REPUBLIC OF TURKEY

MINISTRY OF TRANSPORT, MARITIME AFFAIRS

AND COMMUNICATIONS

ACCIDENT INVESTIGATION BOARD

Accident Investigation Report On

The Foundering of KURT C

Off Kaleiçi Port / Antalya

03 September 2016

36/DNZ-05/2017

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KURT C

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This report is prepared by the Accident Investigation Board

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LEGAL BASIS

This marine accident was investigated in accordance with the By-law on the Investigation of Marine Accidents and Incidents which came into force after being published at the Official Gazette No.29056 on 10th July 2014.

Investigation procedures and principles are further applied by considering Resolutions of International Maritime Organization concerning International Standards and Recommended Applications for Safety Investigations Directed to MSC 255(84) (Casualty Investigation Code) and Resolution A.1075(28) Marine Accidents or Incidents, and European Union Directive 2009/18/EC.

The purpose of a marine accident investigation is tofind the real causal factors that cause the marine accidents and thus to make recommendations to contribute for the development of legislation and practices directed to the safety of navigation, life, property and environment and to prevent similar accidents and incidents in the future.

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FIGURE LIST

SUMMARY

Figure 1: Site of Accident

Note: All times in this Report are local times (GMT+3)

The daily cruise ship KURT C departed from Kaleiçi Port for a day tour on 3 September 2016 at 11:00 am and arrived at Sıçanadası. After the swimming and lunch break, the ship passed to Çaltıcak and after the break there, she started her return voyage to Kaleiçi at 15:30. As there were around 15 minutes to reach of Kaleiçi, due to the suddenly deteriorating weather conditions, the ship fell into heavy rolls and then listed to her side. After staying in her listed position for a while, the boat sank completely at 18:34.

There were a total of 86 passengers and crew members on board, 2 people who were trapped in the ship lost their lives.

The boat was taken ashore at SETUR Marina on 22.10.2016 and her maintenance was carried out there.

On 12.01.2017, the Criminal Court allowed the operation of the ship, on condition that she will not be sold or transferred to third.

On 21.04.2017, Antalya Harbour Master issued a Certificate of Seaworthiness and the ship resumed her voyages from Kaleiçi Port.

PART 1 – FACTUAL INFORMATION

1.1 Ship Particulars

Name	:	KURT C
Flag	:	Türk
Place and Date of Build	:	Marmaris / 1995
Port of Registry	:	Antalya
Ship Type	:	Daily Cruise
Owner	:	Canaktaş Gıda Oto Kir.İnş.Teks.Em.Tur.Tic.San.Ltd.Şti. / Antalya
Gros Tonnage	:	77
Net Tonnage	:	34
Call Sign	:	YM4368
LOA	:	23,90 m.
Width	:	7,00 m.
Depth	:	3,30 m.
No. Of Crew	:	3
Departure Port	:	Çaltıcak Bay
Arrival Port	:	Kaleiçi Port

1.2 Accident Information

Time and Date	:	3 September 2016 / 16:45 (Local Time)
Site of Accident	:	Antalya - Kaleiçi açıkları
Consquence	:	Boat sank, 2 fatalities

1.3 KURT C

KURT C was built in 1995 in Marmaris. The port of registry is Antalya and the owner of the boat is Canaktaş Ltd. Şti. since 18.12.2004. The ship went through repairs in Manavgat in 2015.

Ship's length over all is 23,9 metres, width 7 metres and her depth is 3,3 metres. She is propelled with a Caterpillar main engine which produces 535 Horse Powers. The capacity of the ship is 105 people both for summer time and winter time.

1.4 Weather and Sea Forecast

According to the forecasts from the Meteorology Office, the forecasts for Antalya, Konyaaltı and Muratpaşa for the time period between 18:00 hours on 02.09.2016 and 18:00 hours on 03.09.2016, it is stated that the weather will be overcast cloudy and in the afternoon there will be local showers and showers with thunderstorms. And again for the same locations, it is stated that the minimum temperature will be 25 and maximum 31 degrees celsius.

1.5 Actual Wind Direction and Force

The wind direction and force measured at the Antalya Meteorological District Directorate which is close to the site of the accident (approximately 1 km), is as follows:

14:00 to 14:59: varying between 125-166 degrees; between 2,9-5,7 m/s

15:00 to 15:59: varying between 116-143 degrees; between 3,5-5,6 m/s

16:00 to 16:40: varying between 117-135 degrees; between 3,4-5,9 m/s

16:41 to 16:44: Wind swiftly changed direction towards North; between 1,2-3,3 m/s

16:45 to 16:55: varying between 345-020 degrees; between 4,8-8,0 m/s (average.:6,3)

16:56 to 17:00: varying between 326-018 degrees; between 3,5-5,6 m/s

17:01 to 17:06: varying between 356-023 degrees; between 7,5-9,1 m/s

17:07 to 17:09: varying between 338-016 degrees; between 4,4-5,6 m/s

At 17:10: From 347 degrees; 8 m/s

17:11 to 17:18: varying between 034-144 degrees; between 2,3-3,9 m/s

17:19 to 17:49: first from the North, later rotating clockwise east, South, West and northwest; between 1,0-2,7 m/s

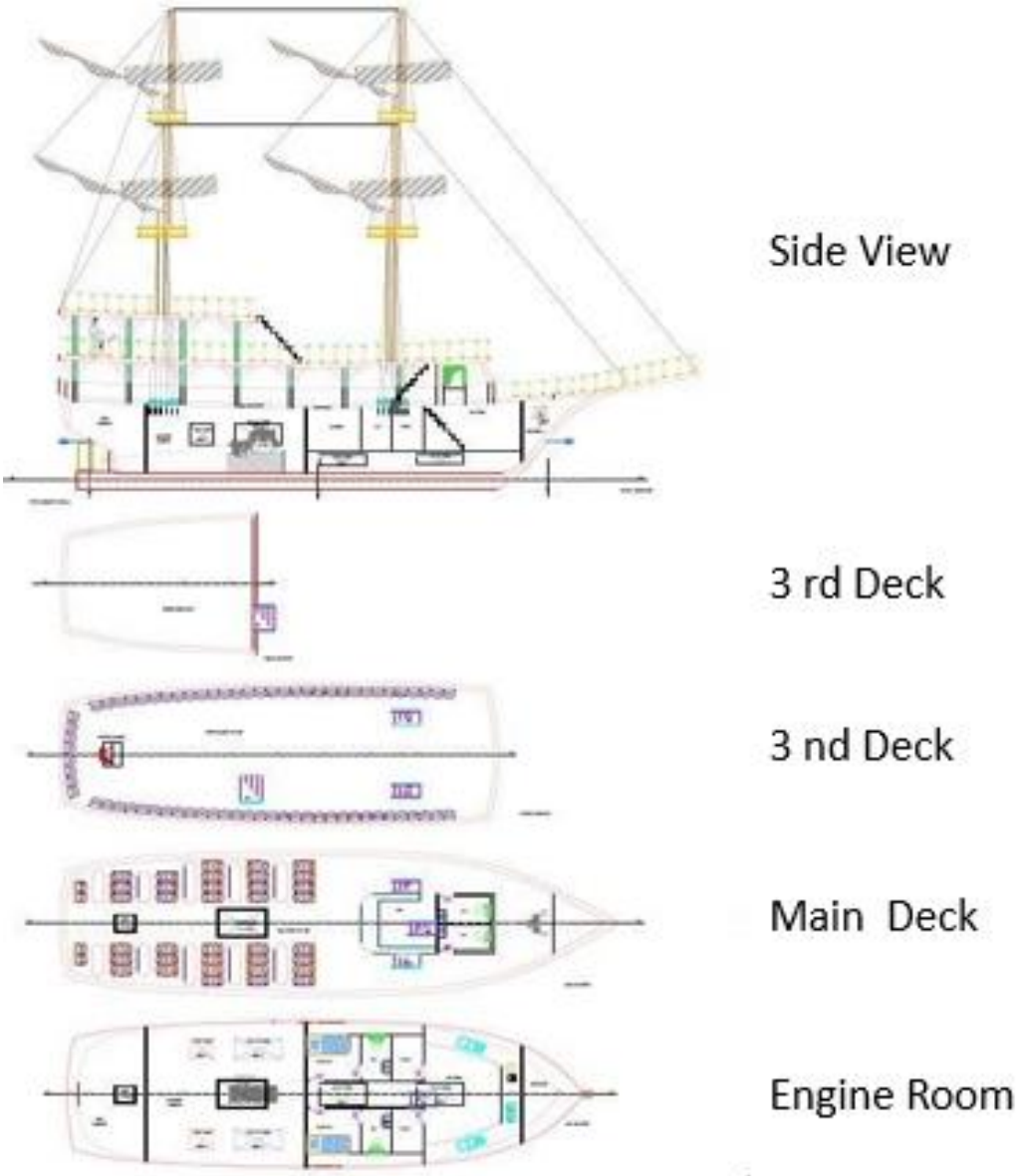

Figure 2: Ship Plans

1.6 Ship's Manning

The ship's Captain is qualified as "Limited Captain", and also holds GMDSS Restricted Radio Operator (ROC) certificate. The Captain has a Certificate of Competence in Using Life-Saving Craft, Personal Life-Saving Techniques at Sea Training, Personnel Safety and Social Responsibility Training Certificate, Basic First Aid Training Certificate, Fire Prevention and Fire Fighting Training Certificate and the certificates continue to be valid.

The Captain is 63 years old and after completing his military service as a sailor (helmsman) in 1976 he received his able seaman certificate. Afterwards, he worked as an able seaman for 8,5 years in international waters. Afterwards, he worked as a captain in agent boats in Çanakkale Strait (the Dardanelles) for 22 years until 2007. In 2012, he started to work as a captain on daily cruise ships in Kaleiçi, Antalya. He started working on the KURT C boat on 29th June 2016 and continued to serve as the boat's captain until the day of the accident.

Both of the two seamen on the boat have been working at sea for one year and they served their whole time at sea on board KURT C.

One of these seamen holds Designated Security Duties Training Certificate, Security Awareness Certificate, Personal Life Rescue Techniques at Sea Training Certificate, Personnel Safety and Social Responsibility Training Certificate, Basic First Aid Training Certificate, Fire Prevention and Fire Fighting Training Certificate, First Aid Training Certificate and Medical Care Training Certificate. and all his certificates continue to be valid.

The other seaman also has a Personal Life Rescue Techniques at Sea Training Certificate, Personnel Safety and Social Responsibility Training Certificate, Basic First Aid Training Certificate, Fire Prevention and Fire Fighting Training Certificate, and his certificates continue to be valid.

It is the Captain's duty to steer at the helm, and the seamen's duty is to observe the passengers for their safety, to follow the instructions given by the Captain and to assist with other tasks on board.

1.7 Voyage Route and Programme

KURT C is one of the cruise boats doing her trips from Antalya Kaleiçi. There are about 45 daily cruise boats in Kaleiçi. These boats start from Kaleiçi and doing one of the three types of tours which are daily, two-hourly or 45-minute tours, they return to Kaleiçi Port.

On the 45-minute tour, the boats sail in the Konyaaltı and Düden Waterfall directions, enabling their passengers to see the caves and cliffs as well as the city of Antalya from the sea. In the 2-hour trip, the boats sail to the east to Düden Waterfall and return to Kaleiçi. In the daily tour, the boats depart from Kaleiçi at around 11:00 hours, sail in the South-west direction, stop at Sıçan Island and Çaltıcak Bay and return to Kaleiçi Port at around 17:00

hours. During the daily tour there is a lunch and swimming time at Sıçan Island and additionally a swimming time is given at Çaltıcak Bay.

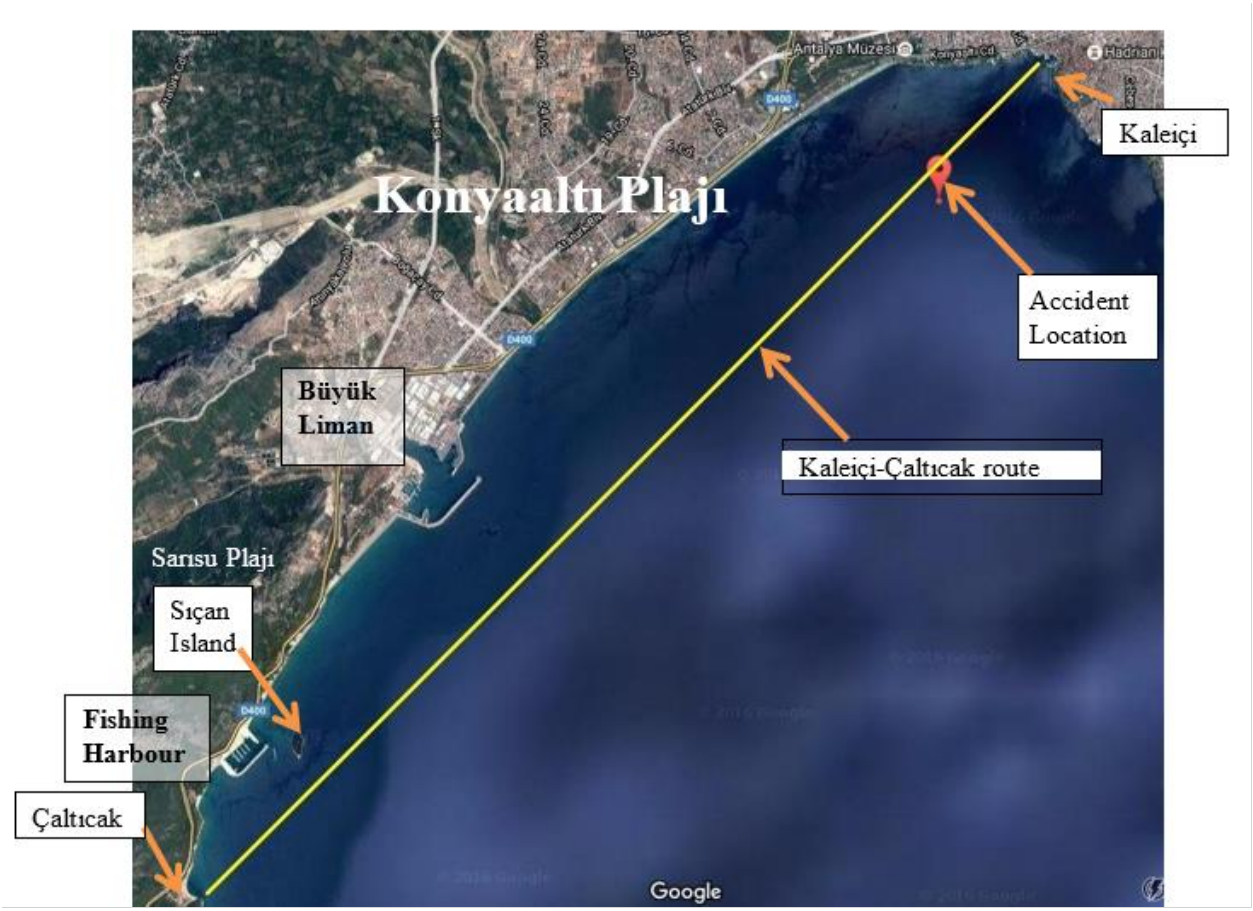

Figure 3: Kaleiçi-Sıçan Island-Çaltıcak route

1.8 Course of Events

On the day of the accident, KURT C boat was on a daily tour program. At about 11:00, the boat departed from Kaleiçi with 86 passengers, crew and other staff (animators and photographer) on board and arrived at Sıçan Island at around 12:30. After a two-hour lunch and swimming break, the boat continued to Çaltıcak Bay. The program continued until 15:30 and after the anchor was heaved up, the boat started at around 15:40 for her return voyage to Kaleiçi.

Figure 4: KURT C as moored at Kaleiçi

On the day of the accident, there was another boat other than KURT C on the daily tour from Kaleiçi. The other boat was the pleasure boat ADONIS. ADONIS also performed the Sıçan Island and Çaltıcak Bay programme around almost the same hours as KURT C. However, on departure from Çaltıcak, ADONIS started with a delay of about 15 minutes and followed KURT C, proceeding towards Kaleiçi. While KURT C preferred to move closer to the shore, ADONIS, which is a smaller boat, preferred to sail further from the shore, so as to be affected less by the wind and the waves. In the meantime, a few ships at anchorage were heaving up their anchors, there were some fishing boats in the vicinity and the marine traffic was very calm.

Figure 5: ADONİS

Figure 6: ADONİS

ADONİS		KURT C	
Cinsi	GEZİNTİ (TENEZZÜH) GEMİSİ	Cinsi	GEZİNTİ (TENEZZÜH) GEMİSİ
Grt	13,88	Grt	77
Net	8,74	Net	34
DWT	0	DWT	0
Boy/En/Derinlik	11,37 m./4,4 m./1,5 m.	Boy/En/Derinlik	19,5 m./7 m./3,3 m.
İnşa Tarihi	12.06.2014	İnşa Tarihi	01.02.1995
İnşa Yeri	MANAVGAT	İnşa Yeri	MARMARİS
Makina Gücü	132 BHP	Makina Gücü	535 BHP
Makina Adeti	1	Makina Adeti	1

Figure 7: Comparison Table for KURTC and ADONİS

From the beginning of the tour in the morning until the time of return, the weather and sea conditions were quite calm. The sea condition was about 3 Beaufort. Visibility was also quite clear. The tall buildings in the city center, in the upper parts of Kaleiçi, were clearly visible. Passengers were having fun dancing with music.

Approximately at a distance of 15 minutes away from Kaleiçi, the weather conditions began to change. Firstly, the rain winds coming from the northeast direction were felt as a sweet breeze. After 5-10 minutes the wind accelerated and the wavelets appeared at sea.

After another 5-10 minutes, at about 16:47, the storm suddenly became violent. With the fog and rain, walnut-sized hailstorms started to fall and storms started, reaching hurricane force. Suddenly developing storm affected both ADONIS and KURT C. Severe weather conditions continued for about 15 minutes. Then the storm calmed down and the sea became smooth.

1.9 The Events at ADONİS

ADONİS started to roll under the influence of severe weather. As the engine overheated at full speed, Captain brought the speed lever firstly to half way and later to slow speed. The power of the wind was exceeding the engine power. The boat was swinging in all directions; forward, aftward and sideways.

1.10 Rescue Activities

After the visibility became clear, crew of ADONİS saw the toppled boat. The boat's hull was inside the water and her masts were visible. As they approached and they saw Captain of KURT C, they realised that the sinking boat was KURT C. They called for help on the

VHF. The VHF did not work in the first 5 minutes. Then they called the Sea Police, Coast Guard and the boats in Kaleiçi Marina and asked for their help.

There were sunbathing beds and bags over the sea surface. ADONİS approached KURT C, showing caution against ropes and other similar objects to prevent their propeller.

1.11 The Events on KURT C

It had started to rain just before the storm. Before the rain, half of the people were on the main deck and the others on the second and third decks. As it started to rain, the passengers went down to the main deck. When the storm began, they all had gathered on the main deck. Together with the rain, walnut-sized hails started to fall.

When the storm started, the boat began to roll. Passengers started to panic. With the instructions from the Captain and the guidance of the staff, all the passengers put on their life jackets.

According to the statements of the seamen, a whirlwind had formed which wrapped the boat inside. They did not see the whirlwind from a distance, but they suddenly entered into it. The whirlwind lifted the stern upwards, and at this instance they could see the propeller. It is also stated by the personnel that there was a vortex on the surface of the water together with the whirlwind and the vibration could be felt on the boat.

Due to the wind, sunbathing cushions on decks 2 and 3 flew into the sea. As the wind was forcing to swing the boat, the Captain who was at the helm tried to keep the boat's bow stable. The captain also tried to resist the wind by increasing engine power. For this purpose, he increased the engine's rpm from 1700 to 2200. In this way he aimed to prevent the boat from swinging and heeling. The storm rendered the boat unable to proceed in the water, and even the boat began to move aftwards little by little. In the meantime, the engine stopped, which could also be observed at the control panel indicators. The first strong wind came from the starboard bow. The second strong wind, which struck within the next minute from the port bow, lifted the boat's bow up into the air, swung the boat towards starboard and toppled her to her starboard side. The boat's toppling to her starboard side happened about 1minute after the engine stopped.

However, according to the statements of the seamen, the boat first leaned to her port side. After being upright, the boat leaned to starboard and remained in that position. The seamen also state that the engine was running when the boat leaned and stopped after the boat leaned to her side. However, when the other statements and the flow of the events are evaluated, it seems more reasonable that the engine stopped first and then the boat toppled onto her side.

As the boat toppled to her starboard, the masts approached the water level. Before the boat sank, Captain tried to call for help on the VHF, but before he could finish his call, the boat toppled. However, it is stated that the Captain's call was heard by some boats in Kaleiçi and from the cruise boat BARBOSSA.

Now the people were in the water. The staff told the passengers not to leave the boat and that assistance was coming. Passengers, on the instructions of the staff, waited clinging to the side of the sunken boat. The captain cut the ropes of the two pontoons (rigid liferaft) on the aft platform. 20 people can hold to this pontoon. Some passengers clung to this pontoon, waiting for help to come.

One of the seamen took a waterproof cellphone from a passenger and called the boat manager ashore, who is at the same time his brother. The manager informed the other boats in the port and the boats quickly started to run to help.

Pleasure boat ADONIS was the first to come to help KURT C, about 10 minutes after toppling. ADONIS threw a rope and the seaman tied the rope to KURT C. Some of the passengers, first of all children and the elderly, clung to the rope and climbed on board ADONIS. In the meantime, the other boats had begun to arrive at the scene of the accident. Other passengers were taken on board these boats. Some of the passengers were evacuated in small groups by the sea police. As the boat was sinking, the seaman cut the rope which was attached to ADONIS. Finally, crew members of KURT C climbed on board one of the rescue boats.

Although all the passengers had worn their lifejackets, the crew could not wear theirs as they didn’t have sufficient time.

Two women, one of them Turkish and the other on a foreigner (tourist) lost their lives, being trapped at the lower deck, the one below the main deck. Their bodies were found in the

galley and the engine room compartment. There is one bulkhead and also one door between the galley and the engine room. As the changing cabins and the toilets are placed at the main deck, there is no need or necessity for the passengers to go down to the engine room deck. It is evaluated that the deceased women had gone down in panic, showing an unconcious reflex. It is also thought that together with the water flowing to the engine deck, the women's capabilities to move were limited because their lifejackets and therefore they could not reach the exit.

Depth at the position where the boat sank is 44-45 metres. Distance from Kaleiçi Yacht Harbour is 1,9 nm and shortest distance from shore is 1,4 nm.

Figure 8: KURT C, in her toppled position.

Figure 9: Boats that came for help.

1.12 Life-saving Equipment

There were 114 lifejackets, 6 child lifejackets, 6 lifebuoys and 2 rigid liferafts as well as 1 fixed fire pump.

1.13 Inspections

The boat went through shaft and bottom survey on 23.06.2015 and sea survey on 31.08.2015. the boat's following inspection period was due between 23.03.2016 and 23.09.2016. As per the day of the accident, the boat's surveys and the Certificate of Seaworthiness were still valid.

1.14 Modifications

The boat was first constructed with the name REGATTA, the construction having been started on 01.02.1995 and completed on 30.03.1996. LOA was 26,00 metres, LBP 21,95 metres, width 6,75 metres and moulded depth 2,80 metres. It is stated in the Ship Construction Declaration that 80 pieces of mahogany was used at her frames, pine tree was used for covering the hull and again mahogany was used to cover the underwater hull as well as the deck. First engine of the boat was again Caterpillar, which produces 535 BHP. The boat was first registered on 03.05.1996 as commercial yacht and upon request from the owner on 30.04.1997 ship type was changed to passenger ship. Again upon the request of

the owner ship type was switched to commercial yacht again on 27.04.2000 and later on back to pleasure boat on 03.05.2000.

The boat went through modifications at Ayla Taş Poyraz Yatçılık in Manavgat between 01.04.2015 and 06.08.2015. In this modification, the boat's length was shortened to 23,90 metres and LBP to 21,70 metres whereas the width was measured as 7 metres and the depth as 3,30 metres. Additionally a third deck was added. In her new condition and at the end of the stability experiments the boat's passenger capacity was determined as 105.

In the modifications, the boat was shortened by cutting at her aft and the aft quarter's position had been changed. In addition to the 90 % change of the boat's structural elements, the boat's upper structure and her inner compartments were totaly changed. The shape of the boat's aft part was changed and as most of her frames were changed and renewed, some were kept in place in order to preserve the general form of the boat.

PART 2–ANALYSIS

2.1 Stability of KURT C

At sea, the term “stability” is defined as the ability of an upright floating ship to return to her upright position after leaning to one side due to external factors.

The stability of a ship is defined by the determination of two points. These are the center of gravity (G) and the center of floatation (B). The center of gravity (G) is the point at which the vertical forces forming the weight of the ship are combined. And the point at which the vertical forces that make a ship float, i.e. that push it upwards, is called the center of buoyancy.

If a ship floating in an upright position leans to one side by the effect of any external influences (such as wind or wave effect) and the weights on the ship have not been displaced due to this leaning, the point G remains constant. Because of this leaning to one side, point B moves towards the leaning side until it becomes the new geometric center of the changing underwater structure and reaches a new point, which can be named as B'. As a result of this leaning movement, the forces acting on the ship at points G and B' will determine the stability of the ship.

Another concept of stability is the Metacentric Point, which is represented by the letter “M”. The point at which the force vector passing through point B' intersects the ship's centerline (CL) is the Metacentre point. It is assumed that this point will remain constant at small leaning angles, such as 10°-15°, and when the ship leans to one side, point B moves over a circle arc where point M is the center. In the case of large leaning angles, since point B will move more, point M will not remain constant and will be displaced.

The distance between the center of gravity (G) and the Metacentric point (M) is called the metacentric height and is referred to as GM. Metacenter height is a function of GZ and is used to calculate ship stability up to 15° leaning angles. GM is considered positive if G is below M and GM is negative if G is above M.

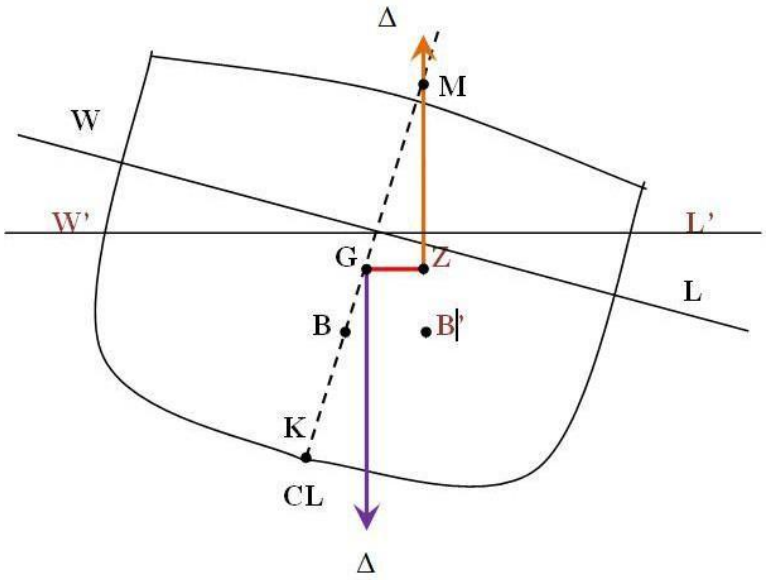

Figure 10: Power couple rotating the ship

The value of this power couple is Δ x GZ

In this formula; Δ = Displacement (Ship's Weight) , GZ = The length of the vertical line from point G to B' force line, which is referred to as the "Righting Lever".

There are three types ship stability. These are defined as stable equilibrium, neutral equilibrium and unstable equilibrium.

If a ship toppling to one side due to external factors can return to her upright position, the she is at stable equilibrium. At stable equilibrium, GM is positive (point G is below point M), vector GZ is on the side to which the ship topples.

If a ship toppling to one side due to external factors, maintains her position, i.e. can neither return to her upright position nor leans further, that ship has a neutral equilibrium. In neutral equilibrium, GM is zero (point G intersects with point M), the value of GZ is zero.

If a ship toppling to one side due to external factors does not return to her original position and continues to lean further, then the vessel's stability in this case is called unstable equilibrium. In unstable equilibrium; GM is negative (point G is above point M), GZ vector arm is on the opposite side with regard to the side to which the ship toppled.

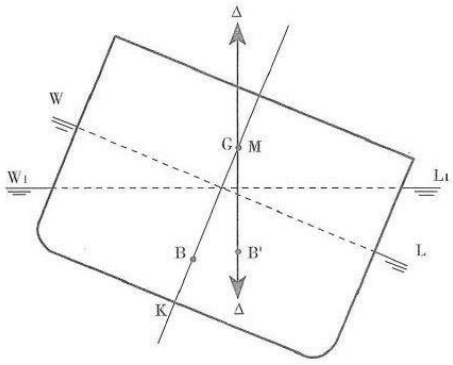

Figure 11: A ship at neutral equilibrium

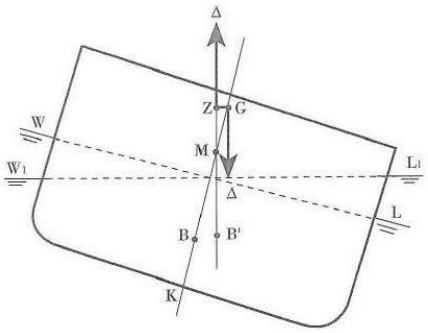

Figure 12: A ship at unstable equilibrium

In this accident, KURT C toppled to her starboard side at such an angle that was too big for her to be able to become upright again and due to the magnitude of the leaning angle, fell into an unstable equilibrium, and as a result could not become upright again and sank.

2.2 GM Values of KURT C

While the GM of the KURT C was measured as 2.12 after the calculations made in September 2010, the GM was determined as 3.00 in the measurement after the modifications where the ship was shortened and a third deck was added. From this point of view, it is considered that there wasn't any negative change in the GM of the boat due to the modification.

2.3 The Ship's Air draught, Upper Structures and Sails

Gemi bordasının yüksek olması, geminin maruz kaldığı rüzgârların etkisini artıracak bir unsurdur. Rüzgâra maruz kalan yüzey büyüdükçe, gemiyi sürüklemek veya yatırmak için ortaya çıkacak kuvvet de o nispette artacaktır.

The fact that the ship has a high freeboard is a factor that will increase the effect of the winds to which the ship is exposed. The larger the surface exposed to the wind, the greater will be the force that will drift or lean the the ship.

KURT C was also more affected by the prevailing strong wind conditions, compared to other small boats, especially in comparison with ADONIS, which was very close to the scene of the accident.

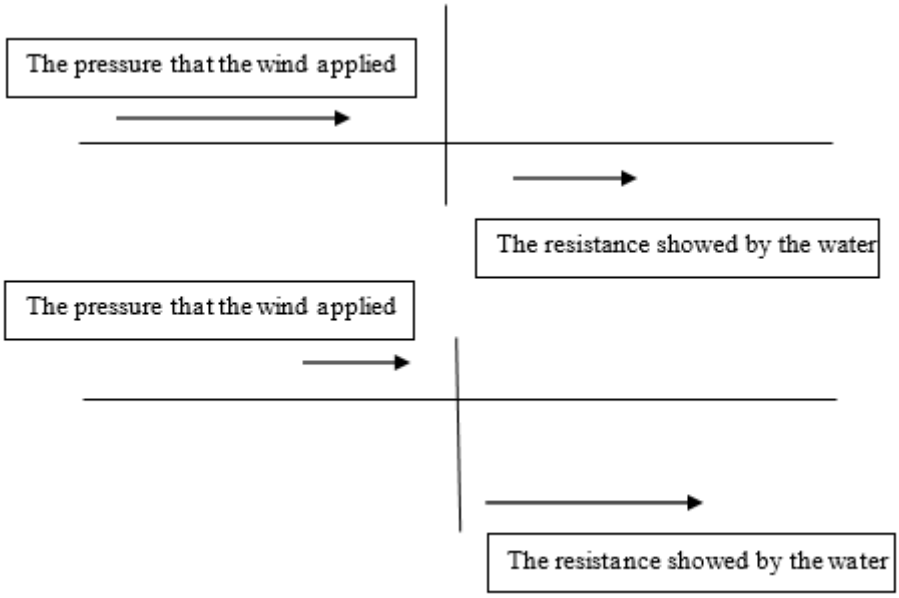

Figure 13: Effect of wind and water at ships with high upperstructure and low upperstructure

As we have tried to explain schematically above, the larger the surface of the boat compared to the underwater section, the greater the power balance will change in favor of wind pressure and against the resistance of the water, and with the effect of wind the boat will lean more and more to her side. In the case of an inverse ratio, the resistance of the water will be higher than the effect of the wind.

The superstructure, masts and sails of KURT C are the factors that make the wind more effective and make the boat topple. With this strong effect of the wind, the boat leaned to such an extent that she could not become upright again and sank.

Figure 14: KURT C, SETUR Marina

2.4 Effect of The Masts Over Stability, Height And Weight of Masts

The masts will shift the ship's centre of gravity upwards. And this means a reduction in the righting forces. The boat will lean to sides (roll) more slowly, but the leaning angle will be greater.

The higher the length of the masts, the more the ship's GM will be reduced and the ship's coming to an upright position again after rolling will be more difficult. As the masts' weight increases, the GM value will likewise be reduced and this will affect stability in a negative manner.

A boat which rolls due to an effect like wind, will roll at a higher degree, as the weight of the mast increases, with comparison to a boat with a lighter mast. However, when the effect of wind disappears, the rolling of a boat with heavier masts will stop more quickly than a boat's rolling with lighter masts.

As removing a boat's mast will increase the stability of the boat, on the other hand it will cause the boat's rolls to be more harsh and the boat will fall into sudden and hard rolls at the same time. Hence, although most of the gulets do not use sails, the reason for having a mast is that the boat becomes more stable particularly in high waves thanks to the mast and cross wires. The rigging and tension of the crosswires render the boat more stable.

Figure 15: The Masts of KURT C

2.5 The Sails

There are sails on the two masts, rigged in pieces. These sails are provided for decorative purposes only, not for sailing purposes.

Under the influnce of the pressure exerted by the strong wind, the sails are involved in the dynamic forces which cause the boat to tilt to the leeward direction (starboard side).

2.6 Portholes

As the height of the portholes is measured to be 1100 mm from the loaded water line, this height value is in line with the Article 24 of the Ships' Technical By-law, which states that "The lower bottom of the portholes shall be at least 500 mm above the water line".

Figure 16: Portholes of KURT C from inside

The portholes at the freeboard of the boat have been equipped with watertight covers. The purpose of theses covers is to be closed at high waves when there is the possibility of water ingress from the freeboards and thus to prevent the boat from being flooded. The pictures taken while the boat was under the water show that the portholes were open. This can be interpretted as the Captain and the crew members had not remembered to close the portholes or they didn't have time to do it.

As a result of the boat' tilting, water penetration from the open portholes caused the boat to lean on its side further more and caused the weights that sank the boat to increase, thus constituting one of the factors in the sinking of the boat or accelerating this process.

Figure 17: KURT C ashore, at SETUR Marina

2.7 Watertight Bulkheads

It is considered that as the boat toppled, the waters that started to flood into the boat from the open portholes proceeded towards the stern of the boat and accelerated the toppling of the boat. During the on shore survey on 20 December 2016, it is stated that "Three bulkheads below the main deck do not provide watertightness and these bulkheads should provide watertightness." It is considered that the lack of watertightness of the bulkheads is a factor for the waters flowing through the portholes to continue to the engine room and topple the boat.

The Article 30 of the Ships' Technical By-Law, titled "Subdivision";

1. All ships over 15 metres and all passenger ships regardless of their length shall have a collision bulkhead (…)

2. All ships of 24 metres length and over shall be fitted with an additional aft bulkhead which shall be watertight up to deck level .
3. The bulkheads shall be so designed as to withstand the pressure of the highest level of water in case of a damage to the ship.
4. The holes through these bulkheads shall be kept at a minimum number as far as possible and the necessary means shall be provided to close these holes (…)

According to the aforementioned By-law, KURT C is obliged to have only the forward collision bulkhead. Since the boat was over 24 meters before the modifications, she was obliged to have an aft bulkhead and additionally another bulkhead forward of the engine room space. KURT C had all these bulkheads.

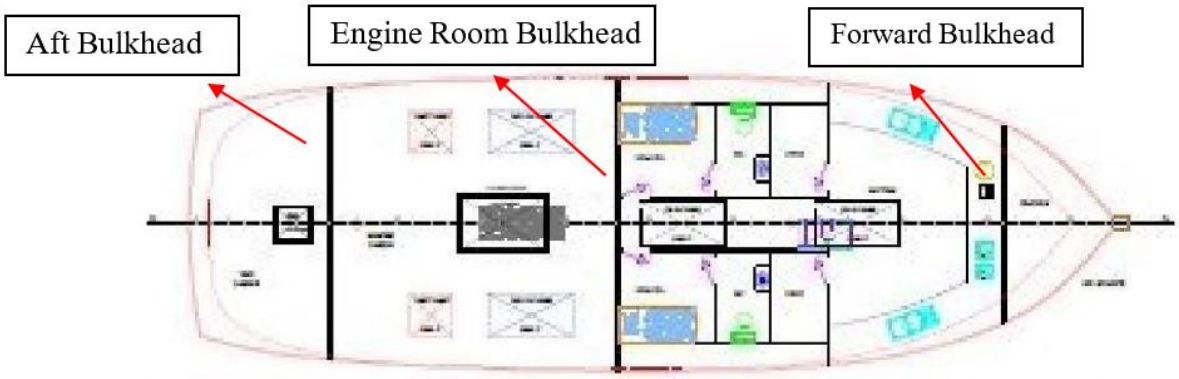

Figure 18: Bulkheads of KURT C

2.8 Bulwarks

According to the Art.21 (4) of the Technical Regulation of Ships, "Scupper holes of sufficient size and number shall be provided at open decks where water can accumulate, as well as at freeboard decks inside watertight superstructures and deck houses, which will enable the effective discharge of water. In the case of bulwarks in the open decks or superstructure decks forming a pool, adequate arrangements shall be made to ensure the rapid discharge of water from these decks." It is considered that the bulwarks on KURT C do not allow the rapid discharge of the water coming to deck due to the ship's toppling.

Water drainage holes are good enough for draining only a small amount of water on the deck (such as deck washing water or rainwater) whereas they are not sufficient for the rapid discharge of large amounts of water.

It is considered that the waters coming to deck have accumulated at the bulwarks and have contributed largely to the forces that laid the boat to her starboard.

Figure 19: Passenger hall, bulwarks and the water drainage hole in front of the bulwarks

2.9 The Unfixed Items on the Boat

It is also considered that as the ship lay to her starboard side, the tables in the passenger hall as well as the tanks (fuel, clean water, dirty water, etc.) in the engine room which were not fixed by a strong lashing hindered the uprighting of the boat.

Figure 20: The Unfixed Items on the Boat

2.10 Weather Conditions

It is considered that the adverse weather effects that caused the accident were due to the cumulonimbus clouds. These clouds are defined at the website of the Meteorological Office as below:

Cumulonimbus clouds, which cause thunderstorms, are caused by different heating of the ground surface, orographic rising and dynamic rising in the frontal systems. Of course, the formation of these clouds requires cold air and humidity at ground level and at higher altitudes. These clouds can rise up to 20 km from the ground and cause hails, strong winds, thunders, lightnings, strong rain and whirlwinds. The speed of the air spining inside the whirlwinds can reach up to 500 km. These clouds cause thunders and they ar observed in summer at the middle latitudes whereas throughout the year at the tropics. These clouds

form over the cold front at the middle latitudes and 100 to 300 km away (dry line) from these fronts.

The crew of KURT C stated that they saw a sudden whirlwind formation at a very close location from the the ship. They also stated that this whirlwind lifted the stern of the ship and at this instance they could see the propeller. On the other hand, the Captain who was at the helm stated that the boat was under the effect of strong winds which first came from the starboard bow and later on from the port bow, that the wind wich came from the port lifted up the forward of the boat and spinned and toppled the boat.

In the event of very strong air currents, the boats can become vulnerable like a toy and depending on the construction characteristics and stability conditions, the boats may fall into unstable equilibrium, tilt to one side or capsize.

The maximum wind forces and wind directions measured at the Meteorology Antalya District Directorate observation station for each month in the last ten years (2007-2016) are as follows:

Table 1: *Maximum wind speed and directions table for the last ten years*

JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT.	OCT.	NOV.	DEC.
SE 29.8	ESE 31.3	S 21.2	SSE 18.4	ESE 17.4	NW 12.3	NNE 11.4	N 14.1	E 14.1	ESE 27.4	S 21.1	SSE 25.2

The graph for the wind force and direction measured at the Meteorology Antalya District Directorate observation station on the day of the accident between 16:00 and 18:00 hours is given below. The wind direction for northerly winds is shown with a 360 degrees addition.

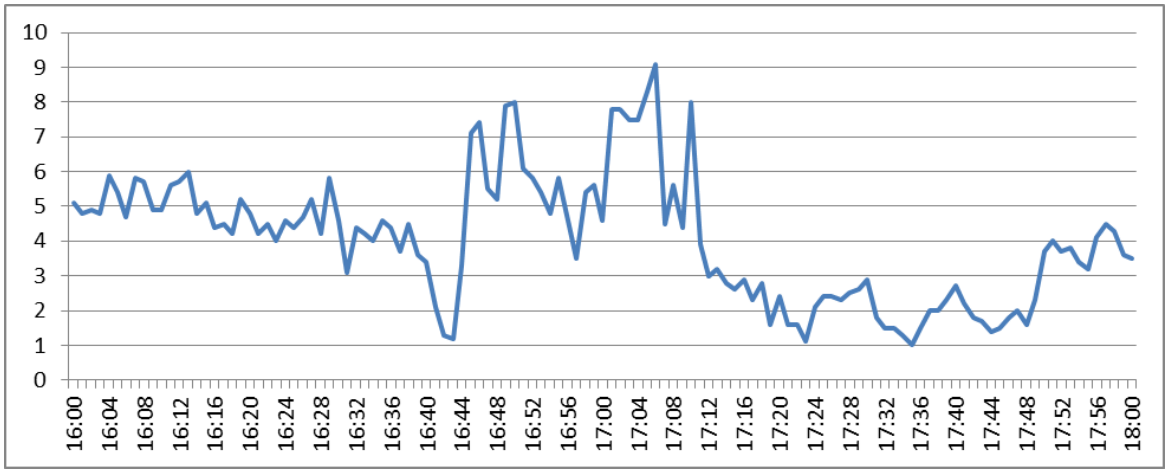

Figure 21:Wind Force (m/s)

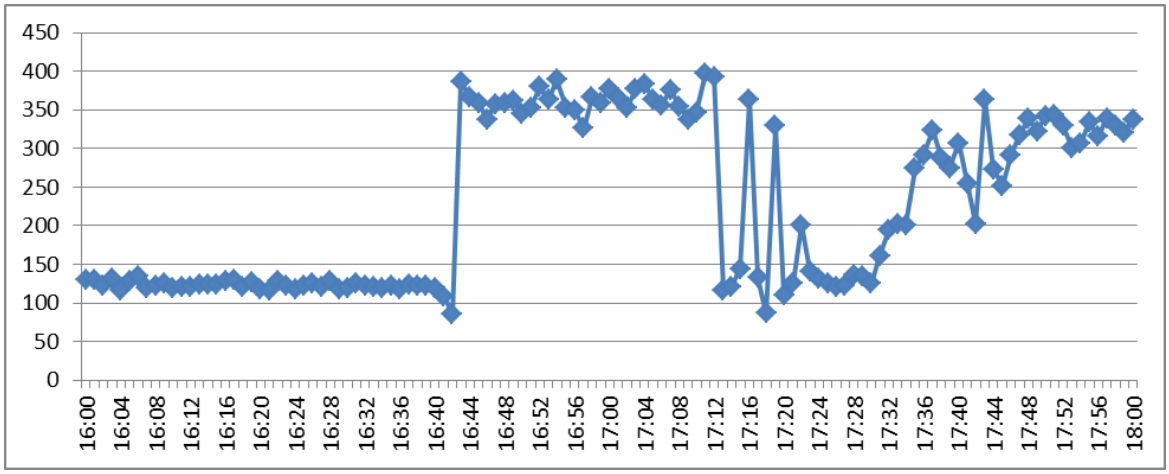

Figure 21:Wind Force (degrees)

As can be seen from the graphs, the wind values measured at the station are well below the maximum wind values measured in the last decade. However, it is considered that a much stronger wind gust occurred locally in the immediate area where the accident occurred.

The interesting issue is, whereas the winds were blowing constantly from the east-southeast directions (from between 116° to 135° - 123° on average) during the 40-minute period prior to the accident, as of 16:41 the winds veered towards North and continued from the North (from between 326° to 038° - 003° on average) until 17:12; whereas the wind speed again during the 40-minute period prior to the accident was between 3,1 to 6,0 m/s (4,7 m/s on average), it blew at 1,2 to 2,1 m/s between 16:41 to 16:43 and the wind which was measured as 3,3 m/s at 16:44 reached 7,1 at 16:45 and 7,4 at 16:46, wind force decreased a bit to 5,5

at 16:47 and it was measured 5,2 at 16:48; increased back to 7,9 at 16:49 and 8,0 at 16:50; after decreasing after 16:51 to as low as 3,5 at 16:57 increased again until 17:06 and reaching 9,1 and decreasing to below 4,0 m/s after 17:11 hours and losing its effect.

The data regarding the wind direction and speed between 16:35 and 17:15 hours is as follows:

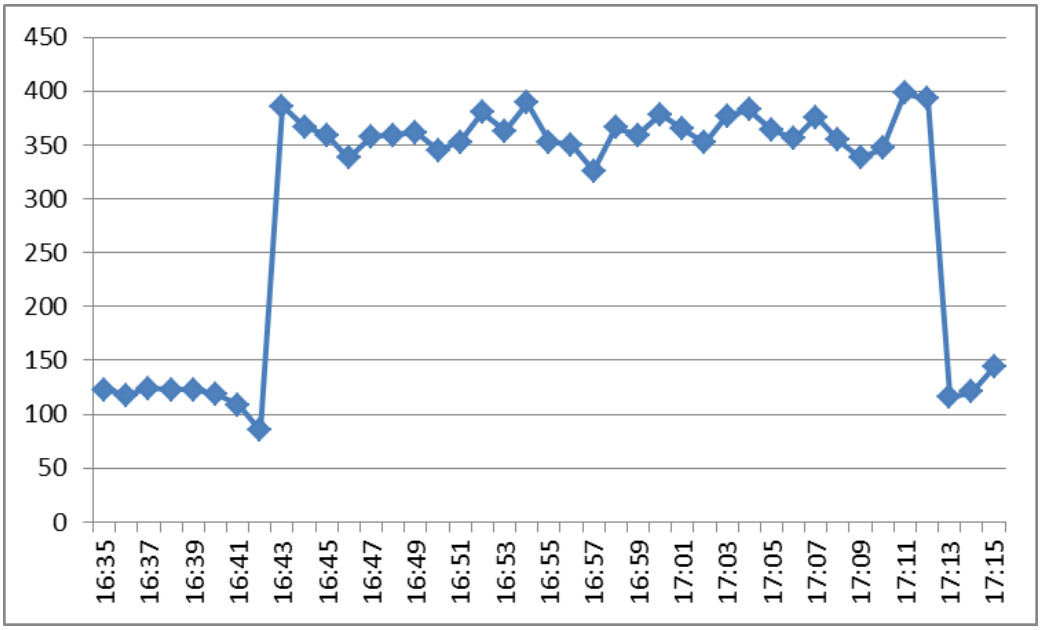

Figure 23:Wind Direction Table

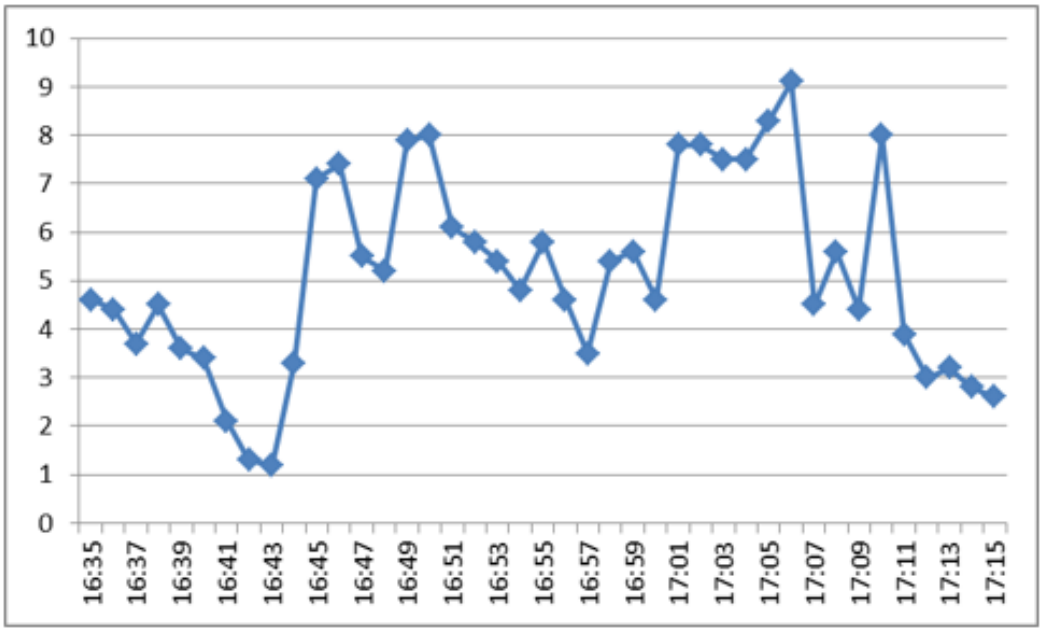

Figure 24:Wind Speed Table

2.11 Surveys After the Accident

Following the completion of the repair and maintenance works of KURT C carried out in the marina (on shore), upon the boat's owner request for the re-issuance of a Seaworthiness Certificate, a bottom survey was carried out by Antalya Harbour Master on 20th December 2016; some of the deficiencies which were identified during the survey are as follows:

1. 3 bulkheads below the main deck do not provide watertightness. These bulkheads shall provide watertightness.
2. Water level alarms and bilge discharge lines are not provided at the compartments which are divided by watertight bulkheads below main deck.
3. Watertightness has not been secured at the locations where the masts pass through the decks.
4. The holes at the ship's bottom that are not in use will be blanked.
5. The tables and seats were not fixed.

During the inspections carried out between 6th and 21st April 2017, it was observed that the deficiencies listed above were rectified.

2.12 Which Occurred Due to Weather in the Past

On 17th August 2014, while the sea bus EMİR SULTAN was doing the Mudanya-Kabataş voyage, the windscreen glass exploded due to the high waves caused by strong winds in the northwest direction and 10 passengers were injured due to glass fractures and panic occurred among passengers on the ship.

Again on the same day, 5 people who went to sea on a pedalo in Istanbul Kumburgaz were dragged away and disappeared due to the sudden deterioration of weather and only one body could be recovered whereas it was not possible to find the other casualties.

On 23rd September 2014, fishing vessel BURHAN KAPTAN-1's stern was lifted into the air due to a suddenly developing storm, while her nets were laid in the sea off the Rumeli Lighthouse. The crew stated that the nets at the sea were holding the ship, and otherwise the ship would have capsized in this incident, where one crew member of the ship was lifted into the air, fell into the sea and was lost at sea; he died as a consequence.

While the rescue activities were being carried out for the personnel of the ship M/V VOLGOBALT-199, which sank off the shore of Şile on 4th December 2012, shortly after the search and rescue boat KIYI EMNİYETİ-7, which was one of the elements of the General Directorate of Coastal Safety, had just left her mooring station, the boat fell sharply from the top of one of the high waves that she encountered, her engines stopped and could not be restarted, the boat was dragged to and grounded on the breakwaters, crashing and breaking into pieces there and three of the four crew members of the boat and a person who came to help them to get out of the sea lost their lives.

2.13 Weather Notifications

Boats follow the weather notifications themselves, usually from the internet. Notifications for adverse weather conditions are made by the Coast Guard through VHF. In such cases, the Harbour Master may not allow the boats to leave the port and implements the decisions taken in this direction by notifying the Kaleiçi Port Administration.

2.14 Emergency Case Notifications By the Meteorological Office

As a result of the evaluations made with the General Directorate of Meteorology, it has been learned that important projects have been developed and important investments have been made in line with these projects in the recent years. Additionally; in the context of meteorological radar, marine radar, meteorological marine buoy, lightning tracking system, new high atmosphere observation systems and digital prediction models, new high performance computer systems have been put into use.

The investments and projects described above have significantly increased the weather observation and forecast capabilities of the General Directorate of Meteorology. For example, the estimation and monitoring of violent and important meteorological events occurring on a very small scale, which are difficult to predict with traditional methods, can be done with the help of high atmospheric observation systems and especially meteorological radars. The fact that numerical models also provide hourly forecasting capabilities also plays an important role in terms of forecasting consistency.

In addition, taking into account the possibility of strong meteorological changes that can occur in a very narrow space, the diameter of very small-scale meteorological changes that may develop in a short time can vary from at least 10 km to 50 km, and it has been evaluated

that.in case of severe meteorological changes in areas smaller than this scale, the estimation and detection will be quite difficult.

It has been learned that the meteorological notices prepared by the General Directorate of Meteorology for the prediction of severe weather events are being announced to the authorities and citizens through such methods as the official website, Voice of Meteorology Radio, electronic media, written and visual press, mobile application etc.

2.15 The Stopping of the Engine

It is evaluated that the stopping of the machine is one of the essential elements of the accident. The strong winds coming from ahead and from the bow turned the boat, whose engine had stopped and thus which was completely left to the mercy of the wind, approximately 90 degrees clockwise, placing it in a position to take the wind from its side and with that inertia toppled the boat to her starboard side. A boat whose engine has stopped already on the water will, if it is not tied anywhere and if it is not anchored, turn to take the wind from her side and thus start drifting and on the other hand leaning towards the leeside. A very strong wind will increase this leaning and a sudden wind may even cause the boat to topple to her side.

In this accident, it is evaluated that the sudden and strong wind leaned KURT C towards the starboard side and the boat, failing to upright, capsized as a result.

Probable causes of the stopping of the engine are considered to be factors such as propeller over-rotating (overspeed) and thus overheating of the propeller, overheating of the engine due to working at high rpm or the blocking of the fuel lines with sediments due to the shaking of the fuel tank and as a result floating of the sediments at the tank’s bottom.

2.16 Life Saving Eequipment

It is evaluated that the passengers on board KURT C had worn their lifejacktes speedily and this had prevented the increase of life losses. On the other hand, the rigid life boat, which is believed to have been retained on board since KURT C had been registered as a commercial yacht and which was not obligatory for KURT C at the time of the accident, had enabled the passengers to cling to it and helped them to remain above the water.

2.17 Emergency Drills

The following provisions are given at Article 73 of "Ship's Technical Regulations" Article 73, under the Title "Trainings and Drills"

> *(1) Training periods, rules and procedures related to abandoning ship, fire, lifeboat launching, emergency rudder, man overboard, collision, grounding, search and rescue and marine pollution are determined at Annex 23 with regard to the ships' type, area of navigation, length, grosstonnage and the required equipment .*
>
> *(2) All ships' crew are obliged to know what to do in case of emergencies. Each new joining crew shall take a familiarisation training within 3 days at the latest. The passengers on board passenger ships shall be informed visually and with written instructions about what they are required to do in emergency cases.*
>
> *(3) The drill records shall be written in the logbook.*

Within the framework of the above-mentioned provisions, it is seen that periodical drills are required to be carried out for the probable emergency cases on board ships. This is valid for both the ship crew and the passengers. In addition, keeping records of these drills is also an obligation according to the provisions.

It is quite difficult to make a healthy assessment, as there is no record of whether the ship's crew is doing the exercises that should be done periodically. However, taking into consideration the precautions taken by the crew both during and after the accident, it is deducted that these drills had not been carried out. As there is no obligation for keeping a logbook for this type of ships, it is evaluated that records of drills can be kept at some kind of record book.

PART 3–CONCLUSIONS

3.1 KURT C had toppled to her side and then sank under the effect of strong winds that she was exposed to.

3.2 Stopping of the engine left the boat helpless against the storm and after the wind turned the boat to take the wind from her side, toppled the boat towards her starboard side and the boat could not upright again and sank.

3.3 The boat's upperstructure, masts and sails increased the effect of the wind and contributed to the toppling of the boat.

3.4 The portholes of the boat being open caused the waters to fill rapidly into the toppled boat and were a factor for the boat's further leaning to her side and not being able to upright again.

3.5 Since the bulkheads that should normally be waterproof were not in proper condition, the waters which filled through the portholes progressed rapidly to the engine room and were effective in the boat's losing of stability and as a result toppling to her side.

3.6 Since the boat's bulwarks were not in a proper structure to allow for rapid discharge of the water, the water that filled the deck accumulated at the bulwarks, causing the boat to topple quickly and not to be able to upright again.

3.7 The tables, chairs, refrigerator and other items that were not fixed to the boat, and the fuel and water tanks and other equipment in the engine room moved/slided towards that side of the boat where the boat toppled, and this was effective in the boat's inability to upright again.

PART 4- ACTIONS TAKEN AFTER THE ACCIDENT

After the accident, as a result of the investigations carried out by the Ministry of Transport, Maritime Affairs and Communications General Directorate of Maritime and Inland Waters Regulations and the General Directorate of Shipyards and Coastal Structures, a series of measures were adopted, aiming to increase safety in recreational boats similar to KURT C. In this context, the stability tests of the boats were repeated and necessary verifications were made. In addition, a number of additional requirements have been brought forward. In this context, the following regulations were decided upon, for minimum 3-deck pleasure boats which were rigged with masts:

1. Repetition of inclination and stability tests on the 3-deck boats in order to verify their inclination data and stability books,
2. Cancelling the third deck of boats of less than 24 metre length whose stability verifications have been carried out and the calculation results based on 7 beaufort wind force have exceeded 10 degrees; not allowing the passengers to use the 3rd deck, lifting the guardrails and the stairs to prevent the passengers' access to 3rd deck,
3. That the mast lengths in these boats are not so big to affect the stability, especially if the mast lengths are increased additionally, these additions should be removed/corrected,
4. These boats should not be allowed to sail at weather conditions of over 5 beaufort force and this condition should be written at the explanation part of the certificate of seaworthiness,
5. The portholes and other Windows below the main deck level should be non-opening type and the strength of the porthole should be identical to the strength of the material of the location where the porthole is fixed,
6. In this regard removal of the water slides (aqua panel) from all the boats, including those which are registered to a classification society and closing of the openings in the outer shell-plating so as to maintain the strength of the shell-plating.
7. Closing of the engine room ventilation openings under the main deck level so as to maintain the integrity of the outer shell-plating and provide the engine room ventilation through ventilation pipes of suitable length over the main deck.

8. Providing the exhaust outlets with an arrangement which will prevent water ingress to the boat and which the Administration will deem sufficient and appropriate.

In this regard, the following actions were carried out by the owners of KURT C:

1. The inclination and stability verifications were carried out under the suprvision of the Project engineer, Administration and the Classification Society.
2. The third deck was cancelled, the guard-rails were detached and the stairs to this deck were removed.
3. All the portholes at the forward part, which were under the main deck level were closed permanently.
4. Tables and chairs on deck as well as the tanks and other equipment in the engine room were tied to the boat and firmly fixed.
5. Watertight bulkheads were strengthened.

PART 5-RECOMMENDATIONS

The Directorate General of Maritime and Inland Waters Regulations is Recommended to;

5.1 Ensure that the boats are inspected in accordance with the specifications determined in the technical regulations regarding whether the bulwarks of the pleasure boats are capable of discharging the sea water that fills the deck quickly,

5.2 Ensure the control of seating groups, cabinets and tanks in the pleasure boats are fixed firmly,

5.3 Inspect so as to check whether the waterproof bulkheads that are (or should have been) built at pleasure boats and yachts have the characteristics specified in the technical regulations of the ships,

5.4 Provide information to the passengers on the pleasure boats by the authorized ship personnel at the beginning of each voyage for the use of life saving equipment in emergency situations.

5.5 Take measures to ensure that the records are kept for the emergency drills which need to be carried out periodically on ships that do not have to keep a logbook, and conduct inspections to reveal whether those drills have been actually carried out,