TUGAS AKHIR - MO184804

ANALISA TEGANGAN PIPA DAN *CONCRETE CRUSHING* PADA INSTALASI *OFFSHORE PIPELINE* MENGGUNAKAN METODE *S-LAY*. STUDI KASUS: PT. PHE WMO

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FINAL PROJECT - MO184804

PIPE STRESS AND CONCRETE CRUSHING ANALYSIS IN OFFSHORE PIPELINE INSTALLATION USING THE S-LAY METHOD. CASE STUDY : PT. PHE WMO

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LEMBAR PENGESAHAN

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TUGAS AKHIR

Diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Teknik (S.T) pada Program Studi S-1 Departemen Teknik Kelautan Fakultas Teknologi Kelautan Institut Sepuluh Nopember Surabaya

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Surabaya, Agustus 2020

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ABSTRAK

Mobilisasi eksplorasi minyak dan gas bumi dari perairan lepas pantai (offshore) menuju daratan (onshore) menggunakan *pipeline* membutuhkan perhatian khusus terutama pada saat instalasi. Pemilihan metode pemasangan pipa bawah laut yang digunakan tergantung pada kondisi lingkungan dan perilaku sistem instalasi pipa yang mendapatkan berbagai beban selama instalasi dan dapat berakibat pada kegagalan. Pada penelitian ini, akan dianalisa tegangan secara statis dan dinamis yang terjadi pada proses instalasi 6.625" o*ffshore pipeline* milik PT. PHE WMO menggunakan metode S-lay, terutama pada daerah kritis *overbend* dan *sagbend* dengan variasi *tension* pada *tensioner* dan *radius of curvature*. Dalam pengerjaan tugas akhir ini analisis dilakukan dengan *software* MOSES dan OFFPIPE untuk membantu pemodelan dan perhitungan tegangan. Analisa respons laybarge dilakukan dengan bantuan MOSES, respons tersebut kemudian dijadikan sebagai input analisa dinamis pada OFFPIPE. Hasil dari analisa dinamis menunjukan bahwa besar tegangan maksimum yang terjadi pada daerah kritis *overbend* adalah sebesar 175.38 Mpa atau setara dengan 48.72% dari SMYS pipa berdiameter 6 inch API 5L grade X52. Sedangkan pada daerah *sagbend* sebesar 122.48 Mpa atau setara dengan 34.02% dari SMYS, dimana tegangan maksimum yang terjadi baik pada daerah *overbend* maupun *sagbend* sama sama terjadi pada arah pembebanan 90°. Hasil analisa dinamis juga menunjukkan bahwa tidak terjadi *crushing* pada saat proses instalasi, dimana nilai maksimum regangan total (*total strain*) pada lapisan *concrete* yang terjadi di bagian *overbend* sebesar 0.098 % dan *sagbend* sebesar 0.0683% . Nilai tersebut berada dibawah batas yang ditetapkan oleh DNV OS F-101, yaitu tegangan maksimum saat instalasi adalah 87% SMYS dan *concrete crushing* terjadi apabila regangan pada lapisan *concrete* sebesar 0.2 %.

Kata kunci : Instalasi Pipa, *overbend, sagbend, stress, concrete crushing*

PIPE STRESS AND CONCRETE CRUSHING ANALYSIS IN OFFSHORE PIPELINE INSTALLATION USING THE S-LAY METHOD. CASE STUDY : PT. PHE WMO

ABSTRACT

Mobilization of oil and gas exploration from offshore to onshore using pipelines requires special attention especially during installation. The choice of underwater pipe installation method used depends on environmental conditions and the behavior of the pipe installation system which gets various loads during installation and can result in failure. In this study, static and dynamic stresses will be analyzed which occur in the 6,625 "offshore pipeline owned by PT. PHE WMO uses the S-lay method, especially in overbend and sagbend critical areas with variations in tension in the tensioner and radius of curvature. In doing this final project, the analysis is carried out with MOSES and OFFPIPE software to help with barge modeling and stress calculation. Laybarge response analysis is done with the help of MOSES, the response is then used as a dynamic analysis input on OFFPIPE. The results of dynamic analysis show that the maximum stress that occurs in overbend critical areas is 175.38 MPa or equivalent to 48.72% of the SMYS pipe 6 inch diameter API 5L grade X52. Whereas in the sagbend area of 122.48 Mpa or equivalent to 34.02% of the SMYS, where the maximum stress that occurs in both the overbend and sagbend regions is the same as in the direction of heading 90 °. The results of dynamic analysis also show that there is no crushing during the installation process, where the maximum total strain value in the concrete layer that occurs in the overbend is 0.098% and sagbend is 0.0683%. This value is below the limit set by DNV OS F-101, ie the maximum stress during installation is 87% SMYS and concrete crushing occurs when the strain on the concrete layer is 0.2%.

Keyword : *Pipeline installation, overbend, sagbend, stress, concrete crushing*

KATA PENGANTAR

Puji syukur kehadirat Tuhan Yang Maha Esa atas segala rahmat-Nya sehingga tugas akhir ini dapat tersusun hingga selesai. Tidak lupa penulis juga mengucapkan banyak terimakasih atas bantuan dari pihak yang telah berkontribusi dengan memberikan sumbangan dalam sebuah materi maupun gagasan pikirannya.

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Surabaya, Agustus 2020

Penulis

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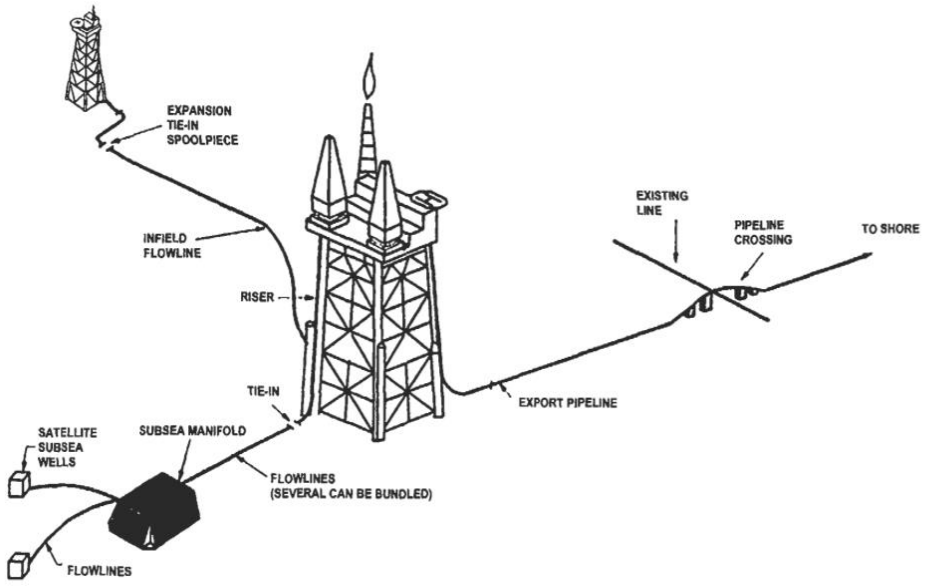
BAB I
PENDAHULUAN

1.1 Latar Belakang

Permintaan minyak dan gas semakin tinggi dari waktu ke waktu. Sehingga mendorong industri minyak dan gas untuk berusaha mengembangkan lokasi kegiatan eksplorasi. Untuk itu dibutuhkan suatu inovasi baik dari segi desain struktur, prosedur, peralatan, dan sebagainya agar tetap ekonomis tanpa mengurangi filosofi efektivitas dan efisiensi. Salah satu kegiatan yang penting dalam industri perminyakan adalah sistem transportasi, yang dalam hal ini adalah transportasi fluida dari reservoir sampai tempat pemrosesan hidrokarbon, maupun penyaluran produk jadi dari suatu tempat ke tempat lainnya. Menurut Soegiono (2007), dibandingkan dengan transportasi secara curah, pengangkutan dengan pipeline relatif lebih aman. Dengan desain *life time* yang panjang, memiliki sebuah *pipeline* merupakan sebuah investasi yang menguntungkan dibandingkan menyewa *shuttle* tanker untuk pendistribusian minyak dan gas bumi, bila tetap mengacu pada standar dan hasil kajian yang berlaku (Marpaung, 2011).



Gambar 1. 1 Sistem Perpipaan Bawah Laut (Guo, 2014)

Konstruksi *pipeline* yang ditunjukkan pada **Gambar 1.1** diawali oleh proses perancangan, fabrikasi, dan instalasi. Menurut Nugroho (2014), instalasi

adalah proses pemasangan pipeline di laut dan merupakan salah satu fase yang sangat penting dalam urutan pekerjaan konstruksi *pipeline*. Instalasi pipa bawah laut umumnya menggunakan metode S-Lay, J-Lay, *Reeling*, dan *Towing Method*. Pemilihan metode yang digunakan tergantung pada kondisi lingkungan dan perilaku sistem instalasi pipa yang mendapatkan berbagai beban selama instalasi. Beban tersebut dapat berasal dari gerakan *laybarge*, tekanan hidrostatis, *tension*, serta *bending* (Sarifudin, 2007).

Nugroho (2014) mengungkapkan bahwa analisa yang dilakukan pada saat proses instalasi ditujukan untuk mengestimasikan minimum *bending stress* yang terjadi pada daerah kritis agar sesuai dengan kriteria desain guna menghindari kegagalan pada proses instalasi, yang dalam hal ini terjadinya *buckling* pada beberapa segmen pipa. Hal yang harus diperhatikan adalah besarnya *stress* yang terjadi pada saat instalasi, mulai dari saat pipa masih di atas *barge*, *stinger*, dan pada saat menyentuh *seabed*. Pada saat diinstal, pipa akan mendapatkan *axial tension* yang diberikan oleh *tensioner* yang berfungsi untuk menahan pipa tidak meluncur dan tertarik ke dasar laut, dan kondisi peletakan pipa dari *laybarge* ke dasar laut membentuk lengkungan menyerupai huruf S sehingga terjadi *bending tension* dan *bending compression* pada daerah *sagbend*. *Overbend* adalah area dimulai dari pipa masih diatas *barge* sampai *stinger*, sedangkan *sagbend* adalah area mulai dari *roller* terakhir pada *stinger* sampai *seabed* (Annisa, 2015).

Instalasi *pipeline* harus memperhatikan beberapa parameter yang sangat penting demi keberhasilan proses instalasi. Konfigurasi radius kurvatur pada *stinger*, besarnya *tension* pada *tensioner* serta konfigurasi *roller* yang tepat perlu dicapai sehingga besarnya tegangan dan regangan yang terjadi pada *pipeline* tidak melebihi nilai yang diperbolehkan standar (Bai dan Bai. 2014). Dan dari aspek properti material, telah diketahui bahwa sebagian besar material memiliki kecenderungan mengalami retak atau patah (*fracture*) pada regangan plastis yang sangat tinggi (*very high fracture strain*) (Nourpanah dan Taheri. 2009).

Melihat cukup banyaknya hal yang dapat dianalisis ketika proses instalasi pipa khususnya dengan metode S-Lay, penulis penelitian ini ingin melakukan

Analisa Tegangan dan *Concrete Crushing* pada Instalasi 6.625" *Offshore Pipeline* menggunakan metode S-Lay, Studi Kasus: PT. PHE WMO. Penelitian ini bertujuan untuk menghitung tegangan *pipeline* dengan analisa statis dan dinamis untuk menentukan distribusi tegangan terbesar untuk pipa 6.625" pada saat instalasi serta untuk mengetahui apakah terjadi *concrete crushing* atau tidak.

1.2 Rumusan Masalah

Adapun permasalahan yang akan dihadapi dalam Tugas Akhir ini adalah :

1. Berapa nilai tegangan yang terjadi pada pipa saat proses instalasi dengan kondisi statis dengan variasi *radius of curvature* dan *tension tensioner*?
2. Berapa nilai tegangan yang terjadi pada pipa saat proses instalasi dengan kondisi dinamis dengan variasi *radius of curvature* dan *tension tensioner*?
3. Apakah *concrete crushing* terjadi pada *pipeline* saat instalasi?

1.3 Tujuan

Dari perumusan masalah diatas, dapat diambil tujuan yang ingin dicapai dalam tugas akhir ini adalah :

1. Menghitung nilai tegangan yang terjadi pada pipa saat proses instalasi dengan kondisi statis dengan variasi *radius of curvature* dan *tension tensioner*
2. Menghitung nilai tegangan yang terjadi pada pipa saat proses instalasi dengan kondisi dinamis dengan variasi *radius of curvature* dan *tension tensioner*
3. Menganalisis apakah *concrete crushing* terjadi pada *pipeline* selama proses instalasi

1.4 Manfaat

Setelah hasil dari analisa dari penelitian didapatkan, diharapkan dapat menjadi suatu referensi bagi pembaca dalam melakukan analisis instalasi *pipeline*. Harapan lain yaitu akan pemahaman mengenai instalasi pipa bawah

laut dengan metode S-Lay, dengan variasi *radius of curvature* dan variasi *tension tensioner* selama proses instalasi, serta analisa *concrete crushing* pada *pipeline* selama instalasi

1.5 Batasan Masalah

Batasan masalah dalam penelitian ini adalah sebagai berikut :

1. Studi kasus yang dipakai adalah data proyek instalasi pipa bawah laut milik PT. PHE WMO dari PHE-24 platform menuju KE-5 CPP
2. Metode instalasi yang digunakan adalah metode S-Lay
3. Arah datang gelombang diasumsikan pada 0°, 45°, 90°, 135°, dan 180° terhadap *barge*
4. Tidak memodelkan bangunan atas *barge*
5. Analisa sistem tali tambat menggunakan 8 titik tambat
6. Beban lingkungan yang diperhitungkan adalah beban gelombang, beban angin, dan beban arus

1.6 Sistematika Penulisan

Sistematika penulisan yang digunakan dalam penyusunan tugas akhir ini adalah sebagai berikut :

1.6.1 BAB I Pendahuluan

Menjelaskan tentang latar belakang disusunnya tugas akhir, perumusan masalah, tujuan, batasan masalah, manfaat, serta sistematika penulisan yang digunakan dalam tugas akhir ini.

1.6.2 BAB II Tinjauan Pustaka dan Landasan Teori

Pada bab ini penulis akan membahas tinjauan pustaka dan dasar teori yang menjadi sumber referensi penulis dalam menyelesaikan tugas akhir ini. Secara rinci bab ini berisikan tinjauan pustaka yang menjadi acuan dari penelitian tugas akhir, dasar-dasar teori, rumus rumus dan *code/rules* yang digunakan dalam penelitian tugas akhir ini dicantumkan dalam bab ini.

1.6.3 BAB III Metodologi Penelitian

Menjelaskan berisi tentang alur pengerjaan tugas akhir ini dengan tujuan untuk memecahkan masalah yang diangkat dalam bentuk diagram alir atau *flow chart* yang disusun secara sistematik yang dilengkapi pula dengan data data penelitian serta penjelasan detail untuk setiap langkah pengerjaanya.

1.6.4 BAB IV Hasil dan Pembahasan

Berupa merupakan pembahsan dari hasil analisa-analisa yang telah dilakukan pada penelitian, meliputi analisa hasil, dan pembahasan hasil analisa.

1.6.5 BAB V Kesimpulan dan Saran

Kesimpulan penting yang diperoleh dari hasil analisa dan pembahasan yang telah dilakukan. Pada bab ini juga berisikan saran sebagai tindak lanjut penelitian untuk permasalahan terkait.

BAB II
TINJAUAN PUSTAKA DAN DASAR TEORI

2.1 Tinjauan Pustaka

Perkembangan ekplorasi dan eksploitasi minyak dan gas di lepas pantai pertama kali ditemukan pada tahun 1940 di teluk meksiko. Pada saat itu, perkembangan dunia migas mengalami percepatan ditunjukan dengan adanya pengeboran *offsshore* dan juga mendapatkan perhatian khusus terhadap penanggulangan bencana yang mungkin terjadi dalam eksplorasi. Selanjutnya pada tahun 1954, dipasang offshore *pipeline* di dasar laut untuk pertama kalinya. Dalam pelaksanaannya, pipa bawah laut menjadi pilihan yang tepat karena tidak tergantung oleh cuaca. Namun proses desain, pemilihan bahan, dan proses instalasi harus diperhatikan dengan benar dan mengikuti aturan yang telah dibuat agar tingkat keamanannya terjaga.

Dalam dunia teknik (*engineering*) merupakan suatu hal yang vital untuk dapat memodelkan suatu proses melalui perangkat lunak sebelum dilakukan proses sebenarnya pada dunia nyata sehingga kegagalan serta kerugian dapat diminimalisir. Begitu juga dengan proses instalasi *pipeline* perlu melalui tahap *modelling* dan analisis sehingga berbagai parameter instalasi yang terdapat pada *standard* dapat terpenuhi. *Offshore pipeline* memiliki metode pemasangan berbeda-beda sesuai keadaan lingkungan di lokasi pemasangan. Untuk perairan dangkal, metode pemasangan yang sering dipakai adalah metode *S-lay* yaitu pada kedalaman dengan katagori shallow water hingga *deep water*. Sedangkan untuk metode pemasangan *J-lay* dan *Reel Lay* digunakan untuk kedalaman dengan katagori *intermediate water* hingga *deepwater water* untuk meminimalisir tegangan yang terjadi. Yang dimaksud *shallow water* adalah laut dari garis pantai hingga kedalaman 500 feet, *intermediate water* adalah perairan dengan kedalaman 500-1000 feet, sedangkan untuk *deepwater* adalah perairan yang kedalamannya diatas 1000 feet (Guo *et al*, 2014). Fasilitas yang digunakan untuk instalasi pipa metode *S-lay* adalah *lay barge* atau bisa juga menggunakan *semi-submersible vessel*.

Lay barge ini dilengkapi dengan berbagai peralatan yang mendukung proses instalasi *pipeline* seperti *stinger*, *tensioner*, *roller*, *winch* dsb. Berbagai peralatan ini memiliki konfigurasi tersendiri sesuai dengan kondisi dan parameter instalasi yang ada. Setelah pipa disambung dengan cara di-las, pipa diturunkan pelan-pelan

ke dasar laut melewati *stinger* dan *barge* akan berjalan ke depan dengan menggunakan sistem tambatnya. Dalam tujuan mengurangi tegangan, *pipelay barge* juga dilengkapi dengan *support* berupa *roller* yang menopang berat pipa diatas *barge*. Agar kecepatan laju pipa saat dilepaskan ke dasar laut tidak terlalu cepat dan tidak terlalu lambat, maka diatas *barge* pada ujung *roller* pertama dipasang *tensioner*. Pada saat melewati *stinger* pipa akan membentuk lengkungan yang disebut *sagbend* dan jari-jari dari *stinger* tersebut yang akan mengontrol seberapa besar lengkungan pipa yang terjadi pada daerah *sagbend* (Bai, 2014). Tegangan dan regangan plastis yang tinggi dapat mengakibatkan kegagalan pada *pipeline* saat proses instalasi.

Silalahi (2010) telah melakukan penelitian mengenai tegangan yang diterjadi pada *pipeline* selama proses instalasi pada kondisi statis dan dinamis, khususnya pada daerah *overbend* dan *sagbend* akibat variasi kedalaman dan gerakan dari *lay barge*.. Namun perlu adanya analisis tambahan terhadap regangan yang terjadi pada *pipeline* selama proses *laying* sehingga kegagalan pada *pipeline* seperti *concrete crushing* dapat dianalisis.

Ness dan Verley (1996) telah melakukan analisis konsentrasi regangan pada bagian *field joint* pada *pipeline* yang dilapisi oleh *concrete coating* dengan menggunakan *semi-analytical model*. Selain itu Irsyad (2017) juga telah melakukan analisis *concrete crushing* dan *concrete sliding* dengan variasi kekuatan *tensioner*, namun tidak menganalisis distribusi tegangan yang terjadi selama proses instalasi dengan metode S-Lay

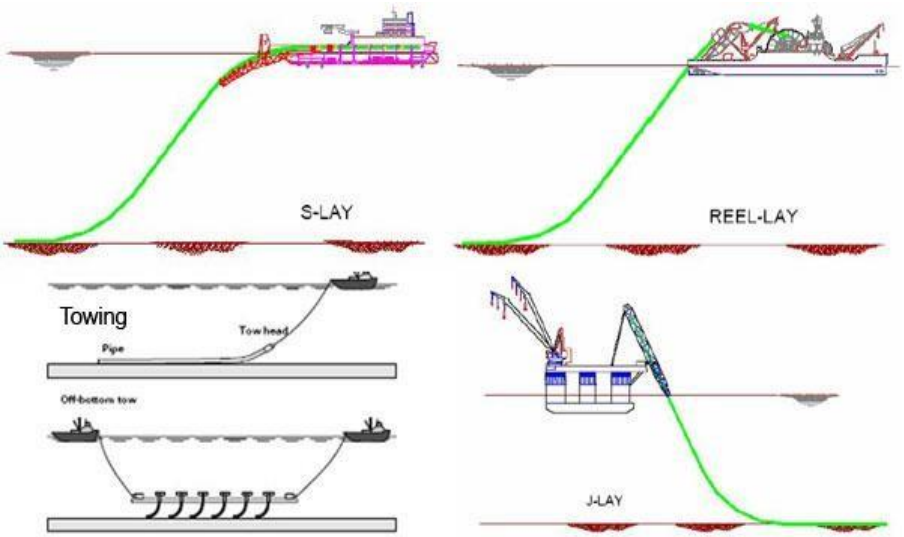
Berdasarkan penelitian-penelitian diatas, penulis mengajukan penelitian mengenai analisis tegangan pipa dan *concrete crushing* pada instalasi *offshore pipeline* dengan variasi *tension tensioner* dan *radius curvature* menggunakan metode S-Lay di wilayah kerja PT.PHE WMO.

2.2 Dasar Teori

2.2.1 Instalasi Pipa Bawah Laut

Ada beberapa metode untuk menginstal pipa, metode yang paling umum adalah S-Lay, J-Lay, dan *reel laying*. Tiap-tiap metode memiliki keunggulannya masing-masing. Pipa bawah laut terkena berbagai macam

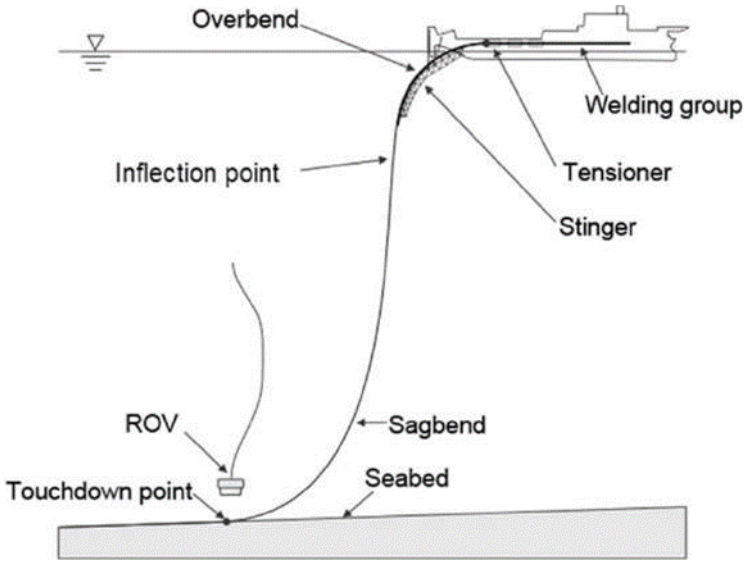
beban selama instalasi. Secara umum, beban ini termasuk tekanan hidrostatik, *tension,* dan *bending*. Kemampuan kapal dalam meletakkan pipa tergantung dari berat pipa itu sendiri. Semakin besar kedalaman air, semakin besar pula berat pipa. Program komputer komersial dapat digunakan sebagai alat yang efektif untuk analisis instalasi pipa dalam menganalisis konfigurasi statis dan dinamis. Program komputer yang biasa digunakan dalam analisis instalasi pipa adalah OFFPIPE. Pada *laybarge* terdapat tempat untuk melakukan pengelasan (*welding station*), *tensioner*, NDT *station* dan *coating station*. *Roller* akan membantu pipa bergerak dari *barge* hingga masuk ke laut. *Roller* yang ditempatkan pada *stinger* dan *barge*, bersama dengan *tensioner* membentuk *curve support* untuk pipa. Pipa akan melengkung pada *curve support* ketika akan masuk kedalam laut sehingga pada bagian ini mengalami *bending* yang disebut *overbend*. *Tensioners* akan mempertahankan tegangan konstan untuk menahan terjadinya *bending* yang berlebih dan mengimbangi gerakan dinamis *lay barge* di permukaan air laut. Mesin *tension* yang paling akhir biasanya terdapat pada bagian buritan pada *barge* yang letaknya berdekatan dengan *stinger*. Sehingga mesin *tension* ini berfungsi untuk mengatur *curvature sagbend* dan menjaga moment pada *stinger* saat pipa bergerak ke laut. Macam macam metode instalasi pipa bawah laut diilustrasikan pada **Gambar 2.1**.



Gambar 2. 1 Metode Instalasi Pipa Bawah Laut (Zenalabidi, 2010)

2.2.2 Metode Instalasi Pipa

a. Metode S-lay

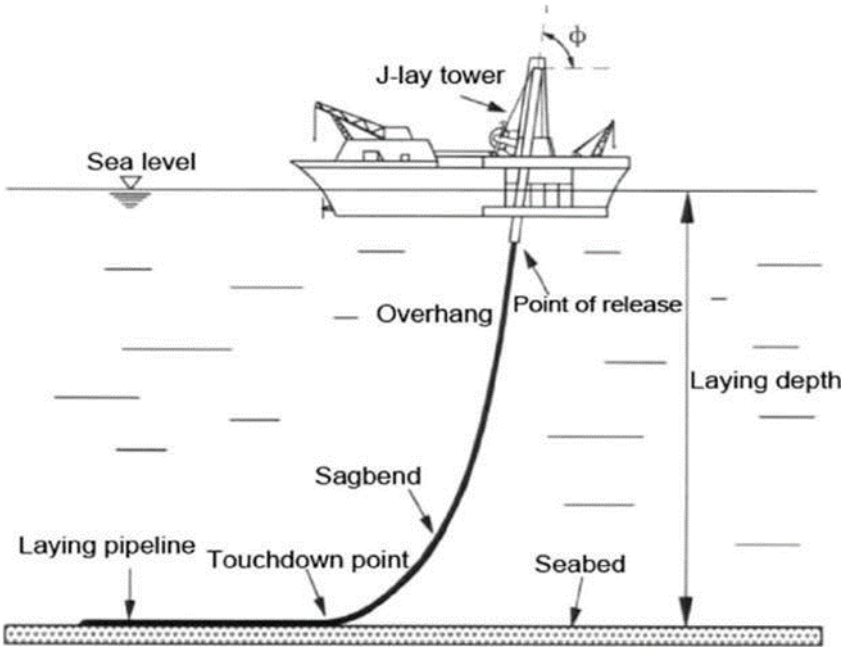


Gambar 2. 2 Metode S-Lay (Bai, 2014)

Metode s-lay yang diilustrasikan pada **Gambar 2.2** adalah metode yang sering digunakan dalam instalasi pipa bawah laut di air yang relatif dangkal. Metode ini disebut demikian karena profil dari segmen pipa antara *stinger* dan dasar laut membentuk huruf S memanjang selama peletakkan pipa. *Stinger* adalah struktur rangka yang dilengkapi dengan *roller* yang berguna untuk mendukung pipa selama instalasi dan juga menciptakan kelengkungan pada pipa ketika berada di *overbending*. Radius

kelengkungan dari *stinger* sesuai dengan *bending stress* maksimum. Bagian pipa antara titik infleksi dan *stinger* disebut dengan wilayah *overbending*, sedangkan bagian pipa antara titik infleksi dengan dasar laut disebut wilayah *sagbending*.

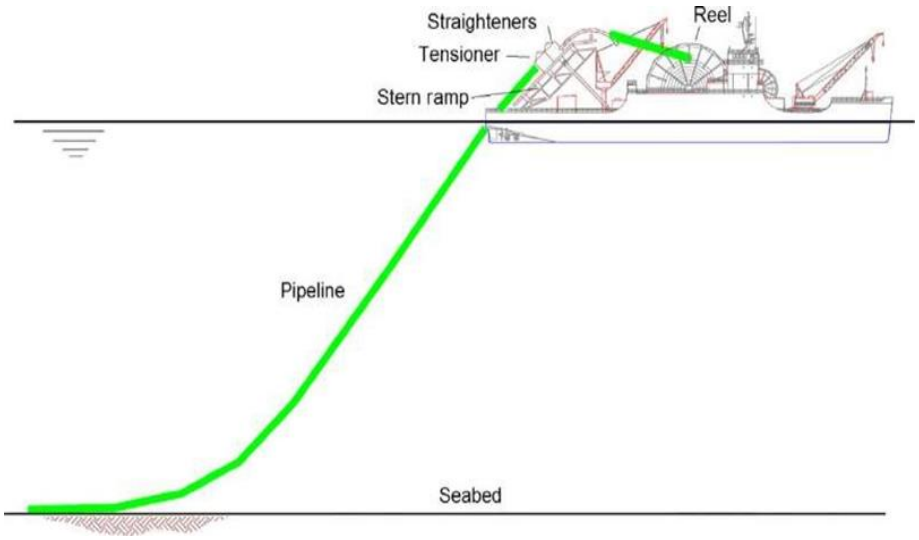
b. Metode J-lay



Gambar 2. 3 Metode J Lay (Bai, 2014)

Metode J-lay yang diilustrasikan pada **Gambar 2.3** sering digunakan dalam instalasi pipa di laut dalam dan telah menjadi metode utama instalasi pipa di laut dalam. Metode J-lay disebut demikian karena dari konfigurasi pipa menyerupai bentuk J selama instalasi. Pada metode J-lay ini tidak terjadi *overbend* seperti yang terjadi pada metode S-lay, tidak ada *stinger* untuk menempatkan pipa dan pipa akan dilas dalam posisi mendekati vertikal yang kemudian akan diturunkan ke laut. Pada *barge* J-lay dilengkapi dengan *tower* yang digunakan untuk memposisikan pipa dan tempat penyambungan pipa. Karena semakin banyak jalur pipa yang terhubung secara bersamaan, *string* dibentuk dan diturunkan ke dasar laut. Oleh karena itu, metode J-lay secara inheren lebih lambat dibandingkan dengan metode S-lay dan juga lebih mahal.

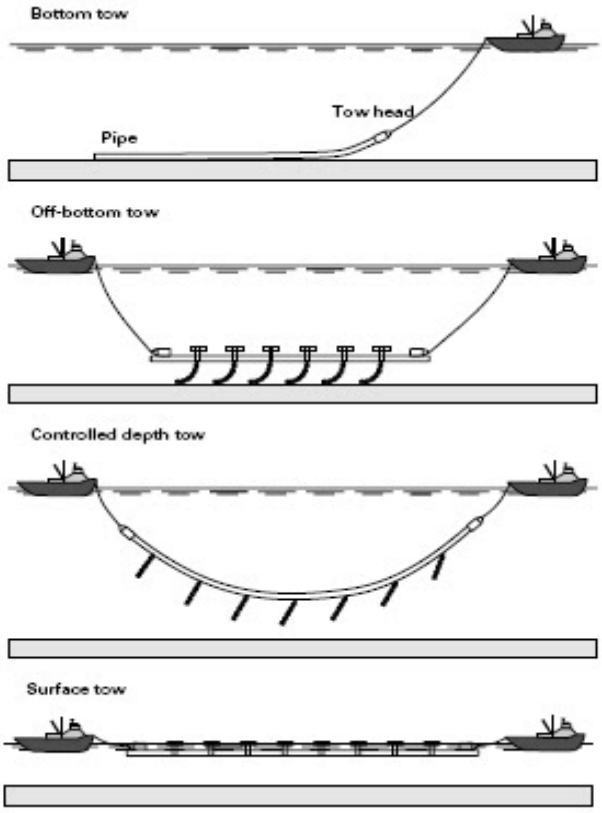
c. Metode Reel lay



Gambar 2. 4 Metode Reel Lay (Bai, 2014)

Metode *reel laying* yang diilustrasikan pada **Gambar 2.4** adalah metode instalasi pipa yang baru muncul di akhir abad ke-20. Keuntungan dari metode ini adalah pipa dapat dihubungkan sepanjang mungkin di darat, kemudian digulung ke dalam sebuah drum yang dipasang pada kapal. Perangkat utama untuk metode instalasi pipa ini yaitu terdapatnya *reeling drum.* Pipa yang dipakai untuk metode ini tidak diselimuti dengan beton akan tetapi pipa harus tetap didisain supaya stabil setelah proses instalasi, hal ini dimaksudkan agar pipa dapat digulung dalam *reel*. Adapun selimut yang digunakan untuk melindungi pipa adalah digunakan bahan yang dapat digulung tanpa mengalami kerusakan seperti seperti jenis bahan *epoxy.*

d. Metode Towing



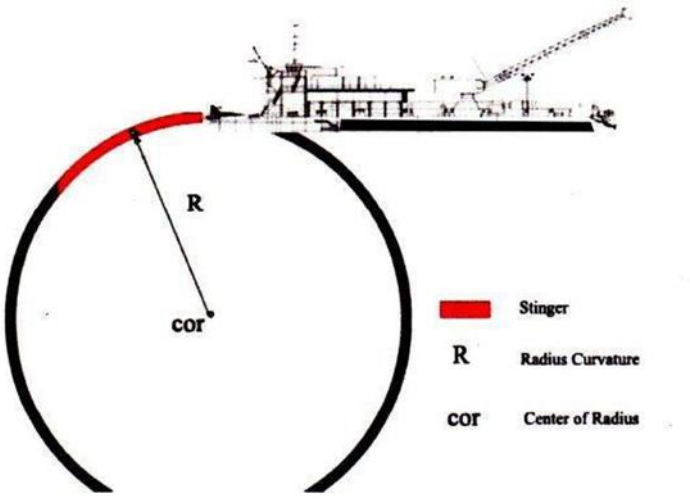
Gambar 2. 5 Instalasi Pipa Bawah Laut dengan Metode Towing (Zenalabidi, 2010)

Pada **Gambar 2.5** diatas merupakan ilustrasi pemasangan pipa bawah laut dengan metode *towing*. Metode *towing* biasanya diguankan untuk proses instalasi pipa bawah laut dengan kondisi perairan laut yang relatif dangkal dan kondisi perairan yang tenang. Secara umum metode ini digunakan dengan cara menarik pipa yang sudah disiapkan di darat dan kemudian ditarik ke tempat instalasi dengan cara ditarik oleh *tug boat*. Masing-masing segmen antara 200-300 meter yang kemudian diberi akses menuju perairan melalui *launching ramp* atau *roller* yang dibangun sepanjang pantai menuju *surf zone*. Setelah segmen pipa yang telah siap (telah melewati pemeriksaan) ditarik ke laut dengan menggunakan *barge/tow vessel* yang berada 1000 meter atau lebih dari pantai. Metode *towing* biasanya dilengkapi dengan menggunakan pelampung atau *buoy* yang dikenakan pada pipa untuk mempermudah pipa ditarik. Selain *bottom tow*, diperlukan minimal dua buah kapal, satu di depan dan satu di belakang. Dalam *controlled depth tow*, kecepatan kapal harus disesuaikan dengan

kedalaman pipa yang diinginkan pada saat *towing*.

2.2.3 Stinger

Stinger berfungsi sebagai pengarah pipa pada *roller* yang terletak antara tubular sehingga pipa dapat meluncur ke bawah dari buritan pada *barge* sampai ke *seabed*. *Stinger* yang berada pada buritan kapal tersebut membentuk *radius curvature* yang disebabkan oleh lengkungan pada *stinger* itu sendiri. Selain itu pada *stinger* tersebut dapat diubah-ubah kelengkungannya dengan menaik-turunkan *roller-roller* dengan menggunakan pin yang berada pada *stinger* hingga membentuk *radius curvature* yang diinginkan. *Stinger* berbentuk melengkung yang merupakan bagian dari lingkaran dengan jari-jari yang biasa disebut *radius curvature* dan digunakan sebagai ukuran lengkung dari *stinger*. Pada **Gambar 2.6** merupakan *radius curvature* dari lingkaran yang dihitung dari *center of radius* pada lingkaran sampai ke ujung lingkaran.



Gambar 2. 6 Radius Curvature Stinger (Rosyidi, 2015)

2.2.4 Overbend

Daerah *overbend* biasanya dimulai dari *tensioner* pada *lay barge*, melalui *barge ramp*, dan turun ke *stinger* sampai titik *lift-off* dimana pipa tidak lagi didukung oleh *stinger*. Pada daerah *overbend* ini diharapkan total regangan akibat dari berat pipa sendiri, momen *bending* pada tumpuan, atau

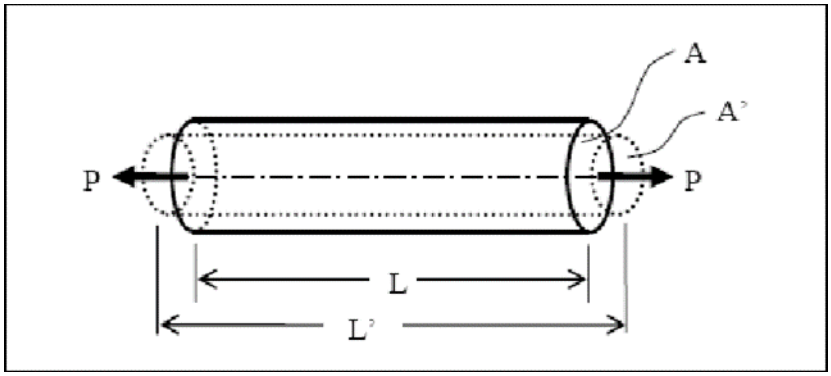
roller tidak melebihi desain faktor yaitu 0.205 % untuk analisa statis dan 0.305% untuk analisa dinamis (berdasarkan DNV OS-F101 2013 sec. 13).

2.2.5 Sagbend

Daerah *sagbend* biasanya dimulai dari titik *inflection* sampai titik *touch down* pada *seabed*. Tegangan pada *sagbend* di kontrol oleh jari-jari *stinger*, *departure angle* dan pengaturan *roller*. Tegangan diharapkan kurang dari 87% SMYS (berdasarkan DNV OS-F101 2013 sec. 13).

2.2.6 Tegangan Normal

Tegangan yang terjadi dapat berupa tegangan tarik (*tensile stress*) atau tegangan tekan (*compressive stress*).



Gambar 2. 7 Pembebanan Aksial pada Batang Tubular (Gere dan Timoshenko, 2009)

Pada gambar di atas, ditunjukkan *tensile stress* dimana tegangan ini akan menyebabkan *normal stress*. Tegangan Normal adalah tegangan yang bekerja dalam arah tegak lurus terhadap bidang yang dapat dihitung dengan Persamaan 2.1 berikut.

$$\sigma = \frac{P}{A} \quad \text{.....(2.1)}$$

Dengan :

σ = tegangan normal (N/m2)

P = gaya tarik/tekan (N)

A = luas penampang melintang (m2)

Pada **Gambar 2.7** batang tubular dengan luas penampang A dan panjang L mengalami pembebanan *aksial* akibat gaya tarik P. Akibat gaya ini, batang akan mengalami perubahan panjang sebesar:

$$\Delta L = L' - L \quad \text{.....(2.2)}$$

Dengan :

ΔL = pertambahan panjang (m)

L' = panjang batang setalah menerima beban (m)

L = panjang batang mula-mula (m)

Perbandingan antara pertambahan panjang (ΔL) dengan panjang mula-mula disebut sebagai regangan *aksial* dan dirumuskan sebagai berikut:

$$\varepsilon = \frac{\Delta L}{L} \quad \text{.....(2.3)}$$

Hal ini berarti jari-jari penampangnya juga mengalami perubahan dari R menjadi R'. Regangan ini disebut dengan regangan radial dan secara matematis dirumuskan sebagai berikut:

$$\varepsilon = \frac{R' - R}{R} \quad \text{..... (2.4)}$$

Dengan :

ε = *aksial strain* (m)

R = jari-jari penampang mula-mula (m)

R' = jari-jari penampang setelah menerima beban (m)

Perbandingan antara regangan radial dengan regangan aksial disebut sebagai *Poisson's ratio*. Secara matematis dirumuskan sebagai berikut:

$$\nu = \frac{\varepsilon'}{\epsilon} \quad \text{..... (2.5)}$$

Dengan :

ε = *aksial strain* (m)

ε' = *radial strain* (m)

2.2.7 Tegangan Geser

Tegangan geser (*shear stress*) adalah tegangan yang bekerja dalam arah tangensial terhadap permukaan bahan. Dimana tegangan geser, secara matematis dapat dirumuskan seperti pada persamaan berikut:

$$\tau = V/A \quad \text{.....(2.7)}$$

Dengan :

τ = tegangan geser (N/m^2)

V = gaya geser (N)

A = luas penampang melintang (m^2)

Tegangan geser yang bekerja pada suatu elemen bahan disertai regangan geser. Tegangan geser tidak mempunyai kecenderungan untuk memperpanjang atau memperpendek elemen dalam arah x, y, dan z. Ini berarti panjang sisi elemen tidak berubah, oleh karenanya tegangan geser menyebabkan perubahan bentuk elemen.

2.2.8 Tegangan Von Mises

Pada elemen tiga dimensi, bekerja tegangan-tegangan searah sumbu x, y, dan z. Pada tiap-tiap sumbu dapat diketahui tegangan utama (σ1, σ2, σ3) yang dihitung dari komponen tegangan dengan persamaan berikut :

$$\begin{bmatrix} \sigma_x - \sigma_0 & \sigma_{xy} & \sigma_{xz} \\ \sigma_{xy} & \sigma_y - \sigma_0 & \sigma_{yz} \\ \sigma_{xz} & \sigma_{yz} & \sigma_z - \sigma_0 \end{bmatrix} = 0 \quad \text{..... (2.8)}$$

Dengan :

σ0 = tegangan utama yang bekerja pada sumbu

σx = tegangan arah sumbu x

σy = tegangan arah sumbu y

σz = tegangan arah sumbu z

σxy = tegangan arah sumbu xy

σxz = tegangan arah sumbu xz

σyz = tegangan arah sumbu yz

Penggabungan tegangan-tegangan utama pada suatu elemen merupakan suatu cara untuk mengetahui nilai tegangan maksimum yang terjadi pada node tersebut. Salah satu cara mendapatkan tegangan gabungan adalah dengan menggunakan formula tegangan *Von Misses* yaitu :

$$\sigma_e = \left[[0.5(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2(\sigma_3 - \sigma_4)^2]\right]^{0.5} \text{..... (2.9)}$$

Dengan :

σ_e = tegangan *Von Mises*

$\sigma 1$ = tegangan utama 1

$\sigma 2$ = tegangan utama 2

$\sigma 3$ = tegangan utama 3

2.2.9 Tegangan pada Overbend

Overbend terjadi terutama pada *stinger* dan pada sebagian *lay barge*. Peletakan penumpu *roller* didesain sehingga membentu *radius curvature* tertentu dan diatur agar dapat mengontrol besar tegangan pada *overbend.* Besar momen yang terjadi disepanjang *stinger* terdistribusi pada gambar. Besar tegangan momen lentur yang terjadi pada *stinger* dapat dihitung dengan persamaan berikut :

$$\sigma_a = \frac{ED}{2Rcv} \quad \text{..... (2.10)}$$

Dimana :

σa = Tegangan lentur (MPa)

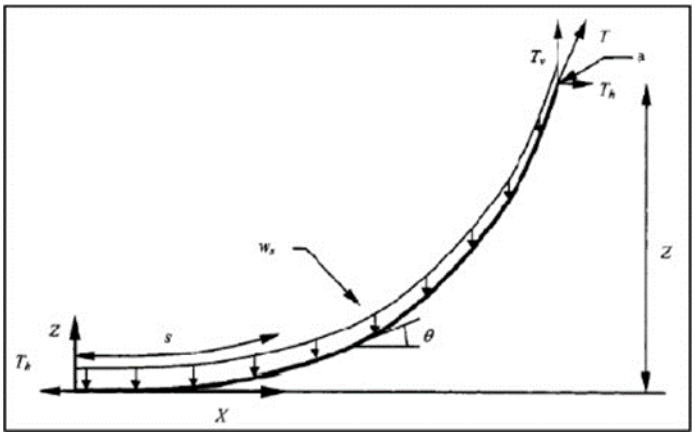
E = *Modulus Young*

Rcv = *Radius Curvature*

D = *Outside* diameter pipa

2.2.10 Tegangan pada Sagbend

Ketika *pipeline* mencapai dasar laut pada saat instalasi, maka *pipeline* akan membentuk kurva tertentu secara alami akibat terjadinya defleksi yang besar. Bentuk kurva tersebut disebut dengan *sagbend*. Kurva *sagbend* sangat dipengaruhi oleh besar gaya aksial yang diberikan oleh *tensioner*. Model *catenary* merupakan model yang dapat digunakan dalam perhitungan hubungan antara gaya tarik *tensioner* dan bentuk kurva. Komponen horizontal dari gaya tarik nilainya konstan dari titik sentuh/jatuh di dasar laut hingga ke ujung *stinger*. Berikut **Gambar 2.8** model *catenary* untuk memperjelas penjelasan sebelumnya :



Gambar 2. 8 Model Catenary pada daerah Sagbend (Guo, 2014)

Pada titik jatuh didasar laut, *radius curvature* merupakan yang terbesar dan nilainya dapat dihitung berdasarkan persamaan diatas dengan kondisi batas.

$$\frac{1}{R} = W_s/T_h \quad \text{..... (2.11)}$$

Hubungan antara kurva *sagbend* dan *regangan* pada pipa sebagai berikut :

$$E = r/R \quad \text{..... (2.12)}$$

Persamaan *catenary shape* pada *sagbend* diekspresikan sebagai berikut :

$$z = \frac{T_h}{W_s}(\cosh\frac{XW_s}{T_h} - 1) \quad \text{..... (2.13)}$$

Dimana :

x = jarak horizontal dari *touch down point*

z = kedalaman

Th = gaya horizontal pada dasar laut

Ws = berat pipa tercelup perunit

Kemudian :

$$\frac{d_\theta}{d_s} = \frac{d^2z}{dx^2}cos\theta = \frac{W_s}{T_h}cosh\frac{X_{ws}}{T_h}cos\theta \quad \text{..... (2.14)}$$

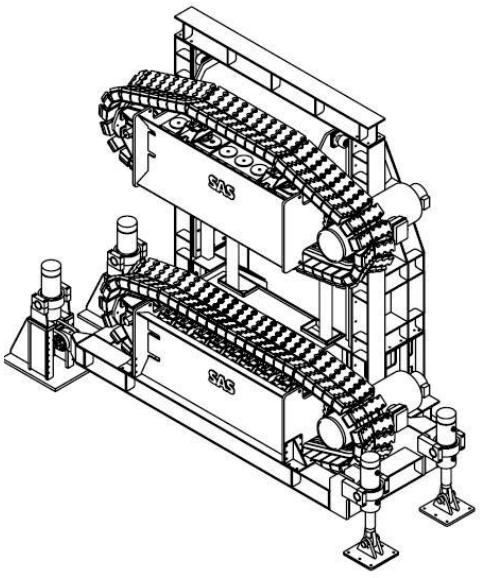
Dimana :

θ = sudut terhadap x aksis

s = panjang bentang pipa

2.2.11 Tegangan Tensioner

Tensioner merupakan mesin penarik yang menarik pipa menuju *stinger*. Selain itu *tensioner* juga berfungsi sebagai pengontrol besar kurva yang terbentuk di *sagbend* dan mengatur momen pada *stinger*. Dengan mengatur beban-beban tersebut maka bentuk-bentuk kegagalan seperti deformasi *plastis*, *buckling* dan *collapse* dapat dihindari. Seperti yang telah dijelaskan sebelumnya bahwa besar gaya *tensioner* ini berkisar antara 100 kN hingga 150 kN untuk kedalaman laut yang dangkal dan 300 kN untuk laut dalam. *Tensioner* biasanya terdiri dari track bawah yang terhubung secara *loop*. Berikut **Gambar 2.9** memperjelas sebuah *tensioner* pada salah satu *barge* :



Gambar 2. 9 General Arrangement Tensioner (SAS, 2009)

2.2.12 Allowable Stress Criteria

Berdasarkan DNV-OS-F101 kriteria tegangan yang diperbolehkan terjadi pada daerah *sagbend* dan *overbend* saat instalasi adalah :

σ_{eq}<0.87f_y

Dengan,
σ_{eq}=$Equivalent\ Stress, Von\ Mises$
f_y=$SMYS$

Dengan σ_{eq} adalah tegangan ekivalen (Von Mises *stress*) merupakan kombinasi dari *hoop stress*, *longitudinal stress* dan *tangential shear stress*.

2.2.13 Allowable Strain Criteria

Mengacu pada DNV-OS-F101 pada *Section* 13 *Commentary* (*Informative*) *G 200 Coating* untuk pembebanan statis nilai dari *strain* yang tejadi pada *pipeline* saat instalasi harus melibatkan efek dari *bending*, gaya aksial dan *roller loads*. Efek dari variasi kekakuan (*stiffness*) pada *field joint* tidak diperhitungkan. Untuk analisa regangan daerah *overbend* nilai-nilai pada **Tabel 2.1** berikut harus dipenuhi :

Tabel 2.1 Simplified Laying Criteria DNV OS-F 101

Criterion	***X70***	***X65***	***X60***	***X52***
I	0.270%	0.250%	0.230%	0.205%
II	0.325%	0.305%	0.290%	0.260%

2.2.14 Concrete Crushing Criteria

Berdasarkan DNV-OS-F101 *Section* 13 *Commentary* (*Informative*) *G 200 Coating* dijelaskan tentang *mean overbend strain* yang terjadi pada *pipeline* saat instalasi.

Mean overbend strain dimana *concrete crushing* pertama kali terjadi tergantung pada :

- *Pipe stiffness*
- *Concrete strength & Concrete thickness*
- *Axial force*
- *Shear resistance capacity of corrosion coating*

Jika informasi yang diperlukan untuk mengetahui terjadi atau tidaknya *concrete crushing* pada *pipeline* tidak mencukupi, maka dapat diasumsikan bahwa *concrete crushing* akan terjadi apabila *strain* pada *concrete* mencapi 0.2%.

2.2.15 Tegangan Pipa pada Offpipe

Ada beberapa jenis tegangan dalam pipa selama instalasi yang dapat mengakibatkan kegagalan. *Total stress* adalah kombinasi dari tegangan-

tegangan dibawah ini yang membentuk *Von Mises Stress*. Tegangan ini adalah *tensile stress, horizontal and vertical bending stress,* dan *hoop stress.*

- Tensile Stress

  Tensile Stress dalam pipa dihitung dengan rumus :

$$\sigma t = \frac{T}{a} + \frac{1}{4}\pi D^2 w \frac{h}{a}$$

  Dimana :

  σ_t = *tensile stress*

  T = tegangan luar pipa

  π = 3.14159

  D = *outside* diameter pipa

  w = *specific weight* dari air laut

  h = kedalaman node pipa

  a = *cross sectional area* pipa

- Horizontal and Vertical Bending Stress

  Horizontal and vertical bending stress dihitung dari *horizontal and vertical bending moment*, menggunakan rumus:

$$\sigma hor, ver = \frac{1}{2} M_{h,v} \frac{D}{I}$$

  Dimana :

  $\sigma_{hor,ver}$ = *horizontal/vertical bending stress*

  $M_{h,v}$ = *horizontal/vertical bending moment*

  I = *cross sectional moment of inertia* pipa

- Combined Horizontal and Vertical Bending Stress

  Combined Horizontal and Vertical Bending Stress adalah jumlah vektor dari *horizontal and vertical bending stress*. Oleh karena itu, dihitung dengan menggunakan rumus:

$$\sigma_c = \sqrt{\sigma^2 hor + \sigma^2 ver}$$

- Hoop Stress

  Hoop stress pada pipa dihitung dengan menggunakan rumus :

$$\sigma_h = \frac{1}{2} wD\left(\frac{h}{t}\right)$$

Dimana :

σ_h = *hoop stress*

t = *wall thickness pipa*

- Total Tegangan Pipa

  Seperti disebutkan sebelumnya, total tegangan pipa dihitung dari tensile, hoop, dan bending stress dengan menggunakan rumus Von Mises:

$$\sigma_{vm} = [(\sigma c + \sigma t)^2 + \sigma h^2 - (\sigma c + \sigma t)\sigma h]\frac{1}{2}$$

2.2.16 Analisa Dinamis

Menurut Chakrabakti ada dua pendekatan dasar yang dipertimbangkan dalam menganalisa masalah struktur terapung, yaitu dengan metode frekuensi *domain* dan *time domain*. *Frequency domain* biasanya dilakukan untuk penyelesaian yang sederhana. Solusi pada metode ini diperoleh menlalui pendekatan persamaan diferensial. Keterbatasan dari metode ini adalah semua persamaan non-linier harus diubah dalam bentuk persamaan linier. Sedangkan untuk metode *time domain* menggunakan pendekatan integrasi numeris dari persamaan gerak dari semua sistem non-linier. Beberapa contoh persamaan yang menggunakan analisa non-linier adalah gaya drag, gaya pada *mooring*, dan viskositas *damping*.

Dalam *American Proteleum Institute* 1987 API RP 2T membagi analisa dinamis struktur lepas pantai kedalam 2 metode analisa *domain* yaitu:

1. *Frequency domain analysis* adalah simulasi kejadian pada saat tertentu dengan interval frekuensi yang telah ditentukan sebelumnya. Frekuensi *domain* juga dapat digunakan untuk memperkirakan respon gelombang acak termasuk gerakan *platfrom* dan percepatan, gaya *tension* dan sudut. Keuntungan dari analisis ini adalah lebih menghemat waktu perhitungan dan juga *input* atau *output* lebih sering digunakan oleh perancang. Namun kekurangan metode ini adalah semua persamaan *non-linier* harus diubah dalam bentuk *linear*.

2. *Time domain analysis* adalah penyelesaian gerakan dinamis struktur berdasarkan fungsi waktu. Pendektan yang dilakukan dalam metode ini menggunakan prosedur integrasi waktu dan akan menghasilkan respon *time history* berdasarkan waktu x(t). Metode *time domain* solution secara umum digunakan untuk tahap final detail desain dan untuk mengecek solusi *frequency domain*. Metode *time domain* biasanya digunakan untuk analisis kondisi ekstrim tetapi tidak digunakan untuk analisis *fatigue* atau analisis kondisi lebih moderat dimana analisis *linierasasi* berkerja lebih efisien. Sejak integrasi numerik langsung persamaan *motion* dilakukan, pengaruh-pengaruh fungsi-fungsi *nonlinier* gelombang relevan dan *variabel-variabel motion* diikutkan. Keuntungan dari metode *time domain* dibandingkan metode *frequency domain* adalah semua tipe *non- linier* (matrik sistem dan beban-beban eksternal) dapat dimodelkan dengan lebih tepat. Ketidakuntungannya adalah memerlukan waktu menghitung yang lebih banyak, seperti *periode* simulasi memerlukan waktu panjang. Simulasi *time domain* dapat dikerjakan menurut beberapa skema integrasi. Untuk dapat mewakili kondisi sebenarnya simulasi minimal dilakukan selama 3 jam. Dalam menyelesaikan persamaan tersebut menggunakan prosedur integrasi waktu, satu didapat solusi pada pola respon *time history* (t). Pada mumnya semua matrik sistem (massa, *damping* dan kelakuan) dapat difungsikan sebagai *response* atau waktu, seperti pada kasus vektor beban (analisis non-linier) matrik sistem konstan memberikan analisis *linier*. *Ouput* dari analisis *time domain* adalah *respon time series* dimana :
   a. Simulasi gelombang reguler dapat digunakan untuk memprediksikan *transfer function* dengan mengambil *respon respon amplitude* dengan *input amplitudo* gelombang.
   b. Spektrum respon dapat dihitung dari *time series*, memberikan informasi yang sama dengan analisis frekuensi domain.
   c. Respon ekstrim dapat diestimasi secara langsung dari puncak respon selama simulasi.

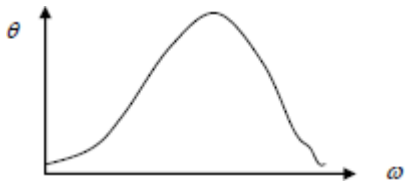
2.2.16 Respon Gerakan pada Gelombang Irreguler

Response Amplitude Operator (RAO) atau yang disebut sebagai *Transfer Function* adalah fungsi respon struktur akibat beban gelombang yang mengenai struktur lepas pantai pada frekuensi tertentu. RAO disebut *Transfer Function* karena RAO merupakan alat untuk mentransfer beban luar (gelombang) dalam bentuk respon pada suatu struktur. Tahap analisa sesuai dengan buku *Dynamics Of Marine Vehicles* (Bhattacharya, 1978) yang perlu dilakukan antara lain :

1. Membuat plot spektrum $S(\omega)$ seperti dengan **Gambar 2.10** di bawah ini yang sesuai dengan obyek analisa:

Gambar 2. 10 Plot Spektrum

2. Membuat plot spektrum respon pada gelombang reguler (θ) seperti **Gambar 2.11** berikut :

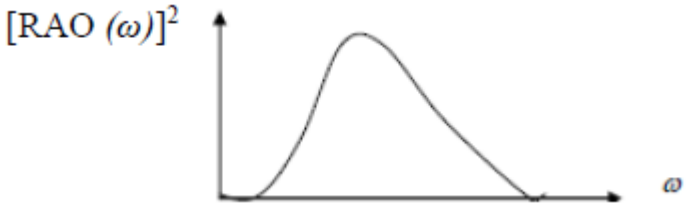


Gambar 2. 11 Plot Spektrum Gelombang Reguler

3. Membuat plot spektrum kuadrat dari RAO yang sesuai pada **Gambat 2.12** untuk mentransfer spektrum pada langkah ke-2 menjadi spektrum respon gelombang irreguler dengan persamaan dan plot gambar sebagai berikut :

   RAO $(\omega) = \theta / \eta a$..... (2.15)

   Dimana ηa = Amplitudo gelombang, m



Gambar 2. 12 Plot Spektrum

4. Membuat plot spektrum respon pada gelombang irreguler seperti **Gambar 2.13** di bawah ini dengan menggunakan persamaan :

$S(\omega) = [\text{RAO } (\omega)]^2 \, S(\omega)$ ..... (2.16)

Gambar 2. 13 Plot Spektrum

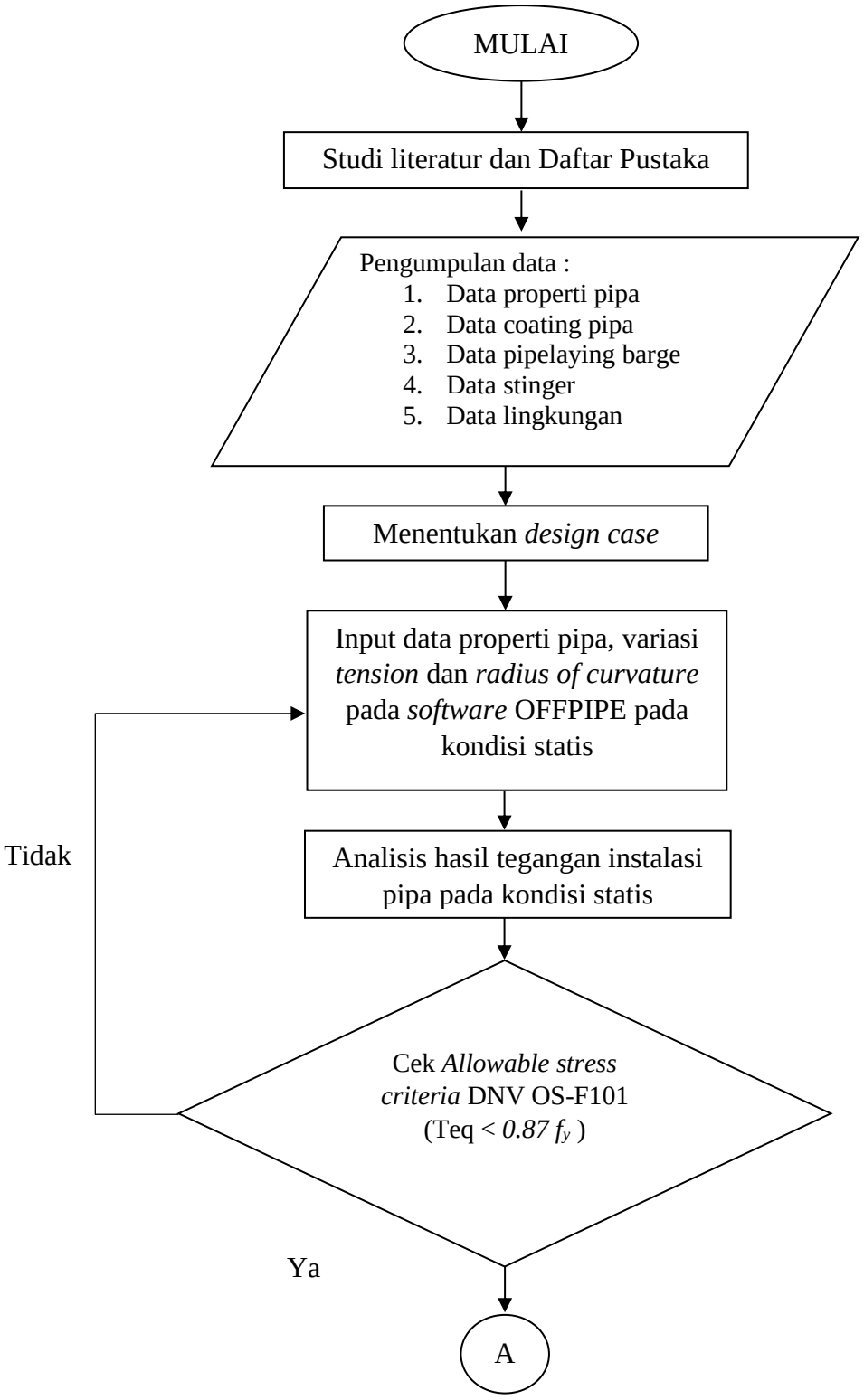
5. Penentuan karakteristik gerakan yang diperlukan dengan menggunakan luas area (m0) di bawah plot spektrum pada langkah ke-4 dengan persamaan berikut ini :

$\theta_{\frac{1}{3}} = 2.000 \, m_0^{0.5}$ ..... (2.17)

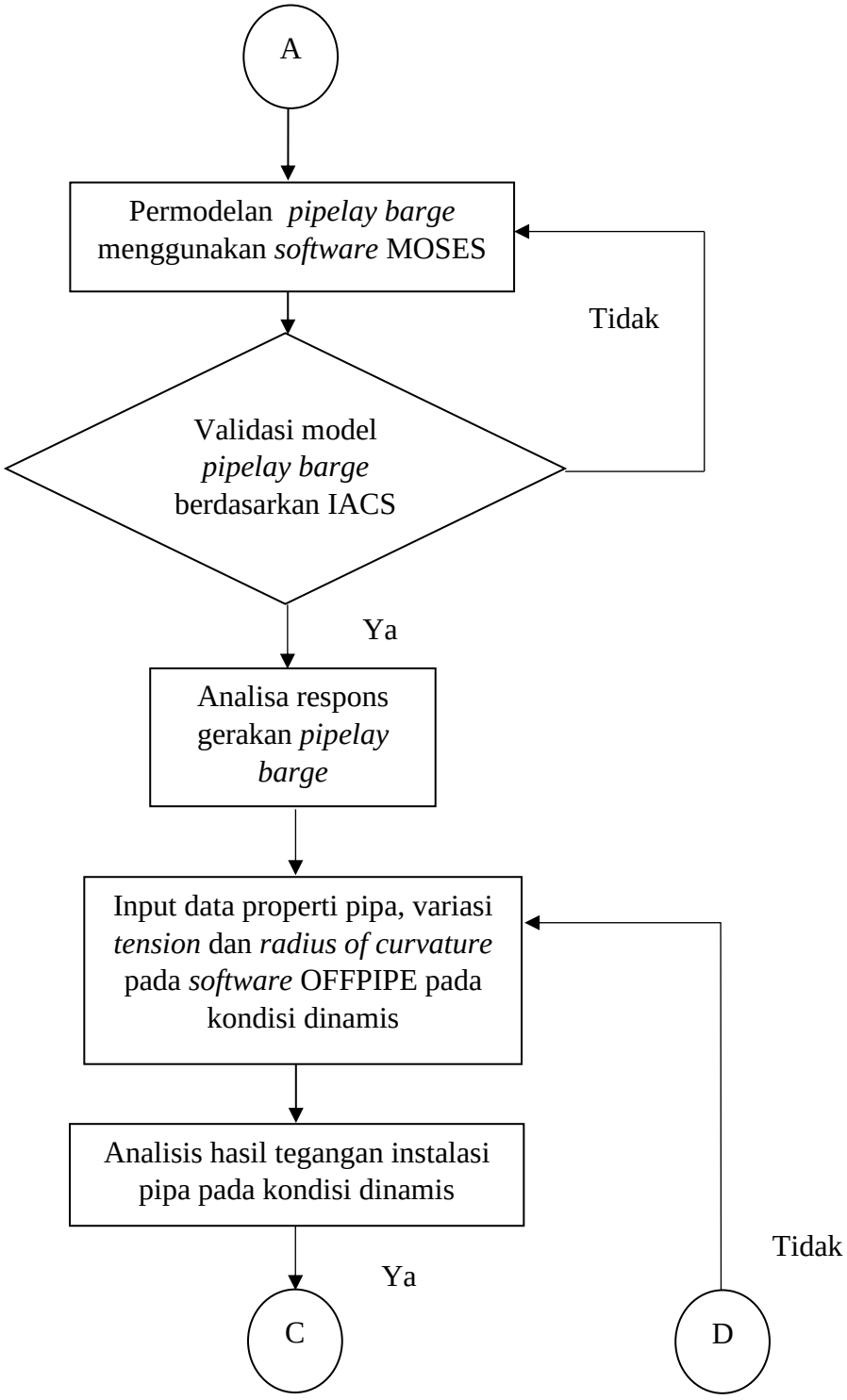
$\theta ekstrem = \left[2ln\left\{\frac{60^2 T}{2\pi}\sqrt{\frac{m_2}{m_0}}\right\}\right]^{0.5} \sqrt{m_0}$ ..... (2.18)

BAB III
METODOLOGI PENELITIAN

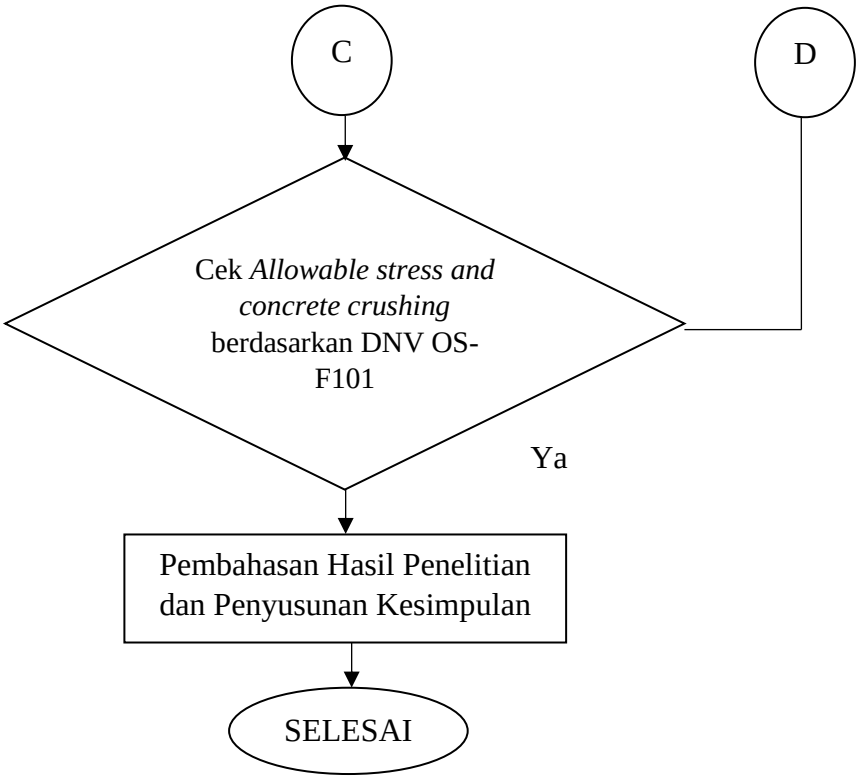
3.1 Skema Diagram Alir



Gambar 3.1 Diagram Alir Metodologi Penelitian



Gambar 3.2 Diagram Alir Metodologi Penelitian (Lanjutan)



Gambar 3.3 Diagram Alir Metodologi Penelitian (Lanjutan)

3.2 Penjelasan Diagram Alir

1. Studi Literatur dan Daftar Pustaka

   Pada tahap ini dilakukan pengumpulan buku, jurnal, prosiding serta *standard* yang berhubungan dengan analisis tegangan dan regangan pada instalasi *pipeline*. Salah satu referensi *codes* yang digunakan penulis untuk mengerjakan tugas akhir ini adalah DNV OS-F101 tentang batas maksimum *stress criteria*.

2. Pengumpulan Data

   Melakukan pengumpulan data yang dibutuhkan guna menganalisa total tegangan dan regangan pipa pada saat instalasi yang akan di-*input* ke dalam *software*. Data tersebut meliputi properti pipa, data *coating* pipa, besar ukuran *pipe lay barge*, panjang *stinger*. Data lingkungan yang digunakan untuk tugas akhir ini adalah data lingkungan milik PT. PHE WMO

3. Penentuan *design case*

   Menentukan kasus-kasus berupa variasi yang akan dianalisa pada tugas akhir ini. Variasi yang akan digunakan pada analisa ini berupa variasi *radius of curvature* ,dan variasi *tension* pada *tensioner* yang digunakan di *pipelay barge*.

4. Input data properti pipa, *tensioner* dan *stinger* pada *software* OFFPIPE pada kondisi statis

   Memasukan semua data yang diperlukan seperti data properti pipa, data *coating* pipa, data *tensioner* dan data *stinger* untuk melakukan *run* pada *software* OFFPIPE sehingga mendapatkan hasil berupa *output* total tegangan dan regangan yang terjadi pada saat instalasi pipa berlangsung pada kondisi statis.

5. Cek distribusi tegangan berdasarkan DNV OS F101

   Melakukan pemeriksaan terhadap *output* yang dihasilkan. *Output* yang dikeluarkan akan berupa tegangan di setiap node pipa. Selanjutnya diperiksa apakah *output* tersebut memenuhi kriteria yang telah ditentukan oleh DNV OS F101 atau tidak.

6. Permodelan *pipelay barge* dan validasi

Melakukan permodelan *pipelay barge* sesuai *principle dimension* dari data yang sudah didapat. Validasi *pipelay barge* dilakukan agar model yang akan digunakan untuk analisis valid atau hampir mendekati struktur *barge* yang asli. Validasi ini didasarkan pada kriteria validasi pada IACS (*International Association of Classification Societies*) dan dibantu oleh *software* MOSES.

7. Analisis hasil permodelan *pipelay barge*

Setelah melakukan permodelan *pipelay barge*, akan dilakukan analisis guna mengetahui respon *pipelay barge* dengan beban-beban lingkungan yang sudah ditentukan.

8. Input data properti pipa, *tensioner* dan *stinger* pada *software* OFFPIPE pada kondisi dinamis

Memasukan semua data yang diperlukan seperti data properti pipa, data *coating* pipa, data *tensioner* dan data *stinger* untuk melakukan *run* pada *software* OFFPIPE sehingga mendapatkan hasil berupa *output* total tegangan dan regangan yang terjadi pada saat instalasi pipa berlangsung pada kondisi dinamis.

9. Cek distribusi tegangan dan *concrete crushing* berdasarkan DNV OS F101

Setelah dilakukan simulasi diperiksa apakah tegangan yang terjadi pada instalasi memenuhi kriteria yang telah di tentukan oleh DNV-OS-F101 atau tidak. Lalu dilakukan cek regangan untuk kriteria *concrete crushing*.

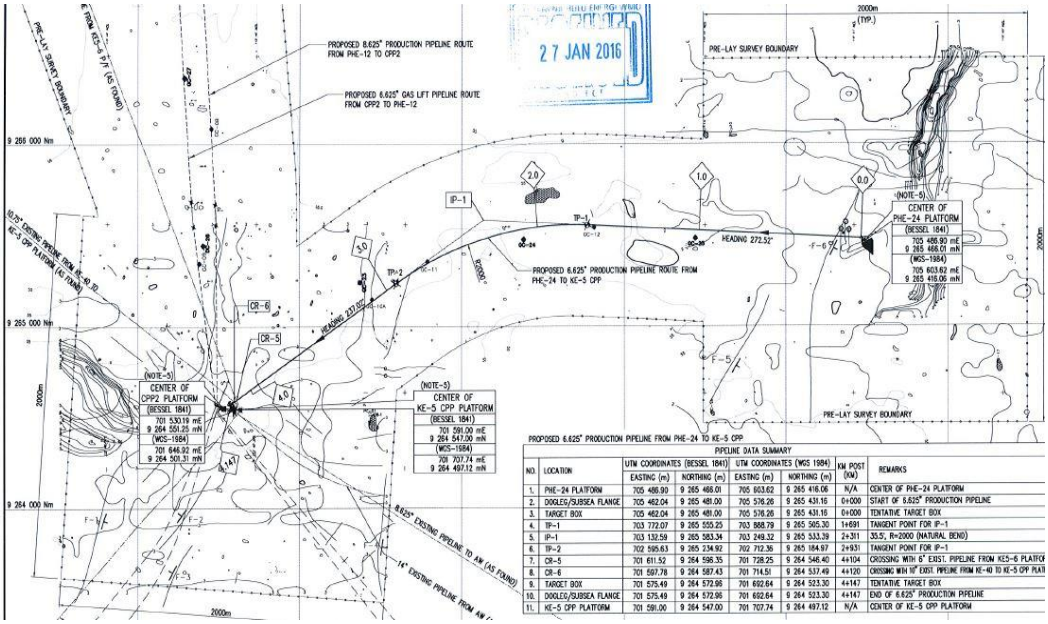
10. Kesimpulan

Setelah melakukan berbagai tahapan analisis, pada akhir penelitian ini dapat disusun sebuah kesimpulan dan saran yang dapat bermanfaat untuk penelitian yang akan dilakukan berikutnya.

BAB IV
ANALISA DAN PEMBAHASAN

4.1 Pengumpulan Data

Pada penelitian ini data yang digunakan adalah data proyek instalasi pipa bawah laut milik PT. PHE West Madura Offshore. Pipa tersebut berdiamater 6.625" dan terletak di sebelah utara selat madura. Pipa ini membentang sejauh 4.174 km dan menghubungkan dua buah *platform*, yaitu dari PHE-24 menuju KE-5 CPP (Central Processing Platform) yang ditunjukkan pada **Gambar 4.1**, serta digunakan untuk jalur transportasi fluida berupa air, minyak, dan gas (*three phase hydrocarbon*).



NO.	LOCATION	UTM COORDINATES (BESSEL 1841) EASTING (m)	UTM COORDINATES (BESSEL 1841) NORTHING (m)	UTM COORDINATES (WGS 1984) EASTING (m)	UTM COORDINATES (WGS 1984) NORTHING (m)	KM POST (KM)	REMARKS
1.	PHE-24 PLATFORM	705 486.90	9 265 466.01	705 603.62	9 265 416.06	N/A	CENTER OF PHE-24 PLATFORM
2.	DOGLEG/SUBSEA FLANGE	705 462.04	9 265 481.00	705 578.26	9 265 431.15	0+000	START OF 8.625" PRODUCTION PIPELINE
3.	TARGET BOX	705 462.04	9 265 481.00	705 578.26	9 265 431.15	0+000	TENTATIVE TARGET BOX
4.	IP-1	703 772.07	9 265 555.25	703 888.79	9 265 505.30	1+691	TANGENT POINT FOR IP-1
5.	IP-1	703 132.59	9 265 583.34	703 249.32	9 265 533.39	2+311	35.5, R=2000 (NATURAL BEND)
6.	IP-2	702 595.63	9 265 234.92	702 712.36	9 265 184.97	2+931	TANGENT POINT FOR IP-1
7.	CR-5	701 611.52	9 264 596.35	701 728.25	9 264 546.40	4+104	CROSSING WITH 6" EXIST. PIPELINE FROM KE5-6 PLATFO
8.	CR-6	701 597.78	9 264 587.43	701 714.51	9 264 537.49	4+120	CROSSING WITH 10" EXIST. PIPELINE FROM KE-40 TO KE-5 CPP PLAT
9.	TARGET BOX	701 575.49	9 264 572.96	701 692.64	9 264 523.30	4+147	TENTATIVE TARGET BOX
10.	DOGLEG/SUBSEA FLANGE	701 575.49	9 264 572.96	701 692.64	9 264 523.30	4+147	END OF 6.625" PRODUCTION PIPELINE
11.	KE-5 CPP PLATFORM	701 591.00	9 264 547.00	701 707.74	9 264 497.12	N/A	CENTER OF KE-5 CPP PLATFORM

Gambar 4. 1 Peta Jalur Pipa PHE-24 menuju KE-5 CPP

4.1.1 Data Properties Pipeline

Tabel 4.1 merupakan data pipeline. Tabel 4.3 merupakan data berat pipa Dan Tabel 4.4 merupakan data pipeline coating.

Tabel 4.1 Data Properties Pipeline

Parameter	Unit	Value
Outside Diameter	Inch	6.625
Pipe Wall Thickness	mm	12.7

Tabel 4.2 Data Properties Pipeline (Lanjutan)

Parameter	Unit	Value
Material Grade	-	API 5L *Grade* X52
SMYS	MPa	360
SMTS	MPa	455
Modulus of Elasticity	MPa	207000
Poisson's Ratio	-	0.3
Density of Steel Pipe	Kg/m^3	7850
Service	-	*Three phase hydrocarbon*

Tabel 4.3 Data Berat Pipa

Parameter	Unit	Value
Dry	Kg/m	95.547
Submerged (empty)	Kg/m	56.9
Submerged (hydrotest)	Kg/m	73.319
Submerged (operating)	Kg/m	72.91

Tabel 4.4 Data Pipeline Coating

Parameter		Unit	Value
Corrosion Coating	Material	-	FBE (Fusion Bonded Epoxy)
	Min. Thickness	mm	0.5
	Density	Kg/m^3	1460
Concrete Coating	Min. Thickness	mm	25
	Density	Kg/m^3	3044
Field Joint Coating	Generic Type	Heat Shrink Sleeve with High Density Polyurethane Foam	

4.1.2 Data Properties Pipe Laying Barge

Tabel 4.5 merupakan data pipe laying barge dan Tabel 4.7 merupakan data roller pada pipe laying barge.

Tabel 4.5 Data Properties Pipe Laying Barge

Description	Unit	Value
Number of Tensioners	Nos.	2
Capacity of Tensioners	MT	1 x 45 and 1 x 68
Hitch X-Location	m	-1.884
Hitch Y-Location	m	-4.495

Tabel 4.6 Data Properties Pipe Laying Barge (Lanjutan)

Description	Unit	Value
Number of Rollers	Nos.	7
Length Overall	m	121.9
Breadth Moulded	m	32.3
Depth Moulded	m	8.7
Draft AFT (During Laying)	m	5.73
Draft MEAN (During Laying)	m	5.20
Draft FWD (During Laying)	m	4.67
Barge Trim (During Laying)	Deg	0.5

Tabel 4.7 Data Konfigurasi Roller pada Barge

Rollers/Tensioners	Distance from PLB Stern (m)	Height from Main Deck (m)
R1	96.37	2.489
R2	84.33	2.27
R3	73.50	2.05
T1	60.15	1.745
R4	46.49	1.43
T2	35.40	1.04
R5	23.38	0.26
R6	8.91	-1.42
R7	3.12	-2.372

4.1.3 Data Properties Stinger

Tabel 4.8 merupakan data stinger pada barge Tabel 4.9 merupakan data roller pada stinger yang digunakan pada penelitian.

Tabel 4.8 Data Properties Stinger

Description	Stinger Parameters
Stinger Type	Fixed Stinger
No. of Rollers on Stinger	9
Total Stinger Length	±79 m

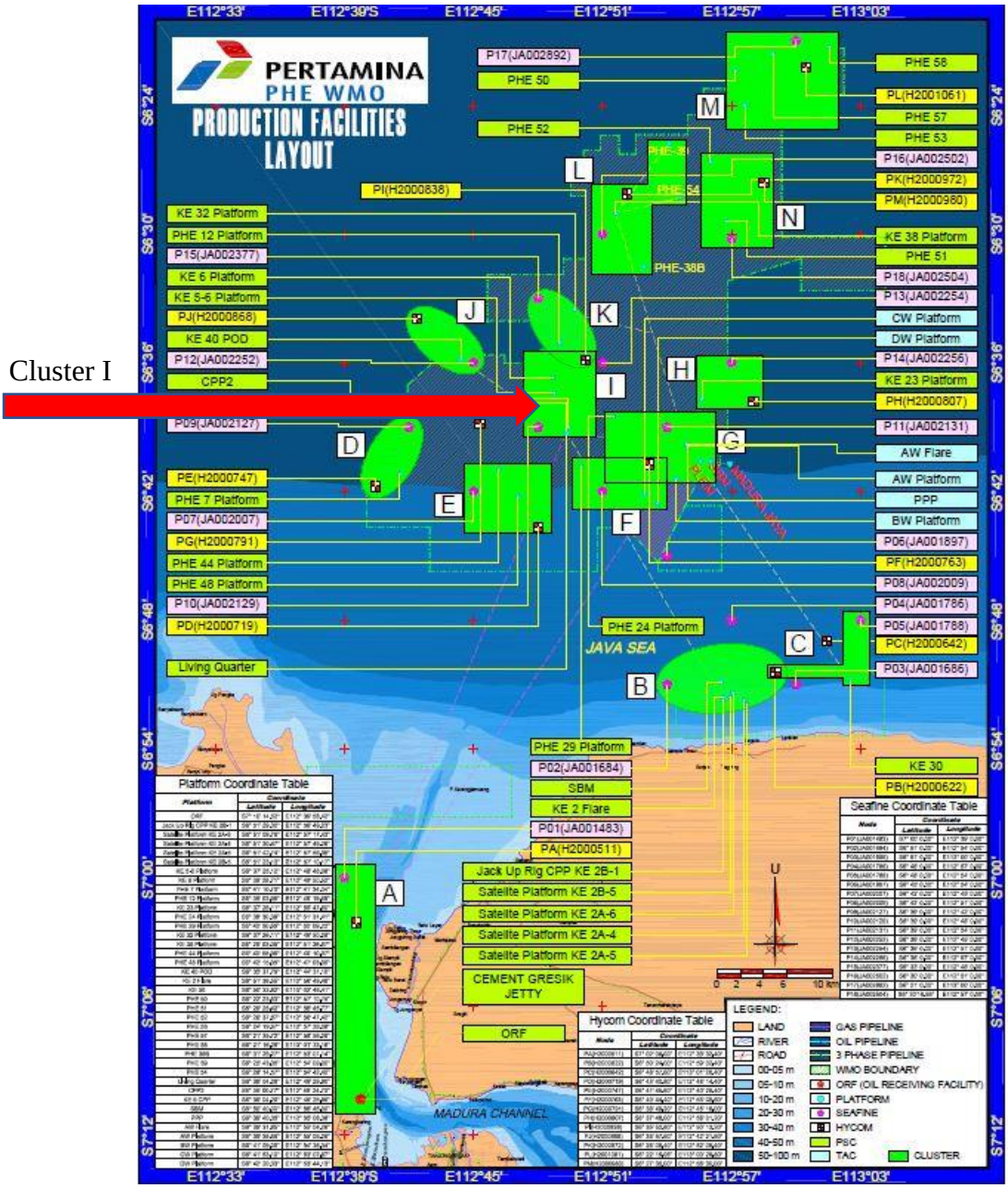
Tabel 4.9 Data Konfigurasi Roller pada Stinger

Roller ID	Distance from PLB Stern (m)	From Stinger upward (m)
S1	-5.593	1.261

Tabel 4.10 Data Konfigurasi Roller pada Stinger (Lanjutan)

Roller ID	Distance from PLB Stern (m)	From Stinger upward (m)
S2	-14.737	1.261
S3	-24.707	1.223
S4	-33.851	1.223
S5	-43.707	1.223
S6	-52.851	1.223
S7	-62.592	1.246
S8	-73.400	1.246
S9	-76.518	0.638

4.1.4 Data Lingkungan



Gambar 4. 2 Peta Persebaran Cluster Wilayah Kerja PT. PHE WMO

Analisa tegangan pipa bawah laut serta analisa *concrete crushing* saat instalasi ini berlokasi di *Cluster* I PT. PHE WMO yang lebih jelasnya dapat dilihat pada **Gambar 4.2**, di sebelah barat laut Pulau Madura. Data lingkungan yang akan digunakan bersumber dari *Metocean Data Integration Study* for WMO *Field*. Di dalam laporan tersebut mencakup keseluruhan *Metocean Data* dari semua cluster milik PHE WMO. *Metocean* (*Meteorology and Physical*

oceanography) adalah data numerik maupun keadaan yang digunakan untuk mengetahui kedalaman, kondisi arus, gelombang, pasang surut, kecepatan angin, suhu udara, *visibility* dan kelembaban di suatu daerah. Data tersebut didapatkan dari survei dengan menggunakan instumen pengukuran yang digunakan di atau di sekitaran wilayah kerja lepas pantai, data ini dibutuhkan karena setiap proyek lepas pantai biasanya membutuhkan data lingkungan yang ekstrim sebagai acuan untuk mendesain bangunan lepas pantai maupun fasilitas lainnya, pada pengerjaan tugas akhir ini data yang digunakan adalah *metocean* data di *Cluster* I. Adapun **Tabel 4.11** sampai **Tabel 4.16** memuat data lingkungan atau *metocean* data yang digunakan pada penelitian ini.

Tabel 4.11 Data Arus 1 tahunan Cluster I

Layers and Distance from Water Surface, z (m) Water Depth (m) = 53.81		Current Speed (cm/s) and Direction (to which)																
		Omni	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1-Year Return Period																		
Layer 10 - Surface (1.0 D)	0.00	63.59	15.47	15.50	19.29	34.09	63.59	55.35	16.71	7.88	6.55	6.61	9.58	18.22	51.57	58.30	29.96	19.34
Layer 9 (0.9 D)	-5.38	62.64	15.24	15.27	19.00	33.58	62.64	54.52	16.46	7.76	6.45	6.51	9.44	17.95	50.80	57.43	29.51	19.05
Layer 8 (0.8 D)	-10.76	61.59	14.98	15.01	18.68	33.02	61.59	53.61	16.19	7.63	6.34	6.40	9.28	17.65	49.95	56.47	29.02	18.73
Layer 7 (0.7 D)	-16.14	60.43	14.70	14.73	18.33	32.40	60.43	52.60	15.88	7.49	6.22	6.28	9.10	17.31	49.01	55.40	28.47	18.38
Layer 6 (0.6 D)	-21.52	59.11	14.38	14.41	17.93	31.69	59.11	51.45	15.53	7.33	6.09	6.14	8.91	16.94	47.94	54.20	27.85	17.98
Layer 5 - Mid Depth (0.5 D)	-26.91	57.59	14.01	14.04	17.47	30.88	57.59	50.13	15.13	7.14	5.93	5.99	8.68	16.50	46.71	52.80	27.14	17.52
Layer 4 (0.4 D)	-32.29	55.79	13.57	13.60	16.92	29.91	55.79	48.56	14.66	6.91	5.75	5.80	8.40	15.98	45.24	51.15	26.28	16.97
Layer 3 (0.3 D)	-37.67	53.54	13.03	13.05	16.24	28.70	53.54	46.60	14.07	6.63	5.51	5.57	8.07	15.34	43.42	49.09	25.23	16.28
Layer 2 (0.2 D)	-43.05	50.53	12.29	12.32	15.33	27.09	50.53	43.98	13.28	6.26	5.20	5.25	7.61	14.48	40.98	46.33	23.81	15.37
Layer 1 - Near Bed (0.1 D)	-48.43	45.76	11.13	11.16	13.88	24.53	45.76	39.83	12.03	5.67	4.71	4.76	6.89	13.11	37.11	41.96	21.56	13.92
(1 m ASB)	-53.81	40.22	9.78	9.80	12.20	21.56	40.22	35.01	10.57	4.98	4.14	4.18	6.06	11.52	32.62	36.87	18.95	12.23

Tabel 4.12 Data Arus 10 tahunan Cluster I

Layers and Distance from Water Surface, z (m) Water Depth (m) = 53.81		Current Speed (cm/s) and Direction (to which)																
		Omni	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
10-Year Return Period																		
Layer 10 - Surface (1.0 D)	0.00	93.79	20.54	21.60	28.69	42.22	93.79	79.87	34.17	22.27	18.49	17.52	19.74	31.37	63.63	68.08	40.27	26.30
Layer 9 (0.9 D)	-5.38	92.39	20.23	21.28	28.26	41.59	92.39	78.68	33.66	21.94	18.21	17.26	19.45	30.90	62.68	67.06	39.67	25.91
Layer 8 (0.8 D)	-10.76	90.85	19.90	20.92	27.79	40.90	90.85	77.36	33.10	21.57	17.91	16.97	19.12	30.39	61.53	65.94	39.01	25.47
Layer 7 (0.7 D)	-16.14	89.13	19.52	20.53	27.26	40.12	89.13	75.90	32.47	21.16	17.57	16.65	18.76	29.81	60.47	64.70	38.27	24.99
Layer 6 (0.6 D)	-21.52	87.19	19.09	20.08	26.67	39.25	87.19	74.25	31.77	20.70	17.19	16.29	18.35	29.16	59.15	63.29	37.44	24.45
Layer 5 - Mid Depth (0.5 D)	-26.91	84.95	18.60	19.56	25.99	38.24	84.95	72.34	30.95	20.17	16.75	15.87	17.88	28.41	57.63	61.66	36.47	23.82
Layer 4 (0.4 D)	-32.29	82.28	18.02	18.95	25.17	37.04	82.28	70.07	29.98	19.54	16.22	15.37	17.32	27.52	55.82	59.73	35.33	23.07
Layer 3 (0.3 D)	-37.67	78.98	17.29	18.19	24.16	35.55	78.97	67.25	28.77	18.75	15.57	14.75	16.62	26.41	53.58	57.32	33.91	22.14
Layer 2 (0.2 D)	-43.05	74.53	16.32	17.16	22.80	33.55	74.53	63.46	27.15	17.70	14.69	13.92	15.69	24.93	50.56	54.10	32.00	20.90
Layer 1 - Near Bed (0.1 D)	-48.43	67.50	14.78	15.55	20.65	30.39	67.50	57.48	24.59	16.03	13.31	12.61	14.21	22.58	45.79	49.00	28.98	18.93
(1 m ASB)	-53.81	59.32	12.99	13.66	18.15	26.70	59.32	50.52	21.61	14.09	11.69	11.08	12.49	19.84	40.24	43.06	25.47	16.63

Tabel 4.13 Data 1 tahunan Kecepatan Angin

1 year Return Period	Wind Speed (m/s) and Direction (from which)																
	Omni	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
60 min wind	11.8	5.72	5.77	6.31	8.46	11	10.8	9.45	7.12	6.51	6.5	7.29	9.46	11.5	11.78	8.58	6.14
10 min wind	12.1	5.9	5.95	6.5	8.71	11.3	11.2	9.73	7.33	6.71	6.7	7.51	9.75	11.9	12.13	8.84	6.32
3 min wind	12.5	6.07	6.12	6.69	8.97	11.6	11.5	10	7.55	6.9	6.89	7.72	10	12.2	12.48	9.1	6.51
2 min wind	12.6	6.12	6.18	6.75	9.05	11.7	11.6	10.1	7.62	6.97	6.96	7.8	10.1	12.3	12.6	9.18	6.57
1 min wind	13	6.3	6.35	6.94	9.31	12.1	11.9	10.4	7.83	7.17	7.15	8.02	10.4	12.7	12.96	9.44	6.75
3 sec gust	15.3	7.44	7.5	8.2	11	14.2	14.1	12.3	9.25	8.47	8.46	9.47	12.3	15	15.31	11.2	7.98

Tabel 4.14 Data 1 dan 10 tahunan Tinggi dan Periode Gelombang Siginifikan

Return Period	Wave height (m) and Associated Periods (second) For All Direction (to which)																
Depth = 51.10 - 56.77 m	Omni	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
from MSL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1-Year Return Period																	
Hs	1.89	0.21	0.17	0.16	0.34	0.69	1.89	1.08	0.40	0.33	0.30	0.42	0.76	1.48	1.03	0.39	0.21
Tp	6.23	3.04	2.90	2.71	3.08	4.28	6.23	5.08	3.35	3.29	3.07	3.34	4.27	5.73	4.54	3.20	2.75
Tz	4.84	2.36	2.26	2.11	2.40	3.33	4.84	3.95	2.61	2.56	2.39	2.6	3.32	4.46	3.53	2.49	2.14
hmax	3.78	0.42	0.34	0.32	0.68	1.38	3.78	2.16	0.80	0.66	0.60	0.84	1.52	2.96	2.06	0.78	0.42
Tmax	5.61	2.74	2.61	2.44	2.77	3.85	5.61	4.57	3.02	2.96	2.76	3.01	3.84	5.16	4.09	2.88	2.48
10-Year Return Period																	
Hs	3.42	0.81	1.00	1.07	1.07	1.76	3.42	2.90	0.93	0.95	0.92	1.00	1.95	2.31	1.50	1.01	0.74
Tp	8.63	3.79	4.09	4.22	4.81	6.27	8.63	8.51	4.75	4.47	4.56	4.67	6.52	6.90	5.78	4.26	3.92
Tz	6.71	2.95	3.18	3.28	3.74	4.88	6.71	6.62	3.69	3.48	3.55	3.63	5.07	5.37	4.49	3.31	3.05
hmax	6.84	1.62	2.00	2.14	2.14	3.52	6.84	5.80	1.86	1.90	1.84	2.00	3.90	4.62	3.00	2.02	1.48
Tmax	7.77	3.41	3.68	3.80	4.33	5.64	7.77	7.66	4.28	4.02	4.10	4.20	5.87	6.21	5.20	3.83	3.53

Tabel 4.15 Data Extreme Wave dan T_s

Extreme Wave and Ts																	
Depth = 51.10 - 56.77 m	Omni	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
from MSL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1-Year Return Period																	
Hmax	3.78	0.42	0.34	0.32	0.68	1.38	3.78	2.16	0.80	0.66	0.60	0.84	1.52	2.96	2.06	0.78	0.42
Ts	5.07	2.74	2.61	2.44	2.77	3.85	5.61	4.57	3.02	2.96	2.76	3.01	3.84	5.16	4.09	2.88	2.48
10-Year Return Period																	
Hmax	6.84	1.62	2.00	2.14	2.14	3.52	6.84	5.80	1.86	1.90	1.84	2.00	3.90	4.62	3.00	2.02	1.48
Ts	7.77	3.41	3.68	3.80	4.33	5.64	7.77	7.66	4.28	4.02	4.10	4.2	5.87	6.21	5.20	3.83	3.53

Tabel 4.16 Data Parameter JONSWAP

Return Period	*Depth* (m)	*Region*	JONSWAP Parameter				*Crest height* H' (m)
			ωp	Tp/√Hs	α	γ	
1 year	57.6	*Deep Water*	1.01	4.53	0.010146	1.71	1
10 year	57.6	*Deep Water*	0.73	4.67	0.009497	1.47	1.81

4.2 Analisa Tegangan Pipa saat Instalasi pada Kondisi Statis

4.2.1 Design Case Analisis Statis

Bedasarkan DNV-OS-F101, nilai tegangan saat instalasi pipa bawah laut dalam kondisi statis tidak boleh melebihi 87% SMYS. Pada penelitian ini jenis material pipa yang digunakan adalah API 5L Grade X52 dengan nilai SMYS 360 MPa. Dengan *allowable percentage yield* sebesar 87% maka nilai tegangan maksium yang boleh terjadi adalah 313.2 MPa di setiap *node* pipanya. Analisis tegangan ini dilakukan dengan menggunakan *software* OFFPIPE 2.05 dimana metode yang digunakan merupakan metode S-Lay, metode ini digunakan karena cocok dengan perairan Indonesia yang relative dangkal. Selanjutnya, untuk menganalisis *total stress* yang paling kecil pada saat instalasi, *design case* harus dibuat. *Design case* atau yang ditampilkan pada **Tabel 4.17** merupakan tabel yang dibuat sebelum menganalisis sesuatu untuk mendefinisikan variasi pada tiap variable yang dapat diubah. Input data yang dimasukan menggunakan pipa dengan *outside diameter* 6.625 inch dan *wall thickness* 0.5 inch sesuai data properti pipa yang telah diberikan, untuk lebih lengkapnya dapat dilihat pada **Tabel 4.18**. Pada penelitian ini penulis memvariasikan 2 variabel yaitu *stinger radius of curvature* dan kekuatan *tensioner*. Sehingga didapatkan sebanyak 9 case untuk analisa statis. Pada analisa statis ini penulis menggunakan beberapa perintah pada OFFPIPE yaitu seperti yang ditunjukan pada tabel dibawah.

Tabel 4.17 Design Case Analisis Statis

Case	Outside Diameter	Wall Thickness	Depth	Tensioner	Radius Curvature
	Inch	mm	m	ton	m
1	6.625	12.7	57.6	15	300
2	6.625	12.7			200
3	6.625	12.7			150
4	6.625	12.7		18	300
5	6.625	12.7			200
6	6.625	12.7			150
7	6.625	12.7		20	300
8	6.625	12.7			200
9	6.625	12.7			150

Tabel 4.18 Variabel Input pada Offpipe saat Analisis Statis

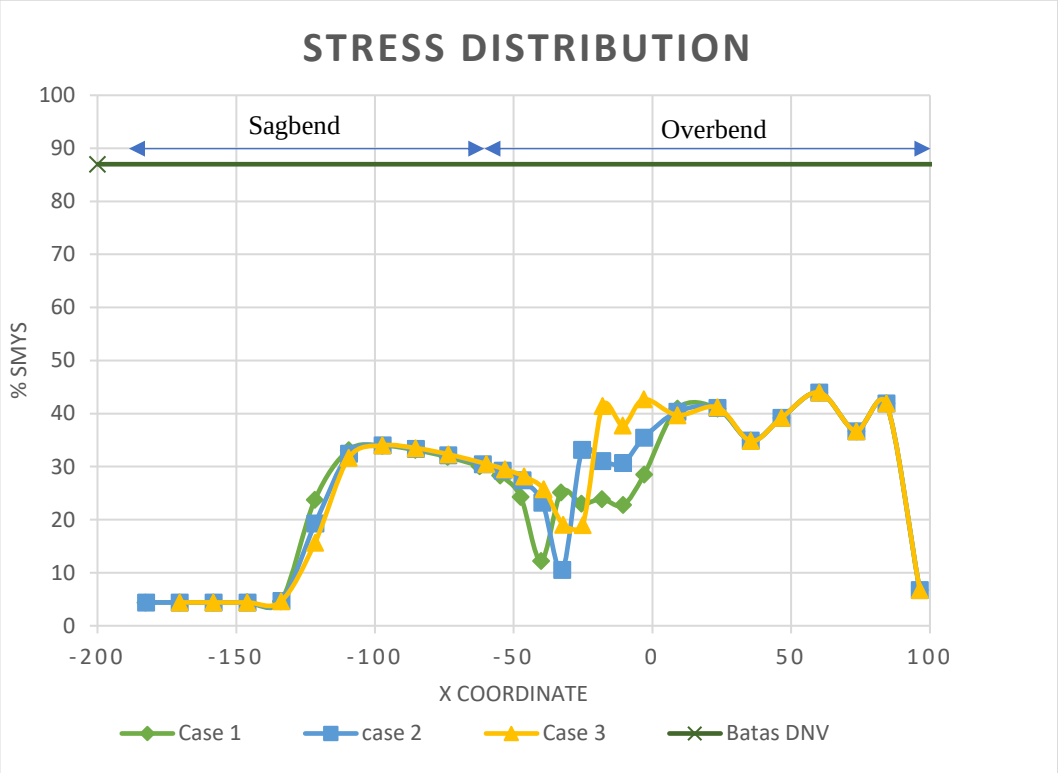
Input/Output/Heading data	Pipe and A&R Cable Data	Pipelay Vessel Data	Stinger Data	Sagbend and Seabed Data
HEAD	PIPE	TENS	STIN	GEOM
PRIN	COAT	BARG	SUPP	CURR
PROF	CABLE	SUPP	BALL	SOIL
HIST	BUND	DAVI	BUOY	LENG
PLTR	FLUI	DCAB	WEIG	FLOA
DIAG	MOME		SECT	SPAN

4.2.2 Hasil Analisa Statis

Sebelum melakukan analisis dinamis, analisis statis harus dilakukan untuk mengetahui hasil total tegangan yang terjadi pada pipa saat instalasi S-lay berlangsung. Jika nanti hasil analisis statis dengan kombinasi variabel variasi tertentu ada yang tidak memenuhi, maka nilai variasi tersebut tidak bisa dilanjutkan untuk tahap pengerjaan analisis dinamis. Pengerjaan Analisis statis ini dibantu oleh software OFFPIPE dengan menggunakan data properti pipa, *barge*, *stinger*, lingkungan, dan *roller* yang sudah didapat dengan asumsi *barge* dianggap diam (statis). Setelah analisa statis dilakukan pada *software* OFFPIPE maka akan didapatkan hasil total tegangan dan %SMYS. Kemudian hasil yang sudah diolah kedalam bentuk tabel dapat dibandingkan dengan maksimum *stress criteria* yang sudah diatur dalam DNV OS-F101. Jika %SMYS yang didapat kemudian tidak memenuhi standar dari DNV OS-F101 maka *case* tersebut dinyatakan mengalami kegagalan atau *overstress*. Adapun hasil analisa statis yang sudah dilakukan oleh penulis :

Tabel 4.19 Hasil AnalisisTegangan pada Kondisi Statis

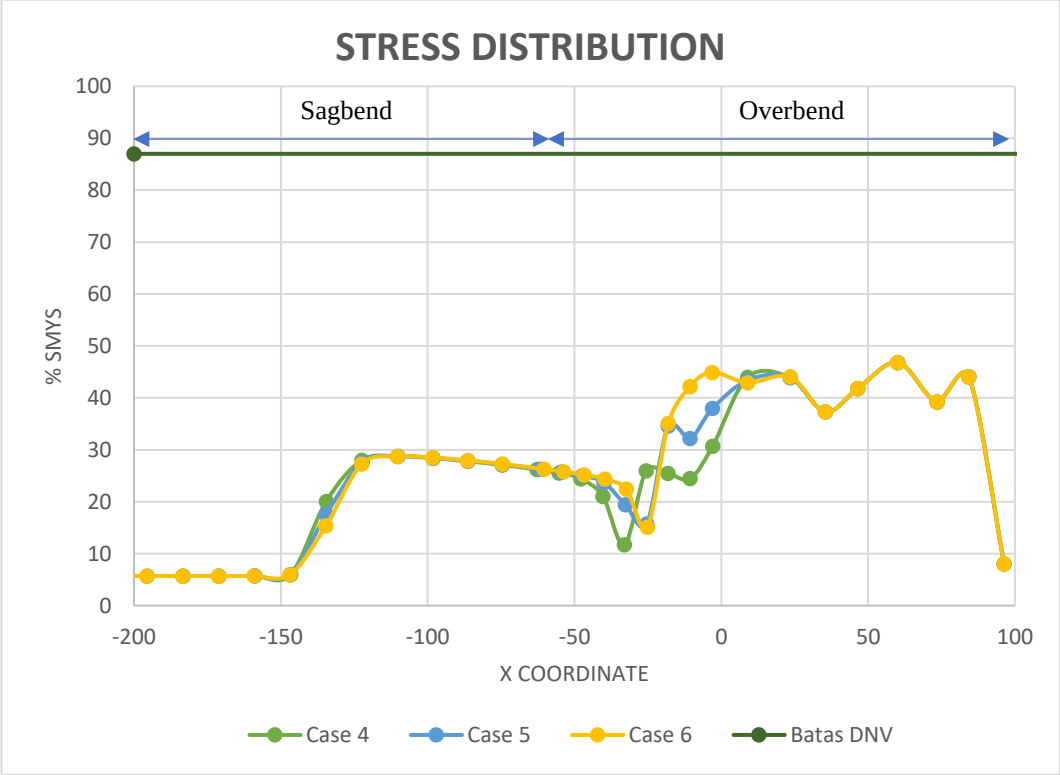
Case	Depth	Tensioner	Stinger Radius of Curvature	Stinger Departure Angle	Total Tegangan				Verify
					Overbend		Sagbend		
	m	ton	m	Deg	Mpa	%SMYS	Mpa	%SMYS	
1	57.6	15	300	24.662	158.32	43.98	122.25	33.96	OK
2			200	24.142	158.32	43.98	122.41	34	OK
3			150	23.999	158.32	43.98	122.36	33.97	OK
4		18	300	22.83	168.54	46.82	103.45	28.74	OK
5			200	22.631	168.54	46.82	103.46	28.74	OK
6			150	22.652	168.54	46.82	103.42	28.73	OK
7		20	300	21.913	175.34	48.71	95.70	26.58	OK
8			200	21.809	175.33	48.7	95.60	26.56	OK
9			150	21.923	175.34	48.71	95.66	26.57	OK



Gambar 4. 3 Distribusi Tegangan dengan Kekuatan Tensioner 15T

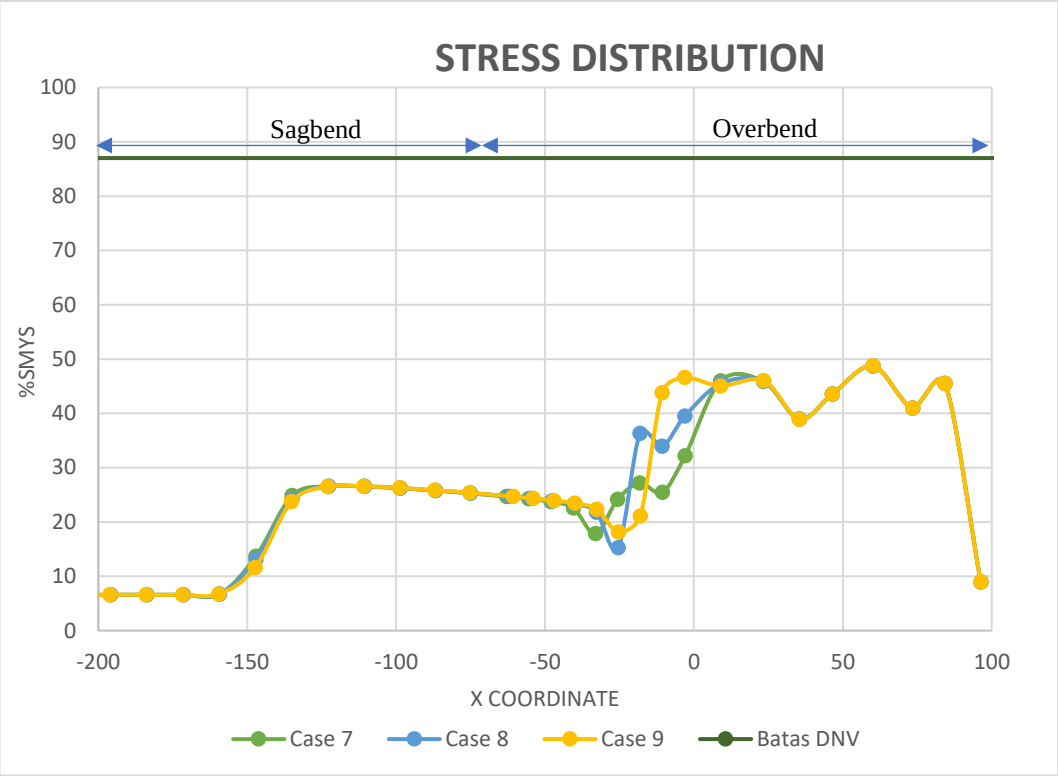
Gambar 4.3 dan **Tabel 4.19** menjelaskan tentang tegangan yang dialami di setiap bagian pipa selama proses instalasi. Sehingga kita dapat memahami tegangan maksimum terjadi pada *case* 2, yaitu di wilayah *overbend*

sebesar 158.32 MPa atau 43.98% SMYS pada *node* pipa ke-7 dan di wilayah *sagbend* sebesar 122.41 MPa atau 34% SMYS pada *node* pipa ke-38.



Gambar 4. 4 Distribusi Tegangan dengan Kekuatan Tensioner 18T

Gambar 4.4 dan **Tabel 4.19** menjelaskan tentang tegangan yang dialami di setiap bagian pipa selama proses instalasi. Sehingga kita dapat memahami tegangan maksimum terjadi pada *case* 5, yaitu di wilayah *overbend* sebesar 168.54 MPa atau 46.82% SMYS pada *node* pipa ke-7 dan di wilayah *sagbend* sebesar 103.46 MPa atau 28.74% SMYS pada *node* pipa ke-39.



Gambar 4. 5 Distribusi Tegangan dengan Kekuatan Tensioner 20T

Gambar 4.5 dan **Tabel 4.19** menjelaskan tentang tegangan yang dialami di setiap bagian pipa selama proses instalasi. Sehingga kita dapat memahami tegangan maksimum terjadi pada *case* 7, yaitu di wilayah *overbend* sebesar 175.34 MPa atau 48.71% SMYS pada *node* pipa ke-7 dan di wilayah *sagbend* sebesar 95.70 MPa atau 26.58% SMYS pada *node* pipa ke-40.

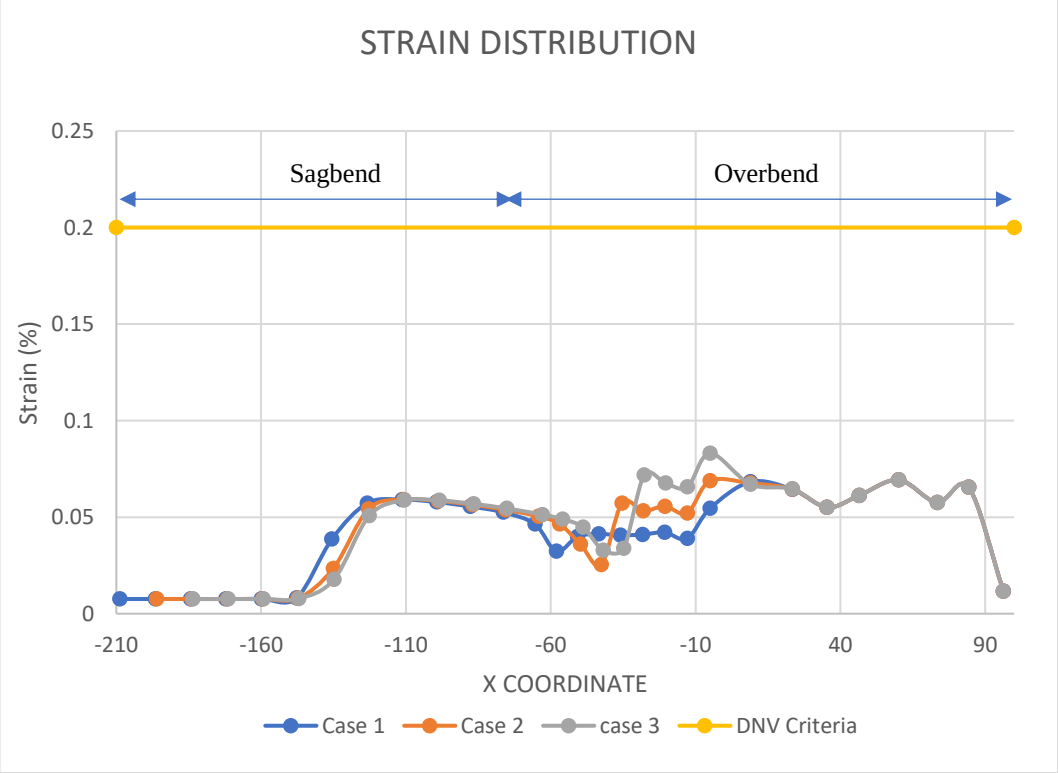
4.3 Analisa Concrete Crushing pada Kondisi Statis

Pada penelitian ini juga dilakukan analisis *concrete crushing* pada kondisi statis, dimana hasil analisis *concrete crushing* pada kondisi statis ini akan dibandingkan hasilnya dengan analisis *concrete crushing* pada kondisi dinamis. Analisa *concrete crushing* ini didasarkan pada *standard* yang telah ditetapkan oleh DNV OS-F101 October 2013. Pada *standard* ini dinyatakan bahwa *concrete crushing* dapat terjadi apabila regangan yang terjadi pada lapisan *concrete* pada pipa melebihi angka 0.2%. Pengerjaan analisa *concrete crushing* pada kondisi statis ini juga dibantu dengan software OFFPIPE 2.05 untuk mendapatkan regangan yang terjadi pada lapisan *concrete*, kemudian hasil yang didapat akan diolah dalam bentuk tabel kemudian dibandingkan dengan *standard* yang telah ditentukan DNV

OS-F101. Adapun hasil analisa *concrete crushing* yang sudah dilakukan oleh penulis adalah sebagai berikut :

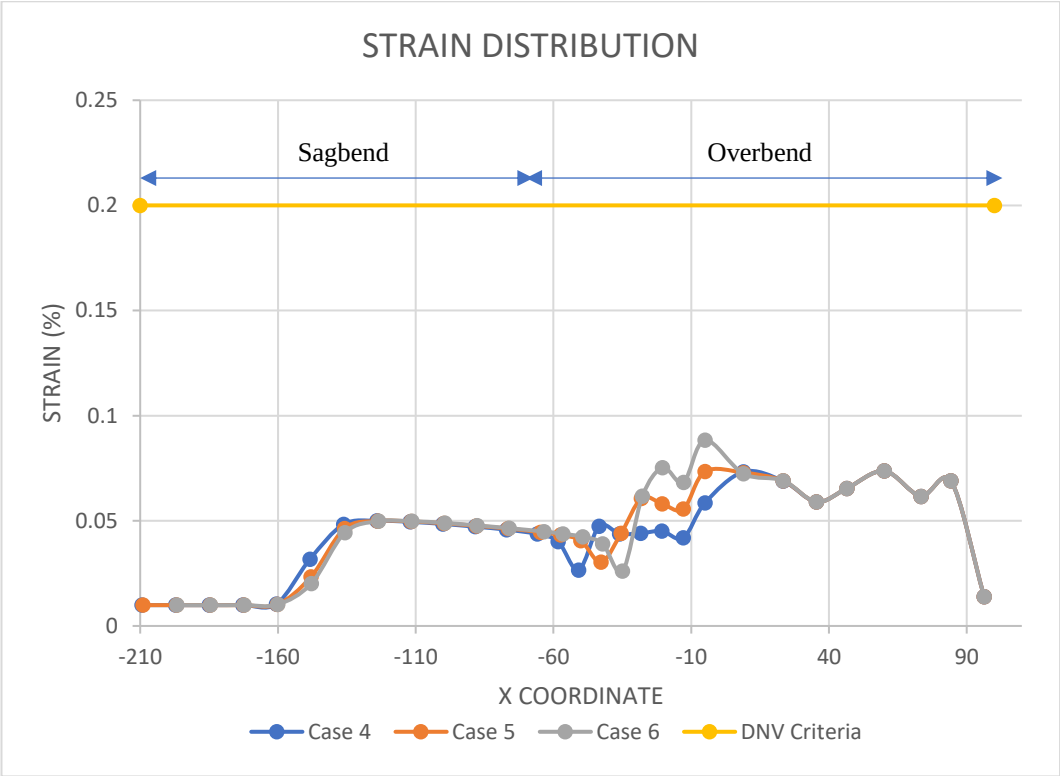
Tabel 4.20 Hasil Analisa *Concrete Crushing* kondisi Statis

Case	Total Regangan				Criteria	Verify
	Overbend		Sagbend			
	Max Strain (%)	Percent Allowance (%)	Max Strain (%)	Percent Allowance (%)		
1	0.069	26.64	0.0591	22.73	0.2%	OK
2	0.069	26.64	0.0591	22.72		OK
3	0.083	31.97	0.058	22.61		OK
4	0.074	28.36	0.05	19.22		OK
5	0.074	28.35	0.049	19.2		OK
6	0.088	34	0.0498	19.15		OK
7	0.0767	29.5	0.0462	17.760		OK
8	0.0767	29.5	0.0463	17.790		OK
9	0.0918	35.33	0.05	17.81		OK



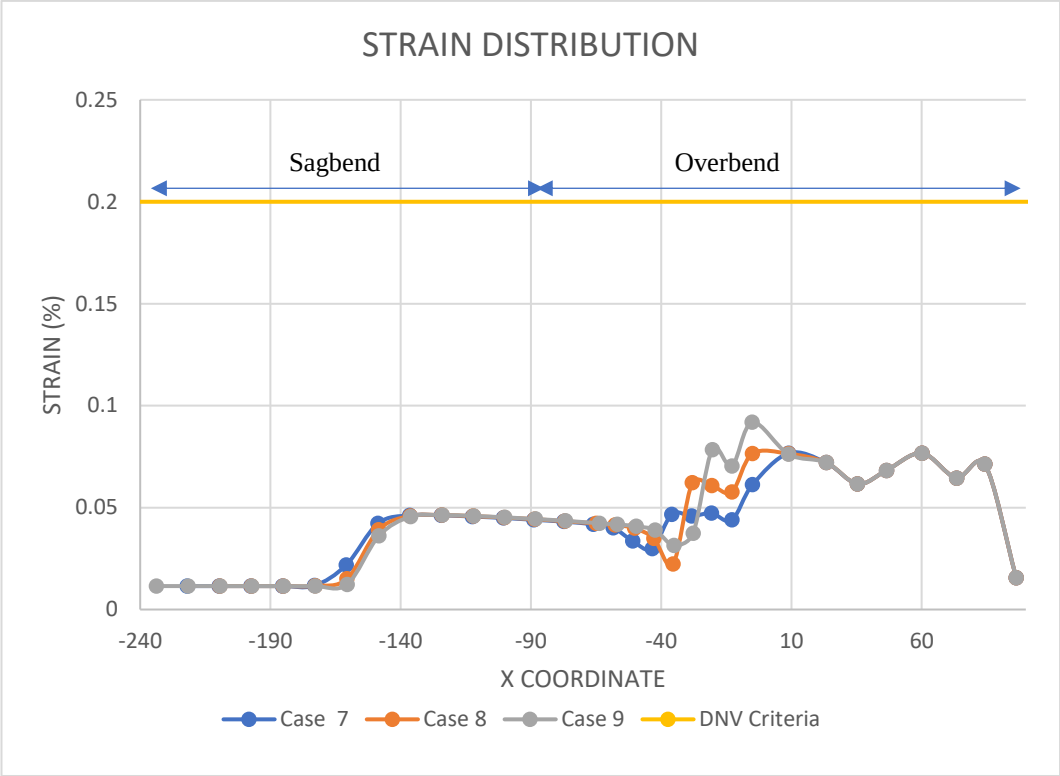
Gambar 4. 6 Distribusi Regangan pada Lapisan Concrete dengan Kekuatan Tensioner 15T

Gambar 4.6 dan **Tabel 4.20** menjelaskan tentang regangan yang dialami di setiap bagian lapisan *concrete* pada pipa selama proses instalasi. Sehingga kita dapat memahami regangan maksimum yang terjadi untuk wilayah *overbend* adalah *case* 3 dengan nilai sebesar 0.083% pada *node* pipa ke-18 dan di wilayah *sagbend* adalah *case* 1&2 dengan nilai sebesar 0.0591% pada *node* pipa ke-39



Gambar 4. 7 Distribusi Regangan pada Lapisan Concrete dengan Kekuatan Tensioner 18T

Gambar 4.7 dan **Tabel 4.20** menjelaskan tentang regangan yang dialami di setiap bagian lapisan *concrete* pada pipa selama proses instalasi. Sehingga kita dapat memahami regangan maksimum yang terjadi untuk wilayah *overbend* adalah *case* 6 dengan nilai sebesar 0.088% pada *node* pipa ke-18 dan di wilayah *sagbend* adalah *case* 4 dengan nilai sebesar 0.05% pada *node* pipa ke-40.



Gambar 4. 8 Distribusi Regangan pada Lapisan Concrete dengan Kekuatan Tensioner 20T

Gambar 4.8 dan **Tabel 4.20** menjelaskan tentang regangan yang dialami di setiap bagian lapisan *concrete* pada pipa selama proses instalasi. Sehingga kita dapat memahami regangan maksimum yang terjadi untuk wilayah *overbend* adalah *case* 9 dengan nilai sebesar 0.0918% pada *node* pipa ke-18 dan di wilayah *sagbend* adalah *case* 8&9 dengan nilai sebesar 0.046% pada *node* pipa ke-40.

4.4 Validasi Tegangan Kondisi Statis

Hasil tegangan pipa pada kondisi statis yang telah dianalisa dengan bantuan *software* Offpipe 2.05 akan divalidasi dengan perhitungan manual yang merujuk pada buku *Subsea Pipeline Design Analysis and Installation* oleh Qiang Bai dan Yong Bai (2014). Validasi perhitungan akan dilakukan terhadap tiap *design case* yang telah ditentukan, pada node pipa ke -34.

4.4.1 Tegangan Pipa pada *Case* 1

Untuk *tension tensioner* 15 kN, *radius curvature* 300 m, dan kedalaman *node* pipa, h : -44.07 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :
σ_t = 2.28 MPa

σ_{hor} = 9.12 MPa
σ_{ver} = 106.86 MPa
σ_c = 107.25 MPa
σ_h = -2.93 MPa
σ_{vm} = 108.28 Mpa

Perhitungan Manual :

$\sigma_t = \frac{150000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-44.07}{0.043315})$
= 2.23 Mpa

$\sigma_{hor} = \frac{1}{2}\ (1.43)(\frac{0.168275}{0.0000129})$
= 9.33 MPa

$\sigma_{ver} = \frac{1}{2}\ (16.46)(\frac{0.168275}{0.0000129})$
= 107.36 MPa

$\sigma_c = \sqrt{(9.33)^2 + \ (107.36)^2}$
= 107.76 MPa

$\sigma_h = \frac{1}{2}\ (10250)(0.168275)(\frac{-44.07}{0.0127})$
= -2.993 MPa

$\sigma_{vm} = [\big(107.76 + (2.23)\big)^2 + (-2.993)^2 - \big(107.76 + (2.23)\big)(-2.993)]\frac{1}{2}$
= 111.52 MPa

4.4.2 Tegangan Pipa pada *Case* 2

Untuk *tension tensioner* 15 kN, *radius curvature* 200 m, dan kedalaman *node* pipa, h : -44.46 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :
σ_t = 2.31 MPa
σ_{hor} = 9.24 MPa
σ_{ver} = 108.44 MPa
σ_c = 108.83 MPa
σ_h = -2.97 MPa
σ_{vm} = 109.55 Mpa

Perhitungan Manual :

$\sigma_t = \frac{150000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-44.46}{0.043315})$
= 2.22 Mpa

$\sigma_{hor} = \frac{1}{2}\ (1.43)(\frac{0.168275}{0.0000129})$
= 9.33 MPa

$\sigma_{ver} = \frac{1}{2}\ (16.66)(\frac{0.168275}{0.0000129})$
= 108.66 MPa

$\sigma_c = \sqrt{(9.33)^2 + \ (108.66)^2}$
= 109.06 MPa

$\sigma_h = \frac{1}{2}\ (10250)(0.168275)(\frac{-44.46}{0.0127})$
= -3.019 MPa

σ_{vm} = $[(109.06 + (2.22))^2 + (-3.019)^2 - (109.06 + (2.22))(-3.019)]^{\frac{1}{2}}$
= 112.82 MPa

4.4.3 Tegangan Pipa pada *Case* 3

Untuk *tension tensioner* 15 kN, *radius curvature* 150 m, dan kedalaman *node* pipa, h : -44.83 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :
σ_t = 2.48 MPa
σ_{hor} = 9.21 MPa
σ_{ver} = 108.81 MPa
σ_c = 109.2 MPa
σ_h = -2.98 MPa
σ_{vm} = 109.84 Mpa

Perhitungan Manual :
σ_t = $\frac{150000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-44.83}{0.043315})$
= 2.22 Mpa
σ_{hor} = $\frac{1}{2}$ $(1.42)(\frac{0.168275}{0.0000129})$
= 9.26 MPa
σ_{ver} = $\frac{1}{2}$ $(16.71)(\frac{0.168275}{0.0000129})$
= 108.99 MPa
σ_c = $\sqrt{(9.26)^2 + (108.99)^2}$
= 109.38 MPa
σ_h = $\frac{1}{2}$ $(10250)(0.168275)(\frac{-44.83}{0.0127})$
= -3.044 MPa
σ_{vm} = $[(109.38 + (2.22))^2 + (-3.044)^2 - (109.38 + (2.22))(-3.044)]^{\frac{1}{2}}$
= 113.15 MPa

4.4.4 Tegangan Pipa pada *Case* 4

Untuk *tension tensioner* 18 kN, *radius curvature* 300 m, dan kedalaman *node* pipa, h : -42.68 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :
σ_t = 2.8 MPa
σ_{hor} = 7.65 MPa
σ_{ver} = 84.68 MPa
σ_c = 85.02 MPa
σ_h = -2.84 MPa
σ_{vm} = 94.39 Mpa

Perhitungan Manual :
σ_t = $\frac{180000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-42.68}{0.043315})$

$= 2.96$ Mpa

$\sigma_{hor} = \frac{1}{2}\ (1.18)(\frac{0.168275}{0.0000129})$

$= 7.7$ MPa

$\sigma_{ver} = \frac{1}{2}\ (13)(\frac{0.168275}{0.0000129})$

$= 84.79$ MPa

$\sigma_c = \sqrt{(7.7)^2 + (84.79)^2}$

$= 85.14$ MPa

$\sigma_h = \frac{1}{2}\ (10250)(0.168275)(\frac{-42.68}{0.0127})$

$= -2.898$ MPa

$\sigma_{vm} = [\big(85.14 + (2.96)\big)^2 + (-2.898)^2 - \big(85.14 + (2.96)\big)(-2.898)]\frac{1}{2}$

$= 89.58$ MPa

4.4.5 Tegangan Pipa pada *Case* 5

Untuk *tension tensioner* 18 kN, *radius curvature* 200 m, dan kedalaman *node* pipa, h : -42.96 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :

$\sigma_t = 2.76$ MPa

$\sigma_{hor} = 7.61$ MPa

$\sigma_{ver} = 85$ MPa

$\sigma_c = 85.34$ MPa

$\sigma_h = -2.86$ MPa

$\sigma_{vm} = 94.63$ Mpa

Perhitungan Manual :

$\sigma_t = \frac{180000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-42.96}{0.043315})$

$= 2.95$ Mpa

$\sigma_{hor} = \frac{1}{2}\ (1.17)(\frac{0.168275}{0.0000129})$

$= 7.63$ MPa

$\sigma_{ver} = \frac{1}{2}\ (13.04)(\frac{0.168275}{0.0000129})$

$= 85.05$ MPa

$\sigma_c = \sqrt{(7.63)^2 + (85.05)^2}$

$= 85.39$ MPa

$\sigma_h = \frac{1}{2}\ (10250)(0.168275)(\frac{-42.96}{0.0127})$

$= -2.917$ MPa

$\sigma_{vm} = [\big(109.06 + (2.95)\big)^2 + (-2.917)^2 - \big(109.06 + (2.95)\big)(-2.917)]\frac{1}{2}$

$= 89.84$ MPa

4.4.6 Tegangan Pipa pada *Case* 6

Untuk *tension tensioner* 18 kN, *radius curvature* 150 m, dan kedalaman *node* pipa, h : -42.94 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :

σ_t = 2.99 MPa
σ_{hor} = 7.59 MPa
σ_{ver} = 84.98 MPa
σ_c = 85.32 MPa
σ_h = -2.86 MPa
σ_{vm} = 94.61 Mpa

Perhitungan Manual :

$\sigma_t = \frac{180000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-42.94}{0.043315})$
= 2.95 Mpa
$\sigma_{hor} = \frac{1}{2}\ (1.16)(\frac{0.168275}{0.0000129})$
= 7.57 MPa
$\sigma_{ver} = \frac{1}{2}\ (13.03)(\frac{0.168275}{0.0000129})$
= 84.99 MPa
$\sigma_c = \sqrt{(7.57)^2 + \ (84.99)^2}$
= 85.32 MPa
$\sigma_h = \frac{1}{2}\ (10250)(0.168275)(\frac{-42.94}{0.0127})$
= -2.916 MPa
$\sigma_{vm} = [\big(85.32 + (2.95)\big)^2 + (-2.916)^2 - \big(85.32 + (2.95)\big)(-2.916)]\frac{1}{2}$
= 89.77 MPa

4.4.7 Tegangan Pipa pada *Case* 7

Untuk *tension tensioner* 20 kN, *radius curvature* 300 m, dan kedalaman *node* pipa, h : -41.82 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :

σ_t = 3.55 MPa
σ_{hor} = 6.87 MPa
σ_{ver} = 74.24 MPa
σ_c = 74.56 MPa
σ_h = -2.78 MPa
σ_{vm} = 88.82 Mpa

Perhitungan Manual :

$\sigma_t = \frac{200000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-41.82}{0.043315})$
= 3.44 Mpa
$\sigma_{hor} = \frac{1}{2}\ (1.05)(\frac{0.168275}{0.0000129})$
= 6.85 MPa
$\sigma_{ver} = \frac{1}{2}\ (11.39)(\frac{0.168275}{0.0000129})$
= 74.29 MPa
$\sigma_c = \sqrt{(6.85)^2 + \ (74.29)^2}$
= 74.6 MPa

$\sigma_h = \frac{1}{2}\ (10250)(0.168275)(\frac{-41.82}{0.0127})$
= -2.84 MPa
$\sigma_{vm} = [(74.6 + (3.44))^2 + (-2.84)^2 - (74.6 + (3.44))(-2.84)]\frac{1}{2}$
= 79.50 MPa

4.4.8 Tegangan Pipa pada *Case* 8

Untuk *tension tensioner* 20 kN, *radius curvature* 200 m, dan kedalaman *node* pipa, h : -41.98 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :
σ_t = 3.48 MPa
σ_{hor} = 6.83 MPa
σ_{ver} = 74.36 MPa
σ_c = 74.67 MPa
σ_h = -2.8 MPa
σ_{vm} = 88.9 Mpa

Perhitungan Manual :
$\sigma_t = \frac{200000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-41.98}{0.043315})$
= 3.43 Mpa
$\sigma_{hor} = \frac{1}{2}\ (1.05)(\frac{0.168275}{0.0000129})$
= 6.85 MPa
$\sigma_{ver} = \frac{1}{2}\ (11.4)(\frac{0.168275}{0.0000129})$
= 74.35 MPa
$\sigma_c = \sqrt{(6.85)^2 + (74.35)^2}$
= 74.67 MPa
$\sigma_h = \frac{1}{2}\ (10250)(0.168275)(\frac{-41.98}{0.0127})$
= -2.851 MPa
$\sigma_{vm} = [(74.67 + (3.43))^2 + (-2.851)^2 - (74.67 + (3.43))(-2.851)]\frac{1}{2}$
= 79.57 MPa

4.4.9 Tegangan Pipa pada *Case* 9

Untuk *tension tensioner* 20 kN, *radius curvature* 150 m, dan kedalaman *node* pipa, h : -41.81 m, tegangan pipa yang terjadi berdasarkan analisa yang dibantu *software* Offpipe 2.05 ditampilkan di bawah ini :

Offpipe Results :
σ_t = 3.59 MPa
σ_{hor} = 6.82 MPa
σ_{ver} = 74.21 MPa
σ_c = 74.52 MPa
σ_h = -2.78 MPa
σ_{vm} = 88.8 Mpa

Perhitungan Manual :

$\sigma_t = \frac{200000}{0.043315} + \frac{1}{4}(3.14)(0.168275)^2(10250)(\frac{-41.81}{0.043315})$

$= 3.44$ Mpa

$\sigma_{hor} = \frac{1}{2}\ (1.04)(\frac{0.168275}{0.0000129})$

$= 6.78$ MPa

$\sigma_{ver} = \frac{1}{2}\ (11.38)(\frac{0.168275}{0.0000129})$

$= 74.22$ MPa

$\sigma_c = \sqrt{(6.78)^2 + \ (74.22)^2}$

$= 74.53$ MPa

$\sigma_h = \frac{1}{2}\ (10250)(0.168275)(\frac{-41.81}{0.0127})$

$= -2.839$ MPa

$\sigma_{vm} = [\big(74.53 + (3.44)\big)^2 + (-2.839)^2 - \big(74.53 + (3.44)\big)(-2.839)]\frac{1}{2}$

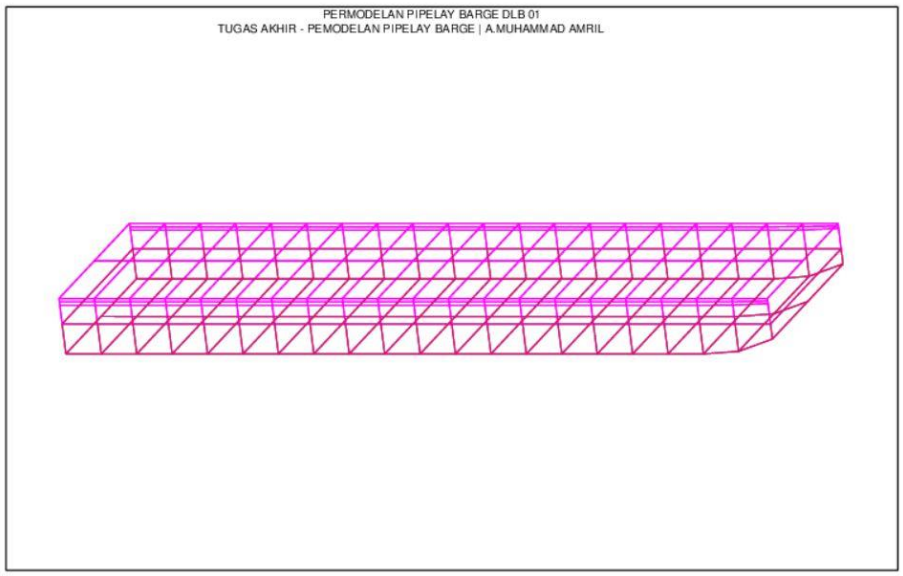
$= 79.43$ MPa

4.5 Pemodelan Pipe Laying Barge

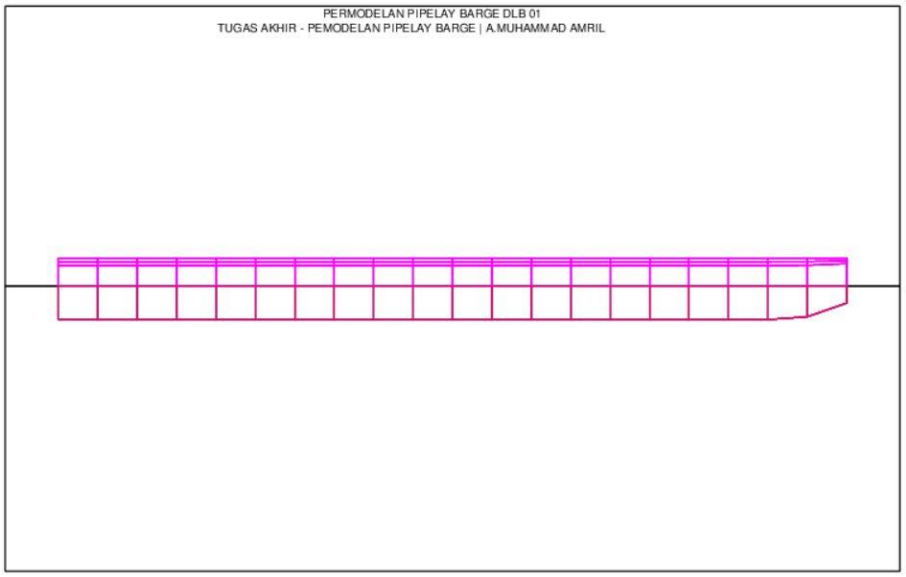
Untuk melakukan analisa instalasi pipa bawah laut diperlukan pemodelan *pipe laying barge* terlebih dahulu. Pemodelan ini dilakukan untuk mengetahui respons gerakan dari *pipe laying barge* saat berada di lokasi instalasi. Respons gerakan ini akan menunjukan nilai-nilai gerakan *barge* pada 6 arah derajat kebebasan, frekuensi gelombang akan memengaruhi gerakan *barge* dan nilainya bergantung pada frekuensi natural dari *barge.*

4.5.1 Pemodelan Struktur Pipe Laying Barge

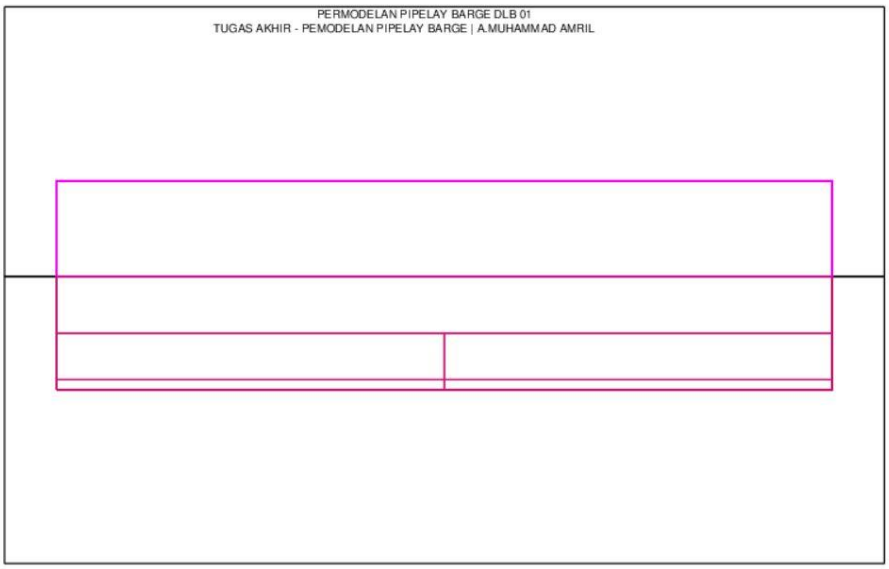
Pemodelan *Pipe Laying Barge* dilakukan dengan menggunakan *software* MOSES. Setelah itu dilakukan analisis RAO untuk mendapatkan angka faktor pengali untuk mendapatkan nilai respons gerakan *pipe laying barge*. Hasil pemodelan ditunjukan pada **Gambar 4.9** sampai **Gambar 4.15** berikut :



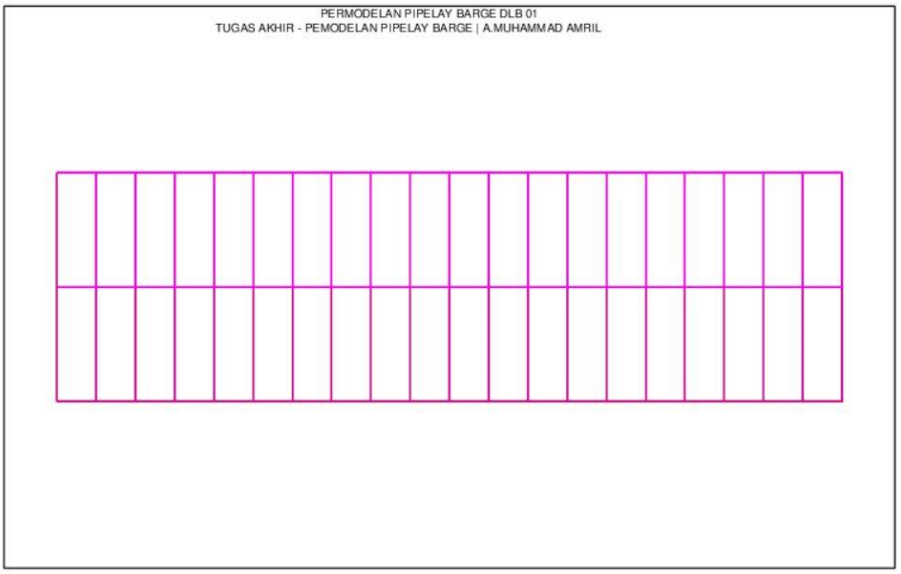
Gambar 4. 9 Model Pipe Laying Barge Tampak Isometri



Gambar 4. 10 Model Pipe Laying Barge Tampak Samping

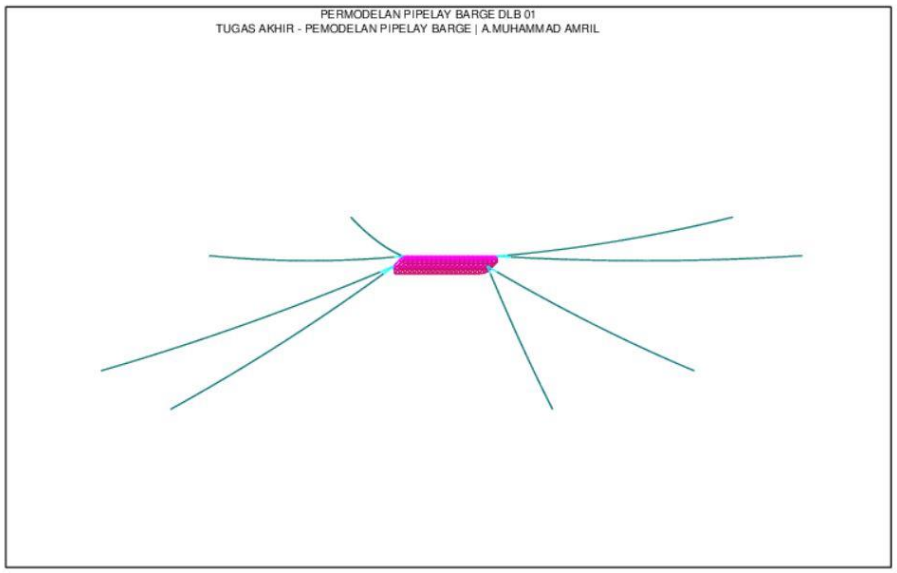


Gambar 4. 11 Model Pipe Laying Barge Tampak Bow

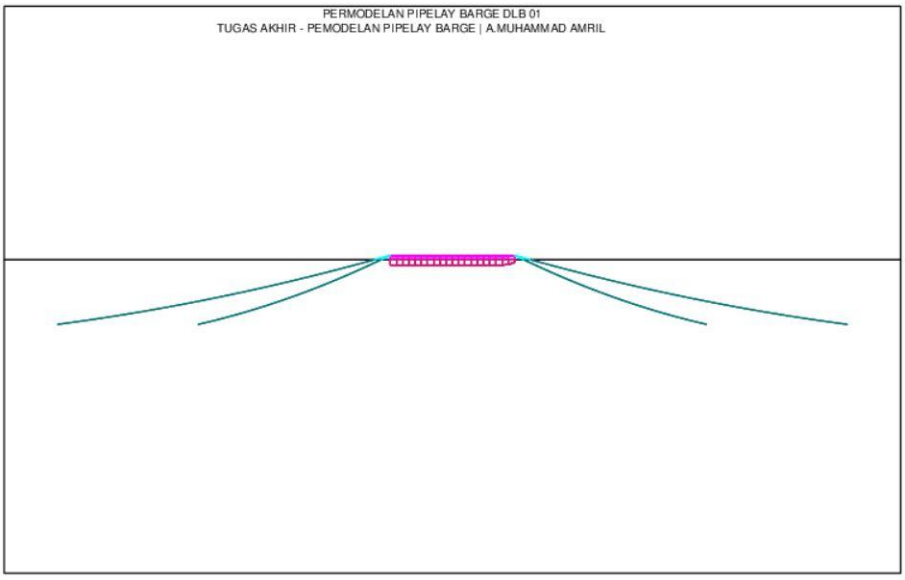


Gambar 4. 12 Model Pipe Laying Barge Tampak Atas

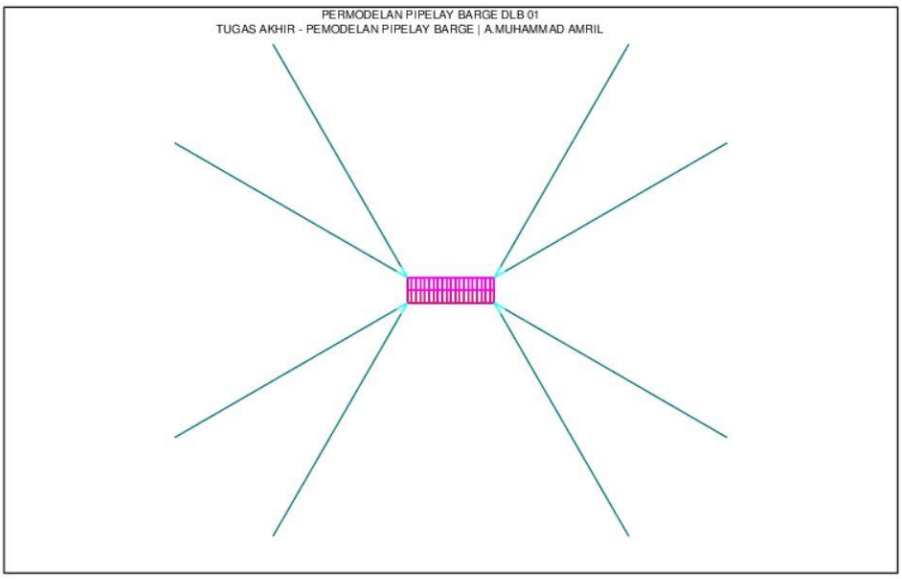
Selain itu, pada penelitian ini juga dilakukan pemodelan *mooring system*. Pada saat instalasi pipa bawah laut sistem *mooring* sangat penting supaya gerakan *pipe laying barge* dapat diredam dan membuat instalasi pipa bawah laut tetap pada jalur yang telah direncanakan. Pemodelan *mooring* juga dilakukan menggunakan *software* MOSES untuk selanjutnya dilakukan analisis respons gerakan struktur.



Gambar 4. 13 Model Mooring Tampak Isometri



Gambar 4. 14 Model Mooring Tampak Samping



Gambar 4. 15 Model Mooring Tampak Atas

4.5.2 Validasi Model Pipe Laying Barge

Sebelum melanjutkan ke tahap selanjutnya, model *pipelay barge* yang telah dibuat dengan bantuan *software* MOSES harus dilakukan validasi terlebih dahulu, agar model yang telah dibuat bisa mewakili keadaan *pipelay barge* yang sebenarnya. Validasi dilakukan dengan membandingkan parameter hasil permodelan dari *software* MOSES dengan data yang ada. Nilai nilai yang divalidasi adalah LOA, Breadth, Depth, Draft, Displacement, GMT, dan GML. Kriteria validasi didasarkan pada IACS (International Association of Classification Societies). Berdasarkan aturan yang terdapat pada IACS toleransi untuk parameter displasmen kapal maksimum sebesar 2% sedangkan untuk parameter lainnya toleransi maksimum sebesar 1%. Hasil validasi ditunjukan pada **Tabel 4.21**.

Tabel 4.21 Validasi Model Pipe Laying Barge

Validasi	Data	Model	Error (%)
LOA (m)	121.9	121.9	0
Breadth (m)	32.3	32.3	0
Depth (m)	8.68	8.68	0
Draft (m)	4.7	4.7	0
Displacement (ton)	17438.69	17562	0.707

Tabel 4.22 Validasi Model Pipe Laying Barge (Lanjutan)

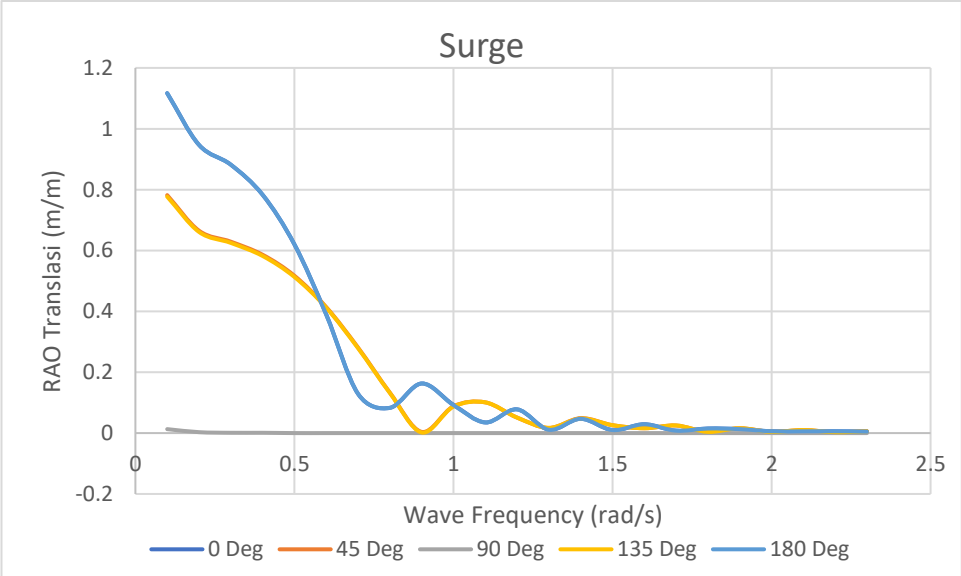
Validasi	Data	Model	Error (%)
GMT (m)	21.447	21.613	0.774
GML (m)	266.47	268.954	0.932

Berdasarkan hasil validasi pada **Tabel 4.21**, maka dapat disimpulkan bahwa model *barge* yang telah dibuat dengan bantuan *software* MOSES dinyatakan valid dan bisa digunakan untuk analisa pada tahapan selanjutnya.

4.6 Analisis *Response Amplitudo Operator* (RAO)

Setelah model *pipe laying barge* di validasi dan memenuhi nilai kriteria yang telah ditentukan oleh IACS (International Association of Classification Societies), maka analisis respons gerakan struktur dapat dilakukan. Untuk menghitung respons gerakan struktur maka perlu menghitung RAO terlebih dahulu. RAO memiliki fungsi sebagai faktor pengali antara amplitude gelombang dan amplitude struktur. Pada penelitian ini, dilakukan analisis RAO dengan meninjau 6 derajat kebebasan (*surge, sway, heave, roll, pitch , yaw*) dan dengan 5 arah pembebanan gelombang yaitu 0°, 45°, 90°, 135°, 180°. Hasil analisis respons gerakan struktur ditunjukkan pada **Gambar 4.16** sampai **Gambar 4.21**.

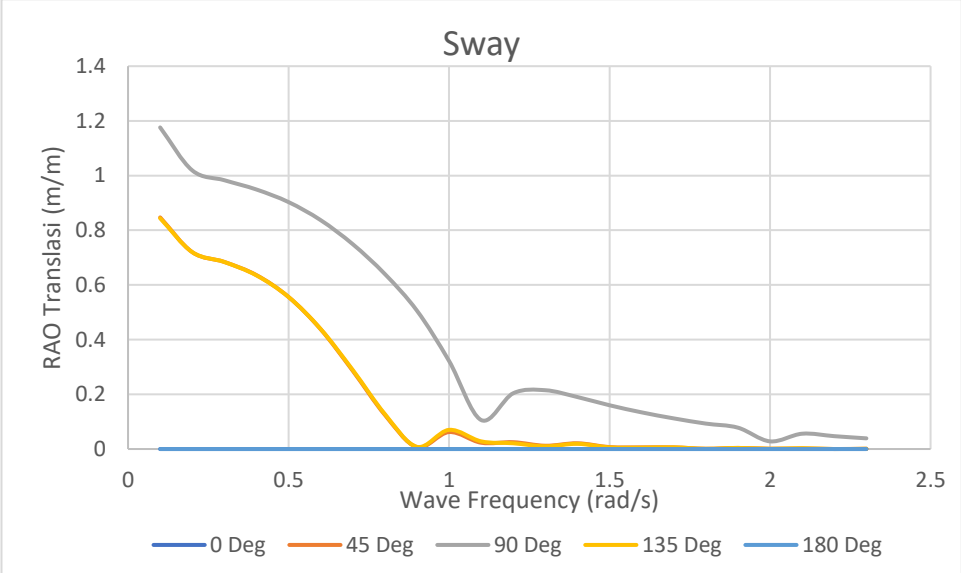
1.6.1 Gerakan Surge



Gambar 4. 16 Grafik RAO Translasi ke Arah Surge

Gerakan *surge* merupakan gerakan translasi yang terjadi pada sumbu –x. Pada hasil analisa yang dilakukan, gerakan ini memiliki RAO paling besar terhadap arah pembebanan datang gelombang 0°, 45°, 90°, 135°, dan 180° dengan nilai 1.117 m/m pada frekuensi 0.1 rad/s, 0.782 m/m pada frekuensi 0.1 rad/s, 0.013 m/m pada frekuensi 0.1 rad/s, 0.777 m/m pada frekuensi 0.1 rad/s, dan 1.117 m/m pada frekuensi 0.1 rad/s.

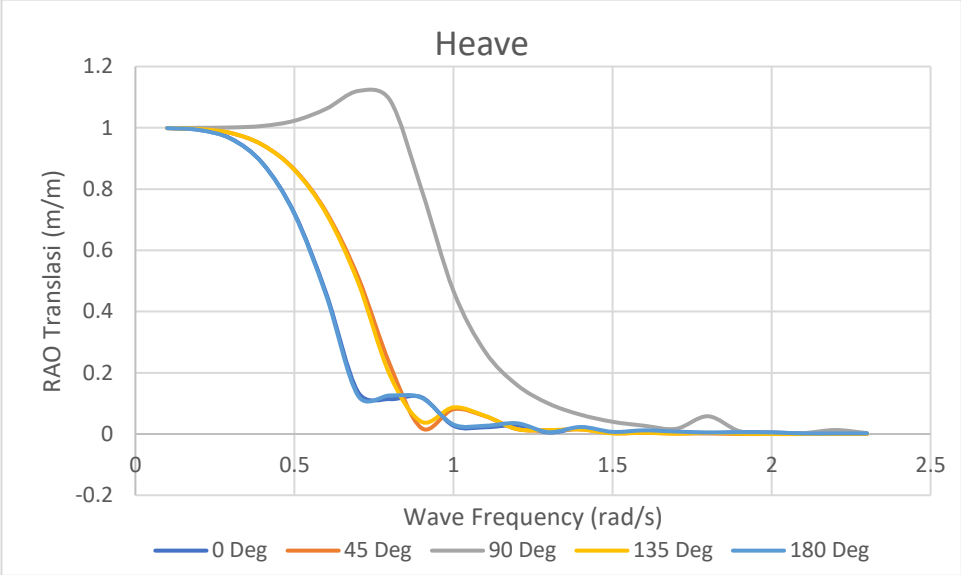
1.6.2 Gerakan Sway



Gambar 4. 17 Grafik RAO Translasi ke Arah Sway

Gerakan *sway* merupakan gerakan translasi yang terjadi pada sumbu –y. Pada hasil analisa yang dilakukan, gerakan ini memiliki RAO paling besar terhadap arah pembebanan datang gelombang 45°, 90°, dan 135° dengan nilai 0.847 m/m pada frekuensi 0.1 rad/s, 1.176 m/m pada frekuensi 0.1 rad/s, dan 0.844 m/m pada frekuensi 0.1. Sedangkan pembebanan gelombang dari arah 0° dan 180° tidak mempengaruhi gerakan ini.

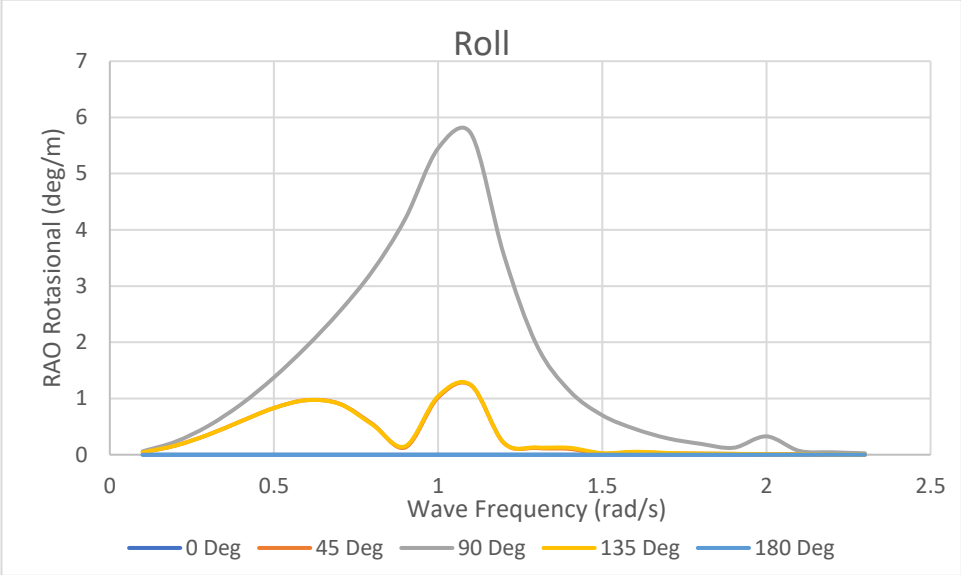
1.6.3 Gerakan Heave



Gambar 4. 18 Grafik RAO Translasi ke Arah Heave

Gerakan *heave* merupakan gerakan translasi yang terjadi pada sumbu –z. Pada hasil analisa yang dilakukan, gerakan ini memiliki RAO paling besar terhadap arah pembebanan datang gelombang 0°, 45°, 90°, 135°, dan 180° dengan nilai 0.999 m/m pada frekuensi 0.1 rad/s, 0.999 m/m pada frekuensi 0.1 rad/s, 1.12 m/m pada frekuensi 0.7 rad/s, 0.999 m/m pada frekuensi 0.1 rad/s, dan 0.999 m/m pada frekuensi 0.1 rad/s.

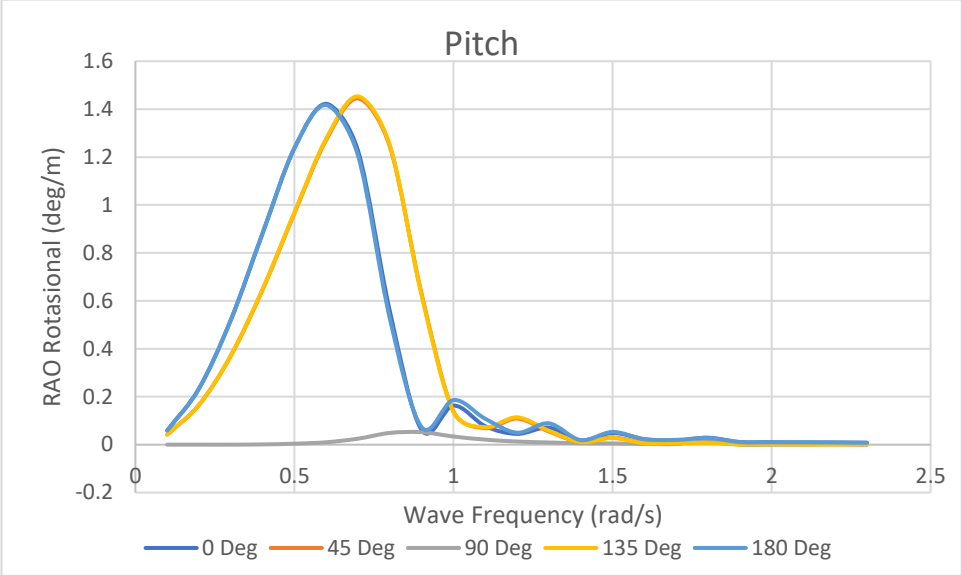
1.6.4 Gerakan Roll



Gambar 4. 19 Grafik RAO Rotasi ke Arah Roll

Gerakan *roll* merupakan gerakan rotasional yang terjadi pada sumbu –x. Pada hasil analisa yang dilakukan, gerakan ini memiliki RAO paling besar terhadap arah pembebanan datang gelombang 45°, 90°, dan 135° dengan nilai 1.236 deg/m pada frekuensi 1.1 rad/s, 5.713 deg/m pada frekuensi 1.1 rad/s, dan 1.241 deg/m pada frekuensi 1.1 rad/s. Sedangkan pembebanan gelombang dari arah 0° dan 180° tidak mempengaruhi gerakan ini.

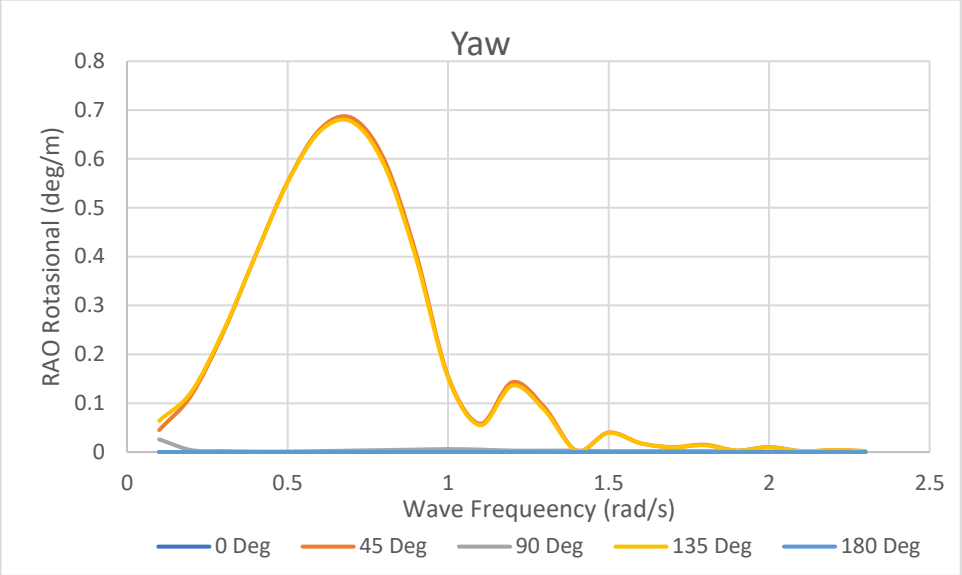
1.6.5 Gerakan Pitch



Gambar 4. 20 Grafik RAO Rotasi ke Arah Pitch

Gerakan *pitch* merupakan gerakan rotasional yang terjadi pada sumbu – y. Pada hasil analisa yang dilakukan, gerakan ini memiliki RAO paling besar terhadap arah pembebanan datang gelombang 0°, 45°, 90°, 135°, dan 180° dengan nilai 1.422 deg/m pada frekuensi 0.6 rad/s, 1.445 deg/m pada frekuensi 0.7 rad/s, 0.052 deg/m pada frekuensi 0.9 rad/s, 1.453 deg/m pada frekuensi 0.7 rad/s, dan 1.417 deg/m pada frekuensi 0.6 rad/s.

1.6.6 Gerakan Yaw



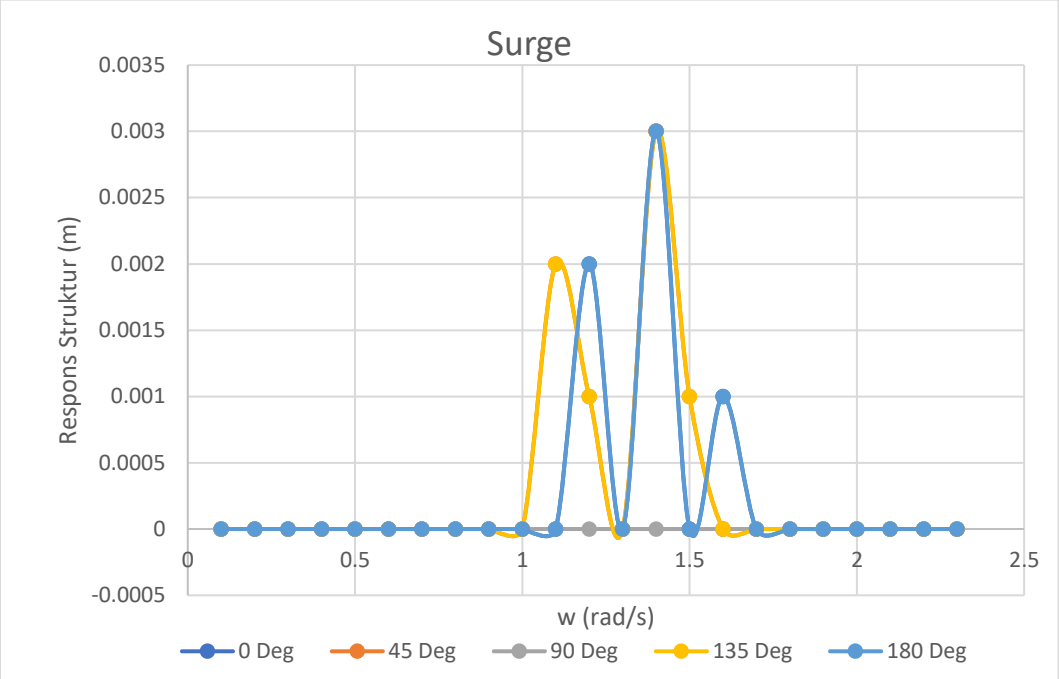
Gambar 4. 21 Grafik RAO Rotasi ke Arah Yaw

Gerakan *yaw* merupakan gerakan rotasional yang terjadi pada sumbu –z. Pada hasil analisa yang dilakukan, gerakan ini memiliki RAO paling besar terhadap arah pembebanan datang gelombang 45°, 90°, dan 135° dengan nilai 0.684 deg/m pada frekuensi 0.7 rad/s, 0.026 deg/m pada frekuensi 0.1 rad/s, dan 0.676 deg/m pada frekuensi 0.7 rad/s. Sedangkan pembebanan gelombang dari arah 0° dan 180° tidak mempengaruhi gerakan ini.

4.7 Analisis Respons Gerakan Pipe Laying Barge

Untuk menghitung respons gerakan struktur maka perlu menghitung RAO terlebih dahulu. Setelah didapat, RAO akan digunakan sebagai faktor pengali antara amplitude gelombang dan amplitude struktur untuk mendapatkan nilai respons gerakan *pipe laying barge*. Hasil analisis respons gerakan struktur ditunjukkan pada **Gambar 4.22** sampai **Gambar 4.27**.

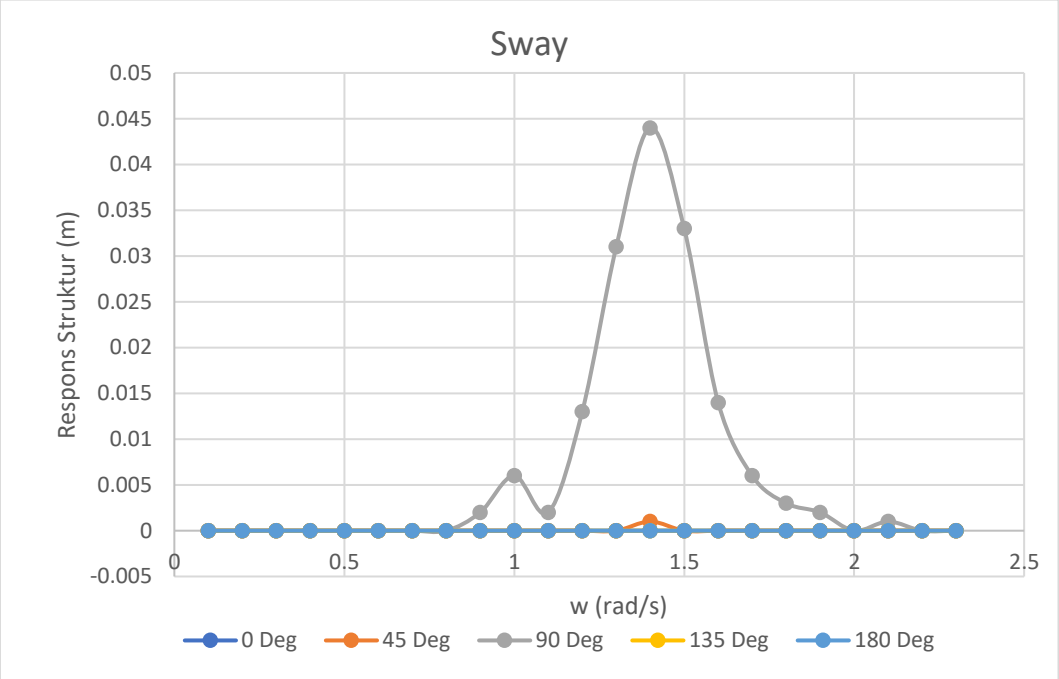
4.7.1 Respons Gerakan Pipe Laying Barge ke Arah Surge



Gambar 4. 22 Respons Gerakan Pipe Laying Barge ke Arah Surge

Gerakan *surge* merupakan gerakan translasi yang terjadi pada sumbu –x. Pada hasil analisa yang dilakukan, gerakan ini memiliki nilai respons paling besar terhadap arah pembebanan datang gelombang 0°,45°, 135°, dan 180° dengan nilai 0.003 m pada frekuensi 1.4 rad/s. Sedangkan pembebanan gelombang dari arah 90° tidak mempengaruhi gerakan ini.

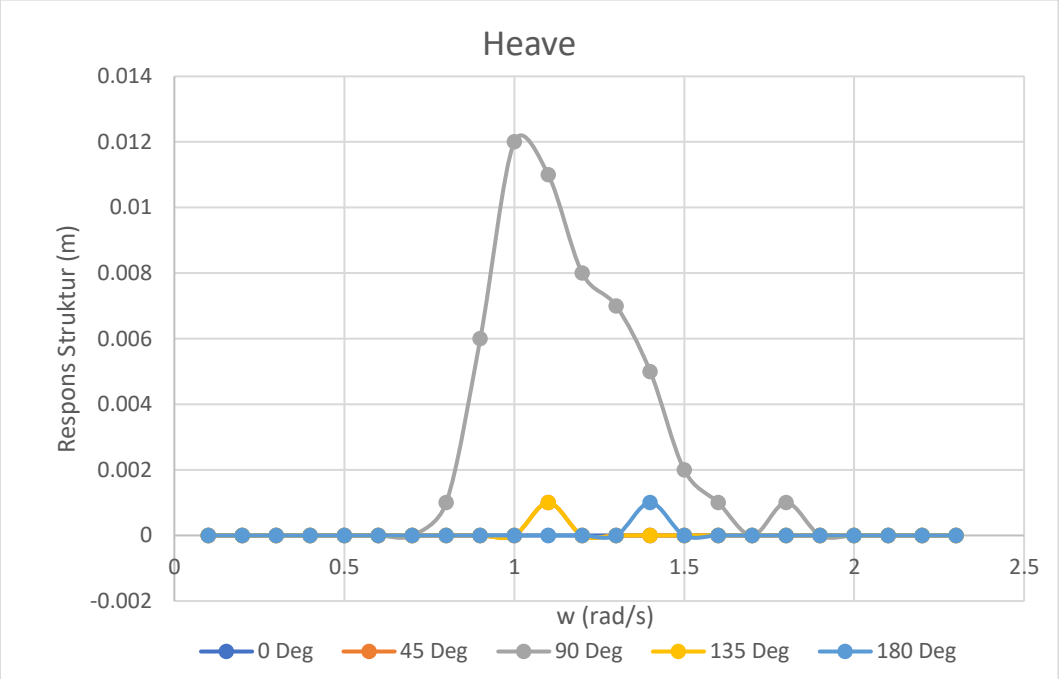
4.7.2 Respons Gerakan Pipe Laying Barge ke Arah Sway



Gambar 4. 23 Respons Gerakan Pipe Laying Barge ke Arah Sway

Gerakan *sway* merupakan gerakan translasi yang terjadi pada sumbu –y. Pada hasil analisa yang dilakukan, gerakan ini memiliki nilai respons paling besar terhadap pembebanan gelombang dari arah 45° dan 90° dengan nilai masing masing 0.001 m dan 0.044 m yang keduanya terjadi pada frekuensi 1.4 rad/s. Sedangkan pembebanan gelombang dari arah 0°, 135° dan 180° tidak mempengaruhi gerakan ini.

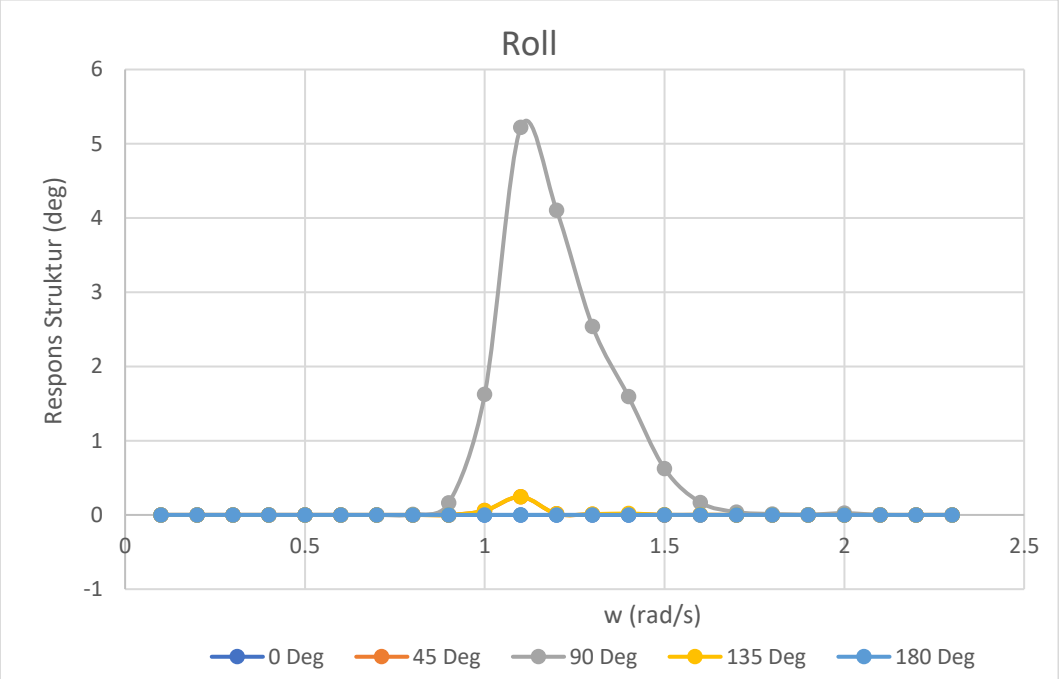
4.7.3 Respons Gerakan Pipe Laying Barge ke Arah Heave



Gambar 4. 24 Respons Gerakan Pipe Laying Barge ke Arah Heave

Gerakan *heave* merupakan gerakan translasi yang terjadi pada sumbu –z. Pada hasil analisa yang dilakukan, gerakan ini memiliki nilai respons paling besar terhadap pembebanan gelombang dari arah 45°, 90°, 135° dan 180° dengan nilai masing masing 0.001 m pada frekuensi 1.1 rad/s, 0.012 m pada frekuensi 1 rad/s, 0.001 pada frekuensi 1.1 rad/s, dan 0.001 m pada frekuensi 1.4 rad/s. Sedangkan pembebanan gelombang dari arah 0°, tidak mempengaruhi gerakan ini.

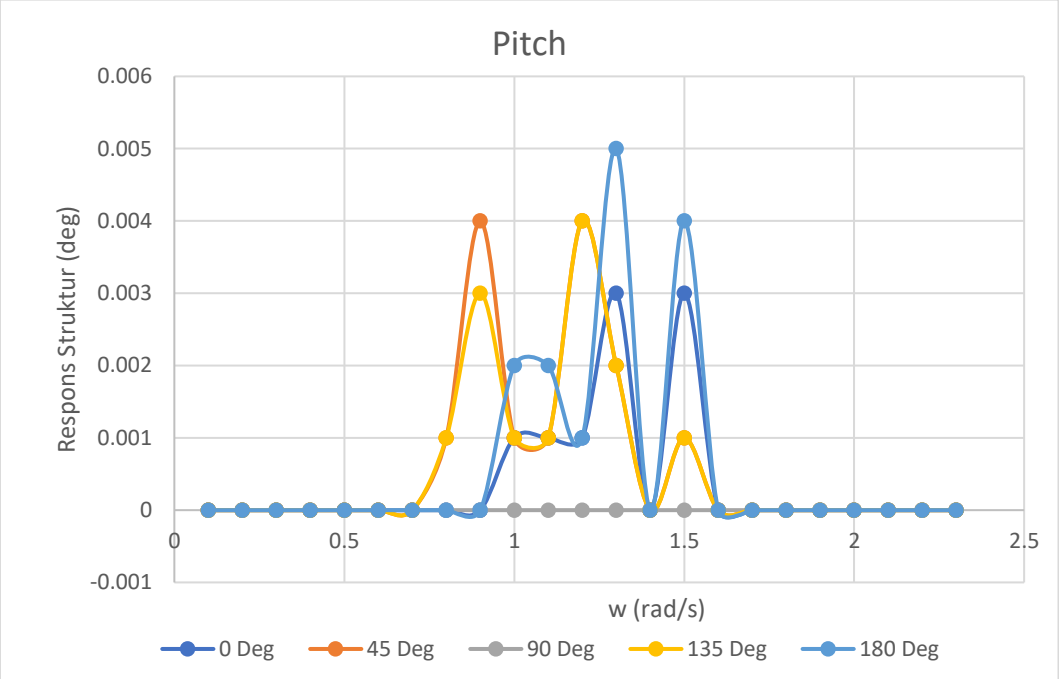
4.7.4 Respons Gerakan Pipe Laying Barge ke Arah Roll



Gambar 4. 25 Respons Gerakan Pipe Laying Barge ke Arah Roll

Gerakan *roll* merupakan gerakan rotasional yang terjadi pada sumbu –x. Pada hasil analisa yang dilakukan, gerakan ini memiliki respons paling besar terhadap pembebanan gelombang dari arah 45°, 90°, dan 135° dengan nilai masing masing 0.244 derajat pada frekuensi 1.1 rad/s, 5.219 derajat pada frekuensi 1.1 rad/s, dan 0.246 derajat pada frekuensi 1.1 rad/s. Sedangkan pembebanan gelombang dari arah 0° dan 180°, tidak mempengaruhi gerakan ini.

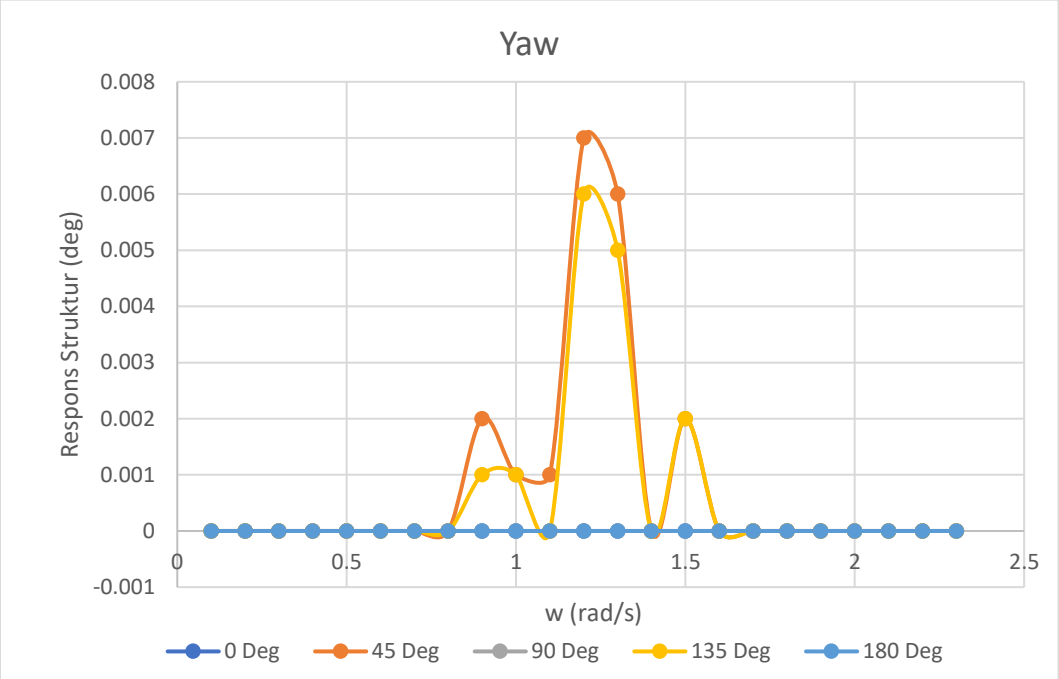
4.7.5 Respons Gerakan Pipe Laying Barge ke Arah Pitch



Gambar 4. 26 Respons Gerakan Pipe Laying Barge ke Arah Pitch

Gerakan *pitch* merupakan gerakan rotasional yang terjadi pada sumbu – y. Pada hasil analisa yang dilakukan, gerakan ini memiliki respons paling besar terhadap pembebanan gelombang dari arah 0°, 45°, 135°, dan 180° dengan nilai masing masing 0.003 derajat pada frekuensi 1.3 rad/s dan 1.5 rad/s, 0.004 derajat pada frekuensi 0.9 rad/s dan 1.2 rad/s, 0.004 derajat pada frekuensi 1.2 rad/s, dan 0.005 pada frekuensi 1.3 rad/s. Sedangkan pembebanan gelombang dari arah 90°, tidak mempengaruhi gerakan ini.

4.7.6 Respons Gerakan Pipe Laying Barge ke Arah Yaw



Gambar 4. 27 Respons Gerakan Pipe Laying Barge ke Arah Yaw

Gerakan *yaw* merupakan gerakan rotasional yang terjadi pada sumbu –z. Pada hasil analisa yang dilakukan, gerakan ini memiliki respons paling besar terhadap pembebanan gelombang dari arah 45° dan 135° dengan nilai masing masing 0.007 derajat pada frekuensi 1.2 rad/s dan 0.006 pada 1.2 rad/s. Sedangkan pembebanan gelombang dari arah 0°, 90°, dan 180°, tidak mempengaruhi gerakan ini.

4.8 Analisa Tegangan Pipa saat Instalasi pada Kondisi Dinamis

4.8.1 Design Case Analisa Dinamis

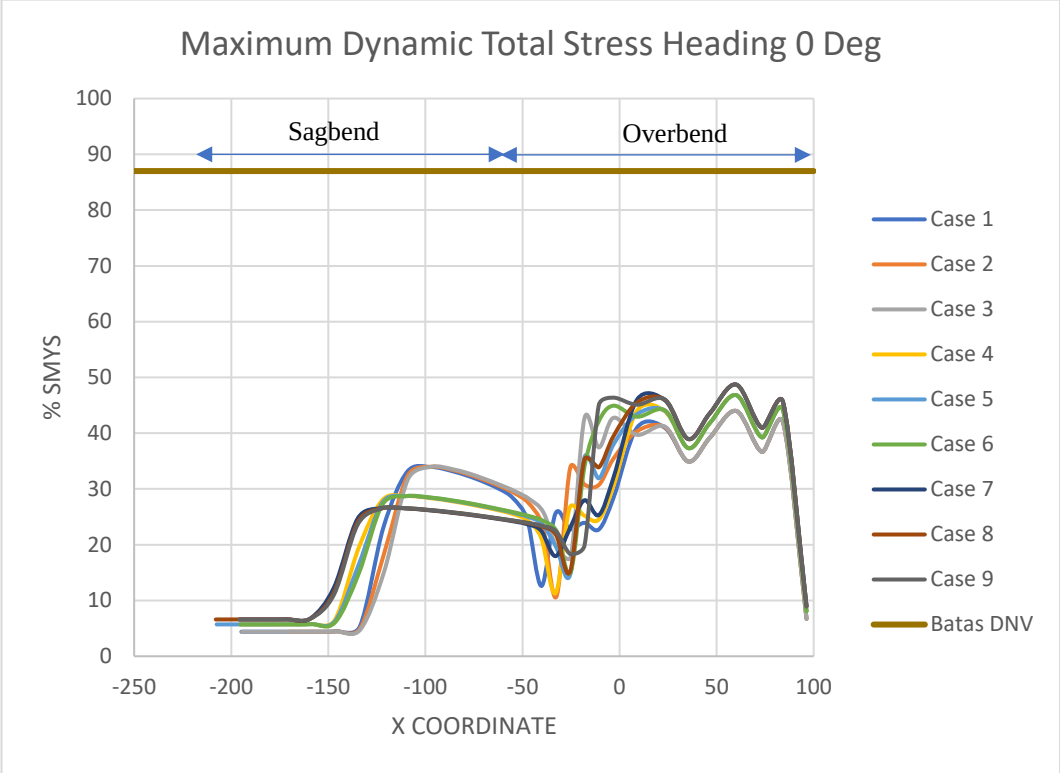
Untuk memulai pengerjaan analisis dinamis instalasi pipa bawah laut maka dibutuhkan beberapa *design case* untuk mengetahui variasi apa saja yang akan dilakukan pada analisis dinamis tersebut. Pada tahap ini, analisis dilakukan dengan menggunakan software MOSES dimana model telah terlebih dahulu ditambahkan pemodelan mooring lines.

Setiap *design case* tersebut nantinya akan dianalisis sebanyak 5 kali sesuai 5 derajat arah pembebanannya yaitu 0°, 45°, 90°, 135°, 180°. Kemudian *design case* tersebut akan dianalisis maksimal tegangan tiap derajat arah pembebananannya dan disesuaikan pada *codes* DNV OS-F101. Untuk *stress criteria* yang berlaku pada analisis dinamis sama dengan analisis statis yaitu karena penulis menggunakan pipa dengan API 5L Grade X52 dengan SMYS 360 Mpa maka *stress criteria*-nya adalah 313.2 Mpa atau setara dengan 87% dari SMYS. **Tabel 4.23** dibawah berikut menampilkan data dan variasi yang digunakan dalam penyusunan tugas akhir ini :

Tabel 4.23 Design Case Analisa Dinamis

Case	Outside Diameter	Wall Thickness	Depth	Tensioner	Radius Curvature
	Inch	mm	m	ton	m
1	6.625	12.7	57.6	15	300
2	6.625	12.7			200
3	6.625	12.7			150
4	6.625	12.7		18	300
5	6.625	12.7			200
6	6.625	12.7			150
7	6.625	12.7		20	300
8	6.625	12.7			200
9	6.625	12.7			150

4.8.2 Hasil Analisa Dinamis pada Arah Pembenan 0°



Gambar 4. 28 Grafik Persebaran Tegangan pada Arah Pembebanan 0 Derajat

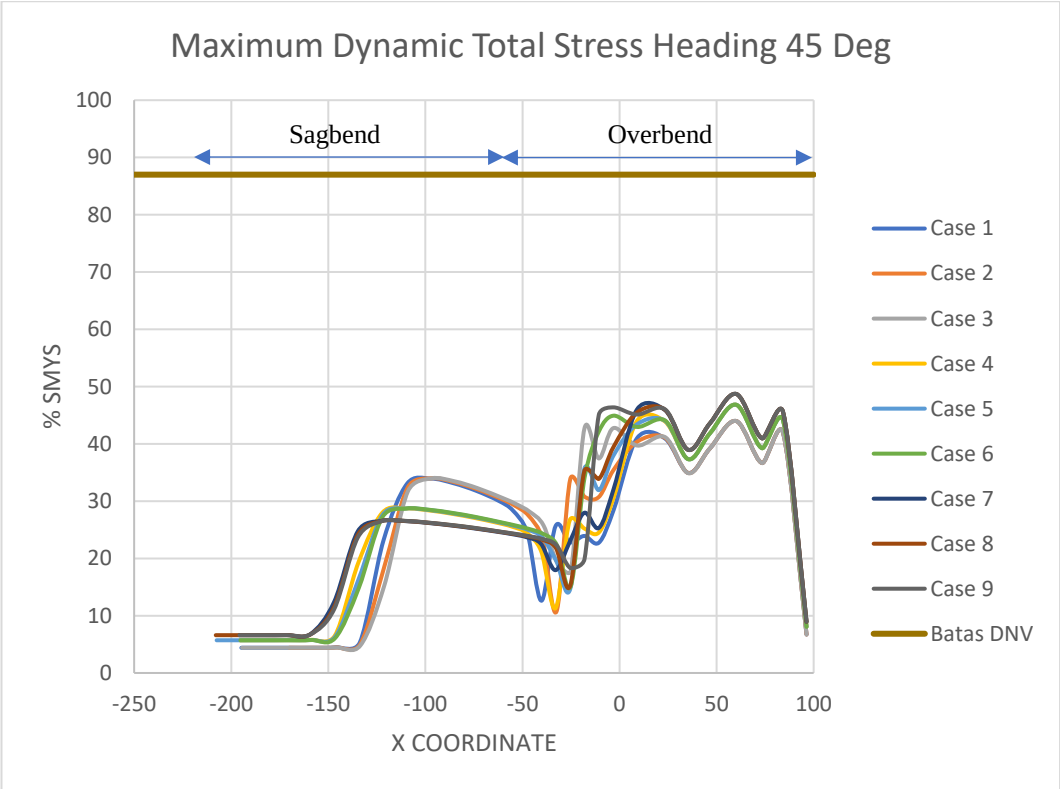
Tabel 4.24 Hasil Analisa Dinamis Tegangan Arah Pembebanan 0 Derajat

Case	Overbend		Sagbend		Criteria	Verify
	Max Stress (MPa)	Percent Yield (%)	Max Stress (MPa)	Percent Yield (%)		
1	158.34	43.98	122.18	33.94	87%	OK!
2	158.34	43.98	122.32	33.98		OK!
3	158.33	43.98	122.29	33.97		OK!
4	168.56	46.82	103.39	28.72		OK!
5	168.56	46.82	103.4	28.72		OK!
6	168.52	46.81	103.36	28.71		OK!
7	175.36	48.71	95.63	26.56		OK!
8	175.36	48.71	95.55	26.54		OK!
9	175.36	48.71	95.61	26.56		OK!

Dengan melihat **Gambar 4.28** dan **Tabel 4.24** diatas, dapat diketahui bahwa total tegangan maksimum yang terjadi adalah pada *case* 7,8, dan 9 yaitu sebesar 175.36 MPa atau setara dengan 48.71% dari SMYS pada daerah *overbend* dengan nomor *node* 7. Sedangkan pada daerah *sagbend* total

tegangan dinamis yang paling besar adalah pada *case* 2 yaitu dengan nilai sebesar 122.32 atau setara dengan 33.98 %SMYS, terjadi pada *node* ke-38. Untuk hasil total tegangan maksimum kondisi dinamis dengan heading 0 derajat semuanya memenuhi kriteria DNV OS F-101 yaitu untuk kondisi dengan beban dinamis pada daerah *sagbend* dan *overbend* harus dibawah 87% dari SMYS pipa yang digunakan.

4.8.3 Hasil Analisa Dinamis pada Arah Pembenan 45°



Gambar 4. 29 Grafik Persebaran Tegangan pada Arah Pembebanan 45 Derajat

Tabel 4.25 Hasil Analisa Dinamis Tegangan Arah Pembebanan 45 Derajat

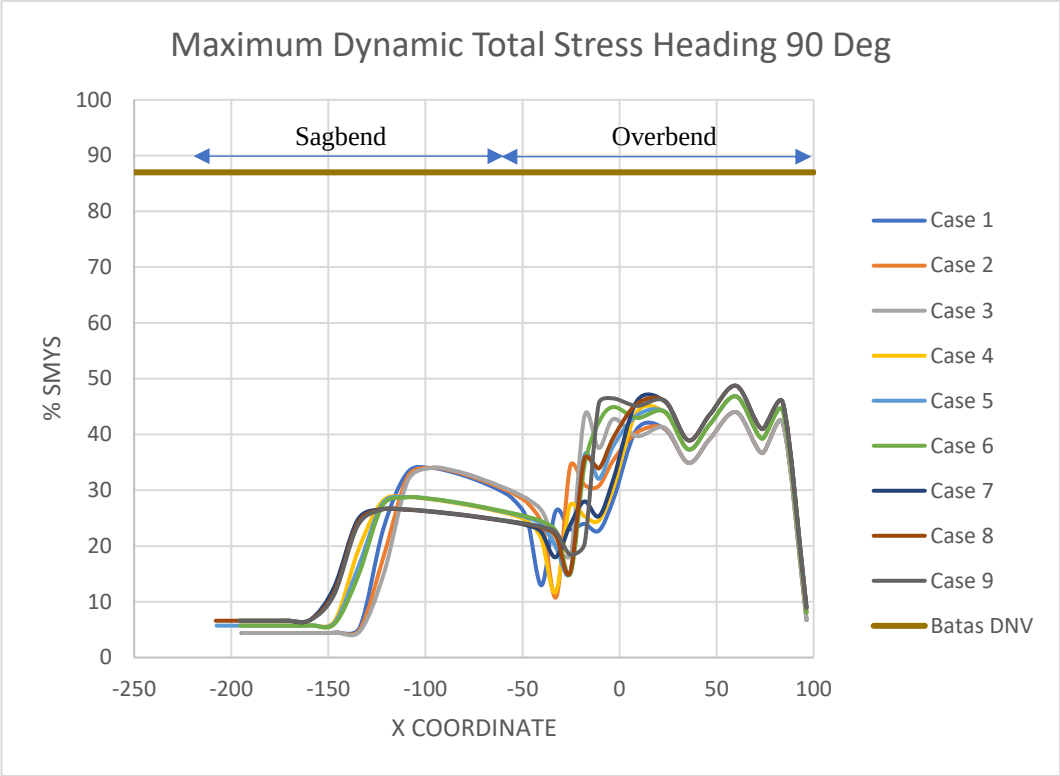
Case	Overbend		Sagbend		Criteria	Verify
	Max Stress (MPa)	Percent Yield (%)	Max Stress (MPa)	Percent Yield (%)		
1	158.34	43.98	122.18	33.94	87%	OK!
2	158.34	43.98	122.33	33.98		OK!
3	158.33	43.98	122.29	33.97		OK!
4	168.56	46.82	103.39	28.72		OK!
5	168.56	46.82	103.4	28.72		OK!

Tabel 4.26 Hasil Analisa Dinamis Tegangan Arah Pembebanan 45 Derajat (Lanjutan)

Case	Overbend		Sagbend		Criteria	Verify
	Max Stress (MPa)	Percent Yield (%)	Max Stress (MPa)	Percent Yield (%)		
6	168.55	46.82	103.36	28.71		OK!
7	175.36	48.71	95.63	26.56		OK!
8	175.36	48.71	95.56	26.54		OK!
9	175.36	48.71	95.61	26.56		OK!

Dengan melihat **Gambar 4.29** dan **Tabel 4.25** diatas, dapat diketahui bahwa total tegangan maksimum yang terjadi adalah pada *case* 7,8, dan 9 yaitu sebesar 175.36 MPa atau setara dengan 48.71% dari SMYS pada daerah *overbend* dengan nomor *node* 7. Sedangkan pada daerah *sagbend* total tegangan dinamis yang paling besar adalah pada *case* 2 yaitu dengan nilai sebesar 122.33 atau setara dengan 33.98 %SMYS, terjadi pada *node* ke-38. Untuk hasil total tegangan maksimum kondisi dinamis dengan heading 45 derajat semuanya memenuhi kriteria DNV OS F-101 yaitu untuk kondisi dengan beban dinamis pada daerah *sagbend* dan *overbend* harus dibawah 87% dari SMYS pipa yang digunakan.

4.8.4 Hasil Analisa Dinamis pada Arah Pembenan 90°



Gambar 4. 30 Grafik Persebaran Tegangan pada Arah Pembebanan 90 Derajat

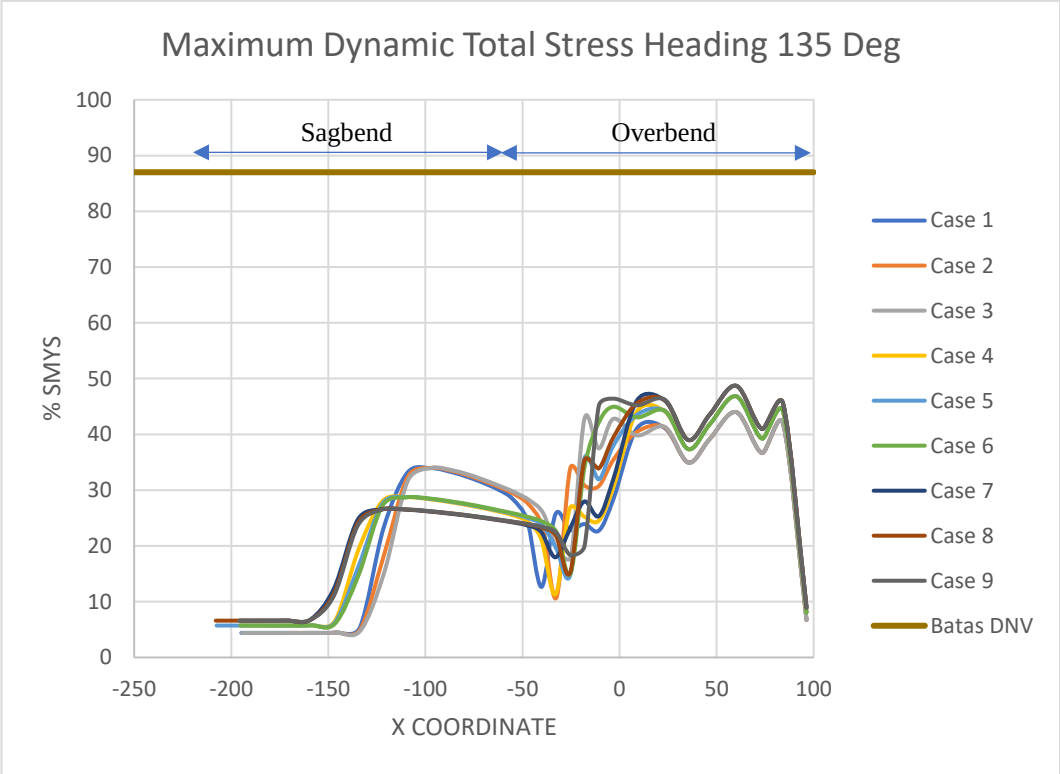
Tabel 4.27 Hasil Analisa Dinamis Tegangan Arah Pembebanan 90 Derajat

Case	Overbend		Sagbend		Criteria	Verify
	Max Stress (MPa)	Percent Yield (%)	Max Stress (MPa)	Percent Yield (%)		
1	158.38	44	122.38	33.99	87%	OK!
2	158.37	43.99	122.48	34.02		OK!
3	158.36	43.99	122.42	34		OK!
4	168.59	46.83	103.51	28.75		OK!
5	168.58	46.83	103.49	28.75		OK!
6	168.55	46.82	103.38	28.72		OK!
7	175.37	48.72	95.65	26.57		OK!
8	175.37	48.71	95.57	26.55		OK!
9	175.38	48.72	95.67	26.58		OK!

Dengan melihat **Gambar 4.30** dan **Tabel 4.27** diatas, dapat diketahui bahwa total tegangan maksimum yang terjadi adalah pada *case* 9 yaitu sebesar 175.38 MPa atau setara dengan 48.72% dari SMYS pada daerah *overbend* dengan nomor *node* 7. Sedangkan pada daerah *sagbend* total tegangan dinamis yang paling besar adalah pada *case* 2 yaitu dengan nilai sebesar 122.48 atau setara dengan 34.02 %SMYS, terjadi pada *node* ke-38. Untuk hasil total

tegangan maksimum kondisi dinamis dengan heading 90 derajat semuanya memenuhi kriteria DNV OS F-101 yaitu untuk kondisi dengan beban dinamis pada daerah *sagbend* dan *overbend* harus dibawah 87% dari SMYS pipa yang digunakan.

4.8.5 Hasil Analisa Dinamis pada Arah Pembenan 135°



Gambar 4. 31 Grafik Persebaran Tegangan pada Arah Pembebanan 135 Derajat

Tabel 4.28 Hasil Analisa Dinamis Tegangan Arah Pembebanan 135 Derajat

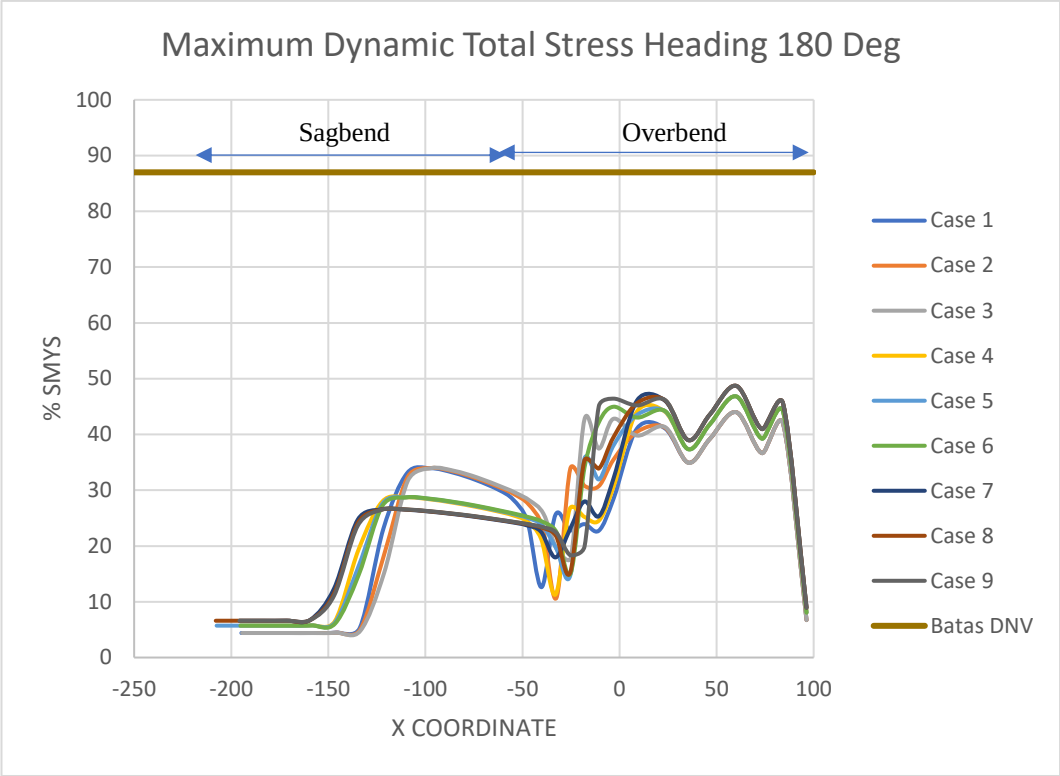
Case	Overbend		Sagbend		Criteria	Verify
	Max Stress (MPa)	Percent Yield (%)	Max Stress (MPa)	Percent Yield (%)		
1	158.36	43.99	122.22	33.95	87%	OK!
2	158.35	43.99	122.36	33.99		OK!
3	158.35	43.99	122.33	33.98		OK!
4	168.57	46.83	103.42	28.73		OK!
5	168.57	46.83	103.43	28.73		OK!
6	168.56	46.82	103.38	28.72		OK!
7	175.37	48.71	95.65	26.57		OK!
8	175.37	48.71	95.57	26.55		OK!

Tabel 4.29 Hasil Analisa Dinamis Tegangan Arah Pembebanan 135 Derajat (Lanjutan)

Case	Overbend		Sagbend		Criteria	Verify
	Max Stress (MPa)	Percent Yield (%)	Max Stress (MPa)	Percent Yield (%)		
9	175.37	48.71	95.63	26.56		OK!

Dengan melihat **Gambar 4.31** dan **Tabel 4.28** diatas, dapat diketahui bahwa total tegangan maksimum yang terjadi adalah pada *case* 7,8, dan 9 yaitu sebesar 175.37 MPa atau setara dengan 48.71% dari SMYS pada daerah *overbend* dengan nomor *node* 7. Sedangkan pada daerah *sagbend* total tegangan dinamis yang paling besar adalah pada *case* 2 yaitu dengan nilai sebesar 122.36 atau setara dengan 33.99 %SMYS, terjadi pada *node* ke-38. Untuk hasil total tegangan maksimum kondisi dinamis dengan heading 135 derajat semuanya memenuhi kriteria DNV OS F-101 yaitu untuk kondisi dengan beban dinamis pada daerah *sagbend* dan *overbend* harus dibawah 87% dari SMYS pipa yang digunakan.

4.8.6 Hasil Analisa Dinamis pada Arah Pembenan 180°



Gambar 4. 32 Grafik Persebaran Tegangan pada Arah Pembebanan 180 Derajat

Tabel 4.30 Hasil Analisa Dinamis Tegangan Arah Pembebanan 180 Derajat

Case	Overbend		Sagbend		Criteria	Verify
	Max Stress (MPa)	Percent Yield (%)	Max Stress (MPa)	Percent Yield (%)		
1	158.36	43.99	122.2	33.94	87%	OK!
2	158.35	43.99	122.34	33.98		OK!
3	158.35	43.99	122.31	33.97		OK!
4	168.57	46.83	103.41	28.72		OK!
5	168.56	46.82	103.41	28.72		OK!
6	168.56	46.82	103.37	28.72		OK!
7	175.37	48.71	95.64	26.57		OK!
8	175.36	48.71	95.56	26.55		OK!
9	175.36	48.71	95.62	26.56		OK!

Dengan melihat **Gambar 4.32** dan **Tabel 4.30** diatas, dapat diketahui bahwa total tegangan maksimum yang terjadi adalah pada *case* 7 yaitu sebesar 175.37 MPa atau setara dengan 48.71% dari SMYS pada daerah *overbend* dengan nomor *node* 7 . Sedangkan pada daerah *sagbend* total tegangan dinamis yang paling besar adalah pada *case* 2 yaitu dengan nilai sebesar 122.34 atau

setara dengan 33.98 %SMYS, terjadi pada *node* ke-38. Untuk hasil total tegangan maksimum kondisi dinamis dengan heading 180 derajat semuanya memenuhi kriteria DNV OS F-101 yaitu untuk kondisi dengan beban dinamis pada daerah *sagbend* dan *overbend* harus dibawah 87% dari SMYS pipa yang digunakan.

Secara keseluruhan tegangan yang terjadi pada pipa baik pada kondisi statis maupun dinamis, tidak melebihi tegangan izin berdasarkan DNV OS F-101 (2013) yang bernilai 87% SMYS atau 313.2 MPa. Selain itu, dapat pula dipahami bahwa, semakin besar *tension* pada *tensioner* maka akan semakin besar tegangan yang terjadi pada *overbend* namun semakin kecil pula tegangan yang terjadi pada *sagbend*. Selain itu, pada penelitian ini variasi yang dilakukan pada *radius curvature of stinger* baik pada kondisi statis maupun dinamis, kurang memberikan pengaruh yang signifikan terhadap tegangan pipa yang dihasilkan baik pada *region overbend* maupun *sagbend*

4.9 Analisa Concrete Crushing pada Kondisi Dinamis

Pada penelitian ini juga dilakukan analisa *concrete crushing* pada kondisi dinamis, dimana hasil analisa *concrete crushing* pada kondisi dinamis ini akan dibandingkan hasilnya dengan analisa *concrete crushing* pada kondisi statis yang sudah terlebih dahulu dilakukan. Analisa *concrete crushing* ini didasarkan pada *standard* yang telah ditetapkan oleh DNV OS-F101 October 2013. Pada *standard* ini dinyatakan bahwa *concrete crushing* dapat terjadi apabila regangan yang terjadi pada lapisan *concrete* pada pipa melebihi angka 0.2%. Selain itu pada **Tabel 4.31**, yang bersumber pada DNV OS-F101 (2013) pada Sec. 9 C 400 juga mengatur syarat-syarat untuk *concrete coating* yang akan digunakan pada pipa bawah laut.

Tabel 4.31 Concrete Coating Criteria dari DNV OS-F101

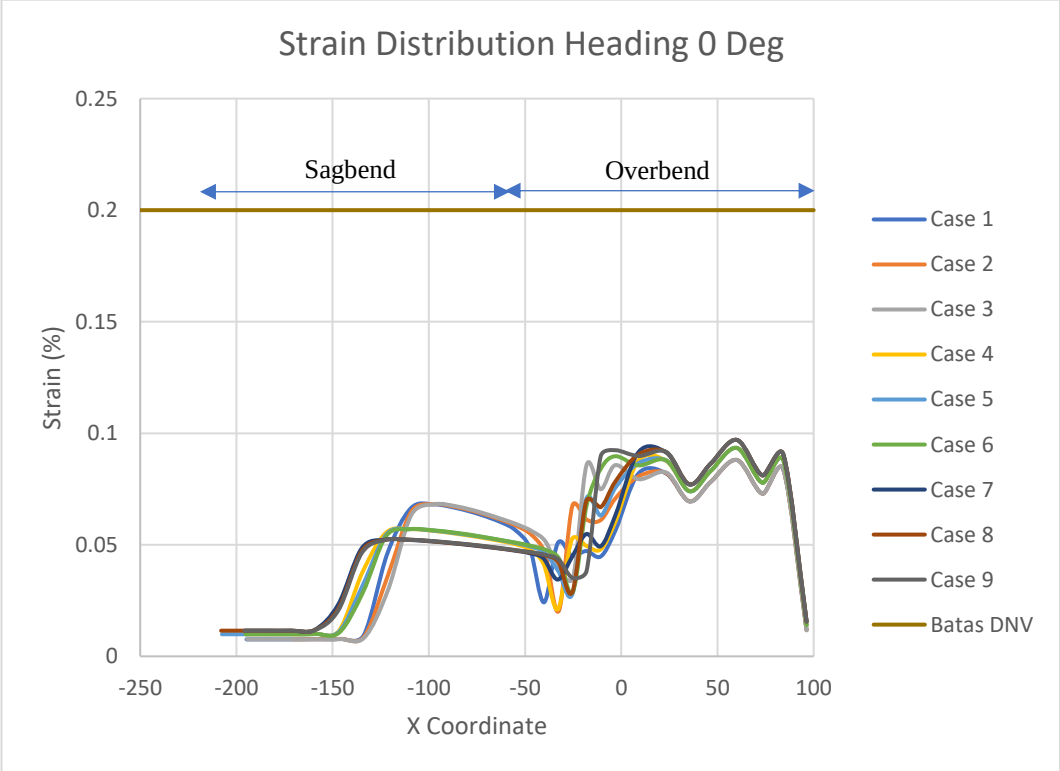
Concrete Coating Criteria	DNV OSF 101	Data
Crushing Criteria	0.20%	0.20%
Minimum Thickness	40 mm	25 mm
Minimum Strength	40 Mpa	40 Mpa

Tabel 4.32 Concrete Coating Criteria dari DNV OS-F101 (Lanjutan)

Concrete Coating Criteria	DNV OSF 101	Data
Diameter minimum dari cage melingkar	5 mm	-
Jarak maksimum antara tulangan cage :		
Melingkar	125 mm	-
Memanjang	250 mm	-

Pengerjaan analisa *concrete crushing* pada kondisi dinamis ini juga dibantu dengan software OFFPIPE 3.02 untuk mendapatkan regangan yang terjadi pada lapisan *concrete*, kemudian hasil yang didapat akan diolah dalam bentuk tabel kemudian dibandingkan dengan *standard* yang telah ditentukan DNV OS-F101. Adapun dibawah ini merupakan hasil analisa *concrete crushing* yang sudah dikerjakan oleh penulis :

4.9.1 Hasil Analisa Dinamis pada Arah Pembenan 0°



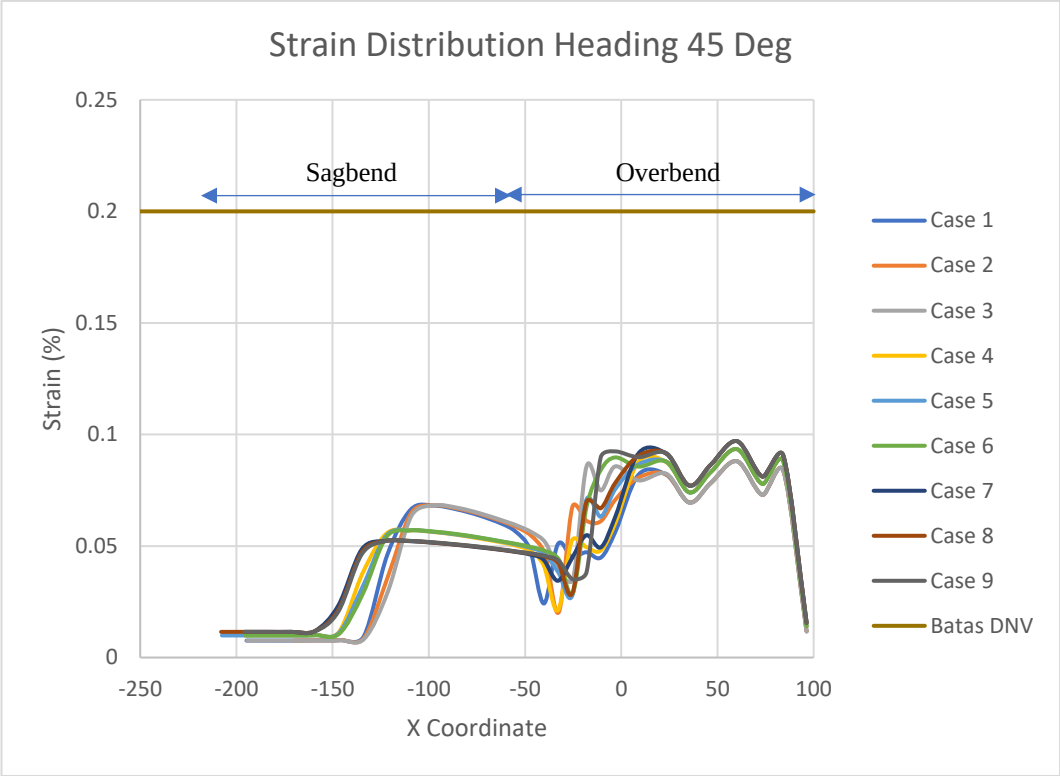
Gambar 4. 33 Distribusi Regangan pada Lapisan Concrete pada Arah Pembebanan 0 Derajat

Tabel 4.33 Hasil Analisa Concrete Crushing pada Kondisi Dinamis pada Arah Pembebanan 0 Derajat

Case	Overbend	Sagbend	Criteria	Verify
	Max Strain (%)	Max Strain (%)		
1	0.088	0.0681	0.2%	OK!
2	0.088	0.0682		OK!
3	0.088	0.0682		OK!
4	0.0934	0.057		OK!
5	0.0934	0.057		OK!
6	0.0934	0.057		OK!
7	0.097	0.0523		OK!
8	0.097	0.0523		OK!
9	0.097	0.0523		OK!

Gambar 4.33 dan **Tabel 4.33** menjelaskan tentang regangan yang dialami di setiap bagian lapisan *concrete* pada pipa selama proses instalasi. Sehingga kita dapat memahami regangan maksimum yang terjadi untuk wilayah *overbend* adalah *case* 7,8, dan 9 dengan nilai sebesar 0.097% pada *node* pipa ke-7 dan di wilayah *sagbend* adalah *case* 2&3 dengan nilai sebesar 0.0682% pada *node* pipa ke-38

4.9.2 Hasil Analisa Dinamis pada Arah Pembenan 45°



Gambar 4. 34 Distribusi Regangan pada Lapisan Concrete pada Arah Pembebanan 45 Derajat

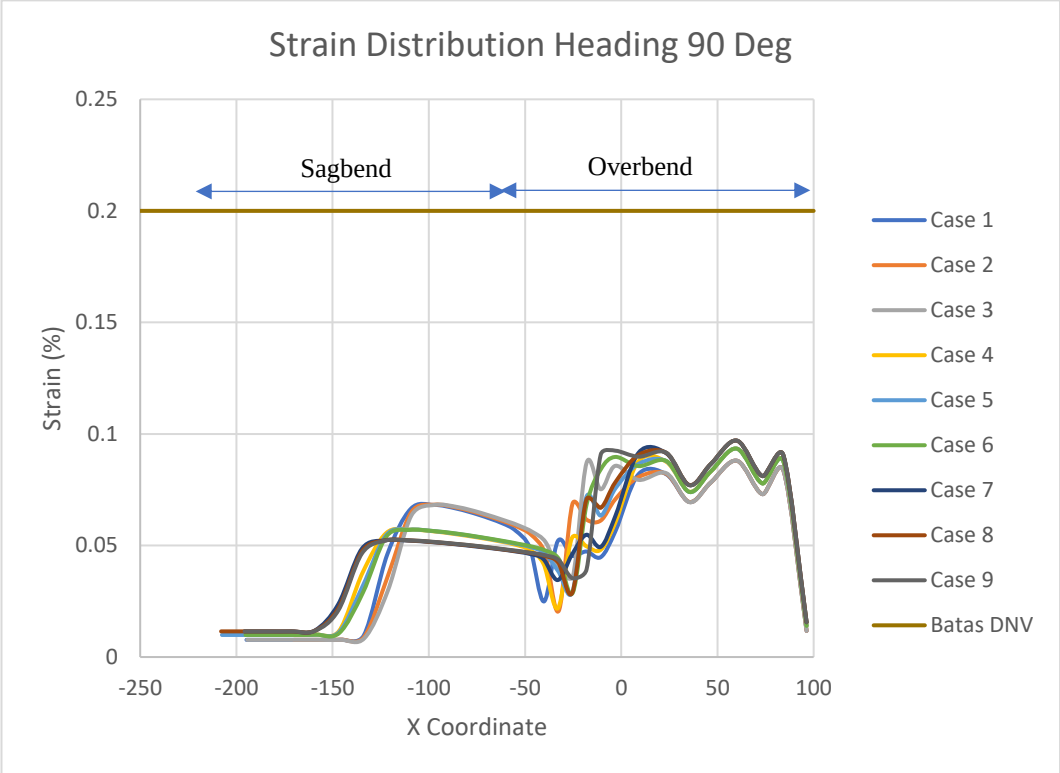
Tabel 4.34 Hasil Analisa Concrete Crushing pada Kondisi Dinamis pada Arah Pembebanan 45 Derajat

Case	Overbend	Sagbend	Criteria	Verify
	Max Strain (%)	Max Strain (%)		
1	0.088	0.0681	0.2%	OK!
2	0.088	0.0682		OK!
3	0.088	0.0682		OK!
4	0.0934	0.057		OK!
5	0.0934	0.057		OK!
6	0.0934	0.057		OK!
7	0.097	0.0523		OK!
8	0.097	0.0523		OK!
9	0.097	0.0523		OK!

Gambar 4.34 dan **Tabel 4.34** menjelaskan tentang regangan yang dialami di setiap bagian lapisan *concrete* pada pipa selama proses instalasi. Sehingga kita dapat memahami regangan maksimum yang terjadi untuk wilayah *overbend* adalah *case* 7,8, dan 9 dengan nilai sebesar 0.097% pada

node pipa ke-7 dan di wilayah *sagbend* adalah *case* 2&3 dengan nilai sebesar 0.0682% pada *node* pipa ke-38

4.9.3 Hasil Analisa Dinamis pada Arah Pembenan 90°



Gambar 4. 35 Distribusi Regangan pada Lapisan Concrete pada Arah Pembebanan 90 Derajat

Tabel 4.35 Hasil Analisa Concrete Crushing pada Kondisi Dinamis pada Arah Pembebanan 90 Derajat

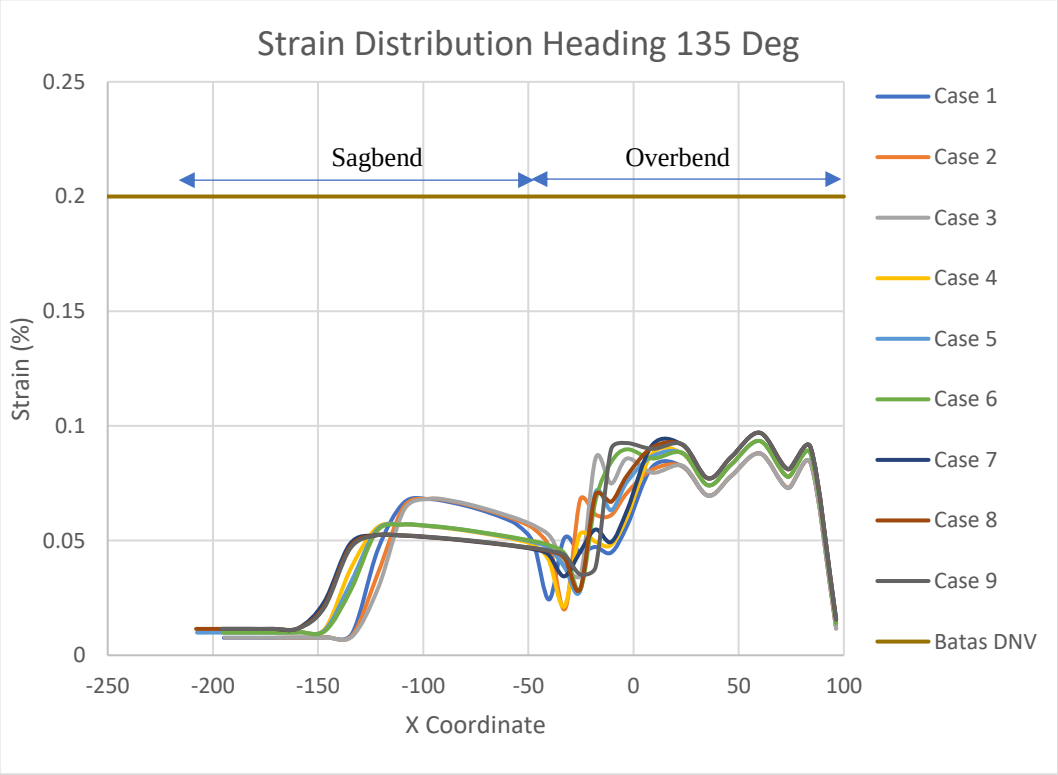
Case	Overbend	Sagbend	Criteria	Verify
	Max Strain (%)	Max Strain (%)		
1	0.088	0.0682	0.2%	OK!
2	0.088	0.0683		OK!
3	0.088	0.0682		OK!
4	0.0934	0.057		OK!
5	0.0934	0.057		OK!
6	0.0934	0.057		OK!
7	0.097	0.0523		OK!
8	0.097	0.0523		OK!

Tabel 4.36 Hasil Analisa Concrete Crushing pada Kondisi Dinamis pada Arah Pembebanan 90 Derajat (Lanjutan)

Case	Overbend	Sagbend	Criteria	Verify
	Max Strain (%)	Max Strain (%)		
9	0.097	0.0523		OK!

Gambar 4.35 dan **Tabel 4.35** menjelaskan tentang regangan yang dialami di setiap bagian lapisan *concrete* pada pipa selama proses instalasi. Sehingga kita dapat memahami regangan maksimum yang terjadi untuk wilayah *overbend* adalah *case* 7,8, dan 9 dengan nilai sebesar 0.097% pada *node* pipa ke-7 dan di wilayah *sagbend* adalah *case* 2 dengan nilai sebesar 0.0683% pada *node* pipa ke-38

4.9.4 Hasil Analisa Dinamis pada Arah Pembenan 135°



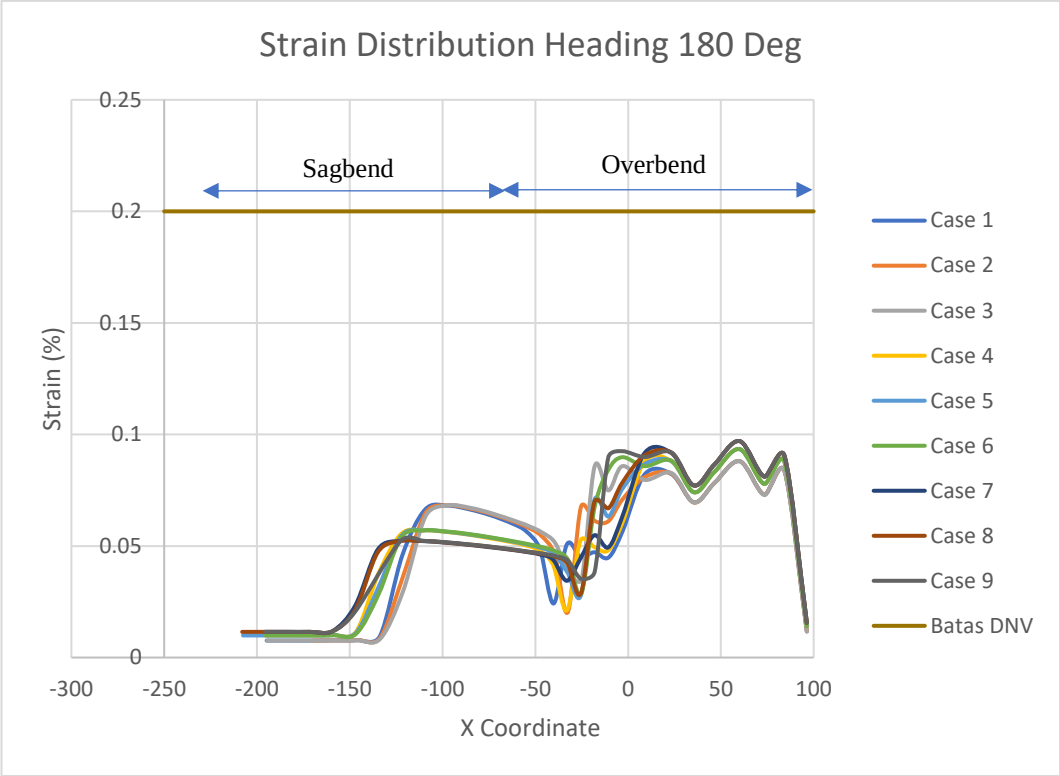
Gambar 4. 36 Distribusi Regangan pada Lapisan Concrete pada Arah Pembebanan 135 Derajat

Tabel 4.37 Hasil Analisa Concrete Crushing pada Kondisi Dinamis pada Arah Pembebanan 135 Derajat

Case	Overbend	Sagbend	Criteria	Verify
	Max Strain (%)	Max Strain (%)		
1	0.088	0.0681	0.2%	OK!
2	0.088	0.0682		OK!
3	0.088	0.0682		OK!
4	0.0934	0.057		OK!
5	0.0934	0.057		OK!
6	0.0934	0.057		OK!
7	0.097	0.0523		OK!
8	0.098	0.0523		OK!
9	0.097	0.0523		OK!

Gambar 4.36 dan **Tabel 4.37** menjelaskan tentang regangan yang dialami di setiap bagian lapisan *concrete* pada pipa selama proses instalasi. Sehingga kita dapat memahami regangan maksimum yang terjadi untuk wilayah *overbend* adalah *case* 8 dengan nilai sebesar 0.098% pada *node* pipa ke-7 dan di wilayah *sagbend* adalah *case* 2 dengan nilai sebesar 0.0682% pada *node* pipa ke-38

4.9.5 Hasil Analisa Dinamis pada Arah Pembenan 180°



Gambar 4. 37 Distribusi Regangan pada Lapisan Concrete pada Arah Pembebanan 180 Derajat

Tabel 4.38 Hasil Analisa Concrete Crushing pada Kondisi Dinamis pada Arah Pembebanan 180 Derajat

Case	Overbend	Sagbend	Criteria	Verify
	Max Strain (%)	Max Strain (%)		
1	0.088	0.068	0.2%	OK!
2	0.088	0.068		OK!
3	0.088	0.068		OK!
4	0.0934	0.057		OK!
5	0.0934	0.057		OK!
6	0.0934	0.057		OK!
7	0.097	0.052		OK!
8	0.097	0.052		OK!
9	0.097	0.052		OK!

Gambar 4.37 dan **Tabel 4.38** menjelaskan tentang regangan yang dialami di setiap bagian lapisan *concrete* pada pipa selama proses instalasi. Sehingga kita dapat memahami regangan maksimum yang terjadi untuk wilayah *overbend* adalah *case* 7,8, dan 9 dengan nilai sebesar 0.097% pada

node pipa ke-7 dan di wilayah *sagbend* adalah *case* 2 dengan nilai sebesar 0.068% pada *node* pipa ke-38.

Dari hasil perhitungan yang telah dilakukan, terdapat peningkatan yang tidak terlalu signifikan pada hasil analisa dinamis dibandingkan analisa statis. Nilai regangan tersebut baik pada kondisi statis maupun dinamis tetap berada dibawah batas yang ditetapkan oleh DNV OS-F101 2013, dimana *concrete crushing* terjadi apabila regangan pada lapisan *concrete* sebesar 0.2 %. Sehingga pada keseluruhan *case* yang telah dianalisa baik pada kondisi statis maupun dinamis, pipa dapat diinstalasi dan tanpa mengalami *concrete crushing*.

BAB V
KESIMPULAN DAN SARAN

5.1 Kesimpulan

Dari hasil analisa yang dilakukan pada penelitian ini, maka didapatkan kesimpulan sebagai berikut :

1. Nilai tegangan maksimum pipa pada daerah *overbend* adalah pada *case* 7 sebesar 175.34 Mpa atau 48.71% SMYS, dengan variasi *radius cuvature of stinger* sebesar 300 meter, dan kekuatan *tensioner* sebesar 20 ton. Sedangkan pada daerah *sagbend*, tegangan maksimum pipa terjadi pada *case* 2 dengan variasi *radius cuvature of stinger* sebesar 200 meter, dan kekuatan *tensioner* sebesar 15 ton, dengan nilai 122.41 Mpa atau 34% SMYS.
2. Nilai tegangan maksimum pada daerah *overbend* sebesar 175.38 MPa atau 48.72% SMYS, yaitu pada *case* 9 dengan variasi *radius curvature of stinger* 150 meter, kekuatan *tensioner* 20 ton, dan dengan gelombang datang arah 90°. Sedangkan daerah *sagbend*, sebesar 122.48 MPa atau 34.02% SMYS, yaitu pada *case* 2 dengan variasi r*adius curvature of stinger* sebesar 200 meter, kekuatan *tensioner* 15 ton, dan dengan gelombang datang juga pada arah 90°.
3. Pada saat instalasi *pipeline* dengan kondisi statis, regangan terbesar yang terjadi pada *overbend* adalah pada case 9 dengan nilai 0.0918%. Pada daerah *sagbend*, regangan terbesar terjadi pada *case* 1 dengan nilai 0.0591%. Sedangkan pada kondisi dinamis, regangan terbesar yang terjadi pada *overbend* adalah pada case 8 dengan gelombang datang arah 135°, sebesar 0.098%. Untuk daerah *sagbend* sendiri, regangan terbesar terjadi pada *case* 2 dengan gelombang datang arah 90°, nilai 0.0683%.

5.2 Saran

1. Diperlukan permodelan *superstructure* dan *stinger* pada *software* MOSES untuk mendapatkan respons *pipe laying barge* yang lebih akurat.
2. Penelitian ini hanya menggunakan sebanyak 5 *heading* dalam analisa dinamisnya, diharapkan dapat menambahkan 5 arah pembebanan tambahan sehingga penelitian yang dilakukan semakin detail.
3. Analisa dapat dilanjutkan dengan perhitungan *fatigue* dan *local buckling*

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LAMPIRAN A
INPUT DAN OUTPUT SOFTWARE MOSES (PERMODELAN BARGE DAN ANALISA RESPONSE)

Input Permodelan Barge

```
$*****************************************      set data
$
$
$*****************************************      define body
$
&DESCRIBE BODY HULL
$
$*****************************************      DIMENSIONS
$
&DIMEN -SAVE -DIMEN METRES   M-TONS
$
$*************************************          define Hull
$
&DESCRIBE BODY Pipe_Lay_Barge
PGEN -PERM 1 -DIFTYPE STRIP  -CS_CURR 0 0 0  -TANAKA  1
PLANE       5.2684  -CART \
     16.1500       2.3402  \
     16.1500       7.8875  \
     16.1500       8.2838  \
     16.1500       8.6800
PLANE      10.8093  -CART \
     16.1500       0.4068  \
     16.1500       7.6458  \
     16.1500       8.1629  \
     16.1500       8.6800
PLANE      16.3502  -CART \
     16.1500       0.0043  \
     16.1500       7.5955  \
     16.1500       8.1378  \
     16.1500       8.6800
PLANE      21.8911  -CART \
     16.1500       0.0007  \
     16.1500       7.5951  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE      27.4321  -CART \
     16.1500       0.0000  \
     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE      32.9730  -CART \
     16.1500       0.0000  \
     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE      38.5139  -CART \
     16.1500       0.0000  \
     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE      44.0548  -CART \
     16.1500       0.0000  \
     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE      49.5957  -CART \
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     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE      55.1366  -CART \
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PLANE      71.7593  -CART \
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PLANE      77.3002  -CART \
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     16.1500       7.5950  \
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PLANE      82.8411  -CART \
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     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE      88.3821  -CART \
     16.1500       0.0000  \
     16.1500       7.5950  \
     16.1500       8.1375  \
```

```
     16.1500       8.6800
PLANE      93.9230  -CART \
     16.1500       0.0000  \
     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE      99.4639  -CART \
     16.1500       0.0000  \
     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE     105.0048  -CART \
     16.1500       0.0000  \
     16.1500       7.5950  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE     110.5457  -CART \
     16.1500       0.0006  \
     16.1500       7.5951  \
     16.1500       8.1375  \
     16.1500       8.6800
PLANE     116.0866  -CART \
     16.1500       0.0082  \
     16.1500       7.5960  \
     16.1500       8.1380  \
     16.1500       8.6800
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$
$*********************************************      all done
$
&DIMEN -REMEMBER
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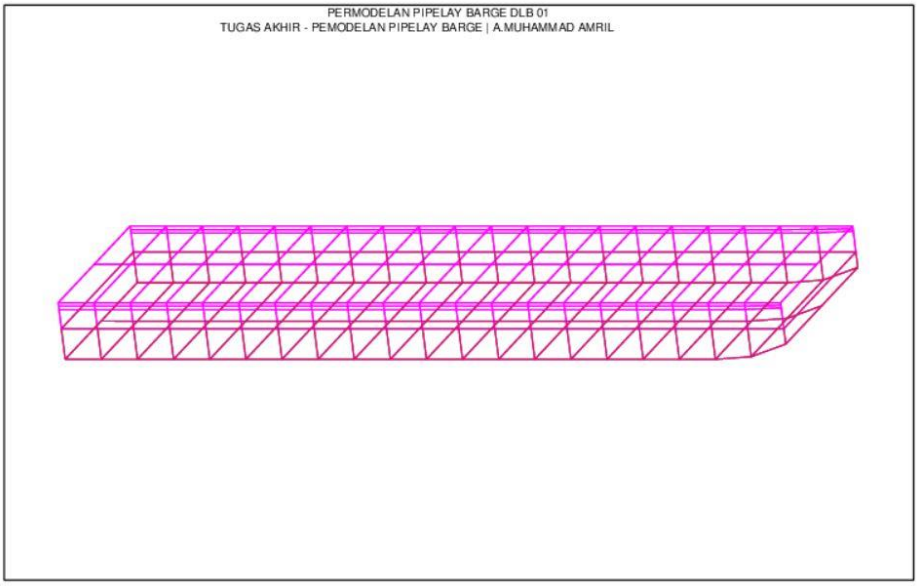

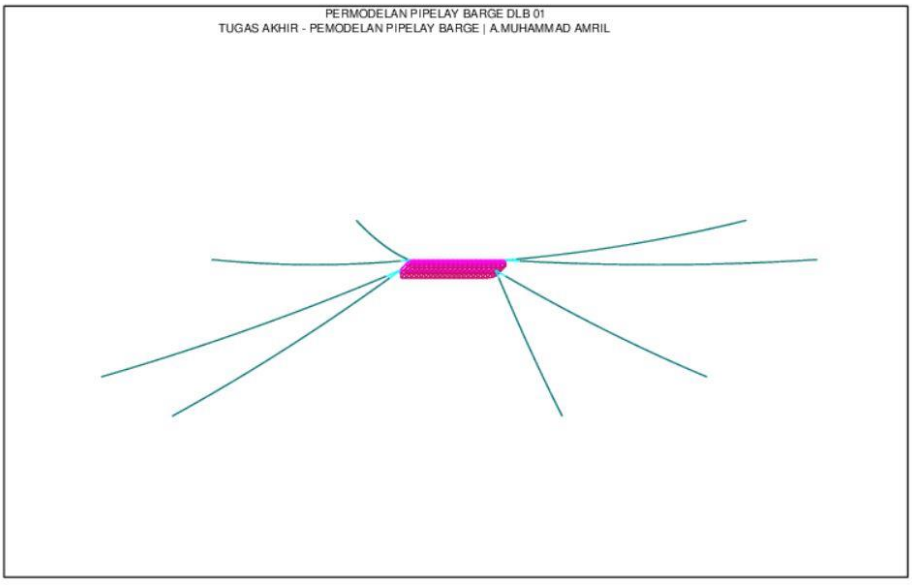

Output RAO dan Respons MOSES Heading 0 derajat

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*****************************************************************************************************************
*                                          ***  MOSES  ***                                                      *
*                                          ---------------                          June 8, 2020                *
*          Equilibrium Position                                                                                 *
*          TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AVRIL                                             *
*   Draft           =   4.7 Meters       Trim Angle     =  -0.00 Deg.     GMT              =  21.6 Meters       *
*   Roll Gy. Radius =   7.7 Meters       Pitch Gy. Radius =  32.4 Meters  Yaw Gy. Radius   =  32.4 Meters       *
*   Heading         =   0.00 Deg.        Forward Speed  =   0.00 Knots    Linearization Based on SEA            *
*                                                                                                               *
*****************************************************************************************************************
```

+++ M O T I O N   R E S P O N S E   O P E R A T O R S +++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

E N C O U N T E R		Surge / Wave Ampl.		Sway / Wave Ampl.		Heave / Wave Ampl.		Roll / Wave Ampl.		Pitch / Wave Ampl.		Yaw / Wave Ampl.	
Frequency -(Rad/Sec)-	Period -(Sec)-	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase
0.1000	62.83	1.117	93	0.000	0	0.999	4	0.000	0	0.059	-86	0.000	0
0.2000	31.42	0.947	104	0.000	0	0.993	14	0.000	0	0.234	-75	0.000	0
0.3000	20.94	0.882	123	0.000	0	0.965	32	0.000	0	0.520	-58	0.000	0
0.4000	15.71	0.783	148	0.000	0	0.884	56	0.000	0	0.882	-35	0.000	0
0.5000	12.57	0.620	-178	0.000	0	0.721	85	0.000	0	1.237	-6	0.000	0
0.6000	10.47	0.390	-138	0.000	0	0.459	120	0.000	0	1.422	26	0.000	0
0.7000	8.98	0.129	-89	0.000	0	0.137	162	0.000	0	1.226	61	0.000	0
0.8000	7.85	0.083	139	0.000	0	0.114	3	0.000	0	0.557	95	0.000	0
0.9000	6.98	0.163	-155	0.000	0	0.120	53	0.000	0	0.061	-24	0.000	0
1.0000	6.28	0.093	-84	0.000	0	0.027	138	0.000	0	0.163	39	0.000	0
1.1000	5.71	0.035	162	0.000	0	0.022	34	0.000	0	0.077	141	0.000	0
1.2000	5.24	0.078	-106	0.000	0	0.028	141	0.000	0	0.045	37	0.000	0
1.3000	4.83	0.011	17	0.000	0	0.005	20	0.000	0	0.071	141	0.000	0
1.4000	4.49	0.047	-100	0.000	0	0.019	146	0.000	0	0.018	49	0.000	0
1.5000	4.19	0.010	47	0.000	0	0.005	83	0.000	0	0.049	151	0.000	0
1.6000	3.93	0.029	-62	0.000	0	0.010	171	0.000	0	0.023	87	0.000	0
1.7000	3.70	0.008	-176	0.000	0	0.007	111	0.000	0	0.017	-175	0.000	0
1.8000	3.49	0.015	14	0.000	0	0.003	156	0.000	0	0.029	139	0.000	0
1.9000	3.31	0.013	-59	0.000	0	0.006	166	0.000	0	0.011	119	0.000	0
2.0000	3.14	0.006	-160	0.000	0	0.005	139	0.000	0	0.010	163	0.000	0
2.1000	2.99	0.006	93	0.000	0	0.002	145	0.000	0	0.009	169	0.000	0
2.2000	2.86	0.006	32	0.000	0	0.002	164	0.000	0	0.009	156	0.000	0

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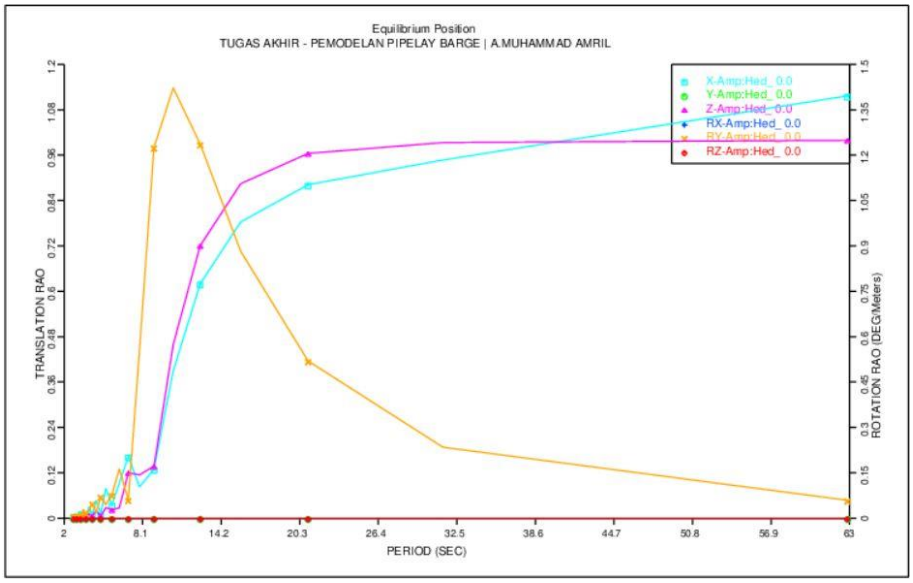

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* *** MOSES *** *

* June 8, 2020 *

* Equilibrium Position *

* TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL *

* Draft = 4.7 Meters Trim Angle = -0.00 Deg. GMT = 21.6 Meters *

* Roll Gy. Radius = 7.7 Meters Pitch Gy. Radius = 32.4 Meters Yaw Gy. Radius = 32.4 Meters *

* JONSWAP Height = 3.15 Meters Mean Period = 3.3 Sec. M. Heading = 0.0 Deg. *

* Heading = 0.0 Deg. S. Coef. = 200. Gamma = 3.3 *

*

****

+++ M O T I O N R E S P O N S E S P E C T R A +++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Frequency	Period	Sea	Surge	Sway	Heave	Roll	Pitch	Yaw
0.100	62.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.200	31.416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.300	20.944	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.400	15.708	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.500	12.566	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.600	10.472	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.700	8.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.800	7.854	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.900	6.981	0.003	0.000	0.000	0.000	0.000	0.000	0.000
1.000	6.283	0.032	0.000	0.000	0.000	0.000	0.001	0.000

1.100	5.712	0.126	0.000	0.000	0.000	0.000	0.001	0.000
1.200	5.236	0.272	0.002	0.000	0.000	0.000	0.001	0.000
1.300	4.833	0.515	0.000	0.000	0.000	0.000	0.003	0.000
1.400	4.488	1.142	0.003	0.000	0.000	0.000	0.000	0.000
1.500	4.189	1.440	0.000	0.000	0.000	0.000	0.003	0.000
1.600	3.927	0.882	0.001	0.000	0.000	0.000	0.000	0.000
1.700	3.696	0.492	0.000	0.000	0.000	0.000	0.000	0.000
1.800	3.491	0.346	0.000	0.000	0.000	0.000	0.000	0.000
1.900	3.307	0.281	0.000	0.000	0.000	0.000	0.000	0.000
2.000	3.142	0.235	0.000	0.000	0.000	0.000	0.000	0.000
2.100	2.992	0.196	0.000	0.000	0.000	0.000	0.000	0.000
2.200	2.856	0.164	0.000	0.000	0.000	0.000	0.000	0.000
2.300	2.732	0.136	0.000	0.000	0.000	0.000	0.000	0.000

Output RAO dan Respons MOSES Heading 45 derajat

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*****************************************************************************************************
*                                        ***  MOSES  ***                                            *
*                                        ---------------                      June 8, 2020          *
*          Equilibrium Position                                                                     *
*          TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL                                 *
*   Draft            =   4.7 Meters     Trim Angle      =   0.00 Deg.     GMT            = 21.6 Meters *
*   Roll Gy. Radius  =   7.7 Meters     Pitch Gy. Radius =  32.4 Meters   Yaw Gy. Radius  = 32.4 Meters *
*   Heading          =  45.00 Deg.      Forward Speed   =   0.00 Knots    Linearization Based on SEA    *
*                                                                                                   *
*****************************************************************************************************
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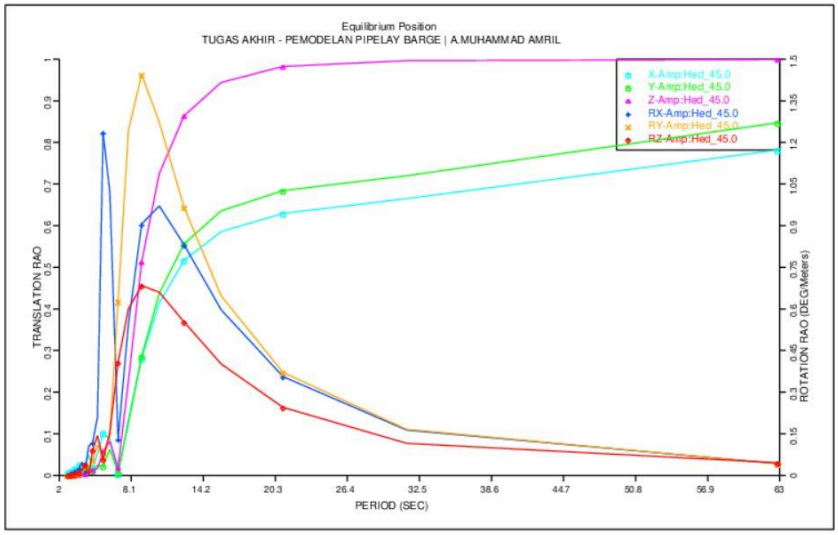
+++ M O T I O N   R E S P O N S E   O P E R A T O R S +++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

E N C O U N T E R		Surge / Wave Ampl.		Sway / Wave Ampl.		Heave / Wave Ampl.		Roll / Wave Ampl.		Pitch / Wave Ampl.		Yaw / Wave Ampl.	
Frequency -(Rad/Sec)-	Period -(Sec)-	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase
0.1000	62.83	0.782	88	0.847	106	0.999	-1	0.042	87	0.042	-91	0.045	-112
0.2000	31.42	0.665	90	0.720	95	0.996	0	0.163	90	0.166	-89	0.116	-172
0.3000	20.94	0.629	98	0.684	99	0.983	7	0.356	97	0.371	-82	0.245	-169
0.4000	15.71	0.586	109	0.636	109	0.944	17	0.597	107	0.647	-73	0.402	-159
0.5000	12.57	0.517	123	0.556	123	0.864	30	0.831	121	0.966	-61	0.553	-144
0.6000	10.47	0.414	140	0.438	139	0.725	44	0.971	137	1.272	-48	0.660	-125
0.7000	8.98	0.281	160	0.286	158	0.513	56	0.906	155	1.445	-38	0.684	-103
0.8000	7.85	0.133	-176	0.125	178	0.227	64	0.545	174	1.244	-33	0.600	-78
0.9000	6.98	0.004	-46	0.007	1	0.019	-141	0.131	8	0.628	-26	0.407	-50
1.0000	6.28	0.088	51	0.062	32	0.081	-93	1.020	23	0.139	-4	0.155	-20
1.1000	5.71	0.101	82	0.023	102	0.058	-55	1.236	6	0.069	-143	0.058	-161
1.2000	5.24	0.051	118	0.025	154	0.016	-12	0.210	3	0.109	-104	0.143	-125
1.3000	4.83	0.017	-38	0.012	23	0.012	-155	0.119	-136	0.055	-65	0.092	-85
1.4000	4.49	0.049	8	0.021	58	0.015	-113	0.104	-80	0.011	169	0.003	-173
1.5000	4.19	0.026	56	0.007	107	0.003	-105	0.016	-18	0.030	-162	0.040	-162
1.6000	3.93	0.016	-96	0.006	-1	0.004	157	0.047	-143	0.007	-132	0.018	-99
1.7000	3.70	0.025	-37	0.006	69	0.002	-168	0.026	-101	0.006	125	0.010	155
1.8000	3.49	0.004	108	0.001	-29	0.002	-101	0.019	149	0.012	170	0.015	-127
1.9000	3.31	0.016	-119	0.004	36	0.000	0	0.015	178	0.001	129	0.003	129
2.0000	3.14	0.004	0	0.001	-125	0.000	0	0.005	59	0.001	-150	0.010	-161
2.1000	2.99	0.010	171	0.002	12	0.000	0	0.009	-145	0.001	128	0.001	48
2.2000	2.86	0.003	-30	0.000	0	0.001	79	0.001	108	0.001	74	0.004	174
2.3000	2.73	0.006	120	0.001	-4	0.000	0	0.002	124	0.001	62	0.002	81



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* *** MOSES *** *

* ———————— June 8, 2020 *

* Equilibrium Position *

* TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL *

* Draft = 4.7 Meters Trim Angle = 0.00 Deg. GMT = 21.6 Meters *

* Roll Gy. Radius = 7.7 Meters Pitch Gy. Radius = 32.4 Meters Yaw Gy. Radius = 32.4 Meters *

* JONSWAP Height = 3.15 Meters Mean Period = 3.3 Sec. M. Heading = 45.0 Deg. *

* Heading = 45.0 Deg. S. Coef. = 200. Gamma = 3.3 *

*

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+++MOTION RESPONSE SPECTRA+++

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Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Frequency	Period	Sea	Surge	Sway	Heave	Roll	Pitch	Yaw
0.100	62.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.200	31.416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.300	20.944	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.400	15.708	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.500	12.566	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.600	10.472	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.700	8.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.800	7.854	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.900	6.981	0.003	0.000	0.000	0.000	0.000	0.004	0.002
1.000	6.283	0.032	0.000	0.000	0.000	0.057	0.001	0.001
1.100	5.712	0.126	0.002	0.000	0.001	0.244	0.001	0.001
1.200	5.236	0.272	0.001	0.000	0.000	0.014	0.004	0.007

1.300	4.833	0.515	0.000	0.000	0.000	0.009	0.002	0.006
1.400	4.488	1.142	0.008	0.001	0.000	0.013	0.000	0.000
1.500	4.189	1.440	0.001	0.000	0.000	0.000	0.001	0.002
1.600	3.927	0.882	0.000	0.000	0.000	0.002	0.000	0.000
1.700	3.696	0.492	0.000	0.000	0.000	0.000	0.000	0.000
1.800	3.491	0.346	0.000	0.000	0.000	0.000	0.000	0.000
1.900	3.307	0.281	0.000	0.000	0.000	0.000	0.000	0.000
2.000	3.142	0.235	0.000	0.000	0.000	0.000	0.000	0.000
2.100	2.992	0.196	0.000	0.000	0.000	0.000	0.000	0.000
2.200	2.856	0.164	0.000	0.000	0.000	0.000	0.000	0.000
2.300	2.732	0.136	0.000	0.000	0.000	0.000	0.000	0.000

Output RAO dan Respons MOSES Heading 90 derajat

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*******************************************************************************************************
*                                         ***  MOSES  ***                                             *
*                                         ---------------                 June 8, 2020                *
*        Equilibrium Position                                                                         *
*        TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL                                     *
*  Draft           =  4.7 Meters     Trim Angle      =  -0.00 Deg.    GMT            =  21.6 Meters   *
*  Roll Gy. Radius =  7.7 Meters     Pitch Gy. Radius =  32.4 Meters  Yaw Gy. Radius =  32.4 Meters   *
*  Heading         =  90.00 Deg.     Forward Speed   =  0.00 Knots    Linearization Based on SEA      *
*                                                                                                     *
*******************************************************************************************************
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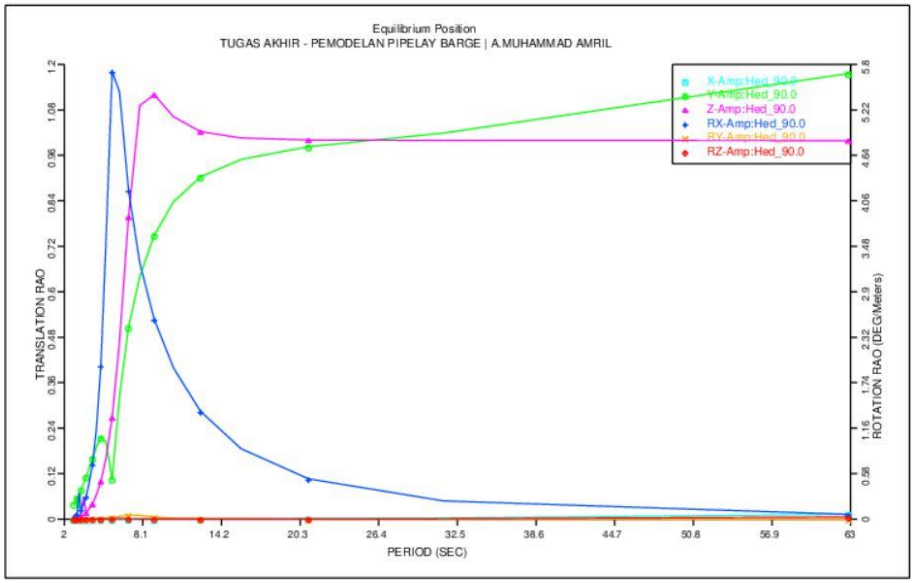
+++ M O T I O N   R E S P O N S E   O P E R A T O R S +++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

E N C O U N T E R		Surge / Wave Ampl.		Sway / Wave Ampl.		Heave / Wave Ampl.		Roll / Wave Ampl.		Pitch / Wave Ampl.		Yaw / Wave Ampl.	
Frequency -(Rad/Sec)-	Period -(Sec)-	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase
0.1000	62.83	0.013	-5	1.176	98	0.999	-6	0.060	82	0.000	0	0.026	-27
0.2000	31.42	0.003	-13	1.019	79	1.000	-13	0.231	75	0.000	0	0.004	-24
0.3000	20.94	0.001	-23	0.983	69	1.001	-22	0.513	66	0.000	0	0.002	-26
0.4000	15.71	0.001	-31	0.949	58	1.006	-31	0.898	56	0.001	142	0.001	-56
0.5000	12.57	0.000	0	0.903	45	1.023	-44	1.375	42	0.004	121	0.001	-112
0.6000	10.47	0.000	0	0.837	29	1.062	-63	1.928	25	0.010	90	0.002	-149
0.7000	8.98	0.000	0	0.749	9	1.120	-90	2.549	4	0.025	44	0.003	-178
0.8000	7.85	0.000	0	0.640	-14	1.091	-130	3.268	-20	0.049	-25	0.004	150
0.9000	6.98	0.000	0	0.506	-42	0.797	-177	4.198	-51	0.052	-106	0.005	111
1.0000	6.28	0.000	0	0.322	-75	0.467	144	5.450	-94	0.034	-169	0.006	57
1.1000	5.71	0.000	0	0.106	-65	0.268	115	5.713	-156	0.021	147	0.005	-26
1.2000	5.24	0.000	0	0.204	-54	0.160	90	3.557	144	0.013	113	0.003	-120
1.3000	4.83	0.000	0	0.215	-86	0.099	67	1.954	103	0.009	84	0.003	164
1.4000	4.49	0.000	0	0.190	-115	0.063	45	1.138	72	0.006	57	0.003	111
1.5000	4.19	0.000	0	0.160	-142	0.040	20	0.702	43	0.005	34	0.002	71
1.6000	3.93	0.000	0	0.134	-168	0.027	-2	0.458	15	0.003	5	0.002	35
1.7000	3.70	0.000	0	0.112	163	0.017	-27	0.290	-12	0.003	-20	0.002	2
1.8000	3.49	0.000	0	0.093	135	0.058	106	0.193	-41	0.018	-72	0.002	-27
1.9000	3.31	0.000	0	0.078	106	0.009	-80	0.124	-70	0.001	-76	0.002	-57
2.0000	3.14	0.000	0	0.028	37	0.005	-110	0.326	33	0.001	-105	0.010	-89
2.1000	2.99	0.000	0	0.056	46	0.003	-140	0.068	-131	0.001	-137	0.002	-139
2.2000	2.86	0.000	0	0.047	13	0.013	-19	0.043	-164	0.003	161	0.001	-157
2.3000	2.73	0.000	0	0.039	-21	0.003	156	0.025	160	0.000	0	0.001	164



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* *** MOSES *** *

* ———— June 8, 2020 *

* Equilibrium Position *

* TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL *

Draft	= 4.7 Meters	Trim Angle	= -0.00 Deg.	GMT	= 21.6 Meters
Roll Gy. Radius	= 7.7 Meters	Pitch Gy. Radius	= 32.4 Meters	Yaw Gy. Radius	= 32.4 Meters
JONSWAP Height	= 3.15 Meters	Mean Period	= 3.3 Sec.	M. Heading	= 90.0 Deg.
Heading	= 90.0 Deg.	S. Coef.	= 200.	Gamma	= 3.3

****

+++MOTION RESPONSE SPECTRA+++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Frequency	Period	Sea	Surge	Sway	Heave	Roll	Pitch	Yaw
0.100	62.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.200	31.416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.300	20.944	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.400	15.708	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.500	12.566	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.600	10.472	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.700	8.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.800	7.854	0.000	0.000	0.000	0.001	0.005	0.000	0.000
0.900	6.981	0.003	0.000	0.002	0.006	0.160	0.000	0.000
1.000	6.283	0.032	0.000	0.006	0.012	1.624	0.000	0.000
1.100	5.712	0.126	0.000	0.002	0.011	5.219	0.000	0.000

1.200	5.236	0.272	0.000	0.013	0.008	4.103	0.000	0.000
1.300	4.833	0.515	0.000	0.031	0.007	2.537	0.000	0.000
1.400	4.488	1.142	0.000	0.044	0.005	1.593	0.000	0.000
1.500	4.189	1.440	0.000	0.033	0.002	0.625	0.000	0.000
1.600	3.927	0.882	0.000	0.014	0.001	0.168	0.000	0.000
1.700	3.696	0.492	0.000	0.006	0.000	0.039	0.000	0.000
1.800	3.491	0.346	0.000	0.003	0.001	0.013	0.000	0.000
1.900	3.307	0.281	0.000	0.002	0.000	0.004	0.000	0.000
2.000	3.142	0.235	0.000	0.000	0.000	0.024	0.000	0.000
2.100	2.992	0.196	0.000	0.001	0.000	0.001	0.000	0.000
2.200	2.856	0.164	0.000	0.000	0.000	0.000	0.000	0.000
2.300	2.732	0.136	0.000	0.000	0.000	0.000	0.000	0.000

Output RAO dan Respons MOSES Heading 135 derajat

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*****************************************************************************************************
*                                    ***  MOSES  ***                                              *
*                                    ---------------                    June 8, 2020              *
*          Equilibrium Position                                                                   *
*          TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL                               *
*   Draft            =  4.7 Meters    Trim Angle      =  -0.01 Deg.    GMT             = 21.6 Meters *
*   Roll Gy. Radius  =  7.7 Meters    Pitch Gy. Radius =  32.4 Meters   Yaw Gy. Radius  = 32.4 Meters *
*   Heading          = 135.00 Deg.    Forward Speed   =  0.00 Knots    Linearization Based on SEA   *
*                                                                                                   *
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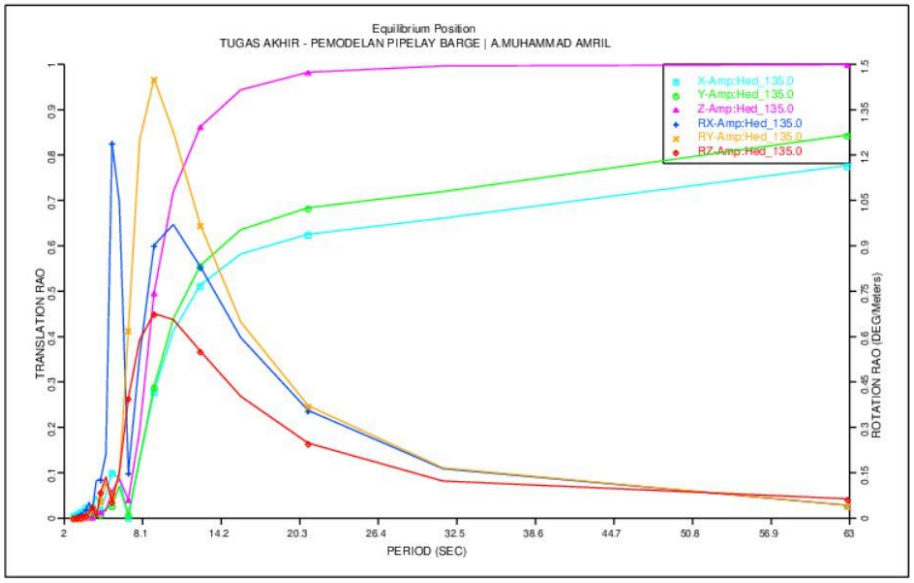
+++ M O T I O N   R E S P O N S E   O P E R A T O R S +++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

E N C O U N T E R		Surge / Wave Ampl.		Sway / Wave Ampl.		Heave / Wave Ampl.		Roll / Wave Ampl.		Pitch / Wave Ampl.		Yaw / Wave Ampl.	
Frequency -(Rad/Sec)-	Period -(Sec)-	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase
0.1000	62.83	0.777	-95	0.844	100	0.999	-6	0.042	82	0.042	83	0.064	18
0.2000	31.42	0.661	-109	0.720	74	0.996	-19	0.163	69	0.166	70	0.123	-14
0.3000	20.94	0.625	-128	0.684	53	0.983	-38	0.356	51	0.372	51	0.248	-36
0.4000	15.71	0.582	-153	0.635	27	0.944	-64	0.597	27	0.649	26	0.402	-61
0.5000	12.57	0.513	174	0.556	-4	0.862	-97	0.831	-4	0.969	-6	0.552	-93
0.6000	10.47	0.412	134	0.439	-44	0.720	-141	0.970	-43	1.277	-49	0.656	-130
0.7000	8.98	0.279	86	0.289	-91	0.496	162	0.902	-90	1.453	-104	0.676	-175
0.8000	7.85	0.132	30	0.128	-147	0.193	87	0.534	-146	1.249	-174	0.589	133
0.9000	6.98	0.002	156	0.008	-63	0.040	-148	0.151	-33	0.622	109	0.397	74
1.0000	6.28	0.087	76	0.070	-118	0.087	128	1.042	-115	0.137	43	0.152	7
1.1000	5.71	0.101	-3	0.028	171	0.059	61	1.241	125	0.073	143	0.055	123
1.2000	5.24	0.051	-92	0.021	130	0.016	-10	0.210	18	0.114	75	0.136	39
1.3000	4.83	0.017	6	0.010	-116	0.013	80	0.129	99	0.058	-3	0.086	-47
1.4000	4.49	0.048	-103	0.019	138	0.015	-7	0.123	31	0.011	64	0.003	87
1.5000	4.19	0.026	140	0.006	38	0.002	-69	0.028	-30	0.028	-13	0.039	-46
1.6000	3.93	0.016	-138	0.005	137	0.004	-32	0.052	20	0.006	-106	0.018	-139
1.7000	3.70	0.025	85	0.006	38	0.001	-126	0.031	-73	0.006	-54	0.010	-54
1.8000	3.49	0.004	-142	0.001	126	0.004	-48	0.020	-34	0.007	62	0.014	-157
1.9000	3.31	0.016	0	0.004	0	0.001	-106	0.015	-130	0.001	-67	0.003	-85
2.0000	3.14	0.004	149	0.001	134	0.000	0	0.010	-99	0.002	-120	0.010	136
2.1000	2.99	0.010	-117	0.003	-79	0.000	0	0.007	37	0.001	-114	0.002	154
2.2000	2.86	0.003	-15	0.000	0	0.000	0	0.002	-157	0.001	151	0.004	55
2.3000	2.73	0.006	88	0.001	-154	0.000	0	0.002	179	0.001	143	0.002	112



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* *** MOSES *** *

* ———— June 8, 2020 *

* Equilibrium Position *

* TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL *

* Draft = 4.7 Meters Trim Angle = -0.01 Deg. GMT = 21.6 Meters *

* Roll Gy. Radius = 7.7 Meters Pitch Gy. Radius = 32.4 Meters Yaw Gy. Radius = 32.4 Meters *

* JONSWAP Height = 3.15 Meters Mean Period = 3.3 Sec. M. Heading = 135.0 Deg. *

* Heading = 135.0 Deg. S. Coef. = 200. Gamma = 3.3 *

* *

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+++ MOTION RESPONSE SPECTRA +++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Frequency	Period	Sea	Surge	Sway	Heave	Roll	Pitch	Yaw
0.100	62.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.200	31.416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.300	20.944	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.400	15.708	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.500	12.566	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.600	10.472	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.700	8.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.800	7.854	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.900	6.981	0.003	0.000	0.000	0.000	0.000	0.003	0.001
1.000	6.283	0.032	0.000	0.000	0.000	0.059	0.001	0.001
1.100	5.712	0.126	0.002	0.000	0.001	0.246	0.001	0.000

1.200	5.236	0.272	0.001	0.000	0.000	0.014	0.004	0.006
1.300	4.833	0.515	0.000	0.000	0.000	0.011	0.002	0.005
1.400	4.488	1.142	0.003	0.000	0.000	0.019	0.000	0.000
1.500	4.189	1.440	0.001	0.000	0.000	0.001	0.001	0.002
1.600	3.927	0.882	0.000	0.000	0.000	0.002	0.000	0.000
1.700	3.696	0.492	0.000	0.000	0.000	0.000	0.000	0.000
1.800	3.491	0.346	0.000	0.000	0.000	0.000	0.000	0.000
1.900	3.307	0.281	0.000	0.000	0.000	0.000	0.000	0.000
2.000	3.142	0.235	0.000	0.000	0.000	0.000	0.000	0.000
2.100	2.992	0.196	0.000	0.000	0.000	0.000	0.000	0.000
2.200	2.856	0.164	0.000	0.000	0.000	0.000	0.000	0.000
2.300	2.732	0.136	0.000	0.000	0.000	0.000	0.000	0.000

Output RAO dan Respons MOSES Heading 180 derajat

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*****************************************************************************************************
*                                    ***  MOSES  ***                                                *
*                                   ---------------                        June 8, 2020             *
*        Equilibrium Position                                                                       *
*        TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL                                   *
*  Draft            =  4.7 Meters     Trim Angle      =  -0.00 Deg.     GMT            =  21.6 Meters *
*  Roll Gy. Radius  =  7.7 Meters     Pitch Gy. Radius =  32.4 Meters   Yaw Gy. Radius  =  32.4 Meters *
*  Heading          = 180.00 Deg.     Forward Speed   =  0.00 Knots     Linearization Based on SEA  *
*                                                                                                   *
*****************************************************************************************************
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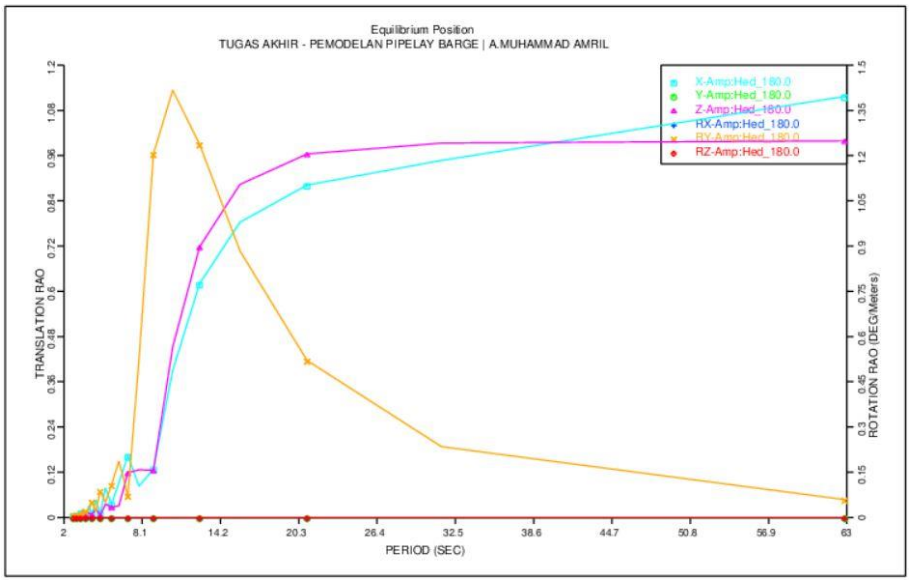
+++ M O T I O N   R E S P O N S E   O P E R A T O R S +++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

E N C O U N T E R		Surge / Wave Ampl.		Sway / Wave Ampl.		Heave / Wave Ampl.		Roll / Wave Ampl.		Pitch / Wave Ampl.		Yaw / Wave Ampl.	
Frequency -(Rad/Sec)-	Period -(Sec)-	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase	Ampl.	Phase
0.1000	62.83	1.117	-92	0.000	0	0.999	-3	0.000	0	0.059	86	0.000	0
0.2000	31.42	0.947	-103	0.000	0	0.993	-14	0.000	0	0.235	76	0.000	0
0.3000	20.94	0.882	-122	0.000	0	0.964	-32	0.000	0	0.521	57	0.000	0
0.4000	15.71	0.783	-147	0.000	0	0.883	-59	0.000	0	0.884	31	0.000	0
0.5000	12.57	0.620	179	0.000	0	0.718	-94	0.000	0	1.238	-3	0.000	0
0.6000	10.47	0.389	139	0.000	0	0.452	-140	0.000	0	1.417	-47	0.000	0
0.7000	8.98	0.129	91	0.000	0	0.125	152	0.000	0	1.206	-103	0.000	0
0.8000	7.85	0.083	-141	0.000	0	0.126	-73	0.000	0	0.526	-171	0.000	0
0.9000	6.98	0.163	156	0.000	0	0.118	-149	0.000	0	0.073	-73	0.000	0
1.0000	6.28	0.092	85	0.000	0	0.031	165	0.000	0	0.186	-117	0.000	0
1.1000	5.71	0.035	-161	0.000	0	0.027	-91	0.000	0	0.108	-165	0.000	0
1.2000	5.24	0.078	106	0.000	0	0.035	-153	0.000	0	0.050	-81	0.000	0
1.3000	4.83	0.011	-17	0.000	0	0.006	-88	0.000	0	0.089	-148	0.000	0
1.4000	4.49	0.047	100	0.000	0	0.023	-151	0.000	0	0.019	-89	0.000	0
1.5000	4.19	0.010	-47	0.000	0	0.007	-93	0.000	0	0.053	-152	0.000	0
1.6000	3.93	0.029	62	0.000	0	0.012	-174	0.000	0	0.023	-101	0.000	0
1.7000	3.70	0.008	176	0.000	0	0.008	-119	0.000	0	0.020	174	0.000	0
1.8000	3.49	0.015	-15	0.000	0	0.005	178	0.000	0	0.028	-152	0.000	0
1.9000	3.31	0.013	58	0.000	0	0.006	-169	0.000	0	0.011	-126	0.000	0
2.0000	3.14	0.006	159	0.000	0	0.005	-140	0.000	0	0.010	-164	0.000	0
2.1000	2.99	0.006	-94	0.000	0	0.002	-156	0.000	0	0.010	-175	0.000	0
2.2000	2.86	0.006	-33	0.000	0	0.002	-173	0.000	0	0.009	-163	0.000	0
2.3000	2.73	0.005	12	0.000	0	0.002	-173	0.000	0	0.008	-166	0.000	0



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* *** MOSES *** *

* ———————— June 8, 2020 *

* Equilibrium Position *

* TUGAS AKHIR - PEMODELAN PIPELAY BARGE | A.MUHAMMAD AMRIL *

Draft	= 4.7 Meters	Trim Angle	= -0.00 Deg.	GMT	= 21.6 Meters
Roll Gy. Radius	= 7.7 Meters	Pitch Gy. Radius	= 32.4 Meters	Yaw Gy. Radius	= 32.4 Meters
JONSWAP Height	= 3.15 Meters	Mean Period	= 3.3 Sec.	M. Heading	= 180.0 Deg.
Heading	= 180.0 Deg.	S. Coef.	= 200.	Gamma	= 3.3

****

+++MOTION RESPONSE SPECTRA+++

Results are in Body System

Of Point On Body PIPE_LAY At X = 61.6 Y = -0.0 Z = 2.2

Process is DEFAULT: Units Are Degrees, Meters, and M-Tons Unless Specified

Frequency	Period	Sea	Surge	Sway	Heave	Roll	Pitch	Yaw
0.100	62.832	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.200	31.416	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.300	20.944	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.400	15.708	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.500	12.566	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.600	10.472	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.700	8.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.800	7.854	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.900	6.981	0.003	0.000	0.000	0.000	0.000	0.000	0.000
1.000	6.283	0.032	0.000	0.000	0.000	0.000	0.002	0.000
1.100	5.712	0.126	0.000	0.000	0.000	0.000	0.002	0.000

1.200	5.236	0.272	0.002	0.000	0.000	0.000	0.001	0.000
1.300	4.833	0.515	0.000	0.000	0.000	0.000	0.005	0.000
1.400	4.488	1.142	0.003	0.000	0.001	0.000	0.000	0.000
1.500	4.189	1.440	0.000	0.000	0.000	0.000	0.004	0.000
1.600	3.927	0.882	0.001	0.000	0.000	0.000	0.000	0.000
1.700	3.696	0.492	0.000	0.000	0.000	0.000	0.000	0.000
1.800	3.491	0.346	0.000	0.000	0.000	0.000	0.000	0.000
1.900	3.307	0.281	0.000	0.000	0.000	0.000	0.000	0.000
2.000	3.142	0.235	0.000	0.000	0.000	0.000	0.000	0.000
2.100	2.992	0.196	0.000	0.000	0.000	0.000	0.000	0.000
2.200	2.856	0.164	0.000	0.000	0.000	0.000	0.000	0.000
2.300	2.732	0.136	0.000	0.000	0.000	0.000	0.000	0.000

LAMPIRAN B
OUTPUT SOFTWARE OFFPIPE
(ANALISIS STATIS TEGANGAN)

Output Analisa Statis (Case 1 - 9)

Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/21/2020 TIME – 21:20:30 PAGE 11
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 1

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.757	.000	11.16	.00	.00	.00	24.16	6.71
3	LAYBARGE	84.28	10.94	.00	.000	3.720	12.050	11.05	.00	-149.07	.00	150.76	41.88
5	LAYBARGE	73.46	9.93	.00	.000	6.812	22.920	10.90	.00	-127.08	.00	131.91	36.64
7	LAYBARGE	60.13	8.03	.00	.000	9.686	36.391	10.59	.00	-158.50	-.01	158.32	43.98
9	LAYBARGE	46.49	5.31	.00	.000	12.689	50.297	10.18	.00	-138.60	.03	141.00	39.17
11	LAYBARGE	35.42	2.52	.00	-.001	15.527	61.711	9.76	.00	-121.09	-.05	125.69	34.91
13	LAYBARGE	23.44	-1.13	.00	-.035	18.476	74.243	9.19	-.08	-147.08	-4.50	147.31	40.92
15	LAYBARGE	9.01	-6.41	.00	.016	21.741	89.606	8.38	-.43	-147.92	-6.40	147.45	40.96
18	STINGER	-2.94	-11.56	.00	.011	24.560	102.619	7.61	-.77	-96.15	-2.97	102.76	28.54
20	STINGER	-10.61	-15.23	.00	.001	26.382	111.120	7.05	-1.01	-72.19	-.93	81.92	22.76
22	STINGER	-18.17	-19.11	.00	-.013	27.961	119.620	6.45	-1.27	-77.39	-2.94	85.92	23.87
24	STINGER	-25.62	-23.20	.00	.061	29.583	128.120	5.83	-1.54	-74.41	4.48	82.97	23.05
26	STINGER	-32.95	-27.50	.00	-.264	31.258	136.620	5.16	-1.83	-78.34	-29.94	90.38	25.11
28	STINGER	-40.18	-31.97	.08	-.889	31.663	145.121	4.49	-2.13	26.55	-13.94	44.08	12.24
30	STINGER	-47.47	-36.34	.20	-.985	30.011	153.621	3.81	-2.42	81.47	4.59	87.40	24.28
32	STINGER	-54.87	-40.41	.32	-.751	27.466	162.062	3.18	-2.69	98.89	8.81	101.94	28.32
34	STINGER	-62.28	-44.04	.40	-.471	24.662	170.321	2.28	-2.93	106.86	9.12	108.28	30.08
36	SAGBEND	-73.87	-48.81	.45	-.074	20.077	182.858	1.89	-3.25	115.03	8.24	114.57	31.83
37	SAGBEND	-85.51	-52.53	.43	.253	15.321	195.083	1.32	-3.50	121.19	7.16	119.30	33.14
38	SAGBEND	-97.41	-55.25	.35	.533	10.363	207.291	0.90	-3.68	125.09	6.39	122.25	33.96
39	SAGBEND	-109.49	-56.91	.21	.757	5.359	219.492	0.64	-3.79	121.89	3.81	119.24	33.12
40	SAGBEND	-121.67	-57.56	.05	.672	1.011	231.692	0.55	-3.83	81.08	-13.62	85.42	23.73
41	SEABED	-133.87	-57.61	.00	-.035	.000	243.892	0.55	-3.84	-.15	.87	16.56	4.60
42	SEABED	-146.07	-57.61	.00	.001	.000	256.092	0.55	-3.84	.00	-.07	15.88	4.41
43	SEABED	-158.27	-57.61	.00	.000	.000	268.292	0.55	-3.84	.00	.00	15.82	4.40
44	SEABED	-170.47	-57.61	.00	.000	.000	280.492	0.55	-3.84	.00	.00	15.82	4.40
45	SEABED	-182.67	-57.61	.00	.000	.000	292.692	0.55	-3.84	.00	.00	15.82	4.40

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/21/2020 TIME – 21:20:30 PAGE 15
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 2

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.757	.000	11.17	.00	.00	.00	24.17	6.71
3	LAYBARGE	84.28	10.94	.00	.000	3.720	12.050	11.05	.00	-149.08	.00	150.76	41.88
5	LAYBARGE	73.46	9.93	.00	.000	6.812	22.920	10.90	.00	-127.08	.00	131.92	36.64
7	LAYBARGE	60.13	8.03	.00	.000	9.686	36.391	10.60	.00	-158.50	-.01	158.32	43.98
9	LAYBARGE	46.49	5.31	.00	.000	12.689	50.297	10.19	.00	-138.63	.03	141.02	39.17
11	LAYBARGE	35.42	2.52	.00	-.002	15.526	61.711	9.76	.00	-120.99	-.05	125.60	34.89
13	LAYBARGE	23.44	-1.13	.00	-.035	18.482	74.243	9.19	-.08	-147.60	-4.48	147.75	41.04
15	LAYBARGE	9.01	-6.41	.00	.015	21.707	89.606	8.38	-.43	-145.28	-6.52	145.21	40.34
18	STINGER	-3.02	-11.61	.00	.017	24.930	102.720	7.59	-.77	-125.51	-2.64	127.69	35.47
20	STINGER	-10.64	-15.38	.00	-.020	27.543	111.221	7.02	-1.02	-105.69	-2.87	110.41	30.67
22	STINGER	-18.10	-19.47	.00	.074	29.920	119.722	6.39	-1.30	-107.78	5.44	111.78	31.05
24	STINGER	-25.37	-23.86	.00	-.318	32.438	128.222	5.71	-1.59	-111.92	-35.59	119.34	33.15
26	STINGER	-32.48	-28.52	.09	-1.048	33.395	136.723	5.02	-1.90	16.47	-14.82	37.84	10.51
28	STINGER	-39.62	-33.13	.24	-1.153	31.936	145.224	4.31	-2.21	76.35	4.74	83.45	23.18
30	STINGER	-46.80	-37.40	.37	-.909	29.543	153.582	3.65	-2.49	94.63	9.19	98.73	27.42
32	STINGER	-54.01	-41.27	.46	-.611	26.878	161.757	3.05	-2.75	102.86	9.79	105.28	29.24
34	STINGER	-61.10	-44.66	.52	-.333	24.142	169.621	2.31	-2.97	108.44	9.24	109.55	30.43
36	SAGBEND	-73.59	-49.62	.55	.088	19.162	183.068	1.77	-3.30	116.42	8.05	115.65	32.12
37	SAGBEND	-85.29	-53.15	.50	.404	14.357	195.292	1.22	-3.54	122.20	7.01	120.07	33.35
38	SAGBEND	-97.23	-55.66	.38	.678	9.375	207.493	0.84	-3.71	125.35	6.19	122.41	34.00
39	SAGBEND	-109.34	-57.12	.21	.878	4.406	219.693	0.61	-3.80	118.99	2.48	116.72	32.42
40	SAGBEND	-121.52	-57.60	.04	.634	.436	231.893	0.55	-3.83	59.27	-22.60	69.46	19.30
41	SEABED	-133.72	-57.61	.00	-.022	.019	244.093	0.55	-3.84	.75	.93	16.82	4.67
42	SEABED	-145.92	-57.61	.00	.000	.000	256.293	0.55	-3.84	-.03	-.03	15.86	4.40
43	SEABED	-158.12	-57.61	.00	.000	.000	268.493	0.55	-3.84	.00	.00	15.82	4.40
44	SEABED	-170.32	-57.61	.00	.000	.000	280.693	0.55	-3.84	.00	.00	15.82	4.40
45	SEABED	-182.52	-57.61	.00	.000	.000	292.893	0.55	-3.84	.00	.00	15.82	4.40

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/21/2020 TIME – 21:20:30 PAGE 19
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 3

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.757	.000	11.17	.00	.00	.00	24.17	6.71
3	LAYBARGE	84.28	10.94	.00	.000	3.720	12.050	11.05	.00	-149.08	.00	150.76	41.88
5	LAYBARGE	73.46	9.93	.00	.000	6.812	22.920	10.90	.00	-127.08	.00	131.92	36.64
7	LAYBARGE	60.13	8.03	.00	.000	9.686	36.391	10.60	.00	-158.50	-.01	158.32	43.98
9	LAYBARGE	46.49	5.31	.00	.000	12.689	50.297	10.19	.00	-138.65	.03	141.03	39.18
11	LAYBARGE	35.42	2.52	.00	-.002	15.525	61.711	9.76	.00	-120.88	-.05	125.51	34.86
13	LAYBARGE	23.44	-1.13	.00	-.035	18.488	74.243	9.19	-.08	-148.13	-4.50	148.20	41.17
15	LAYBARGE	9.01	-6.41	.00	.016	21.673	89.606	8.38	-.43	-142.57	-6.43	142.90	39.70
18	STINGER	-3.11	-11.67	.00	.009	25.322	102.818	7.57	-.78	-156.10	-3.34	153.68	42.69
20	STINGER	-10.68	-15.53	.00	.013	28.692	111.319	6.99	-1.03	-135.68	.34	135.84	37.73
22	STINGER	-18.01	-19.82	.00	-.071	32.027	119.820	6.32	-1.32	-151.67	-10.37	149.21	41.45
24	STINGER	-25.11	-24.50	.04	-.749	34.250	128.322	5.63	-1.63	-43.90	-37.22	68.38	19.00
26	STINGER	-32.14	-29.29	.18	-1.294	33.790	136.823	4.90	-1.95	58.39	-.70	68.53	19.04
28	STINGER	-39.21	-33.85	.33	-1.130	31.697	145.240	4.19	-2.25	87.13	8.25	92.74	25.76
30	STINGER	-46.29	-38.01	.45	-.832	29.182	153.453	3.55	-2.53	97.76	9.96	101.37	28.16
32	STINGER	-53.18	-41.66	.54	-.539	26.590	161.252	2.99	-2.77	103.97	9.91	106.18	29.49
34	STINGER	-59.87	-44.83	.58	-.277	23.999	168.652	2.48	-2.98	108.81	9.21	109.84	30.51
36	SAGBEND	-73.62	-50.18	.59	.179	18.501	183.413	1.68	-3.34	117.36	7.92	116.37	32.33
37	SAGBEND	-85.33	-53.56	.52	.488	13.673	195.613	1.16	-3.57	122.85	6.90	120.57	33.49
38	SAGBEND	-97.30	-55.93	.39	.757	8.675	207.813	0.80	-3.72	125.34	6.04	122.36	33.99
39	SAGBEND	-109.42	-57.24	.21	.939	3.751	220.013	0.60	-3.81	115.88	1.50	114.06	31.68
40	SEABED	-121.61	-57.61	.03	.580	.168	232.213	0.55	-3.84	38.19	-29.17	56.41	15.67
41	SEABED	-133.81	-57.61	.00	-.009	.018	244.413	0.55	-3.84	.79	.64	16.67	4.63
42	SEABED	-146.01	-57.61	.00	.000	.000	256.613	0.55	-3.84	-.02	.00	15.84	4.40
43	SEABED	-158.21	-57.61	.00	.000	.000	268.813	0.55	-3.84	.00	.00	15.82	4.40
44	SEABED	-170.41	-57.61	.00	.000	.000	281.013	0.55	-3.84	.00	.00	15.82	4.40

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/21/2020 TIME – 21:22:13 PAGE 11
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 1

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.759	.000	11.00	.00	.00	.00	29.00	8.05
3	LAYBARGE	84.28	10.94	.00	.000	3.731	12.050	10.88	.00	-152.64	.00	158.62	44.06
5	LAYBARGE	73.46	9.93	.00	.000	6.813	22.920	10.73	.00	-132.35	.00	141.23	39.23
7	LAYBARGE	60.13	8.03	.00	.000	9.689	36.391	10.43	.00	-164.84	-.01	168.54	46.82
9	LAYBARGE	46.49	5.31	.00	.000	12.682	50.297	10.02	.00	-144.05	.03	150.46	41.79
11	LAYBARGE	35.42	2.52	.00	-.002	15.530	61.711	9.59	.00	-125.65	-.10	134.40	37.33
13	LAYBARGE	23.43	-1.13	.00	-.033	18.487	74.243	9.02	-.08	-153.97	-4.45	157.99	43.88
15	LAYBARGE	9.01	-6.41	.00	.015	21.733	89.606	8.21	-.43	-155.08	-6.39	158.35	43.99
18	STINGER	-2.94	-11.56	.00	.015	24.548	102.619	7.44	-.77	-99.66	-2.71	110.57	30.71
20	STINGER	-10.61	-15.23	.00	-.014	26.385	111.120	6.88	-1.01	-73.77	-2.36	88.13	24.48
22	STINGER	-18.17	-19.11	.00	.050	27.956	119.620	6.29	-1.27	-78.52	3.29	91.73	25.48
24	STINGER	-25.62	-23.20	.00	-.216	29.606	128.120	5.66	-1.54	-76.98	-25.74	93.43	25.95
26	STINGER	-32.97	-27.47	.07	-.853	30.258	136.620	5.01	-1.83	3.47	-21.21	42.22	11.73
28	STINGER	-40.34	-31.70	.20	-1.078	29.183	145.121	4.36	-2.11	61.52	2.58	75.78	21.05
30	STINGER	-47.79	-35.70	.33	-.896	27.226	153.580	3.74	-2.38	76.07	7.41	87.92	24.42
32	STINGER	-55.27	-39.37	.43	-.653	25.059	161.917	3.18	-2.62	81.35	8.02	92.00	25.56
34	STINGER	-62.73	-42.68	.50	-.420	22.830	170.071	2.8	-2.84	84.68	7.65	94.39	26.22
36	SAGBEND	-74.66	-47.27	.56	-.088	19.173	182.859	1.96	-3.15	89.08	6.85	97.52	27.09
37	SAGBEND	-86.33	-50.92	.55	.183	15.516	195.084	1.40	-3.39	92.69	5.87	100.09	27.80
38	SAGBEND	-98.19	-53.79	.48	.411	11.731	207.291	0.96	-3.58	95.63	5.27	102.21	28.39
39	SAGBEND	-110.21	-55.87	.37	.621	7.851	219.492	0.64	-3.72	97.40	4.98	103.45	28.74
40	SAGBEND	-122.34	-57.12	.22	.799	3.963	231.692	0.45	-3.80	94.66	3.10	100.91	28.03
41	SAGBEND	-134.53	-57.59	.05	.712	.606	243.892	0.39	-3.83	59.56	-13.42	72.28	20.08
42	SEABED	-146.73	-57.61	.00	-.037	.010	256.092	0.39	-3.84	.48	.94	21.46	5.96
43	SEABED	-158.93	-57.61	.00	.001	.000	268.292	0.39	-3.84	-.01	-.06	20.63	5.73
44	SEABED	-171.13	-57.61	.00	.000	.000	280.492	0.39	-3.84	.00	.00	20.57	5.71
45	SEABED	-183.33	-57.61	.00	.000	.000	292.692	0.39	-3.84	.00	.00	20.57	5.71
46	SEABED	-195.53	-57.61	.00	.000	.000	304.892	0.39	-3.84	.00	.00	20.57	5.71

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/21/2020 TIME – 21:22:13 PAGE 15
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 2

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.759	.000	11.00	.00	.00	.00	29.00	8.06
3	LAYBARGE	84.28	10.94	.00	.000	3.731	12.050	10.88	.00	-152.64	.00	158.62	44.06
5	LAYBARGE	73.46	9.93	.00	.000	6.813	22.920	10.73	.00	-132.35	.00	141.23	39.23
7	LAYBARGE	60.13	8.03	.00	.000	9.689	36.391	10.43	.00	-164.84	-.01	168.54	46.82
9	LAYBARGE	46.49	5.31	.00	.000	12.682	50.297	10.02	.00	-144.07	.03	150.47	41.80
11	LAYBARGE	35.42	2.52	.00	-.002	15.529	61.711	9.59	.00	-125.57	-.09	134.33	37.31
13	LAYBARGE	23.43	-1.13	.00	-.033	18.492	74.243	9.02	-.08	-154.41	-4.48	158.36	43.99
15	LAYBARGE	9.01	-6.41	.00	.016	21.703	89.606	8.21	-.43	-152.63	-6.26	156.27	43.41
18	STINGER	-3.02	-11.61	.00	.004	24.921	102.720	7.42	-.77	-130.36	-3.65	136.66	37.96
20	STINGER	-10.64	-15.38	.00	.032	27.531	111.221	6.85	-1.02	-106.45	2.18	115.87	32.19
22	STINGER	-18.10	-19.47	.00	-.154	29.978	119.722	6.22	-1.30	-115.57	-19.47	124.49	34.58
24	STINGER	-25.39	-23.83	.06	-.827	31.435	128.222	5.57	-1.59	-23.35	-30.02	56.70	15.75
26	STINGER	-32.65	-28.25	.20	-1.207	30.783	136.723	4.89	-1.88	54.15	.96	69.88	19.41
28	STINGER	-39.94	-32.44	.34	-1.044	28.972	145.133	4.24	-2.16	72.57	7.32	85.34	23.71
30	STINGER	-47.26	-36.33	.46	-.795	26.901	153.417	3.65	-2.42	78.62	8.29	90.08	25.02
32	STINGER	-54.51	-39.84	.55	-.550	24.767	161.480	3.11	-2.65	82.16	8.15	92.64	25.73
34	STINGER	-61.62	-42.96	.60	-.327	22.631	169.247	2.76	-2.86	85.00	7.61	94.63	26.29
36	SAGBEND	-74.55	-47.84	.63	.027	18.658	183.069	1.88	-3.19	89.65	6.72	97.92	27.20
37	SAGBEND	-86.25	-51.38	.60	.290	14.980	195.293	1.33	-3.42	93.15	5.73	100.42	27.89
38	SAGBEND	-98.13	-54.14	.52	.513	11.182	207.493	0.91	-3.60	95.97	5.19	102.45	28.46
39	SAGBEND	-110.17	-56.10	.39	.720	7.292	219.693	0.61	-3.74	97.45	4.85	103.46	28.74
40	SAGBEND	-122.31	-57.24	.22	.879	3.425	231.893	0.44	-3.81	93.08	1.98	99.53	27.65
41	SEABED	-134.51	-57.60	.04	.638	.299	244.093	0.39	-3.84	44.93	-23.07	63.32	17.59
42	SEABED	-146.71	-57.61	.00	-.020	.016	256.293	0.39	-3.84	.80	.78	21.51	5.97
43	SEABED	-158.91	-57.61	.00	.000	.000	268.493	0.39	-3.84	-.01	-.02	20.60	5.72
44	SEABED	-171.11	-57.61	.00	.000	.000	280.693	0.39	-3.84	.00	.00	20.57	5.71
45	SEABED	-183.31	-57.61	.00	.000	.000	292.893	0.39	-3.84	.00	.00	20.57	5.71

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/21/2020 TIME – 21:22:13 PAGE 19
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 3

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.759	.000	11.00	.00	.00	.00	29.00	8.06
3	LAYBARGE	84.28	10.94	.00	.000	3.731	12.050	10.88	.00	-152.64	.00	158.62	44.06
5	LAYBARGE	73.46	9.93	.00	.000	6.813	22.920	10.73	.00	-132.35	.00	141.23	39.23
7	LAYBARGE	60.13	8.03	.00	.000	9.689	36.391	10.43	.00	-164.84	-.01	168.54	46.82
9	LAYBARGE	46.49	5.31	.00	.000	12.682	50.297	10.02	.00	-144.08	.03	150.48	41.80
11	LAYBARGE	35.42	2.52	.00	-.002	15.528	61.711	9.59	.00	-125.50	-.09	134.27	37.30
13	LAYBARGE	23.43	-1.13	.00	-.034	18.496	74.243	9.02	-.08	-154.77	-4.51	158.67	44.07
15	LAYBARGE	9.01	-6.41	.00	.019	21.678	89.606	8.21	-.43	-150.62	-6.03	154.56	42.93
18	STINGER	-3.11	-11.67	.00	-.014	25.285	102.818	7.40	-.78	-159.80	-5.14	161.70	44.92
20	STINGER	-10.68	-15.53	.00	.107	28.782	111.319	6.82	-1.03	-148.44	9.51	151.77	42.16
22	STINGER	-18.02	-19.82	.00	-.493	31.648	119.820	6.17	-1.32	-105.87	-55.32	126.36	35.10
24	STINGER	-25.20	-24.37	.13	-1.329	32.254	128.322	5.49	-1.62	35.10	-4.25	54.37	15.10
26	STINGER	-32.39	-28.79	.30	-1.240	30.730	136.767	4.81	-1.92	66.76	6.58	80.81	22.45
28	STINGER	-39.61	-32.91	.44	-.993	28.768	145.079	4.17	-2.19	75.31	8.38	87.70	24.36
30	STINGER	-46.74	-36.66	.55	-.736	26.714	153.137	3.60	-2.44	79.38	8.47	90.69	25.19
32	STINGER	-53.69	-40.01	.62	-.499	24.659	160.855	3.08	-2.66	82.40	8.16	92.82	25.78
34	STINGER	-60.37	-42.94	.67	-.290	22.652	168.146	2.99	-2.86	84.98	7.59	94.61	26.28
36	SAGBEND	-74.67	-48.27	.69	.098	18.252	183.412	1.81	-3.21	90.09	6.64	98.24	27.29
37	SAGBEND	-86.37	-51.72	.64	.356	14.566	195.613	1.28	-3.44	93.51	5.66	100.67	27.97
38	SAGBEND	-98.27	-54.40	.55	.577	10.755	207.813	0.87	-3.62	96.22	5.18	102.64	28.51
39	SAGBEND	-110.32	-56.27	.40	.783	6.860	220.013	0.58	-3.75	97.42	4.79	103.42	28.73
40	SAGBEND	-122.47	-57.31	.22	.934	3.016	232.213	0.42	-3.82	91.35	1.47	98.05	27.24
41	SEABED	-134.67	-57.61	.03	.623	.137	244.413	0.39	-3.84	30.79	-27.17	55.31	15.36
42	SEABED	-146.87	-57.61	.00	-.014	.014	256.613	0.39	-3.84	.72	.62	21.37	5.94
43	SEABED	-159.07	-57.61	.00	.000	.000	268.813	0.39	-3.84	-.01	-.01	20.59	5.72
44	SEABED	-171.27	-57.61	.00	.000	.000	281.013	0.39	-3.84	.00	.00	20.57	5.71
45	SEABED	-183.47	-57.61	.00	.000	.000	293.213	0.39	-3.84	.00	.00	20.57	5.71
46	SEABED	-195.67	-57.61	.00	.000	.000	305.413	0.39	-3.84	.00	.00	20.57	5.71
47	SEABED	-207.87	-57.61	.00	.000	.000	317.613	0.39	-3.84	.00	.00	20.57	5.71

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/21/2020 TIME – 21:23:44 PAGE 11
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 1

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.761	.000	12.22	.00	.00	.00	32.22	8.95
3	LAYBARGE	84.28	10.94	.00	.000	3.738	12.050	12.10	.00	-155.01	.00	163.86	45.52
5	LAYBARGE	73.46	9.93	.00	.000	6.813	22.920	11.95	.00	-135.86	.00	147.43	40.95
7	LAYBARGE	60.13	8.03	.00	.000	9.691	36.391	11.64	.00	-169.05	-.01	175.34	48.71
9	LAYBARGE	46.49	5.31	.00	.000	12.678	50.297	11.23	.00	-147.67	.04	156.75	43.54
11	LAYBARGE	35.42	2.52	.00	-.002	15.531	61.711	10.81	.00	-128.72	-.13	140.22	38.95
13	LAYBARGE	23.43	-1.13	.00	-.032	18.494	74.243	10.24	-.08	-158.54	-4.43	165.09	45.86
15	LAYBARGE	9.01	-6.41	.00	.014	21.727	89.606	9.43	-.43	-159.79	-6.34	165.57	45.99
18	STINGER	-2.94	-11.56	.00	.015	24.542	102.619	8.66	-.77	-102.12	-2.74	115.88	32.19
20	STINGER	-10.61	-15.23	.00	-.012	26.381	111.120	8.10	-1.01	-74.22	-2.26	91.73	25.48
22	STINGER	-18.17	-19.11	.00	.045	27.977	119.620	7.51	-1.27	-81.78	2.37	97.69	27.14
24	STINGER	-25.62	-23.19	.01	-.511	29.356	128.120	6.88	-1.54	-52.84	-45.61	87.00	24.17
26	STINGER	-33.02	-27.38	.14	-1.146	29.209	136.620	6.24	-1.82	43.54	-2.22	64.23	17.84
28	STINGER	-40.45	-31.41	.28	-1.043	27.642	145.080	5.62	-2.09	63.82	6.13	81.18	22.55
30	STINGER	-47.96	-35.19	.40	-.827	25.791	153.481	5.04	-2.34	69.26	7.34	85.44	23.73
32	STINGER	-55.47	-38.67	.50	-.604	23.864	161.761	4.51	-2.57	72.05	7.28	87.37	24.27
34	STINGER	-62.93	-41.82	.56	-.397	21.913	169.866	3.55	-2.78	74.24	6.87	88.82	24.67
36	SAGBEND	-75.12	-46.33	.61	-.095	18.669	182.860	3.33	-3.08	77.48	6.20	90.98	25.27
37	SAGBEND	-86.80	-49.92	.61	.151	15.499	195.084	2.78	-3.32	80.15	5.36	92.76	25.77
38	SAGBEND	-98.65	-52.85	.55	.358	12.233	207.291	2.33	-3.52	82.42	4.71	94.31	26.20
39	SAGBEND	-110.64	-55.09	.46	.544	8.888	219.492	1.99	-3.67	84.14	4.47	95.49	26.53
40	SAGBEND	-122.74	-56.61	.33	.721	5.493	231.692	1.75	-3.77	84.62	4.06	95.70	26.58
41	SAGBEND	-134.91	-57.42	.16	.831	2.178	243.892	1.63	-3.82	77.44	-.24	89.42	24.84
42	SEABED	-147.11	-57.61	.01	.308	.008	256.092	1.61	-3.84	12.21	-27.52	49.23	13.67
43	SEABED	-159.31	-57.61	.00	.005	.007	268.292	1.61	-3.84	.42	-.25	24.17	6.71
44	SEABED	-171.51	-57.61	.00	.000	.000	280.492	1.61	-3.84	.00	.00	23.76	6.60
45	SEABED	-183.71	-57.61	.00	.000	.000	292.692	1.61	-3.84	.00	.00	23.76	6.60
46	SEABED	-195.91	-57.61	.00	.000	.000	304.892	1.61	-3.84	.00	.00	23.76	6.60

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/21/2020 TIME – 21:23:44 PAGE 15
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 2

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.761	.000	12.22	.00	.00	.00	32.22	8.95
3	LAYBARGE	84.28	10.94	.00	.000	3.738	12.050	12.10	.00	-155.01	.00	163.85	45.52
5	LAYBARGE	73.46	9.93	.00	.000	6.813	22.920	11.95	.00	-135.85	.00	147.42	40.95
7	LAYBARGE	60.13	8.03	.00	.000	9.691	36.391	11.64	.00	-169.05	-.01	175.33	48.70
9	LAYBARGE	46.49	5.31	.00	.000	12.678	50.297	11.23	.00	-147.68	.03	156.76	43.54
11	LAYBARGE	35.42	2.52	.00	-.002	15.531	61.711	10.81	.00	-128.65	-.12	140.16	38.93
13	LAYBARGE	23.43	-1.13	.00	-.033	18.498	74.243	10.24	-.08	-158.90	-4.49	165.40	45.94
15	LAYBARGE	9.01	-6.41	.00	.019	21.701	89.606	9.43	-.43	-157.59	-5.98	163.69	45.47
18	STINGER	-3.02	-11.62	.00	-.013	24.909	102.720	8.64	-.77	-133.06	-5.03	142.21	39.50
20	STINGER	-10.64	-15.38	.00	.102	27.547	111.221	8.07	-1.02	-109.64	9.25	122.11	33.92
22	STINGER	-18.10	-19.47	.00	-.477	29.912	119.722	7.44	-1.30	-107.50	-54.89	130.69	36.30
24	STINGER	-25.42	-23.79	.13	-1.269	30.570	128.222	6.79	-1.58	31.89	-3.76	54.90	15.25
26	STINGER	-32.76	-28.02	.29	-1.183	29.180	136.696	6.14	-1.87	60.23	6.09	78.55	21.82
28	STINGER	-40.14	-32.00	.43	-.959	27.406	145.083	5.53	-2.13	67.02	7.54	83.95	23.32
30	STINGER	-47.50	-35.67	.54	-.728	25.548	153.314	4.97	-2.37	70.07	7.57	86.09	23.91
32	STINGER	-54.78	-39.00	.62	-.510	23.671	161.320	4.45	-2.60	72.36	7.29	87.60	24.33
34	STINGER	-61.90	-41.98	.67	-.314	21.809	169.038	3.48	-2.80	74.36	6.83	88.90	24.70
36	SAGBEND	-75.08	-46.80	.70	.009	18.294	183.070	3.26	-3.12	77.84	6.12	91.22	25.34
37	SAGBEND	-86.78	-50.31	.67	.250	15.110	195.293	2.72	-3.35	80.45	5.27	92.97	25.82
38	SAGBEND	-98.65	-53.16	.60	.454	11.835	207.493	2.28	-3.54	82.66	4.66	94.48	26.24
39	SAGBEND	-110.65	-55.31	.49	.639	8.482	219.693	1.95	-3.68	84.30	4.45	95.60	26.56
40	SAGBEND	-122.76	-56.75	.33	.813	5.085	231.893	1.73	-3.78	84.47	3.89	95.55	26.54
41	SAGBEND	-134.94	-57.48	.15	.897	1.806	244.093	1.62	-3.83	74.81	-1.98	87.21	24.22
42	SEABED	-147.14	-57.61	.00	.188	-.026	256.293	1.61	-3.84	4.81	-27.18	47.11	13.09
43	SEABED	-159.34	-57.61	.00	.009	.004	268.493	1.61	-3.84	.23	-.52	24.24	6.73
44	SEABED	-171.54	-57.61	.00	.000	.000	280.693	1.61	-3.84	.00	.00	23.76	6.60
45	SEABED	-183.74	-57.61	.00	.000	.000	292.893	1.61	-3.84	.00	.00	23.76	6.60
46	SEABED	-195.94	-57.61	.00	.000	.000	305.093	1.61	-3.84	.00	.00	23.76	6.60
47	SEABED	-208.14	-57.61	.00	.000	.000	317.293	1.61	-3.84	.00	.00	23.76	6.60
48	SEABED	-220.34	-57.61	.00	.000	.000	329.493	1.61	-3.84	.00	.00	23.76	6.60

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

STATIC PIPE COORDINATES, FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	.00	.000	2.761	.000	12.22	.00	.00	.00	32.22	8.95
3	LAYBARGE	84.28	10.94	.00	.000	3.738	12.050	12.10	.00	-155.01	.00	163.86	45.52
5	LAYBARGE	73.46	9.93	.00	.000	6.813	22.920	11.95	.00	-135.86	.00	147.43	40.95
7	LAYBARGE	60.13	8.03	.00	.000	9.691	36.391	11.65	.00	-169.05	-.01	175.34	48.71
9	LAYBARGE	46.49	5.31	.00	.000	12.678	50.297	11.24	.00	-147.69	.04	156.78	43.55
11	LAYBARGE	35.42	2.52	.00	-.002	15.530	61.711	10.81	.00	-128.59	-.14	140.12	38.92
13	LAYBARGE	23.43	-1.13	.00	-.031	18.501	74.243	10.24	-.08	-159.22	-4.35	165.67	46.02
15	LAYBARGE	9.01	-6.41	.00	.008	21.678	89.606	9.43	-.43	-155.75	-6.84	162.16	45.05
18	STINGER	-3.11	-11.67	.00	.044	25.273	102.818	8.62	-.78	-163.21	-.61	167.75	46.60
20	STINGER	-10.68	-15.53	.00	-.131	28.797	111.319	8.03	-1.03	-150.92	-16.57	157.61	43.78
22	STINGER	-18.03	-19.80	.05	-.819	30.884	119.820	7.41	-1.32	-43.64	-35.72	76.01	21.11
24	STINGER	-25.32	-24.17	.20	-1.284	30.601	128.322	6.74	-1.61	44.35	.02	65.26	18.13
26	STINGER	-32.64	-28.38	.36	-1.142	29.051	136.771	6.09	-1.89	62.53	6.72	80.51	22.36
28	STINGER	-39.93	-32.28	.49	-.914	27.273	145.032	5.49	-2.15	67.54	7.63	84.36	23.43
30	STINGER	-47.08	-35.82	.59	-.688	25.463	153.014	4.95	-2.39	70.22	7.57	86.20	23.94
32	STINGER	-54.03	-39.00	.66	-.481	23.668	160.663	4.46	-2.60	72.36	7.29	87.60	24.33
34	STINGER	-60.70	-41.81	.70	-.296	21.923	167.902	3.59	-2.78	74.21	6.82	88.80	24.67
36	SAGBEND	-75.28	-47.11	.73	.060	18.036	183.412	3.21	-3.14	78.08	6.08	91.39	25.39
37	SAGBEND	-86.98	-50.57	.70	.297	14.849	195.612	2.68	-3.37	80.64	5.19	93.09	25.86
38	SAGBEND	-98.85	-53.35	.61	.498	11.568	207.812	2.25	-3.55	82.81	4.63	94.58	26.27
39	SAGBEND	-110.87	-55.45	.49	.682	8.210	220.012	1.93	-3.69	84.39	4.44	95.66	26.57
40	SAGBEND	-122.99	-56.83	.33	.854	4.813	232.212	1.72	-3.78	84.30	3.74	95.40	26.50
41	SAGBEND	-135.16	-57.50	.13	.916	1.566	244.412	1.62	-3.83	72.60	-3.42	85.38	23.72
42	SEABED	-147.36	-57.61	.00	.118	-.030	256.612	1.61	-3.84	2.04	-21.25	41.80	11.61
43	SEABED	-159.56	-57.61	.00	.008	.003	268.812	1.61	-3.84	.14	-.48	24.18	6.72
44	SEABED	-171.76	-57.61	.00	.000	.000	281.012	1.61	-3.84	.00	.00	23.76	6.60
45	SEABED	-183.96	-57.61	.00	.000	.000	293.212	1.61	-3.84	.00	.00	23.76	6.60
46	SEABED	-196.16	-57.61	.00	.000	.000	305.412	1.61	-3.84	.00	.00	23.76	6.60
47	SEABED	-208.36	-57.61	.00	.000	.000	317.612	1.61	-3.84	.00	.00	23.76	6.60

LAMPIRAN C
OUTPUT SOFTWARE OFFPIPE
(ANALISIS STATIS REGANGAN)

Output Analisa Statis (Case 1 - 9)

Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/26/2020 TIME – 21:51:24 PAGE 11
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 1

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.462	.000	.0117	.0000	.0000	.0000	.0117	4.49
3	LAYBARGE	84.28	11.03	.00	.000	3.157	12.047	.0116	.0000	-.0633	.0000	.0655	25.18
5	LAYBARGE	73.46	10.17	.00	.000	5.777	22.904	.0116	.0000	-.0540	.0000	.0575	22.11
7	LAYBARGE	60.12	8.57	.00	.000	8.146	36.338	.0114	.0000	-.0680	.0000	.0693	26.64
9	LAYBARGE	46.48	6.29	.00	-.001	10.612	50.168	.0113	.0000	-.0588	-.0001	.0612	23.55
11	LAYBARGE	35.41	3.97	.00	.006	13.002	61.480	.0111	.0000	-.0518	.0003	.0551	21.21
13	LAYBARGE	23.42	.95	.00	-.031	15.389	73.848	.0109	.0000	-.0629	-.0012	.0644	24.76
15	LAYBARGE	8.98	-3.39	.00	-.005	18.159	88.921	.0106	-.0001	-.0678	-.0031	.0683	26.25
18	STINGER	-4.95	-8.35	.00	.024	20.747	103.717	.0102	-.0003	-.0520	-.0021	.0546	20.99
20	STINGER	-12.85	-11.50	.00	-.005	22.684	112.217	.0100	-.0004	-.0340	-.0005	.0390	15.01
22	STINGER	-20.64	-14.89	.00	.000	24.234	120.717	.0097	-.0005	-.0378	-.0009	.0421	16.18
24	STINGER	-28.34	-18.49	.00	.005	25.875	129.218	.0094	-.0006	-.0368	-.0005	.0410	15.77
26	STINGER	-35.94	-22.30	.00	-.020	27.490	137.718	.0092	-.0007	-.0366	-.0017	.0406	15.63
28	STINGER	-43.42	-26.33	.00	.087	29.136	146.218	.0089	-.0008	-.0375	.0034	.0413	15.89
30	STINGER	-50.79	-30.57	.00	-.373	30.666	154.719	.0085	-.0010	-.0303	-.0200	.0399	15.35
32	STINGER	-58.08	-34.94	.10	-.999	30.476	163.219	.0082	-.0011	.0277	-.0013	.0323	12.44
34	STINGER	-65.48	-39.12	.23	-.882	28.292	171.719	.0079	-.0013	.0444	.0035	.0464	17.84
36	SAGBEND	-76.42	-44.53	.36	-.489	24.238	183.927	.0075	-.0014	.0519	.0044	.0525	20.18
37	SAGBEND	-87.74	-49.10	.42	-.108	19.754	196.135	.0072	-.0016	.0558	.0039	.0555	21.35
38	SAGBEND	-99.38	-52.75	.40	.215	14.989	208.342	.0069	-.0017	.0587	.0034	.0578	22.21
39	SAGBEND	-111.29	-55.39	.33	.494	10.023	220.547	.0067	-.0018	.0605	.0031	.0591	22.73
40	SAGBEND	-123.39	-56.99	.20	.719	5.027	232.750	.0066	-.0018	.0585	.0019	.0572	22.02
41	SAGBEND	-135.57	-57.58	.04	.639	.793	244.951	.0065	-.0019	.0360	-.0064	.0386	14.83
42	SEABED	-147.77	-57.61	.00	-.035	.009	257.151	.0065	-.0019	.0001	.0006	.0081	3.13
43	SEABED	-159.97	-57.61	.00	.001	.000	269.351	.0065	-.0019	.0000	.0000	.0077	2.95
44	SEABED	-172.17	-57.61	.00	.000	.000	281.551	.0065	-.0019	.0000	.0000	.0076	2.94
45	SEABED	-184.37	-57.61	.00	.000	.000	293.751	.0065	-.0019	.0000	.0000	.0076	2.94
46	SEABED	-196.57	-57.61	.00	.000	.000	305.951	.0065	-.0019	.0000	.0000	.0076	2.94
47	SEABED	-208.77	-57.61	.00	.000	.000	318.151	.0065	-.0019	.0000	.0000	.0076	2.94

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/26/2020 TIME – 21:51:24 PAGE 15
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 2

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.462	.000	.0117	.0000	.0000	.0000	.0117	4.49
3	LAYBARGE	84.28	11.03	.00	.000	3.157	12.047	.0116	.0000	-.0633	.0000	.0655	25.18
5	LAYBARGE	73.46	10.17	.00	.000	5.777	22.904	.0116	.0000	-.0540	.0000	.0575	22.11
7	LAYBARGE	60.12	8.57	.00	.000	8.146	36.338	.0114	.0000	-.0680	.0000	.0693	26.64
9	LAYBARGE	46.48	6.29	.00	-.001	10.612	50.168	.0113	.0000	-.0588	-.0001	.0612	23.55
11	LAYBARGE	35.41	3.97	.00	.006	13.002	61.480	.0111	.0000	-.0518	.0003	.0551	21.20
13	LAYBARGE	23.42	.95	.00	-.031	15.392	73.848	.0109	.0000	-.0631	-.0012	.0645	24.81
15	LAYBARGE	8.98	-3.39	.00	-.006	18.138	88.921	.0106	-.0001	-.0670	-.0031	.0676	26.01
18	STINGER	-4.99	-8.39	.00	.024	21.254	103.763	.0102	-.0003	-.0688	-.0021	.0688	26.48
20	STINGER	-12.83	-11.67	.00	-.005	24.028	112.264	.0099	-.0004	-.0494	-.0004	.0521	20.05
22	STINGER	-20.52	-15.29	.00	-.003	26.389	120.765	.0097	-.0005	-.0537	-.0010	.0556	21.39
24	STINGER	-28.05	-19.23	.00	.020	28.820	129.265	.0094	-.0006	-.0513	.0002	.0533	20.50
26	STINGER	-35.41	-23.49	.00	-.086	31.346	137.766	.0091	-.0008	-.0559	-.0056	.0572	22.01
28	STINGER	-42.59	-28.03	.04	-.696	32.859	146.267	.0087	-.0009	-.0113	-.0153	.0254	9.77
30	STINGER	-49.75	-32.62	.17	-1.136	32.047	154.767	.0084	-.0010	.0318	.0001	.0360	13.83
32	STINGER	-56.97	-36.96	.30	-.964	29.792	163.202	.0081	-.0012	.0443	.0040	.0465	17.89
34	STINGER	-64.22	-40.90	.41	-.679	27.151	171.450	.0078	-.0013	.0492	.0046	.0504	19.39
36	SAGBEND	-75.59	-46.19	.50	-.244	22.751	183.996	.0074	-.0015	.0536	.0044	.0538	20.70
37	SAGBEND	-87.04	-50.47	.51	.123	18.147	196.223	.0071	-.0016	.0569	.0038	.0564	21.68
38	SAGBEND	-98.79	-53.78	.45	.427	13.299	208.435	.0068	-.0017	.0595	.0033	.0584	22.45
39	SAGBEND	-110.78	-56.07	.33	.692	8.291	220.638	.0067	-.0018	.0605	.0028	.0591	22.72
40	SAGBEND	-122.91	-57.30	.17	.852	3.399	232.838	.0066	-.0018	.0550	.0001	.0542	20.85
41	SEABED	-135.10	-57.61	.01	.361	.074	245.038	.0065	-.0019	.0131	-.0133	.0234	9.00
42	SEABED	-147.30	-57.61	.00	.002	.015	257.238	.0065	-.0019	.0003	.0000	.0079	3.05
43	SEABED	-159.50	-57.61	.00	.000	.000	269.438	.0065	-.0019	.0000	.0000	.0077	2.94
44	SEABED	-171.70	-57.61	.00	.000	.000	281.638	.0065	-.0019	.0000	.0000	.0076	2.94
45	SEABED	-183.90	-57.61	.00	.000	.000	293.838	.0065	-.0019	.0000	.0000	.0076	2.94
46	SEABED	-196.10	-57.61	.00	.000	.000	306.038	.0065	-.0019	.0000	.0000	.0076	2.94

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/26/2020 TIME – 21:51:24 PAGE 19
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 3

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.462	.000	.0117	.0000	.0000	.0000	.0117	4.49
3	LAYBARGE	84.28	11.03	.00	.000	3.157	12.047	.0116	.0000	-.0633	.0000	.0655	25.18
5	LAYBARGE	73.46	10.17	.00	.000	5.777	22.904	.0116	.0000	-.0540	.0000	.0575	22.11
7	LAYBARGE	60.12	8.57	.00	.000	8.146	36.338	.0114	.0000	-.0680	.0000	.0693	26.64
9	LAYBARGE	46.48	6.29	.00	-.001	10.612	50.168	.0113	.0000	-.0588	-.0001	.0612	23.56
11	LAYBARGE	35.41	3.97	.00	.006	13.001	61.480	.0111	.0000	-.0517	.0003	.0551	21.19
13	LAYBARGE	23.42	.95	.00	-.031	15.395	73.848	.0109	.0000	-.0632	-.0012	.0646	24.85
15	LAYBARGE	8.98	-3.39	.00	-.006	18.119	88.921	.0106	-.0001	-.0663	-.0031	.0670	25.78
18	STINGER	-5.02	-8.43	.00	.025	21.766	103.809	.0102	-.0003	-.0857	-.0021	.0831	31.97
20	STINGER	-12.81	-11.84	.00	-.009	25.389	112.310	.0099	-.0004	-.0652	-.0006	.0656	25.22
22	STINGER	-20.38	-15.69	.00	.014	28.519	120.811	.0096	-.0005	-.0679	-.0002	.0676	26.01
24	STINGER	-27.73	-19.97	.00	-.055	31.915	129.312	.0093	-.0006	-.0730	-.0041	.0718	27.61
26	STINGER	-34.84	-24.63	.04	-.716	34.151	137.813	.0090	-.0008	-.0221	-.0184	.0338	13.00
28	STINGER	-41.87	-29.41	.17	-1.276	33.720	146.314	.0086	-.0009	.0280	-.0004	.0329	12.67
30	STINGER	-48.91	-33.94	.32	-1.118	31.640	154.696	.0083	-.0011	.0421	.0039	.0448	17.22
32	STINGER	-55.97	-38.08	.44	-.824	29.135	162.879	.0080	-.0012	.0472	.0048	.0490	18.84
34	STINGER	-62.91	-41.75	.52	-.530	26.525	170.727	.0077	-.0013	.0503	.0047	.0513	19.74
36	SAGBEND	-75.12	-47.23	.59	-.072	21.748	184.115	.0073	-.0015	.0544	.0042	.0545	20.95
37	SAGBEND	-86.67	-51.30	.57	.279	17.074	196.362	.0070	-.0017	.0576	.0036	.0569	21.88
38	SAGBEND	-98.47	-54.39	.48	.570	12.182	208.566	.0068	-.0017	.0599	.0032	.0587	22.57
39	SAGBEND	-110.49	-56.43	.33	.822	7.163	220.766	.0066	-.0018	.0602	.0026	.0588	22.61
40	SAGBEND	-122.64	-57.44	.14	.920	2.404	232.966	.0066	-.0018	.0509	-.0016	.0508	19.54
41	SEABED	-134.84	-57.61	.00	.144	-.043	245.166	.0065	-.0019	.0026	-.0118	.0178	6.86
42	SEABED	-147.04	-57.61	.00	.009	.006	257.366	.0065	-.0019	.0001	-.0002	.0078	3.02
43	SEABED	-159.24	-57.61	.00	.000	.000	269.566	.0065	-.0019	.0000	.0000	.0076	2.94
44	SEABED	-171.44	-57.61	.00	.000	.000	281.766	.0065	-.0019	.0000	.0000	.0076	2.94
45	SEABED	-183.64	-57.61	.00	.000	.000	293.966	.0065	-.0019	.0000	.0000	.0076	2.94

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/26/2020 TIME – 22: 5:37 PAGE 11
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 1

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.461	.000	.0140	.0000	.0000	.0000	.0140	5.39
3	LAYBARGE	84.28	11.03	.00	.000	3.168	12.047	.0140	.0000	-.0647	.0000	.0690	26.53
5	LAYBARGE	73.46	10.17	.00	.000	5.776	22.904	.0139	.0000	-.0562	.0000	.0616	23.71
7	LAYBARGE	60.12	8.57	.00	.000	8.149	36.338	.0138	.0000	-.0705	.0000	.0737	28.36
9	LAYBARGE	46.48	6.29	.00	-.001	10.607	50.168	.0136	.0000	-.0609	.0000	.0654	25.16
11	LAYBARGE	35.41	3.97	.00	.005	13.003	61.480	.0134	.0000	-.0536	.0003	.0590	22.69
13	LAYBARGE	23.42	.95	.00	-.030	15.398	73.848	.0132	.0000	-.0656	-.0012	.0689	26.52
15	LAYBARGE	8.98	-3.39	.00	-.005	18.159	88.921	.0129	-.0001	-.0710	-.0031	.0733	28.20
18	STINGER	-4.95	-8.35	.00	.023	20.733	103.717	.0125	-.0003	-.0540	-.0021	.0586	22.53
20	STINGER	-12.85	-11.50	.00	-.006	22.686	112.217	.0123	-.0004	-.0347	-.0005	.0419	16.13
22	STINGER	-20.64	-14.89	.00	.005	24.234	120.717	.0120	-.0005	-.0386	-.0006	.0451	17.35
24	STINGER	-28.34	-18.49	.00	-.019	25.875	129.218	.0118	-.0006	-.0376	-.0016	.0441	16.94
26	STINGER	-35.94	-22.30	.00	.082	27.491	137.718	.0115	-.0007	-.0374	.0033	.0438	16.84
28	STINGER	-43.42	-26.33	.00	-.364	29.132	146.218	.0112	-.0008	-.0369	-.0202	.0474	18.22
30	STINGER	-50.82	-30.52	.10	-1.016	29.365	154.719	.0109	-.0010	.0177	-.0030	.0266	10.24
32	STINGER	-58.28	-34.60	.24	-.976	27.762	163.219	.0106	-.0011	.0340	.0027	.0401	15.44
34	STINGER	-65.80	-38.39	.35	-.756	25.663	171.642	.0103	-.0012	.0384	.0037	.0437	16.82
36	SAGBEND	-77.02	-43.38	.46	-.407	22.321	183.927	.0099	-.0014	.0412	.0037	.0458	17.62
37	SAGBEND	-88.45	-47.67	.51	-.096	18.809	196.135	.0096	-.0015	.0432	.0033	.0472	18.17
38	SAGBEND	-100.12	-51.24	.51	.169	15.143	208.343	.0094	-.0016	.0449	.0028	.0485	18.64
39	SAGBEND	-112.00	-54.04	.45	.393	11.348	220.547	.0091	-.0017	.0463	.0025	.0495	19.02
40	SAGBEND	-124.03	-56.03	.34	.601	7.460	232.750	.0090	-.0018	.0471	.0024	.0500	19.22
41	SAGBEND	-136.17	-57.20	.19	.768	3.585	244.951	.0089	-.0018	.0452	.0012	.0483	18.58
42	SAGBEND	-148.36	-57.60	.04	.591	.381	257.151	.0089	-.0019	.0241	-.0092	.0318	12.23
43	SEABED	-160.56	-57.61	.00	-.021	.015	269.351	.0089	-.0019	.0004	.0004	.0104	3.99
44	SEABED	-172.76	-57.61	.00	.000	.000	281.551	.0089	-.0019	.0000	.0000	.0100	3.83
45	SEABED	-184.96	-57.61	.00	.000	.000	293.751	.0089	-.0019	.0000	.0000	.0099	3.82
46	SEABED	-197.16	-57.61	.00	.000	.000	305.951	.0089	-.0019	.0000	.0000	.0099	3.82
47	SEABED	-209.36	-57.61	.00	.000	.000	318.151	.0089	-.0019	.0000	.0000	.0099	3.82

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/26/2020 TIME – 22: 5:37 PAGE 15
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 2

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.461	.000	.0140	.0000	.0000	.0000	.0140	5.39
3	LAYBARGE	84.28	11.03	.00	.000	3.168	12.047	.0140	.0000	-.0647	.0000	.0690	26.53
5	LAYBARGE	73.46	10.17	.00	.000	5.776	22.904	.0139	.0000	-.0562	.0000	.0616	23.71
7	LAYBARGE	60.12	8.57	.00	.000	8.149	36.338	.0138	.0000	-.0705	.0000	.0737	28.35
9	LAYBARGE	46.48	6.29	.00	-.001	10.607	50.168	.0136	.0000	-.0609	.0000	.0654	25.16
11	LAYBARGE	35.41	3.97	.00	.005	13.003	61.480	.0134	.0000	-.0536	.0003	.0590	22.69
13	LAYBARGE	23.42	.95	.00	-.030	15.400	73.848	.0132	.0000	-.0657	-.0012	.0690	26.55
15	LAYBARGE	8.98	-3.39	.00	-.006	18.144	88.921	.0129	-.0001	-.0704	-.0031	.0729	28.03
18	STINGER	-4.99	-8.39	.00	.022	21.236	103.763	.0125	-.0003	-.0714	-.0021	.0734	28.22
20	STINGER	-12.83	-11.67	.00	-.002	24.035	112.264	.0123	-.0004	-.0507	-.0003	.0556	21.37
22	STINGER	-20.52	-15.29	.00	-.014	26.369	120.765	.0120	-.0005	-.0539	-.0016	.0581	22.35
24	STINGER	-28.05	-19.23	.00	.070	28.906	129.265	.0117	-.0006	-.0572	.0025	.0607	23.33
26	STINGER	-35.41	-23.48	.01	-.491	30.881	137.766	.0114	-.0008	-.0308	-.0230	.0441	16.97
28	STINGER	-42.69	-27.88	.13	-1.190	30.825	146.267	.0111	-.0009	.0220	-.0014	.0303	11.66
30	STINGER	-50.00	-32.10	.28	-1.086	29.124	154.715	.0108	-.0010	.0342	.0032	.0405	15.56
32	STINGER	-57.35	-36.03	.40	-.847	27.069	163.050	.0105	-.0012	.0377	.0039	.0433	16.66
34	STINGER	-64.66	-39.60	.50	-.600	24.925	171.184	.0102	-.0013	.0396	.0039	.0446	17.17
36	SAGBEND	-76.44	-44.64	.58	-.238	21.372	183.998	.0098	-.0014	.0418	.0036	.0463	17.79
37	SAGBEND	-87.95	-48.74	.60	.062	17.808	196.224	.0095	-.0016	.0437	.0031	.0476	18.31
38	SAGBEND	-99.69	-52.10	.56	.315	14.101	208.435	.0093	-.0017	.0454	.0027	.0488	18.76
39	SAGBEND	-111.62	-54.67	.47	.534	10.276	220.638	.0091	-.0018	.0466	.0025	.0497	19.11
40	SAGBEND	-123.68	-56.44	.34	.736	6.374	232.838	.0090	-.0018	.0470	.0022	.0499	19.20
41	SAGBEND	-135.84	-57.39	.16	.859	2.565	245.038	.0089	-.0018	.0429	-.0001	.0463	17.82
42	SEABED	-148.04	-57.61	.01	.326	.026	257.238	.0089	-.0019	.0081	-.0136	.0233	8.96
43	SEABED	-160.24	-57.61	.00	.004	.010	269.438	.0089	-.0019	.0002	-.0001	.0102	3.91
44	SEABED	-172.44	-57.61	.00	.000	.000	281.638	.0089	-.0019	.0000	.0000	.0099	3.82
45	SEABED	-184.64	-57.61	.00	.000	.000	293.838	.0089	-.0019	.0000	.0000	.0099	3.82
46	SEABED	-196.84	-57.61	.00	.000	.000	306.038	.0089	-.0019	.0000	.0000	.0099	3.82
47	SEABED	-209.04	-57.61	.00	.000	.000	318.238	.0089	-.0019	.0000	.0000	.0099	3.82

OFFPIPE – OFFSHORE PIPELINE ANALYSIS SYSTEM – VERSION 2.05 AC DATE – 4/26/2020 TIME – 22: 5:37 PAGE 19
PROJECT – PIPELAY ANALYSIS JOB NO. – TUGAS AKHIR
USER ID – AMA LICENSED TO: RICKY TAWEKAL CASE 3

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.461	.000	.0140	.0000	.0000	.0000	.0140	5.39
3	LAYBARGE	84.28	11.03	.00	.000	3.168	12.047	.0140	.0000	-.0647	.0000	.0690	26.53
5	LAYBARGE	73.46	10.17	.00	.000	5.776	22.904	.0139	.0000	-.0562	.0000	.0616	23.71
7	LAYBARGE	60.12	8.57	.00	.000	8.149	36.338	.0138	.0000	-.0705	.0000	.0737	28.35
9	LAYBARGE	46.48	6.29	.00	-.001	10.607	50.168	.0136	.0000	-.0610	.0000	.0654	25.16
11	LAYBARGE	35.41	3.97	.00	.005	13.003	61.480	.0134	.0000	-.0536	.0003	.0590	22.68
13	LAYBARGE	23.42	.95	.00	-.030	15.402	73.848	.0132	.0000	-.0658	-.0012	.0691	26.58
15	LAYBARGE	8.98	-3.39	.00	-.007	18.130	88.921	.0129	-.0001	-.0699	-.0031	.0724	27.86
18	STINGER	-5.02	-8.43	.00	.030	21.751	103.809	.0125	-.0003	-.0891	-.0019	.0884	34.00
20	STINGER	-12.81	-11.84	.00	-.030	25.372	112.310	.0123	-.0004	-.0656	-.0017	.0683	26.26
22	STINGER	-20.38	-15.69	.00	.110	28.601	120.811	.0120	-.0005	-.0740	.0044	.0753	28.95
24	STINGER	-27.73	-19.97	.00	-.491	31.558	129.312	.0117	-.0006	-.0521	-.0265	.0617	23.72
26	STINGER	-34.92	-24.50	.13	-1.319	32.191	137.813	.0113	-.0008	.0168	-.0020	.0261	10.05
28	STINGER	-42.17	-28.94	.30	-1.227	30.658	146.314	.0110	-.0009	.0323	.0032	.0391	15.03
30	STINGER	-49.37	-33.05	.44	-.981	28.698	154.606	.0107	-.0011	.0364	.0040	.0424	16.31
32	STINGER	-56.51	-36.79	.54	-.725	26.640	162.670	.0104	-.0012	.0384	.0041	.0438	16.86
34	STINGER	-63.46	-40.13	.62	-.489	24.585	170.380	.0102	-.0013	.0398	.0039	.0449	17.25
36	SAGBEND	-76.13	-45.42	.68	-.105	20.746	184.117	.0098	-.0015	.0422	.0035	.0465	17.89
37	SAGBEND	-87.71	-49.40	.67	.188	17.148	196.362	.0095	-.0016	.0440	.0030	.0478	18.40
38	SAGBEND	-99.48	-52.62	.61	.433	13.420	208.566	.0092	-.0017	.0456	.0027	.0490	18.83
39	SAGBEND	-111.43	-55.05	.49	.650	9.578	220.766	.0091	-.0018	.0468	.0025	.0498	19.15
40	SAGBEND	-123.52	-56.67	.34	.847	5.673	232.966	.0089	-.0018	.0469	.0021	.0498	19.14
41	SAGBEND	-135.69	-57.47	.14	.926	1.986	245.166	.0089	-.0018	.0406	-.0015	.0444	17.06
42	SEABED	-147.89	-57.61	.00	.149	-.033	257.366	.0089	-.0019	.0020	-.0120	.0202	7.78
43	SEABED	-160.09	-57.61	.00	.009	.004	269.566	.0089	-.0019	.0001	-.0002	.0102	3.91
44	SEABED	-172.29	-57.61	.00	.000	.000	281.766	.0089	-.0019	.0000	.0000	.0099	3.82
45	SEABED	-184.49	-57.61	.00	.000	.000	293.966	.0089	-.0019	.0000	.0000	.0099	3.82
46	SEABED	-196.69	-57.61	.00	.000	.000	306.166	.0089	-.0019	.0000	.0000	.0099	3.82

20T

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.460	.000	.0156	.0000	.0000	.0000	.0156	5.99
3	LAYBARGE	84.28	11.03	.00	.000	3.175	12.047	.0155	.0000	-.0657	.0000	.0713	27.43
5	LAYBARGE	73.46	10.17	.00	.000	5.776	22.904	.0155	.0000	-.0576	.0000	.0644	24.77
7	LAYBARGE	60.12	8.57	.00	.000	8.150	36.338	.0153	.0000	-.0722	.0000	.0767	29.50
9	LAYBARGE	46.48	6.29	.00	-.001	10.604	50.168	.0152	.0000	-.0624	.0000	.0682	26.23
11	LAYBARGE	35.41	3.97	.00	.005	13.004	61.480	.0150	.0000	-.0548	.0002	.0616	23.69
13	LAYBARGE	23.42	.95	.00	-.029	15.403	73.848	.0148	.0000	-.0673	-.0012	.0720	27.69
15	LAYBARGE	8.98	-3.39	.00	-.005	18.158	88.921	.0144	-.0001	-.0731	-.0031	.0767	29.50
18	STINGER	-4.95	-8.35	.00	.022	20.724	103.717	.0141	-.0003	-.0553	-.0021	.0612	23.56
20	STINGER	-12.85	-11.50	.00	-.004	22.686	112.217	.0139	-.0004	-.0351	-.0005	.0439	16.88
22	STINGER	-20.64	-14.89	.00	-.003	24.235	120.717	.0136	-.0005	-.0392	-.0010	.0472	18.15
24	STINGER	-28.34	-18.49	.00	.017	25.870	129.218	.0133	-.0006	-.0379	.0002	.0458	17.62
26	STINGER	-35.94	-22.30	.00	-.079	27.513	137.718	.0130	-.0007	-.0388	-.0054	.0467	17.95
28	STINGER	-43.43	-26.31	.04	-.641	28.526	146.218	.0128	-.0008	-.0118	-.0156	.0298	11.46
30	STINGER	-50.91	-30.36	.16	-1.050	27.943	154.719	.0125	-.0010	.0243	.0001	.0336	12.92
32	STINGER	-58.43	-34.21	.29	-.917	26.267	163.169	.0122	-.0011	.0321	.0031	.0401	15.42
34	STINGER	-65.99	-37.79	.40	-.705	24.366	171.541	.0119	-.0012	.0343	.0034	.0418	16.09
36	SAGBEND	-77.40	-42.61	.51	-.391	21.390	183.927	.0115	-.0014	.0361	.0033	.0431	16.57
37	SAGBEND	-88.88	-46.76	.56	-.112	18.325	196.136	.0112	-.0015	.0376	.0029	.0440	16.94
38	SAGBEND	-100.57	-50.28	.56	.129	15.147	208.343	.0110	-.0016	.0389	.0025	.0449	17.27
39	SAGBEND	-112.44	-53.13	.51	.332	11.871	220.547	.0108	-.0017	.0399	.0023	.0456	17.55
40	SAGBEND	-124.44	-55.29	.42	.518	8.518	232.750	.0106	-.0018	.0407	.0022	.0462	17.76
41	SAGBEND	-136.55	-56.74	.29	.693	5.121	244.951	.0105	-.0018	.0408	.0019	.0462	17.76
42	SAGBEND	-148.73	-57.47	.13	.788	1.839	257.151	.0104	-.0018	.0363	-.0006	.0422	16.24
43	SEABED	-160.93	-57.61	.00	.161	-.024	269.351	.0104	-.0019	.0026	-.0119	.0218	8.38
44	SEABED	-173.13	-57.61	.00	.009	.004	281.551	.0104	-.0019	.0001	-.0002	.0117	4.50
45	SEABED	-185.33	-57.61	.00	.000	.000	293.751	.0104	-.0019	.0000	.0000	.0115	4.41
46	SEABED	-197.53	-57.61	.00	.000	.000	305.951	.0104	-.0019	.0000	.0000	.0115	4.41
47	SEABED	-209.73	-57.61	.00	.000	.000	318.151	.0104	-.0019	.0000	.0000	.0115	4.41
48	SEABED	-221.93	-57.61	.00	.000	.000	330.351	.0104	-.0019	.0000	.0000	.0115	4.41

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.460	.000	.0156	.0000	.0000	.0000	.0156	5.99
3	LAYBARGE	84.28	11.03	.00	.000	3.175	12.047	.0155	.0000	-.0657	.0000	.0713	27.43
5	LAYBARGE	73.46	10.17	.00	.000	5.776	22.904	.0155	.0000	-.0576	.0000	.0644	24.77
7	LAYBARGE	60.12	8.57	.00	.000	8.150	36.338	.0153	.0000	-.0722	.0000	.0767	29.50
9	LAYBARGE	46.48	6.29	.00	-.001	10.604	50.168	.0152	.0000	-.0624	.0000	.0682	26.23
11	LAYBARGE	35.41	3.97	.00	.005	13.004	61.480	.0150	.0000	-.0548	.0002	.0616	23.68
13	LAYBARGE	23.42	.95	.00	-.029	15.405	73.848	.0148	.0000	-.0674	-.0012	.0721	27.71
15	LAYBARGE	8.98	-3.39	.00	-.006	18.147	88.921	.0144	-.0001	-.0727	-.0031	.0764	29.37
18	STINGER	-4.99	-8.39	.00	.026	21.226	103.763	.0141	-.0003	-.0731	-.0019	.0764	29.39
20	STINGER	-12.83	-11.67	.00	-.018	24.034	112.264	.0138	-.0004	-.0513	-.0011	.0577	22.18
22	STINGER	-20.52	-15.29	.00	.058	26.378	120.765	.0136	-.0005	-.0552	.0020	.0608	23.38
24	STINGER	-28.05	-19.23	.00	-.260	28.869	129.265	.0133	-.0006	-.0551	-.0151	.0621	23.90
26	STINGER	-35.43	-23.45	.08	-.955	30.064	137.766	.0130	-.0008	-.0029	-.0101	.0223	8.59
28	STINGER	-42.81	-27.67	.23	-1.167	29.222	146.267	.0127	-.0009	.0255	.0013	.0348	13.39
30	STINGER	-50.21	-31.67	.37	-.993	27.541	154.687	.0124	-.0010	.0317	.0034	.0399	15.36
32	STINGER	-57.62	-35.39	.48	-.768	25.691	162.973	.0121	-.0011	.0337	.0036	.0414	15.93
34	STINGER	-64.95	-38.77	.57	-.549	23.806	171.052	.0118	-.0012	.0349	.0035	.0422	16.25
36	SAGBEND	-76.94	-43.67	.65	-.225	20.659	183.998	.0115	-.0014	.0365	.0032	.0433	16.67
37	SAGBEND	-88.49	-47.67	.66	.045	17.960	196.224	.0112	-.0015	.0379	.0028	.0443	17.03
38	SAGBEND	-100.22	-51.03	.63	.275	14.356	208.435	.0109	-.0016	.0391	.0024	.0451	17.34
39	SAGBEND	-112.13	-53.72	.55	.471	11.060	220.638	.0107	-.0017	.0401	.0022	.0458	17.61
40	SAGBEND	-124.16	-55.71	.43	.654	7.692	232.838	.0106	-.0018	.0408	.0021	.0463	17.79
41	SAGBEND	-136.29	-56.98	.28	.820	4.297	245.038	.0105	-.0018	.0405	.0017	.0459	17.65
42	SAGBEND	-148.48	-57.55	.10	.834	1.131	257.238	.0104	-.0019	.0324	-.0032	.0391	15.02
43	SEABED	-160.67	-57.61	.00	.008	-.017	269.438	.0104	-.0019	.0001	-.0041	.0150	5.76
44	SEABED	-172.87	-57.61	.00	.005	.001	281.638	.0104	-.0019	.0000	-.0001	.0116	4.46
45	SEABED	-185.07	-57.61	.00	.000	.000	293.838	.0104	-.0019	.0000	.0000	.0115	4.41
46	SEABED	-197.27	-57.61	.00	.000	.000	306.038	.0104	-.0019	.0000	.0000	.0115	4.41
47	SEABED	-209.47	-57.61	.00	.000	.000	318.238	.0104	-.0019	.0000	.0000	.0115	4.41

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

STATIC PIPE COORDINATES, FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.52	.00	.000	2.460	.000	.0156	.0000	.0000	.0000	.0156	5.99
3	LAYBARGE	84.28	11.03	.00	.000	3.175	12.047	.0155	.0000	-.0657	.0000	.0713	27.43
5	LAYBARGE	73.46	10.17	.00	.000	5.776	22.904	.0155	.0000	-.0576	.0000	.0644	24.77
7	LAYBARGE	60.12	8.57	.00	.000	8.150	36.338	.0153	.0000	-.0722	.0000	.0767	29.50
9	LAYBARGE	46.48	6.29	.00	-.001	10.604	50.168	.0152	.0000	-.0624	.0000	.0682	26.23
11	LAYBARGE	35.41	3.97	.00	.005	13.003	61.480	.0150	.0000	-.0548	.0002	.0616	23.68
13	LAYBARGE	23.42	.95	.00	-.029	15.406	73.848	.0148	.0000	-.0675	-.0012	.0721	27.74
15	LAYBARGE	8.98	-3.39	.00	-.005	18.136	88.921	.0144	-.0001	-.0724	-.0030	.0761	29.25
18	STINGER	-5.02	-8.43	.00	.017	21.739	103.809	.0141	-.0003	-.0913	-.0023	.0918	35.33
20	STINGER	-12.81	-11.84	.00	.021	25.370	112.310	.0138	-.0004	-.0664	.0008	.0704	27.09
22	STINGER	-20.38	-15.69	.00	-.118	28.619	120.811	.0135	-.0005	-.0756	-.0078	.0784	30.15
24	STINGER	-27.75	-19.94	.05	-.805	30.802	129.312	.0132	-.0006	-.0219	-.0174	.0373	14.36
26	STINGER	-35.04	-24.30	.20	-1.275	30.540	137.813	.0129	-.0008	.0213	.0000	.0314	12.08
28	STINGER	-42.33	-28.48	.35	-1.135	29.003	146.214	.0126	-.0009	.0302	.0032	.0389	14.95
30	STINGER	-49.60	-32.37	.48	-.908	27.227	154.464	.0123	-.0010	.0326	.0037	.0408	15.68
32	STINGER	-56.77	-35.92	.58	-.683	25.412	162.461	.0120	-.0012	.0339	.0037	.0417	16.02
34	STINGER	-63.74	-39.09	.65	-.476	23.613	170.123	.0118	-.0013	.0350	.0035	.0423	16.28
36	SAGBEND	-76.72	-44.32	.72	-.129	20.195	184.118	.0114	-.0014	.0367	.0032	.0435	16.73
37	SAGBEND	-88.32	-48.23	.72	.136	17.074	196.362	.0111	-.0016	.0381	.0028	.0444	17.08
38	SAGBEND	-100.08	-51.49	.67	.359	13.856	208.566	.0109	-.0017	.0393	.0024	.0452	17.39
39	SAGBEND	-112.00	-54.07	.57	.550	10.549	220.766	.0107	-.0017	.0403	.0022	.0459	17.64
40	SAGBEND	-124.05	-55.95	.44	.732	7.173	232.966	.0106	-.0018	.0409	.0021	.0463	17.81
41	SAGBEND	-136.20	-57.11	.26	.890	3.784	245.166	.0105	-.0018	.0402	.0014	.0456	17.54
42	SAGBEND	-148.38	-57.58	.07	.826	.737	257.366	.0104	-.0019	.0285	-.0057	.0361	13.89
43	SEABED	-160.58	-57.61	.00	-.029	.002	269.566	.0104	-.0019	.0001	-.0010	.0123	4.73
44	SEABED	-172.78	-57.61	.00	.002	.000	281.766	.0104	-.0019	.0000	-.0001	.0115	4.44
45	SEABED	-184.98	-57.61	.00	.000	.000	293.966	.0104	-.0019	.0000	.0000	.0115	4.41
46	SEABED	-197.18	-57.61	.00	.000	.000	306.166	.0104	-.0019	.0000	.0000	.0115	4.41
47	SEABED	-209.38	-57.61	.00	.000	.000	318.366	.0104	-.0019	.0000	.0000	.0115	4.41
48	SEABED	-221.58	-57.61	.00	.000	.000	330.566	.0104	-.0019	.0000	.0000	.0115	4.41
49	SEABED	-233.78	-57.61	.00	.000	.000	342.766	.0104	-.0019	.0000	.0000	.0115	4.41

LAMPIRAN D
INPUT DAN OUTPUT SOFTWARE OFFPIPE
(ANALISA DINAMIS TEGANGAN)

Input Analisa Dinamis Heading 0°

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*COMM ****************************************************************
*COMM ******************** PROBLEM HEADING DATA **********************
*COMM ****************************************************************
*HEAD HEAD='TUGAS AKHIR CLUSTER I PHE WMO 6.625 in', JOB='ANALISA DINAMIS',
      USER='A. MUHAMMAD AMRIL', UNIT=2
*COMM ****************************************************************
*COMM ************************ PLOTTING DATA *************************
*COMM ****************************************************************
*PROF ROW=1, NUMB=1, TYPE=4, TITL='MAXIMUM DYNAMIC STRESS',
      ORDL='PIPE Y COORDINATE', ABSL='PIPE X COORDINATE', ORDI=2, ABSC=1
*PROF ROW=2, NUMB=1, TYPE=4, TITL='MAXIMUM DYNAMIC STRESS',
      ORDL='MAXIMUM TOTAL  STRESS', ABSL='PIPE X COORDINATE', ORDI=14, ABSC=1
*HIST ROW=3, NUMB=2, NODE=34, TITL='DYNAMIC STRESS AT STINGER TIP',
      ORDL='DYNAMIC TOTAL STRESS', ABSL='TIME HISTORY', ORDI=14
*HIST ROW=4, NUMB=3, NODE=34, TITL='DYNAMIC STRESS AT STINGER TIP',
      ORDL='DYNAMIC TOTAL STRESS', ABSL='TIME HISTORY', ORDI=15
*COMM ****************************************************************
*COMM ********************** PRINTED OUTPUT **************************
*COMM ****************************************************************
*PRIN SUMM=1, DYNA=1, STRA=1, DNVS=1, WARN=1, PLOT=1
*COMM ****************************************************************
*COMM ******************* PIPE AND COATING DATA **********************
*COMM ****************************************************************
*PIPE ROW=1, LENG=12, DIAM=16.828, WALL=1.27, AREA=217.306, YIEL=360, STRA=0.26,
      WEIG=955.47, SUBM=729.1, CD=0.7875, ELAS=207000, POIS=0.3
*COAT ROW=1, TCOR=0.05, DCOR=14600, FJNT=0.5, DJNT=10101, TCON=0.25, DCON=30440,
      LENG=12, DSTE=76985
*COMM ****************************************************************
*COMM ************************ BARGE DATA ****************************
*COMM ****************************************************************
*BARG NUMB=8, GEOM=2, RADI=250, DECK=5.2, TRIM=0.5, XTAN=100, YTAN=5.5,
      TABL=(X,Y,SUPP,DAVI)
      96.37,  2.489, 2,
      84.33,  2.27,  1,
      73.5,   2.05,  1,
      60.15,  1.745, 1,
      46.49,  1.43,  1,
```

```
      35.4,   1.04,  1,
      23.38,  0.26,  1,
       8.91, -1.42,  1,
*SUPP ROW=1, TYPE=1, ANGL=30, INCL=60, OFFS=1, LENG=2.064
*COMM ****************************************************************
*COMM ********************** PIPE TENSION ***************************
*COMM ****************************************************************
*TENS TENS=150
*COMM ****************************************************************
*COMM ********************** STINGER DATA ***************************
*COMM ****************************************************************
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=300, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
      -76.518, 0.638, 1, 1, 8.5
*COMM ****************************************************************
*COMM ****************** SAGBEND PIPE SPAN DATA **********************
*COMM ****************************************************************
*GEOM DEPT=57.6, LENG=12.2
*SOIL CFX=0.6, CFZ=0.6
*COMM ****************************************************************
*COMM ******************** CURRENT PROFILE DATA **********************
*COMM ****************************************************************
*CURR NUMB=11, TABL=(DEPT,VELO,DIRE)
       0.00, 1.06, 90
       5.38, 1.04, 90
      10.76, 1.03, 90
      16.14, 1.01, 90
      21.52, 0.98, 90
      26.91, 0.96, 90
      31.29, 0.93, 90
```

```
      37.67, 0.89, 90
      43.05, 0.84, 90
      48.43, 0.76, 90
      52.81, 0.66, 90
*COMM ****************************************************************
*COMM ***************** INTEGRATION TIME STEP DATA ******************
*COMM ****************************************************************
*TIME STEP=0.4, STAR=60, STOP=10860, SAMP=0.8
*COMM ****************************************************************
*COMM ********************** WAVE SPECTRA ***************************
*COMM ****************************************************************
*SPEC SEAS=1, TYPE=8, DIRE=0, FMIN=0.1, FMAX=2.3, NUMB=20, HSIG=0.21, FPEA=1.01,
      JON1=0.010146, JON2=1.71
*COMM ****************************************************************
*COMM ************ LAYBARGE RAOS FOR SINGLE WAVE PERIOD **************
*COMM ****************************************************************
*RAOS NUMB=23, SEAS=1, SIGN=1, TABL=(FREQ,SRGM,SRGA,SWYM,SWYA,HEAM,HEAA)
0.1,0,93,0,0,0,4
0.2,0,104,0,0,0,14
0.3,0,123,0,0,0,32
0.4,0,148,0,0,0,56
0.5,0,-178,0,0,0,85
0.6,0,-138,0,0,0,120
0.7,0,-89,0,0,0,162
0.8,0,139,0,0,0,3
0.9,0,-155,0,0,0,53
1,0,-84,0,0,0,138
1.1,0,162,0,0,0,34
1.2,0.002,-106,0,0,0,141
1.3,0,17,0,0,0,20
1.4,0.003,-100,0,0,0,146
1.5,0,47,0,0,0,83
1.6,0.001,-62,0,0,0,171
1.7,0,-176,0,0,0,111
1.8,0,14,0,0,0,156
1.9,0,-59,0,0,0,166
2,0,-160,0,0,0,139
2.1,0,93,0,0,0,145
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```
2.2,0,32,0,0,0,164
2.3,0,-14,0,0,0,169
      TABL=(FREQ,ROLM,ROLA,PITM,PITA,YAWM,YAWA)
     0.1,0,0,0,-86,0,0
0.2,0,0,0,-75,0,0
0.3,0,0,0,-58,0,0
0.4,0,0,0,-35,0,0
0.5,0,0,0,-6,0,0
0.6,0,0,0,26,0,0
0.7,0,0,0,61,0,0
0.8,0,0,0,95,0,0
0.9,0,0,0,-24,0,0
1,0,0,0.001,39,0,0
1.1,0,0,0.001,141,0,0
1.2,0,0,0.001,37,0,0
1.3,0,0,0.003,141,0,0
1.4,0,0,0,49,0,0
1.5,0,0,0.003,151,0,0
1.6,0,0,0,87,0,0
1.7,0,0,0,-175,0,0
1.8,0,0,0,139,0,0
1.9,0,0,0,119,0,0
2,0,0,0,163,0,0
2.1,0,0,0,169,0,0
2.2,0,0,0,156,0,0
2.3,0,0,0,163,0,0
*RUN ********************** RUN CASE 01 ***************************
*COMM ***************************************************************
*COMM ********************** RUN NEXT CASE *************************
*COMM ***************************************************************
*GEOM DEPT=57.6, LENG=12.2
*TENS TENS=150
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=200, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
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      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
      -76.518, 0.638, 1, 1, 8.5
*RUN ************************ RUN CASE 02 ****************************
*COMM ***************************************************************
*COMM ************************ RUN NEXT CASE ************************
*COMM ***************************************************************
*GEOM DEPT=57.6, LENG=12.2
*TENS TENS=150
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=150, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
      -76.518, 0.638, 1, 1, 8.5
*RUN ************************ RUN CASE 03 ****************************
*COMM ***************************************************************
*COMM ************************ RUN NEXT CASE ************************
*COMM ***************************************************************
*GEOM DEPT=57.6, LENG=12.2
*TENS TENS=180
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=300, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
```

```
      -76.518, 0.638, 1, 1, 8.5
*RUN ********************** RUN CASE 04 ***************************
*COMM ************************************************************
*COMM ********************** RUN NEXT CASE ***************************
*COMM ************************************************************
*GEOM DEPT=57.6, LENG=12.2
*TENS TENS=180
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=200, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
      -76.518, 0.638, 1, 1, 8.5
*RUN ********************** RUN CASE 05 ***************************
*COMM ************************************************************
*COMM ********************** RUN NEXT CASE ***************************
*COMM ************************************************************
*GEOM DEPT=57.6, LENG=12.2
*TENS TENS=180
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=150, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
      -76.518, 0.638, 1, 1, 8.5
*RUN ********************** RUN CASE 06 ***************************
*COMM ************************************************************
*COMM ********************** RUN NEXT CASE ***************************
```

```
*COMM ************************************************************
*COMM ************************************************************
*GEOM DEPT=57.6, LENG=12.2
*TENS TENS=200
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=300, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
      -76.518, 0.638, 1, 1, 8.5
*RUN ********************** RUN CASE 07 ***************************
*COMM ************************************************************
*COMM ********************** RUN NEXT CASE ************************
*COMM ************************************************************
*GEOM DEPT=57.6, LENG=12.2
*TENS TENS=200
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=200, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
      -76.518, 0.638, 1, 1, 8.5
*RUN ********************** RUN CASE 08 ***************************
*COMM ************************************************************
*COMM ********************** RUN NEXT CASE ************************
*COMM ************************************************************
*GEOM DEPT=57.6, LENG=12.2
*TENS TENS=200
```

```
*STIN NUMB=9, GEOM=4, TYPE=1, RADI=150, XHIT=-0.079, YHIT=-1.832,
      TABL=(X,Y,SUPP,SECT,LENG)
       -5.593, 1.261, 1, 2, 8.5
      -14.737, 1.261, 1, 1, 8.5
      -24.707, 1.223, 1, 1, 8.5
      -33.851, 1.223, 1, 1, 8.5
      -43.707, 1.223, 1, 1, 8.5
      -52.851, 1.223, 1, 1, 8.5
      -62.592, 1.246, 1, 1, 8.5
      -73.4,   1.246, 1, 1, 8.5
      -76.518, 0.638, 1, 1, 8.5
*RUN ********************** RUN CASE 09 ****************************
*END
*COMM ************************************************************
*COMM ********************** END OF DATA ***************************
*COMM ************************************************************
```

Output Analisa Dinamis Heading 0°
Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.00	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.90	0.00	-127.09	0.00	131.93	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.52	0.00	158.34	43.98
9	LAYBARGE	46.49	5.31	0.00	0.000	12.688	50.30	23.19	0.00	-138.63	0.03	141.02	39.17
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.527	61.71	22.76	0.00	-121.16	-0.06	125.74	34.93
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.476	74.24	22.19	-0.08	-147.18	-3.60	147.37	40.94
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.741	89.61	21.38	-0.43	-148.05	-5.09	147.52	40.98
18	STINGER	-2.94	-11.56	0.00	0.009	24.560	102.62	20.61	-0.77	-96.22	-2.36	102.80	28.56
20	STINGER	-10.61	-15.23	0.00	0.000	26.381	111.12	20.05	-1.01	-72.15	-0.75	81.89	22.75
22	STINGER	-18.17	-19.11	0.00	-0.010	27.963	119.62	19.45	-1.27	-77.62	-2.31	86.10	23.92
24	STINGER	-25.62	-23.20	0.00	0.048	29.574	128.12	18.83	-1.55	-73.46	3.46	82.12	22.81
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	18.16	-1.83	-82.86	-23.34	92.27	25.63
28	STINGER	-40.17	-31.98	0.06	-0.704	31.723	145.12	17.49	-2.13	29.26	-11.64	45.35	12.60
30	STINGER	-47.46	-36.36	0.16	-0.790	30.025	153.62	16.81	-2.42	82.23	3.51	88.00	24.44
32	STINGER	-54.81	-40.40	0.25	-0.608	27.487	162.01	16.18	-2.69	99.03	6.96	101.94	28.32
34	STINGER	-62.21	-44.02	0.32	-0.387	24.686	170.25	15.63	-2.93	106.89	7.25	108.18	30.05
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.090	182.82	14.89	-3.25	115.06	6.56	114.51	31.81
37	SAGBEND	-85.44	-52.53	0.35	0.189	15.345	195.02	14.32	-3.50	121.21	5.70	119.24	33.12
38	SAGBEND	-97.33	-55.25	0.29	0.412	10.392	207.22	13.90	-3.68	125.07	5.11	122.18	33.94
39	SAGBEND	-109.41	-56.92	0.18	0.593	5.394	219.42	13.64	-3.79	121.61	3.21	118.99	33.05
40	SAGBEND	-121.59	-57.58	0.05	0.547	1.083	231.62	13.55	-3.84	79.07	-9.62	83.24	23.12
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	13.55	-3.84	0.24	-3.93	19.11	5.31
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	13.55	-3.84	-0.29	0.29	16.17	4.49
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	13.55	-3.84	0.02	-0.01	15.85	4.40
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	13.55	-3.84	0.00	0.00	15.82	4.40
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	13.55	-3.84	0.00	0.00	15.82	4.40
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	13.55	-3.84	0.00	0.00	15.82	4.40

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.00	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.90	0.00	-127.09	0.00	131.93	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.52	0.00	158.34	43.98
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	23.19	0.00	-138.65	0.03	141.03	39.18
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.526	61.71	22.76	0.00	-121.06	-0.06	125.67	34.91
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.481	74.24	22.19	-0.08	-147.70	-3.58	147.81	41.06
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.707	89.61	21.38	-0.43	-145.41	-5.18	145.27	40.35
18	STINGER	-3.02	-11.61	0.00	0.014	24.930	102.72	20.59	-0.77	-125.52	-2.10	127.69	35.47
20	STINGER	-10.64	-15.38	0.00	-0.016	27.545	111.22	20.02	-1.02	-105.96	-2.28	110.63	30.73
22	STINGER	-18.10	-19.46	0.00	0.058	29.910	119.72	19.39	-1.30	-106.71	4.29	110.83	30.79
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	18.71	-1.59	-117.05	-28.18	121.84	33.85
26	STINGER	-32.48	-28.53	0.07	-0.835	33.462	136.72	18.02	-1.90	19.56	-12.08	38.53	10.70
28	STINGER	-39.62	-33.14	0.19	-0.924	31.952	145.22	17.30	-2.21	77.21	3.70	84.13	23.37
30	STINGER	-46.81	-37.43	0.29	-0.730	29.542	153.59	16.64	-2.49	94.90	7.29	98.81	27.45
32	STINGER	-54.01	-41.29	0.37	-0.494	26.872	161.77	16.05	-2.75	102.98	7.78	105.23	29.23
34	STINGER	-61.10	-44.68	0.42	-0.272	24.134	169.63	15.53	-2.98	108.52	7.36	109.49	30.41
36	SAGBEND	-73.45	-49.59	0.44	0.058	19.212	182.93	14.77	-3.30	116.41	6.42	115.55	32.10
37	SAGBEND	-85.13	-53.12	0.40	0.309	14.420	195.13	14.23	-3.54	122.18	5.59	120.00	33.33
38	SAGBEND	-97.06	-55.65	0.31	0.528	9.440	207.33	13.84	-3.71	125.30	4.97	122.32	33.98
39	SAGBEND	-109.16	-57.12	0.18	0.693	4.480	219.53	13.61	-3.80	118.62	2.29	116.41	32.34
40	SEABED	-121.35	-57.62	0.04	0.537	0.556	231.73	13.55	-3.84	57.13	-15.83	65.94	18.32
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.030	243.93	13.55	-3.84	-1.30	-2.36	18.07	5.02
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	13.55	-3.84	-0.08	0.23	16.03	4.45
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	13.55	-3.84	0.01	-0.01	15.84	4.40
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	13.55	-3.84	0.00	0.00	15.82	4.40

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 0:16: 6 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.00	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.90	0.00	-127.09	0.00	131.93	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.51	0.00	158.33	43.98
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	23.19	0.00	-138.67	0.03	141.05	39.18
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	22.76	0.00	-120.94	-0.06	125.57	34.88
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.488	74.24	22.19	-0.08	-148.23	-3.58	148.26	41.18
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.672	89.61	21.38	-0.43	-142.64	-5.17	142.92	39.70
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	20.57	-0.78	-156.41	-2.39	153.93	42.76
20	STINGER	-10.68	-15.53	0.00	-0.004	28.681	111.32	19.99	-1.03	-134.48	-1.08	134.82	37.45
22	STINGER	-18.01	-19.82	0.00	0.005	32.074	119.82	19.32	-1.32	-157.51	-1.79	153.88	42.74
24	STINGER	-25.10	-24.51	0.02	-0.498	34.327	128.32	18.63	-1.63	-40.41	-33.71	64.19	17.83
26	STINGER	-32.12	-29.31	0.12	-1.014	33.808	136.82	17.89	-1.95	59.36	-1.64	69.37	19.27
28	STINGER	-39.17	-33.85	0.24	-0.903	31.708	145.21	17.19	-2.25	87.36	6.30	92.79	25.78
30	STINGER	-46.22	-38.00	0.34	-0.672	29.199	153.39	16.55	-2.53	97.82	7.85	101.26	28.13
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	15.99	-2.78	104.03	7.87	106.08	29.47
34	STINGER	-59.83	-44.83	0.45	-0.231	24.007	168.62	15.50	-2.99	108.86	7.33	109.76	30.49
36	SAGBEND	-73.25	-50.08	0.46	0.124	18.640	183.04	14.69	-3.34	117.23	6.32	116.19	32.28
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	14.17	-3.56	122.76	5.51	120.44	33.46
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	13.80	-3.72	125.30	4.79	122.29	33.97
39	SAGBEND	-109.04	-57.23	0.17	0.727	3.903	219.64	13.60	-3.81	115.91	1.07	114.07	31.69
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	13.55	-3.84	41.69	-19.42	54.67	15.19
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	13.55	-3.84	-1.54	-0.97	17.34	4.82
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	13.55	-3.84	-0.01	0.15	15.95	4.43
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	13.55	-3.84	0.01	-0.01	15.83	4.40
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	13.55	-3.84	0.00	0.00	15.82	4.40
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	13.55	-3.84	0.00	0.00	15.82	4.40
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	13.55	-3.84	0.00	0.00	15.82	4.40

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 0:16: 6 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.88	0.00	-152.64	0.00	158.63	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.73	0.00	-132.37	0.00	141.25	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.86	-0.01	168.56	46.82
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.07	0.03	150.48	41.80
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.529	61.71	27.59	0.00	-125.72	-0.10	134.45	37.35
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.487	74.24	27.02	-0.08	-154.06	-3.56	158.05	43.90
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.733	89.61	26.21	-0.43	-155.23	-5.08	158.44	44.01
18	STINGER	-2.94	-11.56	0.00	0.012	24.547	102.62	25.44	-0.77	-99.67	-2.18	110.57	30.71
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	24.88	-1.01	-74.04	-1.77	88.34	24.54
22	STINGER	-18.17	-19.11	0.00	0.035	27.946	119.62	24.29	-1.27	-77.46	2.16	90.80	25.22
24	STINGER	-25.62	-23.20	0.00	-0.151	29.647	128.12	23.66	-1.55	-82.15	-18.27	95.97	26.66
26	STINGER	-32.96	-27.48	0.05	-0.648	30.322	136.62	23.01	-1.83	6.79	-18.42	40.64	11.29
28	STINGER	-40.33	-31.71	0.16	-0.855	29.196	145.12	22.36	-2.11	62.30	1.71	76.41	21.22
30	STINGER	-47.78	-35.71	0.26	-0.716	27.227	153.58	21.74	-2.38	76.25	5.82	87.96	24.43
32	STINGER	-55.27	-39.39	0.34	-0.525	25.058	161.92	21.18	-2.62	81.41	6.36	91.93	25.54
34	STINGER	-62.71	-42.70	0.40	-0.339	22.829	170.07	20.67	-2.84	84.71	6.08	94.31	26.20
36	SAGBEND	-74.62	-47.27	0.44	-0.076	19.182	182.82	19.96	-3.15	89.10	5.45	97.45	27.07
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.532	195.02	19.41	-3.39	92.70	4.67	100.04	27.79
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	18.96	-3.58	95.64	4.19	102.17	28.38
39	SAGBEND	-110.13	-55.87	0.30	0.487	7.872	219.42	18.64	-3.72	97.38	3.95	103.39	28.72
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.990	231.62	18.45	-3.81	94.33	2.33	100.61	27.95
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	18.38	-3.84	56.61	-11.80	69.54	19.32
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	18.38	-3.84	-0.04	-3.34	23.38	6.49
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	18.38	-3.84	-0.16	0.22	20.80	5.78
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	18.38	-3.84	0.01	-0.01	20.58	5.72
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	18.38	-3.84	0.00	0.00	20.57	5.71
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	18.38	-3.84	0.00	0.00	20.57	5.71

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 0:16: 6 PAGE 51
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 5

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.88	0.00	-152.64	0.00	158.62	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.73	0.00	-132.37	0.00	141.25	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.86	-0.01	168.56	46.82
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.09	0.03	150.49	41.80
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	27.59	0.00	-125.63	-0.09	134.38	37.33
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.492	74.24	27.02	-0.08	-154.50	-3.57	158.42	44.01
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.702	89.61	26.21	-0.43	-152.70	-5.01	156.29	43.41
18	STINGER	-3.02	-11.61	0.00	0.005	24.923	102.72	25.42	-0.77	-130.64	-2.74	136.88	38.02
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	24.85	-1.02	-105.32	0.88	114.89	31.91
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	24.22	-1.30	-121.17	-11.33	128.31	35.64
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	23.57	-1.59	-19.81	-26.87	52.76	14.65
26	STINGER	-32.64	-28.26	0.15	-0.959	30.796	136.72	22.89	-1.88	54.98	0.11	70.58	19.61
28	STINGER	-39.96	-32.48	0.26	-0.839	28.967	145.16	22.24	-2.16	72.80	5.70	85.41	23.73
30	STINGER	-47.28	-36.36	0.36	-0.644	26.891	153.45	21.64	-2.42	78.72	6.56	90.02	25.00
32	STINGER	-54.54	-39.87	0.43	-0.449	24.754	161.52	21.10	-2.66	82.22	6.47	92.56	25.71
34	STINGER	-61.65	-42.99	0.47	-0.272	22.616	169.29	20.62	-2.86	85.05	6.06	94.56	26.27
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.696	182.93	19.88	-3.18	89.64	5.35	97.84	27.18
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.027	195.13	19.34	-3.42	93.14	4.57	100.36	27.88
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	18.91	-3.60	95.97	4.14	102.41	28.45
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.342	219.53	18.61	-3.74	97.42	3.88	103.40	28.72
40	SAGBEND	-122.14	-57.24	0.18	0.687	3.481	231.73	18.43	-3.81	92.70	1.76	99.21	27.56
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	18.38	-3.84	42.86	-15.59	59.16	16.43
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	18.38	-3.84	-0.72	-2.44	22.71	6.31
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	18.38	-3.84	-0.07	0.20	20.75	5.76
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	18.38	-3.84	0.01	-0.01	20.58	5.72
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	18.38	-3.84	0.00	0.00	20.57	5.71
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	18.38	-3.84	0.00	0.00	20.57	5.71
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	18.38	-3.84	0.00	0.00	20.57	5.71

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 0:16: 6 PAGE 56
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 6

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.88	0.00	-152.64	0.00	158.62	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.73	0.00	-132.37	0.00	141.25	39.23
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.85	0.00	168.52	46.81
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.10	0.03	150.50	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	27.59	0.00	-125.56	-0.09	134.32	37.31
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.496	74.24	27.02	-0.08	-154.85	-3.60	158.72	44.09
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.677	89.61	26.21	-0.43	-150.73	-4.80	154.61	42.95
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	25.40	-0.78	-159.88	-4.08	161.74	44.93
20	STINGER	-10.68	-15.53	0.00	0.085	28.782	111.32	24.82	-1.03	-148.44	7.53	151.67	42.13
22	STINGER	-18.01	-19.82	0.00	-0.391	31.650	119.82	24.17	-1.32	-106.32	-43.87	122.59	34.05
24	STINGER	-25.20	-24.37	0.11	-1.053	32.261	128.32	23.49	-1.62	35.05	-3.36	54.25	15.07
26	STINGER	-32.40	-28.79	0.24	-0.982	30.734	136.78	22.80	-1.92	66.82	5.25	80.75	22.43
28	STINGER	-39.62	-32.93	0.35	-0.785	28.769	145.10	22.17	-2.19	75.36	6.67	87.60	24.33
30	STINGER	-46.75	-36.68	0.43	-0.581	26.715	153.16	21.59	-2.44	79.41	6.74	90.58	25.16
32	STINGER	-53.70	-40.02	0.49	-0.393	24.661	160.87	21.08	-2.67	82.43	6.49	92.72	25.76
34	STINGER	-60.38	-42.95	0.53	-0.226	22.653	168.16	20.63	-2.86	85.01	6.05	94.54	26.26
36	SAGBEND	-74.31	-48.16	0.55	0.075	18.368	183.04	19.83	-3.21	90.00	5.30	98.11	27.25
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	19.29	-3.44	93.44	4.52	100.57	27.94
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	18.88	-3.62	96.18	4.12	102.56	28.49
39	SAGBEND	-109.95	-56.23	0.32	0.620	6.986	219.64	18.59	-3.75	97.40	3.79	103.36	28.71
40	SAGBEND	-122.10	-57.30	0.17	0.736	3.144	231.84	18.42	-3.82	91.29	0.92	97.99	27.22
41	SEABED	-134.29	-57.63	0.03	0.460	0.268	244.04	18.38	-3.84	33.68	-19.43	53.46	14.85
42	SEABED	-146.49	-57.63	0.00	-0.008	-0.016	256.24	18.38	-3.84	-0.91	-1.30	21.91	6.08
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	18.38	-3.84	-0.03	0.15	20.70	5.75
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	18.38	-3.84	0.00	-0.01	20.58	5.72
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	18.38	-3.84	0.00	0.00	20.57	5.71
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	18.38	-3.84	0.00	0.00	20.57	5.71

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 0:16: 6 PAGE 61
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 7

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.10	0.00	-155.02	0.00	163.86	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.95	0.00	-135.88	0.00	147.45	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.07	-0.01	175.36	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	31.24	0.00	-147.69	0.03	156.77	43.55
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.531	61.71	30.81	0.00	-128.79	-0.12	140.28	38.97
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.494	74.24	30.24	-0.08	-158.63	-3.53	165.15	45.88
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.727	89.61	29.43	-0.43	-159.89	-5.08	165.62	46.01
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	28.66	-0.77	-102.30	-2.00	116.02	32.23
20	STINGER	-10.61	-15.23	0.00	-0.019	26.375	111.12	28.10	-1.01	-73.57	-2.72	91.20	25.33
22	STINGER	-18.17	-19.11	0.00	0.077	28.003	119.62	27.51	-1.27	-85.04	6.48	100.64	27.96
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	26.88	-1.55	-50.83	-39.56	82.41	22.89
26	STINGER	-33.01	-27.39	0.10	-0.909	29.218	136.62	26.24	-1.82	43.98	-2.42	64.61	17.95
28	STINGER	-40.46	-31.43	0.21	-0.837	27.643	145.09	25.62	-2.09	63.93	4.76	81.18	22.55
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	25.04	-2.34	69.30	5.82	85.35	23.71
32	STINGER	-55.47	-38.68	0.39	-0.489	23.864	161.77	24.51	-2.58	72.07	5.79	87.28	24.24
34	STINGER	-62.93	-41.83	0.44	-0.325	21.913	169.87	24.02	-2.79	74.26	5.46	88.74	24.65
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	23.33	-3.09	77.48	4.93	90.91	25.25
37	SAGBEND	-86.74	-49.92	0.48	0.109	15.516	195.02	22.78	-3.32	80.15	4.26	92.71	25.75
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	22.33	-3.52	82.42	3.75	94.27	26.19
39	SAGBEND	-110.57	-55.09	0.36	0.422	8.909	219.42	21.99	-3.67	84.14	3.56	95.46	26.52
40	SAGBEND	-122.67	-56.62	0.26	0.563	5.515	231.62	21.75	-3.77	84.57	3.23	95.63	26.56
41	SAGBEND	-134.84	-57.43	0.13	0.652	2.208	243.82	21.63	-3.83	76.88	-0.13	88.95	24.71
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	21.61	-3.84	16.36	-18.29	44.51	12.36
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	21.61	-3.84	-0.69	-0.38	24.42	6.78
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	21.61	-3.84	0.00	0.07	23.82	6.62
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	21.61	-3.84	0.00	0.00	23.76	6.60

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 0:16: 6 PAGE 66
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 8

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.10	0.00	-155.02	0.00	163.87	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.95	0.00	-135.88	0.00	147.45	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.07	-0.01	175.36	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	31.24	0.00	-147.71	0.03	156.79	43.55
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	30.82	0.00	-128.72	-0.11	140.22	38.95
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.498	74.24	30.24	-0.08	-159.01	-3.59	165.47	45.97
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.701	89.61	29.43	-0.43	-157.73	-4.76	163.78	45.50
18	STINGER	-3.02	-11.61	0.00	-0.011	24.909	102.72	28.64	-0.77	-133.13	-4.00	142.24	39.51
20	STINGER	-10.64	-15.38	0.00	0.082	27.547	111.22	28.07	-1.02	-109.65	7.38	122.00	33.89
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	27.44	-1.30	-107.82	-43.79	127.01	35.28
24	STINGER	-25.41	-23.79	0.10	-1.013	30.574	128.22	26.80	-1.58	31.87	-3.02	54.82	15.23
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	26.15	-1.87	60.26	4.84	78.48	21.80
28	STINGER	-40.14	-32.00	0.34	-0.767	27.411	145.08	25.53	-2.13	67.04	6.00	83.83	23.29
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	24.97	-2.38	70.08	6.02	85.97	23.88
32	STINGER	-54.78	-39.00	0.49	-0.410	23.676	161.32	24.46	-2.60	72.37	5.80	87.49	24.30
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	24.00	-2.80	74.37	5.44	88.81	24.67
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	23.27	-3.11	77.81	4.88	91.13	25.31
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	22.73	-3.35	80.42	4.20	92.90	25.80
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	22.29	-3.54	82.64	3.71	94.42	26.23
39	SAGBEND	-110.49	-55.29	0.39	0.502	8.535	219.53	21.96	-3.68	84.28	3.55	95.55	26.54
40	SAGBEND	-122.60	-56.74	0.27	0.640	5.140	231.73	21.73	-3.78	84.41	3.13	95.48	26.52
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.870	243.93	21.62	-3.83	74.31	-1.21	86.77	24.10
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	21.61	-3.84	10.53	-18.08	41.45	11.51
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	21.61	-3.84	-0.61	-0.10	24.28	6.74
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	21.61	-3.84	0.01	0.05	23.80	6.61
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	21.61	-3.84	0.00	0.00	23.76	6.60
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	21.61	-3.84	0.00	0.00	23.76	6.60

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.10	0.00	-155.02	0.00	163.86	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.95	0.00	-135.88	0.00	147.45	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.07	-0.01	175.36	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	31.24	0.00	-147.71	0.03	156.79	43.55
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	30.81	0.00	-128.66	-0.12	140.17	38.94
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	30.24	-0.08	-159.29	-3.50	165.71	46.03
15	LAYBARGE	9.01	-6.41	0.00	0.008	21.680	89.61	29.43	-0.43	-156.06	-5.27	162.38	45.10
18	STINGER	-3.11	-11.67	0.00	0.024	25.260	102.82	28.63	-0.78	-162.24	-1.40	166.92	46.37
20	STINGER	-10.68	-15.53	0.00	-0.056	28.845	111.32	28.03	-1.03	-156.89	-7.94	162.08	45.02
22	STINGER	-18.02	-19.81	0.03	-0.585	30.957	119.82	27.41	-1.32	-39.73	-32.33	71.61	19.89
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	26.74	-1.61	45.17	-0.76	65.96	18.32
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	26.09	-1.89	62.66	5.20	80.50	22.36
28	STINGER	-39.86	-32.26	0.38	-0.743	27.287	144.97	25.49	-2.15	67.58	6.04	84.26	23.41
30	STINGER	-47.02	-35.82	0.46	-0.564	25.473	152.96	24.95	-2.39	70.24	6.02	86.09	23.91
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	24.46	-2.60	72.37	5.80	87.50	24.31
34	STINGER	-60.66	-41.81	0.55	-0.252	21.929	167.86	24.03	-2.78	74.23	5.43	88.72	24.64
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.128	183.04	23.23	-3.13	78.01	4.85	91.27	25.35
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	22.70	-3.36	80.58	4.15	93.01	25.84
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	22.26	-3.55	82.77	3.69	94.51	26.25
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	21.94	-3.69	84.36	3.54	95.61	26.56
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.915	231.84	21.72	-3.78	84.28	3.09	95.35	26.49
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	21.62	-3.83	72.41	-1.55	85.16	23.66
42	SEABED	-146.98	-57.63	0.01	0.217	0.008	256.24	21.61	-3.84	7.87	-17.59	40.04	11.12
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	21.61	-3.84	-0.54	-0.05	24.21	6.73
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	21.61	-3.84	0.01	0.05	23.80	6.61
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	21.61	-3.84	0.00	0.00	23.76	6.60

Output Analisis Dinamis Heading 45°

Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 22:31:23 PAGE 31
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 1

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.00	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.90	0.00	-127.09	0.00	131.93	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.52	-0.01	158.34	43.98
9	LAYBARGE	46.49	5.31	0.00	0.000	12.688	50.30	23.19	0.00	-138.63	0.03	141.02	39.17
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.527	61.71	22.76	0.00	-121.16	-0.10	125.75	34.93
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.476	74.24	22.19	-0.08	-147.17	-3.75	147.36	40.93
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.741	89.61	21.38	-0.43	-148.06	-5.21	147.52	40.98
18	STINGER	-2.94	-11.56	0.00	0.009	24.560	102.62	20.61	-0.77	-96.20	-2.41	102.79	28.55
20	STINGER	-10.61	-15.23	0.00	0.000	26.381	111.12	20.05	-1.01	-72.15	-0.76	81.89	22.75
22	STINGER	-18.17	-19.11	0.00	-0.010	27.963	119.62	19.46	-1.27	-77.62	-2.33	86.10	23.92
24	STINGER	-25.62	-23.20	0.00	0.048	29.574	128.12	18.83	-1.55	-73.48	3.48	82.13	22.82
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	18.16	-1.83	-82.95	-23.46	92.31	25.64
28	STINGER	-40.17	-31.98	0.06	-0.704	31.723	145.12	17.49	-2.13	29.32	-11.71	45.38	12.61
30	STINGER	-47.46	-36.36	0.16	-0.790	30.025	153.62	16.81	-2.42	82.25	3.54	88.02	24.45
32	STINGER	-54.81	-40.40	0.25	-0.609	27.487	162.01	16.19	-2.69	99.04	6.99	101.95	28.32
34	STINGER	-62.21	-44.02	0.32	-0.387	24.686	170.25	15.63	-2.93	106.89	7.28	108.19	30.05
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.090	182.82	14.89	-3.25	115.06	6.59	114.51	31.81
37	SAGBEND	-85.44	-52.53	0.35	0.189	15.345	195.02	14.32	-3.50	121.21	5.74	119.25	33.12
38	SAGBEND	-97.33	-55.25	0.29	0.412	10.392	207.22	13.90	-3.68	125.08	5.14	122.18	33.94
39	SAGBEND	-109.41	-56.92	0.18	0.593	5.394	219.42	13.64	-3.79	121.62	3.23	118.99	33.05
40	SAGBEND	-121.59	-57.58	0.05	0.547	1.083	231.62	13.55	-3.84	79.07	-9.65	83.24	23.12
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	13.55	-3.84	0.25	-3.94	19.12	5.31
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	13.55	-3.84	-0.29	0.29	16.17	4.49
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	13.55	-3.84	0.02	-0.01	15.85	4.40
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	13.55	-3.84	0.00	0.00	15.82	4.40
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	13.55	-3.84	0.00	0.00	15.82	4.40
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	13.55	-3.84	0.00	0.00	15.82	4.40

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 22:31:23 PAGE 36
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 2

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.00	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.90	0.00	-127.09	0.00	131.93	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.52	-0.01	158.34	43.98
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	23.19	0.00	-138.65	0.03	141.03	39.18
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.526	61.71	22.76	0.00	-121.05	-0.10	125.66	34.91
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.482	74.24	22.19	-0.08	-147.69	-3.72	147.80	41.06
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.707	89.61	21.38	-0.43	-145.42	-5.32	145.28	40.36
18	STINGER	-3.02	-11.61	0.00	0.014	24.929	102.72	20.59	-0.77	-125.51	-2.15	127.68	35.47
20	STINGER	-10.64	-15.38	0.00	-0.016	27.545	111.22	20.02	-1.02	-105.96	-2.29	110.62	30.73
22	STINGER	-18.10	-19.46	0.00	0.058	29.910	119.72	19.39	-1.30	-106.73	4.31	110.84	30.79
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	18.71	-1.59	-117.13	-28.28	121.89	33.86
26	STINGER	-32.48	-28.53	0.07	-0.835	33.463	136.72	18.02	-1.90	19.60	-12.14	38.55	10.71
28	STINGER	-39.62	-33.14	0.19	-0.924	31.952	145.22	17.30	-2.21	77.22	3.73	84.14	23.37
30	STINGER	-46.81	-37.43	0.29	-0.730	29.542	153.59	16.64	-2.49	94.90	7.32	98.82	27.45
32	STINGER	-54.01	-41.29	0.37	-0.494	26.872	161.77	16.05	-2.75	102.98	7.81	105.23	29.23
34	STINGER	-61.10	-44.68	0.42	-0.272	24.134	169.63	15.53	-2.98	108.52	7.38	109.49	30.42
36	SAGBEND	-73.45	-49.59	0.44	0.058	19.212	182.93	14.77	-3.30	116.41	6.44	115.55	32.10
37	SAGBEND	-85.13	-53.12	0.40	0.309	14.420	195.13	14.23	-3.54	122.18	5.62	120.00	33.33
38	SAGBEND	-97.06	-55.65	0.31	0.528	9.440	207.33	13.84	-3.71	125.30	5.00	122.33	33.98
39	SAGBEND	-109.16	-57.12	0.18	0.693	4.480	219.53	13.61	-3.80	118.62	2.30	116.41	32.34
40	SEABED	-121.35	-57.62	0.04	0.537	0.556	231.73	13.55	-3.84	57.13	-15.85	65.94	18.32
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.030	243.93	13.55	-3.84	-1.30	-2.37	18.08	5.02
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	13.55	-3.84	-0.08	0.23	16.03	4.45
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	13.55	-3.84	0.01	-0.01	15.84	4.40
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	13.55	-3.84	0.00	0.00	15.82	4.40

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 22:31:23 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.00	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.90	0.00	-127.09	0.00	131.93	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.51	-0.01	158.33	43.98
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	23.19	0.00	-138.67	0.03	141.05	39.18
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	22.76	0.00	-120.94	-0.10	125.56	34.88
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.488	74.24	22.19	-0.08	-148.23	-3.75	148.26	41.18
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.672	89.61	21.38	-0.43	-142.66	-5.32	142.94	39.71
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	20.57	-0.78	-156.41	-2.44	153.93	42.76
20	STINGER	-10.68	-15.53	0.00	-0.004	28.681	111.32	19.99	-1.03	-134.49	-1.10	134.83	37.45
22	STINGER	-18.01	-19.82	0.00	0.005	32.074	119.82	19.32	-1.32	-157.58	-1.89	153.94	42.76
24	STINGER	-25.10	-24.51	0.02	-0.498	34.327	128.32	18.63	-1.63	-40.46	-33.76	64.25	17.85
26	STINGER	-32.12	-29.31	0.12	-1.014	33.808	136.82	17.89	-1.95	59.37	-1.68	69.37	19.27
28	STINGER	-39.17	-33.85	0.24	-0.903	31.708	145.21	17.19	-2.25	87.36	6.33	92.79	25.78
30	STINGER	-46.22	-38.00	0.34	-0.673	29.199	153.39	16.55	-2.53	97.82	7.88	101.26	28.13
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	15.99	-2.78	104.03	7.89	106.08	29.47
34	STINGER	-59.83	-44.83	0.45	-0.231	24.007	168.62	15.50	-2.99	108.86	7.35	109.76	30.49
36	SAGBEND	-73.25	-50.08	0.46	0.124	18.640	183.04	14.70	-3.34	117.23	6.35	116.19	32.28
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	14.17	-3.56	122.77	5.53	120.45	33.46
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	13.80	-3.72	125.31	4.81	122.29	33.97
39	SAGBEND	-109.04	-57.23	0.17	0.727	3.903	219.64	13.60	-3.81	115.91	1.08	114.08	31.69
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	13.55	-3.84	41.70	-19.46	54.67	15.19
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	13.55	-3.84	-1.54	-0.97	17.34	4.82
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	13.55	-3.84	-0.01	0.15	15.95	4.43
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	13.55	-3.84	0.01	-0.01	15.83	4.40
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	13.55	-3.84	0.00	0.00	15.82	4.40
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	13.55	-3.84	0.00	0.00	15.82	4.40
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	13.55	-3.84	0.00	0.00	15.82	4.40

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 22:31:23 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.88	0.00	-152.64	-0.01	158.63	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.73	0.00	-132.37	0.01	141.25	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.86	-0.01	168.56	46.82
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.07	0.04	150.48	41.80
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.529	61.71	27.59	0.00	-125.72	-0.13	134.46	37.35
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.487	74.24	27.02	-0.08	-154.05	-3.71	158.04	43.90
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.733	89.61	26.21	-0.43	-155.23	-5.22	158.45	44.01
18	STINGER	-2.94	-11.56	0.00	0.012	24.547	102.62	25.44	-0.77	-99.66	-2.22	110.56	30.71
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	24.88	-1.01	-74.03	-1.79	88.34	24.54
22	STINGER	-18.17	-19.11	0.00	0.035	27.946	119.62	24.29	-1.27	-77.48	2.18	90.81	25.23
24	STINGER	-25.62	-23.20	0.00	-0.151	29.647	128.12	23.66	-1.55	-82.23	-18.38	96.01	26.67
26	STINGER	-32.96	-27.48	0.05	-0.648	30.322	136.62	23.01	-1.83	6.85	-18.49	40.67	11.30
28	STINGER	-40.33	-31.71	0.16	-0.855	29.196	145.12	22.36	-2.11	62.30	1.74	76.41	21.23
30	STINGER	-47.78	-35.71	0.26	-0.716	27.227	153.58	21.74	-2.38	76.26	5.85	87.96	24.43
32	STINGER	-55.27	-39.39	0.34	-0.525	25.058	161.92	21.18	-2.62	81.41	6.39	91.93	25.54
34	STINGER	-62.71	-42.70	0.40	-0.339	22.829	170.07	20.67	-2.84	84.71	6.10	94.31	26.20
36	SAGBEND	-74.62	-47.27	0.44	-0.076	19.182	182.82	19.97	-3.15	89.10	5.47	97.45	27.07
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.532	195.02	19.41	-3.39	92.70	4.70	100.04	27.79
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	18.96	-3.58	95.64	4.21	102.17	28.38
39	SAGBEND	-110.13	-55.87	0.30	0.487	7.872	219.42	18.64	-3.72	97.38	3.96	103.39	28.72
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.990	231.62	18.45	-3.81	94.33	2.34	100.61	27.95
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	18.38	-3.84	56.61	-11.82	69.54	19.32
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	18.38	-3.84	-0.04	-3.35	23.39	6.50
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	18.38	-3.84	-0.16	0.23	20.80	5.78
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	18.38	-3.84	0.01	-0.01	20.59	5.72
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	18.38	-3.84	0.00	0.00	20.57	5.72
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	18.38	-3.84	0.00	0.00	20.57	5.71

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.88	0.00	-152.64	0.00	158.62	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.73	0.00	-132.37	0.00	141.25	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.86	-0.01	168.56	46.82
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.09	0.04	150.49	41.80
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.529	61.71	27.59	0.00	-125.63	-0.13	134.38	37.33
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.492	74.24	27.02	-0.08	-154.50	-3.72	158.43	44.01
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.702	89.61	26.21	-0.43	-152.70	-5.14	156.30	43.42
18	STINGER	-3.02	-11.61	0.00	0.005	24.923	102.72	25.42	-0.77	-130.63	-2.78	136.87	38.02
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	24.85	-1.02	-105.33	0.90	114.90	31.92
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	24.22	-1.30	-121.23	-11.42	128.36	35.66
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	23.57	-1.59	-19.87	-26.92	52.81	14.67
26	STINGER	-32.64	-28.26	0.15	-0.959	30.796	136.72	22.89	-1.88	54.98	0.14	70.58	19.61
28	STINGER	-39.96	-32.48	0.26	-0.839	28.967	145.16	22.24	-2.16	72.80	5.72	85.41	23.73
30	STINGER	-47.28	-36.36	0.36	-0.644	26.891	153.45	21.64	-2.42	78.72	6.59	90.02	25.01
32	STINGER	-54.54	-39.87	0.43	-0.449	24.754	161.52	21.10	-2.66	82.22	6.49	92.56	25.71
34	STINGER	-61.65	-42.99	0.47	-0.272	22.616	169.29	20.62	-2.86	85.05	6.07	94.56	26.27
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.696	182.93	19.88	-3.18	89.64	5.37	97.84	27.18
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.027	195.13	19.34	-3.42	93.14	4.58	100.36	27.88
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	18.91	-3.60	95.97	4.15	102.41	28.45
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.342	219.53	18.61	-3.74	97.42	3.89	103.40	28.72
40	SAGBEND	-122.14	-57.24	0.18	0.687	3.481	231.73	18.43	-3.81	92.71	1.77	99.21	27.56
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	18.38	-3.84	42.86	-15.61	59.16	16.43
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	18.38	-3.84	-0.72	-2.45	22.72	6.31
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	18.38	-3.84	-0.07	0.20	20.75	5.76
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	18.38	-3.84	0.01	-0.01	20.58	5.72
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	18.38	-3.84	0.00	0.00	20.57	5.71
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	18.38	-3.84	0.00	0.00	20.57	5.71
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	18.38	-3.84	0.00	0.00	20.57	5.71

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.88	0.00	-152.64	0.00	158.62	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.73	0.00	-132.37	0.00	141.25	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.85	-0.01	168.55	46.82
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.10	0.03	150.50	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	27.59	0.00	-125.57	-0.13	134.33	37.31
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.495	74.24	27.02	-0.08	-154.85	-3.76	158.72	44.09
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.677	89.61	26.21	-0.43	-150.74	-4.93	154.62	42.95
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	25.40	-0.78	-159.87	-4.12	161.73	44.92
20	STINGER	-10.68	-15.53	0.00	0.085	28.782	111.32	24.82	-1.03	-148.44	7.57	151.67	42.13
22	STINGER	-18.01	-19.82	0.00	-0.391	31.650	119.82	24.17	-1.32	-106.32	-44.03	122.64	34.07
24	STINGER	-25.20	-24.37	0.11	-1.053	32.261	128.32	23.49	-1.62	35.05	-3.40	54.25	15.07
26	STINGER	-32.40	-28.79	0.24	-0.982	30.734	136.78	22.80	-1.92	66.82	5.28	80.75	22.43
28	STINGER	-39.62	-32.93	0.35	-0.785	28.769	145.10	22.17	-2.19	75.36	6.70	87.60	24.33
30	STINGER	-46.75	-36.68	0.43	-0.581	26.715	153.16	21.59	-2.44	79.41	6.76	90.58	25.16
32	STINGER	-53.70	-40.02	0.49	-0.393	24.661	160.87	21.08	-2.67	82.43	6.51	92.72	25.76
34	STINGER	-60.38	-42.95	0.53	-0.226	22.653	168.16	20.63	-2.86	85.01	6.06	94.54	26.26
36	SAGBEND	-74.31	-48.16	0.55	0.075	18.368	183.04	19.83	-3.21	90.00	5.32	98.11	27.25
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	19.29	-3.44	93.44	4.53	100.57	27.94
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	18.88	-3.62	96.18	4.13	102.56	28.49
39	SAGBEND	-109.95	-56.23	0.32	0.620	6.986	219.64	18.59	-3.75	97.40	3.80	103.36	28.71
40	SAGBEND	-122.10	-57.30	0.17	0.736	3.144	231.84	18.43	-3.82	91.29	0.93	97.99	27.22
41	SEABED	-134.29	-57.63	0.03	0.460	0.268	244.04	18.38	-3.84	33.69	-19.46	53.47	14.85
42	SEABED	-146.49	-57.63	0.00	-0.008	-0.016	256.24	18.38	-3.84	-0.91	-1.30	21.91	6.09
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	18.38	-3.84	-0.03	0.15	20.70	5.75
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	18.38	-3.84	0.00	-0.01	20.58	5.72
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	18.38	-3.84	0.00	0.00	20.57	5.71
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	18.38	-3.84	0.00	0.00	20.57	5.71

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 22:31:23 PAGE 61
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 7

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.10	0.00	-155.02	-0.01	163.86	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.95	0.00	-135.88	0.01	147.45	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.07	-0.01	175.36	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	31.24	0.00	-147.69	0.04	156.77	43.55
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.531	61.71	30.81	0.00	-128.78	-0.16	140.28	38.97
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.494	74.24	30.24	-0.08	-158.64	-3.68	165.16	45.88
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.727	89.61	29.43	-0.43	-159.90	-5.20	165.63	46.01
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	28.66	-0.77	-102.30	-2.05	116.01	32.23
20	STINGER	-10.61	-15.23	0.00	-0.019	26.375	111.12	28.10	-1.01	-73.57	-2.74	91.19	25.33
22	STINGER	-18.17	-19.11	0.00	0.077	28.003	119.62	27.51	-1.27	-85.04	6.51	100.64	27.96
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	26.88	-1.55	-50.84	-39.71	82.49	22.91
26	STINGER	-33.01	-27.39	0.10	-0.909	29.218	136.62	26.24	-1.82	43.97	-2.46	64.61	17.95
28	STINGER	-40.46	-31.43	0.21	-0.837	27.643	145.09	25.62	-2.09	63.93	4.79	81.18	22.55
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	25.04	-2.34	69.30	5.84	85.35	23.71
32	STINGER	-55.47	-38.68	0.39	-0.489	23.864	161.77	24.51	-2.58	72.07	5.80	87.28	24.24
34	STINGER	-62.93	-41.83	0.44	-0.325	21.913	169.87	24.02	-2.79	74.26	5.48	88.74	24.65
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	23.33	-3.09	77.48	4.95	90.91	25.25
37	SAGBEND	-86.74	-49.92	0.48	0.109	15.516	195.02	22.78	-3.32	80.15	4.28	92.71	25.75
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	22.33	-3.52	82.42	3.77	94.27	26.19
39	SAGBEND	-110.57	-55.09	0.36	0.422	8.909	219.42	21.99	-3.67	84.15	3.57	95.46	26.52
40	SAGBEND	-122.67	-56.62	0.26	0.563	5.515	231.62	21.75	-3.77	84.57	3.25	95.63	26.56
41	SAGBEND	-134.84	-57.43	0.13	0.652	2.208	243.82	21.63	-3.83	76.88	-0.13	88.95	24.71
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	21.61	-3.84	16.37	-18.33	44.53	12.37
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	21.61	-3.84	-0.69	-0.38	24.42	6.78
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	21.61	-3.84	0.00	0.07	23.82	6.62
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	21.61	-3.84	0.00	0.00	23.76	6.60

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/14/2020 TIME - 22:31:23 PAGE 66
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 8

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.10	0.00	-155.02	-0.01	163.87	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.95	0.00	-135.88	0.01	147.45	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.07	-0.01	175.36	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	31.24	0.00	-147.70	0.04	156.79	43.55
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	30.82	0.00	-128.71	-0.15	140.22	38.95
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.498	74.24	30.24	-0.08	-158.99	-3.73	165.46	45.96
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.700	89.61	29.43	-0.43	-157.73	-4.90	163.78	45.49
18	STINGER	-3.02	-11.61	0.00	-0.010	24.909	102.72	28.64	-0.77	-133.12	-4.05	142.23	39.51
20	STINGER	-10.64	-15.38	0.00	0.082	27.547	111.22	28.07	-1.02	-109.65	7.41	122.00	33.89
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	27.44	-1.30	-107.81	-43.95	127.05	35.29
24	STINGER	-25.41	-23.79	0.10	-1.013	30.574	128.22	26.80	-1.58	31.87	-3.06	54.82	15.23
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	26.15	-1.87	60.25	4.87	78.48	21.80
28	STINGER	-40.14	-32.00	0.34	-0.767	27.411	145.08	25.54	-2.13	67.04	6.02	83.83	23.29
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	24.97	-2.38	70.08	6.04	85.97	23.88
32	STINGER	-54.78	-39.00	0.49	-0.410	23.676	161.32	24.46	-2.60	72.37	5.82	87.49	24.30
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	24.00	-2.80	74.37	5.45	88.81	24.67
36	SAGBEND	-74.94	-46.76	0.56	0.000	18.335	182.93	23.27	-3.11	77.81	4.89	91.13	25.31
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	22.73	-3.35	80.42	4.21	92.90	25.80
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	22.29	-3.54	82.64	3.73	94.42	26.23
39	SAGBEND	-110.49	-55.29	0.39	0.502	8.535	219.53	21.96	-3.68	84.28	3.56	95.56	26.54
40	SAGBEND	-122.60	-56.74	0.27	0.640	5.140	231.73	21.73	-3.78	84.41	3.14	95.48	26.52
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.870	243.93	21.62	-3.83	74.31	-1.22	86.77	24.10
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	21.61	-3.84	10.54	-18.11	41.47	11.52
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	21.61	-3.84	-0.61	-0.10	24.28	6.74
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	21.61	-3.84	0.01	0.05	23.80	6.61
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	21.61	-3.84	0.00	0.00	23.76	6.60
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	21.61	-3.84	0.00	0.00	23.76	6.60

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.10	0.00	-155.02	0.00	163.86	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.95	0.00	-135.88	0.00	147.45	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.07	-0.01	175.36	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	31.24	0.00	-147.71	0.04	156.79	43.55
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	30.81	0.00	-128.67	-0.17	140.18	38.94
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	30.24	-0.08	-159.28	-3.66	165.70	46.03
15	LAYBARGE	9.01	-6.41	0.00	0.008	21.680	89.61	29.43	-0.43	-156.08	-5.42	162.40	45.11
18	STINGER	-3.11	-11.67	0.00	0.024	25.260	102.82	28.63	-0.78	-162.24	-1.45	166.92	46.37
20	STINGER	-10.68	-15.53	0.00	-0.056	28.845	111.32	28.03	-1.03	-156.95	-8.02	162.13	45.04
22	STINGER	-18.02	-19.81	0.03	-0.585	30.957	119.82	27.41	-1.32	-39.79	-32.37	71.67	19.91
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	26.74	-1.61	45.17	-0.79	65.95	18.32
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	26.09	-1.89	62.66	5.23	80.50	22.36
28	STINGER	-39.86	-32.26	0.38	-0.743	27.287	144.97	25.49	-2.15	67.58	6.07	84.26	23.41
30	STINGER	-47.02	-35.82	0.46	-0.564	25.473	152.96	24.95	-2.39	70.24	6.03	86.09	23.91
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	24.46	-2.60	72.37	5.81	87.50	24.31
34	STINGER	-60.66	-41.81	0.56	-0.252	21.929	167.86	24.03	-2.78	74.23	5.45	88.72	24.64
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.128	183.04	23.23	-3.13	78.01	4.86	91.27	25.35
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	22.70	-3.36	80.58	4.17	93.01	25.84
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	22.26	-3.55	82.77	3.70	94.51	26.25
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	21.94	-3.69	84.36	3.56	95.61	26.56
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.915	231.84	21.72	-3.78	84.28	3.10	95.36	26.49
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	21.62	-3.83	72.41	-1.56	85.16	23.66
42	SEABED	-146.98	-57.63	0.01	0.217	0.008	256.24	21.61	-3.84	7.87	-17.62	40.06	11.13
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	21.61	-3.84	-0.54	-0.05	24.21	6.73
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	21.61	-3.84	0.01	0.05	23.80	6.61
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	21.61	-3.84	0.00	0.00	23.76	6.60

Output Analisis Dinamis Heading 90°

Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 15:56:41 PAGE 31
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 1

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.19	0.00	0.00	0.00	24.19	6.72
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.07	0.00	-149.09	0.14	150.80	41.89
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.92	0.00	-127.12	0.13	131.97	36.66
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.62	0.00	-158.55	0.16	158.38	44.00
9	LAYBARGE	46.49	5.31	0.00	0.001	12.688	50.30	23.21	0.00	-138.64	0.19	141.06	39.18
11	LAYBARGE	35.42	2.52	0.00	0.000	15.527	61.71	22.78	0.00	-121.15	-0.24	125.75	34.93
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.476	74.24	22.22	-0.08	-147.20	-4.05	147.40	40.94
15	LAYBARGE	9.01	-6.41	0.00	0.014	21.741	89.61	21.40	-0.43	-148.07	-5.66	147.55	40.99
18	STINGER	-2.94	-11.56	0.00	0.010	24.560	102.62	20.63	-0.77	-96.19	-2.73	102.81	28.56
20	STINGER	-10.61	-15.23	0.00	0.002	26.381	111.12	20.07	-1.01	-72.18	-1.01	81.90	22.75
22	STINGER	-18.17	-19.11	0.00	-0.008	27.963	119.62	19.48	-1.27	-77.79	-2.63	86.27	23.96
24	STINGER	-25.62	-23.20	0.00	0.048	29.574	128.12	18.85	-1.55	-74.21	4.52	82.79	23.00
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	18.19	-1.83	-86.30	-27.99	94.24	26.18
28	STINGER	-40.17	-31.98	0.06	-0.707	31.722	145.12	17.51	-2.13	31.59	-14.45	46.63	12.95
30	STINGER	-47.46	-36.36	0.16	-0.792	30.025	153.62	16.83	-2.42	82.99	4.77	88.69	24.64
32	STINGER	-54.81	-40.40	0.25	-0.604	27.487	162.01	16.21	-2.69	99.31	8.20	102.17	28.38
34	STINGER	-62.21	-44.02	0.32	-0.386	24.686	170.25	15.65	-2.93	106.99	8.45	108.29	30.08
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.089	182.82	14.91	-3.25	115.15	7.86	114.62	31.84
37	SAGBEND	-85.44	-52.53	0.35	0.188	15.344	195.02	14.34	-3.50	121.38	6.97	119.42	33.17
38	SAGBEND	-97.33	-55.25	0.29	0.411	10.392	207.22	13.92	-3.68	125.29	6.25	122.38	33.99
39	SAGBEND	-109.41	-56.92	0.18	0.597	5.395	219.42	13.67	-3.79	121.79	3.82	119.13	33.09
40	SAGBEND	-121.59	-57.58	0.05	0.549	1.084	231.62	13.57	-3.84	79.25	-10.79	83.31	23.14
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	13.57	-3.84	0.29	-4.42	19.49	5.41
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	13.57	-3.84	-0.30	0.33	16.17	4.49
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	13.57	-3.84	0.02	-0.01	15.87	4.41
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	13.57	-3.84	0.00	0.00	15.85	4.40
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	13.57	-3.84	0.00	0.00	15.85	4.40
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	13.57	-3.84	0.00	0.00	15.85	4.40

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 15:56:41 PAGE 36
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 2

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.18	0.00	0.00	0.00	24.18	6.72
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.06	0.00	-149.09	0.13	150.79	41.89
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.92	0.00	-127.11	0.12	131.96	36.66
7	LAYBARGE	60.13	8.03	0.00	0.001	9.686	36.39	23.61	0.00	-158.54	0.15	158.37	43.99
9	LAYBARGE	46.49	5.31	0.00	0.001	12.689	50.30	23.20	0.00	-138.66	0.19	141.06	39.18
11	LAYBARGE	35.42	2.52	0.00	0.000	15.526	61.71	22.78	0.00	-121.05	-0.23	125.66	34.91
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.482	74.24	22.21	-0.08	-147.70	-4.02	147.82	41.06
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.707	89.61	21.40	-0.43	-145.44	-5.76	145.31	40.36
18	STINGER	-3.02	-11.61	0.00	0.015	24.929	102.72	20.61	-0.77	-125.50	-2.52	127.67	35.46
20	STINGER	-10.64	-15.38	0.00	-0.014	27.545	111.22	20.04	-1.02	-106.10	-2.53	110.76	30.77
22	STINGER	-18.10	-19.46	0.00	0.060	29.910	119.72	19.41	-1.30	-107.34	5.22	111.38	30.94
24	STINGER	-25.37	-23.86	0.00	-0.252	32.479	128.22	18.73	-1.59	-119.96	-32.13	123.61	34.34
26	STINGER	-32.48	-28.53	0.07	-0.838	33.462	136.72	18.03	-1.90	21.48	-14.40	39.27	10.91
28	STINGER	-39.62	-33.14	0.19	-0.925	31.951	145.22	17.32	-2.21	77.83	4.79	84.69	23.53
30	STINGER	-46.81	-37.43	0.29	-0.726	29.542	153.59	16.66	-2.49	95.13	8.37	99.01	27.50
32	STINGER	-54.01	-41.29	0.37	-0.496	26.872	161.77	16.06	-2.75	103.10	8.72	105.34	29.26
34	STINGER	-61.10	-44.68	0.42	-0.276	24.134	169.63	15.54	-2.98	108.58	8.30	109.57	30.44
36	SAGBEND	-73.45	-49.59	0.44	0.061	19.212	182.93	14.79	-3.30	116.50	7.35	115.65	32.13
37	SAGBEND	-85.13	-53.12	0.40	0.311	14.420	195.13	14.24	-3.54	122.33	6.58	120.13	33.37
38	SAGBEND	-97.06	-55.65	0.31	0.530	9.440	207.33	13.86	-3.71	125.47	5.80	122.48	34.02
39	SAGBEND	-109.16	-57.12	0.18	0.692	4.480	219.53	13.63	-3.80	118.73	2.69	116.49	32.36
40	SEABED	-121.35	-57.62	0.04	0.537	0.556	231.73	13.57	-3.84	57.38	-16.59	66.00	18.33
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.030	243.93	13.57	-3.84	-1.31	-2.72	18.33	5.09
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	13.57	-3.84	-0.08	0.26	16.03	4.45
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	13.57	-3.84	0.01	-0.01	15.85	4.40
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	13.57	-3.84	0.00	0.00	15.84	4.40

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 15:56:41 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.18	0.00	0.00	0.00	24.18	6.72
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.06	0.00	-149.09	0.12	150.78	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.91	0.00	-127.11	0.11	131.95	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.61	0.00	-158.53	-0.14	158.36	43.99
9	LAYBARGE	46.49	5.31	0.00	0.001	12.689	50.30	23.20	0.00	-138.67	0.18	141.07	39.19
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	22.77	0.00	-120.94	-0.23	125.56	34.88
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.487	74.24	22.21	-0.08	-148.26	-4.03	148.30	41.19
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.672	89.61	21.40	-0.43	-142.66	-5.70	142.96	39.71
18	STINGER	-3.11	-11.67	0.00	0.012	25.325	102.82	20.59	-0.78	-156.48	-2.76	154.00	42.78
20	STINGER	-10.68	-15.53	0.00	-0.003	28.681	111.32	20.00	-1.03	-134.98	-2.00	135.23	37.56
22	STINGER	-18.01	-19.82	0.00	0.004	32.075	119.82	19.33	-1.32	-160.04	-5.01	156.04	43.34
24	STINGER	-25.10	-24.51	0.02	-0.499	34.328	128.32	18.64	-1.63	-41.99	-35.63	66.17	18.38
26	STINGER	-32.12	-29.31	0.12	-1.013	33.808	136.82	17.91	-1.95	59.88	-2.58	69.82	19.39
28	STINGER	-39.17	-33.85	0.24	-0.900	31.708	145.21	17.20	-2.26	87.58	7.20	92.97	25.83
30	STINGER	-46.22	-38.00	0.34	-0.675	29.199	153.39	16.56	-2.53	97.95	8.60	101.39	28.16
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	16.00	-2.78	104.12	8.59	106.16	29.49
34	STINGER	-59.83	-44.83	0.45	-0.229	24.006	168.62	15.52	-2.99	108.91	7.98	109.82	30.51
36	SAGBEND	-73.25	-50.08	0.46	0.123	18.640	183.04	14.71	-3.34	117.32	7.05	116.27	32.30
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	14.18	-3.56	122.89	6.20	120.56	33.49
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	13.82	-3.72	125.45	5.31	122.42	34.00
39	SAGBEND	-109.04	-57.23	0.17	0.728	3.904	219.64	13.61	-3.81	115.98	1.29	114.13	31.70
40	SEABED	-121.23	-57.63	0.03	0.436	0.313	231.84	13.56	-3.84	41.91	-20.49	54.90	15.25
41	SEABED	-133.43	-57.63	0.00	-0.012	-0.022	244.04	13.56	-3.84	-1.55	-1.04	17.36	4.82
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	13.56	-3.84	-0.01	0.16	15.95	4.43
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	13.56	-3.84	0.01	-0.01	15.85	4.40
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	13.56	-3.84	0.00	0.00	15.84	4.40
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	13.56	-3.84	0.00	0.00	15.84	4.40
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	13.56	-3.84	0.00	0.00	15.84	4.40

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 15:56:41 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.02	0.00	0.00	0.00	29.02	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.90	0.00	-152.65	0.16	158.65	44.07
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.75	0.00	-132.39	0.15	141.28	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.45	0.00	-164.88	-0.18	168.59	46.83
9	LAYBARGE	46.49	5.31	0.00	0.001	12.682	50.30	28.04	0.00	-144.08	0.23	150.51	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	27.61	0.00	-125.72	-0.28	134.46	37.35
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.487	74.24	27.04	-0.08	-154.08	-4.02	158.08	43.91
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.733	89.61	26.23	-0.43	-155.24	-5.64	158.47	44.02
18	STINGER	-2.94	-11.56	0.00	0.013	24.547	102.62	25.46	-0.77	-99.65	-2.55	110.55	30.71
20	STINGER	-10.61	-15.23	0.00	-0.009	26.387	111.12	24.90	-1.01	-74.17	-2.03	88.47	24.58
22	STINGER	-18.17	-19.11	0.00	0.037	27.946	119.62	24.31	-1.27	-78.08	3.11	91.33	25.37
24	STINGER	-25.62	-23.20	0.00	-0.150	29.647	128.12	23.68	-1.55	-85.17	-22.36	97.87	27.19
26	STINGER	-32.96	-27.48	0.05	-0.654	30.323	136.62	23.03	-1.83	8.89	-20.79	42.13	11.70
28	STINGER	-40.33	-31.71	0.16	-0.855	29.196	145.12	22.37	-2.11	62.85	2.69	76.89	21.36
30	STINGER	-47.78	-35.71	0.26	-0.718	27.227	153.58	21.76	-2.38	76.43	6.79	88.14	24.48
32	STINGER	-55.27	-39.39	0.34	-0.530	25.058	161.92	21.19	-2.62	81.53	7.25	92.03	25.57
34	STINGER	-62.71	-42.70	0.40	-0.342	22.829	170.07	20.69	-2.84	84.78	6.90	94.39	26.22
36	SAGBEND	-74.62	-47.27	0.44	-0.075	19.182	182.82	19.98	-3.15	89.15	6.21	97.51	27.09
37	SAGBEND	-86.26	-50.91	0.43	0.138	15.533	195.02	19.42	-3.39	92.78	5.47	100.11	27.81
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	18.98	-3.58	95.76	4.91	102.28	28.41
39	SAGBEND	-110.13	-55.87	0.30	0.486	7.872	219.42	18.66	-3.72	97.52	4.53	103.51	28.75
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.991	231.62	18.47	-3.81	94.43	2.67	100.68	27.97
41	SEABED	-134.45	-57.60	0.05	0.540	0.681	243.82	18.40	-3.84	56.80	-12.49	69.61	19.34
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	18.40	-3.84	-0.06	-3.69	23.65	6.57
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	18.40	-3.84	-0.16	0.25	20.81	5.78
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	18.40	-3.84	0.01	-0.01	20.60	5.72
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	18.40	-3.84	0.00	0.00	20.59	5.72
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	18.40	-3.84	0.00	0.00	20.59	5.72

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 15:56:41 PAGE 51
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 5

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.01	0.00	0.00	0.00	29.01	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.89	0.00	-152.65	0.15	158.65	44.07
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.75	0.00	-132.38	0.14	141.27	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.44	0.00	-164.87	0.18	168.58	46.83
9	LAYBARGE	46.49	5.31	0.00	0.001	12.682	50.30	28.03	0.00	-144.10	0.22	150.52	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	27.61	0.00	-125.63	-0.29	134.39	37.33
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.492	74.24	27.04	-0.08	-154.53	-4.08	158.46	44.02
15	LAYBARGE	9.01	-6.41	0.00	0.014	21.702	89.61	26.23	-0.43	-152.73	-5.68	156.34	43.43
18	STINGER	-3.02	-11.61	0.00	0.007	24.923	102.72	25.44	-0.77	-130.71	-3.15	136.96	38.04
20	STINGER	-10.64	-15.38	0.00	0.018	27.521	111.22	24.87	-1.02	-105.88	1.80	115.36	32.04
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	24.24	-1.30	-123.82	-14.98	130.35	36.21
24	STINGER	-25.38	-23.84	0.04	-0.604	31.505	128.22	23.58	-1.59	-21.69	-28.95	55.04	15.29
26	STINGER	-32.64	-28.26	0.15	-0.961	30.796	136.72	22.90	-1.88	55.45	0.96	71.00	19.72
28	STINGER	-39.96	-32.48	0.26	-0.840	28.967	145.16	22.25	-2.16	72.97	6.58	85.57	23.77
30	STINGER	-47.28	-36.36	0.36	-0.646	26.891	153.45	21.66	-2.42	78.83	7.30	90.14	25.04
32	STINGER	-54.54	-39.87	0.43	-0.450	24.754	161.52	21.12	-2.66	82.30	7.16	92.64	25.73
34	STINGER	-61.65	-42.99	0.47	-0.272	22.616	169.29	20.64	-2.86	85.11	6.67	94.62	26.28
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.696	182.93	19.90	-3.18	89.68	5.95	97.89	27.19
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.028	195.13	19.35	-3.42	93.22	5.16	100.43	27.90
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.231	207.33	18.93	-3.60	96.08	4.68	102.50	28.47
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.343	219.53	18.63	-3.74	97.53	4.33	103.49	28.75
40	SAGBEND	-122.14	-57.24	0.18	0.688	3.482	231.73	18.45	-3.81	92.78	2.01	99.25	27.57
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	18.40	-3.84	43.06	-16.18	59.22	16.45
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	18.40	-3.84	-0.73	-2.68	22.90	6.36
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	18.40	-3.84	-0.07	0.21	20.76	5.77
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	18.40	-3.84	0.01	-0.01	20.60	5.72
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	18.40	-3.84	0.00	0.00	20.59	5.72
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	18.40	-3.84	0.00	0.00	20.59	5.72
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	18.40	-3.84	0.00	0.00	20.59	5.72

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 15:56:41 PAGE 56
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 6

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.89	0.00	-152.64	-0.16	158.63	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.74	0.00	-132.38	-0.14	141.26	39.24
7	LAYBARGE	60.13	8.03	0.00	-0.001	9.689	36.39	28.43	0.00	-164.86	-0.19	168.56	46.82
9	LAYBARGE	46.49	5.31	0.00	-0.001	12.682	50.30	28.02	0.00	-144.10	0.20	150.51	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.003	15.528	61.71	27.60	0.00	-125.56	-0.30	134.32	37.31
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.495	74.24	27.03	-0.08	-154.88	-4.10	158.75	44.10
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.677	89.61	26.22	-0.43	-150.75	-5.41	154.65	42.96
18	STINGER	-3.11	-11.67	0.00	-0.013	25.285	102.82	25.41	-0.78	-159.86	-4.53	161.73	44.93
20	STINGER	-10.68	-15.53	0.00	0.081	28.782	111.32	24.82	-1.03	-148.44	8.84	151.73	42.15
22	STINGER	-18.01	-19.82	0.00	-0.393	31.650	119.82	24.17	-1.32	-106.41	-48.91	124.16	34.49
24	STINGER	-25.20	-24.37	0.11	-1.050	32.261	128.32	23.49	-1.62	35.08	-4.55	54.37	15.10
26	STINGER	-32.40	-28.79	0.24	-0.982	30.734	136.78	22.81	-1.92	66.82	6.17	80.80	22.45
28	STINGER	-39.62	-32.93	0.35	-0.786	28.769	145.10	22.17	-2.19	75.36	7.48	87.65	24.35
30	STINGER	-46.75	-36.68	0.43	-0.578	26.715	153.16	21.60	-2.44	79.42	7.48	90.63	25.17
32	STINGER	-53.70	-40.02	0.49	-0.390	24.660	160.87	21.08	-2.67	82.45	7.11	92.76	25.77
34	STINGER	-60.38	-42.95	0.53	-0.228	22.653	168.16	20.63	-2.86	85.04	6.62	94.56	26.27
36	SAGBEND	-74.31	-48.16	0.55	0.077	18.368	183.04	19.83	-3.21	90.03	5.84	98.11	27.25
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	19.30	-3.44	93.46	5.07	100.59	27.94
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	18.88	-3.62	96.20	4.66	102.58	28.50
39	SAGBEND	-109.95	-56.23	0.32	0.621	6.986	219.64	18.59	-3.75	97.42	4.25	103.38	28.72
40	SAGBEND	-122.10	-57.30	0.17	0.735	3.144	231.84	18.43	-3.82	91.31	1.16	98.00	27.22
41	SEABED	-134.29	-57.63	0.03	0.463	0.269	244.04	18.39	-3.84	33.77	-19.94	53.71	14.92
42	SEABED	-146.49	-57.63	0.00	-0.007	-0.016	256.24	18.39	-3.84	-0.91	-1.55	22.08	6.13
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	18.39	-3.84	-0.03	0.16	20.71	5.75
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	18.39	-3.84	0.00	-0.01	20.59	5.72
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	18.39	-3.84	0.00	0.00	20.58	5.72
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	18.39	-3.84	0.00	0.00	20.58	5.72

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.23	0.00	0.00	0.00	32.23	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.11	0.00	-155.02	-0.15	163.88	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.96	0.00	-135.88	-0.14	147.46	40.96
7	LAYBARGE	60.13	8.03	0.00	-0.001	9.691	36.39	31.65	0.00	-169.08	-0.19	175.37	48.72
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	31.24	0.00	-147.70	0.21	156.79	43.55
11	LAYBARGE	35.42	2.52	0.00	-0.003	15.531	61.71	30.82	0.00	-128.79	-0.31	140.28	38.97
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.494	74.24	30.25	-0.08	-158.66	-4.02	165.18	45.88
15	LAYBARGE	9.01	-6.41	0.00	0.009	21.727	89.61	29.44	-0.43	-159.92	-5.69	165.66	46.02
18	STINGER	-2.94	-11.56	0.00	0.012	24.543	102.62	28.67	-0.77	-102.28	-2.36	116.01	32.23
20	STINGER	-10.61	-15.23	0.00	-0.021	26.375	111.12	28.11	-1.01	-73.61	-2.97	91.22	25.34
22	STINGER	-18.17	-19.11	0.00	0.075	28.002	119.62	27.51	-1.27	-85.05	7.49	100.71	27.98
24	STINGER	-25.62	-23.20	0.00	-0.347	29.395	128.12	26.89	-1.55	-50.97	-44.23	84.96	23.60
26	STINGER	-33.01	-27.39	0.10	-0.906	29.217	136.62	26.25	-1.82	44.06	-3.62	64.74	17.98
28	STINGER	-40.46	-31.43	0.21	-0.834	27.643	145.09	25.63	-2.09	63.97	5.66	81.23	22.56
30	STINGER	-47.96	-35.21	0.31	-0.667	25.790	153.49	25.05	-2.35	69.32	6.59	85.41	23.72
32	STINGER	-55.47	-38.68	0.39	-0.488	23.864	161.77	24.51	-2.58	72.09	6.52	87.32	24.26
34	STINGER	-62.93	-41.83	0.44	-0.322	21.913	169.87	24.03	-2.79	74.28	6.09	88.77	24.66
36	SAGBEND	-75.08	-46.33	0.48	-0.087	18.680	182.82	23.34	-3.09	77.52	5.50	90.92	25.26
37	SAGBEND	-86.74	-49.92	0.48	0.110	15.516	195.02	22.79	-3.32	80.19	4.82	92.73	25.76
38	SAGBEND	-98.58	-52.84	0.44	0.275	12.253	207.22	22.34	-3.52	82.45	4.30	94.28	26.19
39	SAGBEND	-110.57	-55.09	0.37	0.422	8.909	219.42	21.99	-3.67	84.16	4.10	95.48	26.52
40	SAGBEND	-122.67	-56.62	0.26	0.564	5.515	231.62	21.76	-3.77	84.59	3.66	95.65	26.57
41	SAGBEND	-134.84	-57.43	0.13	0.653	2.209	243.82	21.63	-3.83	76.90	-0.30	88.96	24.71
42	SEABED	-147.04	-57.63	0.01	0.280	0.082	256.02	21.61	-3.84	16.42	-19.44	45.27	12.58
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	21.61	-3.84	-0.69	-0.47	24.45	6.79
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	21.61	-3.84	0.00	0.08	23.82	6.62
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	21.61	-3.84	0.00	0.00	23.77	6.60
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	21.61	-3.84	0.00	0.00	23.77	6.60

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.23	0.00	0.00	0.00	32.23	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.11	0.00	-155.02	0.15	163.88	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.96	0.00	-135.88	0.14	147.46	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.08	-0.17	175.37	48.71
9	LAYBARGE	46.49	5.31	0.00	0.001	12.677	50.30	31.24	0.00	-147.71	0.21	156.80	43.55
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.530	61.71	30.82	0.00	-128.72	-0.31	140.22	38.95
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.498	74.24	30.25	-0.08	-159.04	-4.05	165.51	45.97
15	LAYBARGE	9.01	-6.41	0.00	0.016	21.701	89.61	29.44	-0.43	-157.75	-5.36	163.82	45.50
18	STINGER	-3.02	-11.61	0.00	-0.009	24.909	102.72	28.65	-0.77	-133.11	-4.36	142.24	39.51
20	STINGER	-10.64	-15.38	0.00	0.082	27.547	111.22	28.08	-1.02	-109.65	8.44	122.07	33.91
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	27.45	-1.30	-107.90	-48.42	128.44	35.68
24	STINGER	-25.41	-23.79	0.10	-1.015	30.574	128.22	26.80	-1.58	31.89	-4.06	54.93	15.26
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	26.15	-1.87	60.25	5.59	78.52	21.81
28	STINGER	-40.14	-32.00	0.34	-0.764	27.411	145.08	25.54	-2.13	67.04	6.70	83.88	23.30
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	24.98	-2.38	70.09	6.61	86.01	23.89
32	STINGER	-54.78	-39.00	0.49	-0.412	23.676	161.32	24.47	-2.60	72.38	6.34	87.53	24.31
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	24.01	-2.80	74.38	5.91	88.83	24.68
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	23.27	-3.11	77.83	5.33	91.13	25.31
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	22.73	-3.35	80.44	4.66	92.91	25.81
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	22.30	-3.54	82.66	4.15	94.44	26.23
39	SAGBEND	-110.49	-55.29	0.40	0.502	8.535	219.53	21.96	-3.68	84.30	3.93	95.57	26.55
40	SAGBEND	-122.60	-56.74	0.27	0.641	5.140	231.73	21.74	-3.78	84.43	3.41	95.49	26.53
41	SAGBEND	-134.77	-57.48	0.13	0.714	1.870	243.93	21.63	-3.83	74.33	-1.30	86.79	24.11
42	SEABED	-146.97	-57.63	0.01	0.232	0.028	256.13	21.61	-3.84	10.58	-19.07	42.18	11.72
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	21.61	-3.84	-0.61	-0.11	24.28	6.75
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	21.61	-3.84	0.01	0.05	23.81	6.61
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	21.61	-3.84	0.00	0.00	23.77	6.60
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	21.61	-3.84	0.00	0.00	23.77	6.60
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	21.61	-3.84	0.00	0.00	23.76	6.60

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.23	0.00	0.00	0.00	32.23	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.11	0.00	-155.02	-0.15	163.88	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.97	0.00	-135.89	-0.14	147.47	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.66	0.00	-169.09	-0.18	175.38	48.72
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	31.25	0.00	-147.73	0.21	156.81	43.56
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	30.83	0.00	-128.66	-0.32	140.18	38.94
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.501	74.24	30.26	-0.08	-159.33	-3.99	165.75	46.04
15	LAYBARGE	9.01	-6.41	0.00	0.008	21.680	89.61	29.45	-0.43	-156.15	-5.84	162.47	45.13
18	STINGER	-3.11	-11.67	0.00	0.023	25.260	102.82	28.64	-0.78	-162.60	-2.23	167.21	46.45
20	STINGER	-10.68	-15.53	0.00	-0.057	28.845	111.32	28.05	-1.03	-159.18	-10.87	163.93	45.54
22	STINGER	-18.02	-19.81	0.03	-0.586	30.957	119.82	27.42	-1.32	-41.29	-33.91	73.44	20.40
24	STINGER	-25.31	-24.18	0.15	-1.022	30.613	128.32	26.75	-1.61	45.53	-1.42	66.27	18.41
26	STINGER	-32.59	-28.37	0.27	-0.923	29.063	136.72	26.10	-1.89	62.78	5.83	80.62	22.40
28	STINGER	-39.86	-32.26	0.38	-0.744	27.286	144.97	25.51	-2.15	67.67	6.62	84.35	23.43
30	STINGER	-47.02	-35.82	0.46	-0.564	25.473	152.96	24.96	-2.39	70.31	6.54	86.17	23.93
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	24.47	-2.60	72.43	6.24	87.56	24.32
34	STINGER	-60.66	-41.81	0.56	-0.253	21.930	167.86	24.04	-2.78	74.28	5.82	88.77	24.66
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.129	183.04	23.24	-3.13	78.04	5.21	91.30	25.36
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	22.71	-3.36	80.64	4.52	93.05	25.85
38	SAGBEND	-98.48	-53.29	0.50	0.376	11.667	207.44	22.28	-3.55	82.85	4.07	94.57	26.27
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	21.95	-3.69	84.45	3.88	95.67	26.58
40	SAGBEND	-122.61	-56.81	0.28	0.661	4.916	231.84	21.74	-3.78	84.35	3.32	95.41	26.50
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	21.63	-3.83	72.42	-1.64	85.18	23.66
42	SEABED	-146.98	-57.63	0.01	0.218	0.008	256.24	21.62	-3.84	7.94	-18.33	40.59	11.27
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	21.62	-3.84	-0.54	-0.06	24.23	6.73
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	21.62	-3.84	0.01	0.05	23.81	6.61
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	21.62	-3.84	0.00	0.00	23.77	6.60
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	21.62	-3.84	0.00	0.00	23.77	6.60

Output Analisis Dinamis Heading 135°
Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:21: 5 PAGE 31
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 1

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	-0.02	150.78	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.91	0.00	-127.10	0.02	131.94	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.54	-0.03	158.36	43.99
9	LAYBARGE	46.49	5.31	0.00	0.000	12.688	50.30	23.19	0.00	-138.67	0.10	141.05	39.18
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.526	61.71	22.77	0.00	-121.32	-0.36	125.89	34.97
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.476	74.24	22.20	-0.08	-147.81	-4.41	147.92	41.09
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.741	89.61	21.39	-0.43	-148.49	-5.92	147.91	41.09
18	STINGER	-2.94	-11.56	0.00	0.009	24.560	102.62	20.61	-0.77	-96.39	-2.68	102.95	28.60
20	STINGER	-10.61	-15.23	0.00	0.000	26.381	111.12	20.06	-1.01	-72.18	-0.83	81.92	22.75
22	STINGER	-18.17	-19.11	0.00	-0.010	27.963	119.62	19.46	-1.27	-77.65	-2.40	86.13	23.92
24	STINGER	-25.62	-23.20	0.00	0.047	29.574	128.12	18.83	-1.55	-73.58	3.62	82.22	22.84
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	18.17	-1.83	-83.40	-24.06	92.55	25.71
28	STINGER	-40.17	-31.98	0.06	-0.703	31.723	145.12	17.49	-2.13	29.65	-12.11	45.55	12.65
30	STINGER	-47.46	-36.36	0.16	-0.791	30.025	153.62	16.81	-2.42	82.35	3.69	88.11	24.48
32	STINGER	-54.81	-40.40	0.25	-0.609	27.487	162.01	16.19	-2.69	99.09	7.14	101.99	28.33
34	STINGER	-62.21	-44.02	0.32	-0.387	24.686	170.25	15.63	-2.93	106.91	7.44	108.21	30.06
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.090	182.82	14.89	-3.25	115.08	6.77	114.53	31.81
37	SAGBEND	-85.44	-52.53	0.35	0.189	15.344	195.02	14.32	-3.50	121.25	5.91	119.28	33.13
38	SAGBEND	-97.33	-55.25	0.29	0.412	10.392	207.22	13.90	-3.68	125.12	5.28	122.22	33.95
39	SAGBEND	-109.41	-56.92	0.18	0.594	5.394	219.42	13.65	-3.79	121.65	3.31	119.02	33.06
40	SAGBEND	-121.59	-57.58	0.05	0.547	1.083	231.62	13.56	-3.84	79.11	-9.82	83.27	23.13
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	13.56	-3.84	0.26	-4.01	19.18	5.33
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	13.56	-3.84	-0.29	0.30	16.17	4.49
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	13.56	-3.84	0.02	-0.02	15.85	4.40
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	13.56	-3.84	0.00	0.00	15.83	4.40
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	13.56	-3.84	0.00	0.00	15.83	4.40
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	13.56	-3.84	0.00	0.00	15.83	4.40

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:21: 5 PAGE 36
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 2

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.02	150.78	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.91	0.00	-127.10	0.02	131.94	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.53	-0.03	158.35	43.99
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	23.19	0.00	-138.68	0.10	141.06	39.18
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.526	61.71	22.77	0.00	-121.22	-0.39	125.81	34.95
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.482	74.24	22.20	-0.08	-148.32	-4.38	148.35	41.21
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.707	89.61	21.39	-0.43	-145.85	-6.01	145.67	40.46
18	STINGER	-3.02	-11.61	0.00	0.014	24.929	102.72	20.60	-0.77	-125.68	-2.44	127.83	35.51
20	STINGER	-10.64	-15.38	0.00	-0.016	27.545	111.22	20.02	-1.02	-105.99	-2.37	110.65	30.74
22	STINGER	-18.10	-19.46	0.00	0.059	29.910	119.72	19.40	-1.30	-106.83	4.45	110.93	30.81
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	18.72	-1.59	-117.53	-28.84	122.12	33.92
26	STINGER	-32.48	-28.53	0.07	-0.835	33.463	136.72	18.02	-1.90	19.90	-12.50	38.65	10.74
28	STINGER	-39.62	-33.14	0.19	-0.924	31.951	145.22	17.31	-2.21	77.33	3.89	84.24	23.40
30	STINGER	-46.81	-37.43	0.29	-0.730	29.542	153.59	16.65	-2.49	94.95	7.46	98.86	27.46
32	STINGER	-54.01	-41.29	0.37	-0.494	26.872	161.77	16.05	-2.75	103.01	7.93	105.26	29.24
34	STINGER	-61.10	-44.68	0.42	-0.272	24.134	169.63	15.53	-2.98	108.53	7.50	109.51	30.42
36	SAGBEND	-73.45	-49.59	0.44	0.058	19.212	182.93	14.77	-3.30	116.43	6.58	115.57	32.10
37	SAGBEND	-85.13	-53.12	0.40	0.310	14.420	195.13	14.23	-3.54	122.22	5.75	120.03	33.34
38	SAGBEND	-97.06	-55.65	0.31	0.528	9.440	207.33	13.84	-3.71	125.35	5.11	122.36	33.99
39	SAGBEND	-109.16	-57.12	0.18	0.693	4.480	219.53	13.62	-3.80	118.65	2.37	116.43	32.34
40	SEABED	-121.35	-57.62	0.04	0.537	0.556	231.73	13.55	-3.84	57.21	-15.97	65.99	18.33
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.030	243.93	13.55	-3.84	-1.31	-2.43	18.12	5.03
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	13.55	-3.84	-0.08	0.24	16.03	4.45
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	13.55	-3.84	0.01	-0.02	15.84	4.40
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	13.55	-3.84	0.00	0.00	15.83	4.40

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:21: 5 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	-0.02	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.91	0.00	-127.10	0.02	131.94	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.53	-0.03	158.35	43.99
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	23.19	0.00	-138.70	0.11	141.08	39.19
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.524	61.71	22.77	0.00	-121.10	-0.36	125.70	34.92
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.488	74.24	22.20	-0.08	-148.83	-4.43	148.78	41.33
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.671	89.61	21.39	-0.43	-143.07	-5.93	143.31	39.81
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	20.58	-0.78	-156.61	-2.70	154.09	42.80
20	STINGER	-10.68	-15.53	0.00	-0.004	28.681	111.32	19.99	-1.03	-134.59	-1.23	134.91	37.48
22	STINGER	-18.01	-19.82	0.00	0.005	32.074	119.82	19.32	-1.32	-157.94	-2.44	154.24	42.84
24	STINGER	-25.10	-24.51	0.02	-0.498	34.327	128.32	18.63	-1.63	-40.72	-34.10	64.60	17.95
26	STINGER	-32.12	-29.31	0.12	-1.014	33.808	136.82	17.90	-1.95	59.46	-1.85	69.45	19.29
28	STINGER	-39.17	-33.85	0.24	-0.904	31.708	145.21	17.20	-2.25	87.42	6.46	92.84	25.79
30	STINGER	-46.22	-38.00	0.34	-0.673	29.199	153.39	16.56	-2.53	97.86	7.99	101.29	28.14
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	15.99	-2.78	104.05	8.00	106.10	29.47
34	STINGER	-59.83	-44.83	0.45	-0.231	24.007	168.62	15.51	-2.99	108.87	7.45	109.78	30.49
36	SAGBEND	-73.25	-50.08	0.46	0.123	18.640	183.04	14.70	-3.34	117.26	6.45	116.22	32.28
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	14.17	-3.56	122.81	5.63	120.48	33.47
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	13.81	-3.72	125.36	4.89	122.33	33.98
39	SAGBEND	-109.04	-57.23	0.17	0.727	3.903	219.64	13.60	-3.81	115.93	1.11	114.09	31.69
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	13.55	-3.84	41.78	-19.62	54.75	15.21
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	13.56	-3.84	-1.55	-0.98	17.35	4.82
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	13.56	-3.84	-0.01	0.15	15.95	4.43
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	13.56	-3.84	0.01	-0.01	15.84	4.40
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	13.56	-3.84	0.00	0.00	15.83	4.40
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	13.56	-3.84	0.00	0.00	15.83	4.40
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	13.56	-3.84	0.00	0.00	15.83	4.40

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:21: 5 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.89	0.00	-152.65	-0.02	158.64	44.07
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.74	0.00	-132.38	0.02	141.26	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.87	-0.03	168.57	46.83
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.12	0.10	150.51	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.529	61.71	27.60	0.00	-125.86	-0.41	134.58	37.38
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.487	74.24	27.03	-0.08	-154.78	-4.45	158.67	44.08
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.733	89.61	26.22	-0.43	-155.69	-5.90	158.86	44.13
18	STINGER	-2.94	-11.56	0.00	0.012	24.547	102.62	25.44	-0.77	-99.86	-2.48	110.73	30.76
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	24.89	-1.01	-74.06	-1.85	88.36	24.55
22	STINGER	-18.17	-19.11	0.00	0.035	27.946	119.62	24.29	-1.27	-77.57	2.29	90.89	25.25
24	STINGER	-25.62	-23.20	0.00	-0.152	29.647	128.12	23.66	-1.55	-82.59	-18.91	96.23	26.73
26	STINGER	-32.96	-27.48	0.05	-0.648	30.322	136.62	23.02	-1.83	7.10	-18.77	40.84	11.34
28	STINGER	-40.33	-31.71	0.16	-0.856	29.196	145.12	22.36	-2.11	62.38	1.87	76.48	21.25
30	STINGER	-47.78	-35.71	0.26	-0.716	27.227	153.58	21.75	-2.38	76.30	5.95	88.00	24.44
32	STINGER	-55.27	-39.39	0.34	-0.524	25.058	161.92	21.18	-2.62	81.44	6.48	91.95	25.54
34	STINGER	-62.71	-42.70	0.40	-0.339	22.830	170.07	20.67	-2.84	84.73	6.18	94.33	26.20
36	SAGBEND	-74.62	-47.27	0.44	-0.076	19.182	182.82	19.97	-3.15	89.11	5.55	97.47	27.07
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.532	195.02	19.41	-3.39	92.72	4.78	100.06	27.79
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	18.97	-3.58	95.67	4.29	102.20	28.39
39	SAGBEND	-110.13	-55.87	0.30	0.487	7.872	219.42	18.65	-3.72	97.41	4.03	103.42	28.73
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.990	231.62	18.46	-3.81	94.36	2.38	100.63	27.95
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	18.39	-3.84	56.67	-11.90	69.58	19.33
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	18.39	-3.84	-0.05	-3.39	23.42	6.51
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	18.39	-3.84	-0.16	0.23	20.81	5.78
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	18.39	-3.84	0.01	-0.01	20.59	5.72
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	18.39	-3.84	0.00	0.00	20.58	5.72
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	18.39	-3.84	0.00	0.00	20.58	5.72

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.89	0.00	-152.65	-0.02	158.63	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.74	0.00	-132.37	0.02	141.26	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.87	-0.03	168.57	46.83
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.13	0.10	150.52	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	27.60	0.00	-125.80	-0.40	134.52	37.37
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.492	74.24	27.03	-0.08	-155.08	-4.42	158.92	44.15
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.702	89.61	26.22	-0.43	-153.13	-5.75	156.68	43.52
18	STINGER	-3.02	-11.61	0.00	0.005	24.923	102.72	25.43	-0.77	-130.83	-3.07	137.04	38.07
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	24.86	-1.02	-105.43	1.02	114.99	31.94
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	24.22	-1.30	-121.55	-11.94	128.60	35.72
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	23.57	-1.59	-20.10	-27.23	53.14	14.76
26	STINGER	-32.64	-28.26	0.15	-0.959	30.796	136.72	22.89	-1.88	55.06	0.28	70.65	19.62
28	STINGER	-39.96	-32.48	0.26	-0.840	28.967	145.16	22.24	-2.16	72.85	5.84	85.45	23.74
30	STINGER	-47.28	-36.36	0.36	-0.644	26.891	153.45	21.65	-2.42	78.75	6.68	90.05	25.01
32	STINGER	-54.54	-39.87	0.43	-0.448	24.754	161.52	21.11	-2.66	82.24	6.58	92.58	25.72
34	STINGER	-61.65	-42.99	0.47	-0.271	22.616	169.29	20.63	-2.86	85.07	6.15	94.58	26.27
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.696	182.93	19.89	-3.18	89.65	5.44	97.85	27.18
37	SAGBEND	-86.08	-51.35	0.48	0.216	15.027	195.13	19.34	-3.42	93.17	4.65	100.38	27.88
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	18.92	-3.60	96.01	4.22	102.44	28.46
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.342	219.53	18.61	-3.74	97.46	3.95	103.43	28.73
40	SAGBEND	-122.14	-57.24	0.18	0.687	3.481	231.73	18.44	-3.81	92.72	1.80	99.22	27.56
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	18.39	-3.84	42.94	-15.67	59.22	16.45
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	18.39	-3.84	-0.73	-2.49	22.75	6.32
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	18.39	-3.84	-0.07	0.20	20.75	5.76
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	18.39	-3.84	0.01	-0.01	20.59	5.72
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	18.39	-3.84	0.00	0.00	20.58	5.72
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	18.39	-3.84	0.00	0.00	20.58	5.72
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	18.39	-3.84	0.00	0.00	20.58	5.72

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.88	0.00	-152.64	-0.02	158.63	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.74	0.00	-132.37	0.02	141.25	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.86	-0.03	168.56	46.82
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.13	0.10	150.53	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.528	61.71	27.60	0.00	-125.70	-0.34	134.44	37.34
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.495	74.24	27.03	-0.08	-155.46	-4.35	159.24	44.23
15	LAYBARGE	9.01	-6.41	0.00	0.016	21.678	89.61	26.22	-0.43	-151.14	-5.50	154.98	43.05
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	25.41	-0.78	-160.03	-4.36	161.86	44.96
20	STINGER	-10.68	-15.53	0.00	0.085	28.782	111.32	24.82	-1.03	-148.46	7.73	151.69	42.14
22	STINGER	-18.01	-19.82	0.00	-0.391	31.650	119.82	24.17	-1.32	-106.48	-44.76	122.93	34.15
24	STINGER	-25.20	-24.37	0.11	-1.054	32.261	128.32	23.49	-1.62	35.09	-3.59	54.29	15.08
26	STINGER	-32.40	-28.79	0.24	-0.981	30.734	136.78	22.81	-1.92	66.88	5.43	80.80	22.44
28	STINGER	-39.62	-32.93	0.35	-0.785	28.769	145.10	22.17	-2.19	75.41	6.82	87.63	24.34
30	STINGER	-46.75	-36.68	0.43	-0.581	26.715	153.16	21.60	-2.44	79.45	6.86	90.61	25.17
32	STINGER	-53.70	-40.02	0.49	-0.393	24.661	160.87	21.08	-2.67	82.46	6.60	92.75	25.76
34	STINGER	-60.38	-42.95	0.53	-0.226	22.653	168.16	20.63	-2.86	85.03	6.14	94.55	26.26
36	SAGBEND	-74.31	-48.16	0.55	0.075	18.368	183.04	19.83	-3.21	90.02	5.39	98.12	27.26
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	19.30	-3.44	93.46	4.60	100.59	27.94
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	18.88	-3.62	96.21	4.19	102.58	28.50
39	SAGBEND	-109.95	-56.23	0.32	0.620	6.986	219.64	18.59	-3.75	97.43	3.85	103.38	28.72
40	SAGBEND	-122.10	-57.30	0.17	0.736	3.144	231.84	18.43	-3.82	91.31	0.96	98.00	27.22
41	SEABED	-134.29	-57.63	0.03	0.460	0.268	244.04	18.39	-3.84	33.74	-19.56	53.54	14.87
42	SEABED	-146.49	-57.63	0.00	-0.008	-0.016	256.24	18.39	-3.84	-0.91	-1.32	21.92	6.09
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	18.39	-3.84	-0.03	0.15	20.70	5.75
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	18.39	-3.84	0.00	-0.01	20.58	5.72
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	18.39	-3.84	0.00	0.00	20.58	5.72
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	18.39	-3.84	0.00	0.00	20.58	5.72

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:21: 5 PAGE 61
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 7

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.10	0.00	-155.02	-0.03	163.87	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.96	0.00	-135.88	0.02	147.45	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.08	-0.03	175.37	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	31.24	0.00	-147.73	0.11	156.80	43.56
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.531	61.71	30.82	0.00	-128.95	-0.40	140.42	39.01
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.494	74.24	30.25	-0.08	-159.23	-4.30	165.67	46.02
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.726	89.61	29.43	-0.43	-160.27	-5.81	165.96	46.10
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	28.66	-0.77	-102.46	-2.29	116.16	32.27
20	STINGER	-10.61	-15.23	0.00	-0.019	26.375	111.12	28.11	-1.01	-73.60	-2.81	91.22	25.34
22	STINGER	-18.17	-19.11	0.00	0.077	28.003	119.62	27.51	-1.27	-85.07	6.66	100.67	27.96
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	26.89	-1.55	-50.95	-40.39	82.83	23.01
26	STINGER	-33.01	-27.39	0.10	-0.909	29.218	136.62	26.25	-1.82	44.01	-2.60	64.64	17.96
28	STINGER	-40.46	-31.43	0.21	-0.836	27.643	145.09	25.62	-2.09	63.97	4.89	81.22	22.56
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	25.04	-2.35	69.34	5.94	85.38	23.72
32	STINGER	-55.47	-38.68	0.39	-0.489	23.864	161.77	24.51	-2.58	72.10	5.89	87.30	24.25
34	STINGER	-62.93	-41.83	0.44	-0.325	21.913	169.87	24.03	-2.79	74.28	5.55	88.76	24.65
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	23.34	-3.09	77.50	5.02	90.92	25.26
37	SAGBEND	-86.74	-49.92	0.48	0.109	15.516	195.02	22.78	-3.32	80.17	4.35	92.72	25.76
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	22.33	-3.52	82.44	3.84	94.29	26.19
39	SAGBEND	-110.57	-55.09	0.36	0.422	8.909	219.42	21.99	-3.67	84.17	3.64	95.48	26.52
40	SAGBEND	-122.67	-56.62	0.26	0.563	5.515	231.62	21.76	-3.77	84.59	3.30	95.65	26.57
41	SAGBEND	-134.84	-57.43	0.13	0.652	2.208	243.82	21.63	-3.83	76.88	-0.16	88.95	24.71
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	21.61	-3.84	16.40	-18.48	44.64	12.40
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	21.61	-3.84	-0.69	-0.39	24.43	6.79
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	21.61	-3.84	0.00	0.07	23.82	6.62
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	21.61	-3.84	0.00	-0.01	23.77	6.60
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	21.61	-3.84	0.00	0.00	23.76	6.60

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:21: 5 PAGE 66
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 8

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.23	0.00	0.00	0.00	32.23	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.11	0.00	-155.02	-0.02	163.87	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.96	0.00	-135.88	0.02	147.46	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.08	-0.03	175.37	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	31.24	0.00	-147.74	0.10	156.81	43.56
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	30.82	0.00	-128.86	-0.39	140.35	38.99
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.498	74.24	30.25	-0.08	-159.66	-4.37	166.03	46.12
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.700	89.61	29.44	-0.43	-158.15	-5.52	164.15	45.60
18	STINGER	-3.02	-11.61	0.00	-0.011	24.909	102.72	28.65	-0.77	-133.28	-4.34	142.38	39.55
20	STINGER	-10.64	-15.38	0.00	0.081	27.547	111.22	28.08	-1.02	-109.68	7.56	122.03	33.90
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	27.45	-1.30	-107.97	-44.64	127.31	35.36
24	STINGER	-25.41	-23.79	0.10	-1.013	30.574	128.22	26.80	-1.58	31.91	-3.22	54.86	15.24
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	26.15	-1.87	60.31	4.99	78.52	21.81
28	STINGER	-40.14	-32.00	0.34	-0.767	27.411	145.08	25.54	-2.13	67.08	6.13	83.87	23.30
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	24.97	-2.38	70.12	6.12	86.00	23.89
32	STINGER	-54.78	-39.00	0.49	-0.411	23.676	161.32	24.46	-2.60	72.39	5.89	87.52	24.31
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	24.00	-2.80	74.38	5.52	88.83	24.67
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	23.27	-3.11	77.82	4.96	91.14	25.32
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	22.73	-3.35	80.44	4.28	92.91	25.81
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	22.29	-3.54	82.66	3.79	94.44	26.23
39	SAGBEND	-110.49	-55.29	0.39	0.502	8.535	219.53	21.96	-3.68	84.31	3.61	95.57	26.55
40	SAGBEND	-122.60	-56.74	0.27	0.640	5.140	231.73	21.74	-3.78	84.43	3.17	95.49	26.53
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.870	243.93	21.63	-3.83	74.31	-1.23	86.78	24.10
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	21.61	-3.84	10.56	-18.26	41.58	11.55
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	21.61	-3.84	-0.61	-0.10	24.28	6.74
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	21.61	-3.84	0.01	0.05	23.81	6.61
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	21.61	-3.84	0.00	-0.01	23.77	6.60
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	21.61	-3.84	0.00	0.00	23.76	6.60
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	21.61	-3.84	0.00	0.00	23.76	6.60

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.23	0.00	0.00	0.00	32.23	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.11	0.00	-155.02	0.02	163.87	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.96	0.00	-135.88	0.02	147.46	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.08	-0.04	175.37	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	31.24	0.00	-147.75	0.12	156.82	43.56
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	30.82	0.00	-128.82	-0.46	140.32	38.98
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	30.25	-0.08	-159.99	-4.38	166.31	46.20
15	LAYBARGE	9.01	-6.41	0.00	0.009	21.680	89.61	29.44	-0.43	-156.55	-6.11	162.80	45.22
18	STINGER	-3.11	-11.67	0.00	0.024	25.260	102.82	28.63	-0.78	-162.43	-1.74	167.09	46.41
20	STINGER	-10.68	-15.53	0.00	-0.057	28.845	111.32	28.04	-1.03	-157.27	-8.49	162.38	45.11
22	STINGER	-18.02	-19.81	0.03	-0.585	30.957	119.82	27.41	-1.32	-40.04	-32.70	71.99	20.00
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	26.74	-1.61	45.23	-0.94	66.01	18.34
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	26.10	-1.89	62.71	5.35	80.54	22.37
28	STINGER	-39.86	-32.26	0.38	-0.743	27.287	144.97	25.50	-2.15	67.62	6.17	84.30	23.42
30	STINGER	-47.02	-35.82	0.46	-0.565	25.473	152.96	24.95	-2.39	70.27	6.12	86.12	23.92
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	24.46	-2.60	72.39	5.89	87.52	24.31
34	STINGER	-60.66	-41.81	0.56	-0.252	21.929	167.86	24.03	-2.78	74.25	5.51	88.74	24.65
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.129	183.04	23.23	-3.13	78.03	4.92	91.29	25.36
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	22.70	-3.36	80.61	4.22	93.03	25.84
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	22.27	-3.55	82.80	3.76	94.54	26.26
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	21.94	-3.69	84.39	3.60	95.63	26.56
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.915	231.84	21.73	-3.78	84.30	3.14	95.37	26.49
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	21.62	-3.83	72.42	-1.57	85.17	23.66
42	SEABED	-146.98	-57.63	0.01	0.218	0.008	256.24	21.61	-3.84	7.90	-17.75	40.16	11.16
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	21.61	-3.84	-0.54	-0.05	24.22	6.73
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	21.61	-3.84	0.01	0.05	23.80	6.61
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	21.61	-3.84	0.00	-0.01	23.77	6.60
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	21.61	-3.84	0.00	0.00	23.76	6.60

Output Analisis Dinamis Heading 180°
Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.06	0.00	-149.09	0.00	150.78	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.91	0.00	-127.10	0.00	131.94	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.54	-0.01	158.36	43.99
9	LAYBARGE	46.49	5.31	0.00	0.000	12.688	50.30	23.19	0.00	-138.66	0.04	141.04	39.18
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.527	61.71	22.77	0.00	-121.28	-0.13	125.85	34.96
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.476	74.24	22.20	-0.08	-147.80	-3.68	147.90	41.08
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.741	89.61	21.38	-0.43	-148.45	-5.13	147.85	41.07
18	STINGER	-2.94	-11.56	0.00	0.009	24.560	102.62	20.61	-0.77	-96.42	-2.37	102.98	28.60
20	STINGER	-10.61	-15.23	0.00	0.000	26.381	111.12	20.05	-1.01	-72.20	-0.75	81.94	22.76
22	STINGER	-18.17	-19.11	0.00	-0.010	27.963	119.62	19.46	-1.27	-77.65	-2.32	86.12	23.92
24	STINGER	-25.62	-23.20	0.00	0.048	29.574	128.12	18.83	-1.55	-73.48	3.47	82.13	22.82
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	18.17	-1.83	-82.89	-23.39	92.27	25.63
28	STINGER	-40.17	-31.98	0.06	-0.704	31.723	145.12	17.49	-2.13	29.31	-11.67	45.38	12.61
30	STINGER	-47.46	-36.36	0.16	-0.790	30.025	153.62	16.81	-2.42	82.25	3.52	88.02	24.45
32	STINGER	-54.81	-40.40	0.25	-0.608	27.487	162.01	16.19	-2.69	99.06	6.96	101.97	28.32
34	STINGER	-62.21	-44.02	0.32	-0.387	24.686	170.25	15.63	-2.93	106.91	7.25	108.20	30.06
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.090	182.82	14.89	-3.25	115.07	6.56	114.52	31.81
37	SAGBEND	-85.44	-52.53	0.35	0.189	15.345	195.02	14.32	-3.50	121.22	5.71	119.26	33.13
38	SAGBEND	-97.33	-55.25	0.29	0.412	10.392	207.22	13.90	-3.68	125.10	5.11	122.20	33.94
39	SAGBEND	-109.41	-56.92	0.18	0.593	5.394	219.42	13.65	-3.79	121.63	3.21	119.00	33.06
40	SAGBEND	-121.59	-57.58	0.05	0.547	1.083	231.62	13.55	-3.84	79.09	-9.64	83.26	23.13
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	13.55	-3.84	0.25	-3.93	19.11	5.31
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	13.55	-3.84	-0.29	0.29	16.17	4.49
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	13.55	-3.84	0.02	-0.01	15.85	4.40
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	13.55	-3.84	0.00	0.00	15.83	4.40
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	13.55	-3.84	0.00	0.00	15.82	4.40
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	13.55	-3.84	0.00	0.00	15.82	4.40

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.00	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.91	0.00	-127.10	0.00	131.94	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.53	-0.01	158.35	43.99
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	23.19	0.00	-138.68	0.04	141.06	39.18
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.526	61.71	22.77	0.00	-121.19	-0.13	125.78	34.94
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.482	74.24	22.19	-0.08	-148.38	-3.67	148.39	41.22
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.708	89.61	21.39	-0.43	-145.86	-5.22	145.66	40.46
18	STINGER	-3.02	-11.61	0.00	0.014	24.930	102.72	20.59	-0.77	-125.74	-2.11	127.88	35.52
20	STINGER	-10.64	-15.38	0.00	-0.016	27.545	111.22	20.02	-1.02	-106.02	-2.28	110.67	30.74
22	STINGER	-18.10	-19.46	0.00	0.058	29.910	119.72	19.39	-1.30	-106.74	4.30	110.85	30.79
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	18.71	-1.59	-117.08	-28.24	121.86	33.85
26	STINGER	-32.48	-28.53	0.07	-0.835	33.462	136.72	18.02	-1.90	19.62	-12.13	38.56	10.71
28	STINGER	-39.62	-33.14	0.19	-0.924	31.951	145.22	17.30	-2.21	77.24	3.71	84.15	23.38
30	STINGER	-46.81	-37.43	0.29	-0.730	29.542	153.59	16.64	-2.49	94.93	7.29	98.84	27.46
32	STINGER	-54.01	-41.29	0.37	-0.494	26.872	161.77	16.05	-2.75	103.00	7.78	105.25	29.24
34	STINGER	-61.10	-44.68	0.42	-0.272	24.134	169.63	15.53	-2.98	108.53	7.36	109.51	30.42
36	SAGBEND	-73.45	-49.59	0.44	0.058	19.212	182.93	14.77	-3.30	116.42	6.42	115.56	32.10
37	SAGBEND	-85.13	-53.12	0.40	0.309	14.420	195.13	14.23	-3.54	122.20	5.59	120.01	33.34
38	SAGBEND	-97.06	-55.65	0.31	0.528	9.440	207.33	13.84	-3.71	125.33	4.98	122.34	33.98
39	SAGBEND	-109.16	-57.12	0.18	0.693	4.480	219.53	13.62	-3.80	118.64	2.29	116.42	32.34
40	SEABED	-121.35	-57.62	0.04	0.537	0.556	231.73	13.55	-3.84	57.17	-15.84	65.97	18.33
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.030	243.93	13.55	-3.84	-1.30	-2.36	18.07	5.02
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	13.55	-3.84	-0.08	0.23	16.03	4.45
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	13.55	-3.84	0.01	-0.01	15.84	4.40
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	13.55	-3.84	0.00	0.00	15.82	4.40

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:47:12 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	24.17	0.00	0.00	0.00	24.17	6.71
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	24.05	0.00	-149.08	0.00	150.77	41.88
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	23.91	0.00	-127.10	0.00	131.94	36.65
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	23.60	0.00	-158.53	-0.01	158.35	43.99
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	23.19	0.00	-138.69	0.04	141.07	39.19
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	22.77	0.00	-121.07	-0.13	125.67	34.91
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.487	74.24	22.19	-0.08	-148.86	-3.67	148.80	41.33
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.672	89.61	21.39	-0.43	-143.06	-5.21	143.28	39.80
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	20.57	-0.78	-156.64	-2.39	154.12	42.81
20	STINGER	-10.68	-15.53	0.00	-0.004	28.681	111.32	19.99	-1.03	-134.53	-1.10	134.86	37.46
22	STINGER	-18.01	-19.82	0.00	0.005	32.074	119.82	19.32	-1.32	-157.54	-1.88	153.90	42.75
24	STINGER	-25.10	-24.51	0.02	-0.498	34.327	128.32	18.63	-1.63	-40.50	-33.77	64.28	17.86
26	STINGER	-32.12	-29.31	0.12	-1.014	33.808	136.82	17.89	-1.95	59.40	-1.66	69.40	19.28
28	STINGER	-39.17	-33.85	0.24	-0.903	31.708	145.21	17.19	-2.25	87.41	6.30	92.83	25.79
30	STINGER	-46.22	-38.00	0.34	-0.672	29.199	153.39	16.55	-2.53	97.86	7.86	101.29	28.14
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	15.99	-2.78	104.05	7.87	106.10	29.47
34	STINGER	-59.83	-44.83	0.45	-0.231	24.007	168.62	15.50	-2.99	108.88	7.34	109.78	30.49
36	SAGBEND	-73.25	-50.08	0.46	0.124	18.640	183.04	14.70	-3.34	117.25	6.33	116.20	32.28
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	14.17	-3.56	122.79	5.51	120.46	33.46
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	13.80	-3.72	125.33	4.80	122.31	33.97
39	SAGBEND	-109.04	-57.23	0.17	0.727	3.903	219.64	13.60	-3.81	115.92	1.07	114.08	31.69
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	13.55	-3.84	41.73	-19.43	54.69	15.19
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	13.55	-3.84	-1.54	-0.97	17.34	4.82
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	13.55	-3.84	-0.01	0.15	15.95	4.43
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	13.55	-3.84	0.01	-0.01	15.83	4.40
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	13.55	-3.84	0.00	0.00	15.83	4.40
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	13.55	-3.84	0.00	0.00	15.82	4.40
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	13.55	-3.84	0.00	0.00	15.82	4.40

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:47:12 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.01	0.00	0.00	0.00	29.01	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.89	0.00	-152.65	0.00	158.64	44.07
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.74	0.00	-132.38	0.00	141.26	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.87	-0.01	168.57	46.83
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.11	0.04	150.50	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	27.60	0.00	-125.87	-0.17	134.59	37.39
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.487	74.24	27.03	-0.08	-154.75	-3.65	158.64	44.07
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.732	89.61	26.22	-0.43	-155.63	-5.12	158.79	44.11
18	STINGER	-2.94	-11.56	0.00	0.012	24.547	102.62	25.44	-0.77	-99.90	-2.18	110.76	30.77
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	24.89	-1.01	-74.09	-1.78	88.39	24.55
22	STINGER	-18.17	-19.11	0.00	0.035	27.946	119.62	24.29	-1.27	-77.49	2.17	90.82	25.23
24	STINGER	-25.62	-23.20	0.00	-0.151	29.647	128.12	23.66	-1.55	-82.18	-18.34	95.98	26.66
26	STINGER	-32.96	-27.48	0.05	-0.648	30.322	136.62	23.01	-1.83	6.86	-18.47	40.66	11.29
28	STINGER	-40.33	-31.71	0.16	-0.855	29.196	145.12	22.36	-2.11	62.32	1.72	76.43	21.23
30	STINGER	-47.78	-35.71	0.26	-0.716	27.227	153.58	21.74	-2.38	76.29	5.83	87.99	24.44
32	STINGER	-55.27	-39.39	0.34	-0.525	25.058	161.92	21.18	-2.62	81.44	6.37	91.95	25.54
34	STINGER	-62.71	-42.70	0.40	-0.339	22.829	170.07	20.67	-2.84	84.73	6.09	94.33	26.20
36	SAGBEND	-74.62	-47.27	0.44	-0.076	19.182	182.82	19.97	-3.15	89.11	5.45	97.46	27.07
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.532	195.02	19.41	-3.39	92.72	4.68	100.05	27.79
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	18.96	-3.58	95.66	4.19	102.19	28.39
39	SAGBEND	-110.13	-55.87	0.30	0.487	7.872	219.42	18.65	-3.72	97.40	3.95	103.41	28.72
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.990	231.62	18.45	-3.81	94.34	2.33	100.62	27.95
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	18.39	-3.84	56.64	-11.81	69.56	19.32
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	18.39	-3.84	-0.04	-3.34	23.38	6.50
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	18.39	-3.84	-0.16	0.22	20.81	5.78
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	18.39	-3.84	0.01	-0.01	20.59	5.72
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	18.39	-3.84	0.00	0.00	20.58	5.72
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	18.39	-3.84	0.00	0.00	20.58	5.72

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:47:12 PAGE 51
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 5

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.89	0.00	-152.65	0.00	158.63	44.07
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.74	0.00	-132.37	0.00	141.26	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.87	-0.01	168.57	46.82
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.12	0.04	150.52	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	27.60	0.00	-125.77	-0.16	134.50	37.36
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.492	74.24	27.03	-0.08	-155.14	-3.66	158.96	44.16
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.702	89.61	26.22	-0.43	-153.09	-5.05	156.63	43.51
18	STINGER	-3.02	-11.61	0.00	0.005	24.923	102.72	25.42	-0.77	-130.84	-2.75	137.04	38.07
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	24.86	-1.02	-105.37	0.90	114.93	31.93
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	24.22	-1.30	-121.20	-11.41	128.34	35.65
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	23.57	-1.59	-19.90	-26.94	52.84	14.68
26	STINGER	-32.64	-28.26	0.15	-0.959	30.796	136.72	22.89	-1.88	55.02	0.12	70.61	19.61
28	STINGER	-39.96	-32.47	0.26	-0.839	28.967	145.16	22.24	-2.16	72.85	5.70	85.45	23.74
30	STINGER	-47.28	-36.36	0.36	-0.644	26.891	153.45	21.64	-2.42	78.75	6.57	90.05	25.01
32	STINGER	-54.54	-39.87	0.43	-0.449	24.754	161.52	21.10	-2.66	82.24	6.48	92.58	25.72
34	STINGER	-61.65	-42.99	0.47	-0.272	22.616	169.29	20.62	-2.86	85.07	6.06	94.58	26.27
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.696	182.93	19.88	-3.18	89.65	5.36	97.85	27.18
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.027	195.13	19.34	-3.42	93.16	4.57	100.37	27.88
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	18.91	-3.60	95.99	4.14	102.43	28.45
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.343	219.53	18.61	-3.74	97.43	3.88	103.41	28.72
40	SAGBEND	-122.14	-57.24	0.18	0.687	3.481	231.73	18.44	-3.81	92.71	1.77	99.21	27.56
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	18.39	-3.84	42.89	-15.61	59.18	16.44
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	18.39	-3.84	-0.73	-2.45	22.72	6.31
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	18.39	-3.84	-0.07	0.20	20.75	5.76
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	18.39	-3.84	0.01	-0.01	20.58	5.72
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	18.39	-3.84	0.00	0.00	20.58	5.72
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	18.39	-3.84	0.00	0.00	20.58	5.72
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	18.39	-3.84	0.00	0.00	20.58	5.72

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/15/2020 TIME - 16:47:12 PAGE 56
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 6

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	29.00	0.00	0.00	0.00	29.00	8.06
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	28.89	0.00	-152.64	0.00	158.63	44.06
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	28.74	0.00	-132.37	0.00	141.26	39.24
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	28.43	0.00	-164.86	-0.01	168.56	46.82
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	28.02	0.00	-144.13	0.04	150.52	41.81
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	27.60	0.00	-125.69	-0.15	134.44	37.34
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.495	74.24	27.03	-0.08	-155.42	-3.69	159.20	44.22
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.677	89.61	26.22	-0.43	-151.08	-4.83	154.91	43.03
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	25.41	-0.78	-160.06	-4.09	161.88	44.97
20	STINGER	-10.68	-15.53	0.00	0.085	28.781	111.32	24.82	-1.03	-148.51	7.54	151.73	42.15
22	STINGER	-18.01	-19.82	0.00	-0.391	31.650	119.82	24.17	-1.32	-106.50	-43.87	122.73	34.09
24	STINGER	-25.20	-24.37	0.11	-1.053	32.261	128.32	23.49	-1.62	35.10	-3.36	54.29	15.08
26	STINGER	-32.40	-28.79	0.24	-0.982	30.734	136.78	22.81	-1.92	66.88	5.25	80.81	22.45
28	STINGER	-39.62	-32.93	0.35	-0.785	28.769	145.10	22.17	-2.19	75.41	6.67	87.64	24.34
30	STINGER	-46.75	-36.68	0.43	-0.581	26.715	153.16	21.60	-2.44	79.45	6.74	90.62	25.17
32	STINGER	-53.70	-40.02	0.49	-0.393	24.660	160.87	21.08	-2.67	82.46	6.49	92.75	25.76
34	STINGER	-60.38	-42.95	0.53	-0.226	22.653	168.16	20.63	-2.86	85.03	6.05	94.55	26.27
36	SAGBEND	-74.31	-48.16	0.55	0.075	18.368	183.04	19.83	-3.21	90.02	5.30	98.12	27.26
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	19.30	-3.44	93.46	4.52	100.59	27.94
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	18.88	-3.62	96.20	4.12	102.58	28.49
39	SAGBEND	-109.95	-56.23	0.32	0.620	6.986	219.64	18.59	-3.75	97.41	3.79	103.37	28.72
40	SAGBEND	-122.10	-57.30	0.17	0.736	3.144	231.84	18.43	-3.82	91.30	0.92	98.00	27.22
41	SEABED	-134.29	-57.63	0.03	0.460	0.268	244.04	18.39	-3.84	33.72	-19.44	53.48	14.86
42	SEABED	-146.49	-57.63	0.00	-0.008	-0.016	256.24	18.39	-3.84	-0.91	-1.30	21.91	6.09
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	18.39	-3.84	-0.03	0.15	20.70	5.75
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	18.39	-3.84	0.00	-0.01	20.58	5.72
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	18.39	-3.84	0.00	0.00	20.58	5.72
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	18.39	-3.84	0.00	0.00	20.58	5.72

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.11	0.00	-155.02	0.00	163.87	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.96	0.00	-135.88	0.00	147.46	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.09	-0.01	175.37	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	31.24	0.00	-147.72	0.05	156.80	43.56
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.531	61.71	30.82	0.00	-128.92	-0.19	140.40	39.00
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.494	74.24	30.24	-0.08	-159.33	-3.63	165.74	46.04
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.727	89.61	29.43	-0.43	-160.29	-5.12	165.96	46.10
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	28.66	-0.77	-102.51	-2.01	116.20	32.28
20	STINGER	-10.61	-15.23	0.00	-0.019	26.375	111.12	28.11	-1.01	-73.62	-2.73	91.23	25.34
22	STINGER	-18.17	-19.11	0.00	0.077	28.003	119.62	27.51	-1.27	-85.09	6.48	100.68	27.97
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	26.88	-1.55	-50.96	-39.56	82.50	22.92
26	STINGER	-33.01	-27.39	0.10	-0.909	29.218	136.62	26.24	-1.82	44.01	-2.42	64.64	17.95
28	STINGER	-40.46	-31.43	0.21	-0.837	27.643	145.09	25.62	-2.09	63.97	4.76	81.22	22.56
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	25.04	-2.34	69.34	5.82	85.38	23.72
32	STINGER	-55.47	-38.68	0.39	-0.489	23.864	161.77	24.51	-2.58	72.09	5.79	87.30	24.25
34	STINGER	-62.93	-41.83	0.44	-0.325	21.913	169.87	24.02	-2.79	74.28	5.47	88.76	24.65
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	23.33	-3.09	77.50	4.94	90.92	25.26
37	SAGBEND	-86.74	-49.92	0.48	0.109	15.516	195.02	22.78	-3.32	80.16	4.26	92.72	25.76
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	22.33	-3.52	82.44	3.75	94.28	26.19
39	SAGBEND	-110.57	-55.09	0.36	0.422	8.909	219.42	21.99	-3.67	84.16	3.56	95.47	26.52
40	SAGBEND	-122.67	-56.62	0.26	0.563	5.515	231.62	21.75	-3.77	84.58	3.23	95.64	26.57
41	SAGBEND	-134.84	-57.43	0.13	0.652	2.208	243.82	21.63	-3.83	76.88	-0.13	88.95	24.71
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	21.61	-3.84	16.38	-18.30	44.53	12.37
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	21.61	-3.84	-0.69	-0.38	24.42	6.78
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	21.61	-3.84	0.00	0.07	23.82	6.62
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	21.61	-3.84	0.00	0.00	23.76	6.60

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	BENDING STRESSES HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.23	0.00	0.00	0.00	32.23	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.11	0.00	-155.02	0.00	163.88	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.96	0.00	-135.88	0.00	147.46	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.09	-0.01	175.36	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	31.24	0.00	-147.74	0.04	156.82	43.56
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.530	61.71	30.82	0.00	-128.85	-0.17	140.34	38.98
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.497	74.24	30.25	-0.08	-159.74	-3.66	166.10	46.14
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.701	89.61	29.44	-0.43	-158.21	-4.80	164.18	45.61
18	STINGER	-3.02	-11.61	0.00	-0.011	24.909	102.72	28.65	-0.77	-133.34	-4.01	142.42	39.56
20	STINGER	-10.64	-15.38	0.00	0.082	27.547	111.22	28.08	-1.02	-109.72	7.38	122.06	33.90
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	27.45	-1.30	-107.98	-43.79	127.14	35.32
24	STINGER	-25.41	-23.79	0.10	-1.013	30.574	128.22	26.80	-1.58	31.92	-3.02	54.86	15.24
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	26.15	-1.87	60.32	4.84	78.53	21.81
28	STINGER	-40.14	-32.00	0.34	-0.767	27.411	145.08	25.54	-2.13	67.09	6.00	83.88	23.30
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	24.97	-2.38	70.12	6.02	86.00	23.89
32	STINGER	-54.78	-39.00	0.49	-0.410	23.676	161.32	24.46	-2.60	72.39	5.80	87.52	24.31
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	24.00	-2.80	74.39	5.44	88.83	24.68
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	23.27	-3.11	77.82	4.88	91.14	25.32
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	22.73	-3.35	80.44	4.20	92.91	25.81
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	22.29	-3.54	82.66	3.71	94.43	26.23
39	SAGBEND	-110.49	-55.29	0.39	0.502	8.535	219.53	21.96	-3.68	84.30	3.55	95.56	26.55
40	SAGBEND	-122.60	-56.74	0.27	0.640	5.140	231.73	21.74	-3.78	84.42	3.13	95.48	26.52
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.869	243.93	21.62	-3.83	74.31	-1.22	86.77	24.10
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	21.61	-3.84	10.55	-18.09	41.46	11.52
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	21.61	-3.84	-0.61	-0.10	24.28	6.74
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	21.61	-3.84	0.01	0.05	23.80	6.61
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	21.61	-3.84	0.00	0.00	23.76	6.60
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	21.61	-3.84	0.00	0.00	23.76	6.60

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRESSES

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRESS (MPA)	HOOP STRESS (MPA)	BENDING STRESSES VERT (MPA)	HORIZ (MPA)	TOTAL STRESS (MPA)	PERCNT YIELD (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	32.22	0.00	0.00	0.00	32.22	8.95
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	32.11	0.00	-155.02	0.00	163.87	45.52
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	31.96	0.00	-135.88	0.00	147.46	40.96
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	31.65	0.00	-169.08	-0.01	175.36	48.71
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	31.24	0.00	-147.75	0.05	156.82	43.56
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	30.82	0.00	-128.80	-0.19	140.30	38.97
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	30.24	-0.08	-159.94	-3.59	166.26	46.18
15	LAYBARGE	9.01	-6.41	0.00	0.009	21.680	89.61	29.44	-0.43	-156.45	-5.31	162.71	45.20
18	STINGER	-3.11	-11.67	0.00	0.024	25.260	102.82	28.63	-0.78	-162.44	-1.42	167.10	46.42
20	STINGER	-10.68	-15.53	0.00	-0.056	28.845	111.32	28.04	-1.03	-156.96	-8.04	162.14	45.04
22	STINGER	-18.02	-19.81	0.03	-0.585	30.957	119.82	27.41	-1.32	-39.85	-32.41	71.73	19.92
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	26.74	-1.61	45.23	-0.78	66.01	18.34
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	26.09	-1.89	62.73	5.20	80.55	22.38
28	STINGER	-39.86	-32.26	0.38	-0.743	27.287	144.97	25.50	-2.15	67.63	6.05	84.30	23.42
30	STINGER	-47.02	-35.82	0.46	-0.564	25.473	152.96	24.95	-2.39	70.28	6.02	86.12	23.92
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	24.46	-2.60	72.40	5.80	87.53	24.31
34	STINGER	-60.66	-41.81	0.55	-0.252	21.929	167.86	24.03	-2.78	74.26	5.44	88.74	24.65
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.128	183.04	23.23	-3.13	78.03	4.85	91.29	25.36
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	22.70	-3.36	80.60	4.15	93.02	25.84
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	22.27	-3.55	82.78	3.69	94.52	26.26
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	21.94	-3.69	84.37	3.55	95.62	26.56
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.915	231.84	21.73	-3.78	84.29	3.10	95.36	26.49
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	21.62	-3.83	72.42	-1.56	85.17	23.66
42	SEABED	-146.98	-57.63	0.01	0.217	0.008	256.24	21.61	-3.84	7.88	-17.60	40.05	11.13
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	21.61	-3.84	-0.54	-0.05	24.22	6.73
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	21.61	-3.84	0.01	0.05	23.80	6.61
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	21.61	-3.84	0.00	0.00	23.76	6.60
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	21.61	-3.84	0.00	0.00	23.76	6.60

LAMPIRAN E
OUTPUT SOFTWARE OFFPIPE
(ANALISA DINAMIS REGANGAN)

Output Analisa Dinamis Heading 0°
Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.688	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.527	61.71	0.0110	0.0000	-0.0585	0.0000	0.0695	26.74
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.476	74.24	0.0107	0.0000	-0.0711	-0.0017	0.0819	31.49
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.741	89.61	0.0103	-0.0002	-0.0715	-0.0025	0.0820	31.54
18	STINGER	-2.94	-11.56	0.00	0.009	24.560	102.62	0.0100	-0.0004	-0.0465	-0.0011	0.0566	21.79
20	STINGER	-10.61	-15.23	0.00	0.000	26.381	111.12	0.0097	-0.0005	-0.0349	-0.0004	0.0448	17.23
22	STINGER	-18.17	-19.11	0.00	-0.010	27.963	119.62	0.0094	-0.0006	-0.0375	-0.0011	0.0472	18.16
24	STINGER	-25.62	-23.20	0.00	0.048	29.574	128.12	0.0091	-0.0007	-0.0355	0.0017	0.0450	17.31
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	0.0088	-0.0009	-0.0400	-0.0113	0.0508	19.54
28	STINGER	-40.17	-31.98	0.06	-0.704	31.723	145.12	0.0084	-0.0010	0.0141	-0.0056	0.0242	9.30
30	STINGER	-47.46	-36.36	0.16	-0.790	30.025	153.62	0.0081	-0.0012	0.0397	0.0017	0.0485	18.64
32	STINGER	-54.81	-40.40	0.25	-0.608	27.487	162.01	0.0078	-0.0013	0.0478	0.0034	0.0564	21.71
34	STINGER	-62.21	-44.02	0.32	-0.387	24.686	170.25	0.0075	-0.0014	0.0516	0.0035	0.0600	23.09
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.090	182.82	0.0072	-0.0016	0.0556	0.0032	0.0637	24.49
37	SAGBEND	-85.44	-52.53	0.35	0.189	15.345	195.02	0.0069	-0.0017	0.0586	0.0028	0.0664	25.54
38	SAGBEND	-97.33	-55.25	0.29	0.412	10.392	207.22	0.0067	-0.0018	0.0604	0.0025	0.0681	26.19
39	SAGBEND	-109.41	-56.92	0.18	0.593	5.394	219.42	0.0066	-0.0018	0.0588	0.0016	0.0663	25.50
40	SAGBEND	-121.59	-57.58	0.05	0.547	1.083	231.62	0.0065	-0.0019	0.0382	-0.0046	0.0460	17.68
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	0.0065	-0.0019	0.0001	-0.0019	0.0095	3.66
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	0.0065	-0.0019	-0.0001	0.0001	0.0078	3.01
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	0.0065	-0.0019	0.0000	0.0000	0.0077	2.95
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.526	61.71	0.0110	0.0000	-0.0585	0.0000	0.0695	26.72
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.482	74.24	0.0107	0.0000	-0.0713	-0.0017	0.0821	31.58
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.707	89.61	0.0103	-0.0002	-0.0702	-0.0025	0.0807	31.05
18	STINGER	-3.02	-11.61	0.00	0.014	24.930	102.72	0.0099	-0.0004	-0.0606	-0.0010	0.0708	27.22
20	STINGER	-10.64	-15.38	0.00	-0.016	27.545	111.22	0.0097	-0.0005	-0.0512	-0.0011	0.0611	23.51
22	STINGER	-18.10	-19.46	0.00	0.058	29.910	119.72	0.0094	-0.0006	-0.0516	0.0021	0.0613	23.57
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	0.0090	-0.0008	-0.0565	-0.0136	0.0676	25.99
26	STINGER	-32.48	-28.53	0.07	-0.835	33.462	136.72	0.0087	-0.0009	0.0094	-0.0058	0.0203	7.80
28	STINGER	-39.62	-33.14	0.19	-0.924	31.952	145.22	0.0084	-0.0011	0.0373	0.0018	0.0462	17.79
30	STINGER	-46.81	-37.43	0.29	-0.730	29.542	153.59	0.0080	-0.0012	0.0458	0.0035	0.0546	21.01
32	STINGER	-54.01	-41.29	0.37	-0.494	26.872	161.77	0.0078	-0.0013	0.0497	0.0038	0.0583	22.43
34	STINGER	-61.10	-44.68	0.42	-0.272	24.134	169.63	0.0075	-0.0014	0.0524	0.0036	0.0608	23.38
36	SAGBEND	-73.45	-49.59	0.44	0.058	19.212	182.93	0.0071	-0.0016	0.0562	0.0031	0.0643	24.72
37	SAGBEND	-85.13	-53.12	0.40	0.309	14.420	195.13	0.0069	-0.0017	0.0590	0.0027	0.0668	25.70
38	SAGBEND	-97.06	-55.65	0.31	0.528	9.440	207.33	0.0067	-0.0018	0.0605	0.0024	0.0682	26.22
39	SAGBEND	-109.16	-57.12	0.18	0.693	4.480	219.53	0.0066	-0.0018	0.0573	0.0011	0.0648	24.93
40	SEABED	-121.35	-57.62	0.04	0.537	0.556	231.73	0.0065	-0.0019	0.0276	-0.0076	0.0361	13.90
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.080	243.93	0.0065	-0.0019	-0.0006	-0.0011	0.0089	3.43
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	0.0065	-0.0019	0.0000	0.0001	0.0078	2.98
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	0.0065	-0.0019	0.0000	0.0000	0.0077	2.94
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:33: 1 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	0.0110	0.0000	-0.0584	0.0000	0.0694	26.70
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.487	74.24	0.0107	0.0000	-0.0716	-0.0017	0.0824	31.68
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.672	89.61	0.0103	-0.0002	-0.0689	-0.0025	0.0794	30.53
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	0.0099	-0.0004	-0.0756	-0.0012	0.0857	32.96
20	STINGER	-10.68	-15.53	0.00	-0.004	28.681	111.32	0.0097	-0.0005	-0.0650	-0.0005	0.0749	28.80
22	STINGER	-18.01	-19.82	0.00	0.005	32.074	119.82	0.0093	-0.0006	-0.0761	-0.0009	0.0858	32.98
24	STINGER	-25.10	-24.51	0.02	-0.498	34.327	128.32	0.0090	-0.0008	-0.0195	-0.0163	0.0348	13.39
26	STINGER	-32.12	-29.31	0.12	-1.014	33.808	136.82	0.0086	-0.0009	0.0287	-0.0008	0.0378	14.54
28	STINGER	-39.17	-33.85	0.24	-0.903	31.708	145.21	0.0083	-0.0011	0.0422	0.0030	0.0512	19.68
30	STINGER	-46.22	-38.00	0.34	-0.672	29.199	153.39	0.0080	-0.0012	0.0473	0.0038	0.0560	21.55
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	0.0077	-0.0013	0.0503	0.0038	0.0588	22.62
34	STINGER	-59.83	-44.83	0.45	-0.231	24.007	168.62	0.0075	-0.0014	0.0526	0.0035	0.0609	23.43
36	SAGBEND	-73.25	-50.08	0.46	0.124	18.640	183.04	0.0071	-0.0016	0.0566	0.0031	0.0646	24.86
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	0.0068	-0.0017	0.0593	0.0027	0.0671	25.80
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	0.0067	-0.0018	0.0605	0.0023	0.0682	26.22
39	SAGBEND	-109.04	-57.23	0.17	0.727	3.903	219.64	0.0066	-0.0018	0.0560	0.0005	0.0635	24.42
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	0.0065	-0.0019	0.0201	-0.0094	0.0297	11.44
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	0.0065	-0.0019	-0.0007	-0.0005	0.0085	3.27
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	0.0065	-0.0019	0.0000	0.0001	0.0077	2.97
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:33: 1 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.93
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.91
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0831	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.529	61.71	0.0133	0.0000	-0.0607	0.0000	0.0741	28.49
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.487	74.24	0.0131	0.0000	-0.0744	-0.0017	0.0875	33.66
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.733	89.61	0.0127	-0.0002	-0.0750	-0.0025	0.0878	33.77
18	STINGER	-2.94	-11.56	0.00	0.012	24.547	102.62	0.0123	-0.0004	-0.0481	-0.0011	0.0606	23.32
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	0.0120	-0.0005	-0.0358	-0.0009	0.0480	18.48
22	STINGER	-18.17	-19.11	0.00	0.035	27.946	119.62	0.0117	-0.0006	-0.0374	0.0010	0.0495	19.03
24	STINGER	-25.62	-23.20	0.00	-0.151	29.647	128.12	0.0114	-0.0007	-0.0397	-0.0088	0.0525	20.18
26	STINGER	-32.96	-27.48	0.05	-0.648	30.322	136.62	0.0111	-0.0009	0.0033	-0.0089	0.0211	8.10
28	STINGER	-40.33	-31.71	0.16	-0.855	29.196	145.12	0.0108	-0.0010	0.0301	0.0008	0.0414	15.93
30	STINGER	-47.78	-35.71	0.26	-0.716	27.227	153.58	0.0105	-0.0011	0.0368	0.0028	0.0480	18.47
32	STINGER	-55.27	-39.39	0.34	-0.525	25.058	161.92	0.0102	-0.0013	0.0393	0.0031	0.0503	19.36
34	STINGER	-62.71	-42.70	0.40	-0.339	22.829	170.07	0.0100	-0.0014	0.0409	0.0029	0.0517	19.89
36	SAGBEND	-74.62	-47.27	0.44	-0.076	19.182	182.82	0.0096	-0.0015	0.0430	0.0026	0.0535	20.59
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.532	195.02	0.0094	-0.0016	0.0448	0.0023	0.0550	21.17
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	0.0092	-0.0017	0.0462	0.0020	0.0563	21.65
39	SAGBEND	-110.13	-55.87	0.30	0.487	7.872	219.42	0.0090	-0.0018	0.0470	0.0019	0.0570	21.93
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.990	231.62	0.0089	-0.0018	0.0456	0.0011	0.0554	21.32
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	0.0089	-0.0019	0.0273	-0.0057	0.0378	14.53
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	0.0089	-0.0019	0.0000	-0.0016	0.0115	4.44
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	0.0089	-0.0019	-0.0001	0.0001	0.0101	3.87
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.93
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.91
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0831	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	0.0133	0.0000	-0.0607	0.0000	0.0740	28.47
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.492	74.24	0.0131	0.0000	-0.0746	-0.0017	0.0877	33.74
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.702	89.61	0.0127	-0.0002	-0.0738	-0.0024	0.0866	33.30
18	STINGER	-3.02	-11.61	0.00	0.005	24.923	102.72	0.0123	-0.0004	-0.0631	-0.0013	0.0756	29.07
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	0.0120	-0.0005	-0.0509	0.0004	0.0631	24.28
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	0.0117	-0.0006	-0.0585	-0.0055	0.0708	27.23
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	0.0114	-0.0008	-0.0096	-0.0130	0.0279	10.73
26	STINGER	-32.64	-28.26	0.15	-0.959	30.796	136.72	0.0111	-0.0009	0.0266	0.0001	0.0381	14.65
28	STINGER	-39.96	-32.48	0.26	-0.839	28.967	145.16	0.0107	-0.0010	0.0352	0.0028	0.0466	17.90
30	STINGER	-47.28	-36.36	0.36	-0.644	26.891	153.45	0.0105	-0.0012	0.0380	0.0032	0.0492	18.93
32	STINGER	-54.54	-39.87	0.43	-0.449	24.754	161.52	0.0102	-0.0013	0.0397	0.0031	0.0507	19.50
34	STINGER	-61.65	-42.99	0.47	-0.272	22.616	169.29	0.0100	-0.0014	0.0411	0.0029	0.0519	19.95
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.686	182.93	0.0096	-0.0015	0.0433	0.0026	0.0538	20.68
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.027	195.13	0.0093	-0.0017	0.0450	0.0022	0.0552	21.25
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	0.0091	-0.0017	0.0464	0.0020	0.0564	21.70
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.342	219.53	0.0090	-0.0018	0.0471	0.0019	0.0570	21.93
40	SAGBEND	-122.14	-57.24	0.18	0.687	3.481	231.73	0.0089	-0.0018	0.0448	0.0009	0.0546	21.02
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	0.0089	-0.0019	0.0207	-0.0075	0.0319	12.26
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	0.0089	-0.0019	-0.0003	-0.0012	0.0112	4.29
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	0.0089	-0.0019	0.0000	0.0001	0.0100	3.86
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.93
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.91
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0831	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	0.0133	0.0000	-0.0607	0.0000	0.0740	28.46
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.495	74.24	0.0131	0.0000	-0.0748	-0.0017	0.0879	33.81
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.677	89.61	0.0127	-0.0002	-0.0728	-0.0023	0.0856	32.93
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	0.0123	-0.0004	-0.0772	-0.0020	0.0897	34.51
20	STINGER	-10.68	-15.53	0.00	0.085	28.782	111.32	0.0120	-0.0005	-0.0717	0.0036	0.0840	32.32
22	STINGER	-18.01	-19.82	0.00	-0.391	31.650	119.82	0.0117	-0.0006	-0.0514	-0.0212	0.0676	25.98
24	STINGER	-25.20	-24.37	0.11	-1.053	32.261	128.32	0.0113	-0.0008	0.0169	-0.0016	0.0288	11.06
26	STINGER	-32.40	-28.79	0.24	-0.982	30.734	136.78	0.0110	-0.0009	0.0323	0.0025	0.0439	16.87
28	STINGER	-39.62	-32.93	0.35	-0.785	28.769	145.10	0.0107	-0.0011	0.0364	0.0032	0.0478	18.38
30	STINGER	-46.75	-36.68	0.43	-0.581	26.715	153.16	0.0104	-0.0012	0.0384	0.0033	0.0495	19.05
32	STINGER	-53.70	-40.02	0.49	-0.393	24.661	160.87	0.0102	-0.0013	0.0398	0.0031	0.0508	19.53
34	STINGER	-60.38	-42.95	0.53	-0.226	22.653	168.16	0.0100	-0.0014	0.0411	0.0029	0.0518	19.94
36	SAGBEND	-74.31	-48.16	0.55	0.075	18.368	183.04	0.0096	-0.0015	0.0435	0.0026	0.0539	20.74
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	0.0093	-0.0017	0.0451	0.0022	0.0554	21.29
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	0.0091	-0.0017	0.0465	0.0020	0.0565	21.74
39	SAGBEND	-109.95	-56.23	0.32	0.620	6.986	219.64	0.0090	-0.0018	0.0471	0.0018	0.0570	21.92
40	SAGBEND	-122.10	-57.30	0.17	0.736	3.144	231.84	0.0089	-0.0018	0.0441	0.0004	0.0540	20.75
41	SEABED	-134.29	-57.63	0.03	0.460	0.268	244.04	0.0089	-0.0019	0.0163	-0.0094	0.0286	11.01
42	SEABED	-146.49	-57.63	0.00	-0.008	-0.016	256.24	0.0089	-0.0019	-0.0004	-0.0006	0.0107	4.11
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	0.0089	-0.0019	0.0000	0.0001	0.0100	3.85
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:33: 1 PAGE 61
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 7

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.18
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.29
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	0.0151	0.0000	-0.0713	0.0000	0.0864	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.531	61.71	0.0149	0.0000	-0.0622	-0.0001	0.0771	29.65
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.494	74.24	0.0146	0.0000	-0.0766	-0.0017	0.0913	35.11
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.727	89.61	0.0142	-0.0002	-0.0772	-0.0025	0.0916	35.23
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	0.0138	-0.0004	-0.0494	-0.0010	0.0635	24.41
20	STINGER	-10.61	-15.23	0.00	-0.019	26.375	111.12	0.0136	-0.0005	-0.0355	-0.0013	0.0494	19.00
22	STINGER	-18.17	-19.11	0.00	0.077	28.003	119.62	0.0133	-0.0006	-0.0411	0.0031	0.0548	21.08
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	0.0130	-0.0007	-0.0246	-0.0191	0.0445	17.11
26	STINGER	-33.01	-27.39	0.10	-0.909	29.218	136.62	0.0127	-0.0009	0.0212	-0.0012	0.0344	13.23
28	STINGER	-40.46	-31.43	0.21	-0.837	27.643	145.09	0.0124	-0.0010	0.0309	0.0023	0.0439	16.87
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	0.0121	-0.0011	0.0335	0.0028	0.0463	17.80
32	STINGER	-55.47	-38.68	0.39	-0.489	23.864	161.77	0.0118	-0.0012	0.0348	0.0028	0.0474	18.23
34	STINGER	-62.93	-41.83	0.44	-0.325	21.913	169.87	0.0116	-0.0013	0.0359	0.0026	0.0483	18.56
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	0.0113	-0.0015	0.0374	0.0024	0.0495	19.05
37	SAGBEND	-86.74	-49.92	0.48	0.109	15.516	195.02	0.0110	-0.0016	0.0387	0.0021	0.0506	19.46
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	0.0108	-0.0017	0.0398	0.0018	0.0515	19.81
39	SAGBEND	-110.57	-55.09	0.36	0.422	8.909	219.42	0.0106	-0.0018	0.0406	0.0017	0.0522	20.08
40	SAGBEND	-122.67	-56.62	0.26	0.563	5.515	231.62	0.0105	-0.0018	0.0409	0.0016	0.0523	20.13
41	SAGBEND	-134.84	-57.43	0.13	0.652	2.208	243.82	0.0104	-0.0018	0.0371	-0.0001	0.0485	18.67
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	0.0104	-0.0019	0.0079	-0.0088	0.0233	8.95
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	0.0104	-0.0019	-0.0003	-0.0002	0.0119	4.56
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	0.0104	-0.0019	0.0000	0.0000	0.0115	4.43
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:33: 1 PAGE 66
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 8

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.18
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.29
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	0.0151	0.0000	-0.0714	0.0000	0.0864	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0622	-0.0001	0.0771	29.64
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.498	74.24	0.0146	0.0000	-0.0768	-0.0017	0.0915	35.18
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.701	89.61	0.0142	-0.0002	-0.0762	-0.0023	0.0905	34.83
18	STINGER	-3.02	-11.61	0.00	-0.011	24.909	102.72	0.0138	-0.0004	-0.0643	-0.0019	0.0784	30.14
20	STINGER	-10.64	-15.38	0.00	0.082	27.547	111.22	0.0136	-0.0005	-0.0530	0.0036	0.0669	25.73
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	0.0133	-0.0006	-0.0521	-0.0212	0.0698	26.84
24	STINGER	-25.41	-23.79	0.10	-1.013	30.574	128.22	0.0129	-0.0008	0.0154	-0.0015	0.0288	11.08
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	0.0126	-0.0009	0.0291	0.0023	0.0423	16.27
28	STINGER	-40.14	-32.00	0.34	-0.767	27.411	145.08	0.0123	-0.0010	0.0324	0.0029	0.0454	17.45
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	0.0121	-0.0011	0.0339	0.0029	0.0466	17.93
32	STINGER	-54.78	-39.00	0.49	-0.410	23.676	161.32	0.0118	-0.0013	0.0350	0.0028	0.0475	18.28
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	0.0116	-0.0014	0.0359	0.0026	0.0483	18.58
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	0.0112	-0.0015	0.0376	0.0024	0.0497	19.10
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	0.0110	-0.0016	0.0389	0.0020	0.0507	19.50
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	0.0108	-0.0017	0.0399	0.0018	0.0516	19.85
39	SAGBEND	-110.49	-55.29	0.39	0.502	8.535	219.53	0.0106	-0.0018	0.0407	0.0017	0.0523	20.10
40	SAGBEND	-122.60	-56.74	0.27	0.640	5.140	231.73	0.0105	-0.0018	0.0408	0.0015	0.0522	20.09
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.870	243.93	0.0104	-0.0018	0.0359	-0.0006	0.0473	18.19
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	0.0104	-0.0019	0.0051	-0.0087	0.0215	8.28
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	0.0104	-0.0019	-0.0003	0.0000	0.0118	4.53
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.18
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.29
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	0.0151	0.0000	-0.0714	0.0000	0.0864	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0622	-0.0001	0.0770	29.63
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	0.0146	0.0000	-0.0769	-0.0017	0.0916	35.23
15	LAYBARGE	9.01	-6.41	0.00	0.008	21.680	89.61	0.0142	-0.0002	-0.0754	-0.0025	0.0898	34.52
18	STINGER	-3.11	-11.67	0.00	0.024	25.260	102.82	0.0138	-0.0004	-0.0784	-0.0007	0.0924	35.54
20	STINGER	-10.68	-15.53	0.00	-0.056	28.845	111.32	0.0135	-0.0005	-0.0758	-0.0038	0.0897	34.49
22	STINGER	-18.02	-19.81	0.03	-0.585	30.957	119.82	0.0132	-0.0006	-0.0192	-0.0156	0.0383	14.73
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	0.0129	-0.0008	0.0218	-0.0004	0.0351	13.51
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	0.0126	-0.0009	0.0308	0.0025	0.0434	16.71
28	STINGER	-39.86	-32.26	0.38	-0.743	27.287	144.97	0.0123	-0.0010	0.0326	0.0029	0.0456	17.55
30	STINGER	-47.02	-35.82	0.46	-0.564	25.473	152.96	0.0121	-0.0012	0.0339	0.0029	0.0467	17.96
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	0.0118	-0.0013	0.0350	0.0028	0.0475	18.28
34	STINGER	-60.66	-41.81	0.55	-0.252	21.929	167.86	0.0116	-0.0013	0.0359	0.0026	0.0483	18.56
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.128	183.04	0.0112	-0.0015	0.0377	0.0023	0.0498	19.14
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	0.0110	-0.0016	0.0389	0.0020	0.0508	19.53
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	0.0108	-0.0017	0.0400	0.0018	0.0517	19.87
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	0.0106	-0.0018	0.0408	0.0017	0.0523	20.12
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.915	231.84	0.0105	-0.0018	0.0407	0.0015	0.0522	20.07
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	0.0104	-0.0019	0.0350	-0.0008	0.0464	17.84
42	SEABED	-146.98	-57.63	0.01	0.217	0.008	256.24	0.0104	-0.0019	0.0038	-0.0085	0.0207	7.98
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	0.0104	-0.0019	-0.0003	0.0000	0.0117	4.51
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

Output Analisa Dinamis Heading 45°
Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.688	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.527	61.71	0.0110	0.0000	-0.0585	0.0000	0.0695	26.74
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.476	74.24	0.0107	0.0000	-0.0711	-0.0018	0.0819	31.49
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.741	89.61	0.0103	-0.0002	-0.0715	-0.0025	0.0820	31.55
18	STINGER	-2.94	-11.56	0.00	0.009	24.560	102.62	0.0100	-0.0004	-0.0465	-0.0012	0.0566	21.78
20	STINGER	-10.61	-15.23	0.00	0.000	26.381	111.12	0.0097	-0.0005	-0.0349	-0.0004	0.0448	17.23
22	STINGER	-18.17	-19.11	0.00	-0.010	27.963	119.62	0.0094	-0.0006	-0.0375	-0.0011	0.0472	18.16
24	STINGER	-25.62	-23.20	0.00	0.048	29.574	128.12	0.0091	-0.0007	-0.0355	0.0017	0.0450	17.31
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	0.0088	-0.0009	-0.0401	-0.0113	0.0508	19.55
28	STINGER	-40.17	-31.98	0.06	-0.704	31.723	145.12	0.0084	-0.0010	0.0142	-0.0057	0.0242	9.31
30	STINGER	-47.46	-36.36	0.16	-0.790	30.025	153.62	0.0081	-0.0012	0.0397	0.0017	0.0485	18.65
32	STINGER	-54.81	-40.40	0.25	-0.608	27.487	162.01	0.0078	-0.0013	0.0478	0.0034	0.0564	21.71
34	STINGER	-62.21	-44.02	0.32	-0.387	24.686	170.25	0.0075	-0.0014	0.0516	0.0035	0.0600	23.09
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.090	182.82	0.0072	-0.0016	0.0556	0.0032	0.0637	24.49
37	SAGBEND	-85.44	-52.53	0.35	0.189	15.344	195.02	0.0069	-0.0017	0.0586	0.0028	0.0664	25.54
38	SAGBEND	-97.33	-55.25	0.29	0.412	10.392	207.22	0.0067	-0.0018	0.0604	0.0025	0.0681	26.19
39	SAGBEND	-109.41	-56.92	0.18	0.593	5.394	219.42	0.0066	-0.0018	0.0588	0.0016	0.0663	25.50
40	SAGBEND	-121.59	-57.58	0.05	0.547	1.083	231.62	0.0065	-0.0019	0.0382	-0.0047	0.0460	17.68
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	0.0065	-0.0019	0.0001	-0.0019	0.0095	3.66
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	0.0065	-0.0019	-0.0001	0.0001	0.0078	3.01
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	0.0065	-0.0019	0.0000	0.0000	0.0077	2.95
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.526	61.71	0.0110	0.0000	-0.0585	0.0000	0.0695	26.72
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.482	74.24	0.0107	0.0000	-0.0713	-0.0018	0.0821	31.58
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.707	89.61	0.0103	-0.0002	-0.0703	-0.0026	0.0807	31.05
18	STINGER	-3.02	-11.61	0.00	0.014	24.930	102.72	0.0099	-0.0004	-0.0606	-0.0010	0.0708	27.22
20	STINGER	-10.64	-15.38	0.00	-0.016	27.545	111.22	0.0097	-0.0005	-0.0512	-0.0011	0.0611	23.51
22	STINGER	-18.10	-19.46	0.00	0.058	29.910	119.72	0.0094	-0.0006	-0.0516	0.0021	0.0613	23.57
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	0.0090	-0.0008	-0.0566	-0.0137	0.0676	26.00
26	STINGER	-32.48	-28.53	0.07	-0.835	33.462	136.72	0.0087	-0.0009	0.0095	-0.0059	0.0203	7.80
28	STINGER	-39.62	-33.14	0.19	-0.924	31.952	145.22	0.0084	-0.0011	0.0373	0.0018	0.0463	17.79
30	STINGER	-46.81	-37.43	0.29	-0.730	29.542	153.59	0.0080	-0.0012	0.0458	0.0035	0.0546	21.01
32	STINGER	-54.01	-41.29	0.37	-0.493	26.872	161.77	0.0078	-0.0013	0.0497	0.0038	0.0583	22.43
34	STINGER	-61.10	-44.68	0.42	-0.272	24.134	169.63	0.0075	-0.0014	0.0524	0.0036	0.0608	23.38
36	SAGBEND	-73.45	-49.59	0.44	0.058	19.212	182.93	0.0071	-0.0016	0.0562	0.0031	0.0643	24.72
37	SAGBEND	-85.13	-53.12	0.40	0.309	14.420	195.13	0.0069	-0.0017	0.0590	0.0027	0.0668	25.70
38	SAGBEND	-97.06	-55.65	0.31	0.528	9.440	207.33	0.0067	-0.0018	0.0605	0.0024	0.0682	26.22
39	SAGBEND	-109.16	-57.12	0.18	0.693	4.480	219.53	0.0066	-0.0018	0.0573	0.0011	0.0648	24.94
40	SEABED	-121.35	-57.62	0.04	0.537	0.556	231.73	0.0065	-0.0019	0.0276	-0.0077	0.0361	13.90
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.080	243.93	0.0065	-0.0019	-0.0006	-0.0011	0.0089	3.43
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	0.0065	-0.0019	0.0000	0.0001	0.0078	2.98
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	0.0065	-0.0019	0.0000	0.0000	0.0077	2.94
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:48:30 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	0.0110	0.0000	-0.0584	0.0000	0.0694	26.70
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.487	74.24	0.0107	0.0000	-0.0716	-0.0018	0.0824	31.68
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.672	89.61	0.0103	-0.0002	-0.0689	-0.0026	0.0794	30.54
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	0.0099	-0.0004	-0.0756	-0.0012	0.0857	32.96
20	STINGER	-10.68	-15.53	0.00	-0.004	28.681	111.32	0.0097	-0.0005	-0.0650	-0.0005	0.0749	28.80
22	STINGER	-18.01	-19.82	0.00	0.005	32.074	119.82	0.0093	-0.0006	-0.0761	-0.0009	0.0858	32.99
24	STINGER	-25.10	-24.51	0.02	-0.498	34.327	128.32	0.0090	-0.0008	-0.0195	-0.0163	0.0349	13.41
26	STINGER	-32.12	-29.31	0.12	-1.014	33.808	136.82	0.0086	-0.0009	0.0287	-0.0008	0.0378	14.55
28	STINGER	-39.17	-33.85	0.24	-0.903	31.708	145.21	0.0083	-0.0011	0.0422	0.0031	0.0512	19.68
30	STINGER	-46.22	-38.00	0.34	-0.672	29.199	153.39	0.0080	-0.0012	0.0473	0.0038	0.0560	21.55
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	0.0077	-0.0013	0.0503	0.0038	0.0588	22.62
34	STINGER	-59.83	-44.83	0.45	-0.231	24.007	168.62	0.0075	-0.0014	0.0526	0.0036	0.0609	23.43
36	SAGBEND	-73.25	-50.08	0.46	0.124	18.640	183.04	0.0071	-0.0016	0.0566	0.0031	0.0646	24.86
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	0.0068	-0.0017	0.0593	0.0027	0.0671	25.80
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	0.0067	-0.0018	0.0605	0.0023	0.0682	26.22
39	SAGBEND	-109.04	-57.23	0.17	0.727	3.903	219.64	0.0066	-0.0018	0.0560	0.0005	0.0635	24.43
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	0.0065	-0.0019	0.0201	-0.0094	0.0297	11.44
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	0.0065	-0.0019	-0.0007	-0.0005	0.0085	3.27
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	0.0065	-0.0019	0.0000	0.0001	0.0077	2.97
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:48:30 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.93
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.91
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0831	31.97
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	0.0133	0.0000	-0.0607	-0.0001	0.0741	28.49
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.487	74.24	0.0131	0.0000	-0.0744	-0.0018	0.0875	33.66
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.733	89.61	0.0127	-0.0002	-0.0750	-0.0025	0.0878	33.77
18	STINGER	-2.94	-11.56	0.00	0.012	24.547	102.62	0.0123	-0.0004	-0.0481	-0.0011	0.0606	23.32
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	0.0120	-0.0005	-0.0358	-0.0009	0.0480	18.48
22	STINGER	-18.17	-19.11	0.00	0.035	27.946	119.62	0.0117	-0.0006	-0.0374	0.0011	0.0495	19.03
24	STINGER	-25.62	-23.20	0.00	-0.151	29.647	128.12	0.0114	-0.0007	-0.0397	-0.0089	0.0525	20.19
26	STINGER	-32.96	-27.48	0.05	-0.648	30.322	136.62	0.0111	-0.0009	0.0033	-0.0089	0.0211	8.10
28	STINGER	-40.33	-31.71	0.16	-0.855	29.196	145.12	0.0108	-0.0010	0.0301	0.0008	0.0414	15.93
30	STINGER	-47.78	-35.71	0.26	-0.716	27.227	153.58	0.0105	-0.0011	0.0368	0.0028	0.0480	18.47
32	STINGER	-55.27	-39.39	0.34	-0.525	25.058	161.92	0.0102	-0.0013	0.0393	0.0031	0.0503	19.36
34	STINGER	-62.71	-42.70	0.40	-0.339	22.829	170.07	0.0100	-0.0014	0.0409	0.0029	0.0517	19.89
36	SAGBEND	-74.62	-47.27	0.44	-0.076	19.182	182.82	0.0096	-0.0015	0.0430	0.0026	0.0535	20.59
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.532	195.02	0.0094	-0.0016	0.0448	0.0023	0.0551	21.17
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	0.0092	-0.0017	0.0462	0.0020	0.0563	21.65
39	SAGBEND	-110.13	-55.87	0.30	0.487	7.872	219.42	0.0090	-0.0018	0.0470	0.0019	0.0570	21.93
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.990	231.62	0.0089	-0.0018	0.0456	0.0011	0.0554	21.32
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	0.0089	-0.0019	0.0273	-0.0057	0.0378	14.53
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	0.0089	-0.0019	0.0000	-0.0016	0.0115	4.44
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	0.0089	-0.0019	-0.0001	0.0001	0.0101	3.87
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:48:30 PAGE 51
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 5

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.93
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.91
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0831	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	0.0133	0.0000	-0.0607	-0.0001	0.0740	28.47
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.492	74.24	0.0131	0.0000	-0.0746	-0.0018	0.0877	33.74
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.702	89.61	0.0127	-0.0002	-0.0738	-0.0025	0.0866	33.30
18	STINGER	-3.02	-11.61	0.00	0.005	24.923	102.72	0.0123	-0.0004	-0.0631	-0.0013	0.0756	29.07
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	0.0120	-0.0005	-0.0509	0.0004	0.0631	24.29
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	0.0117	-0.0006	-0.0586	-0.0055	0.0708	27.24
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	0.0114	-0.0008	-0.0096	-0.0130	0.0279	10.74
26	STINGER	-32.64	-28.26	0.15	-0.959	30.796	136.72	0.0111	-0.0009	0.0266	0.0001	0.0381	14.65
28	STINGER	-39.96	-32.48	0.26	-0.839	28.967	145.16	0.0107	-0.0010	0.0352	0.0028	0.0466	17.91
30	STINGER	-47.28	-36.36	0.36	-0.644	26.891	153.45	0.0105	-0.0012	0.0380	0.0032	0.0492	18.93
32	STINGER	-54.54	-39.87	0.43	-0.449	24.754	161.52	0.0102	-0.0013	0.0397	0.0031	0.0507	19.50
34	STINGER	-61.65	-42.99	0.47	-0.272	22.616	169.29	0.0100	-0.0014	0.0411	0.0029	0.0519	19.95
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.686	182.93	0.0096	-0.0015	0.0433	0.0026	0.0538	20.68
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.027	195.13	0.0093	-0.0017	0.0450	0.0022	0.0552	21.25
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	0.0091	-0.0017	0.0464	0.0020	0.0564	21.70
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.342	219.53	0.0090	-0.0018	0.0471	0.0019	0.0570	21.93
40	SAGBEND	-122.14	-57.24	0.18	0.687	3.481	231.73	0.0089	-0.0018	0.0448	0.0009	0.0546	21.02
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	0.0089	-0.0019	0.0207	-0.0075	0.0319	12.26
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	0.0089	-0.0019	-0.0004	-0.0012	0.0112	4.29
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	0.0089	-0.0019	0.0000	0.0001	0.0100	3.86
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:48:30 PAGE 56
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 6

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.93
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.91
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0831	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	0.0133	0.0000	-0.0607	-0.0001	0.0740	28.46
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.495	74.24	0.0131	0.0000	-0.0748	-0.0018	0.0879	33.81
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.677	89.61	0.0127	-0.0002	-0.0728	-0.0024	0.0856	32.93
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	0.0123	-0.0004	-0.0772	-0.0020	0.0897	34.51
20	STINGER	-10.68	-15.53	0.00	0.085	28.782	111.32	0.0120	-0.0005	-0.0717	0.0037	0.0840	32.32
22	STINGER	-18.01	-19.82	0.00	-0.391	31.650	119.82	0.0117	-0.0006	-0.0514	-0.0213	0.0676	26.00
24	STINGER	-25.20	-24.37	0.11	-1.053	32.261	128.32	0.0113	-0.0008	0.0169	-0.0016	0.0288	11.06
26	STINGER	-32.40	-28.79	0.24	-0.982	30.734	136.78	0.0110	-0.0009	0.0323	0.0026	0.0439	16.87
28	STINGER	-39.62	-32.93	0.35	-0.785	28.769	145.10	0.0107	-0.0011	0.0364	0.0032	0.0478	18.38
30	STINGER	-46.75	-36.68	0.43	-0.581	26.715	153.16	0.0104	-0.0012	0.0384	0.0033	0.0495	19.05
32	STINGER	-53.70	-40.02	0.49	-0.393	24.661	160.87	0.0102	-0.0013	0.0398	0.0031	0.0508	19.53
34	STINGER	-60.38	-42.95	0.53	-0.226	22.653	168.16	0.0100	-0.0014	0.0411	0.0029	0.0518	19.94
36	SAGBEND	-74.31	-48.16	0.55	0.075	18.368	183.04	0.0096	-0.0015	0.0435	0.0026	0.0539	20.74
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	0.0093	-0.0017	0.0451	0.0022	0.0554	21.29
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	0.0091	-0.0017	0.0465	0.0020	0.0565	21.74
39	SAGBEND	-109.95	-56.23	0.32	0.620	6.986	219.64	0.0090	-0.0018	0.0471	0.0018	0.0570	21.92
40	SAGBEND	-122.10	-57.30	0.17	0.736	3.144	231.84	0.0089	-0.0018	0.0441	0.0004	0.0540	20.75
41	SEABED	-134.29	-57.63	0.03	0.460	0.268	244.04	0.0089	-0.0019	0.0163	-0.0094	0.0286	11.02
42	SEABED	-146.49	-57.63	0.00	-0.008	-0.016	256.24	0.0089	-0.0019	-0.0004	-0.0006	0.0107	4.11
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	0.0089	-0.0019	0.0000	0.0001	0.0100	3.85
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:48:30 PAGE 61
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 7

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.18
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	0.0151	0.0000	-0.0713	0.0000	0.0864	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.531	61.71	0.0149	0.0000	-0.0622	-0.0001	0.0771	29.65
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.494	74.24	0.0146	0.0000	-0.0766	-0.0018	0.0913	35.11
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.727	89.61	0.0142	-0.0002	-0.0772	-0.0025	0.0916	35.23
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	0.0138	-0.0004	-0.0494	-0.0010	0.0635	24.41
20	STINGER	-10.61	-15.23	0.00	-0.019	26.375	111.12	0.0136	-0.0005	-0.0355	-0.0013	0.0494	19.00
22	STINGER	-18.17	-19.11	0.00	0.077	28.003	119.62	0.0133	-0.0006	-0.0411	0.0031	0.0548	21.08
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	0.0130	-0.0007	-0.0246	-0.0192	0.0445	17.12
26	STINGER	-33.01	-27.39	0.10	-0.909	29.218	136.62	0.0127	-0.0009	0.0212	-0.0012	0.0344	13.23
28	STINGER	-40.46	-31.43	0.21	-0.837	27.643	145.09	0.0124	-0.0010	0.0309	0.0023	0.0439	16.87
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	0.0121	-0.0011	0.0335	0.0028	0.0463	17.80
32	STINGER	-55.47	-38.68	0.39	-0.489	23.864	161.77	0.0118	-0.0012	0.0348	0.0028	0.0474	18.23
34	STINGER	-62.93	-41.83	0.44	-0.325	21.913	169.87	0.0116	-0.0013	0.0359	0.0026	0.0483	18.56
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	0.0113	-0.0015	0.0374	0.0024	0.0495	19.05
37	SAGBEND	-86.74	-49.92	0.48	0.109	15.516	195.02	0.0110	-0.0016	0.0387	0.0021	0.0506	19.46
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	0.0108	-0.0017	0.0398	0.0018	0.0515	19.81
39	SAGBEND	-110.57	-55.09	0.36	0.422	8.909	219.42	0.0106	-0.0018	0.0407	0.0017	0.0522	20.08
40	SAGBEND	-122.67	-56.62	0.26	0.563	5.515	231.62	0.0105	-0.0018	0.0409	0.0016	0.0523	20.13
41	SAGBEND	-134.84	-57.43	0.13	0.652	2.208	243.82	0.0104	-0.0018	0.0371	-0.0001	0.0485	18.67
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	0.0104	-0.0019	0.0079	-0.0089	0.0233	8.96
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	0.0104	-0.0019	-0.0003	-0.0002	0.0119	4.56
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	0.0104	-0.0019	0.0000	0.0000	0.0115	4.43
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:48:30 PAGE 66
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 8

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.18
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	0.0151	0.0000	-0.0714	0.0000	0.0864	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0622	-0.0001	0.0771	29.64
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.498	74.24	0.0146	0.0000	-0.0768	-0.0018	0.0915	35.18
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.700	89.61	0.0142	-0.0002	-0.0762	-0.0024	0.0905	34.83
18	STINGER	-3.02	-11.61	0.00	-0.011	24.909	102.72	0.0138	-0.0004	-0.0643	-0.0020	0.0784	30.14
20	STINGER	-10.64	-15.38	0.00	0.082	27.547	111.22	0.0136	-0.0005	-0.0530	0.0036	0.0669	25.73
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	0.0133	-0.0006	-0.0521	-0.0212	0.0698	26.85
24	STINGER	-25.41	-23.79	0.10	-1.013	30.574	128.22	0.0129	-0.0008	0.0154	-0.0015	0.0288	11.08
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	0.0126	-0.0009	0.0291	0.0024	0.0423	16.27
28	STINGER	-40.14	-32.00	0.34	-0.767	27.411	145.08	0.0123	-0.0010	0.0324	0.0029	0.0454	17.45
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	0.0121	-0.0011	0.0339	0.0029	0.0466	17.93
32	STINGER	-54.78	-39.00	0.49	-0.410	23.676	161.32	0.0118	-0.0013	0.0350	0.0028	0.0475	18.28
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	0.0116	-0.0014	0.0359	0.0026	0.0483	18.58
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	0.0112	-0.0015	0.0376	0.0024	0.0497	19.10
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	0.0110	-0.0016	0.0389	0.0020	0.0507	19.50
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	0.0108	-0.0017	0.0399	0.0018	0.0516	19.85
39	SAGBEND	-110.49	-55.29	0.39	0.502	8.535	219.53	0.0106	-0.0018	0.0407	0.0017	0.0523	20.10
40	SAGBEND	-122.60	-56.74	0.27	0.640	5.140	231.73	0.0105	-0.0018	0.0408	0.0015	0.0522	20.09
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.870	243.93	0.0104	-0.0018	0.0359	-0.0006	0.0473	18.19
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	0.0104	-0.0019	0.0051	-0.0088	0.0215	8.29
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	0.0104	-0.0019	-0.0003	0.0000	0.0118	4.53
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.18
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.29
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	0.0151	0.0000	-0.0714	0.0000	0.0864	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0622	-0.0001	0.0770	29.63
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	0.0146	0.0000	-0.0769	-0.0018	0.0916	35.23
15	LAYBARGE	9.01	-6.41	0.00	0.008	21.680	89.61	0.0142	-0.0002	-0.0754	-0.0026	0.0898	34.52
18	STINGER	-3.11	-11.67	0.00	0.024	25.260	102.82	0.0138	-0.0004	-0.0784	-0.0007	0.0924	35.54
20	STINGER	-10.68	-15.53	0.00	-0.056	28.845	111.32	0.0135	-0.0005	-0.0758	-0.0039	0.0897	34.50
22	STINGER	-18.02	-19.81	0.03	-0.585	30.957	119.82	0.0132	-0.0006	-0.0192	-0.0156	0.0383	14.75
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	0.0129	-0.0008	0.0218	-0.0004	0.0351	13.51
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	0.0126	-0.0009	0.0308	0.0025	0.0434	16.71
28	STINGER	-39.86	-32.26	0.38	-0.743	27.287	144.97	0.0123	-0.0010	0.0326	0.0029	0.0456	17.55
30	STINGER	-47.02	-35.82	0.46	-0.564	25.473	152.96	0.0121	-0.0012	0.0339	0.0029	0.0467	17.96
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	0.0118	-0.0013	0.0350	0.0028	0.0475	18.28
34	STINGER	-60.66	-41.81	0.56	-0.252	21.929	167.86	0.0116	-0.0013	0.0359	0.0026	0.0483	18.56
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.128	183.04	0.0112	-0.0015	0.0377	0.0023	0.0498	19.14
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	0.0110	-0.0016	0.0389	0.0020	0.0508	19.53
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	0.0108	-0.0017	0.0400	0.0018	0.0517	19.87
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	0.0106	-0.0018	0.0408	0.0017	0.0523	20.12
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.915	231.84	0.0105	-0.0018	0.0407	0.0015	0.0522	20.07
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	0.0104	-0.0019	0.0350	-0.0008	0.0464	17.84
42	SEABED	-146.98	-57.63	0.01	0.217	0.008	256.24	0.0104	-0.0019	0.0038	-0.0085	0.0207	7.98
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	0.0104	-0.0019	-0.0003	0.0000	0.0117	4.51
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

Output Analisa Dinamis Heading 90°
Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0001	0.0837	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0116	0.0000	-0.0614	0.0001	0.0730	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	-0.0001	0.0880	33.85
9	LAYBARGE	46.49	5.31	0.00	0.001	12.688	50.30	0.0112	0.0000	-0.0670	0.0001	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.527	61.71	0.0110	0.0000	-0.0585	-0.0001	0.0695	26.74
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.476	74.24	0.0107	0.0000	-0.0711	-0.0020	0.0819	31.49
15	LAYBARGE	9.01	-6.41	0.00	0.014	21.741	89.61	0.0103	-0.0002	-0.0715	-0.0027	0.0820	31.55
18	STINGER	-2.94	-11.56	0.00	0.010	24.560	102.62	0.0100	-0.0004	-0.0465	-0.0013	0.0566	21.78
20	STINGER	-10.61	-15.23	0.00	0.002	26.381	111.12	0.0097	-0.0005	-0.0349	-0.0005	0.0448	17.23
22	STINGER	-18.17	-19.11	0.00	-0.009	27.963	119.62	0.0094	-0.0006	-0.0376	-0.0013	0.0473	18.20
24	STINGER	-25.62	-23.20	0.00	0.051	29.574	128.12	0.0091	-0.0007	-0.0359	0.0022	0.0454	17.46
26	STINGER	-32.95	-27.50	0.00	-0.204	31.294	136.62	0.0088	-0.0009	-0.0418	-0.0137	0.0520	19.99
28	STINGER	-40.17	-31.98	0.06	-0.713	31.722	145.12	0.0085	-0.0010	0.0154	-0.0071	0.0249	9.58
30	STINGER	-47.46	-36.36	0.16	-0.792	30.025	153.62	0.0081	-0.0012	0.0401	0.0023	0.0489	18.80
32	STINGER	-54.81	-40.40	0.25	-0.609	27.487	162.01	0.0078	-0.0013	0.0480	0.0040	0.0566	21.76
34	STINGER	-62.21	-44.02	0.32	-0.392	24.686	170.25	0.0076	-0.0014	0.0517	0.0042	0.0601	23.11
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.089	182.82	0.0072	-0.0016	0.0556	0.0038	0.0637	24.51
37	SAGBEND	-85.44	-52.53	0.35	0.188	15.344	195.02	0.0069	-0.0017	0.0586	0.0034	0.0665	25.58
38	SAGBEND	-97.33	-55.25	0.29	0.413	10.392	207.22	0.0067	-0.0018	0.0605	0.0030	0.0682	26.24
39	SAGBEND	-109.41	-56.92	0.18	0.593	5.395	219.42	0.0066	-0.0018	0.0588	0.0018	0.0664	25.53
40	SAGBEND	-121.59	-57.58	0.05	0.544	1.083	231.62	0.0066	-0.0019	0.0383	-0.0052	0.0460	17.70
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	0.0066	-0.0019	0.0001	-0.0021	0.0097	3.74
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	0.0066	-0.0019	-0.0001	0.0002	0.0078	3.02
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	0.0066	-0.0019	0.0000	0.0000	0.0077	2.95
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	0.0066	-0.0019	0.0000	0.0000	0.0077	2.94
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	0.0066	-0.0019	0.0000	0.0000	0.0077	2.94
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	0.0066	-0.0019	0.0000	0.0000	0.0077	2.94

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	-0.0001	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0116	0.0000	-0.0614	-0.0001	0.0730	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	-0.0001	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0001	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.526	61.71	0.0110	0.0000	-0.0585	-0.0001	0.0695	26.72
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.482	74.24	0.0107	0.0000	-0.0714	-0.0020	0.0821	31.58
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.707	89.61	0.0103	-0.0002	-0.0703	-0.0028	0.0807	31.06
18	STINGER	-3.02	-11.61	0.00	0.013	24.929	102.72	0.0100	-0.0004	-0.0606	-0.0012	0.0708	27.22
20	STINGER	-10.64	-15.38	0.00	-0.017	27.545	111.22	0.0097	-0.0005	-0.0513	-0.0012	0.0612	23.54
22	STINGER	-18.10	-19.46	0.00	0.057	29.910	119.72	0.0094	-0.0006	-0.0519	0.0026	0.0616	23.69
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	0.0090	-0.0008	-0.0580	-0.0154	0.0686	26.39
26	STINGER	-32.48	-28.53	0.07	-0.833	33.462	136.72	0.0087	-0.0009	0.0104	-0.0071	0.0207	7.95
28	STINGER	-39.62	-33.14	0.19	-0.924	31.951	145.22	0.0084	-0.0011	0.0376	0.0023	0.0466	17.91
30	STINGER	-46.81	-37.43	0.29	-0.734	29.541	153.59	0.0080	-0.0012	0.0460	0.0040	0.0548	21.06
32	STINGER	-54.01	-41.29	0.37	-0.491	26.872	161.77	0.0078	-0.0013	0.0498	0.0042	0.0584	22.45
34	STINGER	-61.10	-44.68	0.42	-0.269	24.134	169.63	0.0075	-0.0014	0.0525	0.0040	0.0608	23.39
36	SAGBEND	-73.45	-49.59	0.44	0.057	19.212	182.93	0.0071	-0.0016	0.0563	0.0036	0.0643	24.74
37	SAGBEND	-85.13	-53.12	0.40	0.310	14.420	195.13	0.0069	-0.0017	0.0591	0.0031	0.0669	25.74
38	SAGBEND	-97.06	-55.65	0.31	0.527	9.440	207.33	0.0067	-0.0018	0.0606	0.0028	0.0683	26.26
39	SAGBEND	-109.16	-57.12	0.18	0.695	4.480	219.53	0.0066	-0.0018	0.0574	0.0013	0.0649	24.95
40	SEABED	-121.35	-57.62	0.04	0.538	0.556	231.73	0.0066	-0.0019	0.0277	-0.0080	0.0362	13.92
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.080	243.93	0.0066	-0.0019	-0.0006	-0.0013	0.0091	3.49
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	0.0066	-0.0019	0.0000	0.0001	0.0078	2.99
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	0.0066	-0.0019	0.0000	0.0000	0.0077	2.95
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	0.0066	-0.0019	0.0000	0.0000	0.0077	2.94

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:52:58 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	-0.0001	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0116	0.0000	-0.0614	0.0001	0.0730	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	-0.0001	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0001	0.0782	30.08
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	0.0110	0.0000	-0.0584	-0.0001	0.0694	26.70
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.488	74.24	0.0107	0.0000	-0.0716	-0.0020	0.0824	31.69
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.672	89.61	0.0103	-0.0002	-0.0689	-0.0028	0.0794	30.54
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	0.0099	-0.0004	-0.0756	-0.0014	0.0857	32.98
20	STINGER	-10.68	-15.53	0.00	-0.005	28.681	111.32	0.0097	-0.0005	-0.0653	-0.0010	0.0752	28.91
22	STINGER	-18.01	-19.82	0.00	0.004	32.073	119.82	0.0093	-0.0006	-0.0774	-0.0027	0.0871	33.49
24	STINGER	-25.10	-24.51	0.02	-0.497	34.325	128.32	0.0090	-0.0008	-0.0205	-0.0174	0.0362	13.94
26	STINGER	-32.13	-29.30	0.12	-1.019	33.808	136.82	0.0087	-0.0009	0.0289	-0.0013	0.0381	14.65
28	STINGER	-39.17	-33.85	0.24	-0.904	31.708	145.21	0.0083	-0.0011	0.0423	0.0035	0.0513	19.73
30	STINGER	-46.22	-38.00	0.34	-0.672	29.200	153.39	0.0080	-0.0012	0.0473	0.0042	0.0561	21.58
32	STINGER	-53.15	-41.67	0.41	-0.441	26.593	161.23	0.0077	-0.0013	0.0503	0.0042	0.0589	22.64
34	STINGER	-59.83	-44.83	0.45	-0.233	24.007	168.62	0.0075	-0.0014	0.0526	0.0039	0.0610	23.45
36	SAGBEND	-73.25	-50.08	0.46	0.124	18.640	183.04	0.0071	-0.0016	0.0567	0.0034	0.0647	24.88
37	SAGBEND	-84.96	-53.49	0.41	0.371	13.819	195.24	0.0069	-0.0017	0.0594	0.0030	0.0672	25.83
38	SAGBEND	-96.92	-55.88	0.31	0.586	8.825	207.44	0.0067	-0.0018	0.0606	0.0026	0.0682	26.25
39	SAGBEND	-109.04	-57.23	0.17	0.726	3.904	219.64	0.0066	-0.0018	0.0560	0.0006	0.0635	24.44
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	0.0066	-0.0019	0.0203	-0.0099	0.0299	11.49
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	0.0066	-0.0019	-0.0007	-0.0005	0.0085	3.28
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	0.0066	-0.0019	0.0000	0.0001	0.0077	2.97
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	0.0066	-0.0019	0.0000	0.0000	0.0077	2.94
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	0.0066	-0.0019	0.0000	0.0000	0.0077	2.94
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	0.0066	-0.0019	0.0000	0.0000	0.0077	2.94
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	0.0066	-0.0019	0.0000	0.0000	0.0077	2.94

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:52:58 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	-0.0001	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0640	-0.0001	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0797	-0.0001	0.0934	35.92
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0001	0.0831	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.529	61.71	0.0133	0.0000	-0.0607	-0.0001	0.0741	28.49
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.487	74.24	0.0131	0.0000	-0.0744	-0.0019	0.0875	33.67
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.733	89.61	0.0127	-0.0002	-0.0750	-0.0027	0.0878	33.77
18	STINGER	-2.94	-11.56	0.00	0.011	24.547	102.62	0.0123	-0.0004	-0.0481	-0.0012	0.0606	23.32
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	0.0120	-0.0005	-0.0358	-0.0010	0.0481	18.50
22	STINGER	-18.17	-19.11	0.00	0.034	27.946	119.62	0.0117	-0.0006	-0.0377	0.0015	0.0497	19.13
24	STINGER	-25.62	-23.20	0.00	-0.151	29.647	128.12	0.0114	-0.0007	-0.0409	-0.0105	0.0534	20.53
26	STINGER	-32.96	-27.48	0.05	-0.649	30.322	136.62	0.0111	-0.0009	0.0042	-0.0099	0.0218	8.38
28	STINGER	-40.33	-31.71	0.16	-0.858	29.196	145.12	0.0108	-0.0010	0.0303	0.0013	0.0417	16.03
30	STINGER	-47.78	-35.71	0.26	-0.717	27.227	153.58	0.0105	-0.0011	0.0369	0.0032	0.0481	18.51
32	STINGER	-55.27	-39.39	0.34	-0.525	25.058	161.92	0.0102	-0.0013	0.0394	0.0035	0.0504	19.38
34	STINGER	-62.71	-42.70	0.40	-0.340	22.829	170.07	0.0100	-0.0014	0.0410	0.0033	0.0518	19.91
36	SAGBEND	-74.62	-47.27	0.44	-0.077	19.182	182.82	0.0097	-0.0015	0.0431	0.0030	0.0536	20.60
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.533	195.02	0.0094	-0.0016	0.0448	0.0026	0.0551	21.19
38	SAGBEND	-98.11	-53.79	0.38	0.321	11.751	207.22	0.0092	-0.0017	0.0463	0.0024	0.0564	21.67
39	SAGBEND	-110.13	-55.87	0.30	0.488	7.872	219.42	0.0090	-0.0018	0.0471	0.0022	0.0571	21.95
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.991	231.62	0.0089	-0.0018	0.0456	0.0013	0.0555	21.34
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	0.0089	-0.0019	0.0274	-0.0060	0.0378	14.54
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	0.0089	-0.0019	0.0000	-0.0018	0.0117	4.49
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	0.0089	-0.0019	-0.0001	0.0001	0.0101	3.87
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	0.0089	-0.0019	0.0000	0.0000	0.0100	3.83
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:52:58 PAGE 51
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 5

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0001	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0640	0.0001	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	-0.0001	0.0934	35.92
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0001	0.0832	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	0.0133	0.0000	-0.0607	-0.0001	0.0740	28.47
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.492	74.24	0.0131	0.0000	-0.0747	-0.0020	0.0878	33.75
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.702	89.61	0.0127	-0.0002	-0.0738	-0.0027	0.0866	33.31
18	STINGER	-3.02	-11.61	0.00	0.006	24.923	102.72	0.0123	-0.0004	-0.0631	-0.0015	0.0756	29.09
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	0.0120	-0.0005	-0.0511	0.0008	0.0634	24.38
22	STINGER	-18.10	-19.46	0.00	-0.085	30.022	119.72	0.0117	-0.0006	-0.0597	-0.0071	0.0718	27.63
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	0.0114	-0.0008	-0.0104	-0.0139	0.0291	11.18
26	STINGER	-32.64	-28.26	0.15	-0.962	30.796	136.72	0.0111	-0.0009	0.0268	0.0005	0.0383	14.73
28	STINGER	-39.96	-32.47	0.26	-0.839	28.967	145.16	0.0107	-0.0010	0.0352	0.0031	0.0466	17.94
30	STINGER	-47.28	-36.36	0.36	-0.643	26.891	153.45	0.0105	-0.0012	0.0381	0.0035	0.0493	18.95
32	STINGER	-54.54	-39.87	0.43	-0.450	24.754	161.52	0.0102	-0.0013	0.0398	0.0034	0.0507	19.51
34	STINGER	-61.65	-42.99	0.47	-0.273	22.616	169.29	0.0100	-0.0014	0.0411	0.0032	0.0519	19.96
36	SAGBEND	-74.41	-47.81	0.50	0.007	18.686	182.93	0.0096	-0.0015	0.0433	0.0028	0.0538	20.69
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.027	195.13	0.0093	-0.0017	0.0450	0.0025	0.0553	21.26
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	0.0091	-0.0017	0.0464	0.0023	0.0565	21.72
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.343	219.53	0.0090	-0.0018	0.0471	0.0021	0.0571	21.95
40	SAGBEND	-122.14	-57.24	0.18	0.688	3.482	231.73	0.0089	-0.0018	0.0448	0.0010	0.0547	21.03
41	SEABED	-134.33	-57.62	0.04	0.524	0.409	243.93	0.0089	-0.0019	0.0208	-0.0078	0.0319	12.27
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	0.0089	-0.0019	-0.0004	-0.0013	0.0113	4.33
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	0.0089	-0.0019	0.0000	0.0001	0.0100	3.86
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	0.0089	-0.0019	0.0000	0.0000	0.0100	3.83
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:52:58 PAGE 56
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 6

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0001	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0001	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	-0.0001	0.0934	35.91
9	LAYBARGE	46.49	5.31	0.00	0.001	12.682	50.30	0.0135	0.0000	-0.0696	0.0001	0.0832	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	0.0133	0.0000	-0.0607	-0.0001	0.0740	28.46
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.495	74.24	0.0131	0.0000	-0.0748	-0.0020	0.0879	33.82
15	LAYBARGE	9.01	-6.41	0.00	0.016	21.677	89.61	0.0127	-0.0002	-0.0728	-0.0026	0.0856	32.94
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	0.0123	-0.0004	-0.0772	-0.0022	0.0897	34.51
20	STINGER	-10.68	-15.53	0.00	0.084	28.782	111.32	0.0120	-0.0005	-0.0717	0.0042	0.0841	32.34
22	STINGER	-18.01	-19.82	0.00	-0.392	31.650	119.82	0.0117	-0.0006	-0.0514	-0.0235	0.0684	26.31
24	STINGER	-25.20	-24.37	0.10	-1.055	32.261	128.32	0.0113	-0.0008	0.0169	-0.0022	0.0288	11.09
26	STINGER	-32.40	-28.79	0.24	-0.986	30.734	136.78	0.0110	-0.0009	0.0323	0.0029	0.0439	16.88
28	STINGER	-39.62	-32.93	0.35	-0.784	28.769	145.10	0.0107	-0.0011	0.0364	0.0036	0.0478	18.40
30	STINGER	-46.75	-36.68	0.43	-0.582	26.715	153.16	0.0104	-0.0012	0.0384	0.0036	0.0496	19.06
32	STINGER	-53.70	-40.02	0.49	-0.396	24.660	160.87	0.0102	-0.0013	0.0398	0.0034	0.0508	19.54
34	STINGER	-60.38	-42.95	0.53	-0.228	22.653	168.16	0.0100	-0.0014	0.0411	0.0032	0.0519	19.94
36	SAGBEND	-74.31	-48.16	0.55	0.076	18.368	183.04	0.0096	-0.0015	0.0435	0.0028	0.0539	20.74
37	SAGBEND	-86.00	-51.63	0.51	0.280	14.686	195.24	0.0093	-0.0017	0.0452	0.0024	0.0554	21.30
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	0.0091	-0.0017	0.0465	0.0022	0.0565	21.74
39	SAGBEND	-109.95	-56.23	0.32	0.619	6.986	219.64	0.0090	-0.0018	0.0471	0.0020	0.0570	21.93
40	SAGBEND	-122.10	-57.30	0.17	0.735	3.144	231.84	0.0089	-0.0018	0.0441	0.0005	0.0540	20.75
41	SEABED	-134.29	-57.63	0.03	0.464	0.269	244.04	0.0089	-0.0019	0.0163	-0.0096	0.0288	11.07
42	SEABED	-146.49	-57.63	0.00	-0.007	-0.016	256.24	0.0089	-0.0019	-0.0004	-0.0007	0.0108	4.15
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	0.0089	-0.0019	0.0000	0.0001	0.0100	3.85
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:52:58 PAGE 61
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 7

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0001	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0001	0.0811	31.19
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	-0.0001	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.001	12.677	50.30	0.0151	0.0000	-0.0714	0.0001	0.0864	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.531	61.71	0.0149	0.0000	-0.0622	-0.0001	0.0771	29.65
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.494	74.24	0.0146	0.0000	-0.0766	-0.0019	0.0913	35.12
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.727	89.61	0.0142	-0.0002	-0.0773	-0.0027	0.0916	35.24
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	0.0138	-0.0004	-0.0494	-0.0011	0.0635	24.41
20	STINGER	-10.61	-15.23	0.00	-0.018	26.375	111.12	0.0136	-0.0005	-0.0355	-0.0014	0.0494	19.00
22	STINGER	-18.17	-19.11	0.00	0.078	28.003	119.62	0.0133	-0.0006	-0.0411	0.0036	0.0548	21.09
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	0.0130	-0.0007	-0.0246	-0.0213	0.0459	17.64
26	STINGER	-33.01	-27.39	0.09	-0.910	29.217	136.62	0.0127	-0.0009	0.0213	-0.0017	0.0345	13.25
28	STINGER	-40.46	-31.43	0.21	-0.838	27.643	145.09	0.0124	-0.0010	0.0309	0.0027	0.0439	16.88
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	0.0121	-0.0011	0.0335	0.0032	0.0463	17.81
32	STINGER	-55.47	-38.68	0.39	-0.489	23.864	161.77	0.0118	-0.0012	0.0348	0.0031	0.0474	18.24
34	STINGER	-62.93	-41.83	0.44	-0.326	21.913	169.87	0.0116	-0.0013	0.0359	0.0029	0.0483	18.57
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	0.0113	-0.0015	0.0374	0.0026	0.0495	19.06
37	SAGBEND	-86.74	-49.92	0.48	0.110	15.516	195.02	0.0110	-0.0016	0.0387	0.0023	0.0506	19.46
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	0.0108	-0.0017	0.0398	0.0021	0.0515	19.82
39	SAGBEND	-110.57	-55.09	0.36	0.423	8.909	219.42	0.0106	-0.0018	0.0407	0.0019	0.0522	20.09
40	SAGBEND	-122.67	-56.62	0.26	0.562	5.515	231.62	0.0105	-0.0018	0.0409	0.0017	0.0523	20.13
41	SAGBEND	-134.84	-57.43	0.13	0.652	2.208	243.82	0.0105	-0.0018	0.0371	-0.0001	0.0485	18.67
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	0.0104	-0.0019	0.0079	-0.0093	0.0237	9.10
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	0.0104	-0.0019	-0.0003	-0.0002	0.0119	4.57
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	0.0104	-0.0019	0.0000	0.0000	0.0115	4.43
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 22:52:58 PAGE 66
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 8

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	-0.0001	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	-0.0001	0.0811	31.19
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	-0.0001	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	0.0151	0.0000	-0.0714	0.0001	0.0865	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0622	-0.0002	0.0771	29.64
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.498	74.24	0.0146	0.0000	-0.0768	-0.0020	0.0915	35.19
15	LAYBARGE	9.01	-6.41	0.00	0.014	21.700	89.61	0.0142	-0.0002	-0.0762	-0.0026	0.0906	34.83
18	STINGER	-3.02	-11.61	0.00	-0.011	24.909	102.72	0.0138	-0.0004	-0.0643	-0.0021	0.0784	30.14
20	STINGER	-10.64	-15.38	0.00	0.081	27.547	111.22	0.0136	-0.0005	-0.0530	0.0041	0.0669	25.75
22	STINGER	-18.10	-19.46	0.00	-0.381	29.913	119.72	0.0133	-0.0006	-0.0521	-0.0234	0.0706	27.15
24	STINGER	-25.41	-23.79	0.11	-1.013	30.574	128.22	0.0129	-0.0008	0.0154	-0.0020	0.0289	11.10
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	0.0126	-0.0009	0.0291	0.0027	0.0423	16.28
28	STINGER	-40.14	-32.00	0.34	-0.768	27.411	145.08	0.0123	-0.0010	0.0324	0.0032	0.0454	17.46
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	0.0121	-0.0011	0.0339	0.0032	0.0467	17.94
32	STINGER	-54.78	-39.00	0.49	-0.409	23.676	161.32	0.0118	-0.0013	0.0350	0.0031	0.0475	18.29
34	STINGER	-61.90	-41.99	0.53	-0.253	21.813	169.03	0.0116	-0.0014	0.0359	0.0029	0.0483	18.58
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	0.0112	-0.0015	0.0376	0.0026	0.0497	19.10
37	SAGBEND	-86.62	-50.27	0.54	0.193	15.159	195.13	0.0110	-0.0016	0.0389	0.0022	0.0507	19.51
38	SAGBEND	-98.48	-53.13	0.49	0.354	11.886	207.33	0.0108	-0.0017	0.0399	0.0020	0.0516	19.85
39	SAGBEND	-110.49	-55.29	0.40	0.502	8.535	219.53	0.0106	-0.0018	0.0407	0.0019	0.0523	20.11
40	SAGBEND	-122.60	-56.74	0.27	0.641	5.140	231.73	0.0105	-0.0018	0.0408	0.0017	0.0523	20.10
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.870	243.93	0.0104	-0.0018	0.0359	-0.0006	0.0473	18.20
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	0.0104	-0.0019	0.0051	-0.0092	0.0219	8.44
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	0.0104	-0.0019	-0.0003	-0.0001	0.0118	4.53
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0001	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0001	0.0811	31.19
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	-0.0001	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	0.0151	0.0000	-0.0714	0.0001	0.0865	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0622	-0.0002	0.0770	29.63
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	0.0146	0.0000	-0.0770	-0.0019	0.0916	35.23
15	LAYBARGE	9.01	-6.41	0.00	0.009	21.680	89.61	0.0142	-0.0002	-0.0754	-0.0028	0.0898	34.54
18	STINGER	-3.11	-11.67	0.00	0.025	25.260	102.82	0.0138	-0.0004	-0.0785	-0.0010	0.0925	35.60
20	STINGER	-10.68	-15.53	0.00	-0.056	28.845	111.32	0.0135	-0.0005	-0.0769	-0.0052	0.0907	34.88
22	STINGER	-18.02	-19.81	0.03	-0.586	30.957	119.82	0.0132	-0.0006	-0.0199	-0.0164	0.0393	15.11
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	0.0129	-0.0008	0.0220	-0.0007	0.0353	13.58
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	0.0126	-0.0009	0.0308	0.0028	0.0435	16.73
28	STINGER	-39.86	-32.26	0.38	-0.746	27.287	144.97	0.0123	-0.0010	0.0327	0.0032	0.0457	17.57
30	STINGER	-47.02	-35.82	0.46	-0.565	25.473	152.96	0.0121	-0.0012	0.0340	0.0031	0.0467	17.98
32	STINGER	-53.98	-39.00	0.52	-0.398	23.677	160.62	0.0118	-0.0013	0.0350	0.0030	0.0476	18.29
34	STINGER	-60.66	-41.81	0.56	-0.252	21.929	167.86	0.0116	-0.0013	0.0359	0.0028	0.0483	18.57
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.129	183.04	0.0112	-0.0015	0.0377	0.0025	0.0498	19.14
37	SAGBEND	-86.61	-50.48	0.56	0.216	14.946	195.24	0.0110	-0.0016	0.0390	0.0022	0.0508	19.54
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	0.0108	-0.0017	0.0400	0.0020	0.0517	19.88
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	0.0106	-0.0018	0.0408	0.0019	0.0523	20.13
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.916	231.84	0.0105	-0.0018	0.0407	0.0016	0.0522	20.08
41	SAGBEND	-134.79	-57.51	0.13	0.727	1.673	244.04	0.0104	-0.0019	0.0350	-0.0008	0.0464	17.84
42	SEABED	-146.98	-57.63	0.01	0.217	0.008	256.24	0.0104	-0.0019	0.0038	-0.0088	0.0210	8.09
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	0.0104	-0.0019	-0.0003	0.0000	0.0117	4.52
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	0.0104	-0.0019	0.0000	0.0000	0.0115	4.43
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42

Output Analisa Dinamis Heading 135°

Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:13:51 PAGE 31
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 1

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.688	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.527	61.71	0.0110	0.0000	-0.0586	-0.0002	0.0696	26.77
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.476	74.24	0.0107	0.0000	-0.0714	-0.0021	0.0822	31.60
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.741	89.61	0.0103	-0.0002	-0.0717	-0.0028	0.0822	31.61
18	STINGER	-2.94	-11.56	0.00	0.009	24.560	102.62	0.0100	-0.0004	-0.0466	-0.0013	0.0567	21.81
20	STINGER	-10.61	-15.23	0.00	0.001	26.381	111.12	0.0097	-0.0005	-0.0349	-0.0004	0.0448	17.23
22	STINGER	-18.17	-19.11	0.00	-0.010	27.963	119.62	0.0094	-0.0006	-0.0375	-0.0012	0.0472	18.17
24	STINGER	-25.62	-23.20	0.00	0.048	29.574	128.12	0.0091	-0.0007	-0.0356	0.0017	0.0451	17.33
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	0.0088	-0.0009	-0.0403	-0.0116	0.0510	19.61
28	STINGER	-40.17	-31.98	0.06	-0.704	31.723	145.12	0.0084	-0.0010	0.0143	-0.0058	0.0243	9.35
30	STINGER	-47.46	-36.36	0.16	-0.791	30.025	153.62	0.0081	-0.0012	0.0398	0.0018	0.0485	18.67
32	STINGER	-54.81	-40.40	0.25	-0.608	27.487	162.01	0.0078	-0.0013	0.0479	0.0035	0.0565	21.72
34	STINGER	-62.21	-44.02	0.32	-0.387	24.686	170.25	0.0076	-0.0014	0.0516	0.0036	0.0600	23.09
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.090	182.82	0.0072	-0.0016	0.0556	0.0033	0.0637	24.49
37	SAGBEND	-85.44	-52.53	0.35	0.189	15.345	195.02	0.0069	-0.0017	0.0586	0.0028	0.0664	25.54
38	SAGBEND	-97.33	-55.25	0.29	0.412	10.392	207.22	0.0067	-0.0018	0.0604	0.0025	0.0681	26.20
39	SAGBEND	-109.41	-56.92	0.18	0.594	5.394	219.42	0.0066	-0.0018	0.0588	0.0016	0.0663	25.50
40	SAGBEND	-121.59	-57.58	0.05	0.547	1.083	231.62	0.0065	-0.0019	0.0382	-0.0047	0.0460	17.69
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	0.0065	-0.0019	0.0001	-0.0019	0.0095	3.67
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	0.0065	-0.0019	-0.0001	0.0001	0.0078	3.02
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	0.0065	-0.0019	0.0000	0.0000	0.0077	2.95
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:13:51 PAGE 36
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 2

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0730	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.08
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	0.0110	0.0000	-0.0586	-0.0002	0.0696	26.75
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.481	74.24	0.0107	0.0000	-0.0717	-0.0022	0.0824	31.71
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.707	89.61	0.0103	-0.0002	-0.0705	-0.0029	0.0810	31.14
18	STINGER	-3.02	-11.61	0.00	0.014	24.929	102.72	0.0099	-0.0004	-0.0607	-0.0012	0.0709	27.26
20	STINGER	-10.64	-15.38	0.00	-0.016	27.545	111.22	0.0097	-0.0005	-0.0512	-0.0011	0.0611	23.51
22	STINGER	-18.10	-19.46	0.00	0.058	29.910	119.72	0.0094	-0.0006	-0.0516	0.0021	0.0613	23.59
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	0.0090	-0.0008	-0.0568	-0.0139	0.0678	26.06
26	STINGER	-32.48	-28.53	0.07	-0.835	33.462	136.72	0.0087	-0.0009	0.0096	-0.0060	0.0203	7.83
28	STINGER	-39.62	-33.14	0.19	-0.923	31.952	145.22	0.0084	-0.0011	0.0374	0.0019	0.0463	17.81
30	STINGER	-46.81	-37.43	0.29	-0.730	29.541	153.59	0.0080	-0.0012	0.0459	0.0036	0.0547	21.02
32	STINGER	-54.01	-41.29	0.37	-0.494	26.872	161.77	0.0078	-0.0013	0.0498	0.0038	0.0583	22.44
34	STINGER	-61.10	-44.68	0.42	-0.273	24.134	169.63	0.0075	-0.0014	0.0524	0.0036	0.0608	23.38
36	SAGBEND	-73.45	-49.59	0.44	0.058	19.212	182.93	0.0071	-0.0016	0.0562	0.0032	0.0643	24.72
37	SAGBEND	-85.13	-53.12	0.40	0.309	14.420	195.13	0.0069	-0.0017	0.0590	0.0028	0.0669	25.71
38	SAGBEND	-97.06	-55.65	0.31	0.528	9.440	207.33	0.0067	-0.0018	0.0606	0.0025	0.0682	26.23
39	SAGBEND	-109.16	-57.12	0.18	0.692	4.480	219.53	0.0066	-0.0018	0.0573	0.0011	0.0648	24.94
40	SEABED	-121.35	-57.62	0.04	0.536	0.556	231.73	0.0065	-0.0019	0.0276	-0.0077	0.0362	13.92
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.080	243.93	0.0065	-0.0019	-0.0006	-0.0012	0.0089	3.44
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	0.0065	-0.0019	0.0000	0.0001	0.0078	2.99
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	0.0065	-0.0019	0.0000	0.0000	0.0077	2.94
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.08
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.525	61.71	0.0110	0.0000	-0.0585	-0.0002	0.0695	26.73
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.488	74.24	0.0107	0.0000	-0.0719	-0.0021	0.0826	31.79
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.672	89.61	0.0103	-0.0002	-0.0691	-0.0029	0.0796	30.61
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	0.0099	-0.0004	-0.0756	-0.0013	0.0858	32.99
20	STINGER	-10.68	-15.53	0.00	-0.004	28.681	111.32	0.0097	-0.0005	-0.0650	-0.0006	0.0749	28.82
22	STINGER	-18.01	-19.82	0.00	0.005	32.074	119.82	0.0093	-0.0006	-0.0763	-0.0012	0.0860	33.06
24	STINGER	-25.10	-24.51	0.02	-0.498	34.327	128.32	0.0090	-0.0008	-0.0197	-0.0165	0.0351	13.49
26	STINGER	-32.12	-29.31	0.12	-1.014	33.808	136.82	0.0086	-0.0009	0.0287	-0.0009	0.0379	14.56
28	STINGER	-39.17	-33.85	0.24	-0.904	31.708	145.21	0.0083	-0.0011	0.0422	0.0031	0.0512	19.69
30	STINGER	-46.22	-38.00	0.34	-0.672	29.199	153.39	0.0080	-0.0012	0.0473	0.0039	0.0560	21.56
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	0.0077	-0.0013	0.0503	0.0039	0.0588	22.62
34	STINGER	-59.83	-44.83	0.45	-0.231	24.007	168.62	0.0075	-0.0014	0.0526	0.0036	0.0609	23.44
36	SAGBEND	-73.25	-50.08	0.46	0.124	18.640	183.04	0.0071	-0.0016	0.0566	0.0031	0.0646	24.86
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	0.0068	-0.0017	0.0593	0.0027	0.0671	25.81
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	0.0067	-0.0018	0.0606	0.0024	0.0682	26.22
39	SAGBEND	-109.04	-57.23	0.17	0.727	3.903	219.64	0.0066	-0.0018	0.0560	0.0005	0.0635	24.43
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	0.0065	-0.0019	0.0202	-0.0095	0.0298	11.45
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	0.0065	-0.0019	-0.0007	-0.0005	0.0085	3.27
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	0.0065	-0.0019	0.0000	0.0001	0.0077	2.97
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	0.0065	-0.0019	0.0000	0.0000	0.0077	2.94
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.760	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.92
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0001	0.0832	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	0.0133	0.0000	-0.0608	-0.0002	0.0741	28.51
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.487	74.24	0.0131	0.0000	-0.0747	-0.0021	0.0878	33.77
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.732	89.61	0.0127	-0.0002	-0.0752	-0.0028	0.0880	33.85
18	STINGER	-2.94	-11.56	0.00	0.012	24.547	102.62	0.0123	-0.0004	-0.0482	-0.0012	0.0607	23.35
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	0.0120	-0.0005	-0.0358	-0.0009	0.0481	18.48
22	STINGER	-18.17	-19.11	0.00	0.035	27.946	119.62	0.0117	-0.0006	-0.0375	0.0011	0.0495	19.05
24	STINGER	-25.62	-23.20	0.00	-0.151	29.647	128.12	0.0114	-0.0007	-0.0399	-0.0091	0.0526	20.24
26	STINGER	-32.96	-27.48	0.05	-0.649	30.322	136.62	0.0111	-0.0009	0.0034	-0.0091	0.0212	8.14
28	STINGER	-40.33	-31.71	0.16	-0.855	29.196	145.12	0.0108	-0.0010	0.0301	0.0009	0.0415	15.95
30	STINGER	-47.78	-35.71	0.26	-0.716	27.227	153.58	0.0105	-0.0011	0.0369	0.0029	0.0481	18.48
32	STINGER	-55.27	-39.39	0.34	-0.524	25.058	161.92	0.0102	-0.0013	0.0393	0.0031	0.0503	19.36
34	STINGER	-62.71	-42.70	0.40	-0.339	22.830	170.07	0.0100	-0.0014	0.0409	0.0030	0.0517	19.89
36	SAGBEND	-74.62	-47.27	0.44	-0.076	19.182	182.82	0.0096	-0.0015	0.0430	0.0027	0.0536	20.60
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.532	195.02	0.0094	-0.0016	0.0448	0.0023	0.0551	21.18
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	0.0092	-0.0017	0.0462	0.0021	0.0563	21.66
39	SAGBEND	-110.13	-55.87	0.30	0.487	7.872	219.42	0.0090	-0.0018	0.0471	0.0020	0.0570	21.93
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.990	231.62	0.0089	-0.0018	0.0456	0.0012	0.0554	21.33
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	0.0089	-0.0019	0.0274	-0.0058	0.0378	14.54
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	0.0089	-0.0019	0.0000	-0.0016	0.0116	4.45
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	0.0089	-0.0019	-0.0001	0.0001	0.0101	3.87
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:13:51 PAGE 51
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 5

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.92
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0001	0.0832	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.528	61.71	0.0133	0.0000	-0.0608	-0.0002	0.0741	28.50
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.492	74.24	0.0131	0.0000	-0.0749	-0.0021	0.0880	33.86
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.702	89.61	0.0127	-0.0002	-0.0740	-0.0027	0.0868	33.38
18	STINGER	-3.02	-11.61	0.00	0.005	24.923	102.72	0.0123	-0.0004	-0.0632	-0.0015	0.0757	29.11
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	0.0120	-0.0005	-0.0509	0.0005	0.0632	24.30
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	0.0117	-0.0006	-0.0587	-0.0058	0.0710	27.30
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	0.0114	-0.0008	-0.0097	-0.0132	0.0281	10.82
26	STINGER	-32.64	-28.26	0.15	-0.959	30.796	136.72	0.0111	-0.0009	0.0266	0.0001	0.0381	14.66
28	STINGER	-39.96	-32.47	0.26	-0.839	28.967	145.16	0.0107	-0.0010	0.0352	0.0028	0.0466	17.91
30	STINGER	-47.28	-36.36	0.36	-0.644	26.891	153.45	0.0105	-0.0012	0.0380	0.0032	0.0492	18.93
32	STINGER	-54.54	-39.87	0.43	-0.449	24.754	161.52	0.0102	-0.0013	0.0397	0.0032	0.0507	19.50
34	STINGER	-61.65	-42.99	0.47	-0.272	22.616	169.29	0.0100	-0.0014	0.0411	0.0030	0.0519	19.95
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.696	182.93	0.0096	-0.0015	0.0433	0.0026	0.0538	20.68
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.027	195.13	0.0093	-0.0017	0.0450	0.0022	0.0553	21.25
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	0.0091	-0.0017	0.0464	0.0020	0.0564	21.71
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.343	219.53	0.0090	-0.0018	0.0471	0.0019	0.0570	21.93
40	SAGBEND	-122.14	-57.24	0.18	0.687	3.481	231.73	0.0089	-0.0018	0.0448	0.0009	0.0546	21.02
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	0.0089	-0.0019	0.0207	-0.0076	0.0319	12.27
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	0.0089	-0.0019	-0.0004	-0.0012	0.0112	4.30
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	0.0089	-0.0019	0.0000	0.0001	0.0100	3.86
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:13:51 PAGE 56
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 6

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.92
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0832	31.99
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.528	61.71	0.0133	0.0000	-0.0607	-0.0002	0.0741	28.49
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.495	74.24	0.0131	0.0000	-0.0751	-0.0022	0.0882	33.93
15	LAYBARGE	9.01	-6.41	0.00	0.016	21.678	89.61	0.0127	-0.0002	-0.0730	-0.0027	0.0858	33.02
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	0.0123	-0.0004	-0.0773	-0.0021	0.0898	34.54
20	STINGER	-10.68	-15.53	0.00	0.085	28.782	111.32	0.0120	-0.0005	-0.0717	0.0037	0.0841	32.33
22	STINGER	-18.01	-19.82	0.00	-0.391	31.650	119.82	0.0117	-0.0006	-0.0514	-0.0216	0.0677	26.05
24	STINGER	-25.20	-24.37	0.11	-1.054	32.261	128.32	0.0113	-0.0008	0.0170	-0.0017	0.0288	11.07
26	STINGER	-32.40	-28.79	0.24	-0.982	30.734	136.78	0.0110	-0.0009	0.0323	0.0026	0.0439	16.88
28	STINGER	-39.62	-32.93	0.35	-0.785	28.769	145.10	0.0107	-0.0011	0.0364	0.0033	0.0478	18.39
30	STINGER	-46.75	-36.68	0.43	-0.581	26.715	153.16	0.0104	-0.0012	0.0384	0.0033	0.0496	19.06
32	STINGER	-53.70	-40.02	0.49	-0.393	24.660	160.87	0.0102	-0.0013	0.0398	0.0032	0.0508	19.54
34	STINGER	-60.38	-42.95	0.53	-0.226	22.653	168.16	0.0100	-0.0014	0.0411	0.0030	0.0519	19.94
36	SAGBEND	-74.31	-48.16	0.55	0.075	18.368	183.04	0.0096	-0.0015	0.0435	0.0026	0.0539	20.74
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	0.0093	-0.0017	0.0452	0.0022	0.0554	21.30
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	0.0091	-0.0017	0.0465	0.0020	0.0565	21.74
39	SAGBEND	-109.95	-56.23	0.32	0.620	6.986	219.64	0.0090	-0.0018	0.0471	0.0019	0.0570	21.93
40	SAGBEND	-122.10	-57.30	0.17	0.736	3.144	231.84	0.0089	-0.0018	0.0441	0.0005	0.0540	20.75
41	SEABED	-134.29	-57.63	0.03	0.460	0.268	244.04	0.0089	-0.0019	0.0163	-0.0095	0.0287	11.03
42	SEABED	-146.49	-57.63	0.00	-0.008	-0.016	256.24	0.0089	-0.0019	-0.0004	-0.0006	0.0107	4.12
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	0.0089	-0.0019	0.0000	0.0001	0.0100	3.85
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.18
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	0.0151	0.0000	-0.0714	0.0000	0.0865	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.531	61.71	0.0149	0.0000	-0.0623	-0.0002	0.0772	29.68
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.494	74.24	0.0146	0.0000	-0.0769	-0.0021	0.0916	35.22
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.726	89.61	0.0142	-0.0002	-0.0774	-0.0028	0.0918	35.31
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	0.0138	-0.0004	-0.0495	-0.0011	0.0635	24.44
20	STINGER	-10.61	-15.23	0.00	-0.019	26.375	111.12	0.0136	-0.0005	-0.0356	-0.0014	0.0494	19.00
22	STINGER	-18.17	-19.11	0.00	0.077	28.003	119.62	0.0133	-0.0006	-0.0411	0.0032	0.0548	21.08
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	0.0130	-0.0007	-0.0246	-0.0195	0.0447	17.20
26	STINGER	-33.01	-27.39	0.10	-0.908	29.218	136.62	0.0127	-0.0009	0.0213	-0.0013	0.0344	13.24
28	STINGER	-40.46	-31.43	0.21	-0.836	27.643	145.09	0.0124	-0.0010	0.0309	0.0024	0.0439	16.88
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	0.0121	-0.0011	0.0335	0.0029	0.0463	17.80
32	STINGER	-55.47	-38.68	0.39	-0.490	23.864	161.77	0.0118	-0.0012	0.0348	0.0028	0.0474	18.24
34	STINGER	-62.93	-41.83	0.44	-0.325	21.913	169.87	0.0116	-0.0013	0.0359	0.0027	0.0483	18.57
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	0.0113	-0.0015	0.0374	0.0024	0.0495	19.06
37	SAGBEND	-86.74	-49.92	0.48	0.109	15.516	195.02	0.0110	-0.0016	0.0387	0.0021	0.0506	19.46
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	0.0108	-0.0017	0.0398	0.0019	0.0515	19.82
39	SAGBEND	-110.57	-55.09	0.36	0.422	8.909	219.42	0.0106	-0.0018	0.0407	0.0018	0.0522	20.09
40	SAGBEND	-122.67	-56.62	0.26	0.563	5.515	231.62	0.0105	-0.0018	0.0409	0.0016	0.0523	20.13
41	SAGBEND	-134.84	-57.43	0.13	0.651	2.208	243.82	0.0104	-0.0018	0.0371	-0.0001	0.0485	18.67
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	0.0104	-0.0019	0.0079	-0.0089	0.0233	8.98
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	0.0104	-0.0019	-0.0003	-0.0002	0.0119	4.56
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	0.0104	-0.0019	0.0000	0.0000	0.0115	4.43
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.19
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0980	37.52
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	0.0151	0.0000	-0.0714	0.0000	0.0865	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0623	-0.0002	0.0771	29.67
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.498	74.24	0.0146	0.0000	-0.0771	-0.0021	0.0917	35.29
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.701	89.61	0.0142	-0.0002	-0.0764	-0.0026	0.0907	34.90
18	STINGER	-3.02	-11.61	0.00	-0.011	24.909	102.72	0.0138	-0.0004	-0.0644	-0.0021	0.0784	30.17
20	STINGER	-10.64	-15.38	0.00	0.081	27.547	111.22	0.0136	-0.0005	-0.0530	0.0037	0.0669	25.74
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	0.0133	-0.0006	-0.0522	-0.0216	0.0700	26.90
24	STINGER	-25.41	-23.79	0.10	-1.012	30.574	128.22	0.0129	-0.0008	0.0154	-0.0016	0.0288	11.09
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	0.0126	-0.0009	0.0291	0.0024	0.0423	16.27
28	STINGER	-40.14	-32.00	0.34	-0.767	27.411	145.08	0.0123	-0.0010	0.0324	0.0030	0.0454	17.46
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	0.0121	-0.0011	0.0339	0.0030	0.0466	17.94
32	STINGER	-54.78	-39.00	0.49	-0.410	23.676	161.32	0.0118	-0.0013	0.0350	0.0028	0.0475	18.28
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	0.0116	-0.0014	0.0359	0.0027	0.0483	18.58
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	0.0112	-0.0015	0.0376	0.0024	0.0497	19.11
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	0.0110	-0.0016	0.0389	0.0021	0.0507	19.51
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	0.0108	-0.0017	0.0399	0.0018	0.0516	19.85
39	SAGBEND	-110.49	-55.29	0.39	0.502	8.535	219.53	0.0106	-0.0018	0.0407	0.0017	0.0523	20.11
40	SAGBEND	-122.60	-56.74	0.27	0.640	5.140	231.73	0.0105	-0.0018	0.0408	0.0015	0.0523	20.10
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.870	243.93	0.0104	-0.0018	0.0359	-0.0006	0.0473	18.19
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	0.0104	-0.0019	0.0051	-0.0088	0.0216	8.31
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	0.0104	-0.0019	-0.0003	-0.0001	0.0118	4.53
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.19
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	0.0151	0.0000	-0.0714	0.0000	0.0865	33.26
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0622	-0.0002	0.0771	29.66
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	0.0146	0.0000	-0.0773	-0.0021	0.0919	35.35
15	LAYBARGE	9.01	-6.41	0.00	0.009	21.680	89.61	0.0142	-0.0002	-0.0756	-0.0029	0.0900	34.61
18	STINGER	-3.11	-11.67	0.00	0.023	25.260	102.82	0.0138	-0.0004	-0.0785	-0.0008	0.0925	35.58
20	STINGER	-10.68	-15.53	0.00	-0.056	28.845	111.32	0.0135	-0.0005	-0.0760	-0.0041	0.0898	34.56
22	STINGER	-18.02	-19.81	0.03	-0.585	30.956	119.82	0.0132	-0.0006	-0.0193	-0.0158	0.0385	14.82
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	0.0129	-0.0008	0.0219	-0.0005	0.0352	13.53
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	0.0126	-0.0009	0.0308	0.0026	0.0435	16.72
28	STINGER	-39.86	-32.26	0.38	-0.743	27.287	144.97	0.0123	-0.0010	0.0327	0.0030	0.0456	17.55
30	STINGER	-47.02	-35.82	0.46	-0.564	25.473	152.96	0.0121	-0.0012	0.0340	0.0030	0.0467	17.97
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	0.0118	-0.0013	0.0350	0.0028	0.0475	18.29
34	STINGER	-60.66	-41.81	0.56	-0.252	21.929	167.86	0.0116	-0.0013	0.0359	0.0027	0.0483	18.56
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.129	183.04	0.0112	-0.0015	0.0377	0.0024	0.0498	19.14
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	0.0110	-0.0016	0.0389	0.0020	0.0508	19.53
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	0.0108	-0.0017	0.0400	0.0018	0.0517	19.88
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	0.0106	-0.0018	0.0408	0.0017	0.0523	20.12
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.915	231.84	0.0105	-0.0018	0.0407	0.0015	0.0522	20.07
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	0.0104	-0.0019	0.0350	-0.0008	0.0464	17.84
42	SEABED	-146.98	-57.63	0.01	0.217	0.008	256.24	0.0104	-0.0019	0.0038	-0.0086	0.0208	8.00
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	0.0104	-0.0019	-0.0003	0.0000	0.0117	4.52
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42

Output Analisa Dinamis Heading 180°
Case 1 (Radius Curvature : 300 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0730	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.688	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.527	61.71	0.0110	0.0000	-0.0586	-0.0001	0.0696	26.76
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.476	74.24	0.0107	0.0000	-0.0714	-0.0018	0.0822	31.61
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.741	89.61	0.0103	-0.0002	-0.0717	-0.0025	0.0822	31.61
18	STINGER	-2.94	-11.56	0.00	0.009	24.560	102.62	0.0100	-0.0004	-0.0466	-0.0011	0.0567	21.82
20	STINGER	-10.61	-15.23	0.00	0.000	26.381	111.12	0.0097	-0.0005	-0.0349	-0.0004	0.0448	17.24
22	STINGER	-18.17	-19.11	0.00	-0.010	27.963	119.62	0.0094	-0.0006	-0.0375	-0.0011	0.0472	18.17
24	STINGER	-25.62	-23.20	0.00	0.048	29.574	128.12	0.0091	-0.0007	-0.0355	0.0017	0.0450	17.31
26	STINGER	-32.95	-27.50	0.00	-0.205	31.294	136.62	0.0088	-0.0009	-0.0400	-0.0113	0.0508	19.54
28	STINGER	-40.17	-31.98	0.06	-0.704	31.723	145.12	0.0084	-0.0010	0.0142	-0.0056	0.0242	9.31
30	STINGER	-47.46	-36.36	0.16	-0.790	30.025	153.62	0.0081	-0.0012	0.0397	0.0017	0.0485	18.65
32	STINGER	-54.81	-40.40	0.25	-0.608	27.487	162.01	0.0078	-0.0013	0.0479	0.0034	0.0565	21.71
34	STINGER	-62.21	-44.02	0.32	-0.387	24.686	170.25	0.0075	-0.0014	0.0516	0.0035	0.0600	23.09
36	SAGBEND	-73.83	-48.81	0.36	-0.071	20.090	182.82	0.0072	-0.0016	0.0556	0.0032	0.0637	24.49
37	SAGBEND	-85.44	-52.53	0.35	0.189	15.345	195.02	0.0069	-0.0017	0.0586	0.0028	0.0664	25.54
38	SAGBEND	-97.33	-55.25	0.29	0.412	10.392	207.22	0.0067	-0.0018	0.0604	0.0025	0.0681	26.19
39	SAGBEND	-109.41	-56.92	0.18	0.593	5.394	219.42	0.0066	-0.0018	0.0588	0.0016	0.0663	25.50
40	SAGBEND	-121.59	-57.58	0.05	0.547	1.083	231.62	0.0065	-0.0019	0.0382	-0.0047	0.0460	17.69
41	SEABED	-133.79	-57.63	0.00	0.006	-0.042	243.82	0.0065	-0.0019	0.0001	-0.0019	0.0095	3.66
42	SEABED	-145.99	-57.63	0.00	-0.002	0.000	256.02	0.0065	-0.0019	-0.0001	0.0001	0.0078	3.02
43	SEABED	-158.19	-57.63	0.00	0.000	0.000	268.22	0.0065	-0.0019	0.0000	0.0000	0.0077	2.95
44	SEABED	-170.39	-57.63	0.00	0.000	0.000	280.42	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
45	SEABED	-182.59	-57.63	0.00	0.000	0.000	292.62	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
46	SEABED	-194.79	-57.63	0.00	0.000	0.000	304.82	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 2 (Radius Curvature : 200 m; Tensioner : 15T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0730	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.07
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.526	61.71	0.0110	0.0000	-0.0585	-0.0001	0.0695	26.75
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.481	74.24	0.0107	0.0000	-0.0716	-0.0018	0.0824	31.69
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.708	89.61	0.0103	-0.0002	-0.0704	-0.0025	0.0809	31.12
18	STINGER	-3.02	-11.61	0.00	0.014	24.930	102.72	0.0099	-0.0004	-0.0607	-0.0010	0.0709	27.26
20	STINGER	-10.64	-15.38	0.00	-0.016	27.545	111.22	0.0097	-0.0005	-0.0512	-0.0011	0.0611	23.52
22	STINGER	-18.10	-19.46	0.00	0.058	29.910	119.72	0.0094	-0.0006	-0.0516	0.0021	0.0613	23.57
24	STINGER	-25.37	-23.86	0.00	-0.251	32.479	128.22	0.0090	-0.0008	-0.0566	-0.0136	0.0676	26.00
26	STINGER	-32.48	-28.53	0.07	-0.835	33.462	136.72	0.0087	-0.0009	0.0095	-0.0059	0.0203	7.80
28	STINGER	-39.62	-33.14	0.19	-0.924	31.952	145.22	0.0084	-0.0011	0.0373	0.0018	0.0463	17.79
30	STINGER	-46.81	-37.43	0.29	-0.730	29.542	153.59	0.0080	-0.0012	0.0459	0.0035	0.0546	21.02
32	STINGER	-54.01	-41.29	0.37	-0.494	26.872	161.77	0.0078	-0.0013	0.0498	0.0038	0.0583	22.43
34	STINGER	-61.10	-44.68	0.42	-0.272	24.134	169.63	0.0075	-0.0014	0.0524	0.0036	0.0608	23.38
36	SAGBEND	-73.45	-49.59	0.44	0.058	19.212	182.93	0.0071	-0.0016	0.0562	0.0031	0.0643	24.72
37	SAGBEND	-85.13	-53.12	0.40	0.309	14.420	195.13	0.0069	-0.0017	0.0590	0.0027	0.0668	25.71
38	SAGBEND	-97.06	-55.65	0.31	0.528	9.440	207.33	0.0067	-0.0018	0.0605	0.0024	0.0682	26.23
39	SAGBEND	-109.16	-57.12	0.18	0.693	4.480	219.53	0.0066	-0.0018	0.0573	0.0011	0.0648	24.94
40	SEABED	-121.35	-57.62	0.04	0.537	0.556	231.73	0.0065	-0.0019	0.0276	-0.0076	0.0362	13.91
41	SEABED	-133.55	-57.63	0.00	-0.006	-0.080	243.93	0.0065	-0.0019	-0.0006	-0.0011	0.0089	3.43
42	SEABED	-145.75	-57.63	0.00	-0.001	0.001	256.13	0.0065	-0.0019	0.0000	0.0001	0.0078	2.98
43	SEABED	-157.95	-57.63	0.00	0.000	0.000	268.33	0.0065	-0.0019	0.0000	0.0000	0.0077	2.94
44	SEABED	-170.15	-57.63	0.00	0.000	0.000	280.53	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 3 (Radius Curvature : 150 m; Tensioner : 15T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:20:22 PAGE 41
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 3

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.757	0.00	0.0117	0.0000	0.0000	0.0000	0.0117	4.49
3	LAYBARGE	84.28	10.94	0.00	0.000	3.720	12.05	0.0116	0.0000	-0.0720	0.0000	0.0836	32.17
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0115	0.0000	-0.0614	0.0000	0.0729	28.06
7	LAYBARGE	60.13	8.03	0.00	0.000	9.686	36.39	0.0114	0.0000	-0.0766	0.0000	0.0880	33.84
9	LAYBARGE	46.49	5.31	0.00	0.000	12.689	50.30	0.0112	0.0000	-0.0670	0.0000	0.0782	30.08
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.524	61.71	0.0110	0.0000	-0.0585	-0.0001	0.0695	26.72
13	LAYBARGE	23.44	-1.13	0.00	-0.028	18.487	74.24	0.0107	0.0000	-0.0719	-0.0018	0.0827	31.80
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.672	89.61	0.0103	-0.0002	-0.0691	-0.0025	0.0796	30.60
18	STINGER	-3.11	-11.67	0.00	0.011	25.325	102.82	0.0099	-0.0004	-0.0757	-0.0012	0.0858	33.00
20	STINGER	-10.68	-15.53	0.00	-0.004	28.681	111.32	0.0097	-0.0005	-0.0650	-0.0005	0.0749	28.81
22	STINGER	-18.01	-19.82	0.00	0.005	32.074	119.82	0.0093	-0.0006	-0.0761	-0.0009	0.0858	32.99
24	STINGER	-25.10	-24.51	0.02	-0.498	34.327	128.32	0.0090	-0.0008	-0.0196	-0.0163	0.0349	13.41
26	STINGER	-32.12	-29.31	0.12	-1.014	33.808	136.82	0.0086	-0.0009	0.0287	-0.0008	0.0378	14.55
28	STINGER	-39.17	-33.85	0.24	-0.903	31.708	145.21	0.0083	-0.0011	0.0422	0.0030	0.0512	19.69
30	STINGER	-46.22	-38.00	0.34	-0.672	29.199	153.39	0.0080	-0.0012	0.0473	0.0038	0.0560	21.56
32	STINGER	-53.15	-41.67	0.41	-0.439	26.593	161.23	0.0077	-0.0013	0.0503	0.0038	0.0588	22.62
34	STINGER	-59.83	-44.83	0.45	-0.231	24.007	168.62	0.0075	-0.0014	0.0526	0.0035	0.0609	23.44
36	SAGBEND	-73.25	-50.08	0.46	0.124	18.640	183.04	0.0071	-0.0016	0.0566	0.0031	0.0646	24.86
37	SAGBEND	-84.96	-53.49	0.41	0.370	13.819	195.24	0.0068	-0.0017	0.0593	0.0027	0.0671	25.81
38	SAGBEND	-96.92	-55.88	0.31	0.584	8.825	207.44	0.0067	-0.0018	0.0605	0.0023	0.0682	26.22
39	SAGBEND	-109.04	-57.23	0.17	0.727	3.903	219.64	0.0066	-0.0018	0.0560	0.0005	0.0635	24.43
40	SEABED	-121.23	-57.63	0.03	0.434	0.313	231.84	0.0065	-0.0019	0.0202	-0.0094	0.0298	11.44
41	SEABED	-133.43	-57.63	0.00	-0.011	-0.022	244.04	0.0065	-0.0019	-0.0007	-0.0005	0.0085	3.27
42	SEABED	-145.63	-57.63	0.00	0.000	0.001	256.24	0.0065	-0.0019	0.0000	0.0001	0.0077	2.97
43	SEABED	-157.83	-57.63	0.00	0.000	0.000	268.44	0.0065	-0.0019	0.0000	0.0000	0.0077	2.94
44	SEABED	-170.03	-57.63	0.00	0.000	0.000	280.64	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
45	SEABED	-182.23	-57.63	0.00	0.000	0.000	292.84	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94
46	SEABED	-194.43	-57.63	0.00	0.000	0.000	305.04	0.0065	-0.0019	0.0000	0.0000	0.0076	2.94

Case 4 (Radius Curvature : 300 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:20:22 PAGE 46
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 4

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.92
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0831	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	0.0133	0.0000	-0.0608	-0.0001	0.0741	28.51
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.487	74.24	0.0131	0.0000	-0.0748	-0.0018	0.0879	33.79
15	LAYBARGE	9.01	-6.41	0.00	0.012	21.732	89.61	0.0127	-0.0002	-0.0752	-0.0025	0.0880	33.84
18	STINGER	-2.94	-11.56	0.00	0.012	24.547	102.62	0.0123	-0.0004	-0.0482	-0.0011	0.0607	23.36
20	STINGER	-10.61	-15.23	0.00	-0.010	26.387	111.12	0.0120	-0.0005	-0.0358	-0.0009	0.0481	18.49
22	STINGER	-18.17	-19.11	0.00	0.035	27.946	119.62	0.0117	-0.0006	-0.0374	0.0010	0.0495	19.04
24	STINGER	-25.62	-23.20	0.00	-0.151	29.647	128.12	0.0114	-0.0007	-0.0397	-0.0089	0.0525	20.18
26	STINGER	-32.96	-27.48	0.05	-0.648	30.322	136.62	0.0111	-0.0009	0.0033	-0.0089	0.0211	8.10
28	STINGER	-40.33	-31.71	0.16	-0.855	29.196	145.12	0.0108	-0.0010	0.0301	0.0008	0.0414	15.94
30	STINGER	-47.78	-35.71	0.26	-0.716	27.227	153.58	0.0105	-0.0011	0.0369	0.0028	0.0480	18.48
32	STINGER	-55.27	-39.39	0.34	-0.525	25.058	161.92	0.0102	-0.0013	0.0393	0.0031	0.0503	19.36
34	STINGER	-62.71	-42.70	0.40	-0.339	22.829	170.07	0.0100	-0.0014	0.0409	0.0029	0.0517	19.89
36	SAGBEND	-74.62	-47.27	0.44	-0.076	19.182	182.82	0.0096	-0.0015	0.0430	0.0026	0.0535	20.60
37	SAGBEND	-86.26	-50.91	0.43	0.139	15.532	195.02	0.0094	-0.0016	0.0448	0.0023	0.0551	21.18
38	SAGBEND	-98.11	-53.79	0.38	0.320	11.751	207.22	0.0092	-0.0017	0.0462	0.0020	0.0563	21.65
39	SAGBEND	-110.13	-55.87	0.30	0.487	7.872	219.42	0.0090	-0.0018	0.0470	0.0019	0.0570	21.93
40	SAGBEND	-122.26	-57.13	0.18	0.626	3.990	231.62	0.0089	-0.0018	0.0456	0.0011	0.0554	21.32
41	SEABED	-134.45	-57.60	0.05	0.539	0.681	243.82	0.0089	-0.0019	0.0274	-0.0057	0.0378	14.53
42	SEABED	-146.65	-57.63	0.00	0.005	-0.025	256.02	0.0089	-0.0019	0.0000	-0.0016	0.0115	4.44
43	SEABED	-158.85	-57.63	0.00	-0.002	0.000	268.22	0.0089	-0.0019	-0.0001	0.0001	0.0101	3.87
44	SEABED	-171.05	-57.63	0.00	0.000	0.000	280.42	0.0089	-0.0019	0.0000	0.0000	0.0099	3.83
45	SEABED	-183.25	-57.63	0.00	0.000	0.000	292.62	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.45	-57.63	0.00	0.000	0.000	304.82	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 5 (Radius Curvature : 200 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:20:22 PAGE 51
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 5

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.92
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0832	31.98
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.529	61.71	0.0133	0.0000	-0.0608	-0.0001	0.0741	28.50
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.492	74.24	0.0131	0.0000	-0.0749	-0.0018	0.0880	33.85
15	LAYBARGE	9.01	-6.41	0.00	0.013	21.702	89.61	0.0127	-0.0002	-0.0739	-0.0024	0.0868	33.37
18	STINGER	-3.02	-11.61	0.00	0.005	24.923	102.72	0.0123	-0.0004	-0.0632	-0.0013	0.0757	29.11
20	STINGER	-10.64	-15.38	0.00	0.017	27.521	111.22	0.0120	-0.0005	-0.0509	0.0004	0.0632	24.29
22	STINGER	-18.10	-19.46	0.00	-0.084	30.023	119.72	0.0117	-0.0006	-0.0586	-0.0055	0.0708	27.24
24	STINGER	-25.38	-23.84	0.04	-0.602	31.505	128.22	0.0114	-0.0008	-0.0096	-0.0130	0.0279	10.75
26	STINGER	-32.64	-28.26	0.15	-0.959	30.796	136.72	0.0111	-0.0009	0.0266	0.0001	0.0381	14.65
28	STINGER	-39.96	-32.48	0.26	-0.839	28.967	145.16	0.0107	-0.0010	0.0352	0.0028	0.0466	17.91
30	STINGER	-47.28	-36.36	0.36	-0.644	26.891	153.45	0.0105	-0.0012	0.0380	0.0032	0.0492	18.93
32	STINGER	-54.54	-39.87	0.43	-0.449	24.754	161.52	0.0102	-0.0013	0.0397	0.0031	0.0507	19.50
34	STINGER	-61.65	-42.99	0.47	-0.272	22.616	169.29	0.0100	-0.0014	0.0411	0.0029	0.0519	19.95
36	SAGBEND	-74.41	-47.81	0.50	0.006	18.696	182.93	0.0096	-0.0015	0.0433	0.0026	0.0538	20.68
37	SAGBEND	-86.08	-51.35	0.48	0.215	15.027	195.13	0.0093	-0.0017	0.0450	0.0022	0.0552	21.25
38	SAGBEND	-97.96	-54.12	0.41	0.393	11.230	207.33	0.0091	-0.0017	0.0464	0.0020	0.0564	21.71
39	SAGBEND	-110.00	-56.09	0.31	0.558	7.342	219.53	0.0090	-0.0018	0.0471	0.0019	0.0570	21.93
40	SAGBEND	-122.14	-57.24	0.18	0.687	3.481	231.73	0.0089	-0.0018	0.0448	0.0009	0.0546	21.02
41	SEABED	-134.33	-57.62	0.04	0.523	0.409	243.93	0.0089	-0.0019	0.0207	-0.0075	0.0319	12.27
42	SEABED	-146.53	-57.63	0.00	-0.001	-0.019	256.13	0.0089	-0.0019	-0.0004	-0.0012	0.0112	4.29
43	SEABED	-158.73	-57.63	0.00	-0.001	0.000	268.33	0.0089	-0.0019	0.0000	0.0001	0.0100	3.86
44	SEABED	-170.93	-57.63	0.00	0.000	0.000	280.53	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
45	SEABED	-183.13	-57.63	0.00	0.000	0.000	292.73	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.33	-57.63	0.00	0.000	0.000	304.93	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
47	SEABED	-207.53	-57.63	0.00	0.000	0.000	317.13	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 6 (Radius Curvature : 150 m; Tensioner : 18T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:20:22 PAGE 56
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 6

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.759	0.00	0.0140	0.0000	0.0000	0.0000	0.0140	5.39
3	LAYBARGE	84.28	10.94	0.00	0.000	3.731	12.05	0.0140	0.0000	-0.0737	0.0000	0.0877	33.73
5	LAYBARGE	73.46	9.93	0.00	0.000	6.812	22.92	0.0139	0.0000	-0.0639	0.0000	0.0778	29.94
7	LAYBARGE	60.13	8.03	0.00	0.000	9.689	36.39	0.0137	0.0000	-0.0796	0.0000	0.0934	35.92
9	LAYBARGE	46.49	5.31	0.00	0.000	12.682	50.30	0.0135	0.0000	-0.0696	0.0000	0.0832	31.99
11	LAYBARGE	35.42	2.52	0.00	-0.001	15.528	61.71	0.0133	0.0000	-0.0607	-0.0001	0.0741	28.48
13	LAYBARGE	23.44	-1.13	0.00	-0.027	18.495	74.24	0.0131	0.0000	-0.0751	-0.0018	0.0882	33.93
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.677	89.61	0.0127	-0.0002	-0.0730	-0.0023	0.0858	33.01
18	STINGER	-3.11	-11.67	0.00	-0.011	25.285	102.82	0.0123	-0.0004	-0.0773	-0.0020	0.0898	34.55
20	STINGER	-10.68	-15.53	0.00	0.085	28.782	111.32	0.0120	-0.0005	-0.0717	0.0036	0.0841	32.34
22	STINGER	-18.01	-19.82	0.00	-0.391	31.650	119.82	0.0117	-0.0006	-0.0514	-0.0212	0.0676	26.01
24	STINGER	-25.20	-24.37	0.11	-1.053	32.261	128.32	0.0113	-0.0008	0.0170	-0.0016	0.0288	11.07
26	STINGER	-32.40	-28.79	0.24	-0.982	30.734	136.78	0.0110	-0.0009	0.0323	0.0025	0.0439	16.88
28	STINGER	-39.62	-32.93	0.35	-0.785	28.769	145.10	0.0107	-0.0011	0.0364	0.0032	0.0478	18.39
30	STINGER	-46.75	-36.68	0.43	-0.581	26.715	153.16	0.0104	-0.0012	0.0384	0.0033	0.0496	19.06
32	STINGER	-53.70	-40.02	0.49	-0.393	24.661	160.87	0.0102	-0.0013	0.0398	0.0031	0.0508	19.54
34	STINGER	-60.38	-42.95	0.53	-0.226	22.653	168.16	0.0100	-0.0014	0.0411	0.0029	0.0519	19.94
36	SAGBEND	-74.31	-48.16	0.55	0.075	18.368	183.04	0.0096	-0.0015	0.0435	0.0026	0.0539	20.74
37	SAGBEND	-86.00	-51.63	0.51	0.281	14.686	195.24	0.0093	-0.0017	0.0451	0.0022	0.0554	21.30
38	SAGBEND	-97.90	-54.33	0.43	0.457	10.879	207.44	0.0091	-0.0017	0.0465	0.0020	0.0565	21.74
39	SAGBEND	-109.95	-56.23	0.32	0.620	6.986	219.64	0.0090	-0.0018	0.0471	0.0018	0.0570	21.92
40	SAGBEND	-122.10	-57.30	0.17	0.736	3.144	231.84	0.0089	-0.0018	0.0441	0.0004	0.0540	20.75
41	SEABED	-134.29	-57.63	0.03	0.460	0.268	244.04	0.0089	-0.0019	0.0163	-0.0094	0.0287	11.02
42	SEABED	-146.49	-57.63	0.00	-0.008	-0.016	256.24	0.0089	-0.0019	-0.0004	-0.0006	0.0107	4.11
43	SEABED	-158.69	-57.63	0.00	-0.001	0.000	268.44	0.0089	-0.0019	0.0000	0.0001	0.0100	3.85
44	SEABED	-170.89	-57.63	0.00	0.000	0.000	280.64	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
45	SEABED	-183.09	-57.63	0.00	0.000	0.000	292.84	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82
46	SEABED	-195.29	-57.63	0.00	0.000	0.000	305.04	0.0089	-0.0019	0.0000	0.0000	0.0099	3.82

Case 7 (Radius Curvature : 300 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:20:22 PAGE 61
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 7

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.19
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.677	50.30	0.0151	0.0000	-0.0714	0.0000	0.0865	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.531	61.71	0.0149	0.0000	-0.0623	-0.0001	0.0772	29.68
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.494	74.24	0.0146	0.0000	-0.0769	-0.0018	0.0916	35.22
15	LAYBARGE	9.01	-6.41	0.00	0.011	21.727	89.61	0.0142	-0.0002	-0.0774	-0.0025	0.0918	35.30
18	STINGER	-2.94	-11.56	0.00	0.014	24.543	102.62	0.0138	-0.0004	-0.0495	-0.0010	0.0636	24.44
20	STINGER	-10.61	-15.23	0.00	-0.019	26.375	111.12	0.0136	-0.0005	-0.0356	-0.0013	0.0494	19.00
22	STINGER	-18.17	-19.11	0.00	0.077	28.003	119.62	0.0133	-0.0006	-0.0411	0.0031	0.0548	21.08
24	STINGER	-25.62	-23.20	0.00	-0.346	29.396	128.12	0.0130	-0.0007	-0.0246	-0.0191	0.0445	17.13
26	STINGER	-33.01	-27.39	0.10	-0.909	29.218	136.62	0.0127	-0.0009	0.0213	-0.0012	0.0344	13.24
28	STINGER	-40.46	-31.43	0.21	-0.837	27.643	145.09	0.0124	-0.0010	0.0309	0.0023	0.0439	16.88
30	STINGER	-47.96	-35.21	0.31	-0.666	25.790	153.49	0.0121	-0.0011	0.0335	0.0028	0.0463	17.80
32	STINGER	-55.47	-38.68	0.39	-0.489	23.864	161.77	0.0118	-0.0012	0.0348	0.0028	0.0474	18.24
34	STINGER	-62.93	-41.83	0.44	-0.325	21.913	169.87	0.0116	-0.0013	0.0359	0.0026	0.0483	18.57
36	SAGBEND	-75.08	-46.33	0.48	-0.085	18.680	182.82	0.0113	-0.0015	0.0374	0.0024	0.0495	19.06
37	SAGBEND	-86.74	-49.92	0.48	0.109	15.516	195.02	0.0110	-0.0016	0.0387	0.0021	0.0506	19.46
38	SAGBEND	-98.58	-52.84	0.44	0.274	12.253	207.22	0.0108	-0.0017	0.0398	0.0018	0.0515	19.82
39	SAGBEND	-110.57	-55.09	0.36	0.422	8.909	219.42	0.0106	-0.0018	0.0407	0.0017	0.0522	20.09
40	SAGBEND	-122.67	-56.62	0.26	0.563	5.515	231.62	0.0105	-0.0018	0.0409	0.0016	0.0523	20.13
41	SAGBEND	-134.84	-57.43	0.13	0.652	2.208	243.82	0.0104	-0.0018	0.0371	-0.0001	0.0485	18.67
42	SEABED	-147.04	-57.63	0.01	0.279	0.082	256.02	0.0104	-0.0019	0.0079	-0.0088	0.0233	8.96
43	SEABED	-159.24	-57.63	0.00	-0.007	-0.008	268.22	0.0104	-0.0019	-0.0003	-0.0002	0.0119	4.56
44	SEABED	-171.44	-57.63	0.00	0.000	0.000	280.42	0.0104	-0.0019	0.0000	0.0000	0.0115	4.43
45	SEABED	-183.64	-57.63	0.00	0.000	0.000	292.62	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.84	-57.63	0.00	0.000	0.000	304.82	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

Case 8 (Radius Curvature : 200 m; Tensioner : 20T)

OFFPIPE-3 OFFSHORE PIPELINE ANALYSIS SYSTEM - VERSION NO. - 3.02EX DATE - 6/17/2020 TIME - 23:20:22 PAGE 66
PROJECT - TUGAS AKHIR CLUSTER I PHE WMO 6.625 in JOB NO. - ANALISA DINAMIS
USER ID - A. MUHAMMAD AMRIL LICENSED BY - PT Timas Suplindo CASE 8

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.19
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	0.0151	0.0000	-0.0714	0.0000	0.0865	33.25
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0623	-0.0001	0.0771	29.67
13	LAYBARGE	23.44	-1.13	0.00	-0.026	18.497	74.24	0.0146	0.0000	-0.0772	-0.0018	0.0918	35.31
15	LAYBARGE	9.01	-6.41	0.00	0.015	21.700	89.61	0.0142	-0.0002	-0.0764	-0.0023	0.0907	34.90
18	STINGER	-3.02	-11.61	0.00	-0.011	24.909	102.72	0.0138	-0.0004	-0.0644	-0.0019	0.0785	30.18
20	STINGER	-10.64	-15.38	0.00	0.082	27.547	111.22	0.0136	-0.0005	-0.0530	0.0036	0.0669	25.74
22	STINGER	-18.10	-19.46	0.00	-0.380	29.913	119.72	0.0133	-0.0006	-0.0522	-0.0212	0.0699	26.87
24	STINGER	-25.41	-23.79	0.10	-1.013	30.574	128.22	0.0129	-0.0008	0.0154	-0.0015	0.0288	11.09
26	STINGER	-32.75	-28.02	0.23	-0.945	29.184	136.69	0.0126	-0.0009	0.0291	0.0023	0.0423	16.28
28	STINGER	-40.14	-32.00	0.34	-0.767	27.411	145.08	0.0123	-0.0010	0.0324	0.0029	0.0454	17.46
30	STINGER	-47.50	-35.67	0.43	-0.583	25.552	153.31	0.0121	-0.0011	0.0339	0.0029	0.0466	17.94
32	STINGER	-54.78	-39.00	0.49	-0.410	23.676	161.32	0.0118	-0.0013	0.0350	0.0028	0.0475	18.28
34	STINGER	-61.90	-41.99	0.53	-0.254	21.813	169.03	0.0116	-0.0014	0.0359	0.0026	0.0483	18.58
36	SAGBEND	-74.94	-46.76	0.56	0.001	18.335	182.93	0.0112	-0.0015	0.0376	0.0024	0.0497	19.11
37	SAGBEND	-86.62	-50.27	0.54	0.192	15.159	195.13	0.0110	-0.0016	0.0389	0.0020	0.0507	19.51
38	SAGBEND	-98.48	-53.13	0.48	0.354	11.886	207.33	0.0108	-0.0017	0.0399	0.0018	0.0516	19.85
39	SAGBEND	-110.49	-55.29	0.39	0.502	8.535	219.53	0.0106	-0.0018	0.0407	0.0017	0.0523	20.11
40	SAGBEND	-122.60	-56.74	0.27	0.640	5.140	231.73	0.0105	-0.0018	0.0408	0.0015	0.0522	20.09
41	SAGBEND	-134.77	-57.48	0.13	0.713	1.870	243.93	0.0104	-0.0018	0.0359	-0.0006	0.0473	18.19
42	SEABED	-146.97	-57.63	0.01	0.231	0.028	256.13	0.0104	-0.0019	0.0051	-0.0087	0.0215	8.28
43	SEABED	-159.17	-57.63	0.00	-0.007	-0.005	268.33	0.0104	-0.0019	-0.0003	0.0000	0.0118	4.53
44	SEABED	-171.37	-57.63	0.00	0.000	0.000	280.53	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.57	-57.63	0.00	0.000	0.000	292.73	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.77	-57.63	0.00	0.000	0.000	304.93	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41
47	SEABED	-207.97	-57.63	0.00	0.000	0.000	317.13	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

Case 9 (Radius Curvature : 150 m; Tensioner : 20T)

MAXIMUM DYNAMIC PIPE FORCES AND STRAINS

NODE NO.	PIPE SECTION	X COORD (M)	Y COORD (M)	Z COORD (M)	HORIZ ANGLE (DEG)	VERT ANGLE (DEG)	PIPE LENGTH (M)	TENSILE STRAIN (PCT)	HOOP STRAIN (PCT)	BENDING STRAINS VERT (PCT)	BENDING STRAINS HORIZ (PCT)	TOTAL STRAIN (PCT)	PERCNT ALLOW (PCT)
1	TENSIONR	96.32	11.51	0.00	0.000	2.761	0.00	0.0156	0.0000	0.0000	0.0000	0.0156	5.99
3	LAYBARGE	84.28	10.94	0.00	0.000	3.738	12.05	0.0155	0.0000	-0.0749	0.0000	0.0904	34.77
5	LAYBARGE	73.46	9.93	0.00	0.000	6.813	22.92	0.0154	0.0000	-0.0656	0.0000	0.0811	31.19
7	LAYBARGE	60.13	8.03	0.00	0.000	9.691	36.39	0.0153	0.0000	-0.0817	0.0000	0.0970	37.30
9	LAYBARGE	46.49	5.31	0.00	0.000	12.678	50.30	0.0151	0.0000	-0.0714	0.0000	0.0865	33.26
11	LAYBARGE	35.42	2.52	0.00	-0.002	15.530	61.71	0.0149	0.0000	-0.0622	-0.0001	0.0771	29.66
13	LAYBARGE	23.44	-1.13	0.00	-0.025	18.501	74.24	0.0146	0.0000	-0.0773	-0.0017	0.0919	35.35
15	LAYBARGE	9.01	-6.41	0.00	0.009	21.680	89.61	0.0142	-0.0002	-0.0756	-0.0026	0.0899	34.59
18	STINGER	-3.11	-11.67	0.00	0.024	25.260	102.82	0.0138	-0.0004	-0.0785	-0.0007	0.0925	35.57
20	STINGER	-10.68	-15.53	0.00	-0.056	28.845	111.32	0.0135	-0.0005	-0.0758	-0.0039	0.0897	34.51
22	STINGER	-18.02	-19.81	0.03	-0.585	30.956	119.82	0.0132	-0.0006	-0.0192	-0.0157	0.0384	14.76
24	STINGER	-25.31	-24.18	0.15	-1.023	30.613	128.32	0.0129	-0.0008	0.0218	-0.0004	0.0352	13.52
26	STINGER	-32.59	-28.37	0.27	-0.922	29.063	136.72	0.0126	-0.0009	0.0308	0.0025	0.0435	16.72
28	STINGER	-39.86	-32.26	0.38	-0.743	27.287	144.97	0.0123	-0.0010	0.0327	0.0029	0.0456	17.55
30	STINGER	-47.02	-35.82	0.46	-0.564	25.473	152.96	0.0121	-0.0012	0.0339	0.0029	0.0467	17.97
32	STINGER	-53.98	-39.00	0.52	-0.399	23.677	160.62	0.0118	-0.0013	0.0350	0.0028	0.0475	18.29
34	STINGER	-60.66	-41.81	0.55	-0.252	21.929	167.86	0.0116	-0.0013	0.0359	0.0026	0.0483	18.56
36	SAGBEND	-74.91	-47.01	0.58	0.025	18.128	183.04	0.0112	-0.0015	0.0377	0.0023	0.0498	19.14
37	SAGBEND	-86.61	-50.48	0.56	0.215	14.946	195.24	0.0110	-0.0016	0.0389	0.0020	0.0508	19.53
38	SAGBEND	-98.48	-53.29	0.50	0.375	11.667	207.44	0.0108	-0.0017	0.0400	0.0018	0.0517	19.87
39	SAGBEND	-110.49	-55.41	0.40	0.522	8.311	219.64	0.0106	-0.0018	0.0408	0.0017	0.0523	20.12
40	SAGBEND	-122.61	-56.81	0.28	0.660	4.915	231.84	0.0105	-0.0018	0.0407	0.0015	0.0522	20.07
41	SAGBEND	-134.79	-57.51	0.13	0.728	1.673	244.04	0.0104	-0.0019	0.0350	-0.0008	0.0464	17.84
42	SEABED	-146.98	-57.63	0.01	0.217	0.008	256.24	0.0104	-0.0019	0.0038	-0.0085	0.0207	7.98
43	SEABED	-159.18	-57.63	0.00	-0.007	-0.004	268.44	0.0104	-0.0019	-0.0003	0.0000	0.0117	4.51
44	SEABED	-171.38	-57.63	0.00	0.000	0.000	280.64	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
45	SEABED	-183.58	-57.63	0.00	0.000	0.000	292.84	0.0104	-0.0019	0.0000	0.0000	0.0115	4.42
46	SEABED	-195.78	-57.63	0.00	0.000	0.000	305.04	0.0104	-0.0019	0.0000	0.0000	0.0115	4.41

A.Muhammad Amril lahir di Jakarta pada tanggal 14 Oktober 1998. Penulis merupakan anak ketiga dari tiga bersaudara. Penulis mempunyai orang tua bernama Andi Pahril Pawi dan Andi Amnah. Selain itu penulis mempunyai dua orang kakak bernama Andi Anugrah Pawi dan Andi Bayu Wiraditya Pawi. Pada jenjang taman kanak-kanak, penulis bersekolah di TK Angkasa IV Jakarta. Lalu penulis melanjutkan ke jenjang sekolah dasar di SDN 01 Cipinang Melayu, Jakarta. Lalu penulis melanjutkan sekolah di SMPN 109 Jakarta. Pada jenjang sekolah menengah atas penulis sempat bersekolah di SMAN 42 Jakarta. Selama masa SMA penulis mengikuti ekstrakulikuler bola basket. Setelah lulus dari SMA, penulis diterima di Departemen Teknik Kelautan Institut Teknologi Sepuluh Nopember (ITS) Surabaya. Penulis diterima melalui jalur ujian tulis Seleksi Nasional Masuk Perguruan Tinggi Negeri (SNMPTN) 2016. Selama menjadi mahasiswa penulis aktif mengikuti berbagai kegiatan kepanitiaan, organisasi ekstra kampus maupun lomba yang diadakan organisasi kampus. Pada tahun pertama kuliah penulis mulai aktif mengikuti berbagai kegiatan mahasiswa seperti menjadi volunteer Ocean Engineering Exhibition and Competition (OCEANO) 2017. Pada tahun kedua kuliah, penulis menjadi staf Departemen Kajian Strategis Himatekla 2017/2018, staf Departemen Event NACE SC ITS 2017/2018, dan staf Keamanan OCEANO 2018. Penulis juga pernah menjadi salah satu staf pada PETROLIDA SPE ITS SC 2018. Pada tahun ketiga kuliah penulis diamanatkan menjadi Project Officer OCEANO 2019. Pada tahun ketiga ini juga penulis menjadi Deputy Head of Event NACE SC ITS 2018/2019 dan melakukan kerja praktik di PT PHE WMO. Pada tahun ketiga juga penulis menyempatkan diri untuk mengikuti lomba pada Indo Ocean Expo 2019 yang diselenggarakan oleh KMKL ITB yaitu Oil Rig Design Competition. Pada tahun keempat penulis mengambil tugas akhir dalam bidang perencanaan dan perancangan pipa bawah laut. Judul tugas akhir penulis adalah "ANALISIS TEGANGAN PIPA DAN *CONCRETE CRUSHING* PADA INSTALASI *OFFSHORE PIPELINE* MENGGUNAKAN METODE S-LAY. STUDI KASUS: PT. PHE WMO". Selama pengerjaan tugas akhir tersebut penulis dibimbing oleh bapak Ir. Imam Rochani, M.Sc. dan bapak Ir. Handayanu, M.Sc., Ph.D.

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