



**POLITECNICO DI MILANO**  
**FACOLTA' DI ARCHITETTURA E SOCIETA**  
**CORSO DI LAUREA MAGISTRALE IN ARCHITETTURA**  
**ANNO ACCADEMICO 2011 - 2012**

**ARCHITECTURE ON THE WATER**  
*A 64 MT FERRYBOAT PROJECT*

Tesi di Laurea di:  
**Gulin Keskin**  
**matr. 750963**

Relatore:  
**Prof. Pier Federico Caliari**

Correlatore:  
**Ing. Dario Barbieri**



## 0. ABSTRACT

La tesi svolta comprende una parte di ricerca sulla storia delle imbarcazioni, e sulle loro classificazioni secondo i diversi criteri come la funzione, i sistemi di propulsione, le tipologie di scafo e le tecnologie di costruzioni. La ricerca procede con un'analisi del mercato sulla costruzione, importo ed esporto delle imbarcazioni sia in Italia che in tutto il mondo. La ricerca dettagliata tecnica ed economica prosegue con i criteri del design che permettono di analizzare l'utilizzo dello spazio minimo, della luce, dei colori sul bordo che poi siano utili per il giusto funzionamento del progetto. Nell'ultima parte della parte di ricerca si mettono in confronto diversi modi di vivere nomadi, quindi oltre la barca vengono analizzati i camper, gli aerei privati, gli alberghi e gli automobili dove l'uomo si trova in condizioni di nomadismo fuori dal suo spazio personale. La parte di ricerca viene conclusa con la realizzazione di un progetto di un traghetto lungo 64 metri che si è pensato di essere utilizzato per le escursioni giornaliere tra la costa occidentale della Turchia e le isole greche. Il traghetto composto da 4 deck più un deck sotto permette di trasportare circa 250-300 sia per motivi di escursioni che per i charter privati per le feste di compleanno, eventi di business o matrimoni. Con la sua forma a nastro che diventa poi la struttura portante della barca stessa, cerca di creare una continuità nello spazio tra il mare e il cielo.



## INDEX

### 0 – ABSTRACT

### 1 – MARINE VEHICLES

01

#### 1.1 *Marine story*

01

#### 1.2 *Evolution of the first marine vehicles*

01

#### 1.3 *Origin of yachting*

02

#### 1.4 *Typological analysis*

04

### 2 – MARKET ANALYSIS

10

#### 2.1 *General considerations*

10

#### 2.2 *Italian Boat Market Analysis*

11

#### 2.3 *Global Boating Market Analysis*

14

#### 2.4 *Superyachts Market Analysis*

18

### 3 – CLASSIFICATION AND SUBDIVISION OF MARINE VEHICLES

20

#### 3.1 *By hull typologies*

20

#### 3.2 *By function and propulsion systems*

24

##### 3.2.1 *The commercial ships*

24

##### 3.2.2 *The military ships*

29

##### 3.2.3 *The pleasure boats*

29

##### 3.2.3a *Sail boats*

30

##### 3.2.3b *Motor boats*

33

4– DESIGN ON BOARD	39
4.1 Design Constraints	39
4.2 Use of space on board	40
4.3 Ergonomics	45
4.4 Verification and layout of volumes on board	55
5– COMFORT ON BOARD	60
5.1 Flexibility	60
5.2 Light	63
5.2.1 Reflection	65
5.2.2 Transmission	67
5.2.3 Permeability	69
5.3 Color	74
5.4 Acoustic	79
6– DYNAMIC LIVING	81
6.1 Camper Design	82
6.2 Aeronautical Design	89
6.3 Automobilitic Design	95
6.4 Hotel Design	99
7– PROJECT	104
8– BIBLIOGRAPHY	107

## PHOTO INDEX

1.1 Model of the Royal Yacht, The Mary, Liverpool Museum	03
1.2 A Roman galley	05
1.3 The Carrack "Victoria" of Magellan	05
1.4 An example of caravel from 15th century	06
1.5 The clipper, Sea Witch, 52 meters of length and 10,3 meters of width with 907 tons of displacement	09
1.6 Four masted "Barque Herzogin Cecilie" an archetypal windjammer	09
3.1 Hull typologies	21
3.2 Monohull, catamaran, trimaran sketches	22
3.3 Maxi Catamaran Orange de Bruno Peyron	22
3.4 Basic catamaran scheme	23
3.5 SWATH scheme	23
3.6 SWATH Pilot Boat in Rotterdam	23
3.7 The RMS First Queen Mary, Ocean Liner, 1934	25
3.8 The RMS Titanic, Ocean Liner, 1912	25
3.9 Prinzessin Victoria Luise, Cruise Ship, 1900	26
3.10 MS Oasis Of The Seas, World's largest cruise ship, 2009	26
3.11 A tanker ship	27
3.12 The Ulysses, largest car ferry in the world	28
3.13 Example of dazzle camouflage ship during the World War I	29
3.14 A sloop sailboat example	30
3.15 Sloop and cutter examples	30
3.16 A ketch example	31
3.17 Images of a gulet with 3.5 meters of length by Turkish shipyard MengiYay	32
3.18 Acquariva by Gucci, a limited edition runabout built by Riva Shipyard to celebrate the 90th anniversary of Gucci, 2011	33

3.19 Center Console Fishing Boat 34' by Ocean Master	34
3.20 G50 Fast commuter by Sonny Levi & Sergio Pininfarina by Cantieri Delta	35
3.21 75 Venere Super by Riva Shipyard with 23 meters of length and 32,5 knots of speed	35
3.22 Lateral view and deck plans of 75' Venere Super by Riva Shipyard	36
3.23 Maxi Open 165' by Mangusta	37
3.24 Eclipse, World's largest megayacht with 162,5 meters of length owned by Russian businessman Roman Abramovich	38
4.1 Views from bedroom, kitchen and bathroom of the Space Saver Rotor House by German designer Hanse Colani	41
4.2 Kitchen view of Alloy 40 by Francesco Paskowski, San Lorenzo Shipyard, 2007	43
4.3 Kitchen view of Wally Allseas 70, Wally Shipyard	43
4.4 Elements of Ergonomics with the reference dimensions	47
4.5 Articulated dummy	51
4.6 Fundamental dimensions of living area	52
4.7 Fundamental dimensions of kitchen area	53
4.8 Fundamental dimensions of sleeping area	54
4.9 Verification of the volumes of a boat	57
4.10 Cross sections of different kind of boats to understand the availability of the interior volumes	59
5.1 Interior views of concept boat Nine Zero by Newman Stacey	62
5.2 Specular, diffused and spread reflection diagrams from a surface	66
5.3 Reflection and transmission diagrams	67
5.4 Specular, diffused and spread reflection and transmission from a surface	68
5.5 Views during the day and by night of the "Ocean Pearl" designed by English architect Sir Norman Foster and built by Rodriguez Yachts in 2010	71
5.6 Interior views changing with light effect of "Abrouq Yacht" designed by Ivana Porfiri	73



5.7 Primary, secondary and tertiary colors	75
5.8 A color wheel example	76
5.9 Various examples of installations by Dan Flavin	78
6.1 An Airstream caravan photography that demonstrates the superior reflective qualities of the polished aluminium skin	83
6.2 Airstream floor plans of the 1963 Airstream Fleet	86
6.3 Airstream floor plans of the 1963 Airstream Fleet	87
6.4 Airstream floor plans of the 1963 Airstream Fleet	88
6.5 A view from wagon 4249 of the historic CIWL train, 1940	89
6.6 Technical drawings of historic G.38 by Junkers, 1929	90
6.7 An interior view from historic G.38 by Junkers, 1929	90
6.8 An exterior view from historic G.38 by Junkers, 1929	90
6.9 Deck plans of Airbus A380 Vip Saloon, Lufthansa	91
6.10 An interior view from Airbus A380 Vip Saloon, Lufthansa	91
6.11 An interior view from Airbus A380 Vip Saloon, Lufthansa	91
6.12 Exterior view of Falcon FX designed by Sir Norman Foster for Netjets	93
6.13 Exterior view of Falcon FX designed by Sir Norman Foster for Netjets	93
6.14 Interior views of Falcon FX designed by Sir Norman Foster for Netjets	94
6.15 Andy Warhol, Art Car, Paint on BMW M1 group racing version, 1979	98
6.16 Roy Lichtenstein, Art Car, Paint on BMW 320i group 5 racing version, 1977	98
6.17 Jenny Holzer, Art Car, 1999	98
6.18 Alexander Calder, Art Car, Paint on BMW 30CSL, 1975	98

## TABLE INDEX

Tab. 2.1 Italian Shipbuilding, year 2010	11
Tab. 2.2 Italian Shipbuilding, values in Euro	12
Tab. 2.3 Italian Shipbuilding, composition of global turnover 2005 / 2010 values in Euro	13
Tab. 2.4 The distribution of marinas all over the world, 2009	15
Tab. 2.5 Marinas all over the world by geographical division, year 2009 (by ICOMIA)	17
Tab. 2.6. Production of marine vehicles: geographical division, year 2009 (by ICOMIA)	17
Tab. 5.1 Reflection percentages	77
Tab. 6.1 Standard guestroom dimensions	101

## **ARCHITECTURAL DRAWINGS INDEX**

1. Analysis - Concept
2. Waterlines
3. Lower Deck - Main Deck Plans
4. Upper Deck - Upper Deck Plans
5. Sun Deck - Top View
6. A-A Section - Lateral View
7. B-B Section - Front View - Back View - Details



## **1. MARINE VEHICLES**

### **1.1 MARINE STORY**

Men learn how to survive since its origins by finding his survival tools from the things that surround him. The construction of marine vehicles starts with the need of sea transportation since the first era and it's thought that has an earlier story compared to the invention of the first vehicles on earth. The first era people see the bearing capacity of the water and try to find the ways to take advantage of this capacity. Because of this, when we analyze the first civilizations on earth, we can see that the sea transportation has made a great progress. The first progress steps have seen with the archeological rests of the first Mediterranean civilizations. Egypt, Phoenicians and Greeks have dominated the Mediterranean region and its surroundings by their progresses on the marine vehicle constructions. Again in those ages, it's known that the Chinese have constructed some types of marine vehicles. In the early ages of the Middle Ages no progress can be seen but the arrival of the compass to the Europe by the Arabs provokes the start of a huge innovation in the marine vehicle constructions. So in the Middle Ages, Portuguese, Genoese and Spanish people have made big processes for the new marine constructions that lead the way to discover new lands on earth. Until the discover of the steamboats, mostly the sailboats have been used for the main needs. The most important innovation of the marine vehicle construction is considered the invention of the steamboats that leads to the increase of the tonalitos of the ships and the start of the construction of the iron made ships instead of the wood productions.

### **1.2 EVOLUTION OF THE FIRST MARINE VEHICLES**

It would not be right to appropriate that the origin of the marine transportation and the evolution of the ship construction belongs to only one society or civilization. Specially Greeks is a name that stands out because of the fame of Ulysses that is still immortal thanks to his creator Homeros. Homeros lets us to imagine the first classic sailor with his words dedicated to his hero: "A brave valiant that entrustes his life to some tree trunks roughly worked and challenges the vawes."

The development and the evolution of the watercraft on earth varies according to the geographical location and the historical periods but specially according to the needs.

1500 years before Crist, the Mediterranean basin was already witness to the numerous marine navigations but starting from the II millennium, also the Egypt has favored the maritime navigation because of the geographical advantages.

Round about the VII century, greek civilization has advanced the commercial competition by the sea between different cities like Chalcis, Corinthian, Eretria where the most important commercial products were wheat and metals. Then arose numerous colonies. Athens, Megara, Phocaea build the foreign maritime bases like Byzantine or Marseilles so the Mediterranean basin carries out the function of connection between different colonies.

Greeks rule the Mediterranean starting from the II century until they serve for the growth and the development of the Roman Empire. The Roman laws allow the marine navigation only in the good season while in the winter time from novembre until april it was absolutely forbidden. Even the Venetian have respected this law until the 1280 for their transportation of silk, perfume and spices form the East.

The Egypt watercrafts can navigate on Nile by taking the advantage of the current to descend and the wind to ascend. So these watrecrafts have developed the sail propulsion systems evolved enough. Particularly, the favorable weather conditions let the sail propulsion systems be very reliable since the wind that is useful for going up the river can depend only on downwind.

Phoenicians, Greeks and Romans were navigating offshore in very variable conditions so the sail propulsion was a complementary support on which they can rely only when Eolo blows in the right direction. Frequently to reach the final destination they were forced to use the human energy that serves for the rowing propulsion system.

### **1.3 ORIGIN OF THE YACHTING**

We can assume that the first approach to the marine life can reach to the period that people discover how a floating solid, presumibly a tree trunk fallen into water accidentally, can be used for the beginning of the maritime activities. A tree trunk then becomes the first transport vehicle that will be advanced by time with the evolution of the technology and materials.

The term "yacht" and consequently "yachting" is derived from the Dutch expression "jaght" which means to hunt: the jaght vogel is a predator bird like the hawk, quick as lightning. And the "Jaght Schips" term defines the vessels of very small dimensions that are used for small cabotage of pleasure or military reasons.

Beyond the linguistic genesis of the term "yacht", another important point has to be discovered to understand the origin of the navigation story. As known, in the lake of Nemi, were found two ships, with more than seventy feet of length and built by Emperor Caligula. The location of the archeological rests prove that they were used as pleasure boats like the galleys with which Cleopatra arrive in the port of Tarsus in 42 B.C. Archaeological finds indicate incontrovertibly that the man once get rid of the survival concerns, he discovered sailing. In environmental terms, the canals and rivers and their estauries on the one hand and open waters with the treacherous currents on the other hand, let the internal and coastal navigation more safe and quiet from the meterorological point of view and also to save themselves from the pirates that never reach to these insidious arms of the sea. Under these conditions grew a boating system that was practiced with almost flat bottom boats, to sail in shallow water, and fitted with two side drifts necessary to balance the thrust of the cross-wind on the sails and to prevent drift. We could say that these boats were born with commercial vocation, to transport food and people but were also used to spend some pleasurable time on the canals and rivers with some short episodes in the open waters.

The watercraft construction activities of the wealthy Dutch bourgeois would have continued slowly if the story has not created the conditions that then determine the birth of the naval craft which will change the meaning of the dutch term "yachting". It was year 1660 when the Prince Charles Stuart, that was already in exile in Holland where he enjoyed some surfing and boating experiments, was brought to the throne of England after the death of Cromwell with the name of Charles II. In a public speech, he talks in praise of the qualities of "jaght" on which he had sailed a long time during the forced separation from his home. He also declares that he would build one for himself to sail on the Thames. The Dutch diplomacy that doesn't want to miss any occasion to ingratiate himself, decides to deliver



1.1

a jaght with the similar properties of the one used by the King during his exile times. In August 1660, the “Mary”, the name of the yacht given in honor of the king’s sister, with 16 mt of length, 6 mt of width, 10 cannons and governed by a team of 20 sailors, was already built and ready for sailing through Thames as a gift from the Major of Amsterdam.

The passion of the king passed quickly to courtiers, or perhaps simply because courtiers felt the need to please the king. In both cases this represented a fortune because the first fleet of boating in history was born. In the same year, the local manufacturers that doesn’t want to remain behind the dutch neighbours, try to imitate the ship just arrived from the mainland and the famous carpenter Christopher Pett builds, again for the King, the “Catherine” with the similar shape and size of Mary while Peter Pett launches “Anne” for the Duke of York, brother of the King. So in 1661 on the banks of the Thames, 4 yachts were swinging which are Mary, Catherine, Anne and Bezan that is arrived to England as a gift from the King of Holland to the Monarchy of England. The presence of these four yachts on the calm waters of England, gave rise to the desire to compete that leads to the birth of the first race to build the best pleasure boat. So we can indicate the period of the Charles II of England as the date of birth of first yachting activities.

#### **1.4 TYPOLOGICAL ANALYSIS**

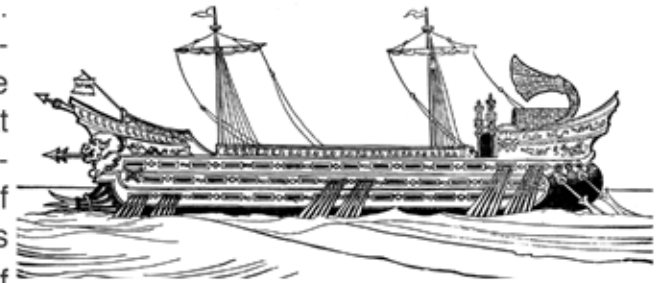
When we talk about the first marine vehicles that lead the way to the birth of the first yachts we must identify some types appeared in the history.

The oar-driven boats, since they could easily be operated during the battles, spread rapidly and generate the first examples of the galleys.

A galley is a type of ship used for the military purposes that is originated in the Mediterranean region. The first galley derives from the Medieval Greek Galea that was belonging to the Byzantine Empire and was used to define an oared war vessel belonging to the Mediterranean tradition starting from the late Middle Ages and onwards. They are specially used for warfare, trade and piracy and dominated naval warfare in the Mediterranean Sea from the 8th century BC until development of advanced sailing warships in the 16th century. Medieval Mediterranean states, notably the Italian maritime republics, including Venice, Pisa, and Genoa, used galleys until the ocean-going man-of-war made them obsolete. The Battle of Lepanto was one of the largest naval battles in which galleys played the principal part. Until the Luigi XIV of France in the XVII century, galleys remain as one of the most



important type of marine vessel in the world. Apart from the Mediterranean galleys, another reason of development of the marine vessels was the commercial shipping that generates the boating systems with more capacity of transportation and the increase of the volumetric quality that adapt themselves to the performance features in terms of power required and developed speed.



1.2

The carracks, three or four masted sailing ships, were born in the Western Europe by the 15th century. The Republic of Genoa recognize the use of carracks to travel over the Atlantic Ocean and they are defined as very innovative and interesting ships from constructive and administrative point of views. They were first used by the Portuguese, that are the inventors of this kind of ship, and then by Spanish to realize exploratory trips over the world. From the constructive point of view they had important evolutions with the passage of time, specially the form of their sails. The big bellied sails give way to the solutions more fractionated that let the carracks to be used in a way more flexible. The word flexibility has an important role in the use of these ships because another innovative evolution



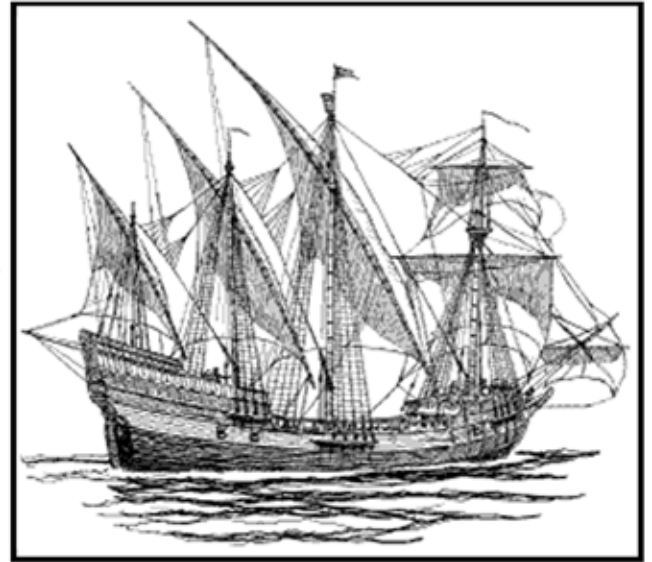
1.3

of the carracks is that they have introduced for the first time the concept of the “time-sharing”. So only one ship could have more than one owners that use the ship for their business purposes with the others and every owner has its unit of ship.

As the forerunner of the reat ships of the age of sail, the carracks were one of the most influential ship designs in history. The most famous ones are “Victoria” of Magellan, that is the first ship in history to circumnavigate the globe (1519-1522), “Santa Maria” in which

Christopher Columbus made his first voyage to America in 1492, "São Gabriel" commanded by Vasco da Gama for the Portuguese expedition from Europe to India by circumnavigating Africa in the 1497.

During the second half of the XIV century, the construction with the planking boards was the most diffused and used technique for almost every vehicle construction. Caravel was a type of ship with the length between 20 and 25 meters and used specially for the coastal cabotage navigation inside the Mediterranean coasts between the XV and XVI centuries. This small and highly manouvable ship then becomes the first transatlantic in the history. Being smaller and having a 1.4

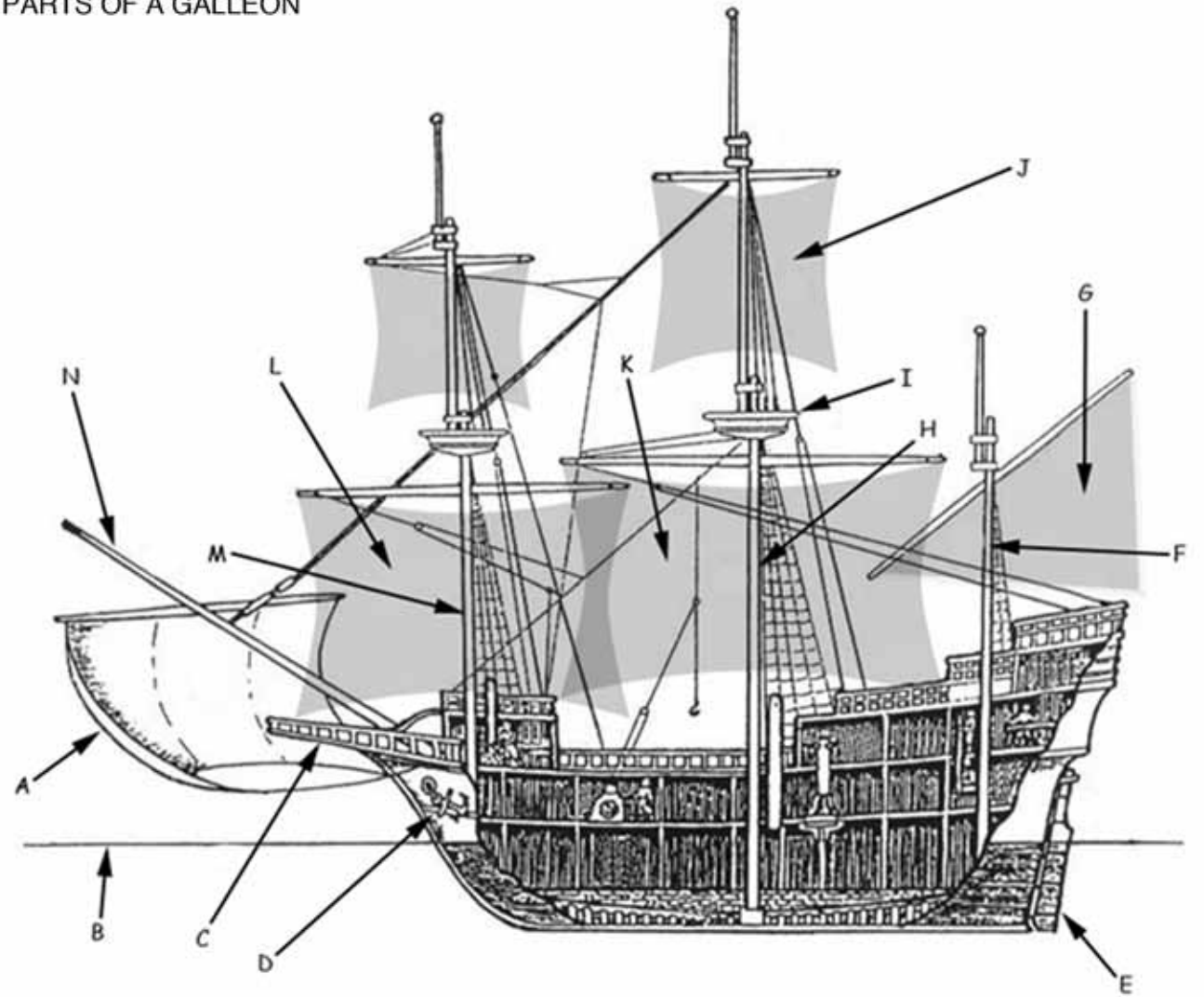


shallow keel let the caravel sail upriver in the shallow coastal waters so it replaces the use of barge or the balinger, the ancient cargo vessels, used in the Mediterranean by Europeans for the carriage of 50 to 200 tons. With the construction of the first caravels, based on the model of existing fishing boats with the financial support of Prince Henry the Navigator of Portugal, it becomes easier to navigate for the explorers.

With its triangular lateen sails attached, it was highly maneuverable and could sail much nearer the wind, while the square Atlantic type sails attached it was faster. Its speed, agility and economy made it esteemed as the best sailing vessel of its time if we don't count its limited capacity of cargo and crew.

With the Renaissance, the change of the needs effects the typology of the naval vehicle constructions. The galleons were seen for the first time exactly in this period, between the XVI and XVIII centuries, and were large, multi-decked sailing ships used specially for war and commercial purposes. With three or sometimes four large squared sails attached, this ocean going ship is evolved from the carrack and differs from them by being longer, lower and narrower and by having a head projecting forward from the bows below the level of the forecastle. The lower forecastle and the longer hull make galleons more stable in the water

PARTS OF A GALLEON



A- Bowsprit Sail  
 F- Mizzen Mast  
 K- Main Sail

B- Waterline  
 G- Mizzen Sail  
 L- Fore Sail

C- Bowsprit  
 H- Main Mast  
 M- Foremast

D- Anchor  
 I- Crowsnest  
 E- Rudder  
 J- Top Sail  
 N- Bowsprit Mast

but less resistant to the wind. In the Spanish fleet and then also in the English and Dutch fleets, the galleons had an important role so became the first vehicle intercontinental and have also seen in the discovery scenes of the new unknown lands. With the use of the galleons, England and Holland have expanded its territories and added new colonies to their territories.

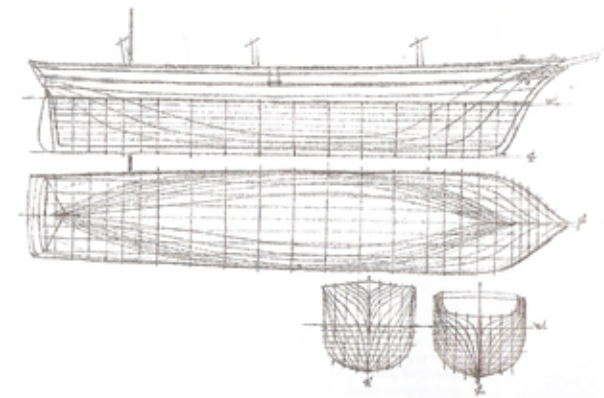
In the XIX century, as the other fields, also the marine world has had deep and important changes to satisfy the new requirements of the era. The shipyard of Baltimore in the USA develops for the first time a typology of ship that's effective and fast for the high-sea navigations. So the first examples of the clippers born. The clipper, a fast and efficient sailing ship with three or more masts and a square rig, becomes widespread because of two main function: the first one is that it was a very efficient passenger carrier so makes easier the communication between New York and San Francisco. The other important function of this new type of ship was that it was a very fast competitor in the race speed for the tea trade from Shanghai to London where the faster competitor that is able to place the new seasonal product was the luckiest one to obtain the most favorable prices of the market. This faster ships have overturned the theories gained with the earlier ship constructions like the galleons which were more stable and slow because of their forms. Clippers with their slender and sharp noses, were able to concentrate the buoyancy in the middle point of the ship and to finish the aft end with softer lines.

After the analyze of all of these historical sailing ships, we arrive to the last one that is seen for the first time in the modern age with the introduction of the new materials and techniques in all over the world. Between the XIX and XX centuries, while the world was going towards to a new kind of living style after the industrial revolution, the capacity of working on big scales with the metal provokes the construction of the windjammers, the last generation of the big sailing ships. These giants of the seas were widespread thanks to the evolution of the sail technology after the clipper experience and they were more evolved in dimensions and in the carriage capacity thanks to their structural strenght realised with the matallic construction. The windjammers reflects exactly how the static-structural knowledges advanced in this new age not only in the marine engineering but also in the civil architecture and engineering. The best examples of this period are Crystal Palace of Joseph Paxton in London or Eiffel Tower of Paris.

The decline of the sailing ships becomes with the introduction of the hybrid ship constructed in te early years of the last century. Firstly the hybrid ships have combined the sailing

propulsion system with the steam propulsion transmitted by the paddle wheel; and then the mechanics arrived to a level where it was possible to realise a propulsion system works completely by windpower. In the first period of the hybrid ships it was not possible to finish the voyage because of the insufficiency of the carbon loaded to the ship before the voyage. So when the carbon finishes, the ship was using the sailing supply. One of the most unforgettable steamship of the history was SS Great Eastern designed by Isambard Kingdom Brunel and built by J.Scott Russell&Co at London. This huge iron sailing steam ship with its length over 210 meters is remarkable still today with its huge dimensions built in the '800. With its capacity to carry 4,000 passengers around the world without refuelling, it was constructed with six masts, two paddle wheels and one propeller; and 4 engines for the paddles and one additional engine for the propeller was built in for its high performance of its period.

The first transatlantics were important not only for the modern society as an intercontinental transportation system but also by the architectural point of view. The design of this giants of the oceans were interesting not only for the naval architecture but also to analyze the first examples of the interior and exterior architectural styles realised for the life on board of the passenger from high society of the period.



1.5



1.6



## 2. MARKET ANALYSIS

### 2.1. GENERAL CONSIDERATIONS

The market of luxury yachts is considered the most interesting and desirable business range of the pleasure boating sector, because of the market trends and target characteristics. This attractiveness is confirmed by the recent introduction of the new international players that are already similar to us as the active players of the luxury goods department. We're talking about Bulgari, Ferragamo, Dredner Kleinworth Capital, ecc..

The Italian marine industry plays an important role in the global market of the luxury yachts, with a capacity to compete in an international way.

The growing interest in the luxury yachting business comes from two important factors. First of all, the Italian marine companies didn't have any defection even though the new political situation has destroyed the other sectors of economy like moda, jewellery, ecc.. So thanks to this progress of the market, today the marine sector becomes one of the most important and leading economical factor of the fame of Made in Italy.

The other important factor of the growing sector is represented by the evolution of the luxury concept that today declares a new kind of paradigm "advanced luxury" which is characterized by the intimacy and confidence if compared to "traditional luxury".

Every year, UCINA (Unione Nazionale Cantieri e Industrie Nautiche ed Affini), prepares a detailed and complete annual report that serves for a complete understanding of the economical and statistic progresses of the yachting market for the experts of this sector. To enrich the statistical informations, UCINA uses also other informations coming from different national and international institutes like ISTAT (Istituto Nazionale di Statistica), Ministero delle Infrastrutture e dei Trasporti, CENSIS (Centro Studi Investimenti Sociali), ASSILEA (Associazione Italiana Leasing), ICOMIA (International Council of marine Industry Associations), IMEC (ICOMIA Marine Engine Committee).

The report is divided into different sections: The first part "Marine Industry in Italy" (L'industria nautica in Italia) analyzes the progress of the national yachting sector with a particular and detailed examination of the overall production from 2006 to 2010. The second part "Marine industry in the world" (L'industria nautica nel mondo) represents the statistics of the progress of the sector in an international level. The third part "Superyachts" examines the pleasure boats sector through the usual verification of the global order book or through a

detailed analyze of the revenue of the 2010 of a significant sample of an Italian yacht company. The fourth and last part of the annual report “Marinas and nautical licences in Italy” (Il parco nautico e le patenti nautiche in Italia) is dedicated to the analyze of the more significant statistics related to 2009, thanks to the collaboration with Osservatorio Nautico Nazionale.

## 2.2 ITALIAN BOATING MARKET ANALYSIS

The last annual report of the UCINA, that represents the statistics of the 2010, declares that the 1.880.150.000 euro of the global revenue (2.006.040.000 euro) is derived from the national production where the 125.890.000 euro result from the import. So if we transform these amounts in percentage, it's easy to see that the 94% of the global revenue comes from the local productions where the 6% is the result of the imports happened in 2010. The productions and constructions realised in Italy are sold in the market with a percentage of 33% and the rest of the local productions are sold to abroad, specially to the Extra-European countries. The percentages of the import are divided like 59% is coming from the Extra-European countries where the rest of the amount comes from the rest of the world.

	Values in Euro	Values in %
NATIONAL PRODUCTION	1.880.150.000	94%
for the national market (a)	616.730.000	33%
for export (b)	1.263.420.000	67%
towards to EU countries	521.670.000	41%
towards to countries not EU	741.750.000	59%
IMPORT	125.890.000	6%
from EU countries	74.090.000	59%
from countries not EU	51.800.000	41%
sold in Italy (c)	113.300.000	90%
sold to the other countries (d)	12.590.000	10%
GLOBAL TURNOVER	2.006.040.000	100%
final destination abroad (b+d)	1.276.010.000	64%
final destination Italy (a+c)	730.030.000	36%

Tab. 2.1



By considering the total amount of the national production and the import, we can find out that 64% of the global revenue is dedicated to the abroad with a value of 1.276.010.000 euro.

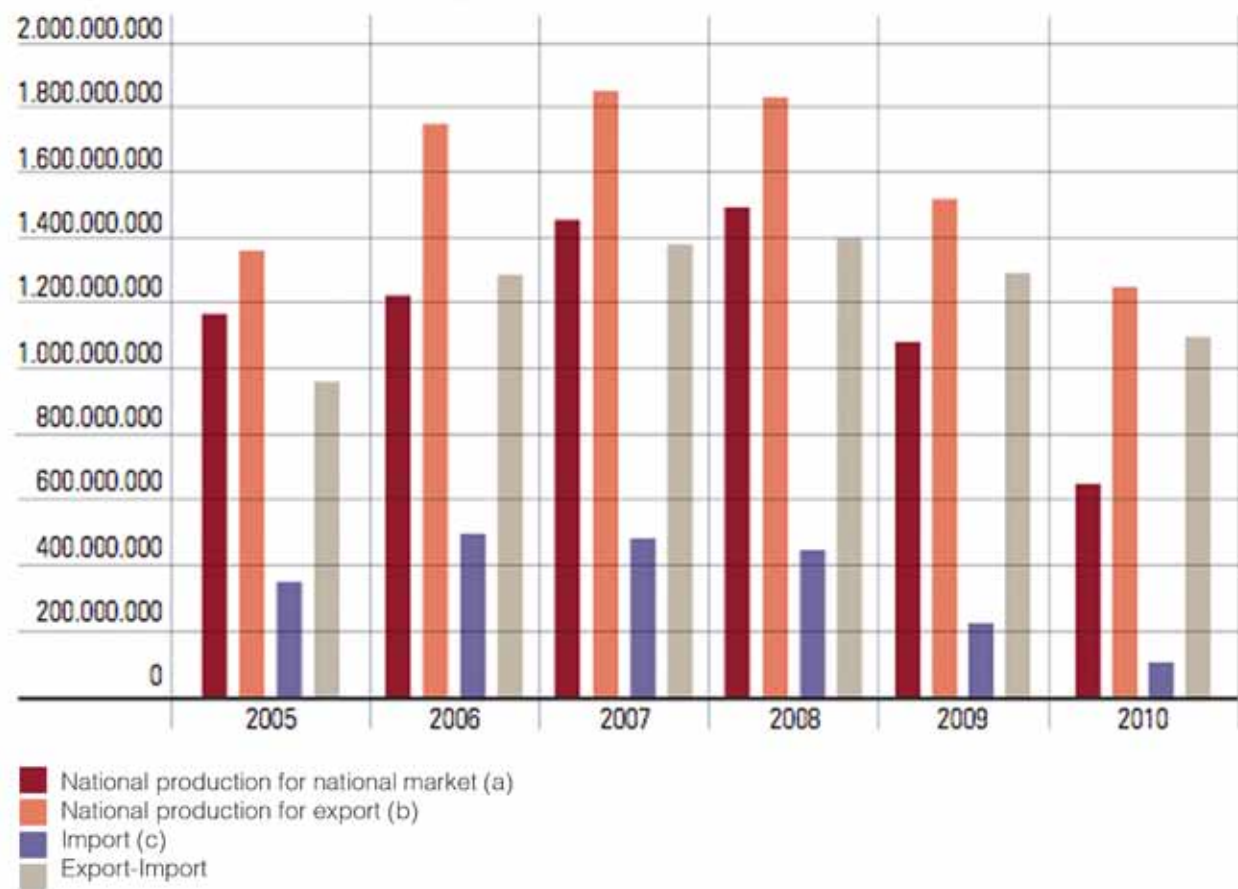
The general performance of the marine industry of the 2010 represented by the annual report of the UCINA declares that the global revenue is decreased 27,2% compared to situation in 2009. This strange and unusual situation that has never seen in the yachting industry in the last 45 years, seems like an important proof of the global crisis of the last years. Particularly, the national production both for the local market and for the export loses like 25,7% where the imports lose like 43,5% but absolutely it's less important than the national production. The import-export balance remains positive like a confirm to the exporter fame of the local italian marine industry. If we observe the statistics of the 2008, it's easy to see an overall fall of the turnover that arrives nearly to the half of the recent value.

The predominance of the turnover comes from the crafts with motors inboard, inboard/outboard drive (sterndrive) or pump-jets. The second place is taken by the sailing crafts that is followed by the pneumatics. The numbers show that the production of motor yachts and sailing boats for abroad exceeds that for Italy while the production of the rest (pneumatics, outboards and minors) is generally for the Italian local market.

The repartation of the sales declares that 55,87% depend on the distributors through the dealers; the boats sold to the client directly from the shipyard occupy the 34,17% while the 10% is occupied by the boats sold to the retailers. For the extreme cases like the boats with the length between 10 to 24 meters, the direct sale from shipyard to the client is more common.

Year	National production for the national market (a)	National production for export (b)	National production (a+b)	Import (c)	Export-Import	Global turnover (a+b+c)
2005	1.175.000.000	1.346.000.000	2.521.000.000	365.000.000	981.000.000	2.886.000.000
2006	1.225.620.000	1.757.960.000	2.983.580.000	467.220.000	1.290.740.000	3.450.800.000
2007	1.457.690.000	1.865.150.000	3.322.840.000	482.350.000	1.382.800.000	3.805.190.000
2008	1.508.250.000	1.855.740.000	3.363.990.000	457.980.000	1.397.760.000	3.821.970.000
2009	1.055.070.000	1.476.020.000	2.531.090.000	222.710.000	1.253.310.000	2.753.800.000
2010	616.730.000	1.263.420.000	1.880.150.000	125.890.000	1.137.530.000	2.006.040.000
Var. %10-09	-41,5%	-14,4%	-25,7%	-43,5%		-27,2%

Tab. 2.2



Tab. 2.3

## 2.3 GLOBAL BOATING MARKET ANALYSIS

We can also take a look at the global boating market thanks to the statistic informations provided by the ICOMIA (International Council of Marine Industry Association) that obtain the numeric values of the 2009 directly from the national associations of the most considerable countries.

During the 2009, boating market in all over the world has registered the lowest demand of the last 45 years, giving rise to contraction of the production, closure of the companies and so the way outs from the market.

In the tables below, the statistical values of the different countries like, Croatia, Denmark, Finland, France, Germany, Ireland, Italy, Norway, Netherlands, Poland, United Kingdom, Czech Republic, Spain, Sweeden, Switzerland, Argentina, Australia, Japan, New Zeland, USA, South Africa and Turkey, are taken in consideration. The methods for the collection of the informations and their reliability vary according to the different countries where there wasn't possible to gain all the information requested in some cases.

The table 2.4 illustrates the statistics of the marina numbers for every country with the analyze of the different typology of the crafts; sailing boats, motor boats with inboard or inboard/outboard motors, outboard motors and hard drive boats, and pneumatic boats with the length >2,5 meters and weight >20 kg. The tables are import to analyze for understanding the quantity of the boats for every 1.000 inhabitant obtained from the ratio between overall marinas and the number of resident population of every different country taken in consideration, grouped together in 3 sections: European countries, Extraeuropean countries and United States of America. It's easy to see that the countries with lower number of population and higher number of boats because of the their habits, like Norway, Sweeden and Finland, the value of the marinas and the quantity of boats for every 1.000 inhabitant is higher than the rest of the world.

In a complete view, it's clear that the values of 2009 are more rigid compared to 2008 and a particular reduction is seen for Norway, Spain and Italy while for Sweeden, Netherlands, Greece, Poland and Switzerland an increase of the values is observed. With reference to the rest of the world, United States of America stands out with nearly 16 millions of boats, represented with three quarters of the units produced are outboard and hard drive motors. This value, in relation to the numerous population of the country, results as for every 1.000 inhabitant there must be 50 units of boats.

COUNTRY	POPULATION	BOAT FOR 1.000 INHABITANT	TOTAL MARINAS	SAILING BOATS	INBOARD OR OUTBOARD MOTOR BOATS	OUTBOARD MOTOR BOATS	PNEUMATIC BOATS >2.5M and >20KG
Norvegia	4.850.000 *	173,87 *	843.250 *	58.250 *	270.000 *	410.000 *	105.000 *
Svezia	9.340.682	87,30	815.400 *	98.650 *	99.700 *	577.550 *	39.500 *
Finlandia	5.351.400	136,32	729.500	Nd	Nd	Nd	Nd
Italia	60.340.328	10,24	618.017	15.210	Nd	Nd	Nd
Regno Unito	61.383.000	8,82 <sup>b</sup>	541.560 <sup>b</sup>	212.305 <sup>b</sup>	94.805 <sup>b</sup>	155.850 <sup>b</sup>	78.600 <sup>b</sup>
Paesi Bassi	16.000.000 *	32,69 *	523.000	202.000	146.000	175.000	Nd
Germania	83.000.000 *	6,022	500.000 <sup>b</sup>	195.000 <sup>b</sup>	190.000 <sup>b</sup>	115.000 <sup>b</sup>	Nd
Francia	65.000.000 <sup>b</sup>	7,56 <sup>c</sup>	491.651 <sup>c</sup>	141.847 <sup>c</sup>	97.763 <sup>c</sup>	146.636 <sup>c</sup>	105.405 <sup>c</sup>
Spagna	47.000.000 *	3,94 *	185.300 *	16.315 *	133.595 *	Nd	35.390 *
Grecia	10.737.428	13,75	147.670	3.800	13.330	114.397	16.143
Svizzera	7.785.000	12,77	99.412	32.108	60.488	6.816	Nd
Polonia	38.000.000 *	1,89 *	72.000 *	68.000 *	1.386 <sup>d</sup>	2.147 <sup>d</sup>	467 <sup>d</sup>
Portogallo	10.605.000 <sup>d</sup>	5,86	62.154 <sup>b</sup>	3.096 <sup>b</sup>	13.809 <sup>b</sup>	24.181 <sup>b</sup>	21.068 <sup>b</sup>
Danimarca	5.534.738	9,94	55.000 *	31.350 *	7.488 <sup>d</sup>	13.777 <sup>d</sup>	2.385 <sup>d</sup>
Irlanda	4.250.000	6,35	27.000	Nd	Nd	Nd	Nd
Rep. Ceca	10.510.000	1,38	14.461	2.575	2.472	4.242	6.150
<b>EUROPA</b>	<b>439.687.576</b>	<b>13,02</b>	<b>5.725.375</b>	<b>1.080.506</b>	<b>1.130.836</b>	<b>1.745.596</b>	<b>410.108</b>
Australia	21.260.000 *	36,90 *	784.500 *	Nd	Nd	Nd	Nd
Nuova Zelanda	4.366.000	109,93	479.952	43.555	20.578	390.196	25.623
Giappone	127.515.000	1,81	231.000	11.000	22.568	185.432	12.000
Argentina	42.000.000	3,63	152.563	3.097	16.571	106.878	26.017
Turchia	73.000.000	0,86	62.510	8.120	24.450	18.475	11.465
Sud Africa	49.109.000 *	0,10	4.881 *	Nd	Nd	Nd	Nd
<b>ALTRI PAESI</b>	<b>317.250.000</b>	<b>5,41</b>	<b>1.715.406</b>	<b>65.772</b>	<b>84.167</b>	<b>700.981</b>	<b>75.105</b>
Stati Uniti	307.500.000 *	50,26	15.454.900 *	1.539.800 *	2.639.600 *	11.275.500 *	Nd *
<b>TOTALE</b>	<b>1.064.437.576</b>	<b>21,51</b>	<b>22.895.681</b>	<b>2.686.078</b>	<b>3.854.603</b>	<b>13.722.077</b>	<b>485.213</b>

Tab. 2.4

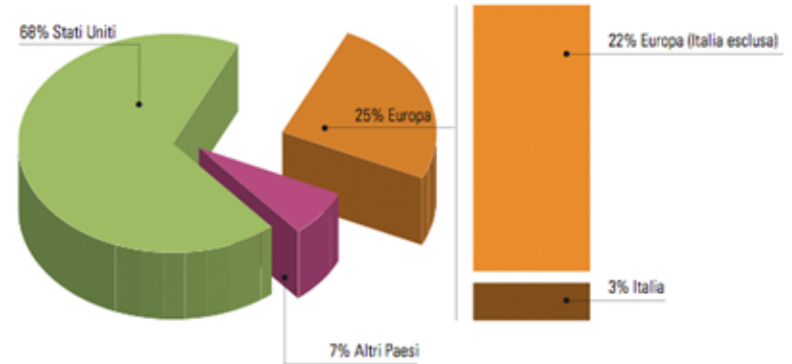
The other extraeuropean countries represent a database less significant both in absolute terms and number of units per capita. Generally, analyzing the different marinas, it's possible to observe that some types of marine crafts are more or less important than the others; for example in some countries the sailing boats are always less requested ones, with exceptions like United Kingdom, Poland and Denmark where sailing boats are always considered more important. Also the different kind of motorboats have variable levels of request between them; the units with outboard and hard drive motors are more dominant compared to the units with inboard, inboard/outboard and pneumatic motors. Some categories doesn't have obligation of registration in some countries or sometime these types aren't considered as ships so this situation prevents and deviates the correct comprehension of the values of superyachts or small units like drifts, surfs, canoes, ecc...

The table 2.5 figures out the subdivision of the marinas in all over the world for every geographical area to give a complete picture of the situation in 2009. So the marinas of the United States of America with a percentage of 68% come first. Europe follows the USA with 25% without Italy that occupies 3% of the general portion. The rest of the percentage like 7% is occupied by the other countries of the rest of the world. This portions didn't have big changes compared to 2008.

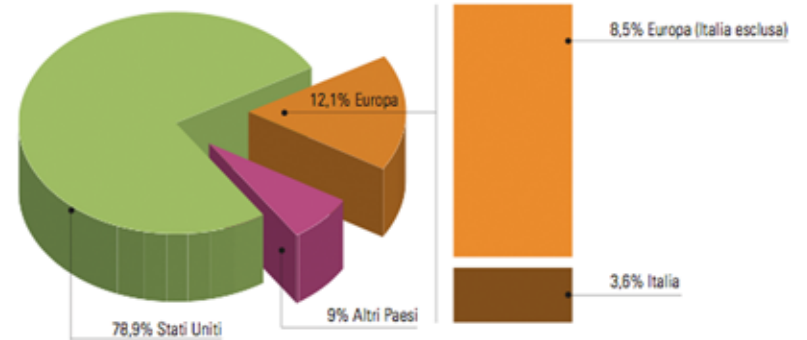
The table 2.6 shows the ripartition of the global boat production of the 2009. The major part (79%) of the 664.746 boats is produced by United States of Amrica, 3% higher than 2008. United States of America, with the global primacy as the biggest producer of the world, is followed by Europe with 12% (against the 17% of 2008). The third portion is destined to the other countries with 9% ( 2% higher than 2008). While Europe looses importance in the productive background compared to 2008, Italy earns points like 0,6% with a final percentage like 3,6% of the global production of the 2009. With this database we can also analyze the typology of the boats produced as we have already seen in the italian market case. The analize of geographical ripartition of the boat typologies shows us that United States of America wins the primacy of all categories, like the previous years before 2009. The predominance of the USA is important for the boats with inboard in/outboard motors and small units while the sailing boats and pneumatic motor boats are less important. For example the first typologies are common also in Italy and France like they're common in the USA but the sailing boat production is more common in France if the values are compared to the american ones.

Another important subject of the statistics of the ICOMIA is the import/export ratio of the 2009. The difference between the values of import and export gives rise to the commercial balance.

We can clearly see that Italy represents the best commercial balance of the boating industry in 2009 by showing a distinct vocation of the export, with the improvement of the difference between the import-export values compared to the 2008. The import value of Italy declares a strong decline, from 680.910 to 328.580 euro, while the export value declines only 17% compared to 2008, from 1.990.920 to 1.642.580 euro.



Tab. 2.5



Tab. 2.6

## 2.4 SUPERYACHTS MARKET ANALYSIS

In the third part of the annual report of the UCINA, the analyzes are concentrated on the boats with the length over 24 meters, the segment of production that represents the excellence of the Italian boat production. The situation of the superyachts in 2010 results stable compared to the previous years but by remaining with the values strongly reorganized because of the global economic crisis.

Every year Showboats International publishes an issue with the Global Order Book that contains the statistics of the yachts over 24,83 metri (80 feet) from all over the world. So compared to 2009, this year the demand of the superyachts is decreased like 1,7% from 762 to 749 orders.

The composition of the orders by the unit typologies shows a significant reorganization; the motoryachts are decreased from 84% to 72% that gives hope to the sailing boats that doubled its percentage to 12%. The open units are increased from 6% to 10% by reaching to the level of the years before while the sportfishers don't have big changes compared to 2009, from 4% to 2%.

From another point of view, the yachts are subdivided in other categories by their length so the lowest section of length, between 80 e 89 feet, occupies the 21% of the orders with the confirmation of the trend of the last two years. The market demonstrates the orientation toward a strong homogenization of the main levels of length; the section between 120-149 feet occupies 21% of the orders too while the section of 100-119 feet occupies 20% , the section between 150-199 feet occupies 18% of the orders and the section between 90-99 feet decreases 2 points so closes the year with the 10% of the orders. The extreme cases, like the section between 200-249 feet with 6% and the section with the length over 250 feet with 4%, remain more stable compared to the rest of the order typologies.

The analyze of the global statistics from 2004 to 2011 lets us understand the latest trends of this industry both from dimensional and typological point of views.

The Global Order Book gives us some information about the principal producer countries where the primacy of Italy comes out immediately, despite the strong economical crisis and the reduced number of orders, with 309 orders of a global total of 749. Italy, the unchallenged leader, is followed by Turkey with 69 orders, for the first time between the 3 big producer countries, and then by Netherlands with 66 orders.

The tables show that, apart from the exceptions like France and Netherlands, the countries with a strong history as a boat producer, have seen a huge reduction of the orders that results as a benefit to the new emerging countries of the sector like Turkey with 34 more orders compared to last years, Chine with 4 more orders, ecc...After Italy, Turkey and Netherlands comes United States of America with 64 orders, followed by United Kingdom with a reduction to 51 orders and also Taiwan with reduced number of numbes like 34. The last three places are occupied by Germay, France and New Zeland.

In an another table, the orders are represented by their lenghts. The values remain equal to the previous table where only Turkey and Netherlands change their positions and Germany makes a progress of two levels. This situation shows that the presence of the first two countries is important because of their specialisation in the cnstruction of the units with great dimensions. It's also interesting that the italian orders are nearly equal to the sum of the orders of the 5 countries that follow Italy: Netherlands, Turkey, USA, United Kingdom and Germany, which confirms the excellenncy of the italian productivity in the marine industry specially in this dimensions.



### **3. CLASSIFICATION AND SUBDIVISION**

Because of the various types and styles of boats, this part is dedicated to categorize these boats according to the different classes in which they belong. With the historical and technological evolution, this need becomes more and more essential to analyze the marine vehicles in a correct way.

If the analysis depends on the variable historical and temporal parameters, the variety observed from boat to boat can be seen also between the same species. So we need to analyze the technological, morfological and functional evolution of the boats from the first species until today.

It's easy to understand how the categorization of the marine vehicles can be done by interpolating the different analyze directions: chronological and functional, but also formal and geometrical.

The fundamental classification applied in nautical reality consists in the subdivision of boats in two large families separated according to the propulsion systems: boats with mechanic propulsion system and boats with sail propulsion system. The last category, that forms the minority compared to the motor boats, is considered the most significant expression for going to sea where the commercial, military and transportation ships are mostly realized with the meccanic propulsion systems.

#### **3.1 CLASSIFICATION BY HULL MORFOLOGY**

Before analyzing the tecnological subdivision by propulsion systems, it's possibile to see how boats can be divided by their hull morfologies.

The most frequent hull typology is monohull formed with only one hull. The first hulls are the simple logs excavated inside but these examples are generally considered unstable and inappropriate for the navigation unless the hollow section penetrates below the log's center of buoyancy. Adding ballast to the bottom of the hull or as low as possibile within the hull, which means giving extra load like water to the bottom of the boat, gives extra stability to the structure. Naval architects place the center of gravity of the boat below the center of buoyancy by adding the ballast explained below. This tecnique is used even in the ancient periods by Romans, Phoenicians and Vikings to maintain the stability of the ships. Nowadays modern ships even the most heavy cargo ships use tons of ballast to

the distribution of weight inside the boat for its correct navigation.

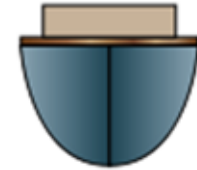
Another kind of hull used in the boat construction is multihull which, unlike the monohull, is formed with two or more individual hulls connected one to another. As explained before, the differences between monohulls and multihulls are due to a fundamental difference in the underlying design principles. The stability problem of the monohull is resolved with a completely different constructional approach of the multihulls. The increased distance between the center of buoyancy and the center of gravity provide a higher stability so it makes a multihull boat more efficient and stable compared to a single hull boat.

This property allows multihulls to have a narrow hull and substantially less wave-forming resistance that results with a greater speed without applying more effort.

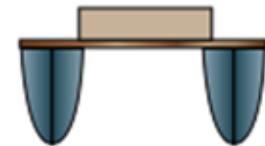
The origin of multihulls reaches until the Polynesian people who discover to tie two round logs together so they don't roll or capsize as easy as a single log and by adding more logs one to another it's possible to create a flat raft that results extremely stable but has problems like requiring a lot of constructional work and having an increased drag and weight. A solution to these problems is found by separating two logs by a pair of sticks, called akas, where they can increase the stability without an increase in weight and with less overall work. Before analyzing the different types of multihulls, it's necessary to understand three important terms that describe the components of different multihulls: vaka, aka and ama. The vaka is the main hull, that looks like a canoe, the ama is the outrigger where the aka is the support connecting the two hulls one to another.

The most important multihulls are proas with two differently shaped hulls with lateral symmetry, catamarans constructed

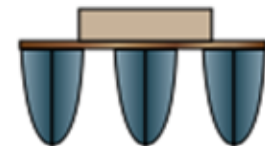
Monohull



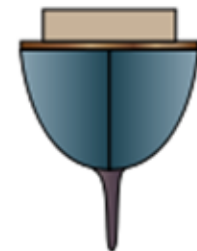
Multihull  
Catamaran



Multihull  
Trimaran



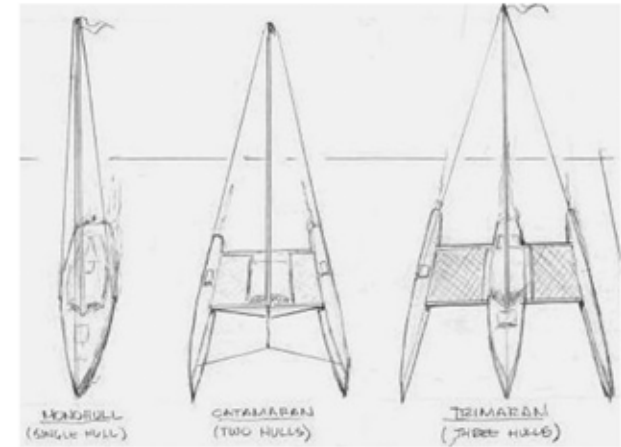
Monohull  
with deep keel



3.1

with two hulls in a longitudinal symmetry and trimarans with symmetric stabilizing hulls attached to a main hull. The multihulls as powerboats that are specially catamarans are used both for racing and transportation and in this case speed, maneuverability and space onboard become the main factors for choosing the multihull design desired.

The catamaran, as described before, is a kind of multihull boat that can be sail or engine-powered and realized with two hulls or vakas joined together with some structure. They are considered as a recent introduction to the boat design world like a leisure and sport sailing boat even though they have been used since a very long time. The western sailors recreates the traditional mono-hulls because they were based on strange concepts with balance based on geometry rather than weight distribution so the multihulls become the best design for fast ferries because of their valuable speed, stability and large capacity. The catamarans can be divided into two main types: the regular ones and the open catamaran that has a trampoline between the hulls instead of plating while the regular catamaran, even powered or not, features two Amas separated by two Akas, which can suspend a platform or trampoline between them. These types can have different sizes but recently they are becoming larger compared to the previous examples.



3.2

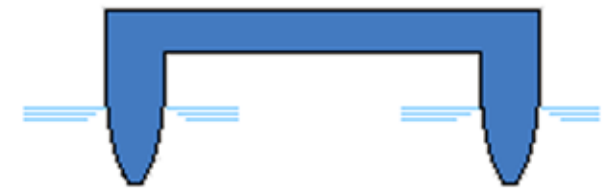


3.3

Another important type of multihull is SWATH (Small Waterplane Area Twin Hull) which is generally used for vessels that require a certain sized ship which results easier to handle in rough seas as well as a larger ship and also has a large deck area without being heavy. The SWATH was invented by Frederick G. Creed in Canada and used for the first time in 60s and 70s as an evolution of catamaran design for use as oceanographic research vessels or submarine rescue ships.

The last multihull typology is trimaran which is formed by a pair of vaka held together by aka whereas the trimaran is a central vaka, with ama on each side attached by aka. The origin of the name and design of the trimaran reaches to the original proa constructed for the first time by Pacific islanders almost 4.000 years ago. But the most important period of the multihulls, both catamarans and trimarans, is the 1960s and 1970s. So in the last 40 years a large number of trimarans is designed to be accommodated on a road trailer. These examples include also Farrier-Corsair and original John Westell swing-wing folding trimaran. The recent trimarans are also becoming used as passenger ferry in worldwide. In 2005 Benchijigua Express, a 127 meters trimaran capable of carrying 1,280 passengers and 340 cars with a speed of 40 knots, is delivered to Spanish ferry operator Fred Olsen for the service of the public

BASIC CATAMARAN



3.4

S.W.A.T.H



3.5



3.6

in the Canary Islands.

Because of the trimarans great resistance to rolling offered by amas, it's less possible for a trimaran to capsize compared to a monohull. We can also say that most trimaran designs are considered nearly unsinkable because the flotation of one ama is enough to keep entire vessel afloat even the boat is filled with water. Another advantage compared to a monohull is their speed which is also important for the safety of the crew because it's easier to leave the area of danger faster in a bad weather condition. These advantages, like stability and safety, let the trimarans become the preferred ones by sailor who restricted mobility.

### **3.2 CLASSIFICATION BY FUNCTION AND PROPULSION SYSTEM**

After analyzing the different kind of boats divided by their hull types, it's also possible to categorize them once again by their functions and intended use. So in this case we have commercial ships, military ships and pleasure boats.

#### ***3.2.1 THE COMMERCIAL SHIPS***

The commercial ships with the main function of transportation both passengers and goods overseas have different kind of types; ferries, cruise ships, ocean-liners, tanker ships, gas carriers, car-carriers and ro-ro ships. So the commercial ships can be analyzed under two main families; passenger carriers and cargo ships.

A passenger carrier ship is a ship with primary function to carry passengers which differs from cargo vessels that have a limited accommodation for passengers. The passenger ships include many class of ships designed to transport substantial numbers of passengers as well as cargo. The most important passenger ships are ocean liners which typically carries passenger or passenger and cargo together on longer line voyages; ferries that are vessels for day and overnight short-sea trips moving passengers and vehicles; and cruise ships that often transport passengers on round-trips in which the trip itself and the attractions of the ship and ports visited are the principal draw. In all the cruise ships, differently from the ocean liners, the cargo capacity is mostly eliminated.

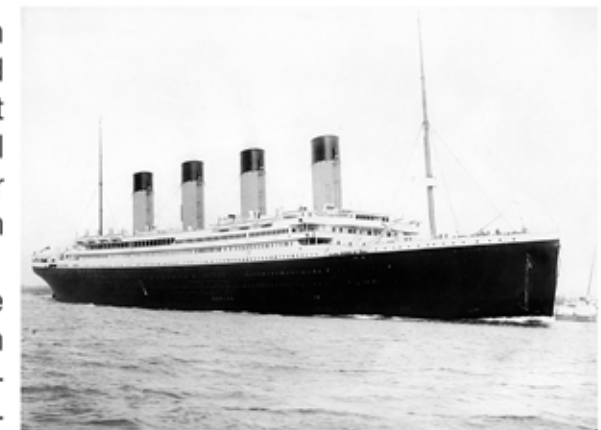
The ocean liners are ships able to transport mail, package freight and express and other cargo in addition to passengers and their luggages. The name ocean liner is derived from its property of being the first vehicle for intercontinental travel in the mid of 19th century

that is then substituted by the cargo airliners in the late 60s. These ships were used also to move gold and other kind of valuable goods. The ocean liners differs from ferries or other vessels dedicated in short-sea trading and from cruise ships where the voyage itself not the transportation, is the primary purpose of the trip. Ocean liners are usually strongly built with a high freeboard to withstand rough seas and adverse conditions encountered in the open ocean, having large capacities for fuel, food and other consumables on long voyages. The first examples are seen in the 1800 with Black Ball Line with a fleet of sailing ships that offered for the first time a regular passenger service from England to United States of America.

In the early 19th century, the steam engine ships begin to appear so the number of ocean liners starts increasing. In 1837 the Great Western crosses the Atlantic in 15 days which is considered as a miracle compared to the normal



3.7



3.8

sail-powered ships that can cross only in two months. Even the more efficient ability of the steam machines, the first steamship examples have had sails as well as engines because of the inefficient consumption of fuel of the machines so having sails have helped to take advantage of the favourable weather conditions and minimise fuel consumption. After Great Western, in 1840 Britannia, in 1847 Great Britain, in 1870 Oceanic becomes the important examples of the ocean liner history. In the 20th century, the most unforgettable ones are Olympic, Britannic and Titanic which is still remembered today because of the most tragic maritime disaster in history that caused the death of 1,517 passengers.

The ferry is another form of passenger ship which is usually a boat or generally a ship used to carry passengers and also vehicles and cargos across waters usually in short time periods. Generally they have regular, frequent and return services and sometimes they are called water bus or water taxi if they have many stops like the examples in Venice.

Ferries by allowing direct transit between water-side cities and islands, become one of the most important marine public transport systems because it's an economical and fast transport method for the small water distances. Also the ship connections of larger distances like the ones on the Mediterranean Sea may be called as ferry services, especially if they carry vehicles in addition to the passengers.

The last example for the passenger carrier ships is the cruise ships which differs from the other two with its most dominant property that is its one and only purpose of carrying passengers. So these ships are used for pleasure voyages where the voyage itself, the ship's amenities and the different destinations and stops are the most attractive parts of the experience. In this case, as different from the recent examples that we have analyzed, the transportation is not the primary purpose as they operate mostly on routes that bring back the passenger to their original port while the ocean liners do line voyages that transport passengers from one destination to another. Another important difference between the cruise ships and ocean liners is that the ocean liners are generally built with a higher standard and larger capacity for fuel,

victual and other stores for consumption on long voyages. The ocean liners, that result unsuitable for long cruising because of the high fuel consumption, have also deep draught that prevent them to enter in shallow waters, enclosed decks that are not useful for the tropical climates and cabins designed to maximize passenger numbers rather than their comfort. But in the modern cruise ships, the properties added to attract tourists make them appropriate for the long pleasure voyages and so they are described as balcony-laden floating



3.8



3.9

condominiums. The cruising is becoming an important font of the tourism industry by accounting 29.4 billion dollars with 19 million passengers carried worldwide in 2011. One of the first examples of cruise ships in the history, that is built only for the purpose of carrying passengers overseas, is the Prinzessin Victoria Luise completed in 1900. The largest ones are Royal Caribbean International's MS Oasis of the Seas and its sister MS Allure of the Seas.

The other family of the commercial ships is formed by cargo ships (or freighter) that have the primary function of carrying goods, vehicles, mail and cargo overseas. They're specially designed for the task, often being equipped with cranes and other mechanisms to load and unload and come in all sizes. Today they are generally built of welded steel and have a life expectancy of 25 to 35 years before being scrapped. The cargo ships can be subdivided into five groups according to the type of cargo they carry: general cargo vessels, tankers, bulk-carriers, gas-carriers and Ro-Ro ships.

The general cargo vessels are ships that carry packaged items like chemicals, foods, furniture, machinery, motor vehicles, footwear, garments, etc.. This kind of cargo vessels are generally equipped with hatch covers designed to bear heavy loads. Watertightness and cargo hold humidity are important issues for their design.

The tankers are designed to carry and transport in bulk hydrocarbon products like oil, liquefied petroleum gas (LPG), and liquefied natural gas (LNG); chemicals like ammonia, chlorine and styrene monomers; fresh water; wine and etc... So the tankers generally include different types like oil tanker, chemical tanker and liquefied natural gas carrier. Besides the ocean or seagoing tankers with the larger capacity of carriage, there are also tankers specialized inland-waterway that can operate on rivers and canals with a smaller cargo



3.11



capacity up to some thousand tons.

Another type of cargo ships is the bulk carrier designed to transport unpackaged bulk cargo like grain, coal, ore and cement in its cargo holds. The first bulker built in 1852 is today more developed because of the economic forces that cause them to grow in size and sophistication so the most recent bulkers are specially designed to maximize capacity, efficiency, safety and to be able to withstand the rigors of their work. Their design differs from one to another: for example some can unload their own cargo while



some depend on port facilities for unloading, 3.12

and some even package the cargo as it is

loaded. The crew of the bulkers, that can range from three to 30 people according to the size of the ship, participates the loading and unloading cargo, navigating the ship and keeping the machinery and equipment maintained.

As explained before, gas carrier is a kind of tanker which carries LNG over the seas and results as the most dangerous ship because of the compressed natural gas carried that is flammable and easily exploding. The gas carriers have large requirements for their machinery, their tanks and their support. The largest gas carrier of the world is LNG Carrier Disha. The last example to analyze as the cargo ship is Ro-Ro (Roll-on/Roll-off) which is a special vessel designed to carry wheeled cargo such as automobiles, trucks, semi-trailer trucks, trailers or railroad cars that are driven on and off the ship with their own wheels. As they use their own wheels, these ships that carry them differ from the Lo-Lo (lift-on/lift-off) which uses a crane to load and unload the vehicles to transport overseas. The ro-ro ships are built with ramps which allow the cargo to be rolled on and rolled off efficiently in the port.

After analyzing the different kinds of commercial boats in the marine world, we need to mention also the military boats under the functional categorization of the marine vehicles. The warships are generally built and intended to be used for the combat. They are usually built in a different way from the commercial and pleasure boats because as their primary function requests, they must be well armed, be more maneuverable, move faster and they are generally designed to withstand damage occurred during the bombardements. As it differs from the other boats by its design and structural force, the warships carry only weapons, ammunition and



3.13

supplies for its own crew, unlike the commercial boats. As they are generally a part of a navy, they can also be operated by individuals or private companies. During the wars, generally the distinction between the warships and commercial ships becomes difficult so the commercial ships were used as auxiliary warships that carry weapons, like Q-ships of the 1st World War and the armed cruisers of the 2nd World War.

Nowadays, the warships become an interesting source of inspiration for the contemporary yacht designers. Ivana Porfiri which is inspired by the dazzle camouflage paintings used on the warships of the 1st World War for its unique work, Guilty built for the Greek art collector and industrialist Dakis Joannau together with the American contemporary artist Jeff Koons. Another important warship inspired design of the today's yacht world is the Wally productions specially Wally 118, which has made a huge innovation in the yacht market from the aesthetical point of view with its sharp forms instead of the classic curves.

### **3.2.3. THE PLEASURE BOATS**

Last category of the marine vehicles subdivided by their functions, pleasure boats, can also be analyzed by another classification element. As this category results a huge family of marine vehicles, it makes more sense to analyze them by their propulsion system so we have sail boats, motor boats and mixed boats.

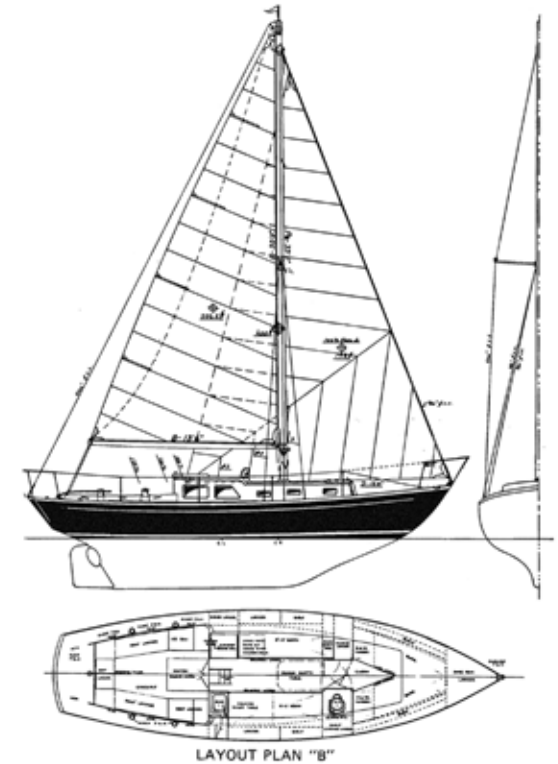
### 3.2.3.a SAILBOATS

The sailboats which are propelled partly or entirely by sails can be analyzed by their hull configuration like monohulls, catamarans or trimarans; by their keel type like full, fin, wing, centerboard; by their function like sport, racing or cruising sailboats; and by their number and configuration of masts. The most important kind of categorization between the ones described above, is the one by the number and configuration of masts.

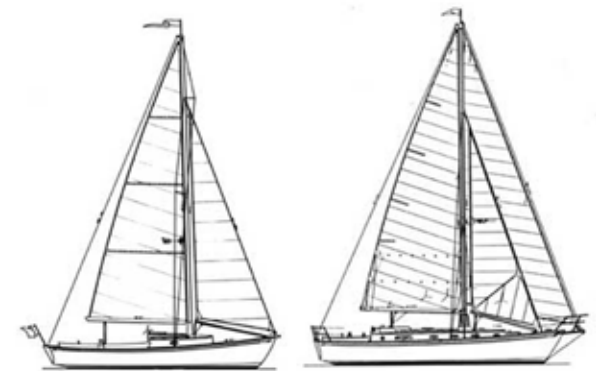
The most common sailboat is sloop which is constructed with only one mast and two sails; mainsail and headsail. The mainsail is attached to the mast and the boom depending on the direction of the wind. This type of sailboat results very efficient for sailing towards the wind. When the sailing happens towards the downwind direction, the configuration to use is called wing to wing where the headsail sails to one side of the boat and the mainsail sails to the another.

Another sailboat with only one mast is cutter, which is similar to a sloop with a single mast and mainsail but generally carries its mast in the further aft to allow the use of two head sails attached to two fore stays; the head stay and the inner stay. This kind of configuration is generally used for the long cruises specially in high wind conditions but not appropriate for the racing cases.

As we said before, the mast numbers is an important classification element between the

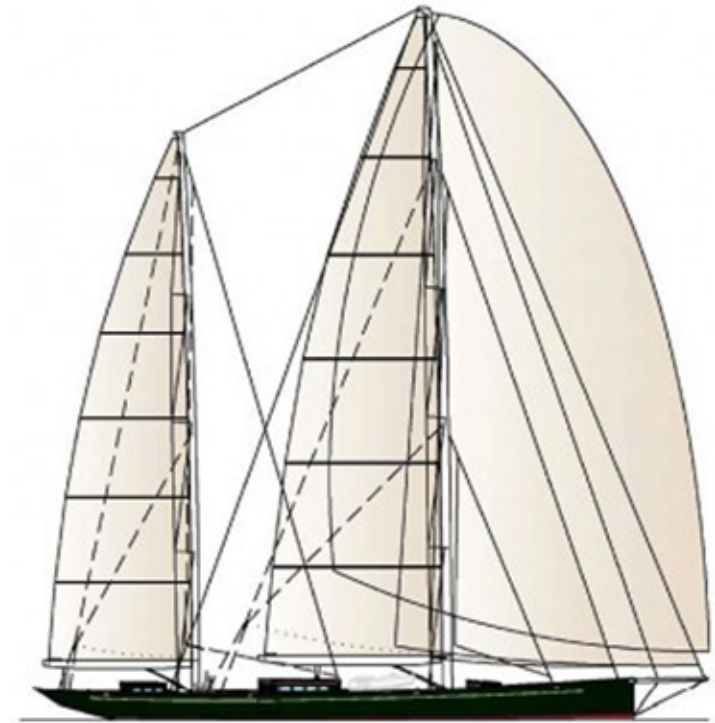


3.14



3.15

sailboats. . So after the single masted sailboats, we can analyze the ones with two masts. A yawl is an important example for the two masted sailboats, that is much similar to a sloop or a cutter but has an additional mast, called mizzenmast located on the aft of the main mast, often right on the transom, specifically aft of the rudder post. Generally the mizzen on a yawl is used more for balance than propulsion and results smaller than a mizzen on a ketch which is another important typology of two masted sailboats. The ketch, similar to a yawl has a main mast and a mizzen mast which is shorter than the main mast but differs from the yawl by the mizzenmast location that is generally situated forward of the rudder post. Both masts are rigged mainly fore



3.16

and aft and the main mast can carry from one to three jibs on the forward side. The lowest fore and aft sail on the main mast is called the mainsail while the sail on the mizzen mast is called mizzen sail. The ketch is generally used and famous for long distance cruises as the additional sail allows a better balance, and a smaller more easily handled mainsail for the same overall sail area.

Another important and famous two masted sailboat is gulet which diffuses from the southwest coast of Turkey, from Bodrum to all over the Mediterranean. It differs from the other two masted sailboats by its huge dimensions that can vary from 14 to 35 meters so this ensures an extreme comfort and it's generally used for the tourist charters even though they were born for fishing and carriage. Today many of them are not properly rigged for sailing but with the help of diesel power. The traditional Bodrum gulets are constructed in wood like mahogany, teak, iroko or pine but today we can see also the examples with the steel

construction.

With its notable width, they result very comfortable for the long cruises. So today the gulets are not rigged only by sails but also by motor because of the obstruction of the cockpit and other superstructures added to make easier the navigation for the long distances. So only one sail can be used for sailing but only in case of the calm sea.



3.17

### 3.2.3.b MOTOR BOATS

As we said before, the pleasure boats can be realised also with the motor systems instead of the sail ones. The motor boats, powered by an engine that can be inboard or outboard, form a large category to analyze by function; by length, from 3 meters to 120 meters and up; and by propeller system etc.. but we will classificate them by another element which is the type of their cabin systems so we can divide the motor boats into 3 classes; open motorboats with no cabin, semi-cabin motorboats with one or two basic cabin under the main deck and motor boats with cabin under and above the main deck.

- Motor Boats**
- Open
  - Semi-cabin
  - Cabin

As we said before, open motor boats used generally for the daily cruises with small lengths, doesn't have any cabins to rest or sleep during the voyage. Their primary function is a daily trip on sea with high speed so the sleeping areas are not generally requested in these kind of boats. The living areas are completely open spaces and if requested they could be protected by the dismountable hard roofs to protect the guests from the bad weather conditions. They are called run-abouts to define their limited capacity of autonomy suitable only for daily cruises. The spaces on board are dedicated for the sofa, sunbathing areas and seats. The control cabin can be automobilistic with a seat in the front part of the boator can be a center-console without a seat. The hull typology is generally planant with outboard motor system.



3.18

The motor boats that are dotated by one or maximum two basic cabins with sleeping possibility are divided by their length and function. Their hull typology is generally planant or sometimes also semi-dislocant with motor systems outboard, inboard or out-inboard that can vary from dimensions and requests of the project. The center console that has the dimensions from 4.20 meters to 9 meters, takes its name from the position of its console in the middle of the boat. They are generally powered by outboard motors installed on the rear. This single decked open hull boat generally has



3.19

cabins located in the bow and holds small berths for sleeping. The console positioned in the center is surrounded by the boat deck so gives the people on board to walk all around the boat from stern to bow easily. The console collect all the control function with steering, ignition, trim control, radio and other electronic devices. These kind of boats are not suitable for long cruisings because of the lack of weather protection or berths and limited sleeping posts.

The runabout, small and fast wooden boats, have larger dimensions compared to center console boats because they start from 6.50 meters and arrive until 9 meters. These typology is generally suitable for racing and pleasure activities like fishing, waterskiing and short daily cruising trips.

The boats that have more sleeping areas in proportion to their longer dimensions can be defined as cabined motor boats and they can be classified under this large family by their lenghts and functions. First of all, the smaller cabined motor boats are called offshores or fast-commuters with a typology similar to the center-console or runabouts but they differ from them by their length that starts from 8,50 meters and reaches to the 25 meters as well. The fast-commuter is a sportive version of the open yachts but with interiors finer and more elegant.

Their performance can be defined as advanced and expensive because of the high speed characteristic of this boat.

The distribution of the functions is realised in a way that living areas and pilot cabin are inserted on the upper part of the boat while the resting and sleeping areas are under the main deck.

Another typology that is included by this family is sport fisherman with bow higher, stern lower and lengths between 9,50 and 40 meters. They are generally considered as an evolution of the traditional commercial fisher boats and lobster boats.

The typology most requested and evaluated of the cabined boats is, without doubt, the classic yacht that gains different names by its length, form and structure.

The yachts with length between 12,50 and 35 meters are called super yachts, and the ones between 35 to 120 meters and up are named megayachts.

They differ from the other fisher and daily cruising boats by their finely worked interior and exterior details and by their capacity of accommodation of different numbers of guests and crew according to the number of rooms inside the boat. Generally they have more than one deck that are dedicated to the common activities like dining and living areas with a bar and to the captain's cabin while the lower deck under the main deck, is dedicated to the bedrooms for both crew and guests, engine rooms and kitchen and dinette. They are generally equipped with fly deck or sun deck where the guests enjoy the jacuzzi and



3.20



3.21





FLY BRIDGE



MAIN DECK



LOWER DECK

3.22

large sunbathing areas. Usually a superyacht with length over 50 meters must have one or more luxury yacht tenders for reaching to shore and other toys like a speed boat, personal water craft, windsurfing and diving equipment and also a banana boat.

An important typology of the megayachts is maxi-open which is easily recognizable with its aggressive and sportive lines and its famous mediterranean style privileges the open spaces on board with spacious and comfortable interiors.

The super and megayacht can be used exclusively by their private owners, as well as they can be operated by the charter business for weekly and sometimes daily rents by different clients. The charter industry lets the private owner handle the running costs of their luxury toys during the year, as well as keeping their yachts and crew in top running order.



3.23



3.24



## 4. DESIGN ON BOARD

### 4.1. DESIGN CONSTRAINTS

In a design process of every kind of product, from a milk package to a skyscraper, the most important phase is the coming out of the concept that is the necessary project proposal to define the main lines of a project and so provides the basis for the realisation of it. So it's considered as the brain of the project process that can be used as guideline for the following phases.

This suffering and difficult concept phase is generally dedicated to understand the needs of the client if it's a private project or to research the possible target by a social analysis if we are talking about a public or a serial production project where the client is not a single person but the purpose of the project is to address to a larger number of people.

We can analyse two different ways of project processes by understanding how an architectural project and industrial product project come out.

An architectural project with a private or public client, is always formed by three important phases that are divided between them by clear lines; preliminary project, definitive project and lastly executive project. The preliminary project phase includes, as we defined above, the first creative process of the project by brain stormings and researches of the project area and its surroundings. This concept lines are brought to the second phase, called definitive project, with improvements and additions of more technical data. This phase prepares the basis for the last and ultimate part called executive project where the project becomes technically defined and so ready for the construction.

In an industrial product project, the process realizes exactly in another way. If we take as an example, an automobile production, first of all, it's necessary to define all the concept lines like habitability, comfort, sportive lines, ecology, resistance, target, context. After defining the basic lines, then it comes to think more detailed with ergonomic researches, stylistic researches and also style tests, material selection, proposed solutions, market researches. Then these notions come enabled in a concept car which is generally exposed during the international events like automobile fairs. The concept phase continues until the project becomes more feasible and deliverable as a definitive model which is then followed by one or more prototypes on which becomes more possible acting directly in order to improve the project details to make it suitable to the project constraints and to the imposed legislative.

In this process, both design and artistic concepts are not thought to be followed by a future industrial production, so they are not always suitable for the executive phase. This conceptual product that remains at virtual or ideological level but they can be reused for a future industrial production.

As we give example of the automobile design process, we can say that the marine vehicles are not so different from them. As it's always the same production field, that can be serial or not depending on the type of project and client needs, even the marine vehicles born with conceptual ideas phase related to the client requires and requests.

The approach to the boat design becomes complicated when it's come to consider the project constrains. Because the boat combines together mobility features with the ones of being a human habitat so it's a kind of transport vehicles derived from architecture. A building is always remembered with its stability, security, intimacy and strenght while a boat is the symbol of the dynamism, manoeuvrability and lightness. As it's easy to see the major difference between these two kind of projects, the project constrains differ as a result of this diversification.

First of all, the naval design handles the psychological, perceptual and dimensional aspects that result important because of the constricted ambient with smaller dimensions compared to the other spaces that human beings generally live, and because of the forced cohabitation on board that is because the people on boat are limited by some edges and so they can feel forced to the living together with minimal intimacy.

With the right utilization of minimal spaces and the importance of ergonomics applied on every field from the monitors of the captain to the armrest of the couch, the perception and the habitability on board become easier. In addition to these important features, also the right disposition of the internal units lets people feel more protected and secure on board.

## **4.2. USE OF SPACE ON BOARD**

In our daily life, we are generally surrounded by the minimal spaces like a seat in our automobiles, our office room, a berth in the train, a bed in the hospital or simply by a shower box. These are some examples of the micro-ambients where the space surrounds the human beings are measured in centimeters. These spaces are perceived in a way that is not so different from the perception of the limited spaces formed in the boats. This is because who enters in a boat, or in another minimal space outside his living area, immediately compares

it with a traditional house by its dimensional point of view. Both of these examples are designed and realized for living but the volume of the cabin in the boat can cause some doubts about the correct and effective functioning of this limited space. So the living style and domestic habits of the traditional housing system must be reconsidered and so modified. The limitation of the individual liberty of moving can be unavoidable where all the guests are constantly in contact between them and so every private action can be transformed in a public activity.

But living in this limited spaces does not need to be a sacrifice like the people who is going to live in this place must adapt himself to these new conditions and dimensions. The minimal space must be accesible by everybody and every basic function of daily life must be done with the same movements used in daily life.

If a boat interior can not resolve and satisfy these basic principles defined by the customer's requests in a correct way, then it means that the project is not adequate for a marine vessel that enclose in itself both comfort and entertainment concepts inside the same area.

THE BEDROOM



THE KITCHEN



THE BATHROOM



The habitability requests that a marine vehicle must absolutely contain, make the interior boat design focus on the use of limited spaces in a correct and appropriated way. The available space must be organized with a precision on details and a careful analysis of the necessary functions, that permit the realization of the multiple activities together in a limited area. The important and considerable occasions available in the minimal spaces can expand in a way that the people on board have a virtual sensation of a much larger and wider space than it really is.

The experimental dimension of the space perceived on board is proportional with the number of occasions that the space itself offers to the users. So the interior space of a vehicle can be much bigger and can join together the comfort with the experience gained by the every day living style of a traditional residence.

Naturally there is also a limit which defines the line that must not be crossed because going beyond this limit may cause that the same space in which the same activities will be done can result psychologically more complicated and concentrated because of the lack of air. The psychology can have an important effect on setting up the saturation of the functions done in a micro-ambient but more important feature is absolutely the anthropometry which measures the level of livability of a space.

The dimensions necessary for the realization of a specific activity are the same both for a minimal space and for a larger one. For example, the space occupied by four people sitting around a table is the same one necessary for a people to sleep or to lay down.

As we think the essential needs of a human being in relation with the characteristics of the ambient that surrounds him, the interior design of a marine vehicle then must be functional and must be planned with reference to the human scale. The main protagonists of the living spaces, the furnitures, are considered as an interface between the man and the space formed around him. And if we talk about this important relationship between the human being and his space at any kind of place (at work, at house or in the car ), then it's important to know that there are some features needed to be satisfied like the aspect, the comfort (acoustic, hygrothermal, comfort, optical-visual, respiratory-olfactory comfort), the hygiene, the security and the usability. These are the main elements to be satisfied in any kind of space that is going to be utilized by a human being and so are the main features to be considered in an interior design of a living or working area.

If we turn back to the relation between human being and the furnitures that surround him, we must underline that every kind of furniture, designed to serve to people, are determined



by the physiology and the lines of the human body. And it does not matter if this furniture is in a minimal or large space, they are surrounded by an invisible area necessary for the execution of the activity associated to the furniture itself. It is easy to understand with a simple example; a wardrobe is a kind of furniture designed and produced for putting and taking clothes or other materials. The people who is going to use this wardrobe needs some space to get near to it and open its doors. The dimension of the space needed depends on the typology of the wardrobes design because if the doors are opening in a perpendicular direction to the furniture then there must be a larger space around it but if the designer has used the sliding doors then the famous invisible area around the wardrobe that we explained above can be smaller compared to the first example. So even in a house or in a boat, or in another kind of living area, all the space remains when we remove the furnitures, is the continuation of them that serves for their correct utilization by the users. If necessary, these spaces can also be limited by some physical elements like walls, screens or other until it's defined as a precise micro-ambient for a specific use.

For these micro-ambients there is a limit under which the functionality of the space is lost so in this case the perception does not depend on the psychology but the anthropometry that measures the availability of the space that is going to be used by a human being.

This rule is valid also for the large spaces where exists an up limit above which the unnecessarily left spaces can be defined as waste of area and energy. For example, around the wardrobe, that we talked about before, if the designer leaves a huge quantity of area then the user must overcome a larger space than he should do to reach



4.2



4.3

that wardrobe. The space wastes are considered as an unprofessional way of planning which causes physical and also economical disadvantages for the future user of the area. But how can we be sure about the dimensions of a minimal space for letting it be appropriate for an efficient use? A minimal space can be defined as livable if lets the people inside to stay both in horizontal and upright position without having any difficulties and problems. We can say that the units of measure of the micro-ambients is the bed, or rather the lying position of human body. And so the space to dedicate to the relax has the dimensions of 180 centimeters of length and 60 centimeters of width. Under this surface dimension man can feel uncomfortable and so the space dedicated for this specific function can be considered as unlivable even though it is only sleeping. To make a space vivable and correct by every point of view, it is necessary to consider the position and the relation with the human body, the accessories of bed and other equipments necessary in a living area or in this case in a relax area. These accessories are considered as the continuation of the bed so of the sleeping or relaxing activity and they are for dressing-undressing, lifting up-down, charging-discharging so activities done by human body which must be fundamental for their utilization.

Therefore, it is possible to define the dimensions of a minimal living space by determining the main function and the equipment and area necessary for its realization. So a minimal living area must have a surface of extension like 2 meters of length and 1 meters of width with minimum 2 meters of height for the correct upright position.

These dimensions permit the comparison with the human body dimensions that is going to be user of this space. Then it results easier to stabilize the relation between the furniture and the anthropometry that verifies the measure of the functionality of the equipments and the space that contains them.

But the convenience and practicalness of a furniture is not enough to understand the livability of a minimal space. The plurality of the operations and the compatibility of the operations are the main features to consider the functionality of a limited space. Moreover, there are also personal considerations like the perception of the space and the environmental comfort can block or expand the real space but this can never be a measurable analysis like the anthropometrical analysis because only the ergonomics can support an another awareness of the space as it's a scientific discipline.

### 4.3. ERGONOMICS

The International Ergonomics Association defines the term ergonomics as:

“ergonomics is the scientific discipline concerned with the understanding of 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.”

So basically, in every kind of project realised for human being, it's necessary to have a knowledge about the notions of kinematic and anthropometric anatomy or in simple words; the rules of the ergonomics.

The ergonomics can be defined as a set of the rules oriented by some analysis and valuations of the project process for comfort and health of the human life. Therefore, it utilizes the knowledges gained by other scientific disciplines of three specific research area;

- area of polytechnic disciplines
- area of biomedic disciplines
- area of social discipline

The ergonomical project process must identify, first of all, who will be the supposed users of this project and which kind of uses will be realised by this product, furniture, machine or ambient. In another words, it is important to define the target of users and the supposed ways of utilization expected from the product in progress.

This new science has had a large diffusion with the growth and expansion of the industrial product design. So the importance of the physical and psychological relation between machines and the people who use them forces the ergonomists to take an empirical approach to the study of human-machine interactions. The main objective is letting the human being take the maximum efficiency as a result of an interaction of him with a machinery. This can be possible only by taking as an example a typical person's size, speed of visualizing and heraind, strenght, physiological stresses like effort, difficulty, fatigue, speed of decision making and demands on memory and perception. Nowadays, the application of ergonomics has a large range realization, from design like furniture design and automobile interiors to work areas like aircraft or seacraft cockpits where the position, size, shape and layout of the switches and gauges on the control panels or layout of keys on computer terminals and

and character height, color and clarity on video displays, have an important effect on the work performance of the human being.

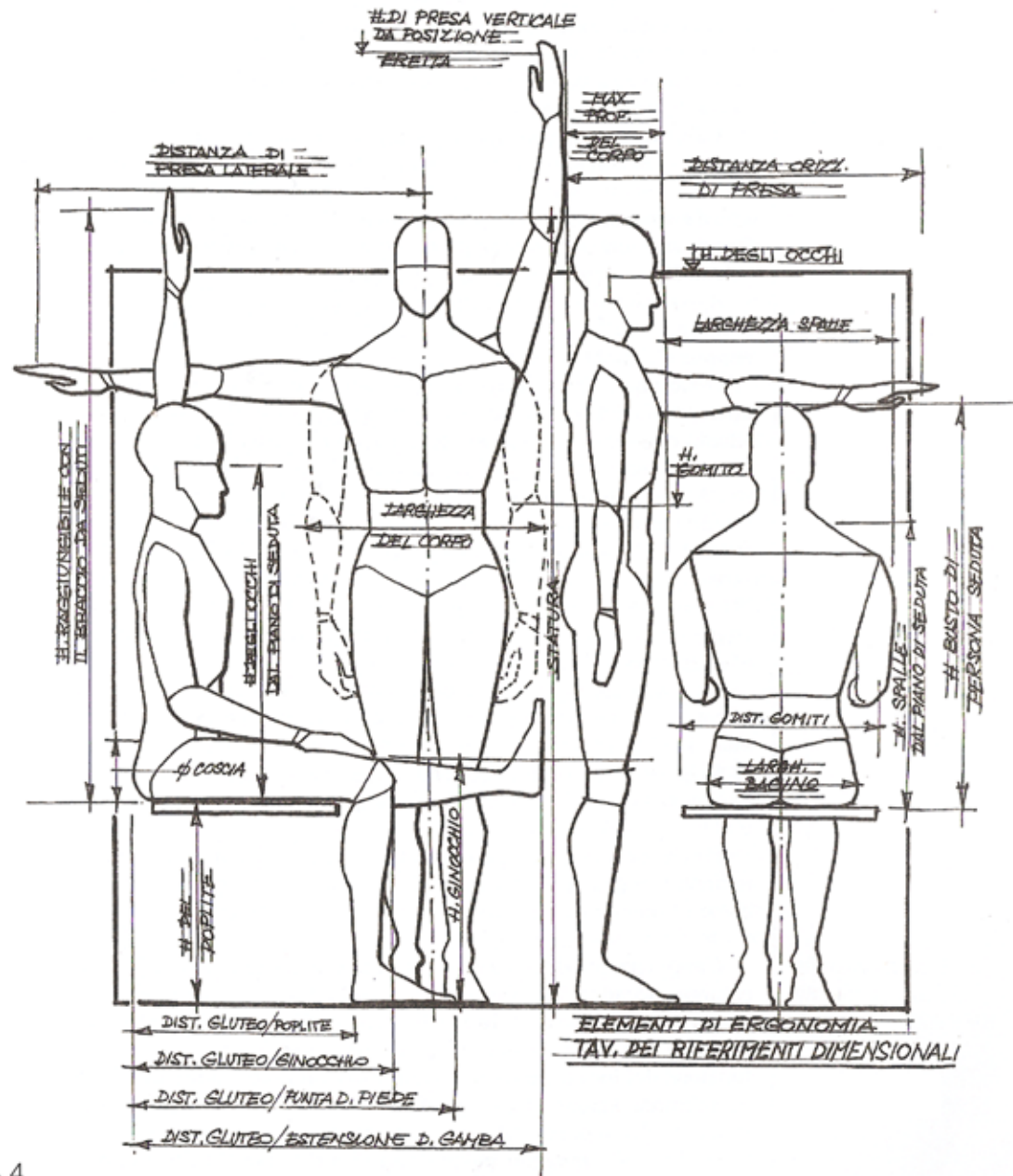
The definition of any industrial product determines the improvement of ergonomic experiences that are getting more and more detailed with the development of techniques and technologies. Today, the definition of anthropometric reference models can be seen mostly in the aeronautical and automobilistic fields because of the importance of the relationship between the human being and the area that surrounds him is the main factor of the habitability of these spaces.

As we talked about the anthropometry as an important factor and basis of the ergonomics, we can quickly analyze what this term exactly means. The anthropometry is the measurement of the quantitative aspects of the individual parts of the human body. As we said before, it has a major role in the design process of the industrial design, clothing design, ergonomics and architecture where the human contact is in the center of the project. The statistical data of the human body dimensions' distribution is generally necessary to optimize the products. As the life styles, nutrition typologies and ethnic compositions of the populations change continuously, the distribution of the body dimensions require a regular updating programme for the anthropometric information heritage. The most common and confidential source for this data is Anthropometric Source Book published by NASA.

To design a living area or a plastic volume correctly and to ensure comfort, security and functionality in these spaces, the primary passage would be the awareness of the metric interaction between the human being and its surroundings. So it becomes necessary to underline the importance of this discipline during the design process because ignoring and not considering it, can give way to serious consequences maybe also mortal results. If we think about the importance of the correct planning of a baby's chair in an automobile, the correct conformation of motorcycle helmet, or the correct positioning of the safety belts so it's easy to understand how an ergonomically respected design could save a life.

The evolution of the human being with its surrounding ambient is in a continuous and mutual change since the origins of the universe: the human being has evolved by its habitat and also produced manufactured products to satisfy the need of utilization.

So analyzing the world that surrounds us, brings us to see that every product designed for humans respects to the anthropometrical factor: from the sofa we are sitting on to the pen with which we write and the glasses that we use for reading.



4.4

As defined in the Harvard School of Public Health of Albert Damon, the 10 most important 10 dimensions to understand a human body are; height (stature), weight, height in sitting position, distance gluteus-knee and gluteus-popliteus, width of the sides and width in sitting position included the knees, height of knees and popliteus from the pavement, and the diameter of the front and back thigh.

So the standardization of the ergonomics derives from the statistical media formed by individuals with different dimensions. But it's clear that there is non possibility to consider a "average-sized human" as universal anthropometric norm because the variation of places, periods, ethnics and other factors generates case studies so different one from another so it can be really a huge error founding the right project sizes on an universal metric system, without a corrispondence with the realty. As the human body typologies differ apperantly from Europe to America or Japan, the serial products like automobiles are forced to be redesigned partially, for example only the cockpit of the automobile where sits the driver which is considered as the main protagonist of the product.

As it is clear that there are no human beings that fit exactly to all ten values of fixed by A. Damon, because of the impossibility of considering a average human to be taken as the basis of all the projects designed all over the world, the anthropometric studies have developed a universal judgment standart, called percentile, which helps to put in comparison different examples of the same specie with its qualification according to a scale formed by 99 units. So for example, two human beings with the same percentile of the stature, like 55°, can have differences by their length of forearm, respectively one with 52° and other with 60°. In poor words, within a gender, the 5° through 95° percentile range covers 90% of people where top 5% and bottom 5% are excluded. In a mixed total population with 50% men and 50% women, the 5° through 95° percentile range covers 95% of people because half of the top 5% of men and half of the bottom 5% of women are excluded. ( 2,5% + 2,5% = 5%). Application of the percentile, represents a parameter with a fundamental importance for a correct design of living spaces so its application lets the designer organize the measures by their kind of utilization. For example, in a yacht, the cabin's interior height must be designed with a reference to the highest percentile which is 95% in order to give the possibility of free movement in the upright position for a wide range of people. Anyway, it's not also correct to consider 95° for every part of design. For example, to stabilize the height of the kitchen shelf it's necessary to consider the lowest percentile which is 5° in order to allow also the short people to reach to the shlef without having any problem.

It becomes difficult and maybe wrong to design an interior architectural space in a customized way like a tailor designs a dress for an only lady's size. So it's necessary to consider the right value of percentile between 5° and °95 to cover and satisfy large masses of human beings.

As we have introduced above, the female and male body dimensions must be classified in different ways because of some kinetic and physical aspects. First of all, the volumetric differences between people by their gender affirm that the masculine figure results always more imposing compared to a woman. So the dimensional analysis show us that an adult human being with an age between 35 and 44, if he's a man with 71.7 kg of weight results classified in 30° while if she's a woman with 69.4 kg of weight, she results classified in 70°. In case of stature, a man with 170.9 cm of height results in 30° while a woman with the same height results in 95° because the average height of stature of a normal human being is considered 174.2 for men and 161.0 for woman.

If wanted, it's also possible to deepen the peculiar aspects of the comparison between two genders, like the analysis of the width of basin and shoulders.

One of the most important element of the activity of living is the seating so the design of a chair or a sofa, despite its structural simplicity, can result as the hardest design object for the designer because of its anthropometrical aspect.

As we have analyzed how it can be possible to standardize the interior spaces by average dimensions and percentiles, the application of these norms can result always more complicated because of the speciality of the yacht interiors design because of its morphological, social and commercial aspects.

A seating platform situated in a very high position causes the lifting the tarsal zone of the feet from the pavement so brings to the compression of the interior zone of the thigh: the results can be the decrease of the general balance of the body and the fatigue of the blood circulation of the legs.

Contrariwise, if the seating platform is designed in a lower position than it should be, it forces the sitting people to stretch the legs, and to restabilize the balance to advance the shoulders: this causes the separation of the bust from the back so the backbone remains without support that needs for staying in the right position.

In the same way, the sitting area too large or too small causes that the weight of the body falls on a surface not suitable so brings the problems of blood circulation.

The function of the back of a chair or a sofa, is mainly to guarantee an efficient support for the lumbar zone of the spinal column. The dimension of this part is directly correlated with the sitting part so it's possible to gain many different sitting positions by changing the width and inclination of both of them in a reciprocal way.

Normally, a sitting position nearer to the lying down needs a lower height of sitting platform with a wide angle and with a backrest very extended in order to support all the vertebral column with the help of a headrest part to support the weight of the cranium.

A very upright position also is not considered as a right way of sitting because of the vertical position of the back that causes problems on the vertebral column.

The armrest parts are not only designed for aesthetic purposes but they result an important element to protect the balance of the body and help its support. The right height is generally considered as correlated with the height of the knees in relax position in relation to the seating platform.

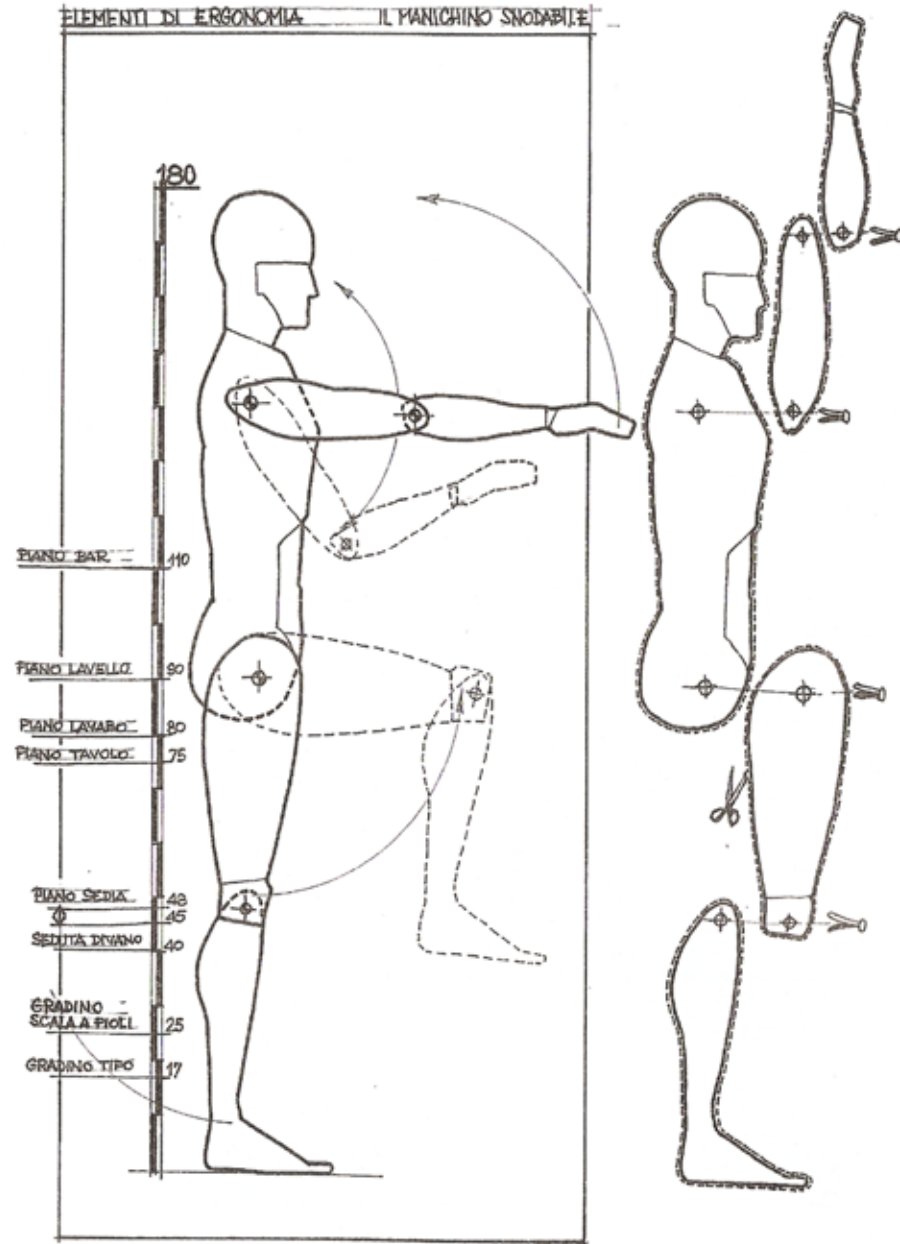
The stuffing also has an important role on the right distribution of the body weight on the seating area. The common idea of the public is that the softness of the seat is directly correlated with its comfort but this theory has no accuracy because a sofa more stuffed creates uncomfortableness and tiredness.

For a careful furniture detail design, from a cushion to a yacht cockpit, it's necessary to consider the measure of taking something, the stretching because of bending the body and kinematics of the human body that are movements not traslatory but rotatory.

The modern control stations are designed in a way that all the components are in a radial position with the user so this permit the user having a wide possibility to control and rule the machinaries with the minimum movement so with the minimum energy used.

The yacht designer both interior and exterior must use a grafical tool that satisfy the 10 basic value fixed by A. Damon, in order to optimize the ergonomics of the ambients created for a very wide range of users from all over the world. As we talked before, also in this case so in yacht design, it is necessary to use from 5° to 95° percentile to satisfy everybody on board with different physical dimensions. If not, only a litte percentage of the clients are going to be satisfied ergonomically while the rest of them remains unsatisfied. The ergonomics laws declare that it is important to verify and check the extreme cases in order to realize a good and satisfactory project.

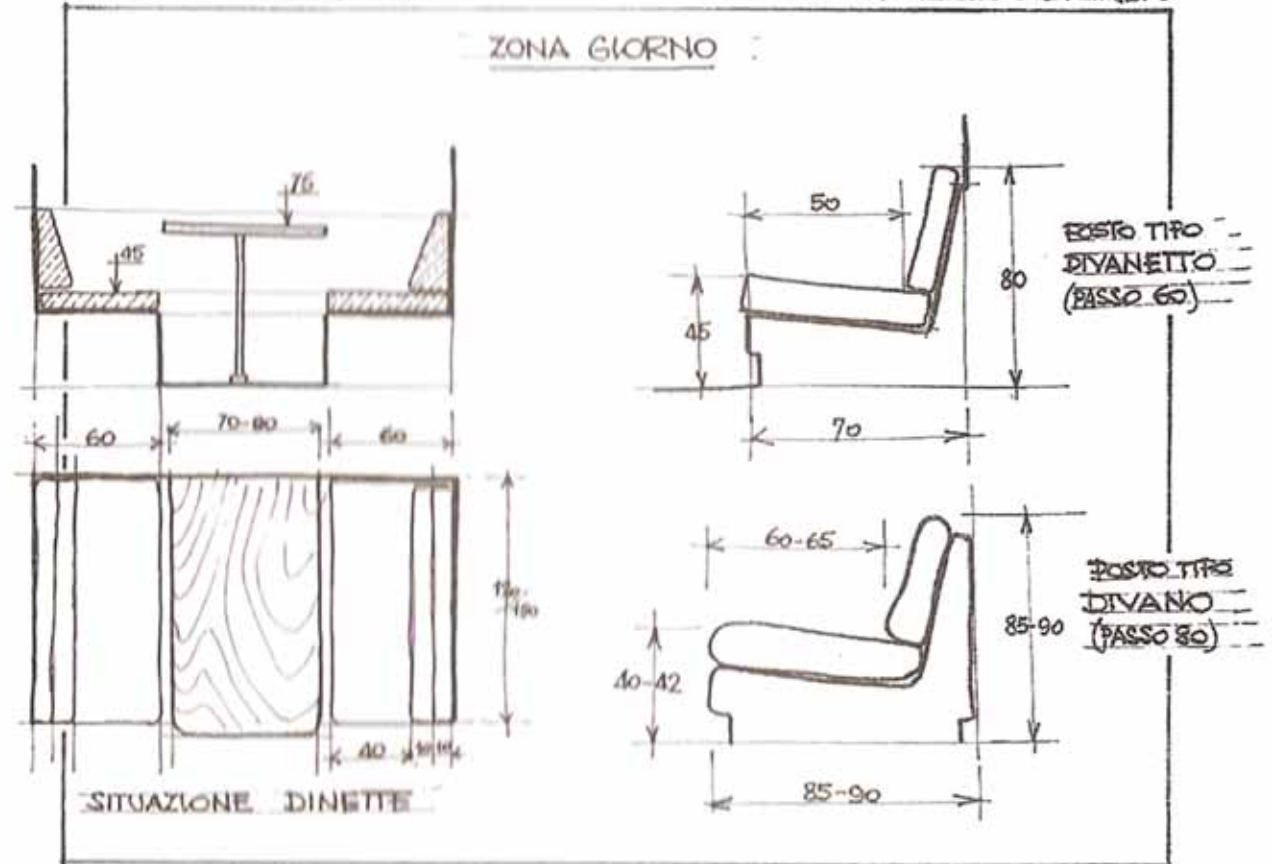




4.5

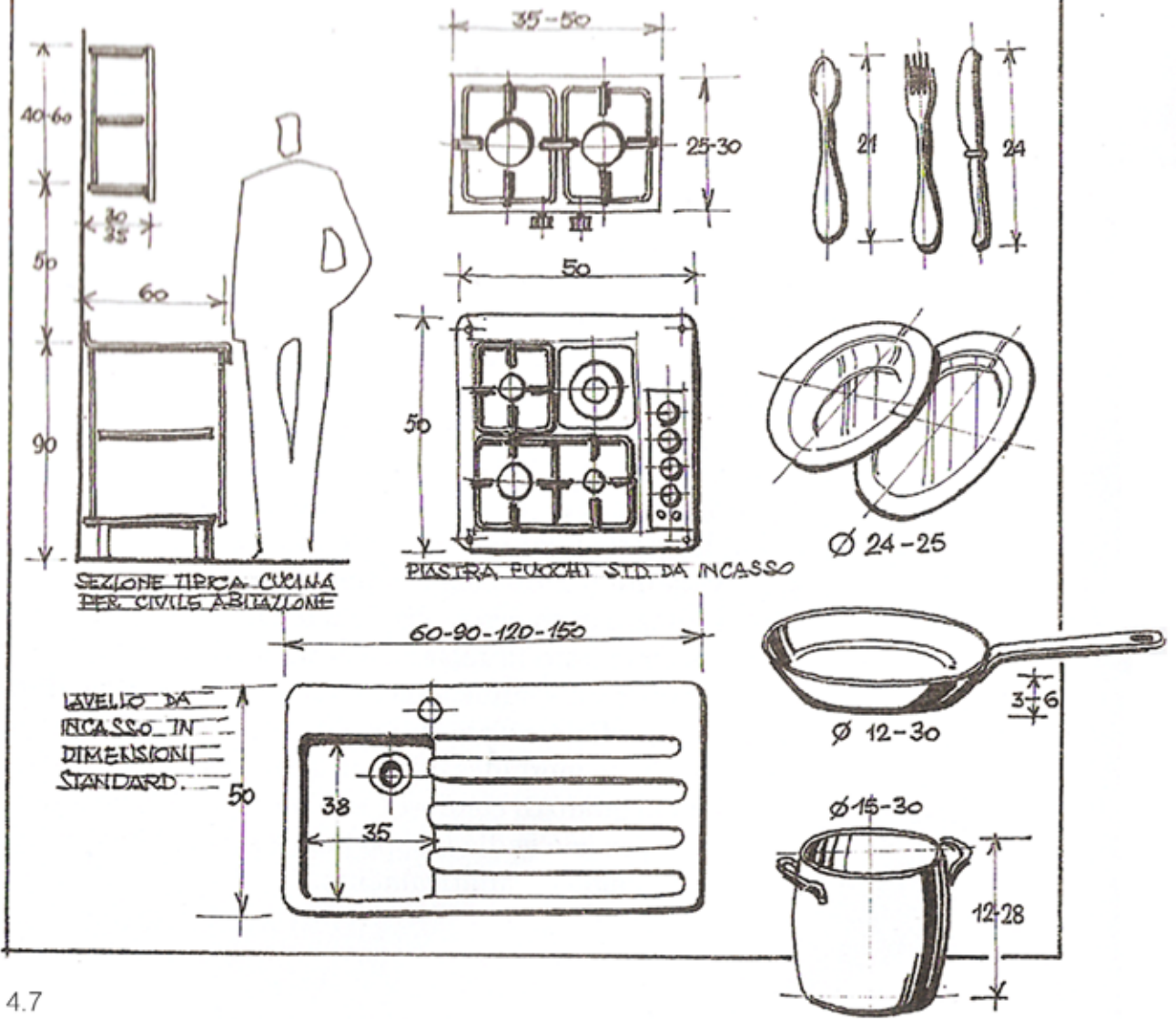
ELEMENTI DI ERGONOMIA

DIMENSIONI FONDAMENTALI



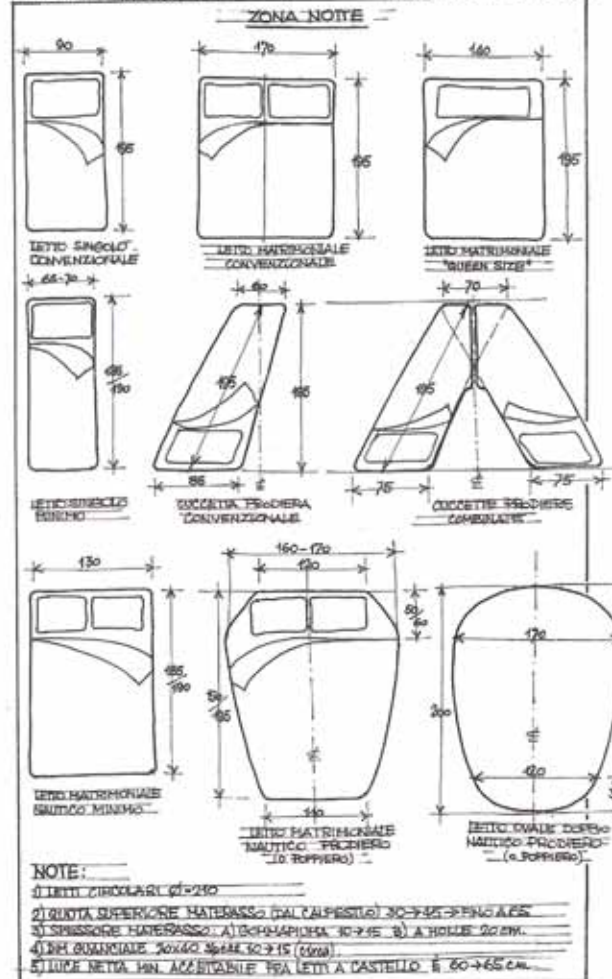
4.6

# AMBIENTE CUCINA

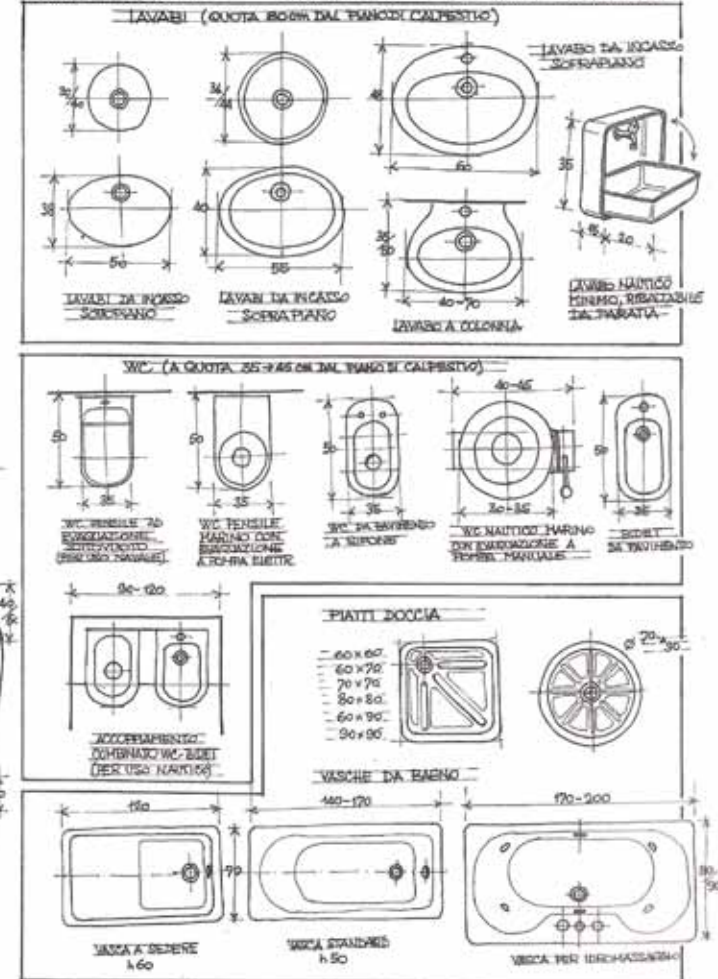


4.7

ELEMENTI DI ERGONOMIA ----- DIMENSIONI FONDAMENTALI



ELEMENTI DI ERGONOMIA ----- ZONA IGIENE ----- DIMENSIONI FONDAMENTALI



#### 4.4. VERIFICATION AND LAYOUT OF VOLUMES ON BOARD

Boat is a human product that is defined by forms according to the different requirements and demands. In order to satisfy the type of utilization chosen by the client, the craft can be developed with a capacity to handle the wild seas or can be designed extremely in another way if it is intended to be used in the shallow waters.

So the necessity of satisfying the different and sometimes more specific kinds of requirements brought the designers to realize a wide variety of boat typologies.

Independently from the performance aspects of the boat, the relation of cost-production for m<sup>2</sup> can be important to point out the importance of the best way of utilization of the interior volumes for living but this feature results high products costs because of the complicated and customized furniture designs.

So the designer needs to arrange his project in respect to the hydrodynamic, hydrostatic and purely performative compartment like speed, autonomy and others. Other than these features, the designer also must consider the importance of the habitability and usability of the interior spaces. Because of this variety, today in the boat market there are many kinds of hull typologies to satisfy every different demand.

If it is true that the hull typology effects mostly the distribution and the design of the interior volumes, it is also true that the stabilized function for the interior spaces can effect the selection of the most ideal hull type to satisfy the needs. For example, if a boat has the main function of navigating on the wild seas, its hull must be designed with the bow in a starry form that makes it loose a lot of spaces to be used for the interior volumes. The opposite example is a boat designed for the shallow and calm waters and for the cruise purposes so the main request would be gaining the maximum efficiency from the use of habitable interior volumes and so the hull must have more flat and rounded lines.

But in any case, it is impossible to think the boat interior as a parallelepiped box that extends in a linear way, as it happens generally in the buildings, so it is necessary to verify the volumetric capacity of the hull in every position of the intervention.

The positional analysis is important to control, in every level of the project, the reality of the various kinds of volumes inserted in the different locations of the boat. So in other words, every time that the designer hypothesize a cabin, or a bathroom, or simply an aft or a fore peak, it's necessary to verify on the construction plane, the practicality of the installation of the components.

The boat, because of its nature, is always aimed to represent volumes always more narrow as the position proceeds to the extreme end points or downwards. So it's clear that the availability of the living volumes are larger in the upper decks that remain on the upper part of the waterline while the lower decks are characterized by narrower dimensions and lower heights.

When we analyse the smaller boat types, like pleasure boats, the space availability is used in a way that the arrangement of the all fixed furnitures are located in the perimeter of the hull so the transit passages can be done in the center position of the boat. It results sensible dedicating the highest locations of the boat to the transit activity which requires an upright position so more needs for a flexible movement area.

In this pleasure boats, it is also possible that berths, sofas, wardrobes and maybe wc and washbasins in the bathrooms can be located in a way that they follow the lines of the perimeter in order to gain more space inside the cabins. Also in this case, the passage is generally in the center part to give maximum height to the person that passes through instead of the activities like sitting, sleeping or resting that are done in the sitting position without the need of higher spaces.

The architects with a background specialised in the housing construction, generally consider the design of a yacht interior as a building so they can follow the same methods they use for more rectangular forms: they can proceed to the distribution of the interior living spaces by using only one kind of technical data which is the plan. In the civil architecture this method is considered as the most practical and optimum way for the working on the different volumes but in naval field this data is not always enough for controlling the feasibility of the elements designed because of the sudden changes on the extreme points and on the heights of the hull as we have already explained above.

In a larger scale, the waterline of the floor plane occurs a limit which permits the utilization of the 90% of this space for the organization of the interior spaces. The same waterline in a smaller scale permits only the utilization of the 20% or 30% . So in this case the spaces at different heights can be used for the organization of the furnitures by overflowing the limits of the floor limited by the waterline.

The organization of the furnitures generally can be limited by the floor edges that are the highest point of the bilge but this area results narrow and reduced so for example the seating floor which can be at a height of 450 mm from the pavement, can have a larger area because of the inclination of the hull borders so at 450 mm height from the pavement there's

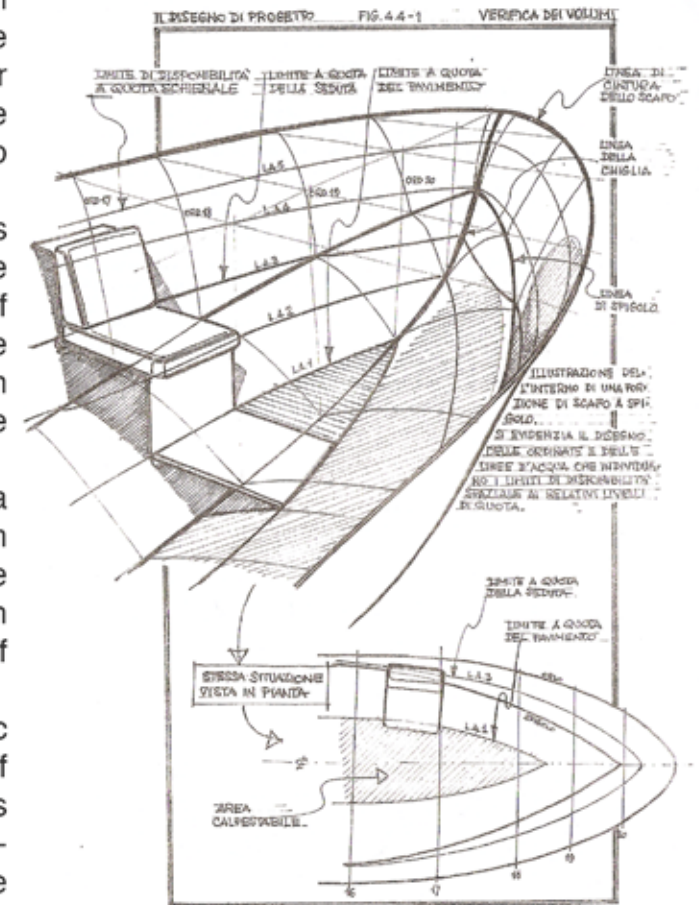
a larger area available for the furnishing. So with the same mentality, a kitchen worktop with a height of 800 mm from the floor can overflow the edges of the floor plane seen on the plan because of the possibility of using more spaces as we go upper inside the boat.

So in this way, while the designer works on the 2D plans, it comes out that maybe a bowman berth that follows the lines of the hull edges can result outside the limits of the waterline floor plane even though it remains inside the limits of the borders of the hull.

But it is also necessary to consider that a berth positioned at 600 mm height from the pavement compared to a berth on the floor will have much more narrower form with a hypothetical ceiling at a height of 1900mm from the floor plane.

All the designs of the interior volumetric organization, represent a distribution of the furnitures inside the hull at various heights, by proposing the elements situated in positions always more near to the centerline of the boat step by step moving towards to the extreme points.

The deck house also represent interesting solutions for the constraints caused by the inclination of the sides from a larger floor to the narrower ceilings. Again it's important to understand the necessity of control and verification of every single element if they are inserted inside the boat in a correct position, by construction lines and sections. So if the designer is working on a bathroom, for example, he must control every element necessary if they fit correctly by width and height in order to realize a correct planning applicable in the



4.9

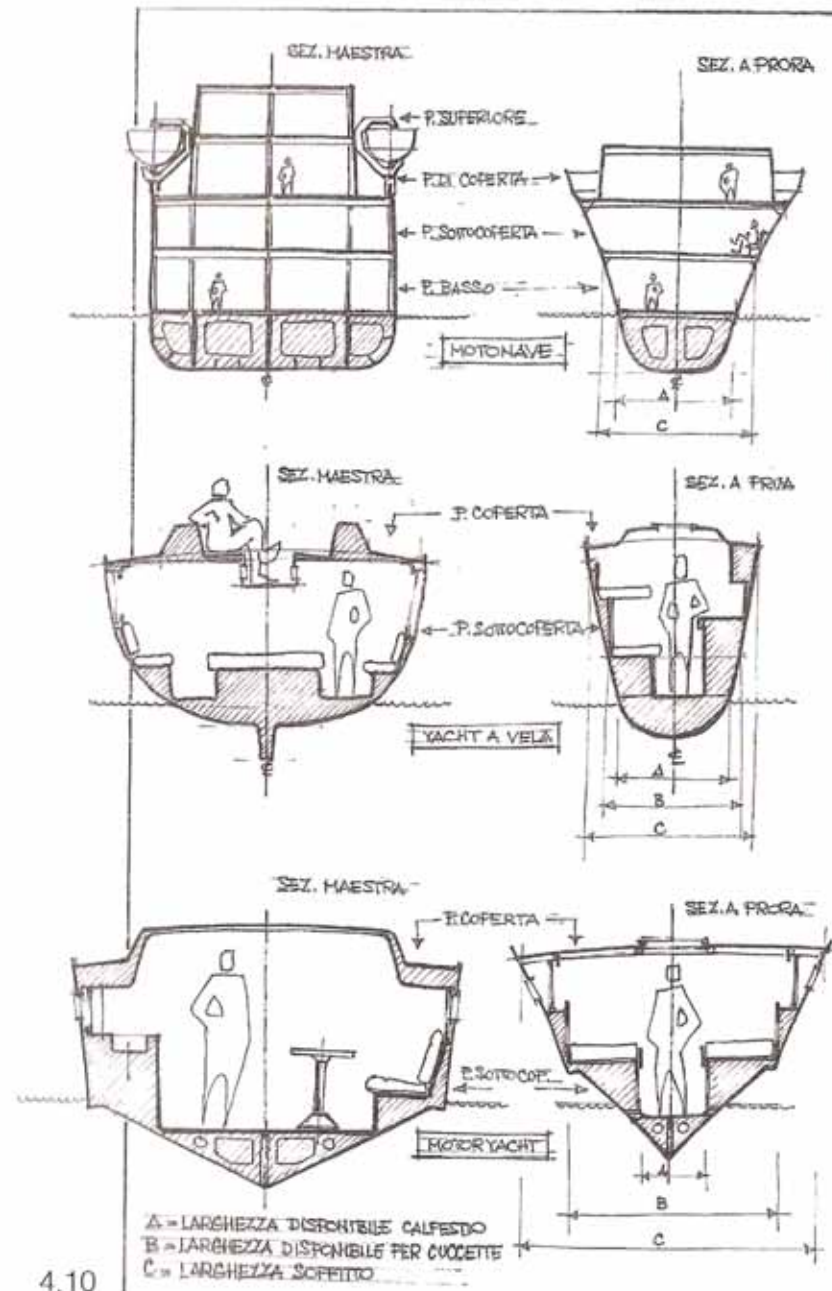
construction phase without having any problems of incompatibility.

As we have always talked about the organization of the furnitures and other element in the disposition of the interior volumes of the boat, we have given the examples of cabins or bathroom or kitchens but in the boat there are also another areas with more technical characters, like engines room where every equipment must have the correct collocation and position in order to gain a high efficiency from the machines. This feature is very important for the correct utilization of all the technical system of the boat.

Other than the engines room, another important feature of the volumetric distribution inside the boat is the liquid tanks: thanks to the construction plan lines the tanks are normally designed according to the hull form and they are generally inserted in the lower and central part of the mass in order to help to keep the general balance of the boat.

The use of the construction plane for the naval organization is always considered necessary but never enough alone for a correct identification of the disponibility of the interior spaces. So there is another method used mostly for this purpose, which is the composition of the numerous sections in vertical, horizontal and transversal dierctions in order to gain the possibility of controlling the available interior spaces within the edges of the hull. So with this methods it results more possibile realizing a volumetric distribution of interior spaces in a satisfied way.





4.10



## 5. COMFORT ON BOARD

A living space with a correct project can make feel comfortable the people that are inside it but the satisfaction percentage from this space can be different from a person to another. The functionality, the technology or the security are certainly important elements to consider in a design process but they are not enough. The designer must offer to the people and to their interior world, the elements that reflect their character to the space around.

Actually, design process of a boat project or a housing project are not so different. First of all it is necessary to define the necessities, the needs and the orientations of mankind on a boat like the designer does also for a house or a hotel project or for a car design.

Everything has an another value when we talk about a boat project because this represents a micro-macro cosmos that must contain inside itself all the requirements of living together in a limited space that results isolated from the rest of the world for short or maybe long periods. So the people on board must feel satisfied by this limited space surrounds by offering them everything they need both psychologically and physically during this isolation.

The social density on board, even if it's a private boat or is a charter, is very high and the members of this little community are forced to live together for some determined periods in little and limited spaces with people that maybe they already know or maybe they have never seen before.

Even though the life on board means sharing most of the time together with the others, every mankind needs his own privacy to take his time for thinking, relaxing or meditating. So boat must offer his users this kind of private zones where the people can retreat away from the others and stay under his personal responsibilities. This is important to enjoy his own privacy even in a limited space full of other people.

### 5.1. FLEXIBILITY

when we talk about the fundamental necessity of comfort on board, the most important theme to underline is the flexibility which becomes an important theme today in design field and can be used in different kind of projects, from an architectural to a product design project. So there is an important attention oriented to this new feature which permits the realization of versatility and multifunctionality in the projects in order to satisfy different kinds of requirements by people from the new contemporary society of today. This flexibility theme

attracts a huge number of designers that never give up trying new experiments and explorations in different fields of architecture and design and they manage to gain very appreciable results by joining together practicality, functionality and aesthetics.

Sometimes the flexibility can be considered as a necessity of creating clean and comfortable spaces by making real the ambiguous solutions that can be done in the same place. These solutions generally asked by clients but in the utilization process never used with their full potentiality. That means that the flexibility permits that the places with request of different activities can be transformable in a quick way to stasify the requirements of the specific activity choosen by the user in that moment.

In the boat project process, the flexibility can be used with a correct organization if requested by the client. Like the application field of the flexibility theme is getting more and more wider nowadays, with the correct choices of functional distributions of volumes, practical materials and best interior organization, it is possible to offer to the client a flexible project also for a boat design. And not only for boat design but also for the car design and aeronautical design it is possible to talk about flexibility with the correct project.

Obviously, the flexibility can be inserted into the design process in two different ways that depend on the necessity and requirement of the client; flexibility by use and flexibility by project.

The flexibility by use means realizing expansions or integrations by reserving the original borders of an existing living or working area. This can give possibility to use the same space for different activities during the day or during a determined period according to the necessities. This results a charming opportunity for the user to obtain possibilities for new activities and spaces without spending lots of money and energy.

The flexibility by use can be divided into three classes by the period of variations; there can be variations for daily periods, medium-length periods and long periods. The flexibility for the daily period includes the variations in the living area because of the temporary necessities. For example, if the living room of a house is divided by a sliding door from the other part of the room, for the day that arrive the guests, this wall can be left open to obtain a spacious area.

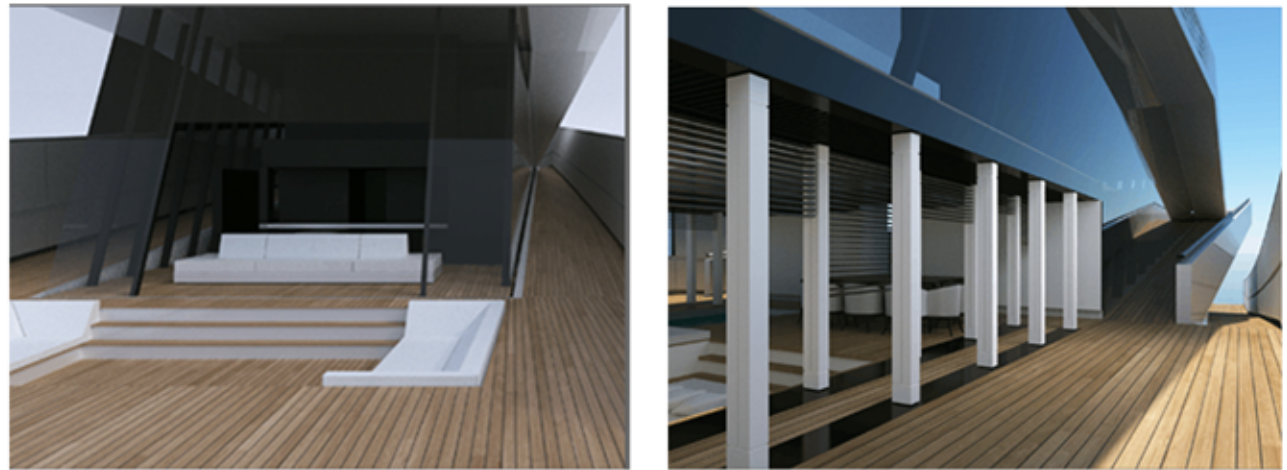
The flexibility for the medium-length periods can be defined as the changes made in the living spaces because of the change of seasons.

And finally, the flexibility for long periods includes the modifications made because of the radical changes happened in the family life.

In the boat design, the flexibility by use can be generally for daily conditions according to the different activities done during the day. Or for example, in a ferryboat project that is going to be explained soon, the rent purposes can cause modifications in the interior spaces of the boat to satisfy the requirements of the client. Because as it is easy to imagine, the requirements for a business meeting and for a wedding ceremony can not be resolved with the same volumetric dimensions.

Another important type of flexibility is the one realised by project so very long before the construction of the project. The designer during the design process works on different solutions for the same spaces in order to have more options to offer to the client. So the client expresses his/her preferences picked up from the options offered by designer and then starts the construction process. For example, the boat designer can offer to the client to realize a study room for himself instead of one more guest room. The user is the one to decide if he needs a personal room for himself or if he needs more space for his guests or family members. This kind of flexibility is valid only before the execution phase starts because once he decides then it becomes difficult to make changes on the project during the construction.

The most common way of creating flexible areas is using much transparent material possible. The concept yacht project of the English designer Newman Stacey, "Nine Zero" aims to create flexible areas on board with the use of sliding windows. A completely fresh approach was taken for this exciting new project. with the realisation of this particular flexible large windows it's possible to create an internal secret garden or a kind of courtyard.



5.1

## 5.2. LIGHT

Le Corbusier once marked that “architecture is the masterly, correct and magnificent play of masses brought together in light.” He describes a house both as “receptible for light and sun” and as a “machine for living”. So recognized that the expressive value of light could make modern architecture an emotive experience. Light and its special effects were seen as they are now, as being both physiological and psychological in nature.

In the interior architectural design, light design is an important element that effects the comfort and pleasure of an ambient with the creation of the shadows and plasticity. In a project, it is important to know how to control the quality of light effects to let the interior spaces be more livable and pleasant.

As it is flexible element, the light project permits to design spaces and define functions without modifying the architectural structure of the ambient. And it is also possible to think the light as the fourth dimension of the architectural design which interprets the spaces and makes them visible and perceptible.

An illumination project requires important a detailed technical studies in order to realize correct projects with which the designer can create particular sensations for the users. With light, the architecture revitalizes and so a static structure becomes animated with light and shadow effects like a live organism that beats.

To realize a good project, it is necessary to study the chromatics, the directionality of the rays and the dynamics of the visual scenes. So the project must aim to produce correctly illuminated perspectives and scenarios not only to satisfy the visual necessity but also to permit to the user to gain the concrete aspects from the space they live in.

Today with the change of conditions, human being is forced to spend more time in spaces artificially illuminated. It means that the necessity of using the sun light is losing its importance even though a responsible designer always aims to use as possible as the natural light with its benefits. But as we said before the contemporary life conditions do not permit us to see the natural light in our office in a skyscraper or in our living room surrounded by high buildings around. Obviously, the artificial light today is not considered as a supplement element to the natural light any more but it substitutes it completely. So in today's design a correct illumination project becomes an emergency, other than its functional role also for its capacity of expression and motivation for the productivity of the user.

The artificial illumination is important not only for a correct and enough visibility degree but also to create ambients where the chiaroscuro and shadows define the volumes and separates the live spaces from the empty ones.

So after this explanation, it is easy to understand that a correct illumination project with every technical detail studied with attention results very important to guarantee the best comfort to the future users. This correct project can be realized with the study of three important principles;

- physical principles for a complete technical study
- aspects and necessities gained from the project approaches
- analysis of the wide variety of the products and technologies available in the market

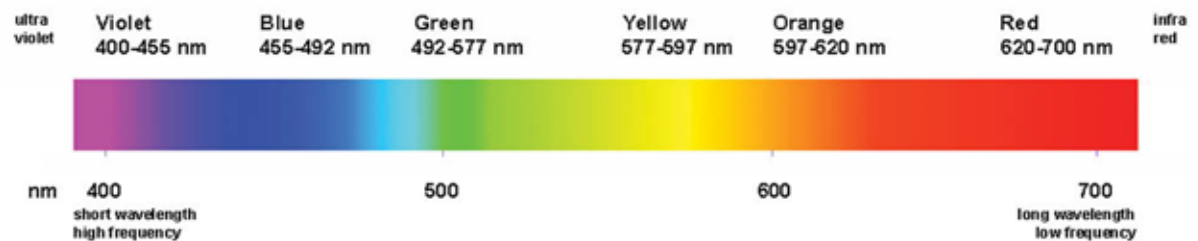
To realize a correct illumination project, it is necessary to understand the technical details of the components necessary for the project. So what is light?

Light is the radiante energy that has its propagation under the form of waves and particles, named photons.

Light is defined as an electromagnetic waves field visible by human eye that matches with a small quantity of electromagnetic photons and the energy that exceeds this limit is not visible any more.

The visible spectrum can be divided into different classes which are matched with a particular type of sensation called 'color':

- 380-436 nm violet
- 436-495 nm blue
- 495-566 green
- 566-589 yellow
- 589-627 orange
- 627-780 nm red



When we analyze this information, we can see a measure unit called nm. The luminous waves field extends between 380nm and 780 nm and the shortest waves match the extreme visibility with violet color, edged with the ultraviolet field, and the longest waves match the extreme visibility with red colour, near the infrared field.

We used the terminology 'color sensation' because actually they are not the electromagnetic waves that create the color but our perceptual system that takes the difference of wave lengths of the light as a variety of colors.

The correct material choice is an important element for the designer to get what he actually designed in his project. Materials can be divided into 3 classes by their relation with the light;

- opaque materials that do not let the light pass through
- translucent materials that permit the light passes through partially but do not let the user distinguish the bodies behind itself
- transparent materials that let the light pass through and have a direct transmission of the incident ray

The incoming luminous rays on a surface are absorbed, transmitted or reflected by different percentages by the qualities of the material with which the surface is made of. So to understand how a material responds to an incoming light, it is important to define the reflection factor, transmission factor and permeability factor.

### ***5.2.1. REFLECTION***

The reflection which has an important impact on the illumination project is given by the ratio of incident luminous flux and luminous flux reflected. The reflection can happen in three different ways;

- specular reflection
- diffused reflection
- spread reflection

The specular reflection is the mirror-like reflection of light, from a surface, in which light from a single incoming direction is reflected into a single outgoing direction. So the reflection angle of the outgoing ray must be equal to the angle of the incoming ray. The materials



that give the specular reflection are;

- silver (92% of reflection)
- silvered glass (80% - 90% of reflection)
- polished aluminium (75%- 85% of reflection)
- shiny and chrome aluminium (60% - 70% of reflection)
- stainless steel (55% - 65% of reflection)

The diffused reflection is the kind of reflection when the luminous ray is distributed into multiple rays more or less intensive in various directions without following any preferred direction. This reflection generally happens on non homogeneous surfaces that cause the diffusion of light to the outside in a multidirectional way. These materials are;

- gypsum plaster (80% - 90% of reflection)
- maple and similar wood types (50% - 60% of reflection)
- concrete (15% - 40% of reflection)
- brick (5% - 25% of reflection)

The spread reflection is the reflection type that happens when the light is diffused in various directions but more intensive in the specular direction. The materials on which happens the mixed reflection are;

- white polish (70% - 90% of reflection)
- satinized aluminium (70% - 90% of reflection)
- brushed aluminium (55% - 60% of reflection)
- satinized chrome (50% - 55% of reflection)

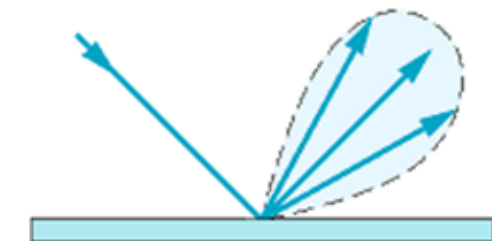
## Specular



## Diffuse



## Spread



5.2

### 5.2.2. TRANSMISSION

The transmission is another important element for the control of an incoming light on a surface so understanding it results fundamental for a correct illumination project. It is given by the ratio of luminous flux transmitted and incident luminous flux. The transmission happens when the light passes through the transparent surfaces and the luminous ray varies from its straight path. The deviation depends on the incoming angle of the ray on the surface, the material type passed through and lastly the thickness of the material. The types of transmission are

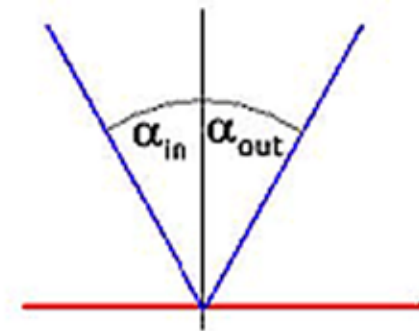
- direct or regular transmission
- diffused transmission
- mixed transmission

The direct transmission happens when the surface with an incoming light lets the incoming rays pass through in a huge quantity without a notable directional change. The quantity of the transmitted light is in a direct proportion with the angle formed by the rays. It means that the quantity increases if the angle formed by the incoming rays on the material's surface gets nearer to  $90^\circ$ .

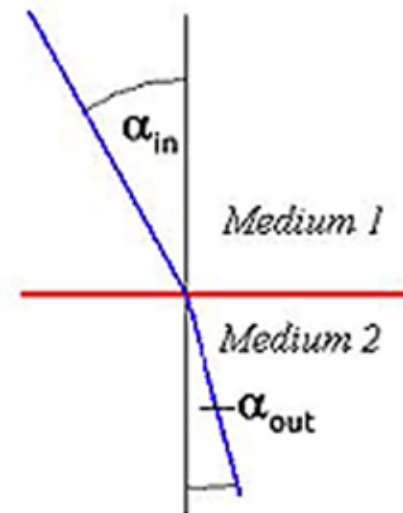
The materials on which happens the direct transmission are glass, transparent plastics, etc..

The diffused transmission is the type of transmission happens when the outgoing luminous flux is distributed into various directions. The materials of diffused transmission are opal glass, translucent surfaces, that contain a little quantity of white

### Reflection



### Transmission

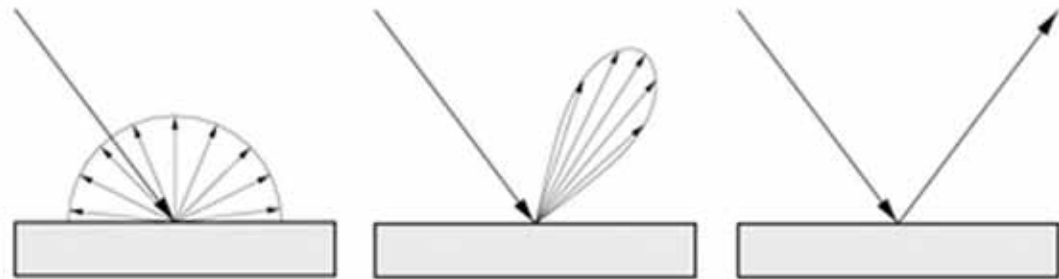


5.3

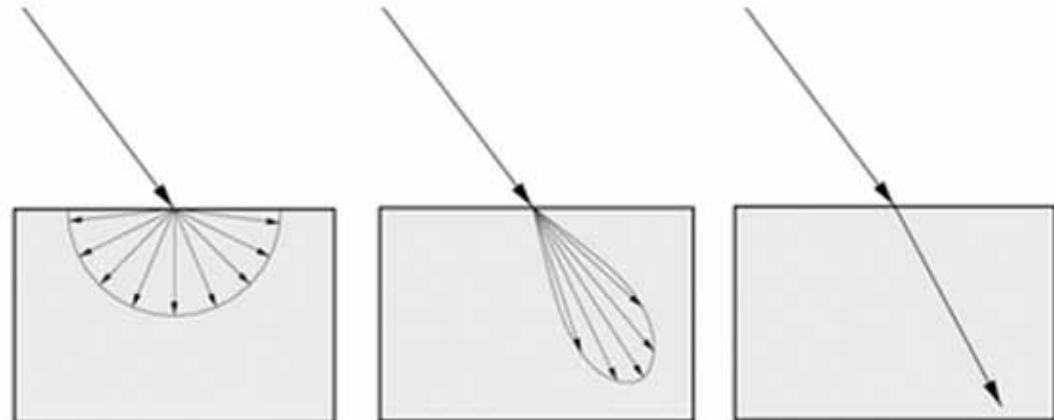
particles.

And lastly the mixed transmission happens when the outgoing lumious beam expands in a privileged direction according to the type of material with which the surface is made of. The suitable materials for this type of transmission are frosted glass, etc..

REFLECTION



TRANSMISSION



5.4

### **5.2.3. PERMEABILITY**

The permeability or absorption of light is the parameter that determines how the substance affects a magnetic field. So it's not applied only to light but also to other magnetic fields. The permeability factor is given by the ratio of luminous flux absorbed by the body and the incoming luminous flux.

When the designer is able to control the light by knowing its technical and physical properties, then it is time to consider some factors for a correct illumination project. An illumination project must never start from the equipment selection as it generally happens. A project realized in an accurated way must be the result of a long and detailed process of analysis and researches, in order to ensure a suitable light distribution for the type of use requested, with the correct quantity and quality.

To a preliminary project, it is always necessary to add also a detailed verify of the comfort conditions of the ambient chosen for the project. It is necessary to consider both lighting aspects like levels of illumination, light direction, visual disturbances; and also aspects connected with the ambient perception of the space like lighted atmosphere, color performances, etc..

It is important to understand that the light is a conditioning factor for the right evaluation of an ambient like some other important features like personal sensibility, behavioral replies and acceptance of the ambient that are tightly connected to the light effect of the ambient. The light creates shadows and plasticity so it affects considerably the pleasantness of a human being in an ambient. It can be considered as one of the main factors that affects directly on the ambient comfort so knowing how to control it results fundamental in every kind of intervention to improve the quality of an interior space.

It is an important project element because of its richness and versatility and thanks to its capacity of changing a space completely without any obstruction. Its flexibility helps to intervent on interior spaces and to define functions and volumes without any structural modification necessity.

For an interior illumination design it is important to follow a certain order so it becomes easier to satisfy the requests of the project without creating confusions.

First of all, it is important to choose the necessary illumination levels and gradations that means determining the quantity of light needed to satisfy the visual sufficiency and the requests of the specific functions. After this step, the designer must decide if the ambient is

is appropriate for a direct illumination or an indirect illumination project. After the choice of illumination type, then it comes to choose the correct equipment between various range of examples and the illumination source type like color temperature, chromatic rendering index, luminous efficiency... At last, to define the final characteristics of the project, the designer must verify the conditions of the visual comfort like the balance of luminance, dazzling control, contrast and shadow harmony and the lumious atmosphere.

As we said before, the light is capable of creating shadows and realizing forms so has an important effect on the pleasantness of a living area and so on the physical comfort of who is going to use this space. The illumination project on board is always more complicated and requests more attention because of the general function and valuableness of the yacht design project.

The electromagnetic fields can transport assimilable energy to the wave system of the sea. If we think about the analogy between the water and the light, we can affirm that the sea produces material waves while the light produces energy waves. So the yacht moves constantly between the waves of the sea and the light that reflect on the hull and on the glass the variations of color and brightness of the sky and the sea.

The glamour of the yachts that we see anchored in port, generally during the night, is determined by the consious use of the light. The yacht appears interesting during the day because the structure and the interior spaces stand out thanks to the day light but generally the same conditions can not be seen in the night version like it is promised for the daytime. So the illumination project can result efficient or dangerous at the same time, with its capacity of highlighting the relation between full and empty spaces or if the project works bad with its possibility of flattening the volumes. Because of this, it must be organized, designed and governed with a good knowledge of the designer for the advantage of the final result.

The light typologies that interest our transport vehicle are natural light and artifical light. To control the natural one, the technology is arrived in good conditions and levels thanks to the technologies and experiences developed for car design, architecture and industrial design through the use materials like metallic paintings; mirror or satinated glasses with different colors; pearly, mat, shiny or even prismatic materials, etc.. If we see the last concept yacht examples, it is easy to understand that the use of different type and color of materials are becoming stylish in the last years. The Wally 88 Tiketitoo is the first example of the application of a special coppery color on the outer surface of the whole hull, in order

Also the artificial light, considered as a creative discipline for resolving not only the functional problems but also for creating atmospheres, emotions and visual effects that become popular in the yacht design field in recent years.

Since a long time, light has a major role in architecture in the design of public and private living spaces but its use in the naval field starts a little bit later because of different factors: physiological stability of the sector, use of non dedicated lighting elements, restrictions of the laws by classification authorities, difficulties caused by the minimal height between two floors but especially because of the lack of illumination project culture.



The peculiarity of the nautical sector can be seen also by the special requests and characteristics for the illumination project. The basic features to consider for the correct light on board are energy saving, control of the heat sources, resistance to the continuous vibrations, miniaturizing, installation compatibility with the structural conformation and reduced thicknesses, adaptability to the standard voltage, reduction of the maintenance frequency of the devices.

Until recently, the illumination project for yachts was concentrated on the punctual devices and equipments like spotlights and spotlights with halogen source with low voltage used for the accent lighting, neons for general and diffused lighting.

An important revolution comes with the introduction of LED (Light Emitting Diodes) in the illumination field, used firstly for the architectural projects on land then finds its application also in the nautical projects with its innovative potentiality. After the diffusion of use in the illumination projects, LED become popular in the nautical projects with its capacity of duration until 50.000 hours and with the minimum request of maintenance. With their reduced sizes, they are well adapted in the nautical projects which are always careful with the space wasting and they also permit the creation of special lighting effects that are colored, dynamic and modular for the different kind of requests. They can be assembled in linear, rectangular and round modules like real bricks left in the hands of the designer to create his project.

Generally, the delay of the arrival of illumination projects in the interior naval design field, is rapidly catching up the civil architecture examples thanks to the effort of the creative designers that are having important experiments with their knowledges gained by the architectural projects, specially by the interior design projects.



5.6



### 5.3. COLOR

Color is one of the most efficient tools in architecture and interior design with its capacity of transforming, enlarging spaces by changing their shapes, defining new volumes and joining different rooms together without any need for structural modifications like we have seen before for the illumination design with light.

Color can also transmit light and warmth to dark corners, highlight or conceal structural elements of the building or in our case of the boat.

Choosing the right color is all that the designer requires to achieve the desired effect by customer and this correct choice can instantly change the character of the different rooms and their intended use.

Before analyzing how to choose the right color to obtain the requested solutions for the interior design projects, it is important to understand the physical characteristics of the color element.

Color is a visual perception that derives from the spectrum of light interacting in the human eye with the spectral sensitivities of the light receptors. Color categories and physical specifications are also associated with materials, light quantity and sources and object qualities based on their physical properties such as light permeability, reflection or emission.

The science that researches color is called generally as chromatics or chromatography which studies the perception of color by the human eye and brain, the origin of the color in materials, color theory in art and the physics of electromagnetic radiation in the visible range.

To better understand the effect of each color, we generally use a color wheel which is formed by primary colors which are red, yellow and blue; secondary colors, named also as intermediate colors; and complementary colors. This color wheel, which has a major importance on the correct choice of the color that depends on the psychological factors, is very important to determine the sensory perception of the space.

The primary colors are called in this way because they can't be created by mixing other colors but by mixing them it is possible to create most of the other colors. Primary colors are not a fundamental property of light but are often related to the physiological response of the eye to light. Fundamentally, light is a continuous spectrum of the wavelengths that can be detected by the human eye. However, the human eye normally contains only three

types of color receptors, called cone cells. Each color receptor responds to different ranges of the color spectrum. Humans and other species with three such types of color receptors are known as trichromats. These species respond to the light stimulus via a three-dimensional sensation, which generally can be modeled as a mixture of three primary colors.

The secondary or intermediate colors are located between the primary colors to indicate from which color they are created. They are colors produced by combining two of the primary colors in equal amounts. Some secondary colors are violet, green, orange that are usually considered more interesting than the primary colors but they do not evoke speed and urgency.

And lastly the complementary or tertiary colors are the combinations of primary and secondary colors. The color theory declares that there are six tertiary color combinations; red-orange, yellow-orange, yellow-green, blue-green, blue-violet and red-violet. As it is clear to see, the primary colors are always written first to indicate that they have the excess over the other color which is a secondary color from the color wheel.

The colors can be divided into different categories. We have already seen an example that classifies them by their dominance and creation. So there are another factors that help us to see different properties of colors to use in our projects.

The harmony is an important element for joining colors together in the same spaces and is defined as a pleasing arrangement of parts whether it can be music, poetry as well as colors. In visual experiences, harmony is something that offers pleasantness to the human eye and engages the viewer with the scene by creating an inner sense of order and a dynamic balance in the visual experience.

PRIMARY COLORS



SECONDARY COLORS



TERTIARY COLORS

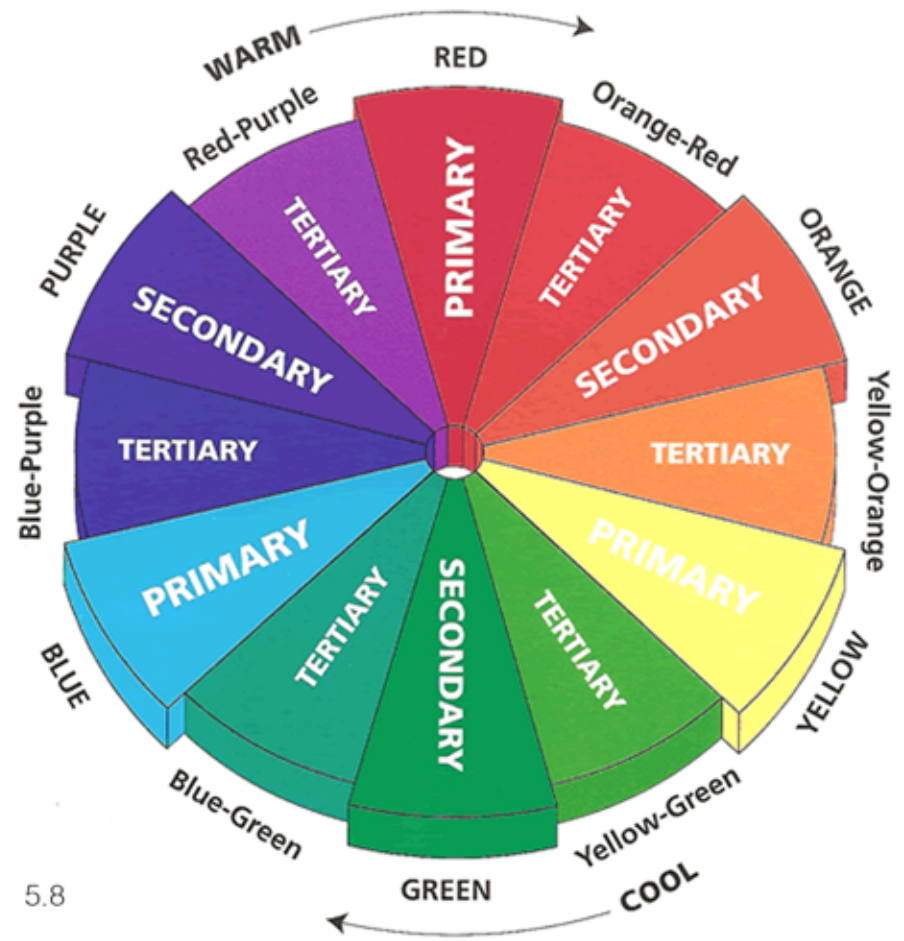


As well as harmony, there is also another term to consider while using together different colors; that is contrast. Contrast is combining opposite tones on the color wheel in order to bring dynamism to the space. It can be overwhelming if the colors have the same strength. The contrast can be achieved by two objects/colors, in front of the users' vision, with different levels of luminance so one can figure out as the background while the other results as the figure itself.

Colors can be divided also into two main families; cool colors and warm colors. Colors like

blue, green, purple and neutrals like white, grey and silver are considered as cool colors which tend to have a calming effect but at the same time they are defined as impersonal and antispectic colors. The perception of cool colors compared to the warm ones is smaller so we can say that warm colors generally overcome the cool colors.

The warm colors like red, orange and yellow are considered warm because they remind fire, excitement or anger. They convey emotions from simple optimism to strong violence. Also neutrals like black or brown carry warm attributes. In nature, warm colors represent change as in the changing of the seasons or the eruption of a volcano.



The use of light for an interior project, does not have considerable variations on land or on board. Certainly, on board there is a need for more relaxed and lighter colors that get on well with the sea and a clear sky.

Most of the designers have a particular attention for the correct use of colors that can expand a space by giving more spaciousness to the ambient or contrarily with a wrong choice it is possibile to make a living space unlivable and unbreathable with the colors that make the ambient and users suffer.

The soft colors generally are used for the ambients where the users spend most of their time so that means soft colors like beige, tan, pastel tones are used for the spaces to stand for a long time like lounge rooms, salons, etc..The bright colors are generally chosen for the objects to be used as an attraction point like some furnitures or floor coverings, etc..

The correct use of colors in an interior space depends also on the knowledge of the designer about the reflection percentages of the main colors on the surfaces.

COLORS	REFLECTION PERCENTAGE
Dark yellow	78%
Orange	71%
Grey	58%
Red	20%
Dark green	18%
Dark blu	9%

Tab. 5.1

The colors' psychological effects can be seen clearly with the artistic operas of Dan Flavin, an american minimalist artist that plays a lot with the colors and lights. His works and installation can be understood only by experiencing them and they result very useful specially for designers to gain the knowledge about colors and their relationship with the ambient in which they are used and with the human eye which observes them with attention.



5.11

## 5.4. ACOUSTIC

The acoustic is an interdisciplinary scientific field that study all the mechanical waves in gases, liquids and solids including vibration, sound, ultrasound and infrasound. Even though it provides more ambiguous informations accordint to the ones provided by the vision process, acoustic has a considerable effect on ambient comfort of an interior space. In fact, it is considered as one of the principal responsables of the creation of some specific spaces even though the sensorial perception can vary from one person to another and also depends a lot on the typology of the ambient.

The projects of an interior space realized in a correct way by acoustic point of view, are generally based on studies of sound waves' comportments of the confined ambient. The notable capacity of extension of the flexible sound waves through the materials effects on the perception of the sound by human ear, or directly from the acoustic source or via reflections from horizontal and vertical planes.

The designer or the architect can affect on the quality of the perception by changing the characteristics of materials used on surfaces inside the space that he is working in.

Even the characteristics of the acoustic source are considered fundamental for the correct understanding of the acoustic project, also some other principles stand out to be analyzed carefully like the texture of the walls, the form and dimensions of the walls, the spaciousness of the ambient, etc..

The acoustic comfort of an interior space can be measured by the quality of some characteristics of the same ambient;

- fullness of the tones
- preciseness, intensity and brightness of the sounds
- quality of the direct or reverberated sounds
- vividness and the balance
- immediateness of the response
- lack of echo
- acoustic uniformity

In architecture field, the application of some important laws about the noise pollution of the buildings makes the acoustic engineers intervene in industrial and civil architectural

projects. So the modern technologies aim to improve the comfort of private and public spaces.

Firstly, the acoustic projects were important only for the projects of traditional ambients like theaters, cinemas, auditoriums, etc.. but today this scientific field becomes one of the most elements to consider in an architectural project of any type, from office projects to residences, schools, hospitals and even boat interiors.

The acoustic treatment fro the interiors and semi-open spaces permit to have spaces more comfortable, livable and relaxing. A correctly designed acoustic project effects directly on the quality of the interior project so the designer must integrate the acoustic principles into his architectural project in order to achieve more satisfying results for the user. Other than the simulations and calculations, also the experience of the designer on choosing the correct materials for the available dimensions of the interior space the function assigned to it.





## 6. DYNAMIC SPACES

The nautical project derives directly from the architectural project but certainly finds references and likenesses from the transportation design. The keywords of the nautical design are living, moving and entertainment that are words that we can see in other design fields. So a project based on these features can not be only a nautical project for a boat but can also be another project realized for ambients connected with the displacement concept or with the living concept outside the personal stable living area, either for necessity or for entertainment.

Between these sectors, there is a continuous information exchange about technologies and innovative solutions. Recently, there can be seen a notable effort for renewals even on the stylistic solutions or on technological innovations.

The boat is one of the few examples of transport vessels that joins the mobility characteristics with being an human habitat with every detail realized for satisfying the necessities of the human being. The boat as well as the camper, includes inside itself the symbolic and functional values of a house like stability, toughness, security and intimacy; with the characteristics of a vehicle like lightness, dynamism and manoeuvrability.

Compared to the camper, the boat needs to be designed more carefully by considering the factor of the movement. But differently from the camper that moves and stops on land, the boat moves in a habitat that is always unstable even the boat is not moving.

Another obstacle of the boat compared to the camper is that people on board remain isolated from the land for determined periods. So the psychological, perceptual and dimensional aspects on board must be studied with more attention to create a correctly designed ambient for the users that are forced to live together with the others for short or long periods on board.

As we said before, the camper design has considerable similarities because both of them aim to provide to their users the comfort of living in a cozy place while travelling. So the living function is as fundamental as the moving activity. While for the aeronautical projects we cannot say the same thing. The main purpose of an aeroplane or a private jet is transporting people from a destination to another. In this case, the living, relaxing and entertainment activities offered by this transportation vessel are limited according to the camper and the boat because of the limited time spent on the aeroplane. So the habitability in an aeroplane has a secondary importance compared to the primary one which is the

transportation. The fourth element analyzed in this chapter, the hotels also differs from the campers and the boats. First of all, the hotel is always located on land so compared to the other examples we cannot actually say that it's a kind of dynamic living typology. The purpose of inserting the hotels into this category is that because they symbolize moving and travelling too, like the others. The people that finds himself/herself in a hotel must be in the same condition with the ones on board because he/she results away from his home. That can be considered as a dynamic living style, in a hotel room with mostly realized with minimal spaces and offering the minimum required by human to survive. Of course with the evolution of the hotel design, today even the hotel rooms have had important mutations and so they can offer all for their clients to keep them satisfied even though they are away from home.

## **6.1. CAMPER DESIGN**

Campervan, caravan, motorhome are the different names that refers to different typologies of living style while moving. They differ from themselves by some details but at the end they symbolize the same thing; a recreation vehicle equipped for camping out while travelling. The earliest caravans were used for practical purposes rather than recreation, such as providing shelter and accommodation for people travelling in search of an audience for their art, or to offer their services to instant employers, or to reach a new place of abode.

In the United States, the term 'recreational vehicle (RV)' is more common for these kind of vehicles and they generally have larger dimensions compared to ones used in Europe and in the rest of the world.

The history of recreational vehicles reaches to 1820s of England where the showmen and circus performers need a living area while they were travelling for their performances.

In United States Of America the earliest examples have been seen in the 1910 and 1920s, built on car or truck bodies. Obviously the modern recreational vehicle industry begins with the advent of the automobile industry. So some companies began manufacturing house trailers like building their units in garage or back yards. Airstream is one of the first and important manufacturer of these vehicles and they are still strong in the market of today.

Before analyzing the interior layouts and dimensions, it is important to define the typologies that we introduced above with their similarities and differences.

The camper is a self-propelled vehicle that provides both transporting and sleeping activities.

activities. They are generally vans that have been fitted out often with a coachbuilt body to be used as an accommodation space.

The motorhome that is generally confused with the campervan, is also a type of self-propelled recreational vehicle which offers living and accommodation activities with a vehicle engine to serve also for transportation. Compared to campervans, it has larger dimensions and they are intended to be more comfortable by using the advantage of their spaciousness. On the other hand, the campervan is designed for more ease of movement and lower cost. Generally the campervans are lack of built-in toilets and showers or a division between the compartment and the cap while the motorhomes have a separate washroom with flushing cassette toilet, shower and basin. The cassette toilet sometimes swivels to provide extra room and can be accessed also from the outside of the motorhome. Other than the washroom, the motorhome is dotated by sleeping areas for two to eight people by its dimension.



6.1

Each berth, sleeping area, is fixed or converts from another part of the motorhome's interior. There is always a kitchenette area that contains cooking equipment like oven, hob, sink and sometimes also microwave. A motorhome have also a cab area with a driver and passenger seat that can be swiveled to become part of the living area if wanted. There must be also a dinette area with a table and seats used for eating meals and a lounge area generally dotated by a u-shaped sofa located in the rear of the motorhome or a side lounge.

One of the most important motorhome producer is an american company, Airstream, founded in 1920s. This luxury recreational vehicles producer is considered the oldest In the industry and their products are easily recognazible by their distinctive rounded alluminium bodies. This particular design was originated in the 1930s by Hawley Bowlus.

Wally Byam, the founder of the company, says 'Adventure is where you find it, any place, every place, except at home in the rocking chair'.

In 1920s Byam begins building trailers in his backyard in Los Angeles and then start his adventure of building after he publishes an article about his experiment. After this important article 'How to build a trailer for one hundred dollars', the readers start asking him more detailed instruction and he sells every layout for one dollar. His company starts full production in 1932 and with years the products were becoming more improved and efficient. Between more than 400 travel trailer builders, only Airstream survives until today even in the more critical periods like the World War II when luxury became unaffordable and non-military industries faced an acute alluminium shortage for their productions. When war ends, people start paying attention again on leisure travelling. Airstream starts producing again in 1948. While some people prefer seven day/six night luxury holiday packages where all the activities are already planned, the users of recreational vehicles were discovering new meanings to the phrases 'comfort zone' and 'leave your troubles behind'. These trips are temporary escapes from the day-to-day grind life, while more often than not they serve as a substitute for actually hitting the road and controlling your own destiny by taking in exotic cultures in their natural habitat without a fixed schedule or tour guide.

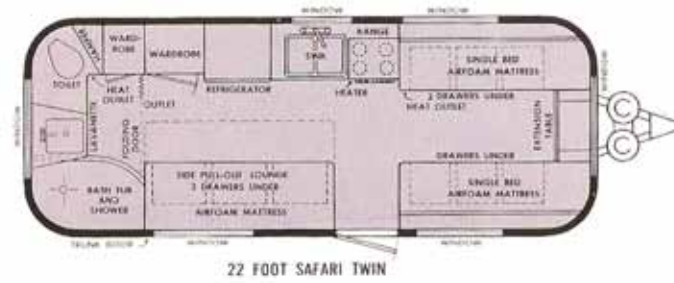
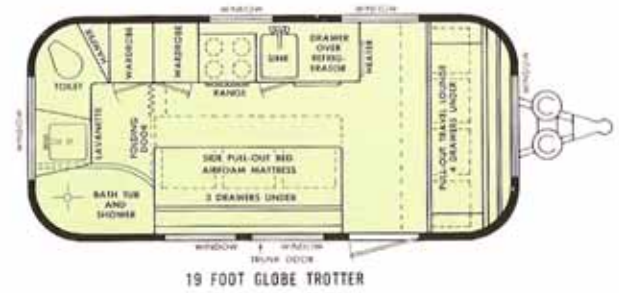
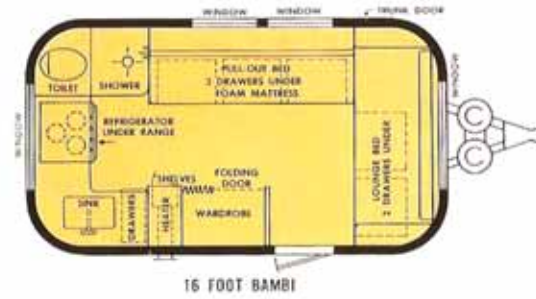
The airstreams are called as land yacht, because of the same mentality of users both on a motorhome and on a yacht. Even it seems more impossible to create a living habitat on sea, also the campers and motorhomes have had a long history for their realization and improvements. As Wally Byam declares 'It was impossible so it took a little longer to accomplish'. This land yacht is designed by following an idea which was competing not with the other products but with the other lifestyles. So as in a boat project, living activity and the

and the comfort of the user were located in the center of the design so this is why the producers always aim to improve their technologies in order to satisfy every new requirement of the clients.

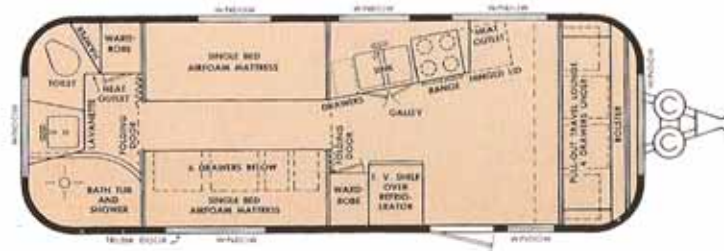
In the novel *Dodsworth* of Sinclair Lewis in 1929, Sam Dodsworth, a visionary in the mold of Henry Ford, is dubbed a crank for raving about the beauty of 'streamlines'. He dreams of: "land yacht, of a very masterwork of caravans: a tiny kitchen with electric stove, electric refrigerator; a tiny toilet with showerbath; a living room which should become a bedroom by night ( a living room with radio and a real writing desk); and on one side of the caravan, or at the back, a folding veranda. He could see his caravanners dining on the veranda" \*

Today the camper style living is still used generally in the United States and rarely in Europe but maybe not so stylish like it was in the 1970s and afterwards. But the idea, the use of minimal spaces for living and other activities, the construction and material technologies have always similarities with the naval design field which results more complicated because of its non stable relation with its habitat.

\* Sinclair Lewis, *Dodsworth*, Harcourt Brace & Company, New York, 1929



6.2



24 FOOT TRADE WIND TWIN



24 FOOT TRADE WIND DOUBLE



26 FOOT OVERLANDER TWIN

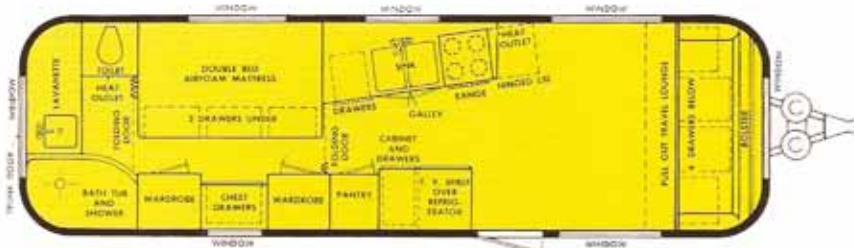


26 FOOT OVERLANDER DOUBLE

6.3



28 FOOT AMBASSADOR TWIN



28 FOOT AMBASSADOR DOUBLE



30 FOOT SOVEREIGN TWIN



30 FOOT SOVEREIGN DOUBLE

6.4



## 6.2. AERONAUTIC DESIGN

In aeronautical field, the biggest turning point is considered the start of the new long-distance routes that request obviously some adaptations for the conditions of new kind of travelling.

The luxury train that has a longer story according to the aeronautical industry, becomes one of the most considerable examples to take as a reference in Europe in the 1930s. The international railway company, Compagnie Internationale des Wagons-Lits (CIWL), known well for its on-train catering and sleeping



6.5

car services as well as being the historical operator of the Orient Express, takes the responsibility of organizing the first restaurant service on board of an Lioré et Olivier LÉO 213 constructed by Air Union. The first LÉO 213 was built in 1928 and a total of eleven were built and operated on routes from Paris to London, Lyons, Marseilles and Geneva.

In the same years, the German aircraft manufacturer, Junkers Flugzeug und Motorenwerke AG (JFM) or shortly the Junkers, produces the first example of the G.38 which was a large four-engined transport aircraft flew for the first time in 1929 by the pilot Wilhelm Zimmermann. The G.38 was able to carry a crew of seven and on board mechanics were able to service the engines in flight due to the aircraft's blended wing design which provides access to all four power plants. With its passenger accommodation considered luxury for the time when it is produced, it was the largest and unique land plane in the world. It was considered unique because the passengers were seated in the wings which were 1.7 meters thick at the root. There were also two seats in the extreme nose. The leading edge of each wing was fitted with sloping windscreens giving these passengers a magnificent view like the pilots. Other than these particularities, there were also three cabins with 11 seats with smoking cabins and wash rooms. So it was a great technology when we consider the conditions of the production period of this particular aircraft.

In United States of America, the evolution of the industrial design and technological

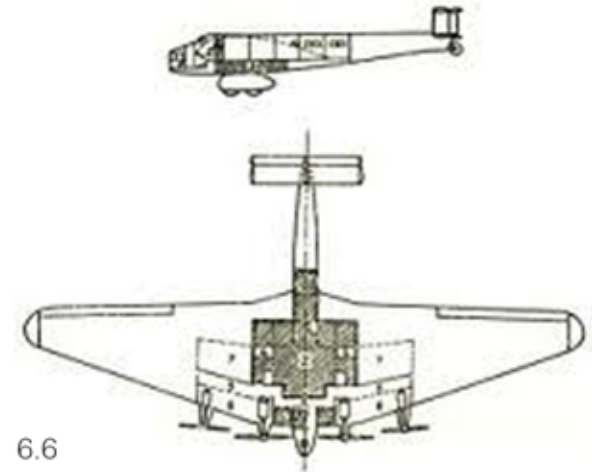
innovations permit to realize improvements also in aeronautical industry by the end of 1930s. And as we said before, the discovery of long-distance routes has completely changed all the aspects that the passengers wait from a traditional aircraft.

For example, A3XX, the huge airplane for 555 passengers manufactured by Airbus as a direct concurrent for the Boeing 747, is designed with 3 decks; 2 superior decks are dedicated to the seats for passengers while the lower deck has a big saloon for lounge and entertainment areas.

Today, most of the aircraft companies like other fields, are trying to improve their technologies and designs in order to offer services with less massive spaces that create possibility of activities like communication with others, working, entertainment and also sleeping like the aircraft examples of the 1930s but with the technology and comfort of the XXI century.

As in the nautical design field, also some aircraft companies decide to work with important architects and designers in order to make difference with their interior and also exterior concepts.

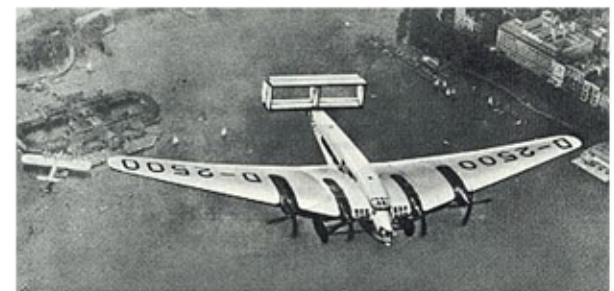
The collaboration of the english architect, Sir Norman Foster, with the private jet company NetJets is one of the best examples to understand the importance given to the layout designs of the contemporary transportation vehicles.



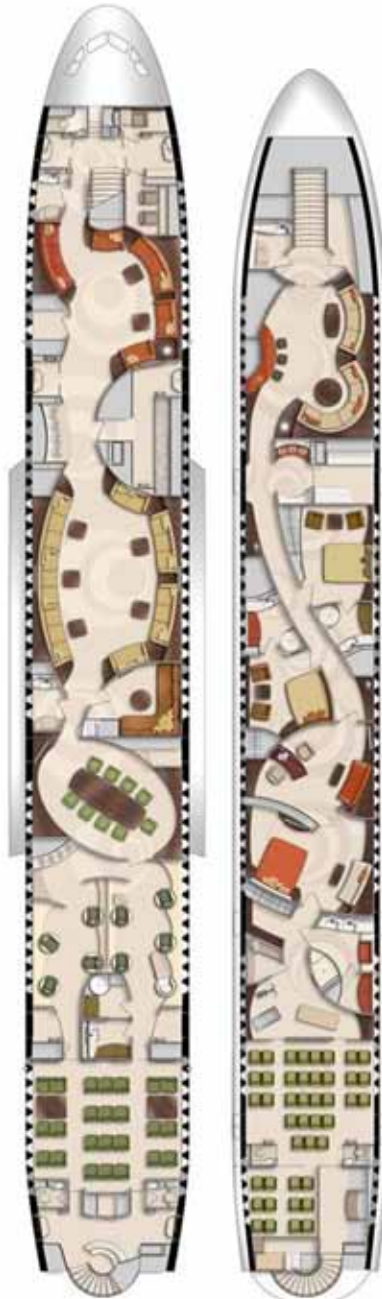
6.6



6.7



6.8



6.9



6.10



6.11

NetJets commissioned architect, pilot and also NetJets' customer Sir Norman Foster, to create a jet that takes the business aviation experience to a new level. The company believes that the English architect will ensure an enduring and lasting sensibility for the NetJets fleet.

For their newest and most advanced private jet Falcon 7X, Norman Foster designs both interior and exterior concept of the aeroplane. The Pritzker-prized architect makes a wide research for this project so he talks with the NetJets' clients and crew in order to get a well-rounded perspective. The result is an aircraft that is serene on the inside and sleek and striking on the exterior. He approaches the design from a holistic perspective so every choice was made to create a superior travel experience.

The interior project is designed as a well-being space for customers and a work space for crew. The passenger cabin is light and calm with the use of cream and tan colors and wood fittings. Foster redesigns also the seating arrangements based on how NetJets owners and passengers use the aircraft, for their business meetings and an enhanced sleeping and dining experience.

In contrast, the working area around the galley reflects an industrial sensation with colors like grey and black as a highlighted contrast with the generic design of the aircraft. Foster chooses to use robust and innovative materials like carbon fibre for the galley and crew areas for its performance, lightness, strength and durability while for the seats it is used a special mixture of perforated leather with solid leather. The area that supports the crew and the cockpit are sensitive to issues of glare so are darker and integrate materials such as sheepskin, which are favoured by pilots for comfort.

An adaptable space for work is provided by a large table, suitable for a group meeting while passengers can easily retreat to the back of the aircraft and draw the curtains to rest. So the interior layout is the result of a correct design that aims both comfort and functionality at the same time. The galley can be used as an entry area and resembles a kitchen only when a meal is being prepared.

Even though it was not originally commissioned to Foster to design also the exterior of the jet, he evolves his design to include the aircraft's livery. The bold, dark blue horizontal stripe unifies the windows of the cockpit and cabin by giving the aircraft a sleeker and aesthetical form.



6.12



6.13



Commenting on the project, Foster says; “ The NetJets 7X is a major aviation milestone in terms of the sheer size of the order. It’s literally a fleet within the NetJets fleet and therefore I felt that this significance should manifest visually both internally and externally. Working on a jet was a new challenge for me and one that I accepted unhesitatingly when NetJets approached me. It presented the opportunity to apply my professional expertise, my passion for aviation and my experience as a NetJets customer to one of the world’s most exciting aircraft. ”

The executive chairman of NetJets, Mark Booth says: “ Design is an area that has been given precious little attention in the world of business aviation. Whether a NetJets owner wants their journey across Europe or the Atlantic to be peaceful or productive, the personal and intuitive touches added by Lord Foster to the Falcon 7X will meet their needs in a way never seen before in aviation. ”

### **6.3. AUTOMOBILE DESIGN**

The car design is always considered as an important branch of design, specially the design of the XXI century. The automobiles have always been an attractive and favourite way of designers to represent and express their new concepts and innovative ideas. On the other hand, the automobile industry has always given all of its possibilities and opportunities to satisfy the new generation designers. This sector has always been very open to the new experiments with the possibility of realization of the prototypes and concept cars even though some of these are not always suitable for the real production because of their disadvantages by the economical point of view of only because of the lack of technologies necessary to realize them.

If we take a look in the history of car design and production, we see that the period between the final part of the 1800 and the 1920s when the automobiles have one and only function which was moving, is then substituted by the period between 1930s and 1970s. Because this period is defined as the golden age of the car industry with the introduction of artistic features into the mechanical functions. So the car design was born which transforms the automobiles into the real sculptures in motion where the aesthetical and formal components were the primary elements that stand out in the concept process and not the functionality. With the arrival of the oil crisis in the 1970s, the car design loses his fame and supremacy but today reborns again with the most interesting and innovative designs thanks to the

technology and materials evolved. These new technologies and evolution on the manufacturing technics permit to realize the automobiles of today with an important attention paid on details like the introduction of the most curvy and delicated external surface that makes difference to the older examples in the market of today.

Another revolutionary progress has been done on the characteristics of the materials used specially for the interiors. The researches and innovations on the plastic materials bring the advantage of removing the classic and old polyurethane in order to use the new applications like new foam expansions that make possible the production of seats thinner, lighter and with the maximum comfort both for the driver and the passengers.

As we said the design has an important role in the automobile industry so the important automobile companies choose the best designers of the design world in order to create unique and attractive examples in order to compete with the best competitors in the market. So the designer sometimes becomes the most effective tool to win this war.

The most important and innovative car designer of the century, Chris Bangle which has worked for Opel, Fiat and lastly for BMW, explains:

“Are Cars Art? Does Art influence Car Design? How do Cars and Architecture relate? These are some of the questions I am asked and ask of myself; finding answers is not so simple. A speech I gave on this subject at the Wolfsonian Institution in Miami, Florida was a good opportunity to summarize my quest so far. I confessed to the audience I believe Cars to be Art, but for many the idea automobiles are even design is a tenuous premise at best. The culture of Car Design is often relegated to the extreme "decorative" end of the Industrial Design spectrum, and for many practitioners of ID I fear our work is seen as too flip-pant, to fashion-fickle, and too functionless to be valued at the level of serious industrial designed products, furniture, or the graphic arts.

A fantastic chance to combine Cars and Art was realized in the Pinakothek der Moderne in München, Germany in 2002. The BMW Design team was asked to make a permanent installation that addressed the issue of Car Design and it's protagonists, the designers, engineers, marketing and other corporate players. The objective was to bring the museum's public in closer contact with the special values, messages, motivations, conflicts, involved in Car Design-why it isn't the same as designing a laptop, for instance. To have worked with such talents as the artists, Steinmetzmeistern, Modelers and Designers who created this work of art in only 50 days and nights was an emotional highlight in my life. It opened my eyes to what we as Car Designers have to learn from artists, and where our craft enters



theirs.

I imagine we in Car Design are guilty of having too much fun without paying the price of thinking about it enough.

The nature of Art and Cars is a good place to begin asking questions, perhaps with enough dialogue we will all conclude that Cars are indeed Art, and a fine one at that."

The future of car design can be imagined by two keywords; the detail and the technology. The luxury is not considered any more between the keywords for a sensible future design and loses its importance in this field. Because the luxury does not mean explicating the technology. It can only be the way of highlighting the quality by the authenticity of the materials but without the banal and unnecessary use of the common textures.

If we turn back to the sensible explanations of the Chris Bangle, he can tell us how the car design made a big passage through years and how will be its future. He declares: "The three great ages of Car Design's Morphological Paradigms have always been thought incapable until a new manufacturing technology coupled with a dramatic shift in consumer interpretation of the "meaning" of the automobile come along - then the change can be bewilderingly rapid.

The last century began with a "wooden houses on wheels" morphology, and the first dramatic shift to the paradigm came with the advent of pressed metal for bodies and a shift to a consumer psychology caught up in the progress of speed. This design canon of a "ship's symmetrical hull combined with voluptuous sculpture" relies on a continuity of form to control reflections on a glossy painted surface; a seamless progression of elevations and curves that owes its heritage to the techniques of "lofting" as perfected by shipwrights over centuries.

Symmetry and Continuity in Surfacing is a part of our legacy from those boat-hull days of Car Design, and we have kept at it ever since. "Boat hulls with sculpture" lasted from the 30's until the 70's when it was overthrown in a major shock to design sensibilities by the "refrigerator box with a veneer of cake-icing-sculpture", a new design canon driven by fully automated assembly restrictions and a shift in priorities towards rational transportation under the predictive umbrella of Big Brands...

However, time does not stand still for Car Design. New materials, new processes, and most importantly, new customer needs and desires are waxing stronger even as car design becomes more dogmatic."



6.15



6.16



6.17



6.18

## 6.4. HOTEL DESIGN

As told in the introduction part, the insertion of the hotels into this category where we have analyzed some basic transportation vehicles that join together the living and travelling activities, is because the hotel rooms are places that people feel themselves away from his personal habitat, so they are considered as places to use in case of travelling and in situation of being away from home, certainly with purposes that differ from one person to another. The reason that motivates the man to travel is the will of being amazed by the innovation, change and newness; something new that impress the human soul and his intimacy deeply. The evolution of the hotel typology reaches to the early years of 1800s when the touristic travels and vacations became stylish. So this new kind of displacement is characterized by the entertainment and pleasure necessities of the new modern society. The requests of the customs, that leave their homes to see new places and learn new cultures, became the basic reference point for improving and refining the hotel design and equipments.

The first Grand Hotel appears in the first half of the 19th century with the consecration of the bourgeoisie class as the new nascent class. This social panorama of the 19th century, gives the possibility of living some kind of experiences also to the other people which was an impossible way of thinking before. So spending nights in historical palaces with the service was not considered as a right of only the noble class any more but it became possible also for the middle class.

As it is easy to understand the first hotel typologies of the 19th century were generally inspired by the classic noble palaces which is completely replaced by new hotel design concepts of the XX century.

The 19th century characterizes a revolution of the interests of the tourist figure; the european or italian grand tours were not dedicated only to the noble class tourists any more but with the development of the railway, the construction of the tunnels and the engineering marvels, the bridges thanks to the evolution of the construction technologies. So making a visit to Europe by passing through the bridges on the rivers is not considered as an adventure any more but it becomes stylish and fun. It is important to highlight the close relationship between the evolution of the hotel concept with the big passes done in the communication and road construction fields. Of course the variant requests of the customs affect directly the evolution of the hotel systems on world. The first tourists of the first half of the 19th century have a profile of visitors that aim to discover new cultures and places by their art,

archeology, culture, habits, music, etc... The second half of the century gave place to the biggest revolutions and consequences after the break out of the Industrial Revolution. So the touristic visits of the second half start becoming a detachment from the chaos and unhealthy conditions of the industrial cities. So that means that the visitors' main purpose of travelling becomes an escape from the city to the more pleasurable places in terms of climate, habits, innovations and comfort.

The hotels could not remain as they were in front of all these social and technological changes. So as they are the structures addressed to satisfy this new social request, travelling, they are forced to be evolved completely. As the society evolves, also its consequences must be evolved like the hotels. They were not considered as places dedicated only to sleeping but they start to change their service profile in order to satisfy the customers' needs and to stimulate the emulation with the other hotels to give the best service.

As the best reference point for the correct design is the visitor profile, we can categorize these visitors into two main families; traveler for work and traveler for holiday, tourism, pleasure, etc.. So this analysis brings together the definition of the activities to be done in a hotel; sleeping, relax, working, dressing up, reflecting.

These analyses are so important to define the function and structure of the hotels in order to satisfy the necessities of a wide range of clients. For work travels, the frugal and rapid visitor generally needs a hotel in the city well-equipped with large meeting and conference halls and a good service. The tourist instead has more particular requests for which predominates the comfort.

If we analyze the volumes in a hotel, we can define 3 main spaces dedicated to the different activities; public spaces with connection to the outside, common spaces like corridors, lounge area, restaurant; and lastly private spaces that are rooms and suites with different dimensions. If we observe the organization of interior volumes and rooms, it is possible to see that important ambients, like large meeting halls, salons, restaurants and private suites, are generally located in the first and last floors. The rest of the floors are dedicated to the multitude of normal sized same rooms for the common clients.

area are generally located near the entrance while the bed for sleeping and relax is in the center of the room and if there is also a study zone, it is always positioned near the window for the maximum daylight use. This classic configuration is being changed by the contemporary designs of the new generation but some standard dimensions are still considered valid.

	LIVING AREA		BATHROOM		TOTAL GUESTROOM	
	Dimensions (m)	Area (m2)	Dimensions (m)	Area (m2)	Dimensions (m)	Area (m2)
Budget	3,5 x 4,5	16	1,5 x 1,5	2,3	3,5 x 6,2	21,9
Mid-price	3,6 x 5,5	20,1	1,5 x 2,3	3,4	3,6 x 6,6	29
First class	4,1 x 5,8	23,8	1,7 x 2,6	4,4	4,1 x 9,6	36,2
Luxury	4,5 x 6,1	27,9	2,3 x 2,7	6,6	4,5 x 9,1	41,8

Tab. 6.1

When we talk about this hierarchy, we can see some similarities in common between hotel design and interior boat design.

The design concept of the earlier hotels was based on the keywords like luxury and richness which can be seen also in the nautical field in the early years and even today. During the first half of the 19th century, another fashionable way of travelling was the transatlantics that were designed as real floating hotels where the clients on board could feel themselves home with all the service dedicated to satisfy their necessities and requirements. The transatlantics were the only way to cross the ocean but today they have lost their importance because of the evolution of the aeronautical industry that makes possible reaching to the long distances in shorter times thanks to their speed.

If we turn back to the common points of hotel and yacht, the first aspect to analyze is the function so both a hotel and a yacht are designed to give hospitality to the visitors so the tourists. We can say that a private yacht is generally considered as a small hotel which aims to satisfy the needs of the passengers on board. The same hierarchy that we explained above can be seen mostly in the boat interiors' layouts. If in a hotel the most important rooms are the suites and they are located in the best positions to give the client the best comfort, even in the yachts the most important cabin is always the owner's suite with its private bathroom, sometimes sauna e spa, study room, dressing room and if possible a large private terrace with a wonderful view on sea. The rest of the yacht layout is designed in order to define spaces for the common activities like lounge area, bar, dining room, beach area and private cabins for the guests or clients. Certainly these cabins are designed in a simple way and result smaller compared to the dimensions of the owner's suite.

It is possible to insert another one or maximum two VIP cabins for special guests but always with dimensions under the owner's one.

If we turn back to the contemporary hotel design, it is important to understand that the recent hotel examples are inspired by the very new requests of the contemporary society. As they refer to a very wide and non homogeneous range of clients, the hotels can not ignore the international standard aspects as the biggest hotel chains do.

The trend of collaborating with the most important designers for the public space projects in order to reflect the newest styles in the architectural and artistic fields, has been introduced also for the hotel design in the early years of 19th century.

The decision of integrating the artistic and architectural design into the project comes from the personal interests of the open-minded employer to follow the new trends and famous designers that have already had an international fame. The forerunners of this trend were the American hotel managers, Ian Schrager and Steve Rubell, aware of the importance and force of design in every field. In 1984 they have opened the Morgan Hotel and five years later the Royaltan Hotel. Their collaboration with André Putman and Philippe Starck becomes a source of inspiration for the next concept hotel designs.

An important concept hotel design realized in Madrid results interesting by its approach to the collaboration with the designers. The Hotel Silken Puerta America is like a space where dreams came true by merging different cultures and ways of interpreting architecture and design. This five star luxury hotel differs from its competitors and becomes a masterpiece that awakens guests' senses with the use of different colors, materials and shapes.

Another important reason that makes this hotel unique is that its 12 floors are designed by 19 different designers and architects from 13 different countries all over the world so it becomes possible to see a mix of 12 ways of thinking and designing spaces. The basic keywords of the project are originality, luxury, innovation and formal freedom that make the visitors have a unique experiment by the innovative spaces that surround them. Each floor demonstrates a different concept in hotel rooms and every designer that has worked for this project plays with different kinds of materials, colors and shapes to create spaces that bring together the best in avantgarde design and architecture.

The important names worked for this unique hotel design are; Terasa Sapey for the garage, John Pawson for reception and salons, Christian Liaigre for the restaurant, Marc Newson for the cocktail bar, Zaha Hadid for the 1st floor, Norman Foster for the 2nd floor, David Chipperfield for the 3rd floor, Eva Castro+Holger Kehne for the 4th floor, Victorio + Lucchino for the

the 5th floor, Marc Newson for the 6th floor, Ron Arad for the 7th floor, Kathryn Findlay for the 8th floor, Richard Gluckman for the 9th floor, Arata Isozaki for the 10th floor, Javier Moriscal + Fernando Salas for the 11th floor and Jean Nouvel for the 12th floor and the exterior facade design.

## 7. PROJECT

The historical, technical, economical and architectural analysis done during the research phase of this thesis becomes considerably important to proceed to the project phase.

The birth and the evolution of a marine vehicle is always considered complicated because of the non stable exterior conditions that surround the project item. During the concept phase, other than the rules of floatation and the materials and technics of construction, also the weather conditions and the instability of the sea result the most important points to work on for a correct realization of the project.

The 64 meters long ferryboat, Serpentine, borns with the idea of serving to a large range of clients for the daily trips between the East Coast of Turkey and the Greek Island where there has already been stabilised an important business for years. The creation of the target of clients that can be interested to go on board for pleasure, events, touristic purpose, etc.. is realized by defining the age and gender classification and by the main division of costs paid by the same clients. This classification is also important to understand what kind of activities can be done on board and in which ways can be rented for different purposes. This client profile permits to define the modalities of going on board, obviously by paying different costs that vary by the usage of services offered on board. So it's possible to have a pleasurable day by renting a VIP room where it's possible to have more privacy and also with the private sun bathing seats on the aft of the ferryboat.

The other possibility is to rent private loggia which still offer privacy for some kind of business meetings or for families with a large number of members that want to stay together during the trip.

Otherwise there are also possibilities of going on board by renting or without renting a seat that still permit to use the services offered on board.

Defining the usage and the purpose of the boat has permitted to pass to another important phase which we can call the technical analysis. In this phase, it was necessary to define the typology of hull and the construction technology. Between the hull typologies that can be planant or displacement. The displacement hull has more resistance of vawe compared to the resistance of friction with the increase of the speed so we can definitely say that they are more suitable for the purposes that require medium speed while the planant hull is generally used for the cases that require high speed. Thanks to its form the speed can rise up quickly without any difficulties. So in this case, for the ferryboat Serpentine it was more suitable to use a displacement hull with bulb in order to arrive to a stable speed withuot spending



oil. This hull typology is always chosen for the huge yachts that travel for long periods at a medium speed so they can obtain a greater stability, balance, resistance to wave, heaviness, manoeuvrability and greater seakeeping.

After this selection it was important to understand with which technology realize my ferryboat. All the researches done have brought me to understand that the most suitable way of realizing this boat was the use of steel construction. Steel construction is suitable only for the boats up to 12 meters because under the 12 meters it can result heavy so becomes impossible to maintain the balance. The steel hull is homogeneous, resists better to the impacts and the watertight is always perfect. The unique problem of this technology is the corrosion that can be resolved easily today with the innovative materials anti-rust.

The useful researches of technologies, materials and interiors has brought me to process the ferryboat project of 64 meters. As it is really important to define in a boat, the movement of clients and the crew, the first interior sketches start with separating the passages of the crew and their spaces from the ones that are going to be used by clients.

The lower deck is defined by the crew areas that are formed by their rooms, realx areas and also the galley which can be used only by them to serve the clients. The other part that remains from the crew area, engine room and toys rooms, is dedicated to the spa area where clients can enjoy some massage, sauna or turkish bath activities on board.

The main deck is dedicated to the seating areas that are different between them by their costs and functions. This deck has also bar and toilet service for the clients that use only this area.

The first upper deck is dedicated to the VIP rooms which every one of them has their private passage through the sliding doors to the lateral corridors realized thanks to the thickness of the lateral structures. So by using double glass, it has been created a special corridor or balcony or passage that clients can use. The passages in front of the rooms bring the clients to their sunbathing area on the bow of the yacht. While the other part of this deck is dedicated to the relax area where some young clients can pass an enjoyable time with internet service and others... This zone is also dotated by the sunbathing areas on the stern.

The second upper deck is dotated by the swimming pool and restaurant area with services while the sun deck is dedicated to the lounge bar where the clients can enjoy the beautiful view on the sea thank to the lateral expanding structure which permits the best manoeuvrability for the captain.

The birth of the exterior structure and view comes from the long and suffering phase of concept. After the hull typology, it was important to realize a superstructure compatible with

the hull so after a long period of trying the most logical idea was creating a structure that permits to the hull continue up to the highest point of the yacht. So it was possible to create a continuity form the lower part of the hull to the sky where the yacht joins it to the sea.

This large and heavy structure, as we said before, permits to create special corridors by double glasses so the clients can use the main and central areas for the movement inside the yacht but also enjoy this special corridors that refer to the classical lateral movement possibility of the classic yacht.

The top of the yacht is adequate for the helicopter landing and not usable for other activities for the clients.

The ferryboat Serpentine with 64 meters, becomes unique by its form and elegance that creates this special unity between the sea and the sky by this strong strip concept of the superstructure.

#### TECHNOCAL INFORMATION ABOUT SERPENTINE OF 64 METERS

<b>SHIPYARD</b>	
<b>MODEL</b>	
<b>HULL/SUPERSTRUCTURE</b>	<b>STEEL/ALLUMINIUM</b>
<b>HULL TYPE</b>	<b>DISPLACEMENT HULL</b>
<b>L.O.A.</b>	<b>64 M</b>
<b>L.W.L.</b>	<b>55.60 M</b>
<b>BEAM</b>	<b>12.40 M</b>
<b>DRAFT</b>	<b>3.70 M</b>
<b>DEPTH</b>	<b>8.40 M</b>
<b>FULL LOAD DISPLACEMENT</b>	
<b>GUEST NUMBER</b>	
<b>CREW NUMBER</b>	<b>8</b>
<b>FUEL TANK</b>	<b>107000 lt</b>
<b>FRESH WATER</b>	<b>27600 lt</b>
<b>MAIN ENGINE</b>	<b>2XCATERPILLAR 3512B</b>
<b>MAIN GENERATORS</b>	<b>2XCATERPILLAR C9 175 KW</b>
<b>EMERGENCY GENERATOR</b>	<b>1XCATERPILLAR C4.4 86 KW</b>
<b>MAX SPEED</b>	<b>15 KNOTS</b>
<b>CRUISING SPEED</b>	<b>14 KNOTS</b>
<b>HELICOPTER PLATFORM</b>	

## BIBLIOGRAPHY

- . DONATELLA RAVIZZA, *Progettare con la luce*, FrancoAngeli, Milano, 2007
- . NONIE NIESEWARD, *Lighting*, London, 1999
- . JULIUS PANERO, MARTIN ZELNIK, *Human dimension & Interior space: a source book of design reference standards*, The Architectural Press, London, 1979
- . BRYAN BURKHART, DAVID HUNT, *Airstream: The History of Land Yacht*, Chronicle Books, San Francisco, 2000
- . LUCIANO FERRARO, *Elementi di Macchine Marine*, Hoepli, Milano, 2009
- . TIM BARLETT, *Motori Diesel Per La Nautica*, Hoepli, Milano, 2008
- . SILVIA PIARDI, ANDREA RATTI, FEDERICO MAGGIULLI, *Yacht Design 2, Costruire imbarcazioni da diporto; Esperienze in cantiere*, Libreria Clup, Milano, 2005
- . MASSIMO MUSIO SALE, *Disegno delle imbarcazioni*, Paravia& C.Spa, Torino, 1995
- . GUIDO L. SPADOLINI, *Design Nautico*, Alinea Editrice, Firenze, 2004
- . C. SCIARELLI, *Lo Yacht*, Mursia, Milano, 1988
- . DOMITILIA DARDI, MASSIMO PAPERINI, *Interior Yacht Design: Abitare tra Cielo e Acqua*, Electa, Milano, 2009

## SITOGRAPHY

- . <http://seamenblog.blogspot.com/2011/06/come-nasce-la-parola-yacht.html>
- . <http://www.luxgallery.it/yacht-alle-origini-di-una-grande-storia-16337.php>
- . <http://www.superyachttimes.com/concepts/details/1073>
- . <http://oceanshaker.com/2010/02/12/sport-fisherman-50m-new-concept-from-brilliant-boats/>
- . [http://www.suonoevita.it/it/progettazione\\_acustica\\_nell\\_edilizia\\_e\\_nell\\_architettura](http://www.suonoevita.it/it/progettazione_acustica_nell_edilizia_e_nell_architettura)
- . <http://www.fosterandpartners.com/Projects/1576/Default.aspx>
- . <http://www.dezeen.com/2009/01/12/netjets-7x-fleet-by-norman-foster/>
- . [http://www.gizmodo.com.au/2009/02/luxury\\_a380\\_interior\\_is\\_just\\_what\\_we\\_need\\_to\\_start\\_a\\_populist\\_revolt-2/](http://www.gizmodo.com.au/2009/02/luxury_a380_interior_is_just_what_we_need_to_start_a_populist_revolt-2/)
- . <http://www.chrisbangleassociates.com/OLINI>, *Design Nautico*, Alinea Editrice, Firenze, 2004
- . [www.proteksan-turquoise.com](http://www.proteksan-turquoise.com)
- . [www.riva-yacht.com](http://www.riva-yacht.com)
- . [www.superyachttimes.com](http://www.superyachttimes.com)
- . [www.superyachts.com](http://www.superyachts.com)
- . <http://www.boatinternational.com/>
- . <http://www.hasb.com.au/construction.html>
- . <http://www.glen-l.com/methods/methdsal.html>
- . [www.nauticaexpo.it](http://www.nauticaexpo.it)
- . [www.azimutyachts.it](http://www.azimutyachts.it)
- . [www.ferrettigroup.it](http://www.ferrettigroup.it)
- . [nauticaonline.it](http://nauticaonline.it)
- . [www.wally.it](http://www.wally.it)
- . [www.boatdesign.net](http://www.boatdesign.net)

