1.000	1.000	335.93	403.33	83.
60	-9.19	5.73	0.00	273.35	132.38	1.000	1.000	335.85	403.33	83.
60	-9.10	5.73	0.00	273.35	132.36	1.000	1.000	335.76	403.33	83.
61	-9.10	2.72	0.00	273.35	131.66	1.000	1.000	332.76	403.33	83.
61	-8.91	2.72	0.00	273.35	131.62	1.000	1.000	332.57	403.33	82.
62	-8.92	9.35	0.00	273.35	133.17	1.000	1.000	339.21	403.33	84.
6.	-8.74	9.35	0.00	273.35	133.13	1.000	1.000	339.02	403.33	84.
[illegible]	-8.73	2.90	0.00	273.35	131.62	1.000	1.000	332.57	403.33	82.
1	[illegible]	[illegible]	0.00	273.35	[illegible]	[illegible]	[illegible]	332.36	403.33	82.
1	[illegible]	[illegible]	[illegible]	[illegible]	131.2[illegible]	[illegible]	1.00[illegible]	[illegible]	403.33	82.
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	403.33	[illegible]
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	403.33	[illegible]
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	8.28	[illegible]	0.00	273.35	131.31	[illegible]	1.000	[illegible]	403.33	82.
2	8.19	2.05	0.00	273.35	[illegible]	1.000	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	3.61	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REPORT, Stresses on Elements
OPE) W+T1+P1

MENT ES	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	------------Stresses (N./sq.mm.)------------							----Stress (N./sq.mm.)----		
2[illegible]	-8.05	3.62	0.00	273.35	131.62	1.000	1.000	332.60	403.33	82.
21	-8.05	0.24	0.00	273.35	130.85	1.000	1.000	329.23	403.33	82.
21	-7.85	0.24	0.00	273.35	130.80	1.000	1.000	329.03	403.33	82.
22	-7.86	4.90	0.00	273.35	131.87	1.000	1.000	333.70	403.33	83.
22	-7.66	4.90	0.00	273.35	131.82	1.000	1.000	333.49	403.33	83.
23	-7.66	4.74	0.00	273.35	131.79	1.000	1.000	333.34	403.33	83.
23	-7.45	4.74	0.00	273.35	131.74	1.000	1.000	333.12	403.33	83.
24	-7.44	4.27	0.00	273.35	131.63	1.000	1.000	332.65	403.33	82.
24	-7.22	4.27	0.00	273.35	131.57	1.000	1.000	332.42	403.33	82.
30	-7.21	2.50	0.00	273.35	131.17	1.000	1.000	330.65	403.33	82.
30	-6.98	2.50	0.00	273.35	131.11	1.000	1.000	330.42	403.33	82.
40	-6.98	8.71	0.00	273.35	132.55	1.000	1.000	336.63	403.33	83.
40	-6.56	8.71	0.00	273.35	132.44	1.000	1.000	336.20	403.33	83.
50	-6.56	0.42	0.00	273.35	130.54	1.000	1.000	327.91	403.33	81.
50	-5.88	0.42	0.00	273.35	130.38	1.000	1.000	327.23	403.33	81.
60	-5.88	0.27	0.00	273.35	130.35	1.000	1.000	327.08	403.33	81.
60	-5.00	0.27	0.00	273.35	130.15	1.000	1.000	326.21	403.33	81.
70	-5.00	0.51	0.00	273.35	130.20	1.000	1.000	326.44	403.33	81.
70	-3.89	0.51	0.00	273.35	129.95	1.000	1.000	325.34	403.33	81.
80	-3.89	7.52	0.00	273.35	131.53	1.000	1.000	332.35	403.33	82.
80	-2.68	7.52	0.00	273.35	131.24	1.000	1.000	331.14	403.33	82.
90	-2.68	63.53	0.00	273.35	145.69	1.000	1.000	387.15	403.33	96.
90	-1.67	63.53	0.00	273.35	145.39	1.000	1.000	386.13	403.33	96.
00	-1.67	51.60	0.00	273.35	142.07	1.000	1.000	374.20	403.33	93.
00	-2.94	41.27	0.00	215.59	112.48	1.000	1.000	295.85	403.33	73.
01	-2.94	2.16	0.00	215.59	102.88	1.000	1.000	256.74	403.33	64.
01	-2.69	2.16	0.00	215.59	102.82	1.000	1.000	256.48	403.33	64.
02	-4.18	60.24	-0.04	215.59	118.18	1.000	1.000	316.05	403.33	78.
02	-3.97	60.24	0.04	215.59	118.11	1.000	1.000	315.84	403.33	78.
03	-4.12	66.73	-0.08	215.59	120.08	1.000	1.000	322.48	403.33	80.
03	-4.17	66.73	0.08	215.59	120.09	1.000	1.000	322.53	403.33	80.
04	-4.15	65.95	-0.03	215.59	119.85	1.000	1.000	321.73	403.33	80.
04	-4.46	65.95	0.03	215.59	119.95	1.000	1.000	322.04	403.33	80.
10	-3.20	13.68	0.22	215.59	105.55	1.000	1.000	268.52	403.33	67.
10	-3.52	13.68	-0.22	215.59	105.63	1.000	1.000	268.84	403.33	67.
20	-3.52	22.18	0.22	215.59	107.69	1.000	1.000	277.34	403.33	69.
20	-2.23	27.73	-0.28	273.35	135.96	1.000	1.000	350.90	403.33	87.
30	-2.23	66.92	0.28	273.35	146.53	1.000	1.000	390.08	403.33	97.
30	-2.57	66.92	-0.28	273.35	146.63	1.000	1.000	390.43	403.33	97.
40	-2.57	72.71	0.28	273.35	148.31	1.000	1.000	396.22	403.33	98.
340	-3.08	72.71	-0.28	273.35	148.47	1.000	1.000	396.73	403.33	98.
341	-3.08	37.54	0.28	273.35	138.70	1.000	1.000	361.56	403.33	90.
341	-3.71	37.54	-0.28	273.35	138.87	1.000	1.000	362.19	403.33	90.
342	-3.73	11.77	0.01	273.35	132.47	1.000	1.000	336.44	403.33	83.
342	-4.32	11.77	-0.01	273.35	132.62	1.000	1.000	337.03	403.33	84.
343	-4.33	5.46	-0.05	273.35	131.16	1.000	1.000	330.72	403.33	82.
343	-4.90	5.46	0.05	273.35	131.30	1.000	1.000	331.30	403.33	82.
344	-4.91	6.83	-0.03	273.35	131.61	1.000	1.000	332.67	403.33	82.
344	-5.47	6.83	0.03	273.35	131.75	1.000	1.000	333.24	403.33	83.
350	-5.46	2.12	-0.01	273.35	130.67	1.000	1.000	328.52	403.33	81.
350	-6.05	2.12	0.01	273.35	130.81	1.000	1.000	329.11	403.33	82.
360	-6.05	6.16	-0.01	273.35	131.73	1.000	1.000	333.14	403.33	83.
3[illegible]	-6.90	6.16	0.01	273.3[illegible]	131.33	1.000	1.000	333.99	403.33	83.
3	-6.90	0.38	0.01	273.3[illegible]	130.61	1.000	1.000	328.21	403.33	81.
3	[illegible].93	0.38	0.01	[illegible]	130.[illegible]	1.[illegible]	1.000	329.24	403.33	82.
3[illegible]	[illegible].93	1.67	-0.01	[illegible]	131.[illegible]	1.000	1.000	330.53	403.33	82.
[illegible]	[illegible]	1.67	0.01	[illegible]	[illegible]	[illegible]	[illegible]	331.43	[illegible]	[illegible]
[illegible]	[illegible]	[illegible].88	0.01	[illegible]	[illegible]	[illegible]	1.000	[illegible]	403.33	84.
[illegible]	9.48	[illegible]	0.01	[illegible]	[illegible]	[illegible]	1.000	338.30	403.33	84.
[illegible]	-9.48	2.94	-0.01	273.[illegible]	131.[illegible]	1.000	1.000	333.36	403.33	[illegible]
[illegible]	-9.95	2.94	0.01	273.[illegible]	131.42	[illegible]	1.000	333.5[illegible]	403.33	[illegible]
[illegible]	-9.96	4.27	0.01	[illegible]	[illegible]	1.000	1.000	335.1[illegible]	403.33	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REPORT, Stresses on Elements
[illegible] W+T1+P1

ELEMENT NODES	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	------------- Stresses (N./sq.mm.) -------------							----Stress(N./sq.mm.)----		
93	-10.82	5.85	0.01	273.35	132.81	1.000	1.000	337.61	403.33	84.
94	-10.82	6.08	-0.01	273.35	132.86	1.000	1.000	337.84	403.33	84.
94	-11.24	6.08	0.01	273.35	132.97	1.000	1.000	338.26	403.33	84.
00	-11.23	0.03	-0.01	273.35	131.55	1.000	1.000	332.19	403.33	82.
00	-11.66	0.03	0.01	273.35	131.65	1.000	1.000	332.62	403.33	82.
10	-11.66	6.96	-0.01	273.35	133.28	1.000	1.000	339.56	403.33	84.
10	-12.42	6.96	0.01	273.35	133.47	1.000	1.000	340.32	403.33	84.
20	-12.42	0.13	-0.01	273.35	131.86	1.000	1.000	333.49	403.33	83.
20	-13.44	0.13	0.01	273.35	132.10	1.000	1.000	334.50	403.33	83.
30	-13.44	1.78	-0.01	273.35	132.49	1.000	1.000	336.15	403.33	83.
30	-14.21	1.78	0.01	273.35	132.68	1.000	1.000	336.92	403.33	84.
40	-14.21	7.89	-0.01	273.35	134.13	1.000	1.000	343.03	403.33	85.
140	-14.67	7.89	0.01	273.35	134.25	1.000	1.000	343.49	403.33	85.
141	-14.67	2.62	-0.01	273.35	132.99	1.000	1.000	338.22	403.33	84.
141	-15.01	2.62	0.01	273.35	133.07	1.000	1.000	338.56	403.33	84.
142	-15.02	4.63	-0.01	273.35	133.55	1.000	1.000	340.59	403.33	84.
142	-15.33	4.63	0.01	273.35	133.63	1.000	1.000	340.90	403.33	85.
143	-15.33	5.99	-0.01	273.35	133.96	1.000	1.000	342.26	403.33	85.
143	-15.64	5.99	0.01	273.35	134.04	1.000	1.000	342.57	403.33	85.
144	-15.64	5.97	0.00	273.35	134.03	1.000	1.000	342.55	403.33	85.
144	-15.94	5.97	0.00	273.35	134.11	1.000	1.000	342.85	403.33	85.
150	-15.93	0.42	0.00	273.35	132.78	1.000	1.000	337.29	403.33	84.
150	-16.24	0.42	0.00	273.35	132.85	1.000	1.000	337.60	403.33	84.
160	-16.24	7.18	0.00	273.35	134.47	1.000	1.000	344.35	403.33	85.
160	-16.69	7.18	0.00	273.35	134.59	1.000	1.000	344.80	403.33	85.
170	-16.69	0.22	0.00	273.35	132.92	1.000	1.000	337.85	403.33	84.
170	-17.23	0.22	0.00	273.35	133.05	1.000	1.000	338.39	403.33	84.
180	-17.23	1.79	0.00	273.35	133.42	1.000	1.000	339.95	403.33	84.
180	-17.69	1.79	0.00	273.35	133.53	1.000	1.000	340.41	403.33	84.
490	-17.69	7.91	0.00	273.35	135.02	1.000	1.000	346.54	403.33	86.
490	-18.02	7.91	0.00	273.35	135.11	1.000	1.000	346.87	403.33	86.
491	-18.02	2.33	0.00	273.35	133.75	1.000	1.000	341.29	403.33	85.
491	-18.26	2.33	0.00	273.35	133.81	1.000	1.000	341.53	403.33	85.
492	-18.27	4.94	0.00	273.35	134.44	1.000	1.000	344.15	403.33	85.
492	-18.49	4.94	0.00	273.35	134.50	1.000	1.000	344.37	403.33	85.
493	-18.49	6.16	0.00	273.35	134.80	1.000	1.000	345.59	403.33	86.
493	-18.71	6.16	0.00	273.35	134.85	1.000	1.000	345.80	403.33	86.
494	-18.71	5.97	0.00	273.35	134.80	1.000	1.000	345.61	403.33	86.
494	-18.92	5.97	0.00	273.35	134.86	1.000	1.000	345.82	403.33	86.
500	-18.91	0.74	0.00	273.35	133.59	1.000	1.000	340.58	403.33	84.
500	-19.12	0.74	0.00	273.35	133.64	1.000	1.000	340.79	403.33	84.
510	-19.12	7.74	0.00	273.35	135.34	1.000	1.000	347.79	403.33	86.
510	-19.50	7.74	0.00	273.35	135.44	1.000	1.000	348.17	403.33	86.
520	-19.50	0.44	0.00	273.35	133.66	1.000	1.000	340.88	403.33	85.
2520	-20.00	0.44	0.00	273.35	133.79	1.000	1.000	341.37	403.33	85.
2530	-20.00	0.12	0.00	273.35	133.71	1.000	1.000	341.06	403.33	85.
2530	-20.31	0.12	0.00	273.35	133.79	1.000	1.000	341.37	403.33	85.
2540	-20.31	0.00	0.00	273.35	133.76	1.000	1.000	341.25	403.33	85.
2540	-20.54	0.00	0.00	273.35	133.82	1.000	1.000	341.48	403.33	85.
2550	-20.54	0.02	0.00	273.35	133.82	1.000	1.000	341.50	403.33	85.
2550	20.83	0.02	0.00	273.35	133.89	1.000	1.000	341.78	403.33	85.
[illegible]	20.83	0.43	0.00	273.35	133.39	1.000	1.000	342.19	403.33	85.
[illegible]	21.08	0.43	[illegible]	[illegible]	[illegible]	1.000	1.000	[illegible]	403.33	85.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	403.33	[illegible]
[illegible]	21.22	1.29	[illegible]	[illegible]	[illegible]	1.000	[illegible]	[illegible]	403.33	85.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	403.33	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	403.33	86.
[illegible]	[illegible]	8.42	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	403.33	[illegible]
[illegible]	21.40	8.42	[illegible]	[illegible]	[illegible]	1.000	[illegible]	[illegible]	403.33	[illegible]
[illegible]	21.40	1.79	[illegible]	[illegible]	134.76	1.000	[illegible]	344.13	403.33	[illegible]
[illegible]	21.48	1.79	[illegible]	[illegible]	134.46	1.000	1.000	[illegible]	[illegible]	[illegible]
[illegible]	21.49	[illegible]	[illegible]	[illegible]	[illegible]	1.000	[illegible]	[illegible]	[illegible]	[illegible]

PORT, Stresses on Elements
EE) W-T1+P1

T	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	Stresses(N./sq.mm.)							Stress(N./sq.mm.)		
	-21.56	7.68	0.00	273.35	135.96	1.000	1.000	350.17	403.33	87.
	-21.62	7.68	0.00	273.35	135.98	1.000	1.000	350.24	403.33	87.
	-21.62	6.95	0.00	273.35	135.79	1.000	1.000	349.50	403.33	87.
	-21.68	6.95	0.00	273.35	135.81	1.000	1.000	349.57	403.33	87.
	-21.67	1.00	0.00	273.35	134.34	1.000	1.000	343.60	403.33	85.
	-21.73	1.00	0.00	273.35	134.36	1.000	1.000	343.67	403.33	85.
	-21.73	9.21	0.00	273.35	136.39	1.000	1.000	351.88	403.33	87.
0	-21.87	9.21	0.00	273.35	136.42	1.000	1.000	352.01	403.33	87.
0	-21.87	0.01	0.00	273.35	134.15	1.000	1.000	342.81	403.33	85.
0	-22.04	0.01	0.00	273.35	134.19	1.000	1.000	342.98	403.33	85.
0	-22.04	1.97	0.00	273.35	134.67	1.000	1.000	344.94	403.33	86.
0	-22.14	1.97	0.00	273.35	134.69	1.000	1.000	345.04	403.33	86.
0	-22.14	7.72	0.00	273.35	136.12	1.000	1.000	350.79	403.33	87.
0	-22.19	7.72	0.00	273.35	136.13	1.000	1.000	350.85	403.33	87.
1	-22.19	1.77	0.00	273.35	134.66	1.000	1.000	344.90	403.33	86.
1	-22.23	1.77	0.00	273.35	134.67	1.000	1.000	344.94	403.33	86.
2	-22.24	5.39	0.00	273.35	135.56	1.000	1.000	348.56	403.33	86.
12	-22.27	5.39	0.00	273.35	135.57	1.000	1.000	348.59	403.33	86.
13	-22.27	6.25	0.00	273.35	135.78	1.000	1.000	349.45	403.33	87.
13	-22.30	6.25	0.00	273.35	135.79	1.000	1.000	349.48	403.33	87.
14	-22.30	5.68	0.00	273.35	135.65	1.000	1.000	348.91	403.33	87.
14	-22.32	5.68	0.00	273.35	135.66	1.000	1.000	348.94	403.33	87.
50	-22.31	1.39	0.00	273.35	134.60	1.000	1.000	344.64	403.33	85.
50	-22.33	1.39	0.00	273.35	134.60	1.000	1.000	344.66	403.33	85.
60	-22.33	7.98	0.00	273.35	136.23	1.000	1.000	351.25	403.33	87.
60	-22.36	7.98	0.00	273.35	136.24	1.000	1.000	351.27	403.33	87.
70	-22.36	0.34	0.00	273.35	134.35	1.000	1.000	343.64	403.33	85.
70	-22.37	0.34	0.00	273.35	134.35	1.000	1.000	343.64	403.33	85.
80	-22.37	0.19	0.00	273.35	134.32	1.000	1.000	343.49	403.33	85.
80	-22.34	0.19	0.00	273.35	134.31	1.000	1.000	343.46	403.33	85.
90	-22.34	0.17	0.00	273.35	134.31	1.000	1.000	343.45	403.33	85.
90	-22.27	0.17	0.00	273.35	134.29	1.000	1.000	343.38	403.33	85.
00	-22.27	3.49	0.00	273.35	135.10	1.000	1.000	346.70	403.33	86.
'00	-22.17	3.49	0.00	273.35	135.08	1.000	1.000	346.60	403.33	86.
'10	-22.17	26.40	0.00	273.35	140.99	1.000	1.000	369.51	403.33	92.
'10	-22.03	26.40	0.00	273.35	140.95	1.000	1.000	369.37	403.33	92.
'20	-22.03	23.01	0.00	273.35	140.05	1.000	1.000	365.98	403.33	91.
'20	-19.35	18.41	0.00	215.59	110.96	1.000	1.000	289.40	403.33	72.
'21	-19.35	37.51	0.00	215.59	116.20	1.000	1.000	308.50	403.33	76.
'21	-19.32	37.51	0.00	215.59	116.19	1.000	1.000	308.46	403.33	76.
'22	-21.35	122.25	0.00	215.59	144.17	1.000	1.000	395.23	403.33	98.
'22	-21.40	122.25	0.00	215.59	144.19	1.000	1.000	395.28	403.33	98.
'30	-19.41	39.30	0.00	215.59	116.73	1.000	1.000	310.35	403.33	77.
'30	-19.51	39.30	0.00	215.59	116.76	1.000	1.000	310.44	403.33	77.
'40	-19.51	16.88	0.00	215.59	110.60	1.000	1.000	288.02	403.33	71.
'740	-22.44	21.11	0.00	273.35	139.65	1.000	1.000	364.48	403.33	90.
'750	-22.44	23.98	0.00	273.35	140.42	1.000	1.000	367.36	403.33	91.
'750	-22.97	23.98	0.00	273.35	140.57	1.000	1.000	367.89	403.33	91.
'760	-22.97	3.10	0.00	273.35	135.19	1.000	1.000	347.01	403.33	86.
'760	-23.42	3.10	0.00	273.35	135.30	1.000	1.000	347.46	403.33	86.
2[illegible]	-23.42	8.39	0.00	273.35	136.62	1.000	1.000	352.74	403.33	87.
2[illegible]	-23.70	8.39	0.00	273.35	136.70	1.000	1.000	353.03	403.33	88.
2[illegible]	-23.70	1.03	0.00	273.35	134.86	1.000	1.000	345.67	403.33	86.
2[illegible]	-23.88	1.03	[illegible]	273.35	[illegible]	1.000	[illegible]	[illegible]	403.33	86.
2[illegible]	[illegible]	[illegible]	[illegible]	273.35	[illegible]	1.000	[illegible]	352.46	403.33	87.
2[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.000	[illegible]	[illegible]	[illegible]	[illegible]
2[illegible]	[illegible]	8.12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2[illegible]	-24.25	8.12	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2[illegible]	-24.23	[illegible]	[illegible]	273.35	[illegible]	1.000	[illegible]	[illegible]	[illegible]	86.
[illegible]	-24.41	[illegible]	[illegible]	273.35	[illegible]	1.000	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	-24.41	[illegible]	[illegible]	273.35	[illegible]	1.000	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REPORT, Stresses on Elements
(OPE) W+T1-P1

ENT S	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	----Stresses(N./sq.mm.)----							----Stress(N./sq.mm.)----		
0	-25.10	0.36	0.00	273.35	135.06	1.000	1.000	346.42	403.33	86.
0	-25.10	0.13	0.00	273.35	135.00	1.000	1.000	346.16	403.33	86.
0	-25.47	0.13	0.00	273.35	135.09	1.000	1.000	346.53	403.33	86.
0	-25.47	0.02	0.00	273.35	135.06	1.000	1.000	346.43	403.33	86.
0	-25.82	0.02	0.00	273.35	135.15	1.000	1.000	346.77	403.33	86.
0	-25.82	0.00	0.00	273.35	135.15	1.000	1.000	346.75	403.33	86.
0	-26.14	0.00	0.00	273.35	135.23	1.000	1.000	347.07	403.33	86.
0	-26.14	0.00	0.00	273.35	135.23	1.000	1.000	347.07	403.33	86.
0	-26.43	0.00	0.00	273.35	135.30	1.000	1.000	347.37	403.33	86.
0	-26.43	0.00	0.00	273.35	135.30	1.000	1.000	347.37	403.33	86.
0	-26.71	0.00	0.00	273.35	135.38	1.000	1.000	347.64	403.33	86.
0	-26.71	0.00	0.00	273.35	135.38	1.000	1.000	347.64	403.33	86.
0	-26.96	0.00	0.00	273.35	135.44	1.000	1.000	347.90	403.33	86.
0	-26.96	0.00	0.00	273.35	135.44	1.000	1.000	347.90	403.33	86.
0	-27.20	0.00	0.00	273.35	135.50	1.000	1.000	348.13	403.33	86.
0	-27.20	0.00	0.00	273.35	135.50	1.000	1.000	348.14	403.33	86.
0	-27.41	0.00	0.00	273.35	135.56	1.000	1.000	348.35	403.33	86.
0	-27.41	0.01	0.00	273.35	135.56	1.000	1.000	348.36	403.33	86.
0	-27.61	0.01	0.00	273.35	135.61	1.000	1.000	348.55	403.33	86.
0	-27.61	0.01	0.00	273.35	135.61	1.000	1.000	348.56	403.33	86.
0	-27.79	0.01	0.00	273.35	135.66	1.000	1.000	348.74	403.33	86.
0	-27.79	0.53	0.00	273.35	135.78	1.000	1.000	349.25	403.33	87.
0	-27.95	0.53	0.00	273.35	135.83	1.000	1.000	349.42	403.33	87.
0	-27.95	2.16	0.00	273.35	136.24	1.000	1.000	351.05	403.33	87.
0	-28.07	2.16	0.00	273.35	136.27	1.000	1.000	351.17	403.33	87.
0	-28.07	7.78	0.00	273.35	137.70	1.000	1.000	356.79	403.33	88.
0	-28.14	7.78	0.00	273.35	137.71	1.000	1.000	356.86	403.33	88.
1	-28.14	0.75	0.00	273.35	135.93	1.000	1.000	349.83	403.33	87.
1	-28.19	0.75	0.00	273.35	135.94	1.000	1.000	349.88	403.33	87.
2	-28.20	7.76	0.00	273.35	137.73	1.000	1.000	356.90	403.33	88.
2	-28.25	7.76	0.00	273.35	137.74	1.000	1.000	356.95	403.33	88.
3	-28.25	7.99	0.00	273.35	137.80	1.000	1.000	357.18	403.33	89.
3	-28.30	7.99	0.00	273.35	137.81	1.000	1.000	357.23	403.33	89.
0	-28.29	0.30	0.00	273.35	135.86	1.000	1.000	349.52	403.33	87.
0	-28.34	0.30	0.00	273.35	135.87	1.000	1.000	349.58	403.33	87.
50	-28.34	8.12	0.00	273.35	137.86	1.000	1.000	357.40	403.33	89.
50	-28.41	8.12	0.00	273.35	137.87	1.000	1.000	357.47	403.33	89.
50	-28.41	0.53	0.00	273.35	135.95	1.000	1.000	349.88	403.33	87.
50	-28.49	0.53	0.00	273.35	135.97	1.000	1.000	349.96	403.33	87.
70	-28.49	0.08	0.00	273.35	135.85	1.000	1.000	349.50	403.33	87.
70	-28.56	0.08	0.00	273.35	135.87	1.000	1.000	349.57	403.33	87.
30	-28.56	9.18	0.00	273.35	138.19	1.000	1.000	358.67	403.33	89.
30	-28.60	9.18	0.00	273.35	138.20	1.000	1.000	358.71	403.33	89.
91	-28.60	0.15	0.00	273.35	135.90	1.000	1.000	349.68	403.33	87.
81	-28.62	0.15	0.00	273.35	135.90	1.000	1.000	349.70	403.33	87.
82	-28.63	9.43	0.00	273.35	138.27	1.000	1.000	359.00	403.33	89.
82	-28.66	9.43	0.00	273.35	138.28	1.000	1.000	359.02	403.33	89.
83	-28.66	9.54	0.00	273.35	138.31	1.000	1.000	359.13	403.33	89.
83	-28.68	9.54	0.00	273.35	138.31	1.000	1.000	359.16	403.33	89.
90	-28.66	0.10	0.00	273.35	135.90	1.000	1.000	349.70	403.33	87.
90	-28.69	0.10	0.00	273.35	135.91	1.000	1.000	349.72	403.33	87.
00	-28.69	9.17	0.00	273.35	138.22	1.000	1.000	358.79	403.33	89.
0	[illegible]	9.17	0.00	273.35	138.23	1.000	1.000	358.83	403.33	89.
1	[illegible]	[illegible]	0.00	273.35	135.94	1.000	1.000	349.86	403.33	87.
1	[illegible]	[illegible]	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	403.33	87.
2	[illegible]	0.21	[illegible]	273.35	[illegible]	[illegible]	[illegible]	[illegible]	403.33	87.
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	403.33	87.
3	[illegible]	[illegible]	[illegible]	273.35	[illegible]	1.000	[illegible]	[illegible]	403.33	87.
3	[illegible]	0.03	0.00	273.35	135.93	[illegible]	1.000	[illegible]	403.33	87.
4	28.84	0.01	0.00	273.35	135.93	1.000	1.000	[illegible]	403.33	87.
4	28.86	[illegible]	0.00	273.35	135.93	1.000	1.000	[illegible]	[illegible]	[illegible]
[illegible]	-28.86	[illegible]	[illegible]	273.35	135.93	1.000	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PORT, Stresses on Elements
DE W-T1+P1

AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS	ALLOWABLE STRESS	%
Stresses(N./sq.mm.)							Stress(N./sq.mm.)		
-28.86	0.51	0.00	273.35	136.06	1.000	1.000	350.31	403.33	87.
-28.86	2.07	0.00	273.35	136.45	1.000	1.000	351.86	403.33	87.
-28.84	2.07	0.00	273.35	136.44	1.000	1.000	351.85	403.33	87.
-28.84	7.75	0.00	273.35	137.89	1.000	1.000	357.53	403.33	89.
-28.83	7.75	0.00	273.35	137.89	1.000	1.000	357.52	403.33	89.
-28.83	0.56	0.00	273.35	136.06	1.000	1.000	350.32	403.33	87.
-28.82	0.56	0.00	273.35	136.06	1.000	1.000	350.31	403.33	87.
-28.83	7.93	0.00	273.35	137.94	1.000	1.000	357.70	403.33	89.
-28.82	7.93	0.00	273.35	137.93	1.000	1.000	357.68	403.33	89.
-28.82	8.07	0.00	273.35	137.97	1.000	1.000	357.82	403.33	89.
-28.81	8.07	0.00	273.35	137.97	1.000	1.000	357.81	403.33	89.
-28.79	0.37	0.00	273.35	136.00	1.000	1.000	350.09	403.33	87.
-28.78	0.37	0.00	273.35	136.00	1.000	1.000	350.08	403.33	87.
-28.78	8.44	0.00	273.35	138.06	1.000	1.000	358.16	403.33	89.
-28.75	8.44	0.00	273.35	138.05	1.000	1.000	358.13	403.33	89.
-28.75	0.05	0.00	273.35	135.91	1.000	1.000	349.74	403.33	87.
-28.70	0.05	0.00	273.35	135.90	1.000	1.000	349.69	403.33	87.
-28.70	1.65	0.00	273.35	136.30	1.000	1.000	351.28	403.33	87.
-28.64	1.65	0.00	273.35	136.28	1.000	1.000	351.22	403.33	87.
-28.64	33.22	0.00	273.35	144.72	1.000	1.000	382.80	403.33	95.
-28.58	33.22	0.00	273.35	144.71	1.000	1.000	382.74	403.33	95.
-28.58	29.97	0.00	273.35	143.79	1.000	1.000	379.48	403.33	94.
-24.60	23.97	0.00	215.59	113.94	1.000	1.000	300.20	403.33	74.
-24.60	56.86	0.00	215.59	123.59	1.000	1.000	333.10	403.33	83.
-24.59	56.86	0.00	215.59	123.58	1.000	1.000	333.09	403.33	83.
-25.15	80.28	0.00	215.59	131.23	1.000	1.000	357.06	403.33	89.
-25.15	80.28	0.00	215.59	131.23	1.000	1.000	357.06	403.33	89.
-24.45	50.73	0.00	215.59	121.66	1.000	1.000	326.81	403.33	81.
-24.45	50.73	0.00	215.59	121.66	1.000	1.000	326.81	403.33	81.
-24.45	13.54	0.00	215.59	111.08	1.000	1.000	289.62	403.33	72.
-28.40	16.93	0.00	273.35	140.18	1.000	1.000	366.27	403.33	91.
-28.40	20.41	0.00	273.35	141.12	1.000	1.000	369.75	403.33	92.
-28.45	20.41	0.00	273.35	141.13	1.000	1.000	369.80	403.33	92.
-28.45	37.48	0.00	273.35	145.88	1.000	1.000	386.87	403.33	96.
-28.48	37.48	0.00	273.35	145.89	1.000	1.000	386.90	403.33	96.
-28.48	41.66	0.00	273.35	147.09	1.000	1.000	391.08	403.33	97.
-24.55	33.32	0.00	215.59	116.56	1.000	1.000	309.51	403.33	77.
-24.55	65.10	0.00	215.59	126.14	1.000	1.000	341.28	403.33	85.
-24.56	65.10	0.00	215.59	126.14	1.000	1.000	341.29	403.33	85.
-25.07	86.82	0.00	215.59	133.37	1.000	1.000	363.53	403.33	90.
-25.09	86.82	0.00	215.59	133.37	1.000	1.000	363.54	403.33	90.
-24.33	55.19	0.00	215.59	122.98	1.000	1.000	331.15	403.33	82.
-24.34	55.19	0.00	215.59	122.99	1.000	1.000	331.16	403.33	82.
-24.34	16.12	0.00	215.59	111.73	1.000	1.000	292.09	403.33	72.
-28.32	20.15	0.00	273.35	141.02	1.000	1.000	369.41	403.33	92.
-28.32	24.86	0.00	273.35	142.30	1.000	1.000	374.11	403.33	93.
-28.47	24.86	0.00	273.35	142.35	1.000	1.000	374.26	403.33	93.
-28.47	1.68	0.00	273.35	136.25	1.000	1.000	351.08	403.33	87.
-28.63	1.68	0.00	273.35	136.29	1.000	1.000	351.24	403.33	87.
-28.63	0.48	0.00	273.35	135.99	1.000	1.000	350.05	403.33	87.
-28.83	0.48	0.00	273.35	136.04	1.000	1.000	350.24	403.33	87.
-28.83	0.09	0.00	273.35	135.94	1.000	1.000	349.85	403.33	87.
-29.04	0.09	0.00	273.35	136.00	1.000	1.000	350.06	403.33	87.
29.04	0.00	[illegible]	273.35	135.98	1.000	1.000	349.9[illegible]	403.33	87.
29.24	[illegible]	[illegible]	273.35	136.[illegible]	1.000	1.000	350.1[illegible]	403.33	87.
29.24	0.00	[illegible]	273.35	136.[illegible]	1.000	1.000	[illegible]	403.33	87.
29.42	[illegible]	[illegible]	273.35	136.[illegible]	[illegible]	[illegible]	[illegible]	403.33	87.
29.42	[illegible]	[illegible]	273.35	136.[illegible]	1.000	1.000	[illegible]	403.33	87.
29.60	0.00	0.00	273.35	136.12	1.000	1.000	350.54	403.33	87.
29.60	0.00	0.00	273.35	136.12	1.000	1.000	350.54	403.33	87.
-29.77	0.00	0.00	273.35	136.16	1.000	1.000	[illegible]	403.33	87.
29.77	[illegible]	[illegible]	273.35	136.16	1.000	1.000	[illegible]	403.33	87.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CPE) W+T1+P1

NT	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS (N./sq.mm.)	ALLOWABLE STRESS (N./sq.mm.)	%
)	-29.92	0.00	0.00	273.35	136.21	1.000	1.000	350.86	403.33	87.
7	-30.07	0.00	0.00	273.35	136.24	1.000	1.000	351.01	403.33	87.
)	-30.07	0.00	0.00	273.35	136.24	1.000	1.000	351.01	403.33	87.
3	-30.21	0.00	0.00	273.35	136.28	1.000	1.000	351.15	403.33	87.
3	-30.21	0.00	0.00	273.35	136.28	1.000	1.000	351.15	403.33	87.
2	-30.34	0.00	0.00	273.35	136.31	1.000	1.000	351.27	403.33	87.
2	-30.34	0.00	0.00	273.35	136.31	1.000	1.000	351.27	403.33	87.
0	-30.46	0.00	0.00	273.35	136.35	1.000	1.000	351.40	403.33	87.
0	-30.46	0.00	0.00	273.35	136.35	1.000	1.000	351.40	403.33	87.
0	-30.58	0.00	0.00	273.35	136.38	1.000	1.000	351.51	403.33	87.
0	-30.58	0.00	0.00	273.35	136.38	1.000	1.000	351.51	403.33	87.
0	-30.69	0.00	0.00	273.35	136.40	1.000	1.000	351.62	403.33	87.
0	-30.69	0.00	0.00	273.35	136.40	1.000	1.000	351.62	403.33	87.
0	-30.79	0.00	0.00	273.35	136.43	1.000	1.000	351.72	403.33	87.
0	-30.79	0.00	0.00	273.35	136.43	1.000	1.000	351.72	403.33	87.
0	-30.89	0.00	0.00	273.35	136.46	1.000	1.000	351.82	403.33	87.
0	-30.89	0.00	0.00	273.35	136.46	1.000	1.000	351.82	403.33	87.
0	-30.98	0.00	0.00	273.35	136.48	1.000	1.000	351.91	403.33	87.
0	-30.98	0.00	0.00	273.35	136.48	1.000	1.000	351.91	403.33	87.
0	-31.06	0.00	0.00	273.35	136.50	1.000	1.000	352.00	403.33	87.
0	-31.06	0.00	0.00	273.35	136.50	1.000	1.000	352.00	403.33	87.
0	-31.14	0.00	0.00	273.35	136.52	1.000	1.000	352.08	403.33	87.
0	-31.14	0.00	0.00	273.35	136.52	1.000	1.000	352.08	403.33	87.
0	-31.22	0.00	0.00	273.35	136.54	1.000	1.000	352.15	403.33	87.
0	-31.22	0.00	0.00	273.35	136.54	1.000	1.000	352.15	403.33	87.
0	-31.29	0.00	0.00	273.35	136.56	1.000	1.000	352.22	403.33	87.
0	-31.29	0.00	0.00	273.35	136.56	1.000	1.000	352.22	403.33	87.
0	-31.36	0.00	0.00	273.35	136.58	1.000	1.000	352.29	403.33	87.
0	-31.36	0.00	0.00	273.35	136.58	1.000	1.000	352.29	403.33	87.
0	-31.42	0.00	0.00	273.35	136.60	1.000	1.000	352.35	403.33	87.
0	-31.42	0.00	0.00	273.35	136.60	1.000	1.000	352.35	403.33	87.
0	-31.48	0.00	0.00	273.35	136.61	1.000	1.000	352.41	403.33	87.
0	-31.48	0.00	0.00	273.35	136.61	1.000	1.000	352.41	403.33	87.
0	-31.53	0.00	0.00	273.35	136.63	1.000	1.000	352.47	403.33	87.
0	-31.53	0.00	0.00	273.35	136.63	1.000	1.000	352.47	403.33	87.
0	-31.59	0.00	0.00	273.35	136.64	1.000	1.000	352.52	403.33	87.
'0	-31.59	0.00	0.00	273.35	136.64	1.000	1.000	352.52	403.33	87.
'0	-31.64	0.00	0.00	273.35	136.65	1.000	1.000	352.57	403.33	87.
'0	-31.64	0.00	0.00	273.35	136.65	1.000	1.000	352.57	403.33	87.
'0	-31.68	0.00	0.00	273.35	136.67	1.000	1.000	352.62	403.33	87.
0	-31.68	0.00	0.00	273.35	136.67	1.000	1.000	352.62	403.33	87.
0	-31.73	0.00	0.00	273.35	136.68	1.000	1.000	352.66	403.33	87.
20	-31.73	0.00	0.00	273.35	136.68	1.000	1.000	352.66	403.33	87.
20	-31.77	0.00	0.00	273.35	136.69	1.000	1.000	352.70	403.33	87.
30	-31.77	0.00	0.00	273.35	136.69	1.000	1.000	352.70	403.33	87.
30	-31.81	0.00	0.00	273.35	136.70	1.000	1.000	352.74	403.33	87.
40	-31.81	0.00	0.00	273.35	136.70	1.000	1.000	352.74	403.33	87.
40	-31.84	0.00	0.00	273.35	136.71	1.000	1.000	352.78	403.33	87.
50	-31.84	0.00	0.00	273.35	136.71	1.000	1.000	352.78	403.33	87.
50	-31.88	0.00	0.00	273.35	136.72	1.000	1.000	352.81	403.33	87.
50	-31.88	0.00	0.00	273.35	136.72	1.000	1.000	352.81	403.33	87.
60	-31.91	0.00	0.00	273.35	136.73	1.000	1.000	352.84	403.33	87.
70	-31.91	0.00	0.00	273.35	136.73	1.000	1.000	352.84	403.33	87.
7	-31.94	0.00	0.00	273.35	136.73	1.000	1.000	352.88	403.33	87.
8	-31.94	[illegible]	[illegible]	273.35	136.73	[illegible]	[illegible]	352.88	403.33	87.
8	31.9[illegible]	[illegible]	[illegible]	273.35	136.74	[illegible]	[illegible]	352.9[illegible]	403.33	87.
9	31.9[illegible]	[illegible]	[illegible]	273.35	136.74	[illegible]	[illegible]	352.9[illegible]	403.33	87.
9	32.0[illegible]	[illegible]	[illegible]	273.35	136.7[illegible]	[illegible]	[illegible]	352.9[illegible]	403.33	88.
0	32.0[illegible]	[illegible]	[illegible]	273.35	136.7[illegible]	[illegible]	[illegible]	352.9[illegible]	403.33	88.
0	32.02	0.00	0.00	273.35	136.75	1.000	1.000	352.96	403.33	88.
1	32.02	0.00	0.00	273.35	136.75	1.000	1.000	352.96	403.33	88.
1	32.04	0.00	0.00	273.35	136.76	1.000	1.000	352.9[illegible]	403.33	8[illegible]
2	32.04	0.00	[illegible]	273.35	136.76	[illegible]	1.000	352.9[illegible]	403.33	8[illegible]

EPORT, Stresses on Elements
(OPE) W+T1+P1

ENT S	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	STRESS INTENSIFICATION OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	Stresses(N./sq.mm.)							Stress(N./sq.mm.)		
0	-32.07	0.00	0.00	273.35	136.77	1.000	1.000	353.00	403.33	88.
0	-32.07	0.00	0.00	273.35	136.77	1.000	1.000	353.00	403.33	88.
0	-32.09	0.00	0.00	273.35	136.77	1.000	1.000	353.02	403.33	88.
0	-32.09	0.00	0.00	273.35	136.77	1.000	1.000	353.02	403.33	88.
0	-32.11	0.00	0.00	273.35	136.78	1.000	1.000	353.04	403.33	88.
0	-32.11	0.00	0.00	273.35	136.78	1.000	1.000	353.04	403.33	88.
0	-32.13	0.00	0.00	273.35	136.78	1.000	1.000	353.06	403.33	88.
0	-32.13	0.00	0.00	273.35	136.78	1.000	1.000	353.06	403.33	88.
0	-32.14	0.00	0.00	273.35	136.79	1.000	1.000	353.08	403.33	88.
0	-32.14	0.00	0.00	273.35	136.79	1.000	1.000	353.08	403.33	88.
0	-32.16	0.00	0.00	273.35	136.79	1.000	1.000	353.09	403.33	88.
0	-32.16	0.00	0.00	273.35	136.79	1.000	1.000	353.09	403.33	88.
0	-32.18	0.00	0.00	273.35	136.79	1.000	1.000	353.11	403.33	88.
0	-32.18	0.00	0.00	273.35	136.79	1.000	1.000	353.11	403.33	88.
0	-32.19	0.00	0.00	273.35	136.80	1.000	1.000	353.13	403.33	88.
0	-32.19	0.00	0.00	273.35	136.80	1.000	1.000	353.13	403.33	88.
0	-32.20	0.00	0.00	273.35	136.80	1.000	1.000	353.14	403.33	88.
0	-32.20	0.00	0.00	273.35	136.80	1.000	1.000	353.14	403.33	88.
0	-32.22	0.00	0.00	273.35	136.81	1.000	1.000	353.15	403.33	88.
0	-32.22	0.00	0.00	273.35	136.81	1.000	1.000	353.15	403.33	88.
0	-32.23	0.00	0.00	273.35	136.81	1.000	1.000	353.16	403.33	88.
0	-32.23	0.00	0.00	273.35	136.81	1.000	1.000	353.16	403.33	88.
0	-32.24	0.00	0.00	273.35	136.81	1.000	1.000	353.17	403.33	88.
0	-32.24	0.00	0.00	273.35	136.81	1.000	1.000	353.17	403.33	88.
0	-32.25	0.00	0.00	273.35	136.81	1.000	1.000	353.18	403.33	88.
0	-32.25	0.00	0.00	273.35	136.81	1.000	1.000	353.18	403.33	88.
0	-32.26	0.00	0.00	273.35	136.82	1.000	1.000	353.19	403.33	88.
0	-32.26	0.00	0.00	273.35	136.82	1.000	1.000	353.19	403.33	88.
0	-32.27	0.00	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
0	-32.27	0.00	0.00	273.35	136.82	1.000	1.000	353.20	403.33	88.
0	-32.28	0.00	0.00	273.35	136.82	1.000	1.000	353.21	403.33	88.
0	-32.28	0.00	0.00	273.35	136.82	1.000	1.000	353.21	403.33	88.
0	-32.29	0.00	0.00	273.35	136.82	1.000	1.000	353.22	403.33	88.
0	-32.29	0.00	0.00	273.35	136.82	1.000	1.000	353.22	403.33	88.
0	-32.29	0.00	0.00	273.35	136.83	1.000	1.000	353.23	403.33	88.
0	-32.29	0.00	0.00	273.35	136.83	1.000	1.000	353.23	403.33	88.
0	-32.30	0.00	0.00	273.35	136.83	1.000	1.000	353.23	403.33	88.
0	-32.30	0.00	0.00	273.35	136.83	1.000	1.000	353.23	403.33	88.
0	-32.31	0.00	0.00	273.35	136.83	1.000	1.000	353.24	403.33	88.
0	-32.31	0.00	0.00	273.35	136.83	1.000	1.000	353.24	403.33	88.
20	-32.31	0.00	0.00	273.35	136.83	1.000	1.000	353.25	403.33	88.
30	-32.31	0.00	0.00	273.35	136.83	1.000	1.000	353.25	403.33	88.
30	-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.25	403.33	88.
40	-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.25	403.33	88.
40	-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
50	-32.32	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
50	-32.33	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
60	-32.33	0.00	0.00	273.35	136.83	1.000	1.000	353.26	403.33	88.
60	-32.33	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
70	-32.33	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
70	-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
80	-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.27	403.33	88.
80	-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
90	-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
90	-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
00	-32.34	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
0	-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
1	-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
1	-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
2	-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.28	403.33	88.
2	-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.29	403.33	88.
30	-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.29	403.33	88.
[illegible]	-32.35	0.00	0.00	273.35	136.84	1.000	1.000	353.29	403.33	88.
[illegible]	-32.35	0.00	[illegible]	273.35	136.84	[illegible]	1.000	353.29	403.33	88.

.EPORT, Stresses on Elements
OPE) W+T1-P1

:NT	AXIAL STRESS	BENDING STRESS	TORSION STRESS	HOOP STRESS	Von Mises STRESS	STRESS INTENSIFICATION IN-PLANE	OUT-PLANE	STRESS	ALLOWABLE STRESS	%
	Stresses(N./sq.mm.)							Stress(N./sq.mm.)		
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.29	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.29	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.29	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.29	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.29	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
)	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
)	-32.36	0.01	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
0	-32.36	0.01	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
9	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
9	-32.36	0.00	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.
0	-32.36	0.01	0.00	273.35	136.84	1.000	1.000	353.30	403.33	88.

6.2. Output Stress Graph

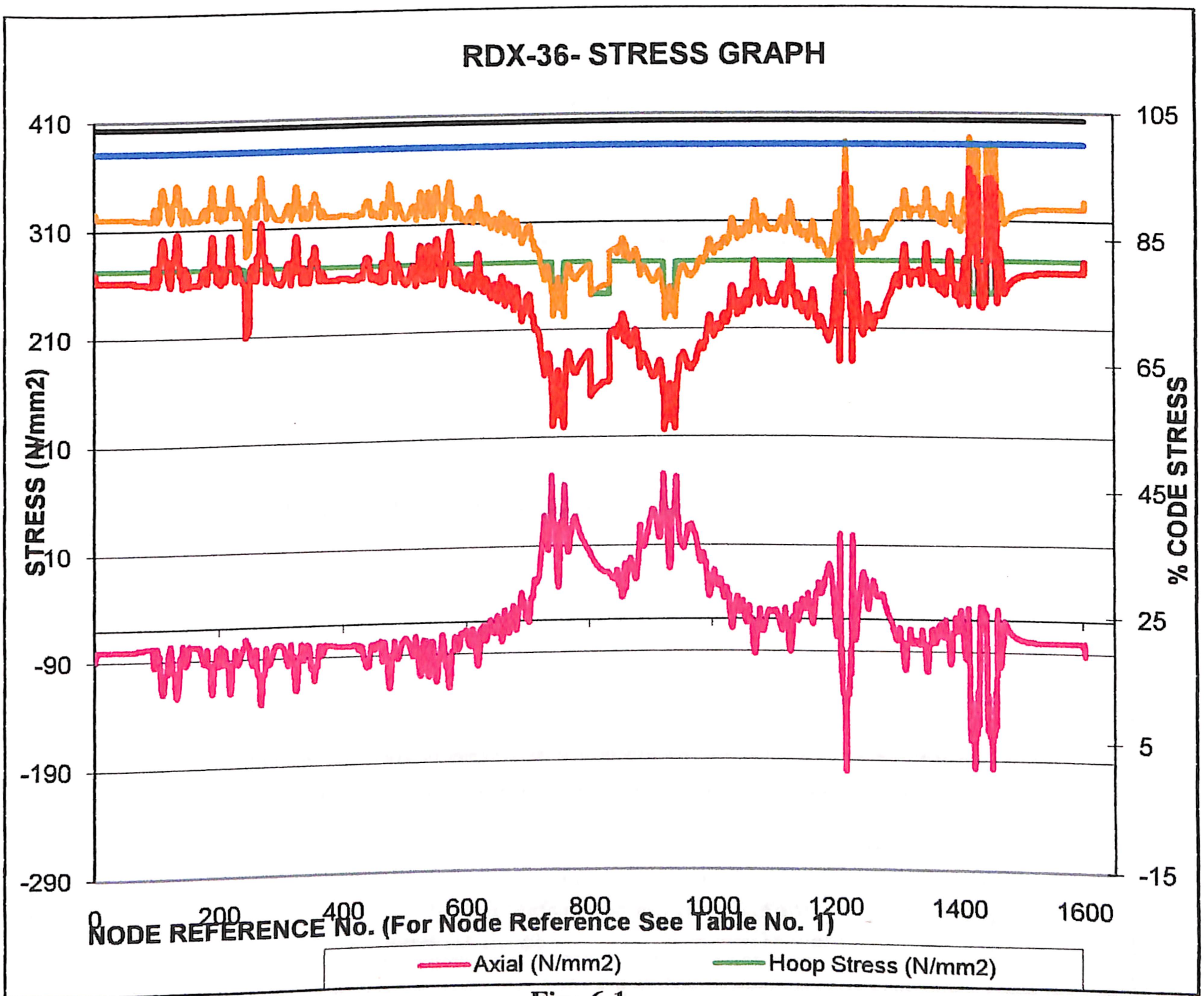


Fig: 6.1

6.3. Output Displacement Graph

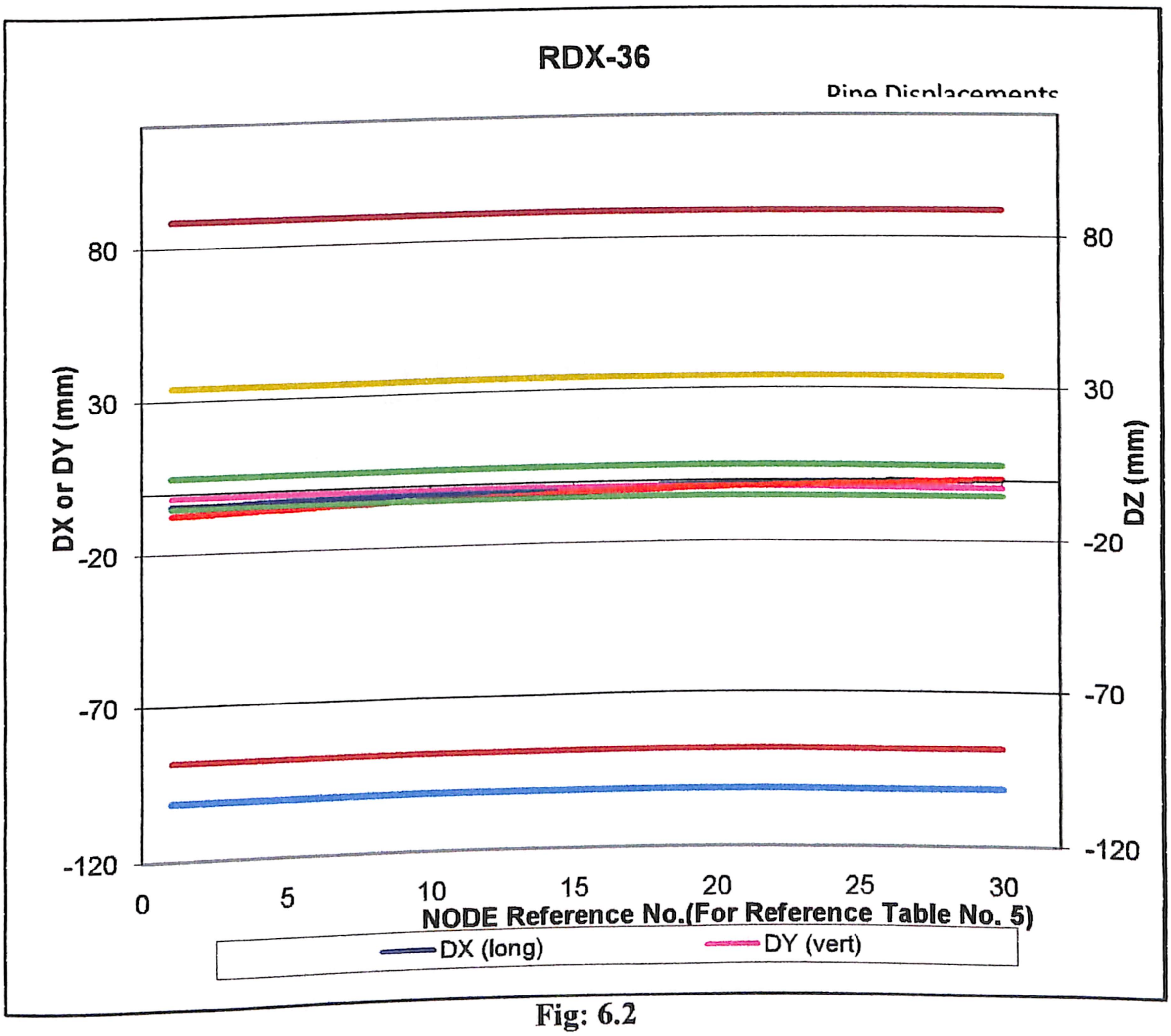


Fig: 6.2

CHAPTER – VII

CONCLUSION

7.1. Conclusion

The pipeline segment considered for analysis under the scope of this dissertation passes under the loading conditions considered for the State Highway as well as for the Nala Crossing. As per the detailed analysis carried out, the line is safe from stress failure under the conditions indicated elsewhere in this report. The maximum stress anywhere on the pipeline was found / calculated to be 396.7 N/mm^2 (just before the 5° vertical downward bend) while the allowable stress is 403 N/mm^2. Stress analysis was carried out by using CAESAR II V4.5 software.

CHAPTER – VIII

REFERENCES

8.1 References

- **ASME B31.4** Pipeline Transportation Systems For Liquid Hydrocarbons and Other Liqulds.
- **API 5L** Specification for Line Pipe.
- **API RP 1102** Steel Pipelines Crossing Railroads and Highways.
- **API RP 1111** Design, Construction, Operation, and Maintenance of Offshore Hydrocarbon Pipelines (Limit State Design).
- Pipeline Rules of Thumb Handbook by E.W. Mc Ellister.