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EVALUATION OF REST CONDITIONS OF THE ACCOMMODATION AREAS USED FOR REST ON BOARD

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DECLARATION

I hereby declare that this master's thesis titled as "Evaluation of Rest Conditions of the Accommodation Areas Used for Rest on Board" has been written by me in accordance with the academic rules and ethical conduct. I also declare that all materials benefited in this thesis consist of the mentioned resources in the reference list. I verify all these with my honor.

23/07/2018

Giray Yiğit KOLCUBAŞI

ABSTRACT

Master's Thesis

Evaluation of Rest Conditions of the Accommodation Areas Used for Rest on Board

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Ergonomics studies have widely been addressed for the job-specific fields. This situation is also observed in the maritime industry due to the fact that focus point of the studies is bridge ergonomics. Statistics have shown that main reason of maritime accidents is fatigue as a reflection of human factor, thereby rest and rest conditions on board become a vital issue. However, in the literature, accommodation areas used for rest on board and their rest conditions including ergonomic criteria have been overlooked.

The purpose of this study is to determine what extent to which seafarers find rest areas' conditions satisfying. In this context, ergonomic measurements for a ship berthing at Alsancak Port has been carried out with the aim of understanding ergonomic measurement methods and seafarers' rest environments. In addition, a questionnaire survey has been applied. The sample of the study is composed of 74 seafarers. Turkish seafarers working in vessels calling to İzmir Alsancak Port, Turkish seafarers working in scientific research vessels and Dokuz Eylül University Maritime Faculty students working as a ship cadet as long as their internship period have been selected as sample.

The findings indicate that comfort perception of seafarers varies. Moreover, seafarers' marital status and education level has been found the determinants of their comfort perception.

Keywords: Maritime Accidents, Fatigue, Ergonomics, Accommodation Areas on board, Rest Conditions.

ÖZET

Yüksek Lisans Tezi

Gemide Dinlenme Amacıyla Kullanılan Yaşam Mahallerinin Dinlenme Koşullarının Değerlendirilmesi

Giray Yiğit KOLCUBAŞI

Dokuz Eylül Üniversitesi

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Denizcilik İşletmeleri ve Yönetimi Anabilim Dalı

Denizcilik İşletmeleri ve Yönetimi Programı

Ergonomi çalışmaları, işe özel alanlar için yaygın olarak ele alınmıştır. Bu durum, denizcilik sektöründe de, çalışmaların odak noktasının köprüüstü ergonomisi olması nedeniyle gözlemlenmektedir. İstatistikler, deniz kazalarının temel nedeninin insan faktörünün bir yansıması olan yorgunluk olduğunu göstermiş, böylece gemideki dinlenme ve dinlenme koşulları hayati bir konu haline gelmiştir. Ancak, literatürde, gemide dinlenme amacıyla kullanılan yaşam mahalleri ve ergonomik koşulları da içeren dinlenme koşulları göz ardı edilmiştir.

Bu çalışmanın amacı gemi adamlarının gemideki dinlenme koşullarını ne ölçüde tatmin edici bulduklarını saptamaktır. Bu kapsamda, ergonomik ölçüm yöntemlerini ve gemi adamlarının dinlenme ortamlarını anlamak amacıyla, Alsancak Limanı'nda bulunan bir gemide ergonomik ölçümler gerçekleştirilmiştir. Ek olarak, bir anket çalışması gerçekleştirilmiştir. Bu çalışmanın örneklemi 74 gemi adamından oluşmaktadır. Alsancak Limanı'na uğrak yapan gemilerde çalışan Türk gemi adamları, bilimsel araştırma gemilerinde çalışan Türk gemi adamları ve zorunlu stajları için gemide stajyer olarak çalışan Dokuz Eylül Üniversitesi Denizcilik Fakültesi öğrencileri örneklem olarak seçilmiştir.

Bulgular, gemi adamlarının konfor algısının değişiklik gösterdiğini işaret etmektedir. Ayrıca, gemi adamlarının medeni durumu ve eğitim düzeylerinin konfor algısı üzerinde belirleyici unsurlar olduğu bulunmuştur.

Anahtar kelimeler: Deniz kazaları, Yorgunluk, Ergonomi, Gemideki Yaşam Mahalleri, Dinlenme Koşulları.

EVALUATION OF REST CONDITIONS OF THE ACCOMMODATION AREAS USED FOR REST ON BOARD

CONTENTS

THESIS APPROVAL PAGE	ii
DECLERATION	iii
ABSTRACT	iv
ÖZET	vi
CONTENTS	viii
LIST OF ABBREVIATIONS	xii
LIST OF TABLES	xiv
LIST OF FIGURES	xvi
LIST OF APPENDICES	xvii
INTRODUCTION	1

CHAPTER ONE

HUMAN ELEMENT

1.1. HUMAN ELEMENT IN THE MARITIME FIELD	2
1.2. MARITIME ACCIDENTS AND HUMAN ERROR	3
1.3. FATIGUE	5
1.4. FATIGUE AS A REASON OF HUMAN ERROR	6

CHAPTER TWO

ERGONOMICS

2.1. DEFINITION OF ERGONOMICS	8
2.2. HISTORY OF ERGONOMICS	9

2.3. OBJECTIVES OF ERGONOMICS 10
2.4. REST AREAS ERGONOMIC PRINCIPLES 10
2.4.1. Noise 11
2.4.1.1. Effects on Noise on Seafarers' Life 12
2.4.1.2. Control and Mitigation of Noise 13
2.4.2. Vibration 14
2.4.2.1. Effects of Vibration to Seafarers' Life 15
2.4.2.2. Control and Mitigation of Vibration 16
2.4.3. Thermal Comfort 17
2.4.3.1. Determinants of Thermal Comfort 17
2.4.3.1.1. Metabolic Rate 18
2.4.3.1.2. Clothing Insulation 18
2.4.3.1.3. Air Temperature 19
2.4.3.1.4. Radiant Temperature 19
2.4.3.1.5. Air Speed 19
2.4.3.1.6. Humidity 20
2.4.4. Ventilation 20
2.4.4.1. Natural Ventilation 21
2.4.4.2. Mechanical Ventilation 21
2.4.4.3. Hybrid Ventilation 22
2.4.5. Lighting 22
2.4.5.1. Daylighting 24
2.4.5.2. Artificial Lighting 24
2.4.6. Bed and Furniture 25

CHAPTER THREE

ILO REGULATIONS AND ABS THE GUIDE FOR CREW HABITABILITY ON SHIPS 2016

3.1. C133 – ACCOMMODATION OF CREWS (SUPPLEMENTARY PROVISIONS) CONVENTION, 1970 (NO.133) 26

3.2. C147 – MERCHANT SHIPPING (MINIMUM STANDARDS) CONVENTION, 1976 (NO.147) 27
3.3. MARITIME LABOUR CONVENTION 2006 27
3.4. ABS – THE GUIDE FOR CREW HABITABILITY ON SHIPS 2016 27

CHAPTER FOUR

APPLICATION TO SEAFARERS' REST AREAS COMFORT PERCEPTION

4.1. AIM OF THE RESEARCH 35
4.2. STAGES OF THE RESEARCH 35
4.3. DATA COLLECTION TOOL 36
4.4. RELIABILITY ANALYSIS 38
4.5. ORGANIZATION AND ANALYSIS OF RESEARCH DATA 38
4.6. POPULATION AND SAMPLE OF THE RESEARCH 38
4.7. RESEARCH MODEL 38
4.8. HYPOTHESES OF RESEARCH 40
4.9. FINDINGS OF RESEARCH 41
4.9.1. Demographic Characteristics 41
4.9.2. Ship-Spesific Characteristics 43
4.9.3. Descriptive Statistics on Rest Areas Comfort Perception Questionnaire Survey 46
4.9.4. Statistical Analyses 46
4.9.4.1. Variability of Rest Areas' Thermal Comfort Perception by Age 46
4.9.4.2. Variability of Rest Areas' Thermal Comfort Perception by Gender 47
4.9.4.3. Variability of Rest Areas' Lighting Perception by Marital Status 47
4.9.4.4. Variability of Rest Areas' Bed-Furniture ComfortPerception by Marital Status 48
4.9.4.5. Variability of Rest Areas' Lighting Perception by Job Position 48
4.9.4.6. Variability of Rest Areas' Noise Perception by Education Level 49
4.9.4.7. Variability of Rest Areas' Noise Perception by Vessel Year of Built 50
4.9.4.8. Variability of Rest Areas' Vibration Perception by Vessel Year of Built 51

4.9.4.9. Variability of Rest Areas' Noise Perception by Type of Vessel 51
4.9.4.10. Variability of Rest Areas' Vibration Perception by Type of Vessel 52
4.10. FINDINGS OF RESEARCH 52

CONCLUSION 54
REFERENCES 56

LIST OF ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
ABCB	Australian Building Board Code
ABS	American Bureau of Shipping
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers, Inc.
a_w	Multi Axis Acceleration Value
dB	Decibel
dB(A)	Decibels Measured Using the A-Weighted Scale
DBT	Dry Bulb Temperature
DOSHA	Department of Occupational Safety and Health Malaysia
EASHW	European Agency for Safety and Health at Work
EMSA	European Maritime Safety Agency
ft/s	Feet per Second
HAB	Ship Habitability Notation
HAB+	Ship Habitability Plus Notation
HAB++	Ship Habitability Plus Plus Notation
HVAC	Heating, Ventilation, Air Conditioning
Hz	Hertz
IAQ	Internal Air Quality
IEA	International Ergonomics Association
ILO	International Labour Organization
IMO	International Maritime Organization
L_{Aeq}	Equivalent Continuous A-Weighted Sound Pressure Level
l/s	Liters per second
mm	Millimeter
m/s	Meters per Second
m/s^2	Meters per Second Squared
Rh	Relative Humidity
RMS	Root-Mean-Square

SPL Sound Pressure Level

LIST OF TABLES

Table 1: Human Error in Marine Accidents p. 4
Table 2: Some Definitions of Fatigue p. 6
Table 3: Some Definitions of Ergonomics p. 8
Table 4: Examples of Noise Levels p.11
Table 5: Frequency of Vibration and Its Effects on Human Body p.16
Table 6: Typical Light Levels Measured in LUX p.23
Table 7: HAB Notations p.28
Table 8: ILO MLC 2006, Title 3 Requirement p.29
Table 9: Maximum Weighted Root-Mean-Square Acceleration Level p.30
Table 10: Noise Criteria for Ships p.31
Table 11: Summary of Indoor Climate Requirements p.32
Table 12: Lighting Criteria for Crew Accommodation Spaces p.34
Table 13: Demographic Characteristics p.43
Table 14: Ship-Specific Characteristics p.45
Table 15: Descriptive Statistics on Rest Areas' Comfort Perception Questionnaire Survey p.46
Table 16: ANOVA Analysis in Relation to Thermal Comfort Perception by Age p. 47
Table 17: ANOVA Analysis in relation to Thermal Comfort Perception by Gender p.47
Table 18: ANOVA Analysis in relation to Lighting Perception by Marital Status p.48
Table 19: ANOVA Analysis in relation to Bed-Furniture Perception by Marital Status p.48
Table 20: ANOVA Analysis in relation to Lighting Perception by Job Position p.48
Table 21: ANOVA Analysis in Relation to Noise Perception by Education Level p.49
Table 22: ANOVA-Tukey Multiple Comparisons Test Analysis in Relation to Noise Perception by Education Level p.50
Table 23: ANOVA Analysis in Relation to Noise Perception by Vessel Year of Built p.50
Table 24: ANOVA Analysis in Relation to Vibration Perception by Vessel Year of Built p.51
Table 25: ANOVA Analysis in Relation to Noise Perception by Type of Vessel p.51

Table 26: ANOVA Analysis in Relation to Vibration Perception by Type of Vessel p.52

LIST OF FIGURES

Figure 1: Distribution of Accidental Events p.4
Figure 2: Relationship between Accidental Events and Contributing Factors p.5
Figure 3: Stages of Research p.36
Figure 4: Research Model p.39

LIST OF APPENDICES

Appendix 1: Measurement Report appendix p.1
Appendix 2: Calibration Certificates of Devices appendix p.15
Appendix 3: Questionnaire Survey Form appendix p.20

INTRODUCTION

The fundamental element in the maritime sector, as many other sectors, is human. General perspective to seafarers has been on their job-specific needs. Therefore, ergonomic criteria for seafarers' job environment, bridge in general, have widely been addressed. The nature of shipping necessitates a unique condition, working and living on board. This situation makes vessel a risky place with its potential accident impacts. Major reason of the maritime accidents is fatigue as a human element. Therefore, seafarers and their needs, especially rest-related conditions, should be overemphasised.

Seafarers spend their free times in cabins, hobby room and mess. Noise, lighting, thermal comfort, vibration and ventilation are the major ergonomic criteria for occupants' comfort need. Cabins are used for individual rest need, thereby bed and furniture have an also impact on seafarersi' comfort perception.

In the first chapter of the study, it has been explained that human error is the major factor of maritime accidents and fatigue is the main reason of human error.

In the second chapter of the study, ergonomics and its criteria has been adressed in the direction of seafarers needs.

In the third chapter, topic-related ILO conventions and criteria of ABS – The Guide for Crew Habitability on Ships 2016 have been evaluated.

In the fourth chapter, the questionnaire survey which is the application to seafarers' rest areas comfort perception has widely been addressed.

CHAPTER ONE
HUMAN ELEMENT

1.1. HUMAN ELEMENT IN THE MARITIME FIELD

The term human element includes a large variety of subjects. The meaning of the term differ by the profession of who use it. The term can be used interchangably with the human factors, human error and even human resource. There are many academic disciplines, particularly organizational behavior, ergonomics and occupational psychology, addressing human element as a field of study (Barnett and Pekcan, 2017: 1).

Human factor in the shipping industry is undeniably critical. Well-educated and highly motivated crew is needed for safe and efficient navigation. In terms of maritime safety, human element and cultural dimensions which human behavior constitutes are needed to be taken seriously (Oluseye and Ogunseye, 2016: 62).

Crew members are expected to be done their daily duties properly. This is an obvious prerequisite in elimination of threats which can be faced in emergent situations. However, mostly, human factor sharpens the threat and becomes an additional threat when an emergent situation occurs. Lisco Gloria ship fire is one of the most typical examples of this type of incidents. Commencing factor of the fire was technical deficiency. In spite of that, poor management of crew members, by spreading fire, induced dozens of injuries (Lozowicka and Kaup, 2015: 72-73).

Work process in ship has been a goal for comprehensive automation similar to the various technical-based work systems. In today's modern ships, human is mostly employed for planning, controlling and supervising activities. On the other hand, at the time when a serious and unfamiliar conditions arises, they are expected to be in active position and have some certain characteristics such as intuitional approach and flexibly dealing with problem (Hanzu-Pazara et al., 2008: 4).

1.2. MARITIME ACCIDENTS AND HUMAN ERROR

Accidents are faced in almost all domain of human presence and in the most of industrial works such as maritime and air transportation. Destructiveness of the accidents is confronted with corporate business success as well as lives and properties (Oluseye and Ogunseye, 2016: 61).

Over the years, maritime has been a perilous domain because of the complicated environment of vessel operation. Thus, maritime disasters had been experienced unavodiably (Anyanwu and Okoroji, 2014: 31).

It is accepted that maritime accidents has been experienced since human being for the first time put to sail. Later on, general acceptances about trade have been standardized and navigational rules have been constituted in the direction of the purpose of preventing marine accidents. Marine accidents which have been faced for the last century lead to a struggle in maritime industry to enhance shipbuilding, reliability of ship systems and operational organization that aims to minimize maritime accidents (Corovic and Djurovic, 2013: 369). Contrary to expectation, systems and regulations could not been succesful to decrease marine accidents which are happened by virtue of human errors (Berg, 2013: 344).

Deficiency in relaxation period, exhaustion, fatigue and insufficient alertness, mistake in radar information, carelessness in the direction of ship, deficiency in watching, technical incompetency, inadequate experience and knowledge, not take pains over rules and procedures may be accepted as human errors (Akten, 2006: 273).

The reasons why maritime industry and its administrative organs have been compelled to re-evaluate their positions with respect to safety at sea are the number of marine accidents and their results. In accordance with the purpose of making maritime transport more efficient and safer, human-oriented approach has gained attention more than overwhelmingly technology-based approach (Reyner and Baulk, 1998: 1).

With reference to the fact that error is certainly faced, within the context of error management, it is aimed to decrease the probability of error and its

consequences. In the case of big scale of disasters, reasons related with human error are attributed to operator error (Hanzu-Pazara et al., 2008: 5).

Table 1 shows that human error is the major contributor to tanker accident, towing vessel groundings, collusions, allisions and fires and explosions.

Table 1: Human Error in Marine Accidents

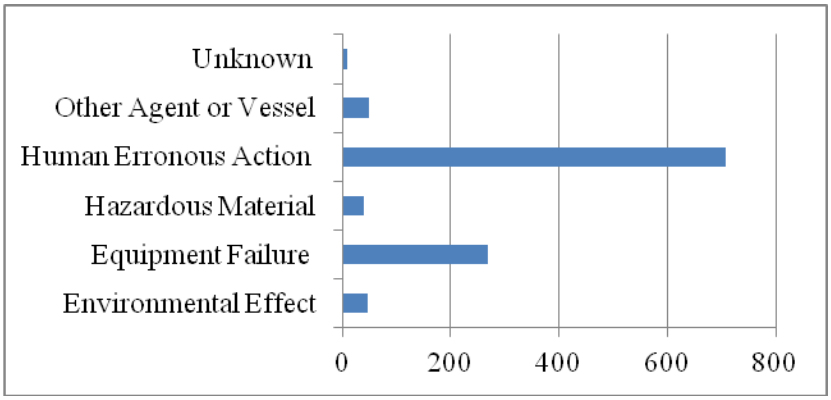
Accident Type	Percentage
Tanker Accident	84-88%
Towing Vessel Groundings	79%
Collusions	89-96 %
Allisions	75%
Fires and Explosions	75 %

Source: Rothblum, 2000: 7

Factors which have been thought to have an impact on incidents and casualties between the years of 2011-2016 were addressed in European Maritime Safety Agency (EMSA) Annual Overview of Marine Casualties and Incidents 2017. According to the annual overview, following results have been reached respectively:

As seen in Figure 1, 60.5 % of a total of 1170 accidental events investigated was connected to human erronous action.

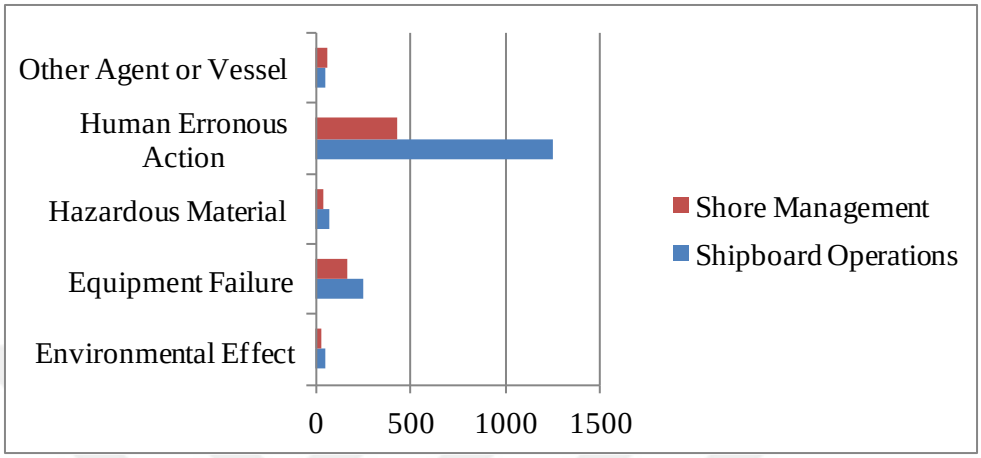
Figure 1: Distribution of Accidental Events



Source: EMSA, 2017: 30

As seen in Figure 2, shipboard operations were found to be the major effecting factor at 71% of the total.

Figure 2: Relationship between Accidental Events and Contributing Factors



Source: EMSA, 2017: 30

1.3. FATIGUE

Apart from work-related factors, factors other than work can also have an effect on fatigue. Sometimes, these two sources of fatigue can also be experienced together. While long shifts and exhausting jobs are typical examples of work-induced fatigue, low-quality of sleep arising from noise is an example of non work-induced fatigue (Safe Work Australia, 2013: 1). Some definitions of fatigue which are encountered in literature can be seen in Table 2.

Table 2: Some Definitions of Fatigue

AUTHOR	DEFINITION
Belza (1994)	*'' is the enduring, subjective sensation of generalized tiredness or exhaustion''*
Seaways (2006)	*''a state of feeling tired, weary, or sleepy that results from prolonged mental or physical work, extended periods of anxiety, exposure to harsh environments, or loss of sleep''*
Troxel M.W. et al (2015)	*''the cognitive, affective, or physical state of tiredness or weariness caused by exertion''*

In addition to physical tiredness, fatigue is also related with the condition of impaired alertness, inadequate carefulness, low-level-of physical and mental performance, diminishing motor coordination and slow responding to external influences. In the situation of fatigue, problems in the matter of environmental awareness, cognitive/logical reasoning skills, judgment, communication and processing information are encountered (Sirois, 2009: 5).

Fatigue is being widely addressed in terms of modes of transportation on a global basis. Influence of fatigue in maritime industry is further perilous compared to other modes of transport because of the distinctive aspects which seafaring offers (Xhelilaj and Lapa, 2010: 24).

1.4. FATIGUE AS A REASON OF HUMAN ERROR

Fatigue is a possible condition to be encountered for each individual during their life. Short-time sleep or eliminating factors which cause fatigue are expected to be succesful in preventing fatigue. Normally, fatigue can not be said to lead to the dangerous consequences. However, it can cause devastating consequences for the jobs which safety is important (www.faa.gov, 14.04.2018).

Through long ages, fatigue has not been considered as a potential reason to or a triggering element of human error. This approach was reling on an idea that some features such as strength, personality, motivation, intelligence, education, professionalism, training, skills, and physical size were effective in preventing fatigue. On the other hand, on the grounds of fatigue's effect on performance, current research outcomes indicated that fatigue has impact upon human error as a direct cause or a triggering factor (IMO, 2001: 4).

CHAPTER TWO
ERGONOMICS

In this part of the study, definition, history and objectives of ergonomics and the factors that has impact on rest are investigated.

2.1. DEFINITION OF ERGONOMICS

The origin of the word ergonomics based on the two Greek words ergon and nomos. While ergon means work, nomos means law. Human factors as term are preffered in use instead of ergonomics by some countries (Dul and Weerdmeester, 2008: 1). Some definitions of ergonomics which are encountered in literature are given at the table below.

Table 3: Some Definitons of Ergonomics

AUTHOR	DEFINITION
International Ergonomics Association (2000)	*''the scientific discipline concerned with understanding of the interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design, in order to optimize human well-being and overall system performance''.*
Waters (2010)	*''the science of fitting or matching workplace conditions and job demands to the capabilities of the working population''*
Lloyd's Register (2007)	*''the study and design of working environments – such as shipbridges, machinery control rooms and galleys; and their components, work practices, and work procedures – for the benefit of the workers' safety, efficiency, effectiveness, health, and comfort''.*
Fernandez (1995)	*''the design of the workplace, equipment, machine, tool, product, environment, and system, taking into consideration the human's physical, physiological, biomechanical, and psychological capabilities, and optimizing the effectiveness and productivity of work systems while assuring the safety, health, and wellbeing of the workers''.*

2.2. HISTORY OF ERGONOMICS

About one hundread years ago, a concensus on the need that working conditions and hours have to be legally organized considering health and safety requirements in some manufacturing plants and mines was arised. Regulations in respect to this working limits was seen as start point of ergonomics. In addition, the activities that fall into International Labour Organization (ILO)'s responsibility area at the present time were also started. (www.ilocis.org, 22.03.2018).

The fundamental development experinced in the 19th century was industrial revolution, especially for western nations. Unlike the perspective which had been common before, ergonomics became an essential issue in the field of industry. With the aim of developing work process, some tools and machines were presented to use. The aim in using those tools and machines was in the same line with today's ergonomics approach. In the early 19th century, labor-intensive production was dominant position in the industry and focus point was on how to improve productivity of workers. In addition to scientific management, Frederick W. Taylor was also the pioneer of ergonomics approach. He was looking for the best and easy ways for jobs. In line with this purpose, he raised production of worker by designing different shovels for each materials which were carried. Studies performed by Frank and Lillian Gilbreth such as standardizations in job process, tools and machines and time motion analysis were contributed to job efficiency and mitigation of fatigue (Pandve, 2017: 1).

World War II was a milestone in terms of approach to ergonomics. In this period, technology and human sciences were used in harmony. Individuals having different scientific backgrounds such as engineers, medical doctors, physiologists and anthropologists worked together regarding to the problems of hard-to-understand military equipments. Following outcomes of the philosophy of joint study was also emerged in the field of industry, national ergonomics society was established in England in the year of 1949. This year was also essential since ergonomics as a term was adopted. In 1961, an organization with the name of International Ergonomics Association (IEA) which stands for ergonomics societies acitvely working in more than 40 countries and regions was created. (Dul and Weedmeester, 2008: 1).

2.3. OBJECTIVES OF ERGONOMICS

Since interaction of machines and their users is the area of investigation for ergonomics, it is aimed to be enhanced the performance level of systems as well as interaction of machine and their users (Bridger, 2003: 1).

Under the concept of ergonomics, focus point is to make task appropriate to doer through removing and mitigating ergonomics - based problems. Accordingly, ergonomics contemplates to boost the level-of-harmony between doer and environment that work is done (Fernandez, 1995: 20).

Ergonomics has a guiding characterestic on human expectations in relation to workplaces, services given and products. From this aspect, ergonomics aims at forming a road map in the fields of management and engineering design (MacLeod, 2000: 4).

2.4. REST AREAS ERGONOMIC PRINCIPLES

Human body needs sufficient level of rest to get rid of fatigue. To fully take advantage of rest, ambient factors such as noise and temperature have to be suitable. For sleep, dirty ambient, improper temperature, noise and vibration are some of the barriers. Those factors are also contributors to nervous stress which interrupts sleep. This difficulty is further severe for seafarers who perform their tasks at night (Hafez, 1999: 6).

In general, employees' time for rest other than break times is expected to be spent out of workplace, mostly at home. Thus, the employees have an opportunity to create desirable rest conditions in their own homes. However, to work at sea has a compelling characteristic since seafarers have to work and rest on board during voyage. Accordingly, ergonomic principles affecting rest on board such as noise, vibration, illumination and thermal comfort have to be addressed and developed.

2.4.1. Noise

Noise, as a general term, is used for every kind of sound that people does not want to hear. Sounds which hamper concentration while working and divide rest and sleep fall into this category (Kim, 2015: 265). Approach to noise as a health problem is a matter of modern times. Scientifically, *Sound (or noise) is the result of pressure variations, or oscillations, in an elastic medium (e.g., air, water, solids), generated by a vibrating surface, or turbulent fluid flow. Sound propagates in the form of longitudinal waves, involving a succession of compressions and rarefactions in the elastic medium* (Hansen, 2001: 23). Loudness of sound depends on its frequency and sound pressure level (SPL). Frequency corresponds to the number of cycles within a second. Hertz (Hz) is used in expressing frequency. Frequencies between 20-20.000 Hz which is called audible sprectrum can be sensed by human ear. Decibels (dB) is used in measuring noise. While measuring average noise levels A-weighting which is symbolized as dB(A) is used, C-weighting that is symbolised as dB(C) is used to express in measuring peak, impact or explosive noise (Mckeown, 2008: 133). Some examples of noise levels can be seen on Table 4.

Table 4: Examples of Noise Levels

Type of Noise	dB(A)
Jet engine at 25 m	130
Jet aircraft starting at 50 m distance	120
Pop Group	110
Pneumatic Chisel	100
Shouting, understandable only at short distance	90
Radio playing at full volume, load conversation	70
Group conversation	60
Radio playing quietly, quiet conversation between two people	50
Library reading room	40
Slight domestic noises	30
Gentle rustling of leaves; indoors in the evening in a quiet neighborhood	20
Very quiet environment	10
Thresold of Hearing	0

Source: Dul and Weerdmeester, 2008: 70

2.4.1.1. Effects of Noise on Seafarers' Life

During voyage, seafarers' work areas and out-of work areas are not separated entirely. Noise and vibration occur on board as a result of operations of engines, propeller, generators and other voyage-related parts of the ship. For this reason, seafarers face with high-level of and constant noise as long as their voyages. Exposure to the perpetual noise may lead to hardship with regard to fatigue mitigation. This situation, by posing an obstacle on fatigue mitigation, may cause weakness in daytime performance and the worst of all, possible catastrophes at sea (Tamura et al., 1997: 417).

Exposure to high-level of noise may be a triggering factor for headache and stress. This situation may also have an impact upon disturbances regarding to concentration and tolerance level. In parallel with the high-level-of noise, rate of errors and risk of accidents may go up and working capacity may fall (Christensen, 2008: 2-2)

Noise is a hard-to-overcome matter which can be faced in most part of a vessel. Pumps, generators, air conditioners and engines are the prominent sources of noise on board. Being under the influence of noise, rises blood pressure, heart and breathing rate and makes metabolism faster. In the situation of long exposure to noise, those body reactions may concentrate and then become handicap for relaxation (Calhoun, 2006: 15-16).

Annoyance and problems associated with hearing and sleep disruption may be the consequences of noise which is undesirable sound. Noise is the unwanted sound heard that also might cause sleep-related drawbacks. Obedience to determined noise criterias associated with accommodations and relaxation areas might escalate comfort and well-being of seafarers using these areas (Mariner Safety Research Initiative, 2016).

2.4.1.2. Control and Mitigation of Noise

Those elements should be taken into consideration to provide an insight on noise problem and constitute control strategy (Hansen and Goelzer, 2001: 246):

- type of noise
- noise levels and temporal pattern
- frequency distribution
- noise sources (location, power, directivity)
- noise propagation pathways, through air or through structure
- room acoustics (reverberation)

There are three aspects that should be evaluated in defining a noise control problem. They are *''control at the source, control along the path and control at the receiver end''*. The control at the source of noise provides further effectual results compared to the others. The fundamental reason of this is engineering approach to design stage. While control along the path focuses on benefiting from appliances like barriers and mufflers, control at the receiver aims to develop necessary protectors (Prasad and Rajavel, 2018: 2).

The wisest solution with respect to the noise problem is to struggle at the starting point of problem since noise mostly results from consumed energy. Adding barriers and enclosing the equipment are the primary ways in applying control along the path approach. In additon to these ways within the context of this approach, sound-absorbent materials may also be used. These solutions should not be expected to provide high-degree of recovery. Within the scope of solutions regarding to noise-exposed employees, practices such as preventing worker to enter sound-area, restricting workers' time spent in this area or stipulating working in this area with the usage of hearing equipments are carried out (DOSH, 2005: 1-2).

Hearing equipments are not usually influental as much as the other methods of noise prevention. The main reasons of this situation are users' acts that are influenced by the equipments' features-related issues such as discomfort, low-degree of signal perception and isolation (EASHW, 2005: 52).

The most successful results are mostly reached by taking measures with respect to source and propagation way of noise. Measures intended to mitigate noise at the receiver area are not chosen as much as the other methods of noise mitigation. Primary reason of this preference is the possibility of still in active of high-level ambient noise. While deciding on which strategy of noise mitigation will be applied, factors such as the level of noise mitigation intended, distinctive features of noise and the budget should also be taken into consideration. Taking noise mitigation measures in a collective way will provide most effective result (The Environment Protection Authority, 2004: 22).

2.4.2. Vibration

Vibration can be expressed as a mechanical movement which oscillates around a point (in general reference). This is a kind of mechanical wave shape and spreads energy. A mechanical structure which can be a part of a machine, a vehicle or even a human is needed for the movement of vibration. However, if mechanical pairing is lost, vibration does not spread (Mansfield, 2005: 1).

Vibration is experienced by people in both their daily and working activities. Exposure to all manner of vibration is faced in their both daily and working activities, for instance, while travelling by various vehicles (car, ship or plane). People who works in the fields of industry, aviation and transportation are also faced with ambient vibration. Those vibration exposures can negatively affect human body comfort when thresold values are exceeded (Niu et al., 2014: 294).

Like sound, vibration is also expressed from the point of its frequency and magnitude. Frequency is defined as realization number of a complete cycle for the duration of one second. Hertz is used in expressing frequency (Grech et al., 2008: 95).

Accelerometer is used to measure vibration. The device is attached to vibrating surface and generates an output proportional to acceleration. First, the frequency weighting is implemented and then the average magnitude of vibration is demonstrated (Health and Safety Authority, 2007: 6).

Vibration exposures can be divided into two categories as ‘‘segmental vibration exposure’’ and ‘‘ whole-body vibration exposure’’. Basically, segmental vibration exposure takes places when the vibration is conveyed to the limited part of the body (hand, arm or leg) and concentrates on these parts of the body. Whole-body vibration realizes when the vibration is conveyed to entire or big part of the body (Government of Alberta, 2010: 8). Along with these two main types of vibration exposures, sea-sickness that take places as a result of esposure to slow vibrations between 0-1 Hertz are accepted as another type of vibration exposure (Helander, 2006: 250-251).

Stimulation depending on machinery and propulsion systems which can cause low and high quakings, lead to shipboard vibration. In addition to machinery system, hull slamming which is the resultant of ship’s movement between waves and troughs is another source of disrupter vibration. This phenomenon is affected by ship speed and the level-of-sea state. When ship speed increases, slamming threshold speed will also increases. The whole-body vibration occurs when these vibrations are conveyed with the parts of body mostly touching to vibrating surfaces (hands and feet). (Grech et al., 2008: 94).

2.4.2.1. Effects of Vibration to Seafarers’ Life

Usually, adverse impacts from vibration are attenuated by human body. On the other hand, resonation of pelvis and spine can be encountered between the frequencies of 1-20 Hertz. In addition to resonation of pelvis and spine, many other health problems can occur within the range of frequency (Government of Alberta, 2010: 20). Human reaction to whole-body vibration can be stay temporary or become a chronic problem. Furthermore, the human reaction to whole-body vibration can also have the psychological or physiological characteristics (Nakashima, 2004: 12). The influences of exposure can come to existence at the time when actual exposure realizes or cumulate. Besides, fatigue can occur as a result of vibration exposure. Vibration can have a triggering impact upon error and accidents. Difficulties in reading and understanding based on vibration can be the typical example of indirect impact of vibration on the performance of employees (Grech et al., 2008: 94).

Human under the influence of whole-body vibration can be affected negatively in terms of sensations. As a result of this circumstance, the feeling of discomfort or annoyance may come out. This type of vibration may lead to health and safety risk pathologically and physiologically and affect human performance capability (Sayed et al., 2012: 7).

The frequency of vibration and its effects on the human body can be seen in the table below.

Table 5: Frequency of Vibration and Its Effects on the Human Body

Frequency of Vibration	Types of Effect
Below 1 Hz	Motion Sickness
3.5 to 6 Hz	Alerting Effect
4 to 10 Hz	Chest and Abdomen Pain
Around 5 Hz	Degrades Manual Actions
7 to 20 Hz	Communication Problems
8 to 10 Hz	Back Ache
10 to 20 Hz	Intestine and Bladder Pain
10 to 30 Hz	Degrades Manual and Visual Controls
10 to 90 Hz	Degrades Visual Actions

Source: (Shivakumara and Sridhar, 2010: 1)

2.4.2.2. Control and Mitigation of Vibration

There are lots of approaches to minimize vibration, based upon what the problem is. The most preferrable approaches are stiffening which is carried out by the way of sliding resonance frequency of structure to the beyond the frequency band of stimulation, damping which is decreasing resonance peaks by distributing vibration energy and isolation which is applied with the aim of defending the systems' sensitive elements respectively (Preumont, 2011: 5).

As a matter of ship structures, in general, three approaches are applied. First approach is aimed at controlling vibration at source. In accordance with this purpose, vibration isolators like machine mounts are used. Because power conveyance from

one vibration source to a structure is controlled by structure impedance, adjusting thoughness of mounting structure can also be performed. The second approach, controlling vibration at receiver locations, can be executed by traditional ways of control as appropriate design of vibration isolators and attaching damping equipments to the structure. In addition, as the third approach, controlling vibration along the path of wave propagation can also be applied (Lin, 2005: 178-179).

Two approaches of control of vibration are generally benefited for the ship vibration control. Those are control at the source and control at receiver locations (Kim and Kong, 2016: 10).

2.4.3. Thermal Comfort

Thermal comfort is that condition of mind which expresses satisfaction with the thermal environment. To please all occupants in an area is a hard-to-make issue, since there are broad individual differences in terms of physiological and psychological characteristics. With regard to comfort, environmental necessities differ from person to person. (ASHRAE,2004:4).

The elements such as age, adaptation and smoking which changes from person to person create hardship to ensure thermal comfort. Those elements have also impact on the sense of comfort levels of people whose work tasks and work environment have the same characteristics (Government of Alberta, 2014: 8).

Thermal comfort is sustained under the condition that the heat produced by human metabolism is enabled of spreading at the rate which keep the thermal balance. The states of loss of heat or gain of heat lead to discomfort. Basically, sustaining thermal comfort depends on equality of the heat that is lost and the heat that is generated (soa.utexas.edu, 07.05.2018).

2.4.3.1. Determinants of Thermal Comfort

People are in the need of having a thermal balance. Both real and felt quality of indoor environment are affected by thermal comfort (HEVAC Humidity Group, 2016: 3).

The six major elements that have to be evaluated are metabolic rate, clothing insulation, air temperature, radiant temperature, air speed and humidity respectively (ASHRAE, 2004: 4).

2.4.3.1.1. Metabolic Rate

The metabolic activity (M), or Metabolic Rate is expressed in W/m2, and is referredto as m2 of human body surface, or directly in met (Fabbri, 2015: 37).

Metabolic rate which identifies the heat that human generates while performing physical activity is important in terms of risk assessment. The heat that human generates increases depending on rise in amount of physical work. Due to the rise in heat that human generates, further loss of heat is needed to eliminate the state of overheat. This influence on thermal comfort depending on metabolic rate is essential (Cercel and Costoiu, 2008: 156).

The feel of cold or hot is affected by how intensively a person works. Heat is produced as a result of walking or working. In the case of working on a high-temperature day, heat stress rise depending on this movement (Government of Alberta, 2014: 8).

2.4.3.1.2. Clothing Insulation

The situation of heat loss is affected by clothing. The fundamental reason of heat stress can be wearing more than adequate regardless the environment is not perceived as hot or warm. In case insulation level of clothing is low, risks depending on hypothermia or frostbite may arise. Due to the climate adaptation of human, clothing has two impacts on thermal comfort as causal and controller. According to the how it is felt, cold or warm, clothes can be taken off or extra clothes can be worn. Those arrangements are forbidden by some companies (Cercel and Costoiu, 2008: 155-156). It can be benefited from clothing to feel warmer. On the other hand, it is felt cold since wet clothes lost their insulation specification when sweat or rain is heavy enough to wet clothes (Government of Alberta, 2014: 6).

2.4.3.1.3. Air Temperature

This is the temperature of the air surrounding the body. It is usually given in degrees Celsius (°C) (Cercel and Costoiu, 2008: 155). Dry bulb temperature (DBT) is used to measure air temperature which is the most significant environmental element. Convective heat spread depends on the air temperature along with air movement (Auliciems and Szokolay, 1997: 8). Under the circumstance of high degree of radiant heat, thermometer does not all the time reveal the real feel of coldness and hotness (Government of Alberta, 2014: 5).

2.4.3.1.4. Radiant Temperature

The heat spreading from a heated substance is named as thermal radiation. The existance of radiant heat depends on the existance of heat sources. The impact of radiant heat over heat loss or heat gain is greater compared to air temperature. To wear reflective clothes is the way of mitigation of absorption of radiant energy by human skin (Cercel and Costoiu, 2008: 155). Heaters, asphalt, hot water and sunlight can be radiant sources. Those elements can influence the feeling heat with the way of radiating heat (Government of Alberta, 2014: 5).

2.4.3.1.5. Air Speed

Air movement is measured by its velocity (v, in m/s) and it also affects the evaporation of moisture from the skin, thus the evaporative cooling effect (Auliciems and Szokolay, 2007: 8). Due to the human sensitivity to air movement, thermal comfort is affected by air movement. The feel of stuffiness may occur if there is artifically-heated motionless air in indoor environments. In addition, this situation may cause odor accumulation (Cercel and Costoiu, 2008: 155).

In general, a person feel cool due to the moving air. This situation lead to relief under the hot environmental circumstances on condition that a person is hotter than moving air. Air movement makes a person feel colder than the real temperature (Government of Alberta, 2014: 6).

2.4.3.1.6. Humidity

Humidity occurs depending on the water in the air generated as a result of heating and evaporating. *Relative humidity is the ratio between the actual amount of water vapour in the air and the maximum amount of water vapour that the air can hold at that air temperature.* The effect of relative humidity between 40% and 70% on thermal comfort is limited. Generally, the rate of relative humidity is tried to be at the rate of between 40-70% in the places with computers. Humidity for indoor environments can diversify substantially. At the same time, humidity may based upon if there is a drying treatments with the help of steam like laundry or not. Humidity is essential for the hot environmental conditions, because evaporation of sweat is low when the rate of humidity is high. The major way of loss of heat for human is the evaporation of sweat (Cercel and Costoiu, 2008: 155).

High degree of humidity lead to the feeling of hotter as sweat does not evaporate through skin. It must be known that the feeling of cool depends on evaporation of sweat. In comparison of dry air and cold air having high level of relative humidity at equal temperature, cold air having high level of relative humidity lead to the feel of colder (Government of Alberta, 2014: 5).

2.4.4. Ventilation

Ventilation is defined as *'' the deliberate provision of a clean outdoor air supply to a building or space to meet criteria associated with the use of that space''*. Fresh air is ventilated to indoor environment due to the reasons such as oxygen supply to occupants, mitigation or elimination of air contaminants, appropriate operation of combustion instruments, building thermal comfort and smoke control. Carbon dioxide accumulation depending on respiration is decreased with the help of vantilation. In addition, accumulation of odour and other air pollutants are reduced. Cooling and expectations related with comfort can be achieved by ventilation (Australian Building Code Board, 2018: 22). For the purpose of freshening current atmosphere, ventilation is benefited to get fresh air (OSHA, 2013: 1).

The health of people who occupy a space can be affected by internal air quality (IAQ) (Sherman et al., 2012: 760). Internal air quality states the type of the circulating air existing in the spaces people work and live. In addition, internal air quality is also related with both comfort that is influenced by odor, temperature and humidity and contaminants and chemicals which are harmful (Pahwa, 1995: 1).

There are three ways to be followed for ventilation (natural, mechanical and the combination of the two applications) (Australian Building Code Board, 2018: 22).

2.4.4.1. Natural Ventilation

The passive way of evacuation indoor contaminants and exchanging of air with the outdoor space is natural ventilation. Temperature differences contribute to forming of differences in air density and wind. The differences in air density and wind cause to occurence of pressure differences by means of air flow through ventilation openings. Additional ventilation openings such as windows and doors are needed for the purpose of achieving large level of air flow (Bluyssen, 2009: 75).

The uncontrollable air movement which goes into a room thanks to doors, windows and cracks and goes out from that room with the same paths, expresses natural ventilation. (Occupational Safety and Health Branch Labour Department, 2004. 1).

In addition to the advantage of saving energy, natural ventilation make occupants more pleased by enabling high level of indoor air quality. The occupants have furher control thanks to manually controllable windows. (Cook et al., 2011: 2257).

2.4.4.2. Mechanical Ventilation

In case natural ventilation does not meet the need due to the unfavorable situations such as pollution and noise or in the places where natural ventilation can not be applied, mechanical ventilation is generally preferred (Bluyssen, 2009: 76).

In this application of ventilation, outdoor air is supplied to the places in which fans are needed to be used. Thanks to the operational flexibility, those systems can properly be used under many different conditions. Filtration and cleaning of air flow are possible with mechanical ventilation. This approach is responsive to the changing expectations of occupants and changing indoor pollutants (Australian Building Code Board, 2018: 23). Efficiency in energy for mechanical systems can be achieved with proper design (Brager et al., 2011: 20).

2.4.4.3. Hybrid Ventilation

In this system, mechanical and natural ventilation systems are used together for the purpose of creating a comfortable area with the philosophy of benefiting different specifications of those systems varying by the season and the time of the day. High-level of user pleasure is achieved with its responsiveness to user interference and suitability to personal control (Hybrid Ventilation Center; 2002: 10).

The basic approach is to facilitate a suitable indoor environment with the additional benefits such as cutting cost and eliminating environmental impacts of air conditioning (Heiselberg; 2000: 2). Natural and mechanical ventilation units can be integrated or independently run. Its working method can be organized by the time and occupants' desire (Australian Building Code Board, 2018: 23).

2.4.5. Lighting

Light, the basis for all vision, is an element of our lives that we take for granted. Visible light is in fact just a small part of an essentially broader spectrum of electromagnetic waves, which range from cosmic rays to radio waves. There is an adjustment between human eye and the sun, the one source of light. Thus, human eye becomes very much sensitive in case of exposure to highest level of solar radiation. Colour perception of human is adapted to continuous spectrum of sunlight. (Ganslandt and Hofmann; 1992: 43).

There are three possible states that can be seen due to the fact that light hit to a surface. They are absorption, conveying or reflection of the energy of light. In terms of visual comfort, light levels, contrast and glare are taken into consideration. There is a direct proportion between the intensity of work and brightness needed. Accordingly, brightness of operating room is further than offices and living rooms (Boduch and Fincher; 2009: 4).

There are two important specifications of light. While one of them is being a kind of energy which consistently moves, the other one is conveyance information regarding to what the source of light is and the substances which the light confronts during its movement. Hence, light is an assistant to perceive interior (Bluyssen, 2009: 55). *The level of light is measured in LUX by using a light meter* (www.ilo.org, 11.07.2018) Some typical light levels can be seen at Table 6.

Table 6: Typical Light Levels Measured in LUX

Illuminance	**Example**
1 lux	Full moon overhead
50 lux	Family living room
80 lux	Hallway/Toilet
100 lux	Very dark overcast day
400 lux	Sunrise or sunset on a clear day. Well lit office area
1000 lux	Overcast day, typical TV studio lighting
10.000-25000 lux	Full daylight (not direct sun)
32.000-130.000 lux	Direct Sunlight

Source: www.ilo.org, 13.05.2018

Daylighting and artificial lighting are the two ways of lighting strategies which are used to create a suitable indoor environment for occupants.

2.4.5.1. Daylighting

The development of ability to see has been with daylighting as the basic source of lighting. Daylight alterations in brightness, colour and direction result from the movement of earth which occurs both daily and yearly. The vision has an extraordinary ability to acclimate to the brightness differences from several lux to more than 100.000 lux (Kofod, 2017: 8).

The amount of light falling is connected with the rising of the sun. There is a direct proportion between elevation of sun and the illumination of earth (VELUX, 2014: 11).

Outdoor daylight level differs on a vast scale. The differantiation is also true for a cloudy day. Reading activity by candlelight becomes possible as a result of the rapid adaptation of human eye to those differentiations (New Zealand Ministry of Education, 2007: 9).

Biological functions and vision are influenced by daylighting. One of the negative sides of undesirable indoor climate is inappropriate daylighting (Mohelnikova, 2010: 38).

2.4.5.2. Artificial Lighting

Firelight arising from the burning of wood is regarded as the earliest form of artificial lighting. Oil lamp, candle and gas lamp came to exist as a result of advancements in the field of technology. Those forms of artificial lighting are preferred when there is a need or in the case of creating the ambience they make feel. Many sorts of electric lamps are produced in consequence of the works of the lighting industry. The ones which are benefited for general lighting are discharge lamps and incandescent lamps respectively. While discharge lamps require control equipment between the lamp and the power supply due to the need of different electrical requirements in starting and maintaining the discharge, incandescent lamps are used with direct connection to power supply. Nowadays, there is a semiconductor, light emitting diode (LED) (Turlej, 2011: 184).

Similar to the daylighting, the fundamental purpose in artificial lighting is to enable to be implemented duties by meeting the requirements regarding to accuracy, comfort, safety and to be created a satisfactory environment. Electric lighting is used completely or partially at the time when the sky is covered by clouds, effect of daylight is diminished or when additional lighting is needed for certain duties (New Zealand Ministry of Education, 2007: 24).

2.4.6. Bed and Furniture

The time which the big majority of people consume in bed is account for nearly one third of their lifetime. The reason of why sleeping is regarded as the most essential activity compared to the other activities which are performed in bed such as sitting and observing is based on its impact on diminishing tiredness and making people ready for the next day. From the viewpoint of sleep comfort, the softness degree of bed is significant to reduce and avoid the suffering and pressure. This situation demonstrates the bed-related necessities that are respectively adequate support to human body and spread the weight of the body well-balanced (Park et al., 2009: 145).

For a person who is sleeping, mattress is the most significant component of the bed. The mattress becomes determining factor of the comfort provided that soundness of bed and platform is proper in terms of structural necessities (Miller, 1999: 9).

The fundamental factor in terms of interior design is furniture which has many different colors and components. From the point of sustainability of furniture, components which have been used in producing stage and possibility of long term usability are taken into consideration (Ayalp, 2012: 165).

Modern furniture, regardless of its intended purpose, is characterised by the domination of form over function and practical use values. On the other hand, a furniture part that is accepted as a phenomenon of applied art is expected to collectively incorporate necessities containing such as functionality, usability and sense of aesthetic (Smardzewski, 2015: 98).

CHAPTER THREE
ILO REGULATIONS AND ABS THE GUIDE FOR CREW HABITABILITY ON SHIPS 2016

In this part of the study, ILO conventions (C133 - Accommodation of Crews (Supplementary Provisions) Convention, 1970 (No. 133), C147 - Merchant Shipping (Minimum Standards) Convention, 1976 (No. 147), Maritime Labour Convention 2006) and ABS – The Guide for Crew Habitability on Ships 2016 are addressed.

3.1. C133 - ACCOMMODATION OF CREWS (SUPPLEMENTARY PROVISIONS) CONVENTION, 1970 (NO. 133)

The convention was approved by the General Conference of the International Labour Organisation on the ground that improvements regarding to crew accommodation in the face of rapidly changing specifications of vessel construction and operation can be made in 14 October 1970. The convention consists of four parts which are general provisions, crew accommodation requirements, application of the convention to existing ships and final provisions respectively. In the general provisions part, the features of the vessels to which the convention can be applied and the provisions that every member of the convention is committed to comply have been specified. In the crew accommodation requirements part, provisions such as the specified floor areas by the number of occupants in the rooms, specified number of occupants in the rooms and furnishing requirements have been stated. In the third part of the convention, how the application of the convention to existing ships is carried out has been clarified. In the last part, final provisions have been explained (www.ilo.org, 13.05.2018)

3.2. C147 - MERCHANT SHIPPING (MINIMUM STANDARDS) CONVENTION, 1976 (NO. 147)

The convention consists of 12 articles. In the first article, the types of the vessels to which the convention can be applied are listed. Members that ratify the convention are responsible to have laws and regulations in relation to safety standards consists of standards of competency, hours of work and manning with the purpose of establishing safety of life on board ship, proper social security rules and shipboard conditions of employment and shipboard living arrangements. The convention forces the members to realize effective jurisdiction and control over ships with regard to safety standards including standards of competency, hours of work and manning, social security rules and shipboard conditions of employment and shipboard living arrangements (www.ilo.org, 13.05.2018).

3.3. MARITIME LABOUR CONVENTION 2006

The convention has been established with the aim of creating a single and coherent instrument covering almost all current standards of existing international maritime labour conventions and the major principles found in the other international labour conventions (www.ilo.org, 13.05.2018).

The convention covers necessities on the subjects of appropriate working and living conditions on board the ship, seafarers wage, special conditions of accommodation and recreational facilities covering room sizes, heating, ventilation, lighting and hospital accommodation, social security protection for seafarers (www.egemenoglu.av.tr, 13.05.2018).

3.4. ABS – THE GUIDE FOR CREW HABITABILITY ON SHIPS 2016

The ABS Guide for Crew Habitability on Ships has been generated with the aim of developing the quality of crew member performance and comfort with the way of enhancing working and living environments. The habitability criteria have been selected to create a tool for mitigation of crew fatigue, developing performance

and safety. The guide presents criteria, limits and measurement methodologies for whole-body vibration, noise, indoor climate and lighting (ABS, 2016: 1).

A vessel's compliance to minimum criteria for accommodation areas and the ambient environment such as noise and lighting, is expressed with HAB notation. If a vessel complies with more rigid criteria in relation to accommodation, whole-body vibration, noise and indoor climate along with HAB notation criteria, the vessel may be recorded by the notation HAB+. If a vessel complies with the whole criteria determined in the guide may be recorded by the notation HAB++ (ABS, 2016:3).

Notations with their requirements can be seen table below.

Table 7: HAB Notations

	HAB	**HAB+**	**HAB++**
Accommodation Areas	HAB Requirements for Accommodation Areas	HAB and HAB+ Requirements for Accommodation Areas	HAB+ and HAB++ Requirements for Accommodation Areas
Whole-Body Vibration	Level of Vibration-reducing discomfort and promoting job performance	Lower level of vibration-promoting job performance and increased comfort	Lower level of vibration – promoting job performance and increased comfort
Noise	IMO Code on Noise with modifications	HAB with additional requirements	HAB+ with additional requirements
Indoor Climate	No provision for individual temperature adjustment		Aimed at enhancing crew comfort by making provisions for individual adjustments of indoor climate temperature
Lighting	No differences among the notations		

Source: ABS, 2016: 3

3.4.1. Accommodation Area Criteria

Compared to HAB notation, HAB+ and HAB++ notations cover further rigid criteria with the aim of ensuring improved living and working conditions to make seafarers comfort and safety better. This includes improved criteria in relation to work space design, crew cabins and recreation areas. For HAB+, it is needed to be met the criteria in relation to accommodation area of HAB and HAB+. At the same time, for HAB++, criteria associated with HAB, HAB+ and HAB++ are needed to be met. For instance, criteria #14 is about three degrees for angles of inclination for stairways. The 40 degrees criteria is needed to be met for HAB++ notation. The meeting criteria in relation to HAB++ means that HAB+ and HAB are met (ABS, 2016: 9).

The table about the example can be seen table below.

Table 8: ILO MLC 2006, Title 3 Requirement

Requirement **# = Related ILO MLC 2006, Title 3 Requirement**			Meets **HAB** Requirements	Meets **HAB+** Requirements	Meets **HAB++** Requirements
	14	Accommodation area stairways have a maximum angle of inclination from the horizontal of:			
		• 50 degrees			
		• 45 degrees			
		• 40 degrees			

Source: ABS, 2016: 9

3.4.2. Whole-Body Vibration Criteria

The fundamental purpose of HAB notation is to mitigate discomfort and obstacles about task performance. For HAB+ and HAB++ notations, more rigid criteria have been determined with the aim of contributing to comfort and performance. *In this instance, ''comfort'' means the ability of the crew to use a space for its intended purpose with minimal interference or annoyance from whole-body vibration. The notation applies to the vibration levels occurring on the deck supporting the human body in the three (3) translational (x-, y- and z-) axes* (ABS, 2016: 13).

Notations with their requirements can be seen table below.

Table 9: Maximum Weighted Root-Mean-Square Acceleration Level

Notation	Frequency Range	Acceleration Measurement	Maximum RMS Level	
			Accommodation Areas	Work Spaces
HAB	1-80 Hz	aw	178 mm/ s^2 (5.0 mm/s)	214 mm/s^2 (6.0 mm/s)
HAB+	1-80 Hz	aw	143 mm/ s^2 (4.0 mm/s)	178 mm/ s^2 (5.0 mm/s)
HAB++	1-80 HZ	aw	107 mm/ s^2 (3.0 mm/s)	143 mm/ s^2 (4.0 mm/ s^2)

Source: ABS, 2016: 14

3.4.3. Noise Criteria

The noise criteria have been developed with the aim of supporting performance of seafarers and enabling communication and sleep in proper vessel spaces. Improving crew safety and comfort is the another purpose of the criteria. Accordingly, comfort expresses using spaces with its intended purposes in minimum interference depending on noise (ABS, 2016: 19).

Noise criteria for ships can be seen on Table 10.

Table 10: Noise Criteria for Ships

Space	Maximum Acceptable Noise L_{Aeq} Level dB(A)					
	HAB		**HAB+**		**HAB++**	
	Vessel Size (Gross Tonnage)					
	<10.000	≥10.000	<10.000	≥10.000	<10.000	≥10.000
Crew Accommodation Spaces and Open Deck Recreation Areas						
Cabins	60	55	55	55	50	50
Sanitary Spaces (if separate from the cabin)	65	65	60	60	55	55
Dining (Mess) Spaces	65	60	60	55	55	50
Indoor Recreation Spaces	65	60	60	55	55	50
Gymnasiums	65	60	60	55	60	55
Medical and First Aid Center	60	55	55	55	55	50
Open Deck Recreation Areas	75	75	70	70	70	70
Navigation and Control Spaces						
Wheelhouse, Pilothouse, Bridge	65	65	60	60	55	55
Radio Room	60	60	55	55	55	55
Offices	65	60	60	55	60	55
Cargo Control Rooms	65	65	60	60	60	60
Machinery Control Room	75	75	70	70	70	70
Service Spaces						
Food Preparation (e.g., Galley, Scullery)	75	75	70	70	65	65
Pantries	75	75	70	70	70	70
Storerooms	75	75	70	70	70	70
Laundry Areas	75	75	70	70	70	70

Continued: Table 10: Noise Criteria for Ships

Operating and Maintenance Spaces						
Machinery Spaces	110	110	110	110	110	110
Workshops (other than those forming part of machinery spaces)	85	85	80	80	80	80
Non-specified work spaces	85	85	80	80	80	80

Source: ABS, 2016: 21

3.4.4. Indoor Climate Criteria

Focus point in HAB and HAB+ notations criteria is HVAC systems which does not make arrangements with regard to indivual preferences and space-specific activities. In HAB++ notation, comfort of seafarers is targeted to be improved with the way of creating provisions related to crew's needs in a specific area about their indoor climate conditions based on air temperature (ABS, 2016: 28).

Summary of indoor climate requirements can be seen table below.

Table 11: Summary of Indoor Climate Requirements

Item	Requirement or Criterion	
	HAB & HAB+	**HAB++**
Adjustability	Non-adjustable air temperature	Adjustable range of air temperatures
Air Temperature	Winter: 20 to 25°C (68 to 77 °F) Summer: 23 to 28°C (73.5 to 82.5 °F)	

Continued: Table 11: Summary of Indoor Climate Requirements

Relative Humidity	A range from 30% minimum to 70% maximum
Vertical Gradient	The acceptable range is 0-3°C (0-6 °F)
Air Velocity	Not exceed 30 meters-per-minute or 100 feet-per-minute (0.5 m/s or 1.7 ft/s)
Horizontal Gradient (Crew Cabin Areas)	The horizontal temperature gradient in crew cabin areas shall be <10°C (18°F)
Air Supply Quantity	The minimum quantity of fresh/outdoor air supply shall be not less than 8 *l*/s per person and in addition will need to be at least 40% of the total air supplied to a specific space.

Source: ABS, 2016: 30

3.4.5. Lighting Criteria

Visual task performance and the movement within the space should be eased with the way of lighting of seafarer spaces. In addition, the lighting of seafarer spaces should help to be generated a suitable visual environment. Lighting design covers combining all those issues with the aim of supporting many duties carried out on board, the safety and well-being of seafarers. In terms of the design of lighting, choosing suitable illuminance levels regarding to specific tasks and spaces used by seafarers is essential point. There is a disagreement about the issue that which level of light is accepted as the most suitable for visual tasks. Due to the fact that the illuminance recommendations are generally the consensus values, an array of illuminances may be applied. Because the visual duties which are carried out on board show similarity to duties faced ashore, lighting requirements on board are generally match up to the duties faced in living, working and recreation areas on shore (ABS, 2016: 36). The lighting criteria can be seen on Table 12.

Table 12: Lighting Criteria for Crew Accommodation Spaces

Space	Illuminance Level in Lux	Space	Illuminance Level in Lux
Cabins and Sanitary Spaces			
General Lighting	150		
Reading and Writing - Desk(*) -Bunk Light(*) (* compliance with one or the other)	500 200	Sanitary Spaces - Lavatory/Toilet - Bath/Shower Area	200 150
Changing Room	200	Light During Sleep Periods	<30
Dining Spaces			
Mess Room and Cafeteria	300	Snack or Coffee Area	150
Recreation Spaces			
Recreation Room/Lounges	200	Gynasiums	300
Library - General Lighting - Reading Area	150 500	Bulletin Boards/Display Areas	150
Multimedia Resource Center (e.g., computer room)	300	All other Recreation Spaces (e.g., Game Rooms)	200
TV Room/Movie Theater	150	Reception Area	300
Medical, Dental and First Aid Center			
General Lighting/Medical Waiting Areas	150	Dispensary - General Lighting - On dispensary table	150 500
Medical and Dental Treatment/Examination Room	500	Laboratories	500
Reading and Writing (Desk)	500	Other Medical Spaces	300

Source: ABS, 2016: 38

CHAPTER FOUR
APPLICATION TO SEAFARERS' REST AREAS COMFORT PERCEPTION

4.1. THE AIM OF THE RESEARCH

Seafarers have to work and rest on board. From this aspect, comfort of rest areas and the quality of rest on board becomes vital points which should be taken into consideration in terms of their potential impacts over possible accidents and casualties. In this study, it is aimed to be determined the extent to which seafarers are satisfied with the places which are used for rest, their cabins, messroom and hobby room.

4.2. STAGES OF RESEARCH

For the purpose of establishing research model, a large scale of literature review has been realised as a first step. In the light of the literature review, face to face interviews has been practiced with specialists associated with the topic (Dr. Altan KOLTAN from KOLTANA Ergonomics Research and Development Center, İbrahim YAMAN from Ulusoy Occupational Health and Safety and Deniz KORKMAZ from Egetest). As a result of these interviews, information has been obtained about ergonomics and environmental factors. Third step has been measurement of noise, vibration, thermal comfort and lighting. Accordingly, measurements of noise, vibration, thermal comfort and lighting has been carried out to a ship berthing at Port of İzmir in company with İbrahim YAMAN from Ulusoy Occupational Health and Safety company.

For the measurements carried out in the port, necessary approvals have been obtained from relevant institutions and organizations. The measurements have been carried out to a ship berthing at Port of İzmir. At the time the measurements have been carried out, the weather was clear and the sea was still. The results of measurements have been evaluated by the criteria set in The Guide for Crew Habitability on Ships 2016. According to the results of measurements, noise levels of deck office and hobby room has been found more than levels of HAB notation

criteria. The noise level of cabin has been found at the thresold value of HAB notation critera. HAB notation criteria is met in terms of noise level of galley, messroom and bridge.

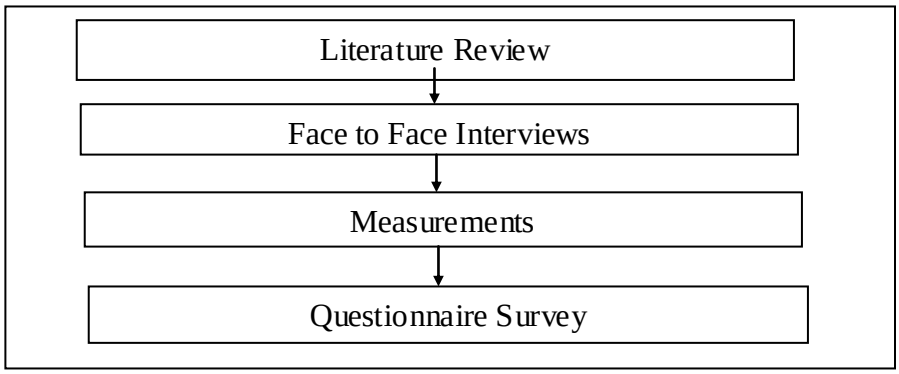
In terms of thermal comfort, the relative humidity value of cabin has been found more than the criteria determined. The other areas' thermal comfort values have showed conformity with the criteria specified.

In terms of lighting levels, the lighting level of deck office, galley and cabin have been found lower than the criteria determined. The lighting level of messroom, hobby room and bridge have showed conformity with the criteria specified.

The whole-body vibration values of deck office, messroom and hobby room have been found more than the criteria determined. However, the measurement values of galley, cabin and bridge comply with the criteria specified. All the details about the devices used, the methods of measurements, comprehensive measurement results and company'-related documents can be seen in appendix 1. Also, calibration certificates of devices used can be seen in appendix 2.

Finally, a questionnaire survey has been constituted with the aim of understanding the degree to which seafarers are happy with their rest area conditions.

Figure 3: Stages of Research



4.3. DATA COLLECTION TOOL

For this study, a questionnaire survey form has been constituted with the different perspectives of those concerned about the topic of the study, ergonomics specialist, occupational health and safety specialists and seafarers who are now actively working onboard. The survey form has 6 subscales and 38 statements.

For all those subscales, 5 likert scales have been used. The agreement level of respondent to the given statement increases by approaching to 5, decreases by approaching to 1. 1 and 5 are the lower and upper values for their agreement level. In the survey form, the names of subscales have been stated.

The scales which have been constituted and informations regarding to those scales are as below:

Noise Scale (1-9 Statements): The subscale has 9 statements that have been created to find out the source and impacts of noise in accommodation areas living for the purpose of rest. Respondents were asked their considerations about the degree to which they are satisfied with the matter.

Thermal Comfort Scale (10-15 Statements): The subscale which has been constituted to determine sufficiency of temperature and breakdown frequency of devices using for air conditioning has 6 statements. Respondents were asked the degree to which they find temperature in their rest areas suitable and breakdown frequency of devices using for air conditioning.

Lighting Scale (16-24 Statements): Under the subscale which has been created to find out the degree to which sufficiency and color of illuminators and dimensions of windows in rest areas affect rest, respondents were taken their opinions for 9 statements.

Vibration Scale (25-27 Statements): The subscale which has been created to understand the degree to which severity of vibration arising from ship motions affects seafarers' rest onboard has 3 statements. Respondents were asked the degree to which they find vibration unfavorable in terms of their rest areas on board.

Ventilation (28-33 Statements): The subscale that has been constituted to determine the degree of need to fresh air and problems related to cigarette, toilet and humid in rest areas has 6 statements. Respondents were asked the degree to which they find ventilation problems destructive for rest.

Bed and Furniture (34-38 Statements): The subscale that has been created to find out the degree to which specifications of bed and furnitures using in rest areas such as dimensions, softness/hardness and comfort affect seafarers' rest and sleep has 5 statements. Respondents were asked the degree to which they find those criterias available to their rest expectations.

4.4. RELIABILITY ANALYSIS

The value of the Cronbach's Alpha for the questionnaire survey has been calculated as 0.952 by excluding 9 items from 74 items, which indicates high level of reliability for the questionnaire survey has been attained.

4.5. ORGANIZATION AND ANALYSIS OF RESEARCH DATA

Datas that obtained at the end of the research have been analyzed through SPSS 20.0 package program. In the given analysis, ANOVA analysis for more than two-grouped variables has been used. In addition to ANOVA analysis, Benferroni and Tukey tests have been carried out.

4.6. POPULATION AND SAMPLE OF THE RESEARCH

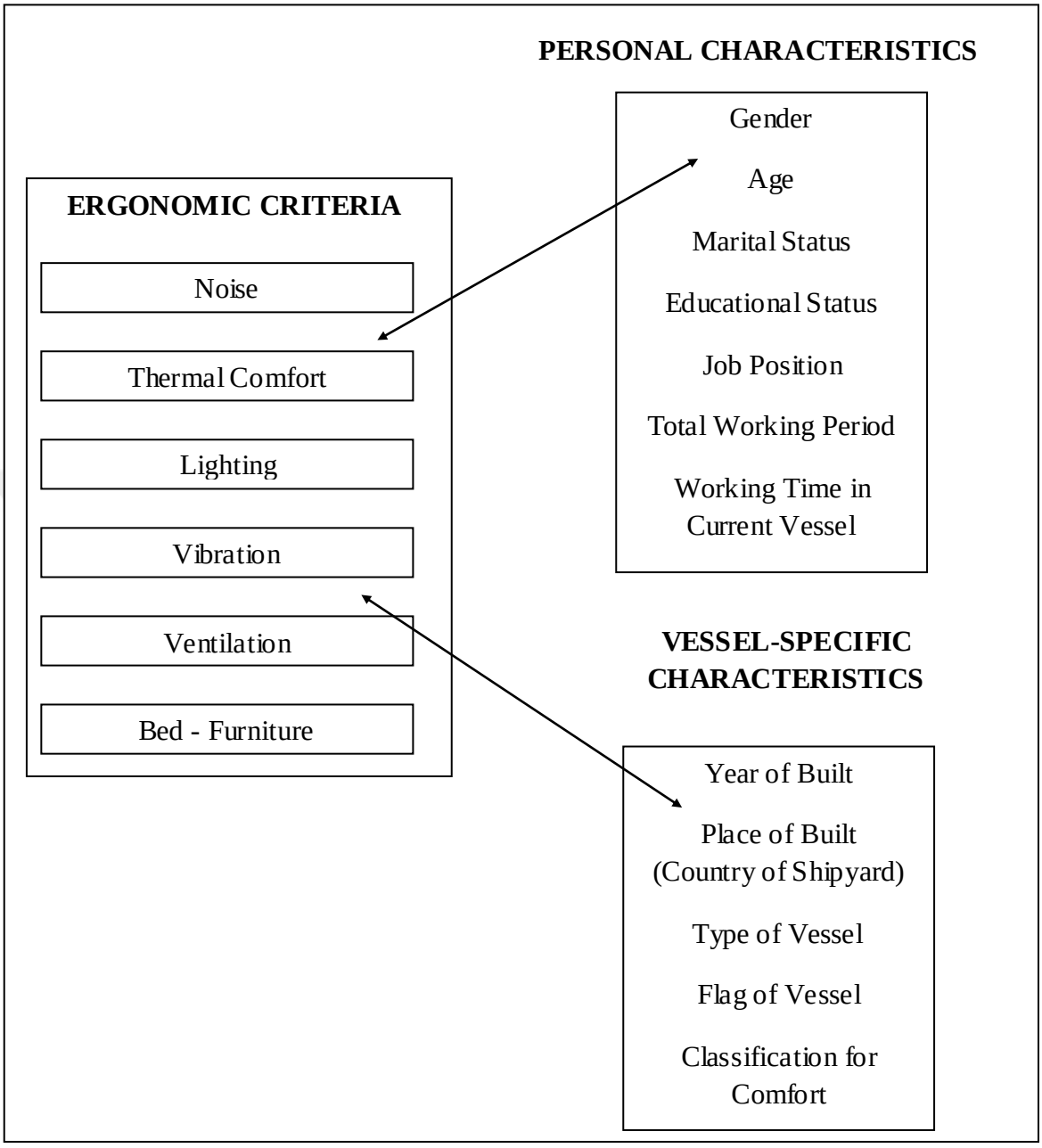
Population of the research is all seafarers working on board all around the world. Due to impossibleness to reach all seafarers, Turkish seafarers working in vessels calling to İzmir Alsancak Port, Turkish seafarers working in scientific research vessels and Dokuz Eylül University Maritime Faculty students working as a ship cadet as long as their internship period have been selected as sample. The research is limited with the datas obtained from the sample.

4.7. RESEARCH MODEL

The research has been built on the basis of descriptive model and relational model. Descriptive model summarizes respondents' demografic characteristics, positions about their preferences about the subject and their attitudes as well as vessel-specific characteristics.

When we look at relational model, relationship among variables which are all the part of research, has been presented. In this context, following model has been developed.

Figure 4: Research Model



4.8. HYPOTHESES OF RESEARCH

1- H_0: There is not a meaningful difference between seafarers' ages and their thermal comfort perceptions.

H_1: There is a meaningful difference between seafarers'ages and their thermal comfort perceptions.

2- H_0: There is not a meaningful difference between seafarers' gender and their thermal comfort perceptions.

H_1: There is a meaningful difference between seafarers' gender and their thermal comfort perceptions.

3- H_0: There is not a meaningful difference between seafarers' marital status and their lighting perceptions.

H_1: There is a meaningful difference between seafarers' marital status and their lighting perceptions.

4- H_0: There is not a meaningful difference between seafarers' marital status and their bed and furniture comfort perceptions.

H_1: There is a meaningful difference between seafarers' marital status and their bed and furniture comfort perceptions.

5- H_0: There is not a meaningful difference between seafarers' job position and their lighting comfort perceptions.

H_1: There is a meaningful difference between seafarers' job position and their lighting comfort perceptions.

6- H_0: There is not a meaningful difference between seafarers'educational status and their noise perceptions.

H_1: There is a meaningful difference between seafarers'educational status and their noise perceptions.

7- H_0: There is not a meaningful difference between vessels' year of built and seafarers' noise perceptions.

H_1: There is a meaningful difference between vessels' year of built and seafarers' noise perceptions.

8- H_0: There is not a meaningful difference between vessels' year of built and seafarers' vibration perceptions.

H_1: There is a meaningful difference between vessels' year of built and seafarers' vibration perceptions.

9- H_0: There is not a meaningful difference between type of vessel and seafarers' noise perceptions.

H_1: There is a meaningful difference between type of vessel and seafarers' noise perceptions.

10- H_0: There is not a meaningful difference between type of vessel and seafarers' vibration perceptions.

H_1: There is a meaningful difference between type of vessel and seafarers' vibration perceptions.

4.9. FINDINGS OF RESEARCH

In this part, the findings of the research have been explained.

4.9.1. Demographic Characteristics

Demographic characteristics of respondents of the questionnaire survey are summarized below.

According to gender status, majority of respondents are‘‘male’’ with 73 % of total. Percentage of ‘‘female’’ respondents is 27% of total.

According to age range, the highest participation rate has been seen in ‘‘18-25 age range’’ with 62.2 % of total. The group is followed by ‘‘26-40 age range’’ with 28.4%. The lowest participation rate has been seen in ‘‘41 and over age range’’ with 9.5% of total.

According to marital status, majority of respondents are single with 78.4% of total. Percentage of married respondents is 21.6% of total.

According to educational status, the highest participation rate has been seen in ‘‘undergraduate degree’’ with 68.9% of total. The group is followed by ‘‘highschool-graduation’’ with 13.5 % and ‘‘associate degree’’ with 8.1% of total respectively. The participation rate of ‘‘phD-degree’’ is 4.1% of total.

The lowest participation rates have been seen in ‘‘master-degree’’ and ‘‘secondary school graduation’’ with 2.7% of total.

According to places where seafarers work on board, the highest participation rate has been seen in the group of ‘‘engine room personnel’’ with 58.1% of total, The group is followed by ‘‘deck office personnel’’ with 39.2% of total. The lowest participation rate of has been seen in the group of ‘‘personnel working at other than those places like galley’’ with 2.7 % of total.

According to total work experiences as seafarer, the highest participation rate has been seen in the group of ‘‘less than one year’’ with 53.4 % of total. The group is followed by ‘‘between 1-10 years’’ with 28.8 % of total and between ‘‘11-20 years of experience’’ with 11 % of total respectively. The lowest participation rate has been seen in the group of ‘‘ over 20 and more experience’’with 6.8 % of total.

According to work experiences for the vessels respondents have currently been working, the highest participation rate has been seen in the group of ‘‘between 4-6 months’’ with 40.3 % of total. The group is followed by ‘‘between 7-12 months’’ with 23.9 % and ‘‘between 0-3 months’’ with 25.4 % of total respectively. The lowest participation rate has been seen in the group of ‘‘more than one year’’ with 10.4 % of total.

Table 13: Demographic Characteristics

		n	%
Gender	Female	20	27
	Male	54	73
	Total	74	100
Age	18-25	46	62.2
	26-40	21	28.4
	41-50	6	8.1
	51 +	1	1.4
	Total	74	100
Marital Status	Single	58	78.4
	Married	16	21.6
	Total	74	100
Educational Status	Secondary School	2	2.7
	Highschool	10	13.5
	Associate Degree	6	8.1
	Undergraduate Degree	51	68.9
	Master Degree	2	2.7
	PhD	3	4.1
	Total	74	100
Places where seafarers work on board	Deck	29	39.2
	Engine	43	58.1
	Other	2	2.7
	Total	74	100
Total Work Experience as Seafarer	Less than 1 year	39	53.4
	1-10 years	21	28.8
	11-20 years	8	11.0
	20 + years	4	6.8
	Total	73	100
Work Experience for the Current Vessel	0-3 months	17	25.4
	4-6 months	27	40.3
	7-12 months	16	23.9
	More than one year	7	10.4
	Total	67	100

4.9.2. Ship-Spesific Characteristics

Characteristics of ships that participants of the questionnaire survey have currently been working are summarized below.

According to year of built, the highest representing rate has been seen in the group of ‘‘between 2001-2010 years’’ with 46.3 % of total. The group is followed by ‘‘2010 and over years’’ with 32.8 % of total. The representing rate of ‘‘ between

1975-1980 years'' and ''between 1991-2000 years'' has been the same with 9.0% of total. The lowest representing rate has been seen in the group of ''between 1981-1990 years'' with 3.0 % of total.

According to place of built (country of shipyard), the highest representing rate has been seen in the group of ''Turkey'' with 45.6 % of total. The group is followed by ''Germany'' with 21.1 % of total and ''South Korea'' with 14.0 % of total. The representing rate of '' China'' and ''Japan'' has been the same with 7.0% of total. The representing rate of ''Poland'' has been 3.5% of total. The lowest representing rate has been seen in the group of ''the Netherlands'' with 1.8 % of total.

According to type of vessel, the highest representing rate has been seen in the group of ''Container vessel'' with 53.5 % of total. The group is followed by ''Liquid Bulk Carriers'' with 28.2 % of total and ''Other types of vessel like scientific research vessels'' with 9.9 % of total. The lowest representing rate has been seen in the group of ''Dry-Bulk Carriers'' with 8.5 % of total.

According to flag of vessel, the highest representing rate has been seen in the group of ''Turkish-flagged vessels'' with 63.4 % of total. The group is followed by ''Marshall Island flagged-vessels'' with 23.9 % of total and ''Malta-flagged vessels'' with 8.5 % of total. The lowest representing rate has been seen in the group of ''Panama-flagged vessels'' with 4.2 % of total.

In terms of presence of comfort class, 55.6 % of respondents have stated that the vessels that they have currently been working have been classed by a classification societies. The rate of respondents who don't know whether the vessels have been classed or not is 43.1% of total. 1.4 % of respondents have stated that the vessels that they have currently been working have not been classed by a classification societies.

Table 14: Ship-Specific Characteristics

		n	%
Year of Built	1975-1980	6	9.0
	1981-1990	2	3.0
	1991-2000	6	9.0
	2001-2010	31	46.3
	2010 +	22	32.8
	Total	67	100
Place of Built (Country of Shipyard)	Turkey	26	45.6
	Germany	12	21.1
	South Korea	8	14.0
	China	4	7.0
	Japan	4	7.0
	Poland	2	3.5
	The Netherlands	1	1.8
	Total	57	100
Type of Vessel	Container	38	53.5
	Dry-Bulk Carrier	6	8.5
	Liquid-Bulk Carrier	20	28.2
	Other	7	9.9
	Total	71	100
Flag of Vessel	Turkey	45	63.4
	Marshall Island	17	23.9
	Malta	6	8.5
	Panama	3	4.2
	Total	71	100
Classification for Comfort	Yes	40	55.6
	No	1	1.4
	No idea	31	43.1
	Total	72	100
	20 + years	4	6.8
	Total	73	100

4.9.3. Descriptive Statistics on Rest Areas' Comfort Perception Questionnaire Survey

Numbers, values of mean and standart deviation values related with sub-scales in the questionnaire survey can be seen table below.

Table 15: Descriptive Statistics on Rest Areas' Comfort Perception Questionnaire Survey

	N	Mean	St. Dev.
Noise	74	**2.52**	0.882
Thermal Comfort	74	**2.53**	0.831
Lighting	74	**2.60**	0.819
Vibration	73	**3.18**	1.163
Ventilation	72	**3.13**	1.086
Bed and Furniture	72	**2.88**	0.768

4.9.4. Statistical Analyses

In this part, statistical analyses have been stated.

4.9.4.1. Variability of Rest Areas' Thermal Comfort Perception by Age

There is a meaningful difference between seafarers' ages and their thermal comfort perceptions. ($p=0.006 < 0.05$). Seafarers at the age group of 26-40 find thermal comfort more satisfying compared to the other age groups.

Table 16: ANOVA Analysis in Relation to Thermal Comfort Perception by Age

	Mean	**Standart Dev.**	**F**	**p**
18-25	2.70	0.685	4.502	0.006
26-40	2.06	0.178		
41-50	2.86	1.243		
51+	4.00	0.00		
Total	2.53	0.831		

4.9.4.2. Variability of Rest Areas' Thermal Comfort Perception by Gender

There is not a meaningful difference between seafarers' gender and their thermal comfort perceptions. ($p=0.351 > 0.05$).

Table 17: ANOVA Analysis in Relation to Thermal Comfort Perception by Gender

	Mean	**Standart Dev.**	**F**	**p**
Female	2.68	0.594	0.883	0.351
Male	2.47	0.902		
Total	2.53	0.831		

4.9.4.3. Variability of Rest Areas' Lighting Perception by Marital Status

There is a meaningful difference between seafarers' marital status and lighting-related comfort perceptions. ($p=0.000 < 0.05$). Married seafarers find lighting more satisfying compared to single seafarers. This approach can be explained with the economic obligations depending on marriage.

Table 18: ANOVA Analysis in Relation to Lighting Perception by Marital Status

	Mean	**Standart Dev.**	**F**	**p**
Single	2.77	0.784	13.854	0.000
Married	1.97	0.634		
Total	2.60	0.819		

4.9.4.4. Variability of Rest Areas' Bed-Furniture Comfort Perception by Marital Status

There is a meaningful difference between seafarers' marital status and bed-furniture comfort perception. ($p=0.020 < 0.05$). Married seafarers find bed-furniture comfort more satisfying compared to single seafarers. This approach can be explained with the economic obligations depending on marriage.

Table 19: ANOVA Analysis in Relation to Bed-Furniture Perception by Marital Status

	Mean	**Standart Dev.**	**F**	**p**
Single	2.99	0.71	5.647	0.020
Married	2.46	0.858		
Total	2.88	0.768		

4.9.4.5. Variability of Rest Areas' Lighting Perception by Job Position

There is not a meaningful difference between seafarers' job position and lighting perception. ($p=0.098 >0.05$).

Table 20: ANOVA Analysis in Relation to Lighting Perception by Job Position

	Mean	**Standart Dev.**	**F**	**p**
Deck	2.36	0.808	2.402	0.098
Engine	2.77	0.808		
Other	2.33	0.314		
Total	2.60	0.81		

4.9.4.6. Variability of Rest Areas' Noise Perception by Education Level

There is a meaningful difference between seafarers' education level and noise-related comfort perception. ($p=0.025 < 0.05$).

Table 21: ANOVA Analysis in Relation to Noise Perception by Education Level

	Mean	**Standart Dev.**	**F**	**p**
Secondary School	1.94	0.235	2.759	0.025
Highschool	2.42	0.973		
Associate Degree	1.51	0.453		
Undergraduate Degree	2.68	0.844		
Master Degree	1.94	0.864		
PhD	3.03	0.788		
Total	2.52	0.882		

Tukey Multiple Comparisons Test has been applied to understand which two variables demonstrate the meaningful difference. As a result of the test, a meaningful difference has been found between the variables of associate degree and undergraduate degree.

Table 22: ANOVA-Tukey Multiple Comparisons Test Analysis in Relation to Noise Perception by Education Level

		Mean Difference	**Std. Error**	**P**
Associate Degree	**Secandary School**	-.425	.645	.975
	Highschool	-.909	.430	.294
	Undergraduate Degree	-1.165*	.359	.022
	Master Degree	-.425	.680	.989
	PhD	-1.518	.589	.118

4.9.4.7. Variability of Rest Areas' Noise Perception by Vessel Year of Built

There is not a meaningful difference between vessel year of built and noise perception. ($p=0.144 > 0.05$).

Table 23: ANOVA Analysis in Relation to Noise Perception by Vessel Year of Built

	Mean	**Standart Dev.**	**F**	**p**
1975-1980	2.69	0.932	1.782	0.144
1981-1990	2.61	0.549		
1991-2000	3.27	0.500		
2001-2010	2.62	0.838		
2010+	2.25	0.959		
Total	2.56	0.884		

4.9.4.8. Variability of Rest Areas' Vibration Perception by Vessel Year of Built

There is not a meaningful difference between vessel year of built and vibration perception. ($p=0.144 > 0.05$).

Table 24: ANOVA Analysis in Relation to Vibration Perception by Vessel Year of Built

	Mean	**Standart Dev.**	**F**	**p**
1975-1980	3.36	1.335	0.216	0.928
1981-1990	3.66	0.942		
1991-2000	3.50	1.224		
2001-2010	3.16	1.167		
2010+	3.12	1.270		
Total	3.21	1.189		

4.9.4.9. Variability of Rest Areas' Noise Perception by Type of Vessel

There is not a meaningful difference between type of vessel and noise perception. ($p=0.580 > 0.05$).

Table 25: ANOVA Analysis in Relation to Noise Perception by Type of Vessel

	Mean	**Standart Dev.**	**F**	**p**
Container	2.39	0.879	0.659	0.580
Dry-Bulk Carrier	2.50	1.272		
Liquid-Bulk Carrier	2.73	0.837		
Other	2.62	0.869		
Total	2.52	0.895		

4.9.4.10. Variability of Rest Areas' Vibration Perception by Type of Vessel

There is not a meaningful difference between type of vessel and vibration perception. (p=0.058 > 0.05).

Table 26: ANOVA Analysis in relation to Vibration Perception by Type of Vessel

	Mean	**Standart Dev.**	**F**	**p**
Container	2.91	1.197	2.616	0.058
Dry-Bulk Carrier	3.11	1.259		
Liquid-Bulk Carrier	3.78	0.860		
Other	3.30	1.226		
Total	3.22	1.157		

4.10. FINDINGS OF RESEARCH

73% of 74 respondents to research is male. The majority of respondents by age groups belongs to 18-25 age group with 62.2 %. 78.4% of respondents are single. The majority of respondents by education level is seen at undergraduare degree and over with 75.7%. 58.1% of respondents work as engine-room personel. According to total work experience, 53.4% of respondents have been working as a seafarer for less than one year. 40.3% of respondents have been working in their current vessel for 4-6 months.

46.3% of vessels that respondents have currently been working were built between the years of 2001 – 2010. According to place of built, the majority of the vessels respondents have currently been working belongs to Turkey with 45.6%. 53.5% of vessels which respondents have currently been working are container vessels. According to flag of vessels, Turkish flagged vessels have the majority with 63.4%. 55.6% of the vessels that respondents have currently been working have been classed in terms of comfort criteria.

In the research, the mean values of ergonomic criteria have respectively been 2.52 for noise, 2.53 for thermal comfort, 2.60 for lighting, 3.18 for vibration, 3.13 for ventilation and 2.88 for bed and furniture. In general, while the values do not show obvious results, respondents' vibration and ventilation comfort perceptions are more negative than noise, thermal comfort, lighting and bed and furniture. The reason of why respondents avoided indicating their comfort perceptions can be attributed to the possible job loss fear and economic concerns.

A relationship has been detected between thermal comfort perception and seafarers' age. Age group of 26-40 stated that their thermal comfort perceptions are more positive compared to the other age groups.

Marital status has been found a clear determinant for two-comfort criteria. In this respect, married seafarers find lighting and bed-furniture comfort more satisfying compared to single seafarers. The main reason for this approach can be directly linked to economic obligations depending on marriage.

In this research, education level has been found a determinant for noise perception. In this respect, approaches of respondents with associate degree to noise is more positive compared to respondents with undergradute degree.

Despite the general view that women are more vulnerable to thermal conditions, in this research, a finding in this direction has not been reached.

Although engine-room personnel is expected to be more dissatisfied with lighting compared to deck-office personel from the point of darkness-brightness condition in their workplace environment, in this research, a finding in this direction has not been reached.

Eventhough noise and vibration perception is expected to be lower in the old vessels from the point of possible insulation and wearing problems, in this research, a finding in this direction has not been reached.

In spite of the fact that noise and vibration perception is expected to be different by type of vessel from the point of changing cargo-related conditions and necessities, in this research, a finding in this direction has not been reached.

CONCLUSION

The fundamental reason of maritime accidents is fatigue as an element of human factor. Fatigue occurs as a result of lack of rest as well as job-specific issues. However, focus point in literature is predominantly over job-specific issues and environments like bridge. Accommodation areas used for rest on board and their rest conditions are dramatically overlooked.

In the research, it is understood that ergonomic comfort perception on accommodation areas used for rest of seafarers differ with their personal conditions and priorities. For some of the ergonomic rest conditions, the degree of satisfaction is higher for married seafarers compared to single seafarers. Married seafarers' economical responsibility to their wife/husband or children is thought to be the main reason of this situation. Thermal comfort is found more satisfying by seafarers at the age group of 26-40. Another result of this research is changing comfort perception by education level (between associate degree and undergraduate degree).

The reason of why seafarers can not clearly express their comfort perceptions is thought to depend on their concerns over lose of job. Due to this situation, clear results for all of the ergonomic rest conditions in specific rest areas on board could not be reached.

It is determined that some of the seafarers do not have any idea about comfort criteria constituted by classification societies. Hence, those seafarers experience difficulties in determining the comfort suitability degree of the vessel they work. Shipowners or shipowning companies should imform seafarers about those criteria.

Limitations and Further Research

The sample of the questionnaire survey consists of 74 seafarers who are Turkish seafarers working in vessels calling to İzmir Alsancak Port, Turkish seafarers working in scientific research vessels and Dokuz Eylül University Maritime Faculty students working as a ship cadet as long as their internship period. The number of women respondents is 20. The months of May, June, July of 2018 are determined as the term for questionnaire survey.

A study supported by quantitative analysis with more respondents may provide more clear view about the topic. In addition, ergonomic measurements for seafarers may also support the further research.

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APPENDICES

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZ. TİC. LTD. ŞTİ.

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ÖLÇÜM RAPORU

Rapor No:KD-2018-010
Ölçüm Tarihi:11.03.2018
Rapor Onay Tarihi:16.04.2018

İÇİNDEKİLER

KONU	SAYFA
Sunuş……..	3
Bölüm 1 Gürültü Ölçümleri..……....	4
Bölüm 2 Termal Konfor Ölçümleri …….	6
Bölüm 3 Aydınlatma Ölçümleri. …….....	8
Bölüm 4 Titreşim Ölçümleri..……....	10
Kaynaklar……..	13
İmza…….....	14

EKLER

Türkak Akreditasyon Belgemiz ……	EK 1

SUNUŞ

Bu rapor bir gemide yapılan; Gürültü, Termal Konfor, Aydınlatma ve Titreşim Ölçümleri sonucu düzenlenmiştir.

Ölçümler 11.03.2018 tarihinde gerçekleştirilmiştir. Ölçümler yetkili tarafından belirlenen noktalarda yapılmıştır. Ölçüm sonuçları, deneyin yapıldığı andaki hava koşulları ve ortam şartları ile sadece ölçüm sırasındaki proses koşulları ile ilgili olup, raporda geçen görüş ve yorumlar sadece bu rapora aittir.

Raporumuz ölçüm sonuçlarını, ölçüm cihazlarının spesifikasyonlarını ve ölçüm yöntemlerini içermektedir.

Bu doküman, 28339 sayılı 30 Haziran 2012 Tarihli, resmi gazete de yayınlanan 6331 sayılı *İş Sağlığı Ve Güvenliği Kanunu* gereğince resmi işlemlerde kullanılamaz.

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

BÖLÜM 1
GÜRÜLTÜ ÖLÇÜMLERİ

1.1. ÖLÇÜM CİHAZLARI

1.1.1. SVAN 971 Sound Level Meter Seri No:39105
Type 1;1
DIN EN 60651: 1994, DIN EN 60804: 1994
IEC 61672: 2002
IEC 1260: 1994
ISO/CD 8041: 2001
Frequancy :1/1 & 1/3 Octave band (0,80 Hz - 20 KHz)

1.2 ÖLÇÜM YÖNTEMLERİ

1.2.1. Lokal Gürültü Ölçümleri

Lokal gürültü seviyesi ölçümleri işletmenin rutin çalışma koşullarını örnekleyecek sürelerde ve çalışanların işitme seviyelerinde, *TS EN ISO 11201 Akustik – Makina ve donanımdan yayılan gürültü – İhmal edilebilir düzeydeki çevresel düzeltmelerle yansıtıcı bir düzlem üzerinde esas olarak açık bir alandaki iş mahallinde ve belirtilen diğer konumlardaki emisyon ses basınç seviyelerinin tayini Havadaki Akustik Gürültülerin Ölçülmesi* standartında yapılmıştır.

1.3. ÖLÇÜM SONUÇLARI

Lokal gürültü seviyesi ölçüm sonuçları Tablo 1.2 de sunulmuştur.

1.4. DEĞERLENDİRME

Ölçüm sonuçlarının değerlendirilmesi ***''ABS GUIDE FOR CREW HABITABILITY ON SHIPS''*** rehberine göre yapılmıştır.

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

Tablo 1.2: Lokal Gürültü Seviyesi Ölçüm Sonuçları **Cihaz Seri No: 39105**

Ölçüm No	Ölçüm İşletmesi	Ölçüm Yeri	Leq (dBA)	HAB	HAB+	HAB++	Ölçüm Tarihi
				≥ 10000 Gross Tonnage			
1	Güverte ofisi	Ofis içi	**64,8**	60	**55**	**55**	11.03.2018
2	Yemekhane	Sancak tarafı	59,3	60	55	**50**	11.03.2018
3	Mutfak	-	68,3	75	70	**65**	11.03.2018
4	Reis kamarası	-	**55,0**	55	55	**50**	11.03.2018
5	Hobi odası	-	**66,3**	**60**	**55**	**50**	11.03.2018
6	Köprü üstü	-	63,5	65	60	55	11.03.2018

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

BÖLÜM 2
TERMAL KONFOR ÖLÇÜMLERİ

2.1. ÖLÇÜM CİHAZI

KIMO HQ210 WBGT RH range : 20% - 95% RH accuracy : ±5%
Temperature range : 0 ºC to 120 ºC Temp.accuracy : ± 0,5
Seri No: 2P170505596

2.2. ÖLÇÜM YÖNTEMLERİ

2.2.1. TS EN ISO 7730 Orta dereceli termal ortamlar – PMV ve PPD indislerinin tayini termal rahatlık için şartların belirlenmesi

Ölçümler dijital termal konformetre ile TS EN ISO 7730 *"Orta dereceli termal ortamlar – PMV ve PPD indislerinin tayini termal rahatlık için şartların belirlenmesi"* standardına uygun olarak yapılmıştır.

2.3. ÖLÇÜM SONUÇLARI

Termal konfor ölçüm sonuçları Tablo 2.1 de sunulmuştur.

2.4. DEĞERLENDİRME

Ölçüm sonuçlarının değerlendirilmesi ***''ABS GUIDE FOR CREW HABITABILITY ON SHIPS"*** rehberine göre yapılmıştır.

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

Tablo 2.1: Termal Konfor Ölçüm Sonuçları **Cihaz Seri No:** 2P170505596
TS EN ISO 7730'a göre değerlendirme

Sıra No	Ölçüm Yeri & Ölçüm personeli	Hava Sıcaklığı (t_a, ºC)	Hava Sıcaklığı Değerlendirme (ºC)	Bağıl Nem (%. Rh)	Bağıl Nem Değerlendirme (%. Rh)	Hava Akım Hızı (m/sn)	Hava Akım Hızı Değerlendirme (m/sn)	Ölçüm Tarihi
1	Güverte ofisi	21,57	20-25 **ºC**	50,07	%30-70	0,47	Max 0,5 m/sn	11.03.2018
2	Yemekhane (Sancak tarafı)	23,23	20-25 **ºC**	45,73	%30-70	0,487	Max 0,5 m/sn	11.03.2018
3	Mutfak	24,16	20-25 **ºC**	44,74	%30-70	0,455	Max 0,5 m/sn	11.03.2018
4	Reis kamarası	24,62	20-25 **ºC**	**73,22**	**%30-70**	0,487	Max 0,5 m/sn	11.03.2018
5	Hobi odası	23,45	20-25 **ºC**	45,37	%30-70	**0,528**	**Max 0,5 m/sn**	11.03.2018
6	Köprü üstü	24,70	20-25 **ºC**	43,20	%30-70	0,418	Max 0,5 m/sn	11.03.2018

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

BÖLÜM 3
AYDINLATMA DÜZEYİ ÖLÇÜMLERİ

3.1. ÖLÇÜM CİHAZI

EXTECH SDL 400
Seri No:Q848742

Fc Ölçümü	200, 2000, 10kFc	0,1Fc	±4%
Lux Ölçümü	2000, 20k, 100kLux	1Lux	±4%
K Tipi Sıcaklık Ölçüm Aralığı	-100 ... +1300°C	0,1°	±0,4%
J Tipi Sıcaklık Ölçüm Aralığı	-100 ... +1200°C	0,1°	±0,4%

EN 610004-2, EN 61010-1 Level 3, EN 61000-4-2 Level 3, EN 61000-4-4 Level 3
EN 61000-4-5 Level 3, EN 61000-4-11, EN 61000-4-3, en 55020 class B

3.2. ÖLÇÜM YÖNTEMİ

Ölçümler digital lüksmetre ile, çalışanın çalışma alanı görüş bölgesinde "COHSR-928-1-IPG-039" standartına göre yapılmıştır.

3.3. ÖLÇÜM SONUÇLARI

İşletmede yapılan aydınlatma düzeyi ölçüm sonuçları Tablo 3.1 de sunulmuştur.

3.4. DEĞERLENDİRME

Ölçüm sonuçlarının değerlendirilmesi ***''ABS GUIDE FOR CREW HABITABILITY ON SHIPS''*** rehberine göre yapılmıştır

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

Tablo 3.1: Aydınlatma Düzeyi Ölçüm Sonuçları **Cihaz No:** Q848742

Ölçüm Noktası	Ölçüm Bölümü & Ölçüm Yeri	Ölçüm Zamanı Gün Işığı Faktörü;	Aydınlatma Düzeyi (Lüks)	*'ABS Guide for Crew Habitability on Ships* 'e göre Değerlendirme (Lüks)	Ölçüm Tarihi
1	Güverte ofisi Ofis içi	Var	**237**	**300**	11.03.2018
2	Yemekhane Sancak tarafı	Var	562	300	11.03.2018
3	Mutfak	Var	**343**	**500**	11.03.2018
4	Reis kamarası	Var	**252**	**300**	11.03.2018
5	Hobi odası	Var	557	300	11.03.2018
6	Köprü üstü	Var	1274	300	11.03.2018

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

BÖLÜM 4
TİTREŞİM MARUZİYETİ ÖLÇÜMLERİ

4.1. ÖLÇÜM CİHAZLARI

Tüm Vücut Titreşim:
SVAN 958 Vibration Data Loger
Seri No: 11790/54706
Type 1 : RMS, Peak, Max, Min, MTVV, VDV, Time history
ISO 8041, ISO 5349, ISO 2631-1,Range : 0.003 ms² - 1000 ms² 0.5 – 20 kHz

4.2. ÖLÇÜM YÖNTEMİ VE TEKNİĞİ

Ölçümler *"TS ISO 2631-1: 2013 Tüm Vücut Titreşime Mağruz Kalma Değerlendirilmesi " ve "TS EN 1032+A1 Titreşim Emisyon Değerinin Belirlenmesi Amacıyla Hareketli Makinaların Deneye Tabi Tutulması"* standartlarında yapılmıştır.

4.3. ÖLÇÜM SONUÇLARI

İşletmede yapılan titreşim ölçüm sonuçları Tablo 3.1 de sunulmuştur.

4.4. DEĞERLENDİRME

Ölçüm sonuçlarının değerlendirilmesi ***''ABS GUIDE FOR CREW HABITABILITY ON SHIPS"*** rehberine göre yapılmıştır.

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

Tablo 3.1: Titreşim Maruziyeti Ölçüm Sonuçlar **Cihaz Seri No:11790/54706**

Ölçüm No	Ölçüm Bölümü & Ünitesi	Ölçüm Yeri & Ölçüm Personeli	Yapılan Ölçüm	Yön	RMS (m/s²)	Çalışma için geçirilen süre (dk)	Günlük Titreşim Maruziyeti A(8) (m/s²)	*'ABS Guide for Crew Habitability on Ships HAB Notation Kriterlerine* göre Değerlendirme		Ölçüm Tarihi
								Accommodation Areas	Work Spaces	
1	Güverte ofisi Ofis içi		Tüm Vücut titreşim maruziyeti	x:	0,10	480	**0,91**	0,178	0,214	11.03.2018
				y:	0,65					
				z:	0,02					
2	Yemekhane (Sancak tarafı)		Tüm Vücut titreşim maruziyeti	x:	0,06	480	**0,99**	0,178	0,214	11.03.2018
				y:	0,71					
				z:	0,02					
3	Mutfak		Tüm Vücut titreşim maruziyeti	x:	0,07	480	0,09	0,178	0,214	11.03.2018
				y:	0,01					
				z:	0,07					

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Ölçüm No	Ölçüm Bölümü & Ünitesi	Ölçüm Yeri & Ölçüm Personeli	Yapılan Ölçüm	Yön	RMS (m/s²)	Çalışma için geçirilen süre (dk)	Günlük Titreşim Maruziyeti A(8) (m/s²)	*'ABS Guide for Crew Habitability on Ships HAB Notation Kriterlerine* göre Değerlendirme		Ölçüm Tarihi
								Accommodation Areas	Work Spaces	
4	Reis kamarası		Tüm Vücut titreşim maruziyeti	x:	0,07	480	0,09	0,178	0,214	11.03.2018
				y:	0,001					
				z:	0,07					
5	Hobi odası		Tüm Vücut titreşim maruziyeti	x:	0,07	480	**1,02**	0,178	0,214	11.03.2018
				y:	0,73					
				z:	0,07					
6	Köprü üstü		Tüm Vücut titreşim maruziyeti	x:	0,02	480	0,02	0,178	0,214	11.03.2018
				y:	0,007					
				z:	0,02					

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

KAYNAKLAR

- TS EN ISO 11201 Akustik - Makina ve donanımdan yayılan gürültü – İhmal edilebilir düzeydeki çevresel düzeltmelerle yansıtıcı birdüzlem üzerinde esas olarak açık bir alandaki iş mahalinde ve belirtilen diğer konumlardaki emisyon ses basınç seviyelerinin tayini
- TS EN ISO 11202 Akustik - Makina ve donanımdan yayılan gürültü – bir iş mahalindeki ve benzer çevresel düeltmeler uygulanmış belirtilen diğer konumlardaki emisyon ses basınç seviyelerinin tayini
- TS EN ISO 11204 Akustik - Makine ve donanım tarafından yayılan gürültü-Bir iş istasyonunda ve belirtilen diğer konumlarda emisyın ses basınç seviyelerinin ölçülmesi - Çevresel düzeltmeler gerektiren yöntemi
- TS ISO 2631-1: 2013 Tüm Vücut Titreşime Mağruz Kalma Değerlendirilmesi
- TS EN 1032+A1 Titreşim Emisyon Değerinin Belirlenmesi Amacıyla Hareketli Makinaların Deneye Tabi Tutulması
- COHSR-928-1-IPG-039 Aydınlatma Düzeyinin Tespiti
- TS EN 7243:2017 Sıcak Ortamlar - WBGT İndeksine Göre Isının Çalışanlar Üzerine Baskısının Tahmini
- EVS-EN ISO 7730:2006 Ergonomocis of the thermal environment- Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria
- ABS Guide for Crew Habitability on Ships

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

Raporu Hazırlayan	Raporu Onaylayan
Şenay EROL	**İbrahim YAMAN**
Kimyager Rapor Sorumlusu C Sınıfı İş Güvenliği Uzmanı	Çevre Mühendisi Laboratuvar Müdürü
16.04.2018	**16.04.2018**

ULUSOY İŞ SAĞLIĞI VE GÜVENLİĞİ ÇEVRE ANALİZ LABORATUVAR HİZMETLERİ TİC. LTD. ŞTİ. tarafından **11.03.2018** tarihinde yapılan ölçümler neticesinde hazırlanan bu rapor, laboratuvarımızın yazılı onayı olmadan kısmen veya tamamen çoğaltılamaz. Çalışma ve Sosyal Güvenlik Bakanlığı'na ait resmi işlemlerde kullanılamaz. İmzasız ve mühürsüz raporlar geçersizdir.

SVANTEK

ISO9001 certified

FACTORY CALIBRATION DATA OF THE SV103 *No. 41056*

with integrated transducer SVANTEK type SV107 No. 29584

1. CALIBRATION with SV107 (vibrational)

Input signal: 140dB; Frequency:79.58Hz;

	Filter	BL Wh
Channel 1 (X)	Indication [dB]	139.97
	Error [dB]	-0.03
Channel 2 (Y)	Indication [dB]	140.04
	Error [dB]	0.01
Channel 3 (Z)	Indication [dB]	140.04
	Error [dB]	0.04

2. LINEARITY TEST with SV107 (vibrational)

Filter: BL Wh; Frequency: 79.58Hz;

	Nominal result RMS [dB]	120.0	130.0	140.0	150.0
Channel 1 (X)	Error [dB]	0.29	0.03	-0.02	-0.02
Channel 2 (Y)	Error [dB]	0.10	-0.08	-0.09	-0.13
Channel 3 (Z)	Error [dB]	0.26	0.02	-0.01	-0.03

3. FREQUENCY RESPONSE with SV107 (vibrational)

Filter: BL Wh; Input signal: 140dB;

	Frequency [Hz]	80	160	800	1600
Channel 1 (X)	Gain [dB]	0.00	-0.02	-0.29	-5.76
	Error [dB]	0.00	-0.02	0.35	-0.30
Channel 2 (Y)	Gain [dB]	0.00	-0.06	-0.79	-5.52
	Error [dB]	0.00	-0.06	-0.15	-0.06
Channel 3 (Z)	Gain [dB]	0.00	0.01	-0.48	-5.78
	Error [dB]	0.00	0.01	0.16	-0.32

4. INTERNAL NOISE with SV107 (vibrational)

	Filter	Wh
Channel 1 (X)	Indication [dB]	91.75
Channel 2 (Y)	Indication [dB]	90.76
Channel 3 (Z)	Indication [dB]	92.46

5. CALIBRATION (electrical)

Input signal: 100mV_{rms}; Frequency: 79.58Hz;

	Filter	BL Wh
Channel 1 (X)	Indication [dB]	163.65
	Error [dB]	0.05
Channel 2 (Y)	Indication [dB]	163.63
	Error [dB]	0.03
Channel 3 (Z)	Indication [dB]	163.64
	Error [dB]	0.04

6. INTERNAL NOISE (electrical)

	Filter	Wh	BL Wh
Channel 1 (X)	Indication [dB]	75.73	92.09
Channel 2 (Y)	Indication [dB]	75.47	92.07
Channel 3 (Z)	Indication [dB]	75.95	92.16

7. ELECTRICAL CROSS-TALK

Filter: BL Wh; Input = 0.741 V_{rms} (117.4 dB re 1µV); f_{sin}= 79.58 Hz; Calibration factor: 0.0 dB;

	Signal input	Channel 1	Channel 2	Channel 3
Channel 1	Cross-talk [dB]	-	-75.6	-88.9
Channel 2	Cross-talk [dB]	-88.9	-	-74.3
Channel 3	Cross-talk [dB]	-89.0	-88.9	-

8. FORCE

	Force nominal	~50 N	~100 N	~150 N
Reference meter	**Force [N]**	55.92	101.34	150.58
SV103 indication	**Force [N]**	60.59	99.45	152.80
	Error [N]	4.67	-1.89	2.22

ENVIRONMENTAL CONDITIONS

Temperature	Relative humidity	Ambient pressure
22 °C	28 %	1009 hPa

TEST EQUIPMENT

Item	Manufacturer	Model	Serial no.	Description
1	SVANTEK	SVAN 401	65	Signal generator
2	SVANTEK	SV 912A	4369	Sound And Vibration Meter & Analyzer
3	KEITHLEY	2000	0910165	Digital multimeter
4	VEB RFT	11077	61014	Shaker
5	DYTRAN	3023	786	Reference accelerometer

CONFORMITY & TEST DECLARATION

1. Herewith Svantek company declares that this instrument has been calibrated and tested in compliance with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass them.
2. Traceability of the calibration is guarantied by the above mentioned ISO9001 procedures.
3. The information appearing on this sheet has been compiled specifically for this instrument. This form is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
4. This calibration sheet shall not be reproduced except in full, without written permission of the SVANTEK Ltd.

Calibration specialist: Ryszard Leoniak ..... Test date: 2017-08-02

0601050759

EGEMET
Kalibrasyon Ölçüm Ticaret Limited Şirketi

6172 Sk,No:8 Işıkkent/İZMİR
Tel: 0 232 472 06 04 Fax: 0 232 472 05 04
e-posta:info@egemet.com.tr web: www.egemet.com.tr

Kalibrasyon
TS EN ISO/IEC 17025
AB-0005-K

Kalibrasyon Sertifikası
Calibration Certificate

AB-0005-K
0601050759
07-17

Cihazın Sahibi / Adresi
Customer Name / Address
: Ulusoy İş Sağlığı ve Güvenliği Çevre Aanaliz Laboratuvar Hizmetleri Tic. Ltd. Şti.
1348 sk No:2/AM Keremoğlu İş Merkezi Yenişehir / İzmir

İstek Numarası
Order Number
: SE 1710229

Makine / Cihaz
Instrument / Device
: Bağıl Nem ve Sıcaklık Ölçer

İmalatçı
Manufacturer
: Quest / TEMP.36

Tip
Type
: Dijital

Seri Numarası
Serial Number
: 86 (TKJ020013)

Kalibrasyon Tarihi
Date of Calibration
: 20.07.2017

Sertifikanın Sayfa Sayısı
Number of Pages of the Certificate
: 3

Bu kalibrasyon sertifikası,Uluslararası Birimler Sisteminde (SI) tanımlanmış birimleri realize eden ulusal ölçüm standartlarına izlenebilirliği belgeler.
This calibration certificate documents the traceability to national standards, which realize the unit of measurement according to the International System of Units (SI).

Kalibrasyon laboratuvarı olarak faaliyet gösteren EGEMET TÜRKAK' tan AB-0005-K ile TS EN ISO/IEC 17025: 2012 standardına göre akredite edilmiştir.
EGEMET accredited by TÜRKAK under registration number AB-0005-K for TS EN ISO/IEC 17025:2012 as "Calibration Laboratory"

Türk Akreditasyon Kurumu(TÜRKAK) kalibrasyon sertifikalarının tanınırlığı konusunda Avrupa Akreditasyon Birliği(EA) ile Çok Taraflı Anlaşma ve Uluslararası Laboratuvar Akreditasyon Birliği (ILAC) ile karşılıklı tanıma anlaşması imzalamıştır.
Turkish Accreditation Agency (TURKAK) is a signatory to the European co-operation for Accreditation (EA) Multilateral Agreement (MLA) and to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA) for the recognition of calibration certificates.

Ölçüm sonuçları,genişletilmiş ölçüm belirsizlikleri ve kalibrasyon metotları bu sertifikanın tamamlayıcı kısmı olan takip eden sayfalarda verilmiştir.
The measurements, the uncertainties with confidence probability and calibration methods are given on the following pages which are part of this certificate.

Kalibrasyon Merkezi egemet İZMİR

Tarih *Date*	Kalibrasyonu Yapan *Calibrated by*	Onaylayan *Approval*
	Elektronik olarak imzalanmıştır	**Elektronik olarak imzalanmıştır**
02.08.2017	Alper Güleryüz	Meral Acay

AY.K.02.08.2017.00.00

Bu sertifika, laboratuarın yazılı izni olmadan kısmen kopyalanıp çoğaltılamaz.
This certificate shall not be reproduced other than in full except with the permission of the Laboratory.
İmzasız ve mühürsüz sertifikalar geçersizdir.
Calibration certificates without signature and seal are not valid.

Bu belge 5070 sayılı elektronik imza kanuna göre güvenli elektronik imza ile imzalanmıştır.

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EGEMET
Kalibrasyon Ölçüm Ticaret Limited Şirketi

Makine/Cihaz : **Cihazın Adı** : Bağıl Nem ve Sıcaklık Ölçer — **Seri No** : 86 (TKJ020013)
Instrument / Device — Device Name — Serial Number

Ölçme Aralığı : 0 - 100 %rh / -5 - 60 °C — **Çözünürlüğü** : 1 %rh / 0.1 °C
Measurement Range — Resolution

Lab. Kabul Tarihi : 19.07.2017
Date of receipt of device

Prosedür : Kalibrasyon T 504.428 kalibrasyon talimatına uygun olarak gerçekleştirilmiştir.
Procedures
The calibration is performed in accordance with T 504.428 calibration procedure.

Ölçüm Şartları : İklimlendirme kabini içerisinde oluşturulan ortamın gerçek nem ve sıcaklık değerleri, referans cihaz ile ölçülerek test cihazından okunan değerler ile karşılaştırılmıştır.
Measurement Conditions
The true humidity and temperature values of the ambient conditions realized in the climate chamber are measured once with the reference equipment and compared with the test object readings.

Kalibrasyon Ekipmanları
Calibration Equipment

Cihaz Kodu Device Code	**Cihaz Adı** Device Name	**Sertifika Tarihi** Certificate Date	**Sertifika No** Certificate No	**İzlenebilirlik** Traceability
EKC-210	Sıcaklık-Nem Ölçer	17.08.2016	16N00295	AB-0002-K

Ön Muayene : Cihaza yeni bir pil takılarak kalibrasyonu yapılmıştır.Glop şeklinde tabir edilen kürede yamukluklar mevcut.Aynı zamanda boyasında dökülmeler mevcuttur.
Pre-Inspection

Çevre Şartları : Sıcaklık : (23±2) °C — Nem : (50±10) %rh
Enviromental Conditions — Temperature — Humidity

Ölçüm Sonuçları : Ölçüm sonuçları takip eden sayfa(lar)da verilmiştir.
Measurement Results
The measurement results are given in the following page(s).

Ölçüm Belirsizliği : Beyan edilen genişletilmiş ölçüm belirsizliği, standart belirsizliğin, k=2 olarak alınan genişletme katsayısı ile çarpımı sonucunda bulunan değerdir ve %95 oranında güvenilirlik sağlamaktadır.Bu sertifikada beyan edilen sonuçlar cihazın kalibrasyon tarihindeki durumunu kapsar ve uzun dönem stabilitesi hakkında bir yorum içermez.
Measurement Uncertainty
The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k =2 which for a normal distribution corresponds to a coverage probabilty of approximately 95%. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of this instrument.

Açıklamalar : Kalibrasyon sonuçları sadece kalibrasyonu yapılan 86 (TKJ020013) seri numaralı cihaza aittir. Cihazın performansı için gerekli çevre şartlarında kullanımından ve uygun aralıklarla kalibre edilmesinin sağlanmasından kullanıcı sorumludur.
Explanations
The calibration results belong to device with serial number 86 (TKJ020013). Users are responsible for using the device necessary environmental conditions and providing calibration for convenient intervals.

Sıcaklık ölçümleri müşteri isteği doğrultusunda cihazın ''DRY'' kısmından alınmıştır.

Uygunluk Beyanı : Ölçüm sonuçlarının değerlendirilmesi müşteriye bırakılmıştır.
Declaration of Conformity
The evaluation of the measurement results will be done by the customer.

AB-0005-K
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07-17

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EGEMET

Kalibrasyon Ölçüm Ticaret Limited Şirketi

Ölçüm Sonuçları

Measurement Results

Kabin Set Değeri Set Value		**Referans Değer** Reference Value		**Test Cihazı Değeri** Test Device		**Sapma** Deviation		**Ölçüm Belirsizliği** Measurement Uncertainty	
%rh	°C	%rh	°C	%rh	°C	%rh	°C	%rh	°C
40	10	40.09	10.35	45	9.4	4	-1.0	1.45	0.51
70	10	69.86	10.40	77	9.6	7	-0.8	2.35	0.51
95	10	95.52	10.23	98	10.2	2	-0.0	1.61	0.51
30	20	30.80	19.78	39	19.0	8	-0.8	1.59	0.40
70	20	70.12	19.98	72	19.4	2	-0.6	2.22	0.60
95	20	95.47	20.17	98	19.5	3	-0.6	2.11	0.40
30	40	30.07	40.84	36	40.1	6	-0.7	2.00	0.50
50	40	49.14	40.91	55	40.2	6	-0.7	2.00	0.50
95	40	93.75	41.04	99	39.9	5	-1.1	1.70	0.50

GEMİLERDEKİ DİNLENME AMACIYLA KULLANILAN YAŞAM MAHALLERİNİN KONFORUNUN GEMİ ADAMLARININ DİNLENME DÜZEYLERİ ÜZERİNDEKİ ETKİSİNİN DEĞERLENDİRİLMESİNE YÖNELİK BİR ANKET ÇALIŞMASI

Değerli Katılımcı,

Bu çalışma ile, gemi adamlarının gemilerde dinlenme amacıyla kullandıkları yaşam mahallerinin konforunun; gemi adamlarının dinlenme düzeyleri üzerindeki etkisinin değerlendirilmesi amaçlanmaktadır. Ankette bulunan sorulara vereceğiniz cevaplar yüksek lisans tez çalışması kapsamında, tamamen bilimsel amaçlı olarak kullanılacaktır.

Bu anket üç bölümden oluşmaktadır. Birinci bölüm kişisel bilgilerin elde edilmesi amacıyla hazırlanan sorulardan; ikinci bölüm gemiye ilişkin bilgilerin elde edilmesi amacıyla hazırlanan sorulardan; üçüncü bölüm ise gemideki dinlenme amacıyla kullanılan yaşam mahallerinin konfor algısının tespitine yönelik olarak hazırlanan sorulardan oluşmaktadır.

Bu sorulara ek olarak, görüş ve düşüncelerinizi paylaşabilmeniz amacıyla ayrılmış bir bölüm de bulunmaktadır.

Anket sorularını doğru ve samimi olarak cevaplamanız, anket sonucunun bilimselliği adına büyük önem taşımaktadır. Lütfen anketlerin üzerine isim belirtmeyiniz.

İlgi ve yardımlarınız için şimdiden teşekkür ederiz.

Dr. Öğr. Üye. K. Emrah ERGİNER

Yük. Lis. Öğr. G. Yiğit KOLCUBAŞI

A Bölümü:

Kişisel Bilgiler: (Kişisel bilgilerinizi içeren aşağıdaki soruları cevaplayınız.)

1) Cinsiyetiniz: ☐ Kadın ☐ Erkek

2) Yaşınız: ☐ 18-25 ☐ 26-40 ☐ 41-50 ☐ 51+

3) Medeni Durumunuz: ☐ Bekar ☐ Evli

4) Eğitim Durumunuz: ☐ İlkokul ☐ Ortaokul ☐ Lise ☐ Yüksekokul

☐ Lisans ☐ Lisansüstü ☐ Doktora

5) İş Pozisyonunuz: ☐ Güverte _____

☐ Makine _____

☐ Diğer (Belirtiniz) _____

6) Gemi adamı olarak ne kadar süredir çalışıyorsunuz ? _____yıldır. (1 yıldan az ise: _____ aydır.)

7) Bu gemide ne kadar süredir çalışıyorsunuz ? _____ yıldır. (1 yıldan az ise: _____ aydır.)

B Bölümü:

Gemiye İlişkin Bilgiler: (Biliyorsanız, gemiye ilişkin aşağıdaki soruları cevaplayınız.)

1) Geminin İnşa Yılı: _____

2) Geminin İnşa Edildiği Tersane:_____

3) Geminin Tipi: ☐ Konteyner ☐Kuru Dökme Yük ☐ Sıvı Dökme Yük ☐ Ro-Ro ☐ Yolcu Gemisi

☐ Diğer (Belirtiniz: _____)

4) Geminin Bayrağı:_____

5) Geminin konfor açısından yeterliliğine ilişkin klaslaması yapılmıştır.

☐ Evet ☐ Hayır ☐ Bilgim Yok

C Bölümü:

Gemideki Dinlenme Amacıyla Kullanılan Yaşam Mahallerinin Konfor Algısı:

Gemi adamlarının gemide bulundukları süre içerisinde mesai süreleri dışında, uyuma, dinlenme, yemek yeme, sohbet etme, TV/film/video izleme ve oyun oynama gibi iş dışındaki amaçlar için kullandıkları alanların konfor algısına yönelik aşağıdaki ifadeler için, 1 ve 5 arasında verilen değerlerden sizin için uygun olanı işaretleyiniz.

Bu değerlere karşılık gelen cevaplar sırasıyla aşağıda gösterilmiştir.

1: Kesinlikle Katılmıyorum

2: Katılmıyorum

3: Kararsızım

4: Katılıyorum

5: Kesinlikle Katılıyorum

Not: Hobi salonu, gemideki tv izlenen, oyun oynanan, spor yapılan, sohbet edilen ortak alanı; yemekhane ise gemide gemi adamlarının birlikte yemek yedikleri ortak alanı ifade etmektedir.

MAHAL	SORULAR	KESİNLİKLE KATILMIYORUM	KATILMIYORUM	KARARSIZIM	KATILIYORUM	KESİNLİKLE KATILIYORUM
	GÜRÜLTÜ	**1**	**2**	**3**	**4**	**5**
Kamara	1) Dış ortamdan gelen rahatsız edici düzeydeki ses nedeniyle, kamaralarda iletişim kurmak için ses yükseltme ihtiyacı duyulmaktadır.					
	2) Kamaralardaki gürültü kaynağı çoğunlukla bitişik mahal olmaktadır.					
	3) Gemi hareketlerinden kaynaklı olarak ortaya çıkan yoğun ses, kamara içerisinde dinlenmeyi olumsuz yönde etkiler.					
Yemekhane	4) Dış ortamdan gelen rahatsız edici düzeydeki ses nedeniyle, yemekhanede iletişim kurmak için ses yükseltme ihtiyacı duyulmaktadır.					
	5) Yemekhanedeki gürültü kaynağı çoğunlukla bitişik mahal olmaktadır.					
	6) Gemi hareketlerinden kaynaklı olarak ortaya çıkan yoğun ses, yemekhane konforunu olumsuz yönde etkilemektedir.					
Hobi Salonu	7) Dış ortamdan gelen rahatsız edici düzeydeki ses nedeniyle, hobi salonunda iletişim kurmak için ses yükseltme ihtiyacı duyulmaktadır.					
	8) Hobi salonundaki gürültü kaynağı çoğunlukla bitişik mahal olmaktadır.					
	9) Gemi hareketlerinden kaynaklı olarak ortaya çıkan yoğun ses, hobi salonu konforunu olumsuz yönde etkilemektedir.					
	TERMAL KONFOR					
Kamara	10) Kamaraların iç ortam sıcaklığı, dinlenme konforu için yeterli düzeyde değildir.					
	11) Kamaraların ısıtma/soğutma sisteminde sıklıkla arıza yaşanması nedeniyle dinlenme konforu olumsuz yönde etkilenmektedir.					
Yemekhane	12) Yemekhanenin iç ortam sıcaklığı, dinlenme konforu için yeterli düzeyde değildir.					
	13) Yemekhanenin ısıtma/soğutma sisteminde sıklıkla arıza yaşanması nedeniyle dinlenme konforu olumsuz yönde etkilenmektedir.					
Hobi Salonu	14) Hobi salonundaki iç ortam sıcaklığı, dinlenme konforu için yeterli düzeyde değildir.					
	15) Hobi salonunda ısıtma/soğutma sisteminde sıklıkla arıza yaşanması nedeniyle dinlenme konforu olumsuz yönde etkilenmektedir.					

MAHAL	SORULAR	KESİNLİKLE KATILMIYORUM	KATILMIYORUM	KARARSIZIM	KATILIYORUM	KESİNLİKLE KATILIYORUM
	AYDINLATMA	**1**	**2**	**3**	**4**	**5**
Kamara	16) Gemideki aydınlatma yetersizliği, kamaralardaki dinlenme konforunu olumsuz yönde etkilemektedir.					
	17) Kamaralarda kullanılan aydınlatıcının rengi dinlenmeyi olumsuz yönde etkilemektedir.					
	18) Kamaralardaki pencerelerin boyutları, dinlenme için ihtiyaç duyulan düzeyde gün ışığını almak için yeterli değildir.					
Yemekhane	19) Gemideki aydınlatma yetersizliği, yemekhanedeki dinlenme konforunu olumsuz yönde etkilemektedir.					
	20) Yemekhanede kullanılan aydınlatıcının rengi dinlenmeyi olumsuz yönde etkilemektedir.					
	21) Yemekhanedeki pencerelerin boyutları, dinlenme için ihtiyaç duyulan gün ışığını almak için yeterli değildir.					
Hobi Salonu	22) Gemideki aydınlatma yetersizliği, hobi salonundaki dinlenme konforunu olumsuz yönde etkilemektedir.					
	23) Hobi salonunda kullanılan aydınlatıcının rengi dinlenmeyi olumsuz yönde etkilemektedir.					
	24) Hobi salonundaki pencerelerin boyutları, dinlenme için ihtiyaç duyulan gün ışığını almak için yeterli değildir.					
	TİTREŞİM					
Kamara	25) Geminin hareketinden kaynaklı olarak ortaya çıkan titreşimin şiddeti, kamaralardaki dinlenme üzerinde olumsuz etki yaratmaktadır.					
Yemekhane	26) Geminin hareketinden kaynaklı olarak ortaya çıkan titreşimin şiddeti, yemekhanedeki dinlenme konforu üzerinde olumsuz etki yaratmaktadır.					
Hobi Salonu	27) Geminin hareketinden kaynaklı olarak ortaya çıkan titreşimin şiddeti, hobi salonundaki dinlenme konforu üzerinde olumsuz etki yaratmaktadır.					

MAHAL	SORULAR	KESİNLİKLE KATILMIYORUM	KATILMIYORUM	KARARSIZIM	KATILIYORUM	KESİNLİKLE KATILIYORUM
HAVALANDIRMA		**1**	**2**	**3**	**4**	**5**
Kamara	28) Kamaralarda temiz hava ihtiyacı bulunmaktadır.					
	29) Kamaralarda hissedilen sigara, tuvalet ve nem kaynaklı koku problemi nedeniyle dinlenme konforu azalmaktadır.					
Yemekhane	30) Yemekhanede temiz hava ihtiyacı bulunmaktadır.					
	31) Yemekhanede hissedilen sigara, tuvalet ve nem kaynaklı koku problemi nedeniyle dinlenme konforu azalmaktadır.					
Hobi Salonu	32) Hobi salonunda temiz hava ihtiyacı bulunmaktadır.					
	33) Hobi salonunda hissedilen sigara, tuvalet ve nem kaynaklı koku problemi nedeniyle dinlenme konforu azalmaktadır.					
YATAK – MOBİLYA						
Kamara	34) Kamaralarda kullanılan masa ve sandalye ebatları ile sertlik/yumuşaklık gibi nitelikleri kullanıcının rahat etmesi için uygun değildir.					
	35) Kamaralarda kullanılan yatakların konfor ve rahatlığı dinlenme üzerinde olumsuz etki göstermektedir.					
	36) Kamaralarda kullanılan yatakların konfor ve rahatlığı uyku kalitesi üzerinde olumsuz etki göstermektedir.					
Yemekhane	37) Yemekhanede kullanılan masa ve sandalye ebatları ile sertlik/yumuşaklık gibi nitelikleri kullanıcının rahat etmesi için uygun değildir.					
Hobi Salonu	38) Hobi salonunda kullanılan masa ve sandalye ebatları ile sertlik/yumuşaklık gibi nitelikleri kullanıcının rahat etmesi için uygun değildir.					

Görüş ve düşüncelerinizi belirtmek için aşağıdaki alanı kullanabilirsiniz.

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