Maritime training and research activities using a high-tech training ship
"Fukae-maru"

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Abstract

The Sea Training Center of Kobe University of Mercantile Marine is a unique Center, which provides students with opportunities of research on maritime affairs and instruction in seamanship skills utilizing the training ship and the small vessels. The Fukae-maru is a 449GT’s training ship belonging to the Sea Training Center, and is a high-tech training ship equipped with modern apparatus for navigation and a data processing computer with Local Area Network (LAN) system connected with optical fiber for collecting data relating to navigation and engine conditions at sea as well as in port. Therefore, she has been used for onboard training to undergraduate students as an ordinary training ship and for research activities on safety navigation, effective operation and environmental protection to graduate students and academic staff as a floating laboratory.

The details of the short-term training programs using the Fukae-maru are introduced and the advantages of the training curriculum over other training methods are discussed in this paper. The authors also introduce research activities, which have been carried out on the Fukae-maru. As a summary of this topic, the effective use of such a high-tech training ship not only for onboard training but also for research activities is discussed and proposed to achieve the main purpose of maritime universities over the world, which is shown as a slogan "Safer shipping and Cleaner oceans".

1. Introduction

Kobe University of Mercantile Marine (KUMM) has been established on 26th May 1952. The purpose of establishing KUMM is to provide students with a good knowledge of theories and technology required especially in the field of marine science and engineering, and to instill high intelligence and rich culture into the students so as to enable them to contribute to the development of sea transportation and other marine industries.

The Fukae-maru has been taken an active part in the history of KUMM. The present Fukae-maru corresponds to the third generation being counted from the founder. She has been built in October 1987, and she is now 14 years old.

The highly developed technology and equipments have been adopted in the Fukae-maru for the purpose of education, practice, training, investigation and research. Then these facilities have taken an active part now and have contributed very much. In this paper, the recent activities of the Fukae-maru are introduced, and the ideal image in the future of her as a training ship, which belongs to KUMM, is discussed.

2. The Principal Particulars of the Fukae-maru

Owner: Ministry of Education, Culture, Sports, Science and Technology
User: Kobe University of Mercantile Marine
Belonging: Sea Training Center, KUMM
Delivered: 14th October 1987
Builder: Mitsui Engineering & Shipbuilding Co., Ltd., Tamano Works, Japan
Kind of ship : Training ship
Type : Twin decks Flush decker
Plying limit : Greater coasting service
Class : JG
Gross tonnage: 449 tons, International gross tonnage: 674 tons
Loa: 49.95m, Breadth: 10.00m, Depth: 6.10m/3.75m, Draft: 3.20m
Main Engine: Diesel 1,100KW×1, Engine Room M0 qualification
Propeller: 4 bladed CPP with anticlockwise turn
Service speed: 12.5 Knots, Cruising range: 3,000 Nautical miles
Complement: 64 Persons (Captain and Crew 12, Professor 4, Cadet 48)

Fig.1 The Fukae-maru berthing at the mooring pond of KUMM

3. Sea Training Center

The Sea Training Center has been established in May 1983, and been refurbished in 1997 to research and to instruct about maritime affairs of the university as a superlative degree of maritime training organization which Japanese Government admitted. Therefore, the role of the Sea Training Center is never to aim the course concerning seafarer's qualification, and this Center is peculiar facilities for the students of KUMM.

The purpose of establishing the Center is as follows.
① Administer the training ship and the other small vessels of KUMM
② Management of each practice facilities around mooring pond
③ Execution of boat seamanship and ship management practice provided in curriculum
④ Research and instruction in seamanship skills on maritime affairs

Training ship "Fukae-maru", training boat "Hakuo" and "Muko-maru", cruising yacht "Kleiner Berg", cutters etc. belong to this Center. In addition, there are Ship Handling Simulator, Radar Navigation Simulator, Rope Work Exercise Room and Marine Communications Exercise Room as attached training equipment for students. Moreover, there are cutters, yachts and boats as student's club activities.

4. The results of service of the Fukae-maru for one year (1st. April, 2000 ~31st. March, 2001)

The days of service of Fukae-maru of the previous year were 112 days. Besides this, there are a lot of lecture and handling practice of navigation instruments onboard, and visits. However, these are not counted on 112 days. The number of people who visit Fukae-maru berthing at the pond of KUMM exceeds 700 for one year.

4.1 The purpose of the activity and days of service

![Purpose of the activity and days of service](image)

4.2 The total number of person onboard

![Total number of person onboard](image)
4.3 The classification and percentage of person onboard

![Diagram showing percentage and classification of people onboard]

**Fig. 5 Classification and percentage of person onboard**

5. Short-term training program of the Fukae-maru

The four departments are prepared in the faculty of KUMM.

1. Department of Maritime Science
   - Nautical Science Course
   - Marine Engineering Course
2. Department of Transportation & Information Systems Engineering
3. Department of Ocean Electro-Mechanical Engineering
4. Department of Power Systems Engineering

Maritime license of deck officer or engineer is classified into the six classes respectively. The curriculum of Department of Maritime Science is organized to meet the third grade deck officer or third grade maritime engineer licensing requirements. The student who hopes for the acquisition of the maritime license can take a national examination after completing the on-board training, described later. The on-board training is done with the large-scale, ocean going, training ships of National Institute for Sea Training, Independent Administrative Institution, Ministry of Land, Infrastructure and Transport. The above-mentioned students must complete on-board training I of 3 months and on-board training II of 3 months by graduation of the faculty. Then, they proceed to the Sea Training Course of 6 months to get the 12 months' embarkation career for the license. The fleets of training ships are shown below.

1. Ginga-maru 4,888 GT's, Loa 115m, Diesel engine 4,560KW 1set, Cadets 180
2. Seiun-maru 5,884 GT's, Loa 116m, Diesel engine 7,723KW 1set, Cadets 180
3. Hokuto-maru 5,877 GT's, Loa 125m, Steam turbine engine 5,148KW 1set, Cadets 160
4. Taisei-maru 5,886 GT's, Loa 125m, Steam turbine engine 5,148KW 1set, Cadets 140
5. Nippon-maru <Tall ship> 2,570 GT's, Loa 110m, Diesel engine 2,206KW 2set, Cadets 120
6. Kaiwo-maru <Tall ship> 2,556 GT's, Loa 110m, Diesel engine 2,206KW 2 set, Cadets 130

The university is taking charge of the practical education in navigation, ship handling, seamanship, marine safety, communications, navigational aids and maritime regulation etc., excluding the embarkation career, demanded as a superlative degree of maritime training university in Japan. To enhance the content of the practical education for the students more, and to make the understanding deepened, an experiment and a short-term training program onboard the Fukae-maru are executed. The students other than department of marine science need not acquire maritime license, therefore, the on-board training is not imposed. However, ship management practice or the experiment onboard the Fukae-maru has been imposed at the third school year in consideration of the viewpoint by which abundant education talent is promoted about maritime affairs.
5.1 Nautical Science Course, Department of Maritime Science

5.1.1 Ship management practice I-1 <at the first school year: 2 days>

This onboard practice is the first time experience for freshman of undergraduate. Students experience the works such as watchkeeping, leaving and entering port, anchoring and watch on deck as an initial introduction for various onboard practices, which will be developed in the future. The urgent drill such as boat station and fire station is done; moreover, the students experience various stations, which relate to the service of the ship. Basic posture concerning the maritime affairs and seamanship skills, which will be needed, is acquired. And they train the natures such as cooperation and seamanship through the life and joint work onboard.

The main content of ship management practice I-1

Attention and information of onboard practice, Deck and engine watchkeeping, Steer handling experience, Visit of narrow channel, Emergency station drill, Handling of fire fighting apparatus and lifesaving appliances, Visit of anchor work, Visit of work on leaving and entering port, etc.

5.1.2 Ship management practice I-2 <at the second school year: 2 days>

Students deepen knowledge concerning maritime affairs by investigating and reporting the problem about the ship equipments and structure, maritime regulations and marine traffic regulations.

The main content of ship management practice I-2

Investigation of equipments of the ship, Deck and engine watchkeeping, Visit of narrow channel, Emergency station drill, Handling of fire fighting apparatus and lifesaving appliances, Anchor work, Work of leaving and entering port, etc.

5.1.3 Ship management practice I-3 <at the junior: 2 days>

Ship maneuver and anchoring work are executed in individual or the team. Two buoys are set up about 1.5 nautical miles apart, then student’s practice approaching to the buoy and leaving using main engine with controlling the ship. This practice is the summary of ship management practice I.

The main content of ship management practice I-3

Ship maneuver with controlling main engine, Deck and engine watchkeeping, Visit of narrow channel, Emergency station drill, Handling of fire fighting apparatus and lifesaving appliances, Anchor work, Work of leaving and entering port, etc.

5.1.4 Ship management practice II <at the senior: 4 days>

As a summary of the faculty education concerning maritime affairs, and inspection of knowledge such as ship management and the seamanship skills, ship management practice II is executed. Passing through the inland Sea, the improvement of the ability demanded by the deck officer in charge is aimed at. Ship maneuver and anchoring work are executed in individual or the team. The program of this practice encourages the students to develop their leadership for a captain.

The main content of ship management practice II

Ship maneuver and anchoring, Navigation schedule planning, Deck and engine watchkeeping, Narrow channel passing, Emergency station drill, Handling of fire fighting apparatus and lifesaving appliances, Anchor work, Work of leaving and entering port, etc.

5.1.5 Exercise I and II in seamanship <at the junior 2 days, senior 1 day>

Students have exercise I at the latter term of the junior and exercise II at the first term of the senior. Man-over-board maneuver and Z trial maneuver are done by changing various elements. Then students report the analytical result based on the acquired data with a report of the control characteristic of CPP ship. Work of leaving and entering port and practice of the operation of the navigation equipment are done at the same time.

5.2 Marine Engineering Course, Department of Maritime Science

5.2.1 Ship management practice <senior 4 days>

Students embark the Fukae-maru as a summary of the knowledge learnt by a lecture and a current practice. First, they practice main engine and auxiliary engine operation for two days onboard the Fukae-maru of the university pond and understand the structure and function of them. Then, they have a four days onboard practice to understand an overall engine plant as a summary of ship management practice.

The main content of ship management practice

Engine and deck watchkeeping, Main engine and auxiliary engine operation,
Visit of narrow channel, Emergency station drill, Handling of fire fighting apparatus and lifesaving appliances, Anchor work, Work of leaving and entering port, etc.

5.3 Laboratory in Transportation System Science II, Department of Transportation & Information Systems Engineering (junior 4 days)

Students understand the outline of the service of the ship, and do various experiences onboard besides the watchkeeping, steer handling, etc.

The main content of Laboratory in Transportation System Science II
Attention and information onboard, Watchkeeping experience on deck, Steer handling experience,
Visit of narrow channel, Emergency station drill, Handling of fire fighting apparatus and lifesaving appliances, Visit of anchor work, Visit of work on leaving and entering port,
Investigation of ship equipment, Harbor investigation, etc.

5.4 Department of Ocean Electro-Mechanical Engineering and Department of Power Systems Engineering

5.4.1 Ship management practice (junior 4 days)

Students understand structure of engine, the basis of the operation of main engine and auxiliary engine, and the engine plant through the practice. Then they understand the outline of the service of the ship, and do various experiences onboard.

The main content of ship management practice
Attention and information onboard, Watchkeeping experience on engine and deck,
Main engine and auxiliary engine operation, Steer handling experience,
Visit of narrow channel, Emergency station drill, Handling of fire fighting apparatus and lifesaving appliances, Visit of anchor work, Visit of work on leaving and entering port, etc.

6. Other activities

6.1 Investigation and research cruise
The investigation and research cruise is executed in season of spring and summer. A lot of students and researchers participate from other universities and research laboratories to this cruise besides that of KUMM. The cruising period is for about 4 days in spring, 9-10 days in summer. The area of activity is decided according to the content of the theme of investigation and research.

6.2 Commemoration or request cruise, experience embarkation
Openings to the public and experience embarkation are executed in cooperation with such as maritime organization of Hyogo prefecture and Kobe city for a day to 3 days. At this time, the enlightenment activities are done to the public includes children about the protection of oceanic environment, the importance of the sea and marine transportation.

6.3 Training onboard
Onboard training is executed for the new instructor and staff, staff group, research group of KUMM and for various research groups outside.

6.4 Open college, Experience embarkation for children
The open college is executed for the man and woman more than the high school student for 4 days to 10 days depending on the theme of the course. Moreover, experience embarkation like a summer school and summer seminar is executed for the school children for a day to 2 days.

6.5 Event of KUMM
The experience embarkation for new undergraduate students and general person at the University festival is executed.

6.6 Training onboard of other university
The ship training is executed for the students of Department of Engineering of Kobe University and University of Osaka Prefecture for 2 days to 3 days.

6.7 Trial run
The trial run is done at least once every week when there are neither various practices nor experiments. The check and the maintenance of main engine, auxiliary engine and various ship equipment are done at this chance. In addition, the preparation for various service which will be done in the future and ship maintenance are done
while berthing at the mooring pond of KUMM.

7 LAN systems as a floating laboratory

One of the features of the Fukae-maru is having a data processing room, which conveys not merely data from the apparatus through LAN system using optical fiber to a microcomputer, but also remote control signals to each equipment, thus making it possible to perform experiments, research and survey through this data processing system. In addition to that, a large number of apparatus and systems with the latest electronics technology are adopted. This kind of ship with such a system is called a "high-tech ship", and is expected to answer the needs of the new era and solve any problems, which might arise in the course of the students' training, experiments and research, as well as instructors'. The LAN system of the Fukae-maru can be collected about navigation information, main engine and auxiliary engine information, ship maneuver information and oceanic weather observation information. Moreover, a display, a record and an analytical function of the recorded data are possessed. These are composed of the main device set up by the data processing room and data input-output, display device set up in a fixed place. Necessary data can be collected 0.1-second cycle in high-speed system when experiment, research and investigation are carried out.

7.1 Number of measurement points

A lot of measurement points shown as follows are prepared.

① Navigation system: 23 points (Time, Heading, Ship speed, Lat., Long., Wind, etc.)
② Integrated radio navigation: 12 points (Time, Lat., Long., Ship course, Ship speed, etc.)
③ ARPA and RADAR: 198 points (Own ship's and Target's Course, Speed, Azimuth, Distance, etc.)
④ Navigation log: 7 points (Ship course, Ship speed, Wind, Engine revolution, Telegraph instruction, etc.)
⑤ Track plot: 8 points (Time, Lat., Long., Turning ratio, Distance run, etc.)
⑥ Engine control system
  Main engine thermal efficiency calculation: 5 points (Fuel flowing quantity, Shaft horse power, etc.)
  Monitor of temperature for data logger: 9 points (Main engine exhaust, etc.)
  Warning: 177 points (Main engine and auxiliary engine)
⑦ Environment system: 33 points (Lat., Long., Current, Temperature, Depth, etc.)
⑧ The weather trend: 8 points (Time, Lat., Long., Depth, Wind, etc.)

7.2 Other functions

Connection with campus information network

8. Investigation and research done recently using Fukae-maru

Researchers and students in various fields use the Fukae-maru. And various experiment, investigation and research are done.

The research themes done recently are shown as follows.
- Observation of the greenhouse effect gas in air and sea water
- Observation of flow structure under the sea water of Osaka Bay
- Observation of microorganism and physical observation of surface sea water
- Measurement of optical characteristic of aerosol in sea area
- Measurement of the sun radiation
- Performance evaluation experiment of new type hybrid fender with oil mechanism
- Performance evaluation experiment of the device of movement prevention on ship berthing
- Experiment of new type oil curtain expansion for oil spill of the ship
- Research on arrangement of control button of ARPA and RADAR panel
- Collection of radar reflection in the area of Seto inland sea for education
- Measurement of sinking volume from sea water level of a man who fall into the sea
- Measurement of sea water level of the midship of hull side in high waves
- Research on human factor about duty officer on watch
- Measurement of sight function of duty officer on watch
- Action record of eye movement of duty officer on watch
9. Vision for utilizing the Fukae-maru

The area where Fukae-maru acts mainly is Seto Inland Sea, which is called "Setonaikai" in Japan. This is the waters of about 240 nautical miles from east to west, 10-30 nautical miles from north to south enclosed by the Honsyu, Shikoku and Kyushu is dotted with a lot of large industrial zones and is abundant fisheries of the fishery resource. For this situation, not only a domestic and foreign merchant vessel but also it is crowded with the fishing boat and fishing gears day and night. Moreover, the narrow passing waters enclosed by islands such as Akasi straits, Bisan Seto passages and Kurusima straits range there. This water is under a peculiar weather condition and sometimes becomes a severe condition such as dense fog and rough sea according to low-pressure passing. Therefore, a mental tension is always compelled for the captain and duty officer on watch for the safety service of the ship. Students can inspect the knowledge and skills of seamanship acquired by the current university education while doing various experiences in each scene through onboard practice. Besides this, participating in the investigation and researches concerning an ocean and the ship, etc. while using the ability, which she can have as floating laboratory, is an important mission. In addition, it is also important to open to the public and to hold experience embarkation for young generation in cooperation with the municipality and the schools etc. in region, and to do the enlightenment activity about maritime affairs and the marine transportation. The authors will propose that she should positively develop the next stage of effective activity for contribution to the society while maintaining the type of ship originally as a training ship of Kobe University of Mercantile Marine in cooperation with another universities, research laboratories and enterprises etc. related to maritime affairs in the future.

References