PUSH OVER ANALYSIS OF UNIFORM CORRSION DAMAGED ON FIXED-JACKET STRCUTURE

By

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Dissertation submitted in partial fulfilment of
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CERTIFICATION OF APPROVAL

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Approved by,

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(Dr. Do Kyun Kim)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2015

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgement, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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ZULHELMY BIN ZA’ABA

ABSTRACT

Oil and gas industry has been one of the major industries in the world nowadays. The exploration of the oil and gas has been started between the ranges of 1800s to 1900s. Since then the business of oil and gas has been improving from time to time. As the year goes on, many of the offshore platforms are still operating and was build years ago and was build in an outdated criteria. Regarding the condition of the platform, the condition assessment need to be done according to the damages that was course by the corrosion and will be analyze in this study. SACS 5.3 software will be used in this study. The primary goal of this study is to study the effect of average mean corrosion and severe mean corrosion to the platform. In this study, collapse analysis will be adopted to get the ultimate strength and the reserve strength ratio (RSR) of the platform.

ACKNOWLEDGEMENT

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1. INTRODUCTION

1.1. **Background: Overview of jacket platform in Malaysia**.

In oil and gas field, fixed offshore structure has been commonly used especially for shallow water with depth less than 500m. Most of the structure is constructed by steel. The performance and robustness of the structure has made the use of the platform more than their original design lives (Chakrabarti, 2005). In the year 2010, it is estimated that 1733 offshore structures in Asia Pacific with Indonesia and Malaysia leading in number (Zawawi et al., 2012).

There are roughly 300 shallow water fixed platforms that are installed in Malaysia. That is operated in various regions that are Peninsular Malaysia Operation (PMO), Sarawak Operation (SKO) and Sabah Operation (SBO). Roughly most of the platforms in Malaysia are shallow water with the water depth of 50 – 70 m, especially in Peninsular Malaysia (Zawawi et al., 2012). Most of the facilities that are operated in Malaysia are fixed jacket platform whether it is drilling, wellhead, living quarters, production, riser and vent.

Fixed offshore platform or jacket platform is mainly made of turbular member steel framed structure. Chakrabarti, (2005), stated it got the name “jacket” because all of the well conductors arrangement within the substructure as a protection to them. API RP2A WSD is the mostly used design code (Idrus et al., 2011). In Malaysia oil and gas, they have their own standard that is PTS 34.19.10.13 that are owned by the PETRONAS (PETRONAS, 2012).

Corrosion is one of the worst threats to the structural integrity of ships and offshore structure. In a long time, many theoretical ways or approach has been used to determine the reliability and the strength of the corrode structure (White and Ayyub, 1992). Usually corrosion always has been presume that it is linearly with time. Usually in predecting the uncertainies of the residual strength of corrode structure, it mostly are effect depending on the variability of the plate thickness (Soares, 1998).

In what has been mention earlier many research on the corrosion effect to the ships and offshore structure has been done by this researcher. A Time-dependent residual ultimate longitudinal strength - grounding damage index (R-D) diagram was conducted by kim et al. (2014). Research that has been done by Melchers (2005) on the effect of corrosion to the steel platform. Also not to forget GUEDES SCARES et al. (2005) on studying the behavior of the corrosion due to the effect of the different marine environmental factors.

The same as the other platform, all of the jacket platform are affected by the environmental loads that are wind, wave and current. For this study it will focus on determining the efficient for decommissioning of fixed platform jacket and fixed the platform. For that, in this research, software SACS 5.3 will be used especially on Collapse Analysis to get reserved strength ratio (RSR) not to forget also the corrosion model for getting the RSR. By getting the RSR we may be able to get the ultimate strength of the platform also effective time by using numerical method.

1.2. Problem Statement

For every offshore platform structure it has their own loading, support condition and also different environmental load depend on it region of the platform. As stated by Paik and Thayamballi (2007) that the ultimate strength of the structure is vary from each of them depending on certain criteria and it behaviors also depend on variety of influence factor such as geometric properties, loading characteristic and boundary conditions.

Corrosion related problems are one of the major leading problem factor for age-related structural degradation of offshore structure and many other types of steel structure. In the view of safety corrosion can cause harm that is lead to thickness penetration, fatigue crack, brittle fracture and unstable failure. All of this failure may lead to loss of human lives and risk of polluting the environmental depend in the ship type (Carlos Soares et al., 2009).

Under these circumstances it needs to be reassessment as it is subjected to the corrosion effect. Analysis will be conducted to acknowledge which part of the jacket structure will be affected the most by the corrosion. Corrosion damage that is affecting the jacket structure during the 25 years will also is considering (Bai et al., 2015).

1.3. Objective

The objective of this study is to study the effect and compare the result of average and severe mean corrosion from Paik 2003 with the corrosion data from Paik 1998 to the platform. Also to see which angle of the platform affected the most.

1.4. Scope of Study

Throughout the study, SACS 5.3 software is used for performing the Collapse analysis on the corrosion model or platform. First and foremost, the scope is using the 100 years environmental wave data from Samarang field.

2. LITERATURE REVIEW

2.1. Historical Development

The first offshore oil wells were drilled from extended piers into water of Pacific Ocean offshore Summerland, California in the 1890's and offshore Baku, Azerbaijan in the Caspian Sea in 1923 (Fadly, 2011). However the beginning of the offshore is considered as in 1947 where the first fixed platform was successfully installed in the coast of Louisiana. Since then, the offshore industry has seen much innovative structure, whether in fixed or floating that are placed in gradually deeper waters and in more aggressive environment.

More than 10,000 offshore platforms of various types and sized has already been constructed and installed worldwide since 1946. New crude oil discoveries have been made in increasingly deeper water and in 2003, 3% of the world's oil and gas supply came from deepwater (>305m) offshore production (Westwood, 2003). In the next 15 years this project can grow to 10%. The oil will come from deep and ultra-deepwater production from three offshore areas, which are known as the Golden Triangle; the Gulf of Mexico, West Africa and Brazil (Chakrabarti, 2005).

2.2. Structural Integrity Assessment

According to ISO (2004), it is the owner responsibility to maintain and demonstrate the fitness of purpose of the platform for the particular site and operating conditions. The goal is to demonstrate that the annual probability of failure is sufficiently low. The acceptable annual probability depends on regulatory requirements supplemented by regional or industry standards and practices. The ISO 19902 clearly states that the design fundamentals for existing structures allows for accepting limited damage to individual components, provided that both the reserve against overall system failure and deformation remain acceptable. The standard is for the application of existing jacket substructure, but could also be applied for topsides structures (ISO 19902, 2004). An ultimate strength analysis is to demonstrate adequate structural strength and stability to withstand a significant overload, with respect to the applied load. Potential local damages and local overstress are allowed, but excessive deformations and total collapse are to be avoided. Reserve strength ratio (RSR) is determined for typically eight directions and the lowest value obtained are the RSR.

For design of fixed offshore structure in the United States API (2007), are the commonly used standards. However, the standard is only focusing on existing offshore standard that takes assessment to a detailed level. The standard is stated to be applicable only for the assessment of platforms, which were designed according to the 20th or earlier editions of the same API standard and structures designed after the 21st edition, should be assessed according to the criteria originally used for the design. By this clause, API is limiting the possibility for using assessment of existing platform to minimize the structural cost.

API (2000) mentioned there are two potential analysis checks; there are a design level analysis and an ultimate strength analysis. The analysis is quite the same as in ISO 19902, but the criteria for acceptance are different. The procedure for design level analysis are similar to those used for new platform design, including the application of all safety factors, the use of characteristic rather than mean yield stress. In the ultimate strength analysis, the reserve strength ratio (RSR) is defined as the ratio of platform collapse load to its 100-year environmental condition lateral loading.

2.3. Application of Ultimate Strength Analysis

According Dalane (1996), Environmental loads of wind, waves and current are not likely to occur simultaneously, which calls for joint probability. In pushover analysis using USFOS, the larger load is assumed to occur as the largest wave that is passed through the structure. Reliability analysis is to estimate the annual probability of failure that the load exceeds resistance. Based on Dalane (1996), study as long as the wave crest does not reach the deck level, there will be no threat to structural safety. Structural failure depends if the probability of failure increase with the increase of subsidence as well as the increase of impact area.

Choi (2007), presented in his book that the study of structural reliability is concerned with the calculation and prediction of the probability of limit-state violations at any stage during a structure's life. Once the probability is determined, the next goal is to choose the design alternatives that improve structural reliability and minimize the risk of failure. He discussed probabilistic analysis to characterize structural reliability and its methods that includes first and second-order reliability methods, (FORM and SORM) and Monte Carlo Sampling. The structure is considered unreliable if the failure probability of the structure limit-state exceeds the required value. Ultimate limit-state is the structural collapse that involves corrosion, fatigue, deterioration, fire, plastic mechanism, progressive collapse and fracture. Since it may risk the loss of life and major financial loss, is should have a very low probability of occurrence. As for serviceability limit-state, it is a disruption of a normal use of a structure that involves excessive deflection and vibration, drainage, leakage and local damage. It encompasses less danger than ultimate limit state; therefore higher probability of occurrence may be tolerated. The safety index approach in reliability analysis is actually a mathematical optimization problem for finding the point on the structural response surface that has the shortest distance from the origin to the surface in the standard normal space.

Pueksap-anan (2010)**,** studied the sensitivity of RSR with respect to water depth, topside payload, jacket side diagonal bracing scheme and jacket leg batter. He also identified the critical structural members and joints to platform structure failures. Metocean (meteorology and oceanography) loading used in the analysis include storm wave height, wave periods, storm wind spends, gust condition, tides, current and earthquake. However the most important parameters are wave, wind and current. Other loadings include gravity load, which is the selfweight of jacket, miscellaneous dead load, live load, and environmental load which uses the Morison Equation and Stoke's 5th Order according to API RP 2A WSD. In determining the ultimate strength of the offshore platform, non-linear static pushover analysis applies. The environmental load is incremented until the structure collapse. The global failure in indicated by load-deflection curve obtained from the analysis. The results from the pushover analysis are used to derive the formulas for predicting a platform RSR by regression analysis. Based on this study, it is determined that the base shear generated for lower water depth is larger than the base shear at deeper water depth.

Fadly (2011), studied the relationship between the return period and the reliability index of typical jacket platforms in three Malaysian offshore regions by using pushover analysis and simplified structural reliability assessment (SSRA). The study showed that the establish and incorporation of bracing type factor with respect to repeated analysis into SSRA calculation might improve the reliability index estimations since X-braced structures are more robust than K-braced structures.

2.4. Corrosion effect on structures

Corrosion of steel in marine environmental is a complicated aspect that depends on environmental and material factors. There are usually two critical design criteria that are strength capacity and integrity for structural system such as offshore platform and ships. (Melchers, 2005). As stated by Melchers the first one is basically is a function of material loss due to pitting corrosion. As for the second one it is quite localized and in particular due to pitting corrosion and both of them are considered as structural capacity perspective.

For structural capacity it is usually depends on the cross-sectional dimensions of the structural member (Melchers, 2005). In figure 1(a), the axial member of cross-sectional area A are under axial stress σ and surrounded by sea water.

$$R(t) = \sigma\,[A - P.c(t)] \tag{1}$$

Where corrosion loss $c(t)$ is a function of time and P is the perimeter area exposed to seawater. For plate bending with a possible corrosion on both side of the plate, the bending resistance become

$$R(t) = k\,.\,\sigma_b\,.\,[d(t)]^2 = k\,.\,\sigma_b\,.\,[d_0 - 2\,.\,c(t)]^2 \tag{2}$$

Where d_0 is the initial thickness of the plate, $d(t)$ is the remaining thickness, σ_b is the maximum stress imposed by bending fracture, k = 0.25 for elastic-plastic material response and 0.167 for elastic response (Fig. 1b).

When considering the strength in ductile (plastic) structure. It is acceptable to obtain $c(t)$ from weight-loss measurements or estimation of the corrosion depth, averaged over a local surface area. Local maximum of $c(t)$ at the point of maximum local stress is required when local stress is intensity and cause local rupture, as in brittle material (Melchers, 2005).

As for pitting (Fig. 1c), remaining thickness (d_0) of a plate of initial thickness ($d(t)$) is given by

$$d(t) = d_0 - d_p(t) \tag{3}$$

Where $d_p(t)$ is the maximum depth at time t. Since the first pit will cause perforation, the maximum probable pit depth is required. Occurs when $d(t) \rightarrow 0$, (Melchers, 2005).

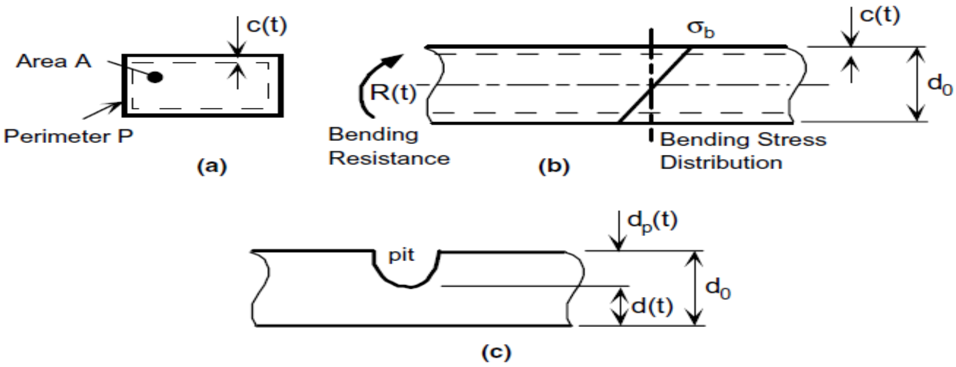

Figure 1. (a) Cross-section of a bar under axial stress showing corrosion loss, (b) cross-section of a plate under bending stress showing effect of corrosion and (c) cross-section of a plate subject to pitting from one side (Melchers, 2005).

2.5. Classification of Oil Well Tube Corrosion

Commonly they are several type of corrosion that is related to the offshore steel structure (Fig.2). However for subsea oil well tube structures are different, there are five types: Which are (Hairil Mohd & Paik, 2013)

- Ring Corrosion
- Line Corrosion
- General Corrosion
- Isolated Corrosion
- Hole Corrosion

It is shown in Figure 3.

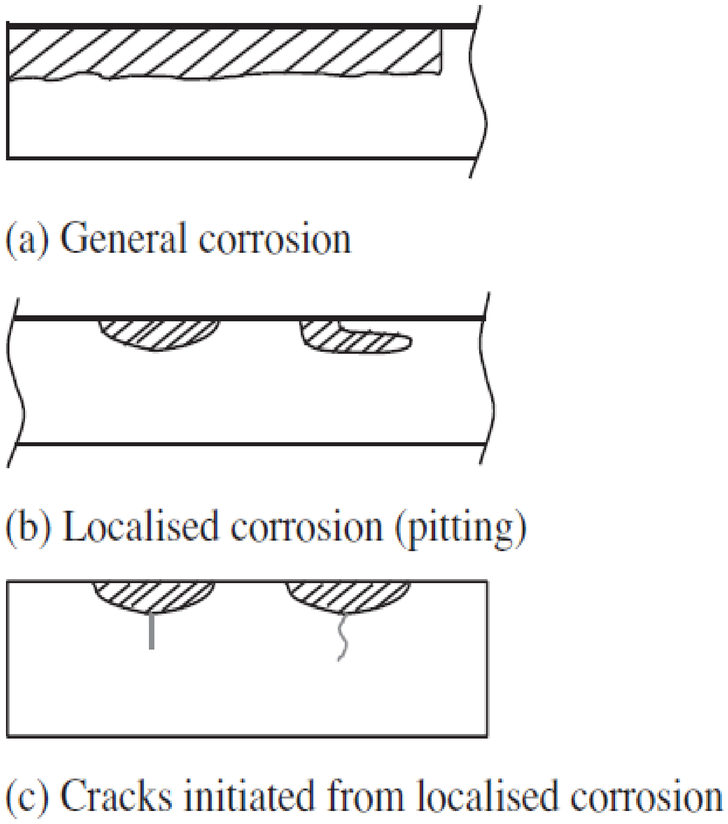

Figure 2. Typical types of corrosion of marine steel structures (Hairil Mohd & Paik, 2013).

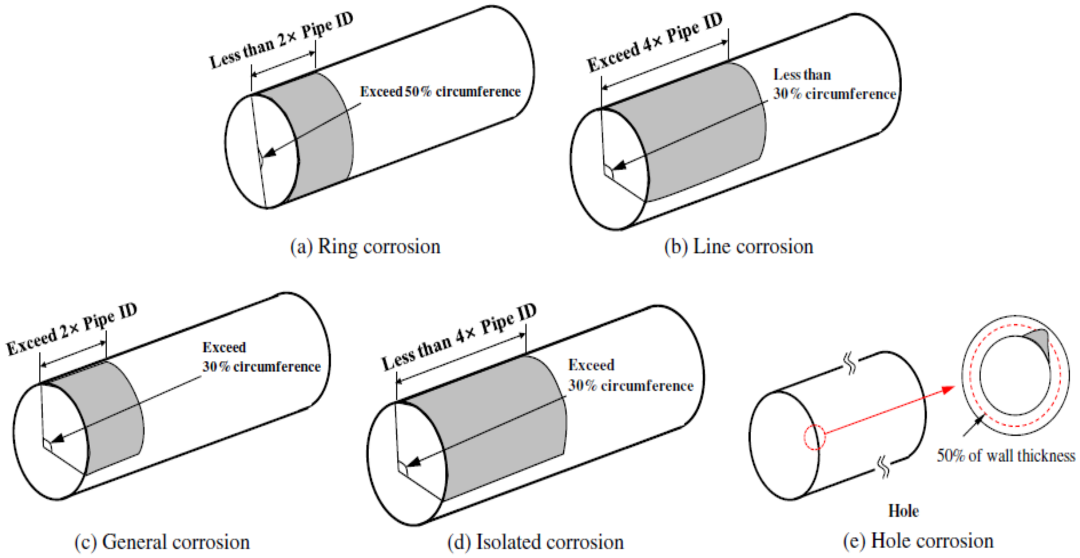

Figure 3. Corrosion classification (internal corrosion) for oil well tubes structures (Hairil Mohd & Paik, 2013).

As stated by Hairil Mohd & Paik. (2013), for oil well tube the internal surface is normally well coated. For oil well tube the internal surface coating is an important protection for them. As for corrosion it will not occurs until the coating has become lesser and ineffective. The corrosion will start take effect as the coating is getting thinner and break down. A sample view of corrosion is illustrated in Figure 4.

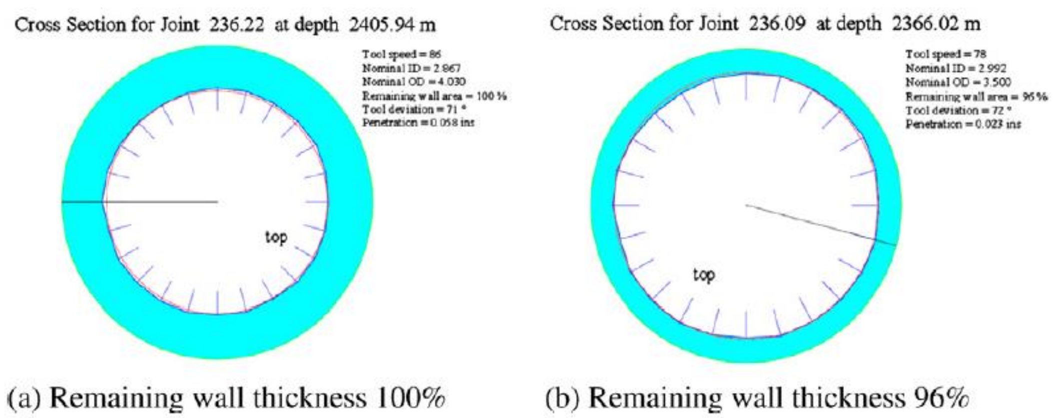

Figure 4. Typical view of cross section of a corroded oil well tube (Hairil Mohd & Paik, 2013).

2.6. Collapse Analysis

Collapse analysis also called as push-over analysis it is a simplified nonlinear analysis technique in which a structure modeled with non-linear properties (such as plastic hinge properties) and environmental loads is subjected to an incremental lateral load from zero to a prescribed ultimate displacement or until the structure is unable to resist further loads

It is performed using SACS software. When running the collapse analysis, SACS required three input files, there are:

- Model input files
- Collapse input file
- Pile soil interaction input file (optional)

There are two step in when perform the analysis. The first one all of the platform dead weight and topside are applied. Second, apply the environmental load incrementally until the failure of the platform occurs.

2.7. Corrosion Rate Model

According to Bai et al. (2015),there are two type of corrosion damage. There are:

- General corrosion
- Localized corrosion.

General corrosion are the most common type of corrosion, there uniformly reduce the wall thickness of the member. While localized corrosion caused deterioration in local region. There are many factors that influent the corrosion rate including coating properties, maintenance system, temperature of the area and inert gas properties.

Three phases has been divided in the time-variant corrosion rate model. The first one the corrosion rate is zero because of the protection of the coating. The second one is where the corrosion protection has been damage and corrosion happen, which make the tubular member element reduce it thickness. Lastly the third phase where they are corresponds to a constant corrosion rate (Bai et al., 2015).

A model is suggested to be:

$$r(t) = r_s[\, 1 - \exp\left(-\left(t - \frac{\tau_i}{\tau_t}\right)\right)] \tag{4}$$

Where τ_t is the transition time, τ_i is the coating lifetime and r_s is the steady corrosion rate. Figure 5 show the corrosion rate model as for figure 6 it show the corrosion depth as a time function.

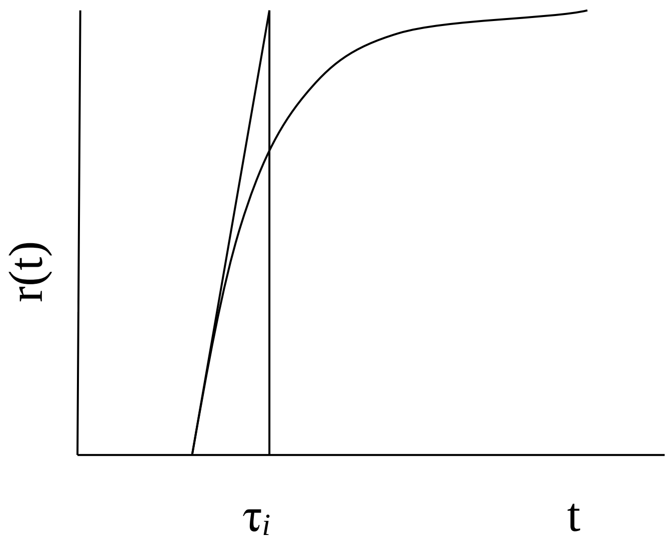

Figure 5. Model of corrosion rate (Bai, et al., 2015).

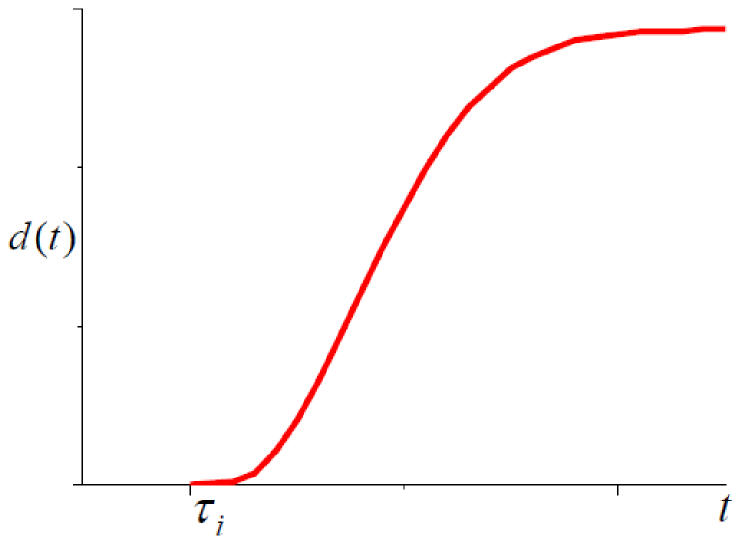

Figure 6. Loss of plate thickness from corrosion (Bai, et al., 2015).

The corrosion depth can be determined to be by integrating Eq. (4):

$$d(t) = r_s \,[\, t - (\tau_i + \tau_t) + \tau_t \exp(-\left(t - \frac{\tau_i}{\tau_t}\right))] \quad (5)$$

Whereτ_i, τ_t and r_s should be fitted for inspection result. The coating lifetime τ_i can be assumed to be fitted by a Weibull Distribution and r to be fitted by normal distribution.

$$f(\tau_i) = \frac{\alpha}{\beta} \,(\frac{\tau_i}{\beta})^{\alpha-1} \exp[\,-(\frac{\tau_i}{\beta})^{\alpha}] \quad (6)$$

2.8. Ultimate Strength Analysis

Through figure 7, ultimate strength is able to be defined which are from the result of the collapse analysis using SACS. From figure 7 we can see that the displacement rise sharply after RSR is at 0.14. From this, the ultimate strength of the jacket may be occurred when RSR is reached 0.14. The initial failure of the jacket may occurred at the same time and from several times analysis it is usually occurred at the bottom part of the structure like in Figure 8 (Bai, et al., 2015).

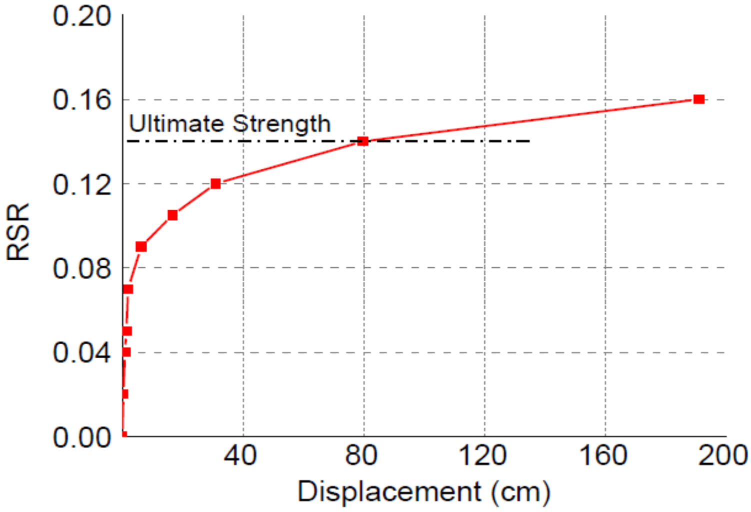

Figure 7. Reserve strength ratio of the jacket structure (in 270 degrees) (Bai, et al., 2015).

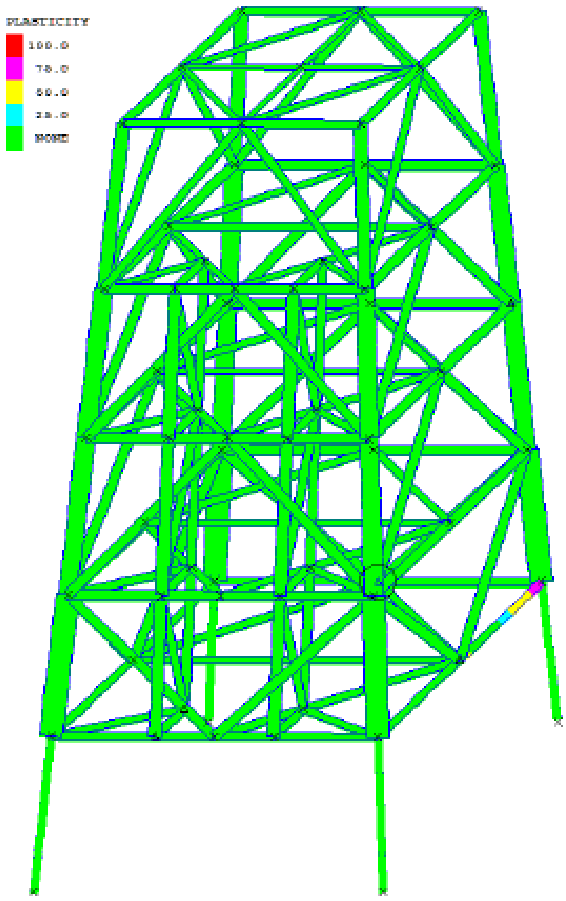

Figure 8. Initial failure of the jacket structure (Bai et al., 2015).

2.9. Push Over Analysis

Ayob et al. (2014), stated that Push Over analysis can be carried out with eight or twelve environmental loading direction to determine the ultimate strength of the substructure, which measure in RSR (reserve Strength Ratio). The RSR measures the ultimate strength of the substructure beyond the 100-years environmental loads.

The applied loads are the combination of:

- Operating Gravity Load (basic Load Case)
- 100-years Environmental Loads (Wave, Current and Wind)
- Buoyancy

General description procedure in Push-Over Analysis:

- Basic load cases for operating gravity loads are applied to unity (1.0)
- Environmental loads are applied incrementally until a defined characteristic displacement is reached.
- Each load is applied in predefined steps i.e 1%
- The deformed modal coordinated is updated after each load step to record the changes in geometry.
- Elements stiffness is computed according to the updated geometry and to be re-assembled in each load step.
- Plastic capacity of the element (end and mid) is checked at each load level and will be automatically scaled to the yield capacity whenever the force exceeds the element capacity.
- As element forces reach their yield surfaces, a plastic hinge is incorporated to demonstrate the material non-linearity. The plastic hinge will be removed if the member later is unloaded and become elastic.
- The load increment is automatically reversed if global instability is detected.
- Push-Over run is performed for 8 (eight) environmental load directions.
- RSR of the structure is retrieved at the structure’s collapse point.
- Collapse Base Shear is obtained by multiplying RSR with 100-year Base Shear of specified direction.

- Identify first member failure and final collapse mechanism and their associated load step.

2.10. Reserved Strength Ratio (RSR)

The strength capacity of the structure is defined in term of Reserve Strength Ratio (RSR). RSR is defined as a ratio of collapse of load structure ultimate lateral load carrying the total load at 100-years design as figure 9 below. The structure is being "pushed" with the increasing of lateral environmental load until the platform failed or collapse. One of the important that affect the structure when performing the Collapse Analysis are:

- Water depth
- Omni directional wave height
- Wind Speed
- Current Velocity.

RSR formula:

$$RSR = \frac{R_{ult}}{F_{wave(100)} + F_{current(100)} + (+F_{deck(100)} + F_{wind})"} \tag{7}$$

Where R_{ult} is responding to ultimate strength. $F_{current(100)}$ and $F_{wave(100)}$ are 100-years current force and wave force acting on jacket structure. $F_{deck(100)}$ and F_{wind} should be considered if there is any topside and wind force that is acting on the structure. In figure 7 is a way the RSR is being calculated by using the SACS software. On the graph the x-axis represented the RSR and on y-axis it represented the displacement (Bai et al., 2015).

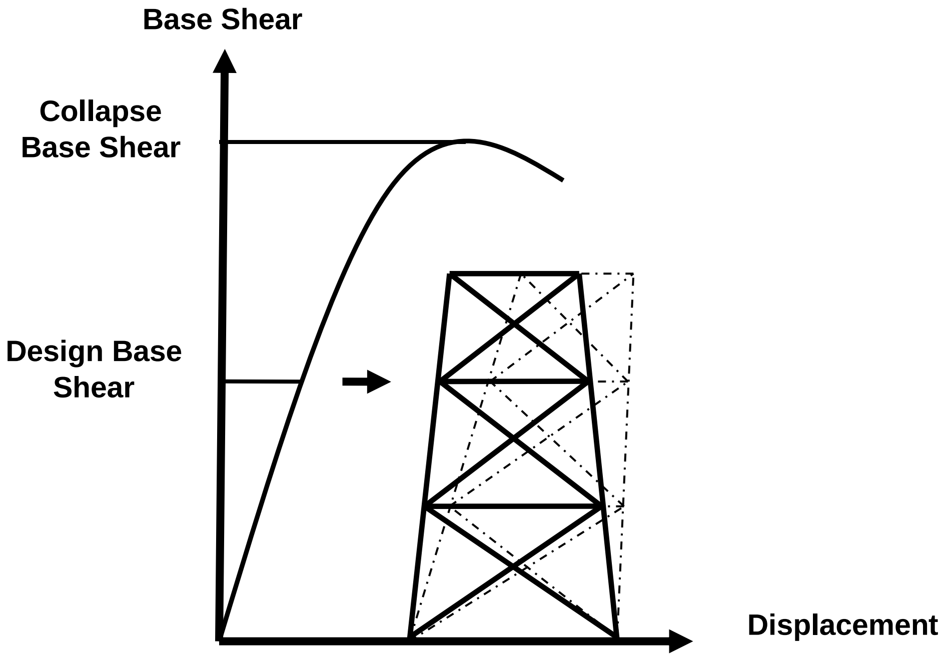

Figure 9: Reserve Strength Ratio (RSR) defines (Kurian et al., 2013).

2.11. Incremental Wave Theory

According to Bai et al, SACS software is the most accurate method in evaluate the platform behavior due to incremental wave approach. In conducting the incremental wave analysis the structure model should be assigned individually to incremental wave height. The non- linear static analysis will be done and the structural demand such as overturning moment, displacement, base shear, etc will be acquired as needed. As the analysis is running, the structure will not be able to withstand some of the wave load at the particular wave height. When it happens the analysis will be terminated.

In deciding the direction of the metocean data, the ultimate strength and some of the data were conducted in certain degree. Figure 10 show the result of the pushover analysis to find where the minimum ultimate strength is occurred (Bai, et al., 2015).

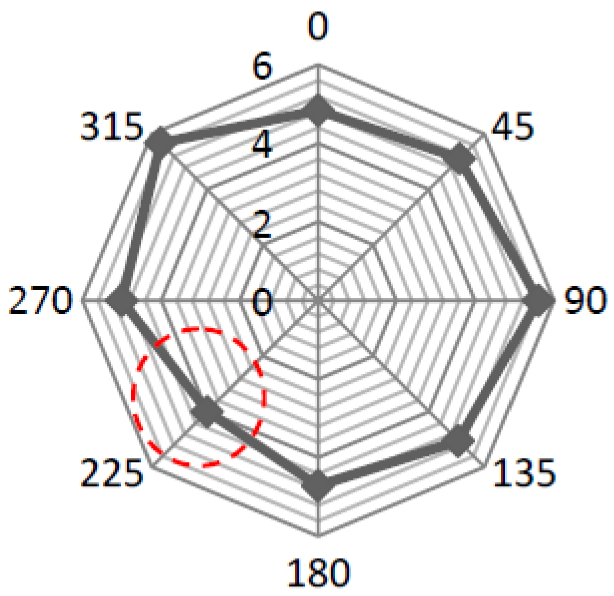

Figure 10. Ultimate strength along the directions (Kurian, et al., 2013).

3. METHODOLOGY

3.1. Procedure of Analysis

In this chapter will be explain what method is used to achieve the objectives of the study. SACS software will be used in achieving the objective of the study. Collapse Analysis of the software will used in obtaining the incremental environmental load factor and platform RSR value.

In this methodology it consists of three main parts. First part is structural modeling and data preparation. Second part it will be on Structural model analysis using SACS software of Collapse Analysis in obtaining the incremental load factor and the platform RSR value. Lastly it will be on develop formula in predicting the reserve strength ratio (RSR).

Usually in Collapse Analysis, the environmental loads that are acting on the structure will be increase until the structure is failed or collapse. These are the steps in performing the Collapse Analysis.

- Making a detail structural model. Include also all the additional load and detail it need to be considered, this is to ensure that the load carrying capacity on the structure is accurate.
- Applied load to the structural, live, dead and environmental load. Then making a load combination that are Gravitational Load and Environmental Load. Gravitational load consists of combination of live load and dead load. Whereas the environmental consists of combination of wind, wave and current load.
- Run the analysis. For more detail and accurate result, this where the pile-soil interaction is included during the analysis. For references foundation is optional in this study.
- Verify the result.
- Interpreting the results to gain information from the analysis and to understand the behavior of the structure.

3.2. Data Preparation

The environmental data that are wind speed, wave height, and current profile will be applied to all structures in this study. For modeling this offshore structure, it assumes that the computer program will follow the guideline of API RP 2A WSD 21st Edition 2000. The metocean data that will use in this model to generated load to the structure will be obtained from reliable sources.

The purpose of the structural analysis is to achieve the safety requirement and getting the effective structure. The review of the structural configuration includes also the properties of the material that will be used in the platform need to be done. Include also the method of designing, strength calculation as well as code check.

3.3. Progressive Collapse Analysis

The method of non-linear collapse analysis is adopted in this non-linear static analysis. With given the permanent load included also the increasing of lateral loads until failure in various structural components and finally collapse. The character of the collapse can be defined using a plot of total displacement against the total base shear. In this analysis, the gravity loading will be applied first to the structure, and then it will be followed by gradually increasing of the environmental load until the structural is collapse. In collapse analysis the strength capacity of the structure is presented in terms of Reserve Strength Ratio (RSR), which is the ratio of collapse load structure failure at the total load structure at 100 years design as in Figure 11.

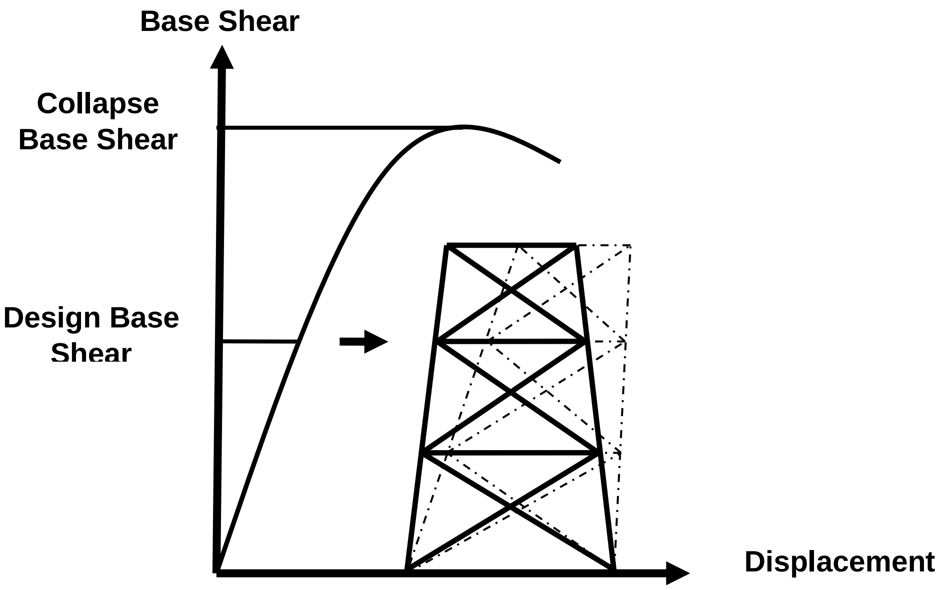

Figure 11 . Definition of Reserve Strength Ratio (RSR) (Kurian, et al., 2013).

With the incremental of the lateral environmental load the structure is pushed until the structure is collapse.

$$RSR = \frac{BS\ collapse}{BS\ 100year} \quad (8)$$

3.4. Research Methodology

In completing the report books, journals and paper work from academician will be used reference to understand this study.

3.5. Gantt chart and Key Milestone

Table 1: Gants chart for the final year project (FYP I)

Activities	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Selection of Project Title	■	■												
- Preliminary research work - Develop objective, problem statement, general methodology			■	■										
-Register Laboratory Facilities and Services Unit (LFSU) -Purchase or usage of resource and services (form 03) -Submission of Extended Proposal					■	■								
- Searching for corrosion data							■	■	■	■				
- Continuing searching for corrosion data from various journal - Proposal Defense											■	■		
- Submission of Interim draft report - Submission of Interim report													■	■
Experimental Studies	FYP 2													
Analysis of the results														

Table 2: Gants chart for the final year project (FYP II)

Activities	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
- Confirmation on corrosion data that will be used														
-Run the Push Over Analysis														
-Report the findings of the analysis -Preparing the progress report FYP 2														
-Submission of Progress report -Pre SEDEX Preparation														
-Write Technical Paper -Pre SEDEX -SEDEX Preparation														
-Submission of dissertation (soft bound) and technical paper -SEDEX														
-Viva presentation														
-Submission of dissertation (hard bound)														

4. RESULTS AND DISCUSSION

4.1. Data Input

Input parameters used in this study based on available design reports include platform age, water depth, air gap and wave height. These parameters are used to estimate the reserve strength ratio (RSR) of fixed offshore platforms.

As for this experiment the wall thickness and the outer diameter will be decreasing from years to years (5 years to 40 years) according to the corrosion data from the figure 11b below. The data is gotten from Paik 2003 and Paik 1998 (table 3). As for this study we will focus on decreasing only on the splash zone area. As stated in PETRONAS (2012), splash zone defined as that region below +5.0m mean sea level (MSL) and above -3.0m MSL for Malaysian Waters.

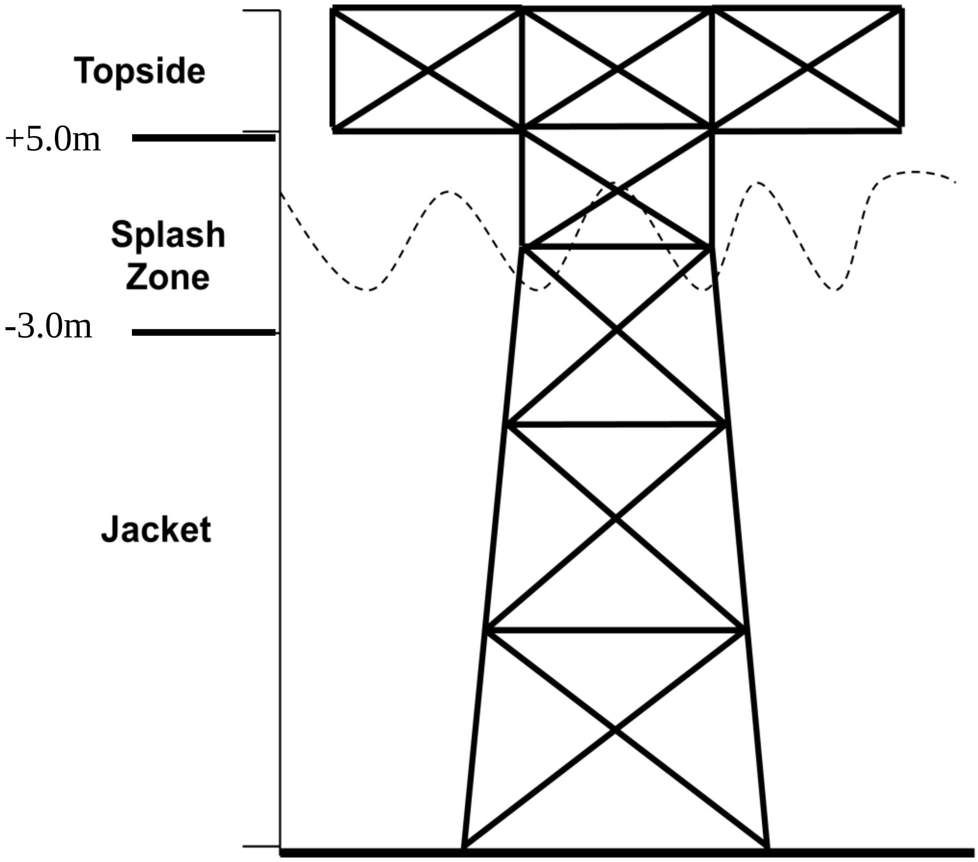

Figure 11a: Splash zone area between +5.0m and -3.0m MSL (PETRONAS, 2012)

Table 3: Corrosion data.

Year	Average (Paik 2003) (mm)	Severe (Paik 2003) (mm)	Paik 1998 (mm)
5	0.122	0.224	0.23
10	0.612	1.121	0.99
15	1.224	2.242	1.49
20	1.836	3.363	1.61
25	2.448	4.484	1.63
30	3.060	5.605	
35	3.672	6.726	
40	4.284	7.847	
45	4.896	8.968	
50	5.508	10.089	

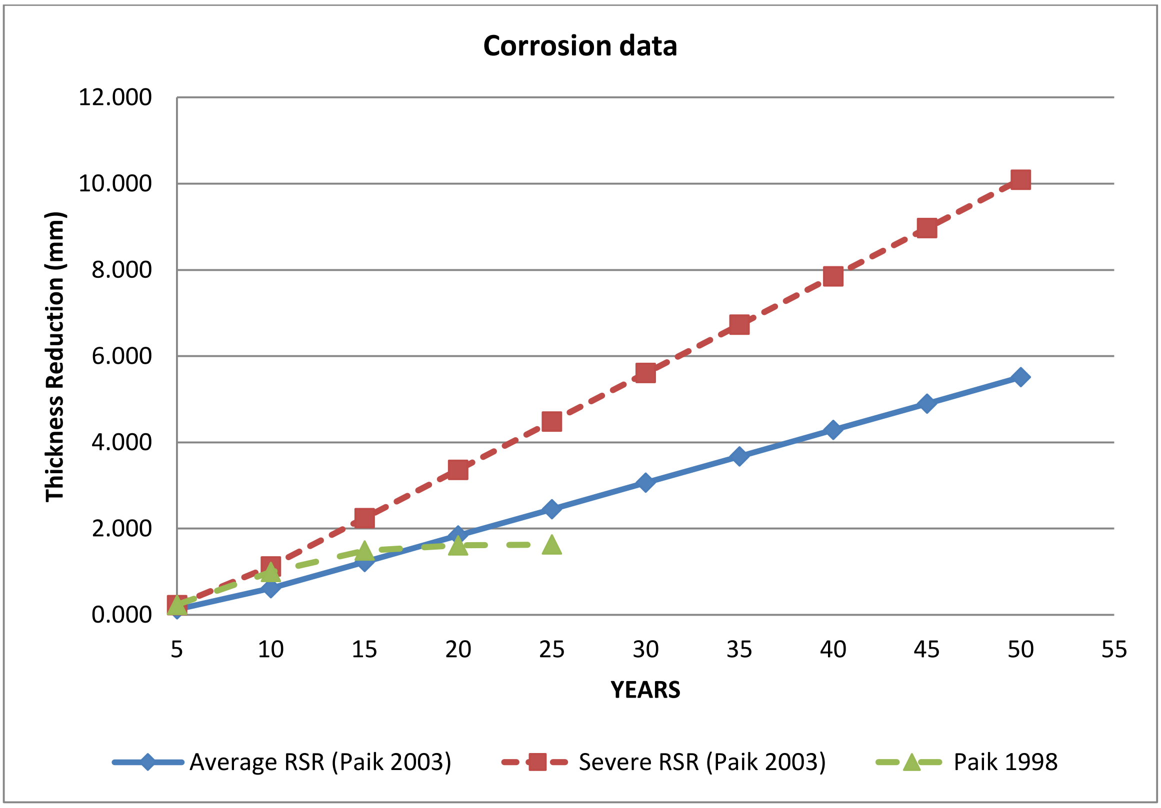

Figure 11b: Corrosion data apply on the platform.

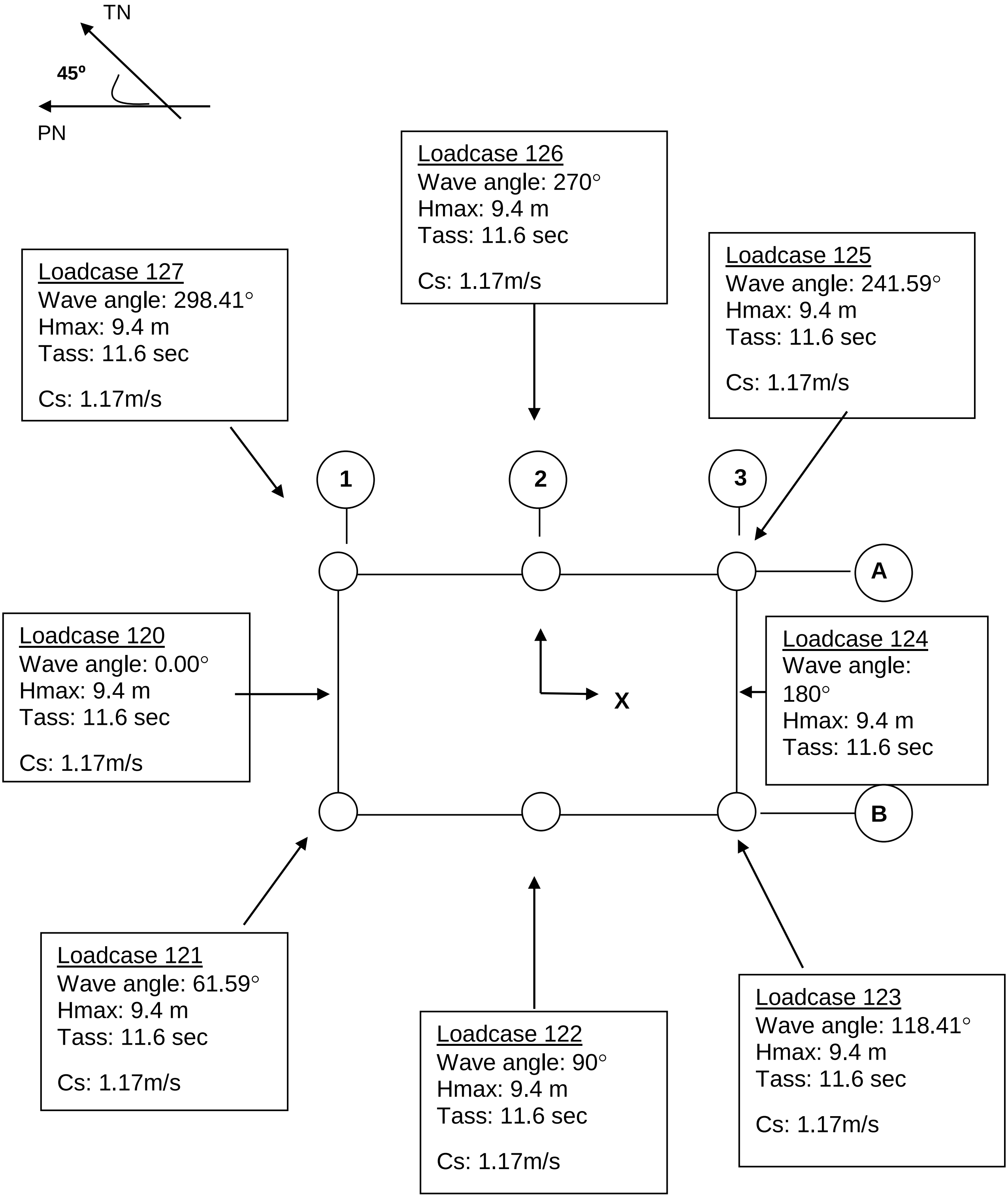

Figure 12: Environmental load applied on the structure.

4.2. Average Mean RSR (Paik 2003).

Table 4: Average mean (Paik 2003) RSR for each year.

Angle/Year	**5 Years**	**10 Years**	**15 Years**	**20 Years**	**25 Years**	**30 Years**	**35 Years**	**40 Years**	**45 Years**	**50 Years**
0°	3.28	2.1	1.76	1.75	1.3	1.2	1.2	1.1	0.29	0.41
61.59°	3.06	3.06	3.06	3.06	2.89	2.36	2.05	1.9	1.1	0.41
90°	2.69	2.69	2.68	2.68	2.68	2.69	2.68	2.68	1.9	0.39
118.41°	2.19	2.19	2.19	2.19	2.19	2.19	1.77	1.59	0.79	0.39
180°	3.99	3.09	2.99	1.99	2	1.43	1.4	1.39	0.59	0.41
241.59°	3.05	3.02	2.83	2.67	2.67	2.24	1.83	1.59	1.1	0.41
270°	2.88	2.88	2.88	2.88	2.69	2.69	2.19	2.07	1.3	0.39
298.41°	2.39	2.39	2.38	1.58	1.46	1.19	1.19	1.19	1.1	0.39

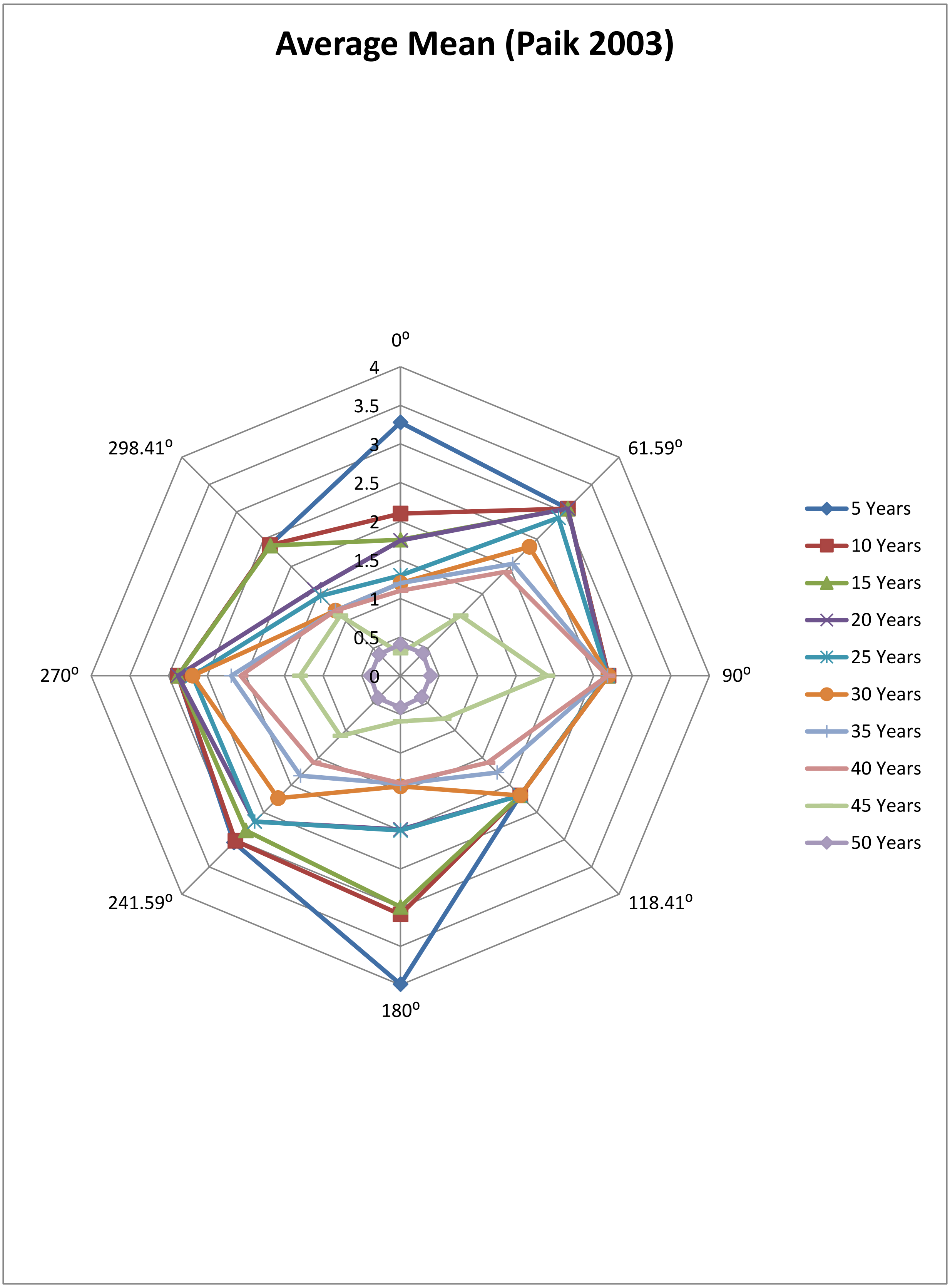

Figure 13: Average mean RSR (Paik 2003).

4.3. Severe mean RSR (Paik 2003)

Table 5: Severe mean (Paik 2003) RSR for each year.

Angle/Year	5 Years	10 Years	15 Years	20 Years	25 Years	30 Years	35 Years	40 Years	45 Years	50 Years
0°	2.49	1.99	1.54	1.3	1.39	1.29	1.29	1.1	0.33	0.41
61.59°	3.07	3.06	2.96	2.73	2	1.98	1.98	1.89	0.33	0.41
90°	2.69	2.68	2.68	2.68	2.67	2.66	2.66	2.39	0.31	0.41
118.41°	2.19	2.19	2.19	2.19	2.19	2.18	2.08	1.2	0.31	0.41
180°	3.79	2.69	2.31	1.7	1.69	1.44	1.42	1.1	0.33	0.41
241.59°	3.05	2.96	2.34	2.2	1.99	1.69	1.6	1.55	0.33	0.41
270°	2.88	2.88	2.68	2.58	2.26	2.15	2.07	2.09	0.31	0.41
298.41°	2.39	2.38	2.29	1.48	1.26	1.19	1.19	1.09	0.31	0.41

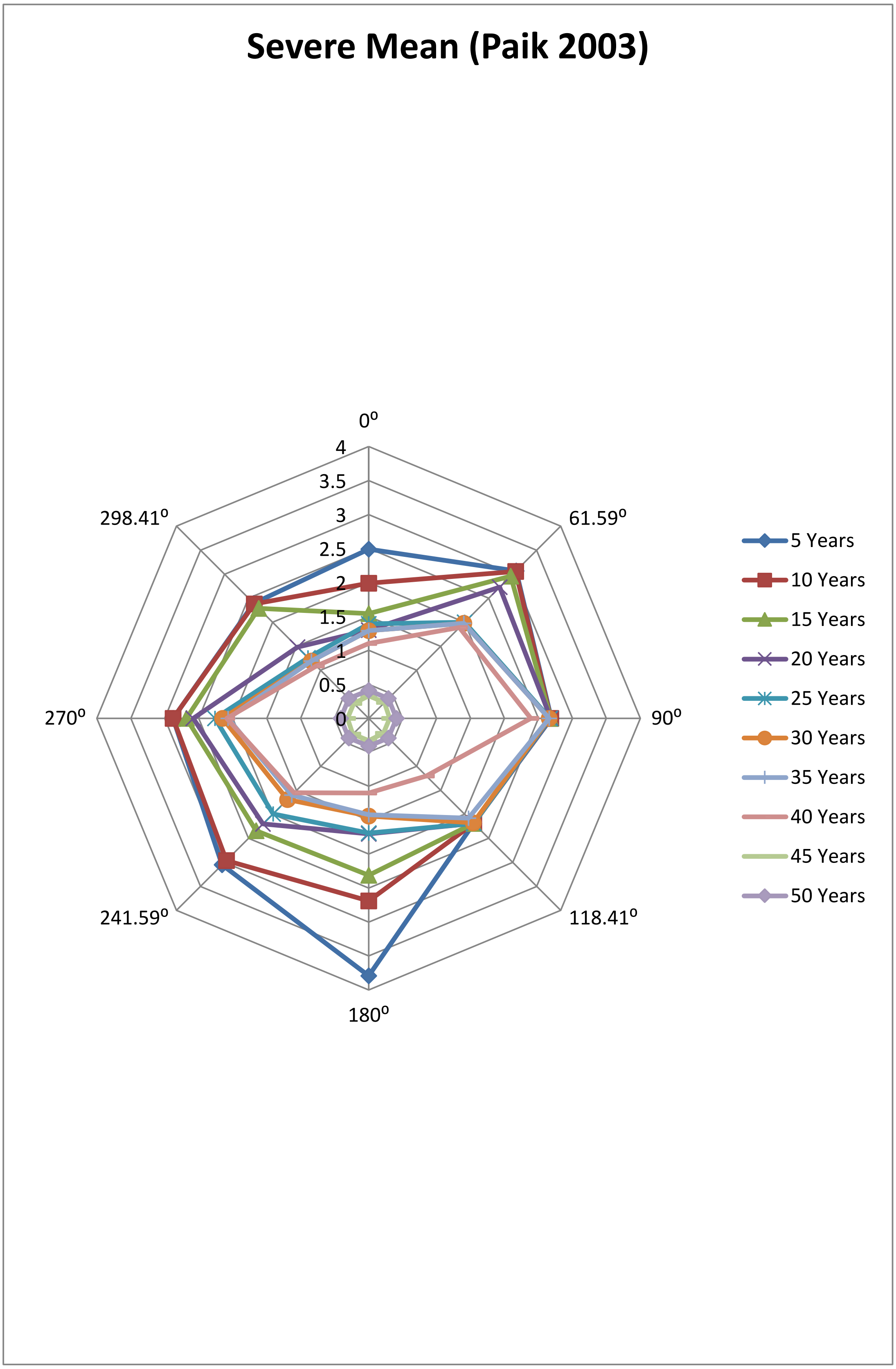

Figure 14: **Severe mean RSR (Paik 2003)**

4.4. Paik 1998 RSR

Table 5a: Paik 1998 RSR for each year.

	5 Years	10 Years	15 Years	20 Years	25 Years
0^o	2.19	2.08	1.96	1.37	1.23
61.59^o	3.06	2.69	2.17	2	1.99
90^o	2.69	2.69	2.69	2.68	2.68
118.41^o	2.19	2.19	2.19	2.19	2.09
180^o	3.99	2.4	2.16	2.1	1.9
241.59^o	3.05	3.05	3.05	2.29	1.69
270^o	2.88	2.88	2.57	2.4	1.99
298.41^o	2.38	2.38	2.38	1.57	1.09

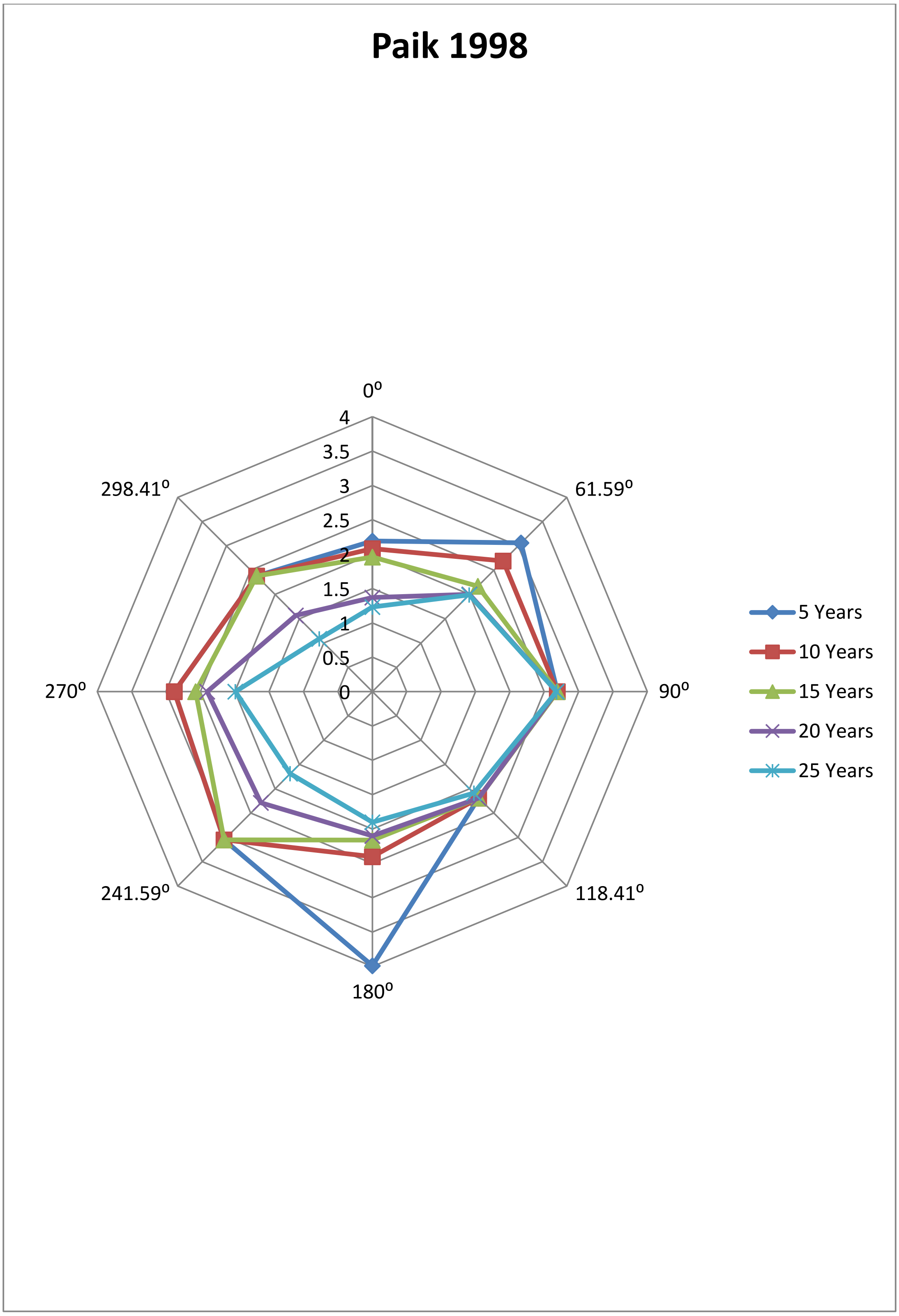

Figure 14a: RSR Paik 1998.

4.5. Comparison between Average and Severe Mean RSR

4.5.1. Result for 0^{o}

Table 6: Comparison between Paik 2003 and Paik 2008 for 0^{o}.

0^{o}	Average RSR (Paik 2003)	Severe RSR (Paik 2003)	Paik 2008
5	3.28	2.49	2.19
10	2.10	1.99	2.08
15	1.76	1.54	1.96
20	1.75	1.30	1.37
25	1.30	1.39	1.23
30	1.20	1.29	
35	1.20	1.29	
40	1.10	1.10	
45	0.29	0.33	
50	0.41	0.41	

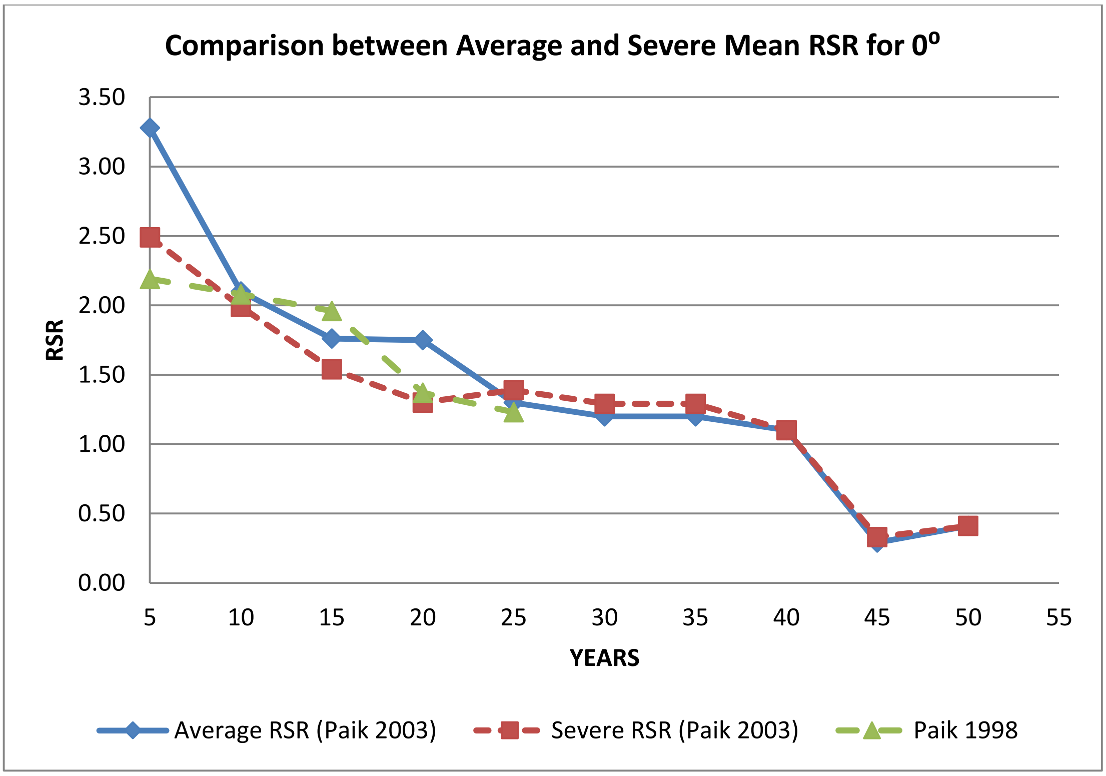

Figure 15: Comparison between Paik 2003 and Paik 1998 for 0^{o}.

For figure 15 we can see that from year 5 to 20 years the average mean is higher than the severe Mean. As the year increasing we can see that both of the average and severe mean they are given the same result. This happen because of the collapse base shear of them both are the same.

4.5.2. Result for 61.59°

Table 7: Comparison between Paik 2003 and Paik 2008 for 61.59°.

61.59°	Average RSR (Paik 2003)	Severe RSR (Paik 2003)	Paik 2008
5	3.06	3.07	3.05
10	3.06	3.06	2.69
15	3.06	2.96	2.17
20	3.06	2.73	2.00
25	2.89	2.00	1.99
30	2.36	1.98	
35	2.05	1.98	
40	1.90	1.89	
45	1.10	0.33	
50	0.41	0.41	

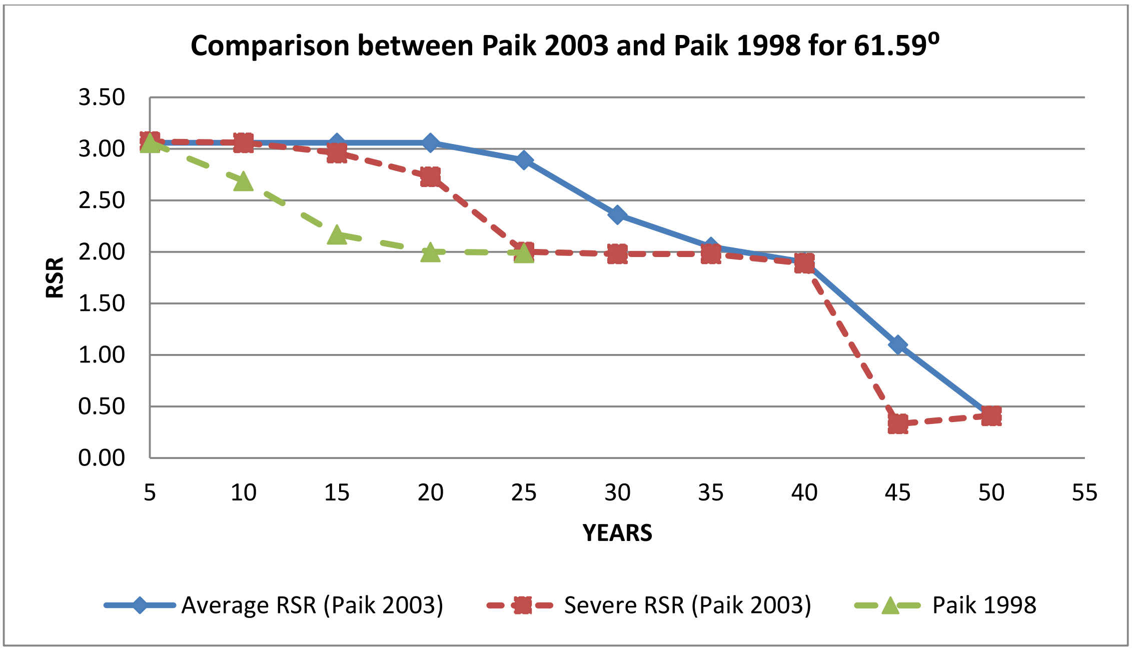

Figure 16: Comparison between Paik 2003 and Paik 1998 for 61.59°.

For figure 16 we can see that the RSR given by the average mean is higher than the RSR given by the severe mean RSR. This may happen due to the decreasing of the wall thickness and outer diameter that are applied on the platform. According to the corrosion data given.

4.5.3. Result for 90^o

Table 8: Comparison between Paik 2003 and Paik 2008 for 90^o.

90^o	**Average RSR (Paik 2003)**	**Severe RSR (Paik 2003)**	**Paik 2008**
5	2.69	2.69	2.69
10	2.69	2.68	2.69
15	2.68	2.68	2.69
20	2.68	2.68	2.68
25	2.68	2.67	2.68
30	2.69	2.66	
35	2.68	2.66	
40	2.68	2.39	
45	1.90	0.31	
50	0.39	0.41	

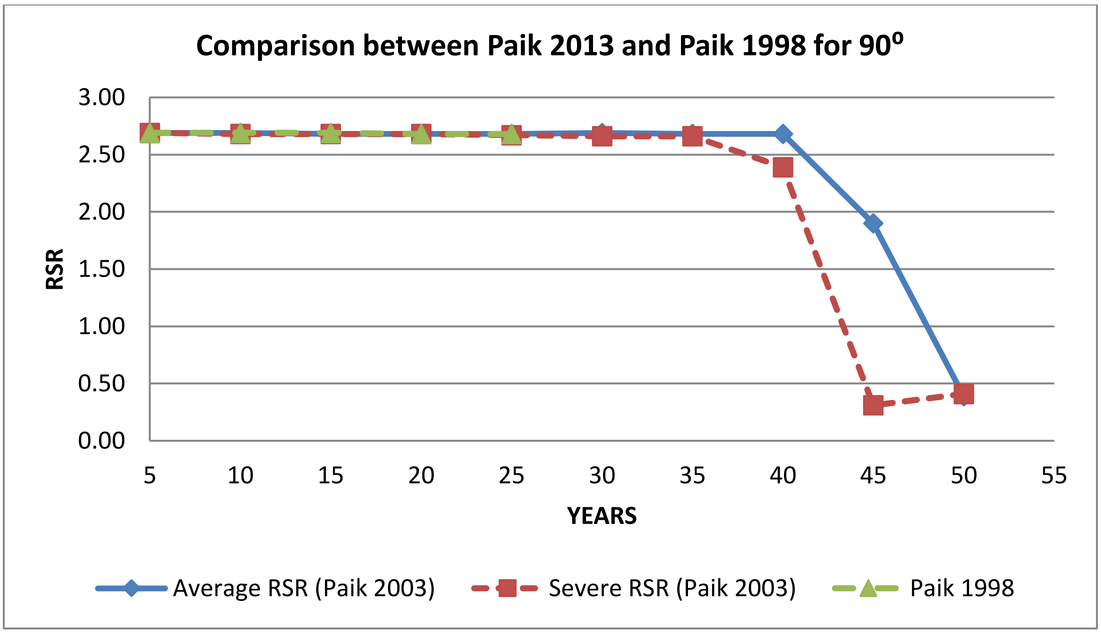

Figure 17: Comparison between Paik 2003 and Paik 1998 for 90^o.

For figure 17 we can see that from the year 5 to 30 years the RSR of Average mean and Severe Mean is the same and not decreasing. As the year increase from 35 years to 50 years both of the RSR decrease. This may happen because the load on that angle is low compare to the rest of the angle.

4.5.4. Result for 118.41°

Table 9: Comparison between Paik 2003 and Paik 2008 for 118.41°.

118.41°	Average RSR (Paik 2003)	Severe RSR (Paik 2003)	Paik 2008
5	2.19	2.19	2.19
10	2.19	2.19	2.19
15	2.19	2.19	2.19
20	2.19	2.19	2.19
25	2.19	2.19	2.09
30	2.19	2.18	
35	1.77	2.08	
40	1.59	1.20	
45	0.79	0.31	
50	0.39	0.41	

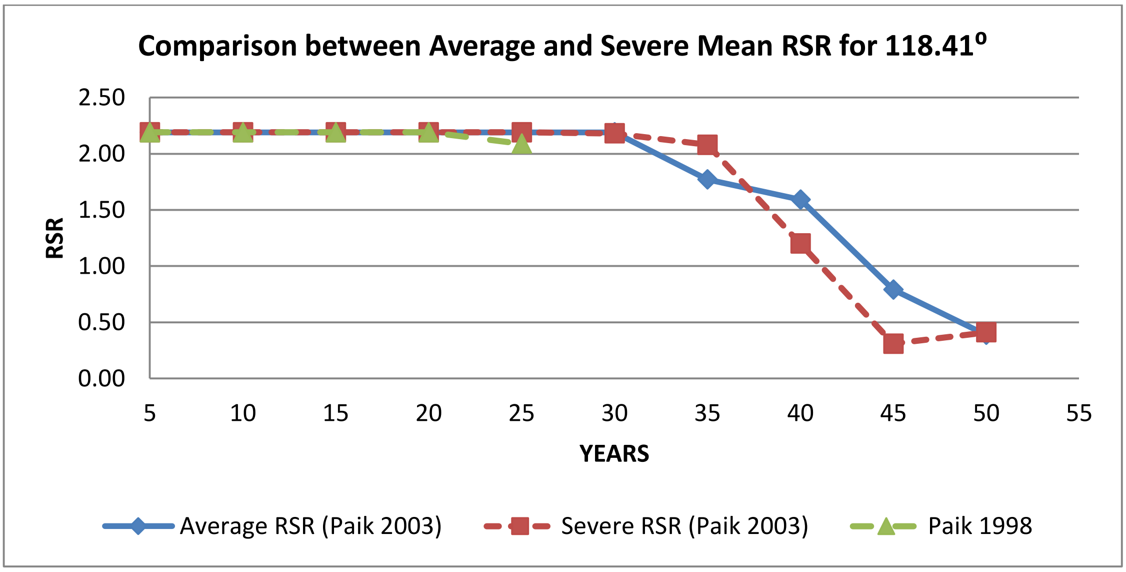

Figure18: Comparison between Paik 2003 and Paik 1998 for 118.41°.

For figure 18 we can says that it is the same as figure 17. The same reason, because the load on that angle is lower compare to the rest of the angle.

4.5.5. Result for 180^o

Table 10: Comparison between Paik 2003 and Paik 2008 for 180^o.

180^o	Average RSR (Paik 2003)	Severe RSR (Paik 2003)	Paik 2008
5	3.99	3.79	3.99
10	3.09	2.69	2.40
15	2.99	2.31	2.16
20	1.99	1.70	2.10
25	2.00	1.69	1.90
30	1.43	1.44	
35	1.40	1.42	
40	1.39	1.10	
45	0.59	0.33	
50	0.41	0.41	

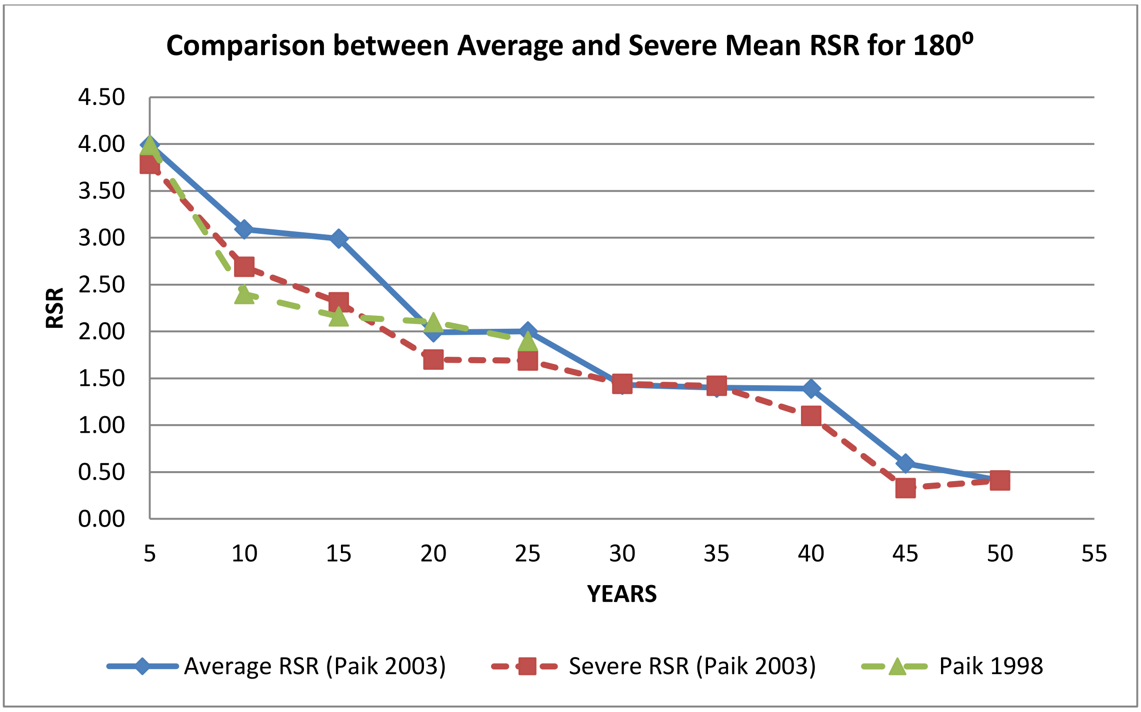

Figure 19: Comparison between Paik 2003 and Paik 1998 for 180^o.

For figure 19 we can see that the RSR given by the average mean is higher than the RSR given by the severe mean RSR. This may happen due to the decreasing of the wall thickness and outer diameter that are applied on the platform. According to the corrosion data given.

4.5.6. Result for 241.59°

Table 11: Comparison between Paik 2003 and Paik 2008 for 241.59°.

241.59°	Average RSR (Paik 2003)	Severe RSR (Paik 2003)	Paik 2008
5	3.05	3.05	3.05
10	3.02	2.96	3.05
15	2.83	2.34	3.05
20	2.67	2.20	2.29
25	2.67	1.99	1.69
30	2.24	1.69	
35	1.83	1.60	
40	1.59	1.55	
45	1.10	0.33	
50	0.41	0.41	

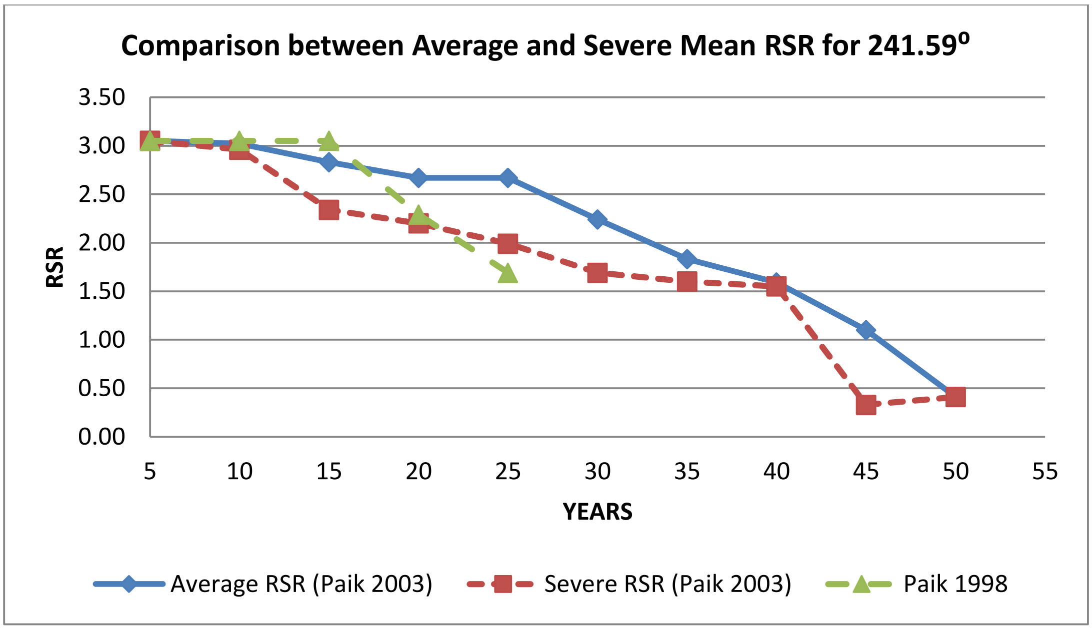

Figure 20: Comparison between Paik 2003 and Paik 1998 for 241.59°.

For figure 20 we can see that the RSR given by the average mean is higher than the RSR given by the severe mean RSR. This may happen due to the decreasing of the wall thickness and outer diameter that are applied on the platform. According to the corrosion data given.

4.5.7. Result for 270°

Table 12: Comparison between Paik 2003 and Paik 2008 for 270°.

270°	Average RSR (Paik 2003)	Severe RSR (Paik 2003)	Paik 2008
5	3.06	2.88	2.88
10	2.88	2.88	2.88
15	2.88	2.68	2.57
20	2.88	2.58	2.40
25	2.69	2.26	1.99
30	2.69	2.15	
35	2.19	2.07	
40	2.07	2.09	
45	1.30	0.31	
50	0.39	0.41	

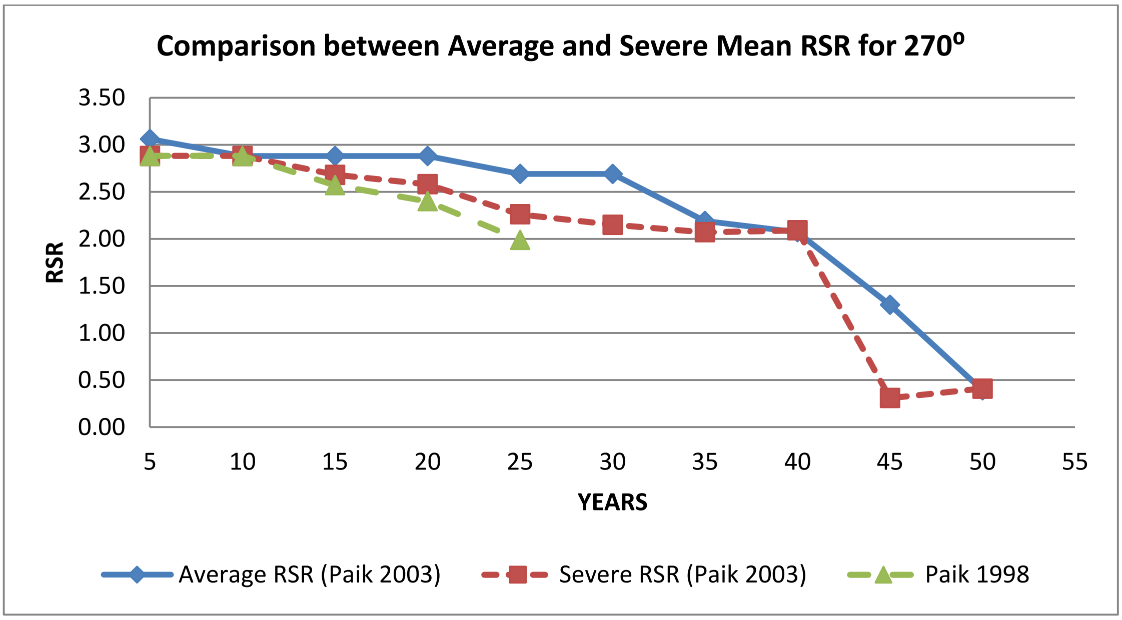

Table 21: Comparison between Paik 2003 and Paik 2008 for 270°.

For figure 21 we can see that the RSR given by the average mean is higher than the RSR given by the severe mean RSR. This may happen due to the decreasing of the wall thickness and outer diameter that are applied on the platform. According to the corrosion data given.

4.5.8. Result for 298.41°

Table 13: Comparison between Paik 2003 and Paik 2008 for 298.41°.

298.41°	Average RSR (Paik 2003)	Severe RSR (Paik 2003)	Paik 2008
5	2.39	2.39	2.38
10	2.39	2.38	2.38
15	2.38	2.29	2.38
20	1.58	1.48	1.57
25	1.46	1.26	1.09
30	1.19	1.19	
35	1.19	1.19	
40	1.19	1.09	
45	1.10	0.31	
50	0.39	0.41	

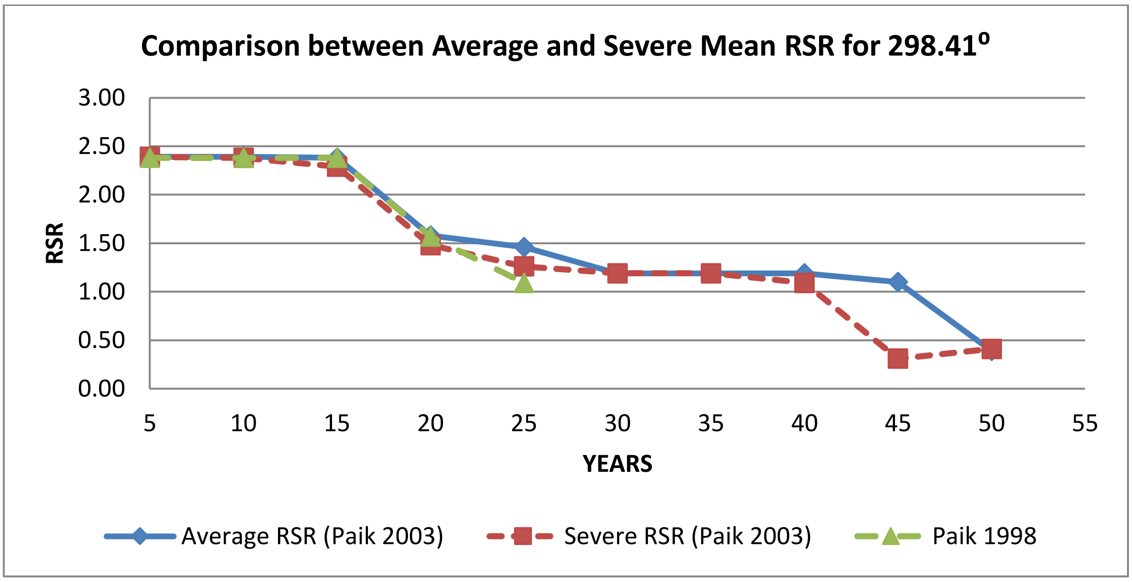

Figure 22: Comparison between Paik 2003 and Paik 1998 for 298.41°.

For figure 22 we can see the sudden drop of RSR for average mean and severe mean after 15 years. This may be because the loads are applied on that are is higher compare to the other angles.

4.5.9. RSR/RSR$_o$ for average mean for Paik 2003.

Table 14: RSR/RSR$_o$ for average mean for Paik 2003.

Year/Angle	0°	61.59°	90°	118.41°	180°	241.59°	270°	298.41°
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.64	1.00	1.00	1.00	0.77	0.99	0.94	1.00
15	0.54	1.00	1.00	1.00	0.75	0.93	0.94	1.00
20	0.53	1.00	1.00	1.00	0.50	0.88	0.94	0.66
25	0.40	0.94	1.00	1.00	0.50	0.88	0.88	0.61
30	0.37	0.77	1.00	1.00	0.36	0.73	0.88	0.50
35	0.37	0.67	1.00	0.81	0.35	0.60	0.72	0.50
40	0.34	0.62	1.00	0.73	0.35	0.52	0.68	0.50
45	0.09	0.36	0.71	0.36	0.15	0.36	0.42	0.46
50	0.13	0.13	0.14	0.18	0.10	0.13	0.13	0.16

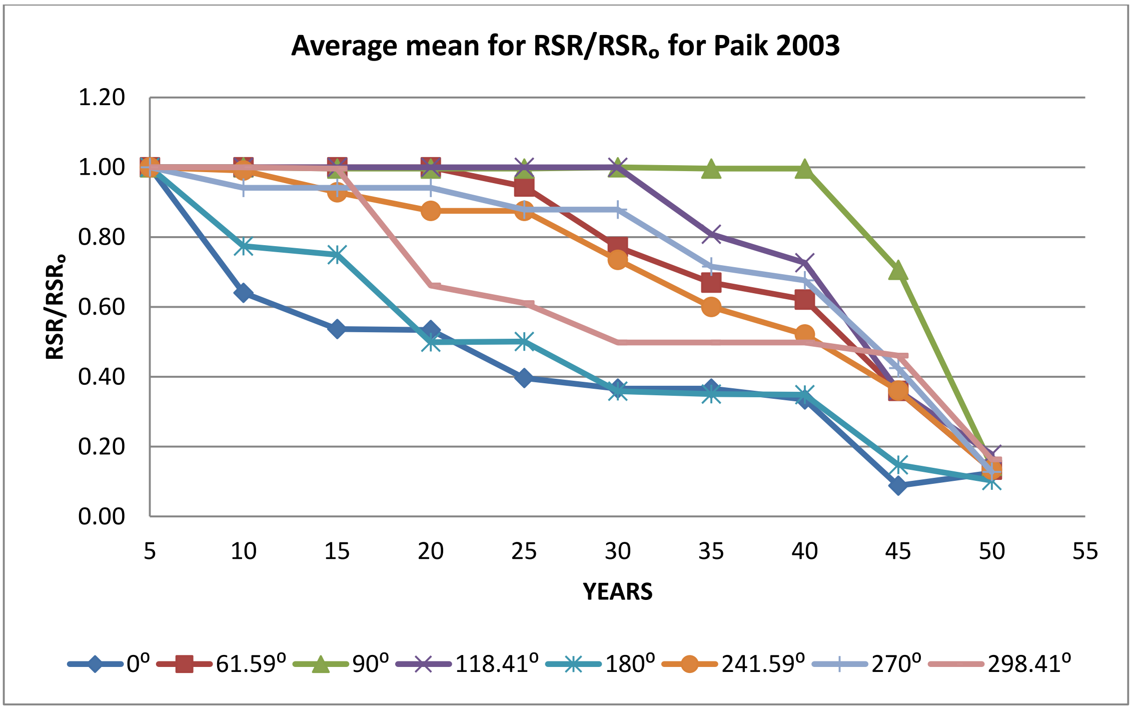

Figure 23: Average mean of RSR/RSR$_o$ for Paik 2003.

4.5.10. RSR/RSR$_o$ for severe mean for Paik 2003.

Table 15: RSR/RSR$_o$ for severe mean for Paik 2003.

Year/Angle	0°	61.59°	90°	118.41°	180°	241.59°	270°	298.41°
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.80	1.00	1.00	1.00	0.71	0.97	1.00	1.00
15	0.62	0.96	1.00	1.00	0.61	0.77	0.93	0.96
20	0.52	0.89	1.00	1.00	0.45	0.72	0.90	0.62
25	0.56	0.65	0.99	1.00	0.45	0.65	0.78	0.53
30	0.52	0.64	0.99	1.00	0.38	0.55	0.75	0.50
35	0.52	0.64	0.99	0.95	0.37	0.52	0.72	0.50
40	0.44	0.62	0.89	0.55	0.29	0.51	0.73	0.46
45	0.13	0.11	0.12	0.14	0.09	0.11	0.11	0.13
50	0.16	0.13	0.15	0.19	0.11	0.13	0.14	0.17

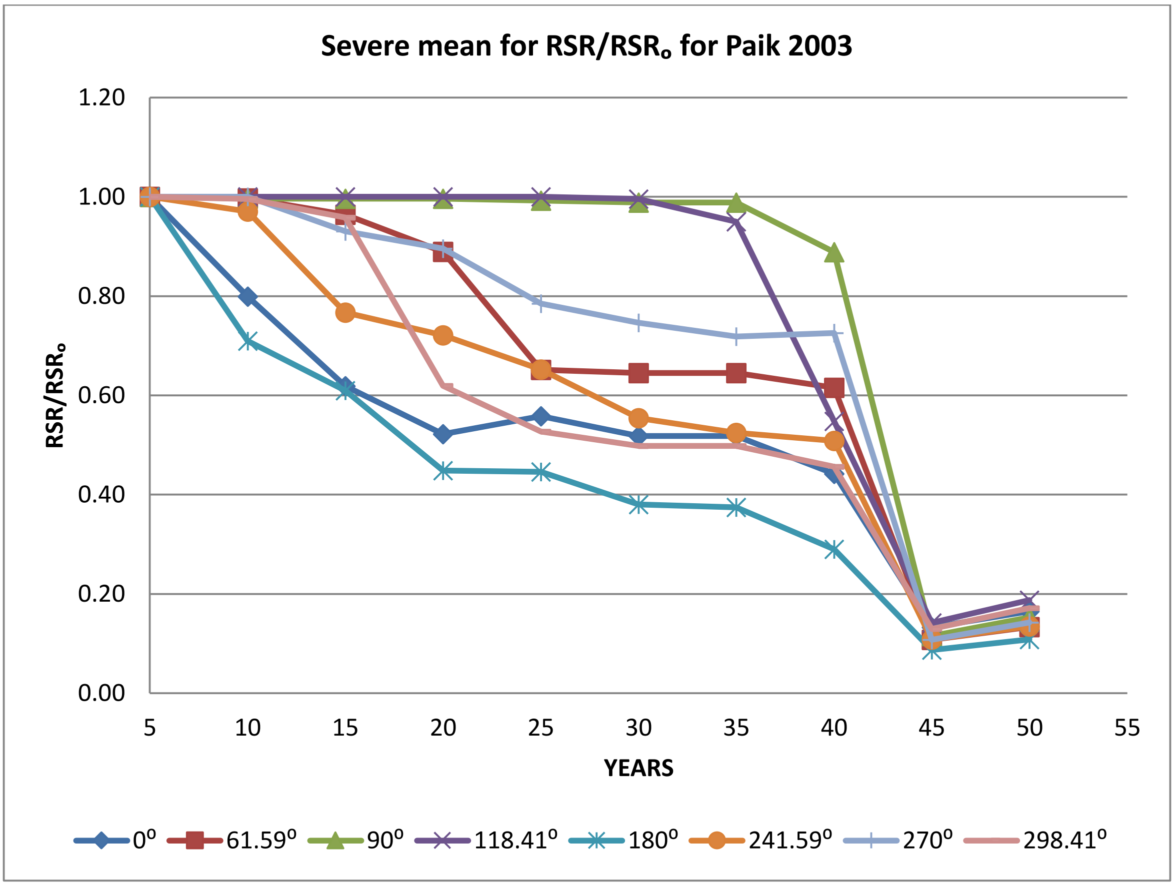

Figure 24: Severe mean of RSR/RSR$_o$ for Paik 2003.

4.5.11. RSR/RSR$_o$ for Paik 1998.

Table 16: RSR/RSR$_o$ for Paik 1998.

Year/Angle	0°	61.59°	90°	118.41°	180°	241.59°	270°	298.41°
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.95	0.88	1.00	1.00	0.60	1.00	1.00	1.00
15	0.89	0.71	1.00	1.00	0.54	1.00	0.89	1.00
20	0.63	0.65	1.00	1.00	0.53	0.75	0.83	0.66
25	0.56	0.65	1.00	0.95	0.48	0.55	0.69	0.46

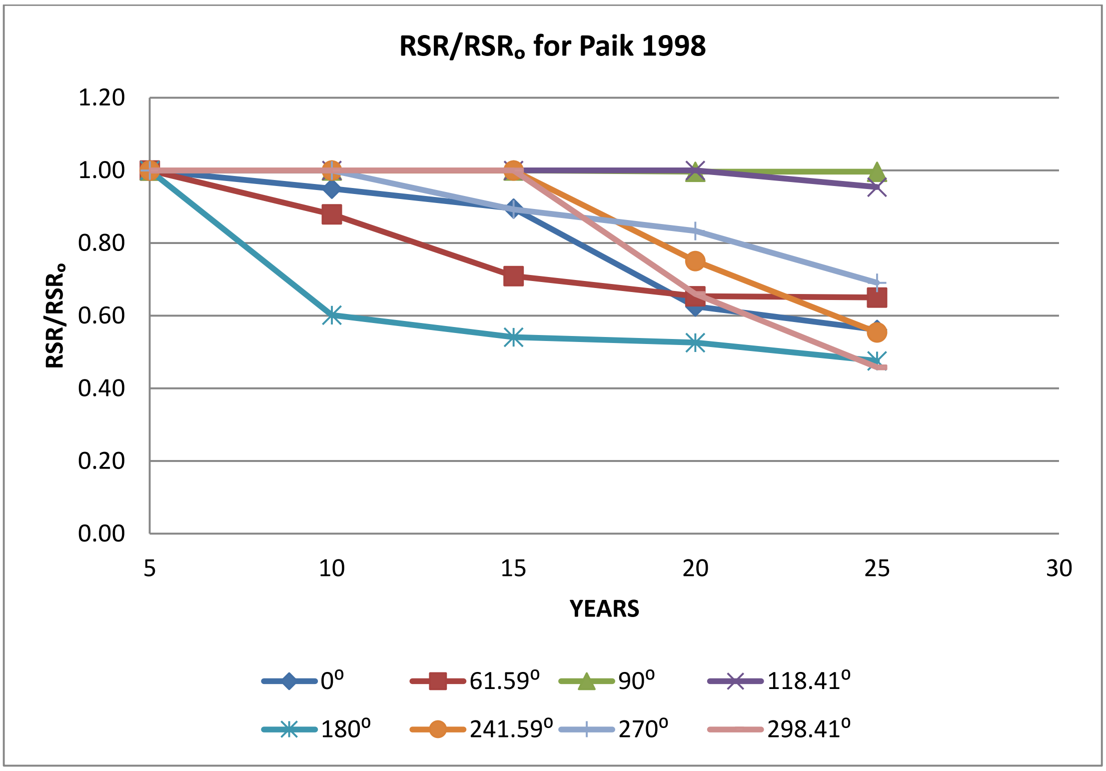

Figure 25: RSR/RSR$_o$ for Paik 1998.

For figure 23, figure 24 and figure 25 it is the ratio of the RSR. Where RSR$_o$ is RSR in 0 years as for this study it is 5 years.

5. CONCLUSION AND RECOMMENDATION

The conclusion of this study based on the results of the push-over analysis which are conducted for the 8 different set of Wall Thickness and Outer Diameter according to each year. From here we can see that the RSR given from the average mean and severe mean from Paik 2003 are not much different and sometime the data are not linear according to the year and thickness reduction. We also can say that the RSR from Paik 1998 are more severe compare to Paik 2003. From the result also we know angle that been most affected are 0^{o} angle. As for the graph it is going down as expected.

The structural strength or the ultimate strength is performed by Pushover Analysis of SACS which returns strength of the platform in terms of reserve strength ratio (RSR).

The aim of this study is to study the effect and compare the result of average and severe mean corrosion from Paik 2003 with the corrosion data from Paik 1998 to the platform. Also to see which angle of the platform affected the most. By using the SACS software and run the Collapse Analysis and both of the aim are obtain from the result.

Platform RSR can be affected by both load and resistance factor. However due to confidentiality and data restriction, some of the information are classified and held private. In order to obtain a more precise and accurate value of RSR in comparison with the validated RSR, future studies could include realistic data such as 8-directional metocean data, pile-soil interaction, seabed subsidence due to compaction of reservoir, corrosion, configuration of jacket legs and marine growth.

For future references instead applying the corrosion on one part of the platform we can apply corrosion on all 3 part of the platform that is topside, splash zone and jacket. So we can know which part is most affected by the corrosion and also run the RSR using USFOS software, so we can compare the result.

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APPENDIX

Wall thickness reduction for average mean (Paik 2003)

Group Member	(cm)	5 Years	10 Years	15 Years	20 Years	25 Years	30 Years	35 Years	40 Years	45 Years	50 Years
CSB	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
CSB	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
CSB	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
CSB	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
CSC	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
CSC	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
CSC	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
CSD	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
CSD	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
CSD	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
CSE	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
CSE	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
CSE	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
CSE	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
CSG	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
CSG	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
CSH	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75

CSH	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
CSH	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
CSH	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
CSJ	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
CSK	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
CSK	1.50	1.49	1.44	1.38	1.32	1.26	1.19	1.13	1.07	1.01	0.95
CSK	1.50	1.49	1.44	1.38	1.32	1.26	1.19	1.13	1.07	1.01	0.95
CSK	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
H3C	1.70	1.69	1.64	1.58	1.52	1.46	1.39	1.33	1.27	1.21	1.15
H3D	0.90	0.89	0.84	0.78	0.72	0.66	0.59	0.53	0.47	0.41	0.35
H3E	0.90	0.89	0.84	0.78	0.72	0.66	0.59	0.53	0.47	0.41	0.35
H3F	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3F	0.90	0.89	0.84	0.78	0.72	0.66	0.59	0.53	0.47	0.41	0.35
H3G	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3G	0.90	0.89	0.84	0.78	0.72	0.66	0.59	0.53	0.47	0.41	0.35
H3G	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3H	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3H	0.90	0.89	0.84	0.78	0.72	0.66	0.59	0.53	0.47	0.41	0.35
H3H	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85

H3I	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3I	0.90	0.89	0.84	0.78	0.72	0.66	0.59	0.53	0.47	0.41	0.35
H3I	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3J	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3J	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3J	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3K	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3K	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3K	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3P	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
H3P	2.70	2.69	2.64	2.58	2.52	2.46	2.39	2.33	2.27	2.21	2.15
H3Q	2.70	2.69	2.64	2.58	2.52	2.46	2.39	2.33	2.27	2.21	2.15
H3R	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
H3R	1.20	1.19	1.14	1.08	1.02	0.96	0.89	0.83	0.77	0.71	0.65
H3S	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
H3T	1.70	1.69	1.64	1.58	1.52	1.46	1.39	1.33	1.27	1.21	1.15
H3U	2.70	2.69	2.64	2.58	2.52	2.46	2.39	2.33	2.27	2.21	2.15
H3U	1.20	1.19	1.14	1.08	1.02	0.96	0.89	0.83	0.77	0.71	0.65
H3V	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65

H3W	1.20	1.19	1.14	1.08	1.02	0.96	0.89	0.83	0.77	0.71	0.65
H3X	0.97	0.96	0.91	0.85	0.79	0.73	0.66	0.60	0.54	0.48	0.42
H3Y	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
H3Z	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
HA3	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
HB3	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
HB3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HC3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HC3	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
HC3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HD3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HE3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HE3	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
HE3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HF3	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
HF3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HG3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HG3	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
HG3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65

HH3	3.20	3.19	3.14	3.08	3.02	2.96	2.89	2.83	2.77	2.71	2.65
HH3	2.20	2.19	2.14	2.08	2.02	1.96	1.89	1.83	1.77	1.71	1.65
HI3	1.70	1.69	1.64	1.58	1.52	1.46	1.39	1.33	1.27	1.21	1.15
L10	5.00	4.99	4.94	4.88	4.82	4.76	4.69	4.63	4.57	4.51	4.45
L10	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
L10	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
L10	4.30	4.29	4.24	4.18	4.12	4.06	3.99	3.93	3.87	3.81	3.75
L13	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
L13	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
L13	4.30	4.29	4.24	4.18	4.12	4.06	3.99	3.93	3.87	3.81	3.75
L14	5.00	4.99	4.94	4.88	4.82	4.76	4.69	4.63	4.57	4.51	4.45
L14	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
L14	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
L14	4.30	4.29	4.24	4.18	4.12	4.06	3.99	3.93	3.87	3.81	3.75
L15	4.30	4.29	4.24	4.18	4.12	4.06	3.99	3.93	3.87	3.81	3.75
LDT	3.80	3.79	3.74	3.68	3.62	3.56	3.49	3.43	3.37	3.31	3.25
LDT	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
LDT	4.00	3.99	3.94	3.88	3.82	3.76	3.69	3.63	3.57	3.51	3.45
LG6	5.00	4.99	4.94	4.88	4.82	4.76	4.69	4.63	4.57	4.51	4.45

LG6	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
LG6	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
LG6	4.30	4.29	4.24	4.18	4.12	4.06	3.99	3.93	3.87	3.81	3.75
LKT	3.80	3.79	3.74	3.68	3.62	3.56	3.49	3.43	3.37	3.31	3.25
LKT	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
LKT	4.00	3.99	3.94	3.88	3.82	3.76	3.69	3.63	3.57	3.51	3.45
LTJ	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
LTJ	1.40	1.39	1.34	1.28	1.22	1.16	1.09	1.03	0.97	0.91	0.85
LTJ	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
LTK	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
LTK	1.40	1.39	1.34	1.28	1.22	1.16	1.09	1.03	0.97	0.91	0.85
LTL	1.40	1.39	1.34	1.28	1.22	1.16	1.09	1.03	0.97	0.91	0.85
LTL	2.40	2.39	2.34	2.28	2.22	2.16	2.09	2.03	1.97	1.91	1.85
LTM	1.40	1.39	1.34	1.28	1.22	1.16	1.09	1.03	0.97	0.91	0.85
LTT	3.80	3.79	3.74	3.68	3.62	3.56	3.49	3.43	3.37	3.31	3.25
XE1	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
XE1	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
XE1	4.00	3.99	3.94	3.88	3.82	3.76	3.69	3.63	3.57	3.51	3.45
XE2	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75

XE2	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
XE2	4.00	3.99	3.94	3.88	3.82	3.76	3.69	3.63	3.57	3.51	3.45
XE3	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
XE3	4.00	3.99	3.94	3.88	3.82	3.76	3.69	3.63	3.57	3.51	3.45
XF1	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
XF1	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
XF2	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
XF2	2.50	2.49	2.44	2.38	2.32	2.26	2.19	2.13	2.07	2.01	1.95
XF3	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
XF3	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
XGB	4.00	3.99	3.94	3.88	3.82	3.76	3.69	3.63	3.57	3.51	3.45
XGB	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
XHA	3.00	2.99	2.94	2.88	2.82	2.76	2.69	2.63	2.57	2.51	2.45
XHA	3.00	2.99	2.94	2.88	2.82	2.76	2.69	2.63	2.57	2.51	2.45
XHA	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25
XHB	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
XHB	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
XHB	4.00	3.99	3.94	3.88	3.82	3.76	3.69	3.63	3.57	3.51	3.45
XIA	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25

XIA	2.30	2.29	2.24	2.18	2.12	2.06	1.99	1.93	1.87	1.81	1.75
XIA	3.50	3.49	3.44	3.38	3.32	3.26	3.19	3.13	3.07	3.01	2.95
XIA	3.00	2.99	2.94	2.88	2.82	2.76	2.69	2.63	2.57	2.51	2.45
XIB	3.00	2.99	2.94	2.88	2.82	2.76	2.69	2.63	2.57	2.51	2.45
XJA	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25
XJB	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25
XJB	2.30	2.29	2.24	2.18	2.12	2.06	1.99	1.93	1.87	1.81	1.75
XJB	3.50	3.49	3.44	3.38	3.32	3.26	3.19	3.13	3.07	3.01	2.95
XKA	2.00	1.99	1.94	1.88	1.82	1.76	1.69	1.63	1.57	1.51	1.45
XKA	0.80	0.79	0.74	0.68	0.62	0.56	0.49	0.43	0.37	0.31	0.25
XKB	1.30	1.29	1.24	1.18	1.12	1.06	0.99	0.93	0.87	0.81	0.75
XKB	4.00	3.99	3.94	3.88	3.82	3.76	3.69	3.63	3.57	3.51	3.45
XLA	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25
XMB	3.80	3.79	3.74	3.68	3.62	3.56	3.49	3.43	3.37	3.31	3.25
XMB	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25
XNA	3.00	2.99	2.94	2.88	2.82	2.76	2.69	2.63	2.57	2.51	2.45
XNA	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25
XPB	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25
XVB	1.80	1.79	1.74	1.68	1.62	1.56	1.49	1.43	1.37	1.31	1.25

Wall thickness reduction for severe mean (Paik 2003)

Group Member	(cm)	5 Years	10 Years	15 Years	20 Years	25 Years	30 Years	35 Years	40 Years	45 Years	50 Years
CSB	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
CSB	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
CSB	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
CSB	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
CSC	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
CSC	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
CSC	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
CSD	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
CSD	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
CSD	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
CSE	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
CSE	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
CSE	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
CSE	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
CSG	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
CSG	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
CSH	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
CSH	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
CSH	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
CSH	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
CSJ	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
CSK	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49

CSK	1.50	1.48	1.39	1.28	1.16	1.05	0.94	0.83	0.72	0.60	0.49
CSK	1.50	1.48	1.39	1.28	1.16	1.05	0.94	0.83	0.72	0.60	0.49
CSK	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
H3C	1.70	1.68	1.59	1.48	1.36	1.25	1.14	1.03	0.92	0.80	0.69
H3D	0.90	0.88	0.79	0.68	0.56	0.45	0.34	0.23	0.12	0.00	0.00
H3E	0.90	0.88	0.79	0.68	0.56	0.45	0.34	0.23	0.12	0.00	0.00
H3F	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3F	0.90	0.88	0.79	0.68	0.56	0.45	0.34	0.23	0.12	0.00	0.00
H3G	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3G	0.90	0.88	0.79	0.68	0.56	0.45	0.34	0.23	0.12	0.00	0.00
H3G	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3H	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3H	0.90	0.88	0.79	0.68	0.56	0.45	0.34	0.23	0.12	0.00	0.00
H3H	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3I	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3I	0.90	0.88	0.79	0.68	0.56	0.45	0.34	0.23	0.12	0.00	0.00
H3I	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3J	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3J	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3J	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3K	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3K	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3K	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3P	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19

H3P	2.70	2.68	2.59	2.48	2.36	2.25	2.14	2.03	1.92	1.80	1.69
H3Q	2.70	2.68	2.59	2.48	2.36	2.25	2.14	2.03	1.92	1.80	1.69
H3R	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
H3R	1.20	1.18	1.09	0.98	0.86	0.75	0.64	0.53	0.42	0.30	0.19
H3S	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
H3T	1.70	1.68	1.59	1.48	1.36	1.25	1.14	1.03	0.92	0.80	0.69
H3U	2.70	2.68	2.59	2.48	2.36	2.25	2.14	2.03	1.92	1.80	1.69
H3U	1.20	1.18	1.09	0.98	0.86	0.75	0.64	0.53	0.42	0.30	0.19
H3V	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
H3W	1.20	1.18	1.09	0.98	0.86	0.75	0.64	0.53	0.42	0.30	0.19
H3X	0.97	0.95	0.86	0.75	0.63	0.52	0.41	0.30	0.19	0.07	0.00
H3Y	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
H3Z	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
HA3	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
HB3	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
HB3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HC3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HC3	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
HC3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HD3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HE3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HE3	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
HE3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HF3	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19

HF3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HG3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HG3	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
HG3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HH3	3.20	3.18	3.09	2.98	2.86	2.75	2.64	2.53	2.42	2.30	2.19
HH3	2.20	2.18	2.09	1.98	1.86	1.75	1.64	1.53	1.42	1.30	1.19
HI3	1.70	1.68	1.59	1.48	1.36	1.25	1.14	1.03	0.92	0.80	0.69
L10	5.00	4.98	4.89	4.78	4.66	4.55	4.44	4.33	4.22	4.10	3.99
L10	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
L10	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
L10	4.30	4.28	4.19	4.08	3.96	3.85	3.74	3.63	3.52	3.40	3.29
L13	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
L13	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
L13	4.30	4.28	4.19	4.08	3.96	3.85	3.74	3.63	3.52	3.40	3.29
L14	5.00	4.98	4.89	4.78	4.66	4.55	4.44	4.33	4.22	4.10	3.99
L14	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
L14	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
L14	4.30	4.28	4.19	4.08	3.96	3.85	3.74	3.63	3.52	3.40	3.29
L15	4.30	4.28	4.19	4.08	3.96	3.85	3.74	3.63	3.52	3.40	3.29
LDT	3.80	3.78	3.69	3.58	3.46	3.35	3.24	3.13	3.02	2.90	2.79
LDT	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
LDT	4.00	3.98	3.89	3.78	3.66	3.55	3.44	3.33	3.22	3.10	2.99
LG6	5.00	4.98	4.89	4.78	4.66	4.55	4.44	4.33	4.22	4.10	3.99
LG6	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49

LG6	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
LG6	4.30	4.28	4.19	4.08	3.96	3.85	3.74	3.63	3.52	3.40	3.29
LKT	3.80	3.78	3.69	3.58	3.46	3.35	3.24	3.13	3.02	2.90	2.79
LKT	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
LKT	4.00	3.98	3.89	3.78	3.66	3.55	3.44	3.33	3.22	3.10	2.99
LTJ	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
LTJ	1.40	1.38	1.29	1.18	1.06	0.95	0.84	0.73	0.62	0.50	0.39
LTJ	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
LTK	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
LTK	1.40	1.38	1.29	1.18	1.06	0.95	0.84	0.73	0.62	0.50	0.39
LTL	1.40	1.38	1.29	1.18	1.06	0.95	0.84	0.73	0.62	0.50	0.39
LTL	2.40	2.38	2.29	2.18	2.06	1.95	1.84	1.73	1.62	1.50	1.39
LTM	1.40	1.38	1.29	1.18	1.06	0.95	0.84	0.73	0.62	0.50	0.39
LTT	3.80	3.78	3.69	3.58	3.46	3.35	3.24	3.13	3.02	2.90	2.79
XE1	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
XE1	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
XE1	4.00	3.98	3.89	3.78	3.66	3.55	3.44	3.33	3.22	3.10	2.99
XE2	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
XE2	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
XE2	4.00	3.98	3.89	3.78	3.66	3.55	3.44	3.33	3.22	3.10	2.99
XE3	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
XE3	4.00	3.98	3.89	3.78	3.66	3.55	3.44	3.33	3.22	3.10	2.99
XF1	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
XF1	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99

XF2	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29
XF2	2.50	2.48	2.39	2.28	2.16	2.05	1.94	1.83	1.72	1.60	1.49
XF3	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
XF3	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
XGB	4.00	3.98	3.89	3.78	3.66	3.55	3.44	3.33	3.22	3.10	2.99
XGB	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
XHA	3.00	2.98	2.89	2.78	2.66	2.55	2.44	2.33	2.22	2.10	1.99
XHA	3.00	2.98	2.89	2.78	2.66	2.55	2.44	2.33	2.22	2.10	1.99
XHA	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79
XHB	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
XHB	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
XHB	4.00	3.98	3.89	3.78	3.66	3.55	3.44	3.33	3.22	3.10	2.99
XIA	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79
XIA	2.30	2.28	2.19	2.08	1.96	1.85	1.74	1.63	1.52	1.40	1.29
XIA	3.50	3.48	3.39	3.28	3.16	3.05	2.94	2.83	2.72	2.60	2.49
XIA	3.00	2.98	2.89	2.78	2.66	2.55	2.44	2.33	2.22	2.10	1.99
XIB	3.00	2.98	2.89	2.78	2.66	2.55	2.44	2.33	2.22	2.10	1.99
XJA	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79
XJB	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79
XJB	2.30	2.28	2.19	2.08	1.96	1.85	1.74	1.63	1.52	1.40	1.29
XJB	3.50	3.48	3.39	3.28	3.16	3.05	2.94	2.83	2.72	2.60	2.49
XKA	2.00	1.98	1.89	1.78	1.66	1.55	1.44	1.33	1.22	1.10	0.99
XKA	0.80	0.78	0.69	0.58	0.46	0.35	0.24	0.13	0.02	0.00	0.00
XKB	1.30	1.28	1.19	1.08	0.96	0.85	0.74	0.63	0.52	0.40	0.29

XKB	4.00	3.98	3.89	3.78	3.66	3.55	3.44	3.33	3.22	3.10	2.99
XLA	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79
XMB	3.80	3.78	3.69	3.58	3.46	3.35	3.24	3.13	3.02	2.90	2.79
XMB	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79
XNA	3.00	2.98	2.89	2.78	2.66	2.55	2.44	2.33	2.22	2.10	1.99
XNA	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79
XPB	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79
XVB	1.80	1.78	1.69	1.58	1.46	1.35	1.24	1.13	1.02	0.90	0.79

Outer diameter reduction for average mean (Paik 2003)

Group Member	(cm)	5 Years	10 Years	15 Years	20 Years	25 Years	30 Years	35 Years	40 Years	45 Years	50 Years
CSB	78.9	78.88	78.78	78.66	78.53	78.41	78.29	78.17	78.04	77.92	77.80
CSB	78.9	78.88	78.78	78.66	78.53	78.41	78.29	78.17	78.04	77.92	77.80
CSB	81.3	81.28	81.18	81.06	80.93	80.81	80.69	80.57	80.44	80.32	80.20
CSB	81.3	81.28	81.18	81.06	80.93	80.81	80.69	80.57	80.44	80.32	80.20
CSC	81.3	81.28	81.18	81.06	80.93	80.81	80.69	80.57	80.44	80.32	80.20
CSC	81.3	81.28	81.18	81.06	80.93	80.81	80.69	80.57	80.44	80.32	80.20
CSC	78.9	78.88	78.78	78.66	78.53	78.41	78.29	78.17	78.04	77.92	77.80
CSD	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
CSD	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
CSD	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
CSE	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
CSE	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
CSE	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
CSE	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
CSG	81.3	81.28	81.18	81.06	80.93	80.81	80.69	80.57	80.44	80.32	80.20
CSG	78.9	78.88	78.78	78.66	78.53	78.41	78.29	78.17	78.04	77.92	77.80
CSH	78.9	78.88	78.78	78.66	78.53	78.41	78.29	78.17	78.04	77.92	77.80
CSH	78.9	78.88	78.78	78.66	78.53	78.41	78.29	78.17	78.04	77.92	77.80
CSH	81.3	81.28	81.18	81.06	80.93	80.81	80.69	80.57	80.44	80.32	80.20
CSH	81.3	81.28	81.18	81.06	80.93	80.81	80.69	80.57	80.44	80.32	80.20
CSJ	40.6	40.58	40.48	40.36	40.23	40.11	39.99	39.87	39.74	39.62	39.50
CSK	40.6	40.58	40.48	40.36	40.23	40.11	39.99	39.87	39.74	39.62	39.50
CSK	40.6	40.58	40.48	40.36	40.23	40.11	39.99	39.87	39.74	39.62	39.50
CSK	40.6	40.58	40.48	40.36	40.23	40.11	39.99	39.87	39.74	39.62	39.50
CSK	40.6	40.58	40.48	40.36	40.23	40.11	39.99	39.87	39.74	39.62	39.50

H3C	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
H3D	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3E	60.4	60.38	60.28	60.16	60.03	59.91	59.79	59.67	59.54	59.42	59.30
H3F	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3F	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3G	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3G	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3G	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3H	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3H	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3H	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3I	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3I	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3I	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3J	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3J	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3J	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3K	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3K	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3K	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3P	85.8	85.78	85.68	85.56	85.43	85.31	85.19	85.07	84.94	84.82	84.70
H3P	85.8	85.78	85.68	85.56	85.43	85.31	85.19	85.07	84.94	84.82	84.70
H3Q	85.8	85.78	85.68	85.56	85.43	85.31	85.19	85.07	84.94	84.82	84.70
H3R	60.4	60.38	60.28	60.16	60.03	59.91	59.79	59.67	59.54	59.42	59.30
H3R	60.4	60.38	60.28	60.16	60.03	59.91	59.79	59.67	59.54	59.42	59.30
H3S	60.4	60.38	60.28	60.16	60.03	59.91	59.79	59.67	59.54	59.42	59.30
H3T	45.1	45.08	44.98	44.86	44.73	44.61	44.49	44.37	44.24	44.12	44.00
H3U	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50

H3U	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
H3V	60.4	60.38	60.28	60.16	60.03	59.91	59.79	59.67	59.54	59.42	59.30
H3W	60.4	60.38	60.28	60.16	60.03	59.91	59.79	59.67	59.54	59.42	59.30
H3X	31.8	31.78	31.68	31.56	31.43	31.31	31.19	31.07	30.94	30.82	30.70
H3Y	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
H3Z	85.2	85.18	85.08	84.96	84.83	84.71	84.59	84.47	84.34	84.22	84.10
HA3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HB3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HB3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HC3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HC3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HC3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HD3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HE3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HE3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HE3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HF3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HF3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HG3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HG3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HG3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HH3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HH3	75.6	75.58	75.48	75.36	75.23	75.11	74.99	74.87	74.74	74.62	74.50
HI3	60.4	60.38	60.28	60.16	60.03	59.91	59.79	59.67	59.54	59.42	59.30
L10	170	169.98	169.88	169.76	169.63	169.51	169.39	169.27	169.14	169.02	168.90
L10	165	164.98	164.88	164.76	164.63	164.51	164.39	164.27	164.14	164.02	163.90
L10	162.6	162.58	162.48	162.36	162.23	162.11	161.99	161.87	161.74	161.62	161.50
L10	168.6	168.58	168.48	168.36	168.23	168.11	167.99	167.87	167.74	167.62	167.50

L13	165	164.98	164.88	164.76	164.63	164.51	164.39	164.27	164.14	164.02	163.90
L13	162.6	162.58	162.48	162.36	162.23	162.11	161.99	161.87	161.74	161.62	161.50
L13	168.6	168.58	168.48	168.36	168.23	168.11	167.99	167.87	167.74	167.62	167.50
L14	170	169.98	169.88	169.76	169.63	169.51	169.39	169.27	169.14	169.02	168.90
L14	165	164.98	164.88	164.76	164.63	164.51	164.39	164.27	164.14	164.02	163.90
L14	162.6	162.58	162.48	162.36	162.23	162.11	161.99	161.87	161.74	161.62	161.50
L14	168.6	168.58	168.48	168.36	168.23	168.11	167.99	167.87	167.74	167.62	167.50
L15	168.6	168.58	168.48	168.36	168.23	168.11	167.99	167.87	167.74	167.62	167.50
LDT	117.6	117.58	117.48	117.36	117.23	117.11	116.99	116.87	116.74	116.62	116.50
LDT	117.6	117.58	117.48	117.36	117.23	117.11	116.99	116.87	116.74	116.62	116.50
LDT	120	119.98	119.88	119.76	119.63	119.51	119.39	119.27	119.14	119.02	118.90
LG6	170	169.98	169.88	169.76	169.63	169.51	169.39	169.27	169.14	169.02	168.90
LG6	165	164.98	164.88	164.76	164.63	164.51	164.39	164.27	164.14	164.02	163.90
LG6	162.6	162.58	162.48	162.36	162.23	162.11	161.99	161.87	161.74	161.62	161.50
LG6	168.6	168.58	168.48	168.36	168.23	168.11	167.99	167.87	167.74	167.62	167.50
LKT	117.6	117.58	117.48	117.36	117.23	117.11	116.99	116.87	116.74	116.62	116.50
LKT	117.6	117.58	117.48	117.36	117.23	117.11	116.99	116.87	116.74	116.62	116.50
LKT	120	119.98	119.88	119.76	119.63	119.51	119.39	119.27	119.14	119.02	118.90
LTJ	76.2	76.18	76.08	75.96	75.83	75.71	75.59	75.47	75.34	75.22	75.10
LTJ	75	74.98	74.88	74.76	74.63	74.51	74.39	74.27	74.14	74.02	73.90
LTJ	75	74.98	74.88	74.76	74.63	74.51	74.39	74.27	74.14	74.02	73.90
LTK	66	65.98	65.88	65.76	65.63	65.51	65.39	65.27	65.14	65.02	64.90
LTK	64.8	64.78	64.68	64.56	64.43	64.31	64.19	64.07	63.94	63.82	63.70
LTL	75	74.98	74.88	74.76	74.63	74.51	74.39	74.27	74.14	74.02	73.90
LTL	75	74.98	74.88	74.76	74.63	74.51	74.39	74.27	74.14	74.02	73.90
LTM	64.8	64.78	64.68	64.56	64.43	64.31	64.19	64.07	63.94	63.82	63.70
LTT	117.6	117.58	117.48	117.36	117.23	117.11	116.99	116.87	116.74	116.62	116.50
XE1	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90

XE1	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XE1	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XE2	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
XE2	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XE2	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XE3	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
XE3	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XF1	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
XF1	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XF2	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
XF2	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XF3	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
XF3	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XGB	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XGB	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
XHA	76.2	76.18	76.08	75.96	75.83	75.71	75.59	75.47	75.34	75.22	75.10
XHA	76.2	76.18	76.08	75.96	75.83	75.71	75.59	75.47	75.34	75.22	75.10
XHA	73.8	73.78	73.68	73.56	73.43	73.31	73.19	73.07	72.94	72.82	72.70
XHB	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
XHB	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XHB	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XIA	73.8	73.78	73.68	73.56	73.43	73.31	73.19	73.07	72.94	72.82	72.70
XIA	68.7	68.68	68.58	68.46	68.33	68.21	68.09	67.97	67.84	67.72	67.60
XIA	71.1	71.08	70.98	70.86	70.73	70.61	70.49	70.37	70.24	70.12	70.00
XIA	71.1	71.08	70.98	70.86	70.73	70.61	70.49	70.37	70.24	70.12	70.00
XIB	71.1	71.08	70.98	70.86	70.73	70.61	70.49	70.37	70.24	70.12	70.00
XJA	73.8	73.78	73.68	73.56	73.43	73.31	73.19	73.07	72.94	72.82	72.70
XJB	73.8	73.78	73.68	73.56	73.43	73.31	73.19	73.07	72.94	72.82	72.70

XJB	68.7	68.68	68.58	68.46	68.33	68.21	68.09	67.97	67.84	67.72	67.60
XJB	71.1	71.08	70.98	70.86	70.73	70.61	70.49	70.37	70.24	70.12	70.00
XKA	61	60.98	60.88	60.76	60.63	60.51	60.39	60.27	60.14	60.02	59.90
XKA	58.6	58.58	58.48	58.36	58.23	58.11	57.99	57.87	57.74	57.62	57.50
XKB	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90
XKB	91.4	91.38	91.28	91.16	91.03	90.91	90.79	90.67	90.54	90.42	90.30
XLA	73.8	73.78	73.68	73.56	73.43	73.31	73.19	73.07	72.94	72.82	72.70
XMB	117.6	117.58	117.48	117.36	117.23	117.11	116.99	116.87	116.74	116.62	116.50
XMB	78.9	78.88	78.78	78.66	78.53	78.41	78.29	78.17	78.04	77.92	77.80
XNA	76.2	76.18	76.08	75.96	75.83	75.71	75.59	75.47	75.34	75.22	75.10
XNA	73.8	73.78	73.68	73.56	73.43	73.31	73.19	73.07	72.94	72.82	72.70
XPB	73.8	73.78	73.68	73.56	73.43	73.31	73.19	73.07	72.94	72.82	72.70
XVB	89	88.98	88.88	88.76	88.63	88.51	88.39	88.27	88.14	88.02	87.90

Outer diameter reduction for severe mean (Paik 2003)

Group Member	(cm)	5 Years	10 Years	15 Years	20 Years	25 Years	30 Years	35 Years	40 Years	45 Years	50 Years
CSB	78.9	78.86	78.68	78.45	78.23	78.00	77.78	77.55	77.33	77.11	76.88
CSB	78.9	78.86	78.68	78.45	78.23	78.00	77.78	77.55	77.33	77.11	76.88
CSB	81.3	81.26	81.08	80.85	80.63	80.40	80.18	79.95	79.73	79.51	79.28
CSB	81.3	81.26	81.08	80.85	80.63	80.40	80.18	79.95	79.73	79.51	79.28
CSC	81.3	81.26	81.08	80.85	80.63	80.40	80.18	79.95	79.73	79.51	79.28
CSC	81.3	81.26	81.08	80.85	80.63	80.40	80.18	79.95	79.73	79.51	79.28
CSC	78.9	78.86	78.68	78.45	78.23	78.00	77.78	77.55	77.33	77.11	76.88
CSD	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
CSD	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
CSD	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
CSE	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
CSE	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
CSE	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
CSE	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
CSG	81.3	81.26	81.08	80.85	80.63	80.40	80.18	79.95	79.73	79.51	79.28
CSG	78.9	78.86	78.68	78.45	78.23	78.00	77.78	77.55	77.33	77.11	76.88
CSH	78.9	78.86	78.68	78.45	78.23	78.00	77.78	77.55	77.33	77.11	76.88
CSH	78.9	78.86	78.68	78.45	78.23	78.00	77.78	77.55	77.33	77.11	76.88
CSH	81.3	81.26	81.08	80.85	80.63	80.40	80.18	79.95	79.73	79.51	79.28
CSH	81.3	81.26	81.08	80.85	80.63	80.40	80.18	79.95	79.73	79.51	79.28
CSJ	40.6	40.56	40.38	40.15	39.93	39.70	39.48	39.25	39.03	38.81	38.58
CSK	40.6	40.56	40.38	40.15	39.93	39.70	39.48	39.25	39.03	38.81	38.58
CSK	40.6	40.56	40.38	40.15	39.93	39.70	39.48	39.25	39.03	38.81	38.58
CSK	40.6	40.56	40.38	40.15	39.93	39.70	39.48	39.25	39.03	38.81	38.58
CSK	40.6	40.56	40.38	40.15	39.93	39.70	39.48	39.25	39.03	38.81	38.58

H3C	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
H3D	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3E	60.4	60.36	60.18	59.95	59.73	59.50	59.28	59.05	58.83	58.61	58.38
H3F	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3F	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3G	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3G	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3G	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3H	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3H	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3H	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3I	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3I	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3I	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3J	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3J	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3J	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3K	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3K	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3K	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3P	85.8	85.76	85.58	85.35	85.13	84.90	84.68	84.45	84.23	84.01	83.78
H3P	85.8	85.76	85.58	85.35	85.13	84.90	84.68	84.45	84.23	84.01	83.78
H3Q	85.8	85.76	85.58	85.35	85.13	84.90	84.68	84.45	84.23	84.01	83.78
H3R	60.4	60.36	60.18	59.95	59.73	59.50	59.28	59.05	58.83	58.61	58.38
H3R	60.4	60.36	60.18	59.95	59.73	59.50	59.28	59.05	58.83	58.61	58.38
H3S	60.4	60.36	60.18	59.95	59.73	59.50	59.28	59.05	58.83	58.61	58.38
H3T	45.1	45.06	44.88	44.65	44.43	44.20	43.98	43.75	43.53	43.31	43.08
H3U	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58

H3U	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
H3V	60.4	60.36	60.18	59.95	59.73	59.50	59.28	59.05	58.83	58.61	58.38
H3W	60.4	60.36	60.18	59.95	59.73	59.50	59.28	59.05	58.83	58.61	58.38
H3X	31.8	31.76	31.58	31.35	31.13	30.90	30.68	30.45	30.23	30.01	29.78
H3Y	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
H3Z	85.2	85.16	84.98	84.75	84.53	84.30	84.08	83.85	83.63	83.41	83.18
HA3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HB3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HB3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HC3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HC3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HC3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HD3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HE3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HE3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HE3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HF3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HF3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HG3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HG3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HG3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HH3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HH3	75.6	75.56	75.38	75.15	74.93	74.70	74.48	74.25	74.03	73.81	73.58
HI3	60.4	60.36	60.18	59.95	59.73	59.50	59.28	59.05	58.83	58.61	58.38
L10	170	169.96	169.78	169.55	169.33	169.10	168.88	168.65	168.43	168.21	167.98
L10	165	164.96	164.78	164.55	164.33	164.10	163.88	163.65	163.43	163.21	162.98
L10	162.6	162.56	162.38	162.15	161.93	161.70	161.48	161.25	161.03	160.81	160.58
L10	168.6	168.56	168.38	168.15	167.93	167.70	167.48	167.25	167.03	166.81	166.58

L13	165	164.96	164.78	164.55	164.33	164.10	163.88	163.65	163.43	163.21	162.98
L13	162.6	162.56	162.38	162.15	161.93	161.70	161.48	161.25	161.03	160.81	160.58
L13	168.6	168.56	168.38	168.15	167.93	167.70	167.48	167.25	167.03	166.81	166.58
L14	170	169.96	169.78	169.55	169.33	169.10	168.88	168.65	168.43	168.21	167.98
L14	165	164.96	164.78	164.55	164.33	164.10	163.88	163.65	163.43	163.21	162.98
L14	162.6	162.56	162.38	162.15	161.93	161.70	161.48	161.25	161.03	160.81	160.58
L14	168.6	168.56	168.38	168.15	167.93	167.70	167.48	167.25	167.03	166.81	166.58
L15	168.6	168.56	168.38	168.15	167.93	167.70	167.48	167.25	167.03	166.81	166.58
LDT	117.6	117.56	117.38	117.15	116.93	116.70	116.48	116.25	116.03	115.81	115.58
LDT	117.6	117.56	117.38	117.15	116.93	116.70	116.48	116.25	116.03	115.81	115.58
LDT	120	119.96	119.78	119.55	119.33	119.10	118.88	118.65	118.43	118.21	117.98
LG6	170	169.96	169.78	169.55	169.33	169.10	168.88	168.65	168.43	168.21	167.98
LG6	165	164.96	164.78	164.55	164.33	164.10	163.88	163.65	163.43	163.21	162.98
LG6	162.6	162.56	162.38	162.15	161.93	161.70	161.48	161.25	161.03	160.81	160.58
LG6	168.6	168.56	168.38	168.15	167.93	167.70	167.48	167.25	167.03	166.81	166.58
LKT	117.6	117.56	117.38	117.15	116.93	116.70	116.48	116.25	116.03	115.81	115.58
LKT	117.6	117.56	117.38	117.15	116.93	116.70	116.48	116.25	116.03	115.81	115.58
LKT	120	119.96	119.78	119.55	119.33	119.10	118.88	118.65	118.43	118.21	117.98
LTJ	76.2	76.16	75.98	75.75	75.53	75.30	75.08	74.85	74.63	74.41	74.18
LTJ	75	74.96	74.78	74.55	74.33	74.10	73.88	73.65	73.43	73.21	72.98
LTJ	75	74.96	74.78	74.55	74.33	74.10	73.88	73.65	73.43	73.21	72.98
LTK	66	65.96	65.78	65.55	65.33	65.10	64.88	64.65	64.43	64.21	63.98
LTK	64.8	64.76	64.58	64.35	64.13	63.90	63.68	63.45	63.23	63.01	62.78
LTL	75	74.96	74.78	74.55	74.33	74.10	73.88	73.65	73.43	73.21	72.98
LTL	75	74.96	74.78	74.55	74.33	74.10	73.88	73.65	73.43	73.21	72.98
LTM	64.8	64.76	64.58	64.35	64.13	63.90	63.68	63.45	63.23	63.01	62.78
LTT	117.6	117.56	117.38	117.15	116.93	116.70	116.48	116.25	116.03	115.81	115.58
XE1	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98

XE1	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XE1	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XE2	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
XE2	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XE2	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XE3	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
XE3	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XF1	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
XF1	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XF2	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
XF2	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XF3	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
XF3	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XGB	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XGB	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
XHA	76.2	76.16	75.98	75.75	75.53	75.30	75.08	74.85	74.63	74.41	74.18
XHA	76.2	76.16	75.98	75.75	75.53	75.30	75.08	74.85	74.63	74.41	74.18
XHA	73.8	73.76	73.58	73.35	73.13	72.90	72.68	72.45	72.23	72.01	71.78
XHB	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
XHB	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XHB	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XIA	73.8	73.76	73.58	73.35	73.13	72.90	72.68	72.45	72.23	72.01	71.78
XIA	68.7	68.66	68.48	68.25	68.03	67.80	67.58	67.35	67.13	66.91	66.68
XIA	71.1	71.06	70.88	70.65	70.43	70.20	69.98	69.75	69.53	69.31	69.08
XIA	71.1	71.06	70.88	70.65	70.43	70.20	69.98	69.75	69.53	69.31	69.08
XIB	71.1	71.06	70.88	70.65	70.43	70.20	69.98	69.75	69.53	69.31	69.08
XJA	73.8	73.76	73.58	73.35	73.13	72.90	72.68	72.45	72.23	72.01	71.78
XJB	73.8	73.76	73.58	73.35	73.13	72.90	72.68	72.45	72.23	72.01	71.78

XJB	68.7	68.66	68.48	68.25	68.03	67.80	67.58	67.35	67.13	66.91	66.68
XJB	71.1	71.06	70.88	70.65	70.43	70.20	69.98	69.75	69.53	69.31	69.08
XKA	61	60.96	60.78	60.55	60.33	60.10	59.88	59.65	59.43	59.21	58.98
XKA	58.6	58.56	58.38	58.15	57.93	57.70	57.48	57.25	57.03	56.81	56.58
XKB	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98
XKB	91.4	91.36	91.18	90.95	90.73	90.50	90.28	90.05	89.83	89.61	89.38
XLA	73.8	73.76	73.58	73.35	73.13	72.90	72.68	72.45	72.23	72.01	71.78
XMB	117.6	117.56	117.38	117.15	116.93	116.70	116.48	116.25	116.03	115.81	115.58
XMB	78.9	78.86	78.68	78.45	78.23	78.00	77.78	77.55	77.33	77.11	76.88
XNA	76.2	76.16	75.98	75.75	75.53	75.30	75.08	74.85	74.63	74.41	74.18
XNA	73.8	73.76	73.58	73.35	73.13	72.90	72.68	72.45	72.23	72.01	71.78
XPB	73.8	73.76	73.58	73.35	73.13	72.90	72.68	72.45	72.23	72.01	71.78
XVB	89	88.96	88.78	88.55	88.33	88.10	87.88	87.65	87.43	87.21	86.98

Wall thickness reduction for Paik 1998.

Group Member	(cm)	5 Years	10 Years	15 Years	20 Years	25 Years
CSB	1.29	1.25	1.23	1.22	1.22	1.29
CSB	0.79	0.75	0.73	0.72	0.72	0.79
CSB	1.99	1.95	1.93	1.92	1.92	1.99
CSB	2.49	2.45	2.43	2.42	2.42	2.49
CSC	1.99	1.95	1.93	1.92	1.92	1.99
CSC	1.99	1.95	1.93	1.92	1.92	1.99
CSC	1.29	1.25	1.23	1.22	1.22	1.29
CSD	1.99	1.95	1.93	1.92	1.92	1.99
CSD	1.99	1.95	1.93	1.92	1.92	1.99
CSD	1.29	1.25	1.23	1.22	1.22	1.29
CSE	1.29	1.25	1.23	1.22	1.22	1.29
CSE	0.79	0.75	0.73	0.72	0.72	0.79
CSE	1.99	1.95	1.93	1.92	1.92	1.99
CSE	2.49	2.45	2.43	2.42	2.42	2.49
CSG	1.99	1.95	1.93	1.92	1.92	1.99
CSG	1.29	1.25	1.23	1.22	1.22	1.29
CSH	1.29	1.25	1.23	1.22	1.22	1.29
CSH	0.79	0.75	0.73	0.72	0.72	0.79
CSH	1.99	1.95	1.93	1.92	1.92	1.99
CSH	2.49	2.45	2.43	2.42	2.42	2.49
CSJ	2.49	2.45	2.43	2.42	2.42	2.49
CSK	2.49	2.45	2.43	2.42	2.42	2.49
CSK	1.49	1.45	1.43	1.42	1.42	1.49
CSK	1.49	1.45	1.43	1.42	1.42	1.49
CSK	2.49	2.45	2.43	2.42	2.42	2.49
H3C	1.69	1.65	1.63	1.62	1.62	1.69
H3D	0.89	0.85	0.83	0.82	0.82	0.89
H3E	0.89	0.85	0.83	0.82	0.82	0.89
H3F	2.39	2.35	2.33	2.32	2.32	2.39
H3F	0.89	0.85	0.83	0.82	0.82	0.89

H3G	2.39	2.35	2.33	2.32	2.32	2.39
H3G	0.89	0.85	0.83	0.82	0.82	0.89
H3G	2.39	2.35	2.33	2.32	2.32	2.39
H3H	2.39	2.35	2.33	2.32	2.32	2.39
H3H	0.89	0.85	0.83	0.82	0.82	0.89
H3H	2.39	2.35	2.33	2.32	2.32	2.39
H3I	2.39	2.35	2.33	2.32	2.32	2.39
H3I	0.89	0.85	0.83	0.82	0.82	0.89
H3I	2.39	2.35	2.33	2.32	2.32	2.39
H3J	2.39	2.35	2.33	2.32	2.32	2.39
H3J	2.39	2.35	2.33	2.32	2.32	2.39
H3J	2.39	2.35	2.33	2.32	2.32	2.39
H3K	2.39	2.35	2.33	2.32	2.32	2.39
H3K	2.39	2.35	2.33	2.32	2.32	2.39
H3K	2.39	2.35	2.33	2.32	2.32	2.39
H3P	2.19	2.15	2.13	2.12	2.12	2.19
H3P	2.69	2.65	2.63	2.62	2.62	2.69
H3Q	2.69	2.65	2.63	2.62	2.62	2.69
H3R	2.19	2.15	2.13	2.12	2.12	2.19
H3R	1.19	1.15	1.13	1.12	1.12	1.19
H3S	2.19	2.15	2.13	2.12	2.12	2.19
H3T	1.69	1.65	1.63	1.62	1.62	1.69
H3U	2.69	2.65	2.63	2.62	2.62	2.69
H3U	1.19	1.15	1.13	1.12	1.12	1.19
H3V	2.19	2.15	2.13	2.12	2.12	2.19
H3W	1.19	1.15	1.13	1.12	1.12	1.19
H3X	0.96	0.92	0.90	0.89	0.89	0.96
H3Y	2.39	2.35	2.33	2.32	2.32	2.39
H3Z	2.39	2.35	2.33	2.32	2.32	2.39
HA3	2.19	2.15	2.13	2.12	2.12	2.19
HB3	2.19	2.15	2.13	2.12	2.12	2.19
HB3	3.19	3.15	3.13	3.12	3.12	3.19
HC3	3.19	3.15	3.13	3.12	3.12	3.19

HC3	2.19	2.15	2.13	2.12	2.12	2.19
HC3	3.19	3.15	3.13	3.12	3.12	3.19
HD3	3.19	3.15	3.13	3.12	3.12	3.19
HE3	3.19	3.15	3.13	3.12	3.12	3.19
HE3	2.19	2.15	2.13	2.12	2.12	2.19
HE3	3.19	3.15	3.13	3.12	3.12	3.19
HF3	2.19	2.15	2.13	2.12	2.12	2.19
HF3	3.19	3.15	3.13	3.12	3.12	3.19
HG3	3.19	3.15	3.13	3.12	3.12	3.19
HG3	2.19	2.15	2.13	2.12	2.12	2.19
HG3	3.19	3.15	3.13	3.12	3.12	3.19
HH3	3.19	3.15	3.13	3.12	3.12	3.19
HH3	2.19	2.15	2.13	2.12	2.12	2.19
HI3	1.69	1.65	1.63	1.62	1.62	1.69
L10	4.99	4.95	4.93	4.92	4.92	4.99
L10	2.49	2.45	2.43	2.42	2.42	2.49
L10	1.29	1.25	1.23	1.22	1.22	1.29
L10	4.29	4.25	4.23	4.22	4.22	4.29
L13	2.49	2.45	2.43	2.42	2.42	2.49
L13	1.29	1.25	1.23	1.22	1.22	1.29
L13	4.29	4.25	4.23	4.22	4.22	4.29
L14	4.99	4.95	4.93	4.92	4.92	4.99
L14	2.49	2.45	2.43	2.42	2.42	2.49
L14	1.29	1.25	1.23	1.22	1.22	1.29
L14	4.29	4.25	4.23	4.22	4.22	4.29
L15	4.29	4.25	4.23	4.22	4.22	4.29
LDT	3.79	3.75	3.73	3.72	3.72	3.79
LDT	0.79	0.75	0.73	0.72	0.72	0.79
LDT	3.99	3.95	3.93	3.92	3.92	3.99
LG6	4.99	4.95	4.93	4.92	4.92	4.99
LG6	2.49	2.45	2.43	2.42	2.42	2.49
LG6	1.29	1.25	1.23	1.22	1.22	1.29
LG6	4.29	4.25	4.23	4.22	4.22	4.29

LKT	3.79	3.75	3.73	3.72	3.72	3.79
LKT	0.79	0.75	0.73	0.72	0.72	0.79
LKT	3.99	3.95	3.93	3.92	3.92	3.99
LTJ	1.99	1.95	1.93	1.92	1.92	1.99
LTJ	1.39	1.35	1.33	1.32	1.32	1.39
LTJ	2.39	2.35	2.33	2.32	2.32	2.39
LTK	1.99	1.95	1.93	1.92	1.92	1.99
LTK	1.39	1.35	1.33	1.32	1.32	1.39
LTL	1.39	1.35	1.33	1.32	1.32	1.39
LTL	2.39	2.35	2.33	2.32	2.32	2.39
LTM	1.39	1.35	1.33	1.32	1.32	1.39
LTT	3.79	3.75	3.73	3.72	3.72	3.79
XE1	1.29	1.25	1.23	1.22	1.22	1.29
XE1	2.49	2.45	2.43	2.42	2.42	2.49
XE1	3.99	3.95	3.93	3.92	3.92	3.99
XE2	1.29	1.25	1.23	1.22	1.22	1.29
XE2	2.49	2.45	2.43	2.42	2.42	2.49
XE2	3.99	3.95	3.93	3.92	3.92	3.99
XE3	1.29	1.25	1.23	1.22	1.22	1.29
XE3	3.99	3.95	3.93	3.92	3.92	3.99
XF1	0.79	0.75	0.73	0.72	0.72	0.79
XF1	1.99	1.95	1.93	1.92	1.92	1.99
XF2	1.29	1.25	1.23	1.22	1.22	1.29
XF2	2.49	2.45	2.43	2.42	2.42	2.49
XF3	0.79	0.75	0.73	0.72	0.72	0.79
XF3	1.99	1.95	1.93	1.92	1.92	1.99
XGB	3.99	3.95	3.93	3.92	3.92	3.99
XGB	0.79	0.75	0.73	0.72	0.72	0.79
XHA	2.99	2.95	2.93	2.92	2.92	2.99
XHA	2.99	2.95	2.93	2.92	2.92	2.99
XHA	1.79	1.75	1.73	1.72	1.72	1.79
XHB	0.79	0.75	0.73	0.72	0.72	0.79
XHB	1.99	1.95	1.93	1.92	1.92	1.99

XHB	3.99	3.95	3.93	3.92	3.92	3.99
XIA	1.79	1.75	1.73	1.72	1.72	1.79
XIA	2.29	2.25	2.23	2.22	2.22	2.29
XIA	3.49	3.45	3.43	3.42	3.42	3.49
XIA	2.99	2.95	2.93	2.92	2.92	2.99
XIB	2.99	2.95	2.93	2.92	2.92	2.99
XJA	1.79	1.75	1.73	1.72	1.72	1.79
XJB	1.79	1.75	1.73	1.72	1.72	1.79
XJB	2.29	2.25	2.23	2.22	2.22	2.29
XJB	3.49	3.45	3.43	3.42	3.42	3.49
XKA	1.99	1.95	1.93	1.92	1.92	1.99
XKA	0.79	0.75	0.73	0.72	0.72	0.79
XKB	1.29	1.25	1.23	1.22	1.22	1.29
XKB	3.99	3.95	3.93	3.92	3.92	3.99
XLA	1.79	1.75	1.73	1.72	1.72	1.79
XMB	3.79	3.75	3.73	3.72	3.72	3.79
XMB	1.79	1.75	1.73	1.72	1.72	1.79
XNA	2.99	2.95	2.93	2.92	2.92	2.99
XNA	1.79	1.75	1.73	1.72	1.72	1.79
XPB	1.79	1.75	1.73	1.72	1.72	1.79
XVB	1.79	1.75	1.73	1.72	1.72	1.79

Outer Diameter reduction for Paik 1998.

Group Member	(cm)	5 Years	10 Years	15 Years	20 Years	25 Years
CSB	78.88	78.80	78.75	78.74	78.74	78.88
CSB	78.88	78.80	78.75	78.74	78.74	78.88
CSB	81.28	81.20	81.15	81.14	81.14	81.28
CSB	81.28	81.20	81.15	81.14	81.14	81.28
CSC	81.28	81.20	81.15	81.14	81.14	81.28
CSC	81.28	81.20	81.15	81.14	81.14	81.28
CSC	78.88	78.80	78.75	78.74	78.74	78.88
CSD	91.38	91.30	91.25	91.24	91.24	91.38
CSD	91.38	91.30	91.25	91.24	91.24	91.38
CSD	88.98	88.90	88.85	88.84	88.84	88.98
CSE	88.98	88.90	88.85	88.84	88.84	88.98
CSE	88.98	88.90	88.85	88.84	88.84	88.98
CSE	91.38	91.30	91.25	91.24	91.24	91.38
CSE	91.38	91.30	91.25	91.24	91.24	91.38
CSG	81.28	81.20	81.15	81.14	81.14	81.28
CSG	78.88	78.80	78.75	78.74	78.74	78.88
CSH	78.88	78.80	78.75	78.74	78.74	78.88
CSH	78.88	78.80	78.75	78.74	78.74	78.88
CSH	81.28	81.20	81.15	81.14	81.14	81.28
CSH	81.28	81.20	81.15	81.14	81.14	81.28
CSJ	40.58	40.50	40.45	40.44	40.44	40.58
CSK	40.58	40.50	40.45	40.44	40.44	40.58
CSK	40.58	40.50	40.45	40.44	40.44	40.58
CSK	40.58	40.50	40.45	40.44	40.44	40.58
CSK	40.58	40.50	40.45	40.44	40.44	40.58
H3C	75.58	75.50	75.45	75.44	75.44	75.58
H3D	85.18	85.10	85.05	85.04	85.04	85.18
H3E	60.38	60.30	60.25	60.24	60.24	60.38
H3F	85.18	85.10	85.05	85.04	85.04	85.18
H3F	85.18	85.10	85.05	85.04	85.04	85.18

H3G	85.18	85.10	85.05	85.04	85.04	85.18
H3G	85.18	85.10	85.05	85.04	85.04	85.18
H3G	85.18	85.10	85.05	85.04	85.04	85.18
H3H	85.18	85.10	85.05	85.04	85.04	85.18
H3H	85.18	85.10	85.05	85.04	85.04	85.18
H3H	85.18	85.10	85.05	85.04	85.04	85.18
H3I	85.18	85.10	85.05	85.04	85.04	85.18
H3I	85.18	85.10	85.05	85.04	85.04	85.18
H3I	85.18	85.10	85.05	85.04	85.04	85.18
H3J	85.18	85.10	85.05	85.04	85.04	85.18
H3J	85.18	85.10	85.05	85.04	85.04	85.18
H3J	85.18	85.10	85.05	85.04	85.04	85.18
H3K	85.18	85.10	85.05	85.04	85.04	85.18
H3K	85.18	85.10	85.05	85.04	85.04	85.18
H3K	85.18	85.10	85.05	85.04	85.04	85.18
H3P	85.78	85.70	85.65	85.64	85.64	85.78
H3P	85.78	85.70	85.65	85.64	85.64	85.78
H3Q	85.78	85.70	85.65	85.64	85.64	85.78
H3R	60.38	60.30	60.25	60.24	60.24	60.38
H3R	60.38	60.30	60.25	60.24	60.24	60.38
H3S	60.38	60.30	60.25	60.24	60.24	60.38
H3T	45.08	45.00	44.95	44.94	44.94	45.08
H3U	75.58	75.50	75.45	75.44	75.44	75.58
H3U	75.58	75.50	75.45	75.44	75.44	75.58
H3V	60.38	60.30	60.25	60.24	60.24	60.38
H3W	60.38	60.30	60.25	60.24	60.24	60.38
H3X	31.78	31.70	31.65	31.64	31.64	31.78
H3Y	85.18	85.10	85.05	85.04	85.04	85.18
H3Z	85.18	85.10	85.05	85.04	85.04	85.18
HA3	75.58	75.50	75.45	75.44	75.44	75.58
HB3	75.58	75.50	75.45	75.44	75.44	75.58
HB3	75.58	75.50	75.45	75.44	75.44	75.58
HC3	75.58	75.50	75.45	75.44	75.44	75.58

HC3	75.58	75.50	75.45	75.44	75.44	75.58
HC3	75.58	75.50	75.45	75.44	75.44	75.58
HD3	75.58	75.50	75.45	75.44	75.44	75.58
HE3	75.58	75.50	75.45	75.44	75.44	75.58
HE3	75.58	75.50	75.45	75.44	75.44	75.58
HE3	75.58	75.50	75.45	75.44	75.44	75.58
HF3	75.58	75.50	75.45	75.44	75.44	75.58
HF3	75.58	75.50	75.45	75.44	75.44	75.58
HG3	75.58	75.50	75.45	75.44	75.44	75.58
HG3	75.58	75.50	75.45	75.44	75.44	75.58
HG3	75.58	75.50	75.45	75.44	75.44	75.58
HH3	75.58	75.50	75.45	75.44	75.44	75.58
HH3	75.58	75.50	75.45	75.44	75.44	75.58
HI3	60.38	60.30	60.25	60.24	60.24	60.38
L10	169.98	169.90	169.85	169.84	169.84	169.98
L10	164.98	164.90	164.85	164.84	164.84	164.98
L10	162.58	162.50	162.45	162.44	162.44	162.58
L10	168.58	168.50	168.45	168.44	168.44	168.58
L13	164.98	164.90	164.85	164.84	164.84	164.98
L13	162.58	162.50	162.45	162.44	162.44	162.58
L13	168.58	168.50	168.45	168.44	168.44	168.58
L14	169.98	169.90	169.85	169.84	169.84	169.98
L14	164.98	164.90	164.85	164.84	164.84	164.98
L14	162.58	162.50	162.45	162.44	162.44	162.58
L14	168.58	168.50	168.45	168.44	168.44	168.58
L15	168.58	168.50	168.45	168.44	168.44	168.58
LDT	117.58	117.50	117.45	117.44	117.44	117.58
LDT	117.58	117.50	117.45	117.44	117.44	117.58
LDT	119.98	119.90	119.85	119.84	119.84	119.98
LG6	169.98	169.90	169.85	169.84	169.84	169.98
LG6	164.98	164.90	164.85	164.84	164.84	164.98
LG6	162.58	162.50	162.45	162.44	162.44	162.58
LG6	168.58	168.50	168.45	168.44	168.44	168.58

LKT	117.58	117.50	117.45	117.44	117.44	117.58
LKT	117.58	117.50	117.45	117.44	117.44	117.58
LKT	119.98	119.90	119.85	119.84	119.84	119.98
LTJ	76.18	76.10	76.05	76.04	76.04	76.18
LTJ	74.98	74.90	74.85	74.84	74.84	74.98
LTJ	74.98	74.90	74.85	74.84	74.84	74.98
LTK	65.98	65.90	65.85	65.84	65.84	65.98
LTK	64.78	64.70	64.65	64.64	64.64	64.78
LTL	74.98	74.90	74.85	74.84	74.84	74.98
LTL	74.98	74.90	74.85	74.84	74.84	74.98
LTM	64.78	64.70	64.65	64.64	64.64	64.78
LTT	117.58	117.50	117.45	117.44	117.44	117.58
XE1	88.98	88.90	88.85	88.84	88.84	88.98
XE1	91.38	91.30	91.25	91.24	91.24	91.38
XE1	91.38	91.30	91.25	91.24	91.24	91.38
XE2	88.98	88.90	88.85	88.84	88.84	88.98
XE2	91.38	91.30	91.25	91.24	91.24	91.38
XE2	91.38	91.30	91.25	91.24	91.24	91.38
XE3	88.98	88.90	88.85	88.84	88.84	88.98
XE3	91.38	91.30	91.25	91.24	91.24	91.38
XF1	88.98	88.90	88.85	88.84	88.84	88.98
XF1	91.38	91.30	91.25	91.24	91.24	91.38
XF2	88.98	88.90	88.85	88.84	88.84	88.98
XF2	91.38	91.30	91.25	91.24	91.24	91.38
XF3	88.98	88.90	88.85	88.84	88.84	88.98
XF3	91.38	91.30	91.25	91.24	91.24	91.38
XGB	91.38	91.30	91.25	91.24	91.24	91.38
XGB	88.98	88.90	88.85	88.84	88.84	88.98
XHA	76.18	76.10	76.05	76.04	76.04	76.18
XHA	76.18	76.10	76.05	76.04	76.04	76.18
XHA	73.78	73.70	73.65	73.64	73.64	73.78
XHB	88.98	88.90	88.85	88.84	88.84	88.98
XHB	91.38	91.30	91.25	91.24	91.24	91.38

XHB	91.38	91.30	91.25	91.24	91.24	91.38
XIA	73.78	73.70	73.65	73.64	73.64	73.78
XIA	68.68	68.60	68.55	68.54	68.54	68.68
XIA	71.08	71.00	70.95	70.94	70.94	71.08
XIA	71.08	71.00	70.95	70.94	70.94	71.08
XIB	71.08	71.00	70.95	70.94	70.94	71.08
XJA	73.78	73.70	73.65	73.64	73.64	73.78
XJB	73.78	73.70	73.65	73.64	73.64	73.78
XJB	68.68	68.60	68.55	68.54	68.54	68.68
XJB	71.08	71.00	70.95	70.94	70.94	71.08
XKA	60.98	60.90	60.85	60.84	60.84	60.98
XKA	58.58	58.50	58.45	58.44	58.44	58.58
XKB	88.98	88.90	88.85	88.84	88.84	88.98
XKB	91.38	91.30	91.25	91.24	91.24	91.38
XLA	73.78	73.70	73.65	73.64	73.64	73.78
XMB	117.58	117.50	117.45	117.44	117.44	117.58
XMB	78.88	78.80	78.75	78.74	78.74	78.88
XNA	76.18	76.10	76.05	76.04	76.04	76.18
XNA	73.78	73.70	73.65	73.64	73.64	73.78
XPB	73.78	73.70	73.65	73.64	73.64	73.78
XVB	88.98	88.90	88.85	88.84	88.84	88.98