The United Nations University
FISHERIES TRAINING PROGRAMME

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CURRICULUM FOR FISHING TECHNOLOGY AND SEAMANSHIP COURSES

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ABSTRACT

The project's objective is to develop a training curriculum (integrated syllabus that will consist of a set of course topics and their contents) for fishing technology and seamanship courses at NAMFI (Namibian Maritime and Fisheries Institute) in which clear aims in the working practices for fisheries training and methods are set out as part of the syllabus. Due to ever changing technology and new demands, it seems natural to review the curriculum to keep up with challenges in the fisheries sector. So the training has practical relevance to the fishing industry, keeping in mind the career destinations of our students. Emphasis is placed on improving the students' knowledge and skills by taking into account more practical exercises. The major topics involved are fishing gear design and modifications, responsible fisheries practices, fish handling and quality issues, which were divided into sub-topics. However, the whole structure was tailored down to a syllabus with a defined content, duration, methods of teaching, teaching material and assessment criteria for both Deck Officer Class 6 and 5 levels respectively. Classroom lectures are presented and practical demonstrations will be exercised for each of the main topics. The curriculum fits the needs and challenges of training deck hands, mates and skippers in compliance to international standards.

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1 INTRODUCTION

1.1 A brief overview of the Namibian fisheries sector

Namibia is situated on the south west coast of Africa. It is known for its rich fishing grounds, thanks to the cold plankton rich Benguella current that flows in a northwesterly direction all along the Namibian coastline from south to north. The upwelling system supports one of the most productive marine ecosystems in the world. It is a relatively simple ecosystem where the different species have fairly simple interactions with other components of the system (Boyer and Hampton 2001). The Namibian coastline stretches for a distance of about 1500 km and the exclusive economic zone of the Republic of Namibia is about 580,000 km^2(FAO 2002). Marine fishing in Namibia is relatively young with many large-scale modern fisheries, which consist of deep sea demersal and mid-water trawling, demersal and pelagic longlining and purse seining. Over 20 commercially important species are harvested using large to medium size vessels ranging from 30 – 90 m in length. Before independence in 1990, foreign fishing fleets from European countries fished illegally in Namibian waters (Bonfil *et al.* 1998, Sumaila and Vasconcellos 2000) and for that reason the Namibian fisheries sector was faced with many challenges. Amongst those were illegal fishing, illegal landings, discards and fish stocks were over-exploited (Pauly *et al.* 2002, Myers and Worm 2003). Since independence in 1990, the control of this valuable resource was vested in the hands of the Namibian government. Since then with the aim to protect ocean areas of Namibia, the government implemented new management systems to promote sustainable harvesting of marine resources and to foster the Namibianisation policy for the benefit of both current and future generations of Namibia.

Despite measures towards better management, Namibia is still facing diminishing fish stocks like those of anchovy, pilchard and orange roughy. To further strengthen fisheries management, Namibia has been in collaboration with several SADC (Southern African Development Countries). They have taken part in programmes like the BENEFIT (Benguella Environment Fisheries Interaction and Training Programme, BCLME (Benguella Large Marine Ecosystem) and the ICCAT (International Commission for the Conservation of Atlantic Tunas), which may help the sector to meet the goals and objectives of vision 2030 through regional and international co-operation.

Today the fishing sector employs about 14,000 Namibians both land based factory employees and sea going personnel of which the majority works as mates, bosun's and ordinary seaman. From a total number of 279 licensed vessels (Ministry of Fisheries and Marine Resources 2003), about 80% are Namibian owned and 20% foreign owned. As an attempt to further strengthen the fisheries sector in Namibia the government has been operating a maritime school (NAMFI) since 1996. The main objective of NAMFI is to provide training and education to both land based and sea going personnel. Thus, the idea of Namibianising the fishing industry may be achieved if more Namibians are trained for the fishing sector.

2 THE ROLE OF NAMFI IN THE FISHERIES SECTOR

1.2 The Namibian Maritime and Fisheries Institute

The Minister of Fisheries and Marine Resources in July 1996 created the Namibian Trust for Maritime and Fisheries Training with the aim to provide adequate maritime and fisheries training to Namibian fisherman. Today its main aim is to be the leading maritime institute in the SADC region. Thus, fishing technology and seamanship has been dealt with at NAMFI since its inception in 1996 and ever since NAMFI has endeavoured to offer Namibian fishermen competitive training. NAMFI has an existing syllabus that covers traditional fishing technology and seamanship but not much has been done regarding fishing gear construction, fish handling, quality control on board, and responsible fisheries practices in compliance to international standards (NAMFI 2005). NAMFI as the only maritime and fisheries institute in the country under the leadership of the board of trustees, is a rapid developing training institute. Therefore, NAMFI strives to deliver quality maritime and fisheries training to sea going deck and engineer officers both nationally and regionally. Thus, in meeting all requirements of stakeholders and engendering commitments, the Namibianisation policy of government may be achieved.

1.3 Fisheries training and certification

NAMFI consist of three departments namely Navigation, Engineering and Safety, which provide training to the fishing, offshore mining and merchant fleets. The navigation department offers fisheries training from Class 6 (beginner level) up to Class 5 (higher level) on support level. In addition to other maritime courses offered by NAMFI, the flowchart in Figure 1 below shows the structure of fisheries courses offered by NAMFI in compliance to the STCW-95 and STCW 95/F[1] international conventions.

Mate II/Skipper II and Mate I/Skipper I/ are initial qualifications of competency issued to the graduates by the Directorate of Maritime Affairs (DMA) on completion of their academic studies at NAMFI. After completing the 12 months sea going service on board any fishing vessel, the DMA will revise the academic certificates issued by NAMFI and the professional sea going service, before deciding on what manning rights (rank of certificate) the graduates will be issued in relation to the size of vessel in gross registered tonnage. It certifies and grants the holder of the qualification the right to sail on board a fishing vessel in a certified rank or capacity. Thus, depending on the length of in service training (sea experience) and the size of vessel, the qualification varies from a third Navigation Officer (Mate) to a second Navigation Officer (Mate) to a Chief Navigation Officer (Chief Mate) up to the highest rank that is a Commander of a fishing vessel (skipper). Whereas on completion of the Class 5 course, the graduates are also required to complete 12 months sea going service as an officer in charge of a navigational watch. After which on satisfaction of the DMA, the graduates will then be certified as skipper on board any fishing vessel of unlimited size (Namibian Directorate of Maritime Affairs 2002).

[1] International Conventions on the Standard of Training, Certification and Watch keeping/F-Fishing vessels, 1995

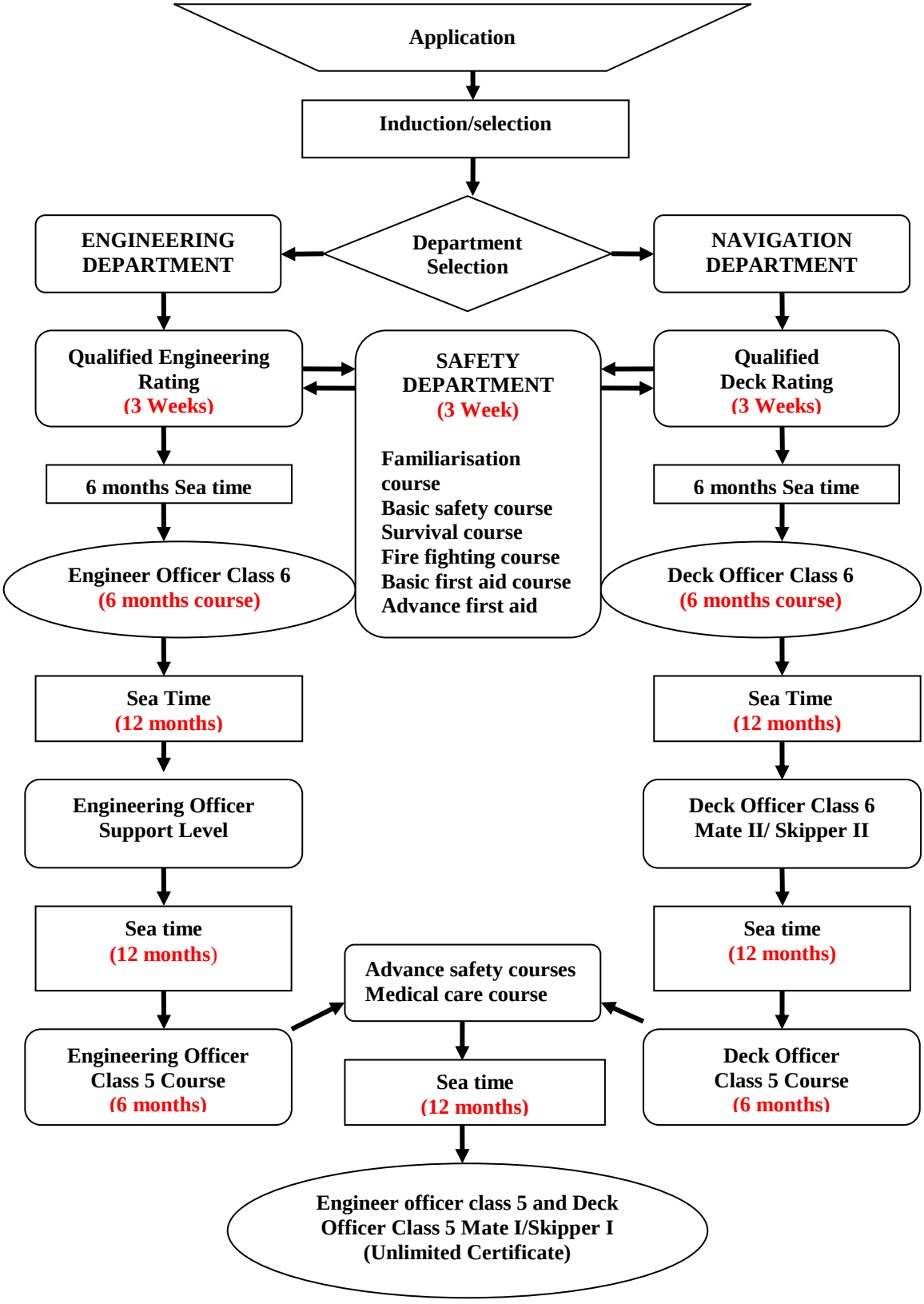

Figure 1: Flowchart of fisheries training at NAMFI.

3 CURRICULUM

1.4 Existing fisheries curriculum

The existing curriculum is indeed a child of its time, limiting itself by only providing a list of topics and sub-topics (APPENDIX 1).

Outlined as follows:

1) Fishing technology
2) Fish handling
3) Fish biology and fishing ecology
4) Responsible fisheries practices
5) No pollution
6) Ability to be safe working leader personnel on board
7) Namibian fishing legislation

Nowhere in the document is it explained how training will be delivered or what the expected training outcomes to be attained at the end of training are. As a result, some subjects, especially seamanship practical training, receives less attention than desired by the fishing industry. This is causing a problem because the fishing industry requires the graduates to have at least basic practical skills in order to be of full use on board the fishing vessels (NAMFI, 2005).

However, the status is such that more practical classes or exercises at NAMFI will steer training so it has more practical relevance to what is required by the student's professional line of duty onboard fishing vessels.

Therefore, in light of recent research in the field of curriculum development (Colin 2004) and the result from [studies on competency of NAMFI graduates] the following issues will be addressed in the new curriculum:

- Time/duration of topics
- Training aims and objectives
- Training outcomes to be specified in terms of knowledge and skills
- Main teaching/learning methods
- Teaching/learning aids or material to be used
- Method or criteria of competence evaluation to be specified
- Didactical/pedagogical evaluation of main topics to be covered from most important to less important should be reflected

4 NEW CURRICULUM

1.5 Aims and objectives

This describes the knowledge and skills to be achieved by the students on completion of the full fishing technology and seamanship syllabi. At the end of the 6 month course, the students should be able to:

- Name and identify the main fishing gear types used in Namibia.
- Name the characteristics, physical properties of fishing gear materials and accessories.
- Explain the area of use of fishing gear materials and accessories.
- Classify different fishing gear used in Namibia.
- Explain and identify how fishing gears are handled and appreciate the main tensions on fishing gear.
- Explain effectiveness of different fishing gears and the behaviour patterns of fish towards gear.
- Know the impact of fishing gears on the marine ecosystem.
- Identify the suppliers of fishing gear material and accessories.
- Explain how to order material for making fishing gear.
- Perform fishing gear calculations for example the volume, costs, size/length, length of towing warps, trawl winch capacity etc.
- Design, construct, maintain and repair fishing gears.
- Measure different parts on a set of fishing gear, using correct measuring devices, cut netting, wire, rope and chain according to plans.
- Assemble/set-up fishing gear using the different materials and accessories in fishing gear.
- Know how to identify and solve gear related problems on board.
- Make different fisherman’s knots and know the common uses.
- Make different splices/whippings on all categories of ropes/ wire and know the application of each.
- Understand the use and importance of fish finding equipment on board fishing vessels.
- Have a good understanding of working conditions on board fishing vessels.
- Understand and know the fisheries regulations relating to minimum mesh sizes and other fishing gear requirements or equipment.
- Name and explain good fish handling practices on board and what are the effects of poor fish handling practices on board.
- Describe good hygiene/cleanliness methods and the treatment of fish before stowage on board.
- Plan a fishing trip according to the species to be caught, method of capture and the fishing area selected.

1.6 Target group

The syllabus aims at providing quality fisheries training to successful high school graduates wishing to begin or further a career at sea, ratings forming part of a navigational watch, old fishermen who wish to upgrade their qualifications from the old grade system to the new class system and deck officers. In addition, tailor made courses can be presented to both land based and sea going fisheries observers and inspectors as well as refresher courses for old fishermen on new fishing techniques, gear design or operation.

1.7 Entry requirements

Since it is NAMFI's vision to be the preferred provider and co-ordinator of competently trained officers for the fisheries sector mainly in Namibia, all successful candidates must meet the following entry requirements as stipulated in the Main Quality Management Manual of NAMFI.

- Must be literate (read and write) in English
- Must have passed grade 12 with at least (C symbol) in English, Mathematics and Physical Science
- Must be medically fit or hold a seafarers medical certificate not older than 6 months
- Must have an eyesight and colour blindness test (Ishihara) medical certificate
- Must be 18 years or older, but not older than 50 years
- Must have passed the NAMFI entrance exam on appropriate level
- Should have no criminal record

1.8 Levels of training

1.8.1 Deck officers Class 6 – Beginner level

Applicants should have completed grade 12 at the secondary level. They should have passed Physical Science, English and Mathematics at secondary level or have a minimum of 18 months sea going service on board any sea going fishing vessel. Requirements to meet should be in compliance with the NAMFI Operational Manual for Maritime Training, referring to minimum entry requirements for further education at NAMFI (Namibian Directorate of Maritime Affairs 2002).

1.8.2 Deck officers Class 5 – Higher level

Applicants should be holders of a Class 6 certificate of competency and should have completed the required basic maritime safety and survival training courses. The applicants are also required to complete at least 30 months of sea going service as officers in charge of a navigational watch on board any sea going fishing vessel as described in the national regulations on the standards of training, certification and watch keeping of seafarers (Namibian Directorate of Maritime Affairs 2002).

1.9 Content of Class 6 curriculum

1.9.1 Fishing technology and seamanship course structure

The study in fishing technology and seamanship is a technical apprenticeship. Clear aims in working practices and methods are set out as part of the curriculum. The curriculum is divided into general theory subjects and practical classroom training subjects totalling 120 class hours. Note that one class hour referred to in Table 1 below is 40 minutes. Increasing each student's understanding and skills is important and therefore the course is designed to be covered in 6 months. Applicants at beginner level (Class 6) are advised on application to first complete at least 18 months of sea going service on board any sea going fishing vessel as a private cadet or ordinary seaman before applying to NAMFI to do the Class 6 course. In addition to fishing technology and seamanship, the following modules in Table 1 below forms part of the Class 6 and 5 module courses to be completed in 6 months. Note: This project will deal with designing a training curriculum for fishing technology and seamanship only.

Table 1: Class 6 and 5 module courses.

Module courses/semester	Total class hours
1. Navigation	**120**
2. Rules of the road (orals)	**120**
3. Stability	**120**
4. Electronic navigation systems	**80**
5. Global Maritime Distress and Safety System (GMDSS)	**120**
6. Fishing technology	**80**
7. Seamanship	**40**
8. Meteorology	**40**
9. Mathematics	**80**
10. Maritime English	**40**
11. Maritime law	**40**
12. Engine Theory	**40**

On successful completion of the Class 6 course, graduates will have the choice of either continuing their academic studies onto Class 5 level for another 6 months or meeting the 12 months sea time requirement. The Directorate of Maritime Affairs in Namibia is the only institution that is responsible for issuing the final certificates of competency.

1.9.2 List of courses, duration and expected training outcomes/unit

The list of study units below clearly outlines the manner in which the curriculum aims to achieve or meet the training outcomes. Clear reference is made regarding the content of the curriculum courses with an emphasis on practical training to meet the demands of the fishing industry (NAMFI, 2005). The duration and methods of teaching in the list of study units below has been decided based on my personal teaching experience and considering the time it takes to present and demonstrate certain lessons.

Class 6 fishing technology and seamanship courses – 120 class hours
Note that one class hour referred to in the list below is 40 minutes

1. Netting materials for fishing gear
2. Introduction to net mending
3. Fishing vessel types and fishing methods
4. Rigging fitments and their strength
5. Fishing gear calculations
6. Interpretations and modifications of fishing gear designs
7. Rigging bosun's chair and pilot ladder
8. Fisheries acoustics
9. Selectivity devices for fishing gear
10. Fish handling and preservation
11. Fish biology
12. Namibian fisheries regulations

1. Netting materials for fishing gear – 20 class hrs

Objective:
Introduce the students to different types of ropes, twine, care and storage, related to its application and strength.

Contents:
- Ropes, knots and splices
- Main categories, construction and identification
- Application and breaking strength calculations
- Choice of netting material for fishing gear

Teaching material:
- Fishing technology handbook by Tobias Nambala (Nambala 2004)
- Fisherman's workbook by John Prado (Prado 1990)
- Instructor handouts on paper and in electronic format
- Practical exercises and demonstrations
- Site visits and videotapes

Training outcomes: (Students should be able to:)
- Know appropriate use and physical properties of ropes and splices
- Know the application of commonly used fisherman's knots and splices
- Calculate breaking strength of ropes
- Identify main categories of ropes
- Select the right netting materials for its application
- Demonstrate tying the main fisherman's knots
- Demonstrate the ability to make different splices with ropes
- Demonstrate the care and storage of ropes

2. Introduction to net mending – 20 class hrs

Objective:
Make students familiar with how to mend nets of equal size, measure them and repair them.

Contents:
- Select the right tools to use
- Make correct starting knots and mend meshes of equal size
- Measure size of meshes using the right tool

Teaching material:
- Instructor handouts on paper and in electronic format
- Videotapes and site visits

Training outcomes: (Students should be able to:)
- Select the right working tools to use
- Assess the degree of tear/cut
- Demonstrate proper use of working tools
- Demonstrate ability to mend equal size meshes in all directions

3. Fishing vessel types and fishing methods – 20 class hrs

Objective:
Teach students how to classify different fishing vessels in relation to its design, size and understand the basic operation of different methods of fishing.

Contents:
- Classify different fishing vessels in accordance to the international standards of statistical classification of fishing vessels
- Setting and hauling operations of pots and traps
- Setting and hauling operations of purse seining
- Setting and hauling operations of long lining
- Setting and hauling operations of trawling
- Draw and name the different parts of fishing gears used in pot and trap setting, long lining, purse seining and trawling

Teaching material:
- Fishing technology handbook Tobias Nambala (Nambala 2004)
- FAO technical paper on the ISSCFV[2]
- Instructor handouts on paper and in electronic format

Training outcomes: (Students should be able to:)
- Identify and classify different fishing vessels
- Draw and describe different fishing methods used in Namibia
- Describe setting and hauling operations of main fishing gear used in Namibian waters

[2] International Standards on Statistical Classification of fishing vessels

4. Rigging fitments and their strength – 4 class hrs

Objective:
Make students familiar with the main rigging fitments used in the fishing industry and its strength.

Contents:
- Rigging fitments and their uses
- Safe working load and breaking strength of blocks and tackles

Teaching material:
- Fisherman's workbook by John Prado (Prado 1990)
- Fishing technology handbook Tobias Nambala (Nambala 2004)
- Instructor handouts on paper and in electronic format
- Site visits and videotapes

Training outcomes: (Students should be able to:)
- Know the application/uses of rigging fitments
- Know the different parts of rigging fitments
- Identify different rigging fitments
- Calculate safe working load and breaking strength of rigging fitments

5. Fishing gear calculations – 10 class hrs

Objective:
Introduce the students to important fishing gear calculations and why they are calculated.

Contents:
- Rough estimation of float buoyancy
- Estimate weight of netting in air and sea water
- Calculate the twine surface area covered by a piece of netting
- Length of stretched netting (Lsn)
- Height of stretched netting (Hsn)
- Effective height (Eh)
- Number of meshes in length (n°)
- Number of meshes in height (n°)
- Estimate the length of towing warps and trawling depth
- Calculate the spread of otter boards
- Spread of trawl, length of sweeps, bridles and length of trawl

Teaching material:
- Fisherman's workbook by John Prado (Prado 1990)
- Fishing technology handbook Tobias Nambala (Nambala 2004)
- Instructor handouts on paper and in electronic format
- Site visits and videotapes

Training outcomes: (Students should be able to:)
- Understand why these calculations are calculated
- Demonstrate the ability of make fishing gear calculations

6. Interpretations and modifications of fishing gear designs – 20 class hrs

Objective:
Teach students how to interpret net plans from designers and make modifications on fishing gear.

Contents:
- Read and understand fishing gear designs
- Make drawings of modified fishing gear designs to scale
- Make modifications on fishing gear

Teaching material:
- Net makers workbook by Larus Palmason (Palmason 2006)
- Instructor handouts on paper and in electronic format
- Site visits

Training outcomes: (Students should be able to:)
- Read fishing gear plans
- Demonstrate ability to make adjustments/modifications on fishing gear

7. Rigging bosun's chair and pilot ladder - 6 class hrs

Objective:
Make students familiar with how to rig a bosun chair, stage and pilot ladder.

Contents:
- Introduction to bosun chairs, stages and pilot ladders and their applications
- Select the right material to use
- Make measurements to correct size
- Rig a bosun's chair or a stage and a pilot ladder

Teaching material:
- Net makers workbook by Larus Palmason (Palmason 2006)
- Instructor handouts on paper and in electronic format
- Site visits

Training outcomes: (Students should be able to:)
- Describe the applications of a bosun's chair, stage or pilot ladder
- Demonstrate ability to rig a bosun's chair, stage or pilot ladder

8. Fisheries acoustics – 4 class hrs

Objective:
Is to make students familiar with fish finding and gear monitoring equipment in use.

Contents:
- Echo sounders
- Net sounders/net sensors
- Sonar

Teaching material:
- Instructor material/handouts on paper and in electronic format
- Echo grams from Pall Reynisson/Marine Research Institute of Iceland
- Echo grams from Einar Hreinsson/Marine Research Institute of Iceland
- Site visits

Training outcomes: (Students should be able to:)
- Know the purpose of electronic fishing aids
- Demonstrate ability to interpreted echo signals

9. Selectivity devices for fishing gear – 2 class hrs

Objective:
Make students familiar with the importance of selectivity devices.

Contents:
- Fishing gear selectivity
- Selective properties of a grid
- Selective properties of square mesh panels

Teaching material:
- Fishing technology handbook by Tobias Nambala (Nambala 2004)
- Instructor handouts on paper and in electronic format
- Site visits and videotapes

Training outcomes: (Students should be able to:)
- Describe the importance of fishing gear selectivity

10. Fish handling and preservation - 6 class hrs

Objective:
Make students familiar with good fish handling practices onboard, to maintain good fish quality.

Contents:
- Methods of preservation and treatment of fish before storage
- Care and good hygiene practices

Teaching material:
- Instructor material/handouts on paper and electronic format
- European Union, Council directives 91/493/EEC (fishery products)
- Site visits

Training outcomes: (Students should be able to :)
- Describe different staff hygiene requirements with regards to fish handling
- Describe different cleaning and disinfecting requirements
- Identify the appropriate personnel protective equipment to use in a fish processing plant onboard
- Demonstrate the care and preservation methods of the catch

11. Fish Biology - 4 class hrs

Objective:
Make students familiar with the basic names and characteristics of a fish.

Contents:
- Local and scientific names of fish and measurements of fish
- Internal and external anatomy of a fish
- Life cycle of fish
- Growth and age determination

Teaching material:
- Instructor material/handouts on paper and in electronic format
- Site visits

Training outcomes: (Students should be able to:)
- Name the main fish species harvested in Namibian waters
- Name the external and internal anatomy of fish
- Describe the life cycle of fish and know how the age of fish is determined
- Demonstrate how to measure the length of different fish species

12. Namibian fisheries regulations – 4 class hrs

Objective:
Introduce students to the main fisheries regulations on minimum mesh sizes and how to record data in the fishing logbooks.

Contents:
- Regulations on the minimum mesh sizes
- Regulations of pollution
- Regulations on penalties on offenses
- Duties of fisheries observers and inspectors

Teaching material:
- Marine Resources Act'2000

Training outcomes: (Students should be able to:)
- Demonstrate how to measure the correct mesh sizes of fishing gear
- Know the regulations on the minimum mesh sizes, discarding and pollution

1.10 Content of Class 5 curriculum

1.10.1 Fishing technology and seamanship course structure

As mentioned above in chapter 4.5.1, the total class hours/semester remains the same. The only thing that changes at the Class 5 level is the content of the fishing technology and seamanship courses. At this level, it goes into greater depths because it is the highest level of fisheries training for which the students on successful completion of the course will be issued an unlimited certificate of competency in accordance to national regulations on the standards of training, certification and watch keeping of seafarers (Namibian Directorate of Maritime Affairs 2002).

It will be beneficial to make some changes because of the responsibilities and decision making the graduate will carry out as skipper. In that regard, future employers (fishing industry) will expect that the Skipper takes proper charge of a vessel and enables them to land fish products of high quality to the market. Therefore, it is necessary for a Skipper to have certain qualities in terms of planning, decision-making and have proper organisation of the vessel's operation. That is why the course structure of both fishing technology and seamanship is designed to tailor for all these matters in general. The duration and methods of teaching in this project has been decided based on my personnel teaching experience, considering the time it takes to present and demonstrate certain lessons.

1.10.2 List of courses, duration and expected training outcomes/unit

The list of study units below was developed to clearly outline the way in which the curriculum aims to meet the training outcomes at the end of this course. In Appendix 3 clear reference is made to how the different topics, study material and duration are divided. This table has been compiled having more emphasis on practical training, what the training outcomes per study unit should be and the teaching aid/resources

that will be use to supplement learning. In addition to computer projectors and other visual aids recommended during lessons, site visits will also be carried out to supplement the learning process. Thus, it may give the students a broader view of the subject and exposure to the real life situation.

Class 5 Fishing technology and seamanship courses – 120 class hours
Note that one class hour referred to in the list below is 40 minutes

1. Introduction to fishing gear technology (equipment for deck and wheelhouse)
2. Fishing methods and fish behaviour
3. Fishing gear design, construction and modifications
4. Model designing and flume tank simulations
5. Fisheries acoustics
6. Fish handling and storage
7. Responsible fisheries practices
8. Namibian fisheries regulations (Marine Resources Act'2000)

1. Introduction to fishing gear technology – 10 class hrs

Objective:
Introduce students to the main materials used for fishing gear design in relation to their application, physical properties and strength.

Contents:
- Netting material for fishing gear
- Numbering systems for netting twine
- Safe working load and breaking strength calculations
- Choice of netting material for fishing gear
- Ordering equipment for deck and wheelhouse

Teaching material:
- Fishing technology handbook by Tobias Nambala (Nambala 2004)
- Fisherman's workbook by John Prado (Prado 1990)
- Net makers workbook by Larus Palmason (Palmason 2006)
- Instructor handouts on paper and in electronic format
- Site visits and videotapes

Training outcomes: (Students should be able to:)
- Know the physical properties
- Name the suppliers of fishing material and accessories
- Describe how to order fishing materials and accessories
- Select appropriate fishing gear material for use
- Calculate and measure size of different netting twine
- Calculate the safe working load and breaking strength of ropes, blocks and tackles in a purchase

2. Fishing methods and fish behaviour – 20 class hours

Objective:
Make students familiar with different fishing methods, their operation and how fish behaves towards fishing gear.

Contents:
- Pots and traps and fish behaviour
- Long lining and fish behaviour
- Purse seining and fish behaviour
- Trawling and fish behaviour

Teaching material:
- Instructor material/handouts on paper and in electronic format
- Videotapes
- Site visits

Training outcomes: (Students should be able to:)
- Understand the behaviour of fish in relation to gear
- Modify fishing gear for better yield and efficiency

3. Fishing gear designs, construction and modifications – 30 class hours

Objective:
To make students familiar with the principles of fishing gear design and modifications, in relation to vessel power, size and fuel consumption.

Contents:
- Gear calculations (gear designer)
- Manual drawings of fishing gear plans
- Computer aided drawings of fishing gear plans (DesignCAD, CADtrawl)
- Gear construction

Teaching material:
- Handbook on fishing gear design, modelling and simulation/Larus Palmason
- Net makers workbook by Larus Palmason (Palmason 2006)

Training outcomes: (Students should be able to:)
- Know all symbols relating to gear design and demonstrate ability to make necessary gear design calculations
- Know how to read fishing gear plans
- Draw fishing gear plans manually and on computer
- Enlarge or reduce designs according to scale on paper and on computer
- Demonstrate proper techniques of net mending and repair
- Measure all netting panels/cuts it using the correct instruments
- Attaches net sections and parts

4. Model designing and flume tank simulations – 20 class hrs

Objective:
To teach students how to design scale models of their own fishing gear and test it in a flume tank so they could identify problems and make modifications.

Contents:
- Calculate a suitable scale and reduce design to that scale
- Choice of material and accessories
- Cutting rates and measurements

Teaching material:
- Handbook on fishing gear design, modelling and simulation by Larus Palmason (Palmason 2006)
- Instructor material on paper and in electronic format
- Videotapes
- Site visits

Training outcomes: (Students should be able to:)
- Have an overview of how fishing behaves underwater
- Rig a trawl model to scale and test it in a flume tank and make adjustments to improve fishing.

5. Fisheries acoustics – 10 class hrs

Objectives:
Give students an overview of fish finding equipment and gear monitoring devices in use and how to interpret echo signals.

Contents:
- Echo sounder and interpretation of echo grams/signals
- Sonar and interpretation of echo signals
- Net sounders and sensors

Teaching material:
- Instructor material/handouts on paper and in electronic format
- Echo grams from the north seas/Pall Reynisons
- Sonar signals an echo grams from the north seas/Einar Hreinsson
- Videotapes

Training outcomes: (Students should be able to:)
- Know the types of fish finding equipment and fishing gear monitoring devices in use
- Read/interpret signals from fish finding devices

6. Fish handling and storage – 20 class hrs

Objective:
To make the students familiar with good fish handling practices onboard concerning good hygiene requirements.

Contents:
- Spoilage and refrigeration
- Icing and mechanical refrigeration
- Refrigerated sea water
- Freezing at sea
- Staff hygiene requirements
- Basic requirements during the handling of fishery products
- Cleaning and disinfecting requirements
- Monitoring hygiene and pests control
- Introduction to HACCP

Teaching material:
- Instructor material/handouts on paper and in electronic format
- European Union, Council directives 91/493/EEC (fishery products)
- Site visits

Training outcomes: (Students should be able to:)
- Describe good fish handling practices and methods of preservation
- Describe proper hygiene requirements in fish processing plants
- Identify hazards to fish handling in processing plants onboard fishing vessels
- Supervise and inspect fish processing plants prior to processing
- Give instructions and advise on good fish handling practices onboard

7. Responsible fisheries practices – 10 class hrs

Objective:
To introduce the students to the fishing grounds of Namibia and their resources in compliance to harvesting regulations of the government.

Content:
- Biological cycle of the sea
- Fishing grounds of Namibia
- Undersize fish/by catch
- Problem of over fishing
- Discarding the catch
- Fishing logbook

Teaching material:
- Instructor material/handouts/Seas of Southern Africa
- Marine Resources Act of 2000
- Videotapes
- Site visits

Training outcomes: (Students should be able to:)

- Understand the biological cycles of the sea/fishing grounds.
- Know the effects of over fishing, catching of juvenile fish and discarding
- Select the best fishing grounds for fishing

8. Namibian fisheries regulations – 4 class hrs

Objective:
To introduce students to the main fisheries regulations relating to fishing operations, restrictions and data recordings in the fishing logbooks.

Contents:

- Harvesting of marine resources
- Management and control measures
- Offences and proceedings
- Duties of fisheries observers and Inspectors

Teaching material:

- Marine Resources Act'2000

Training outcomes: (Students should be able to:)

- Know the limitations on fishing and harvesting regulations and related punishments granted offences.

1.10.3 Assessment criteria and competence evaluation

An assessment criterion is developed on the basis of how well a student has to achieve the learning outcomes. It is therefore very important to assess the progress of the students and to evaluate the level to which the student has achieved the training outcomes of the course at each section. Therefore, all instructors should assess each student's progress using the assessment criteria in Table 2 below for both Class 6 and 5 levels. The information that students assessments of progress provides, helps teachers in setting further targets and can also be the reason for making alterations to the syllabus, the order of teaching material used over the years and the teaching methods used.

A criterion for evaluating competence in fishing technology and seamanship is an important tool that can be used to encourage students to improve their results. At the same time allowing them an opportunity to monitor their own progress and therefore, may help them to increase interest in the subject. However, during the final fishing technology examination, all students will be required to submit written answers to questions related to theoretical aspects of fishing technology. Whereas, the seamanship course is designed to cover the practical aspects of the subject area and intended to enable students to gain practical working skills that will be beneficial to the students in their future employment.

During the academic semester, all instructors should continuously assess the level of competency of students. In that regard, continuous assessments will account for 20% out of the total credit at the end of the semester. Therefore, this exercise may not only motivate the students to succeed but will drive them positively and allow more room

for improvement before the end of the academic semester. Amongst many, below are methods the instructors could use to evaluate whether the students have met the required training outcomes per lesson.

Methods for evaluating competence of students:

- Use of projects/practical cases that students can complete in class or as homework
- Continuous assessments
- Written and practical test in which the level of understanding and skills of different subjects can be demonstrated
- Oral test
- Final written examination
- Practical examination

Table 2: Assessment criteria for Classes 6 and 5

FISHING TECHNOLOGY - THEORY

STUDY UNITS		GRADE A 90-100%	GRADE B 80-90%	GRADE C 70-80%	GRADE D 60-70%	GRADE E/fail
1.	Fishing technology	Excellent clarity and has met training outcomes	Clear evidence of students ability to meet the training outcomes	Ability of understanding indicated in the subject area	Some ability of understanding the subject area	Failure of understanding the subject area, incompetent
2.	Responsible fisheries practices	Excellent clarity and has met training outcomes	Clear evidence of students ability to meet the training outcomes	Ability of understanding indicated in the subject area	Some ability of understanding the subject area	Failure of understanding the subject area, incompetent
3.	Fish handling	Excellent clarity and has met training outcomes	Clear evidence of students ability to meet the training outcomes	Ability of understanding indicated in the subject area	Some ability of understanding the subject area	Failure of understanding the subject area, incompetent
SEAMANSHIP – PRACTICAL						
1.	Fishing gear design	Application of skills very well demonstrated as outlined in the training outcomes	Clear evidence of skills demonstrated as outlined in the training outcomes with few mistakes	Ability of skills demonstrated with many mistakes	Attempts are logical and some ability of skills demonstrated	Failure to demonstrate ability of skills, student still lacks required skills
2.	Technical drawing and computer aided drawing	Demonstrated excellent drawing skills	Clear evidence of drawing skills with few mistakes	Ability demonstrated with many mistakes	Some ability of technique/skills demonstrated with many mistakes	Failure to demonstrate ability to draw and work incomplete
3.	Model designing for flume tank observations	Demonstrated excellent skills and clear understanding of trawl testing in flume tank	Clear evidence of skills demonstrated with few mistakes	Ability demonstrated with many mistakes	Some ability of skills and application with many mistakes	Failure to demonstrate required ability, students lacks required skills
4.	Modification of fishing gear	Application of skills well demonstrated as outlined in the training outcomes	Clear evidence of skills demonstrated as outlined in the training outcomes with few mistakes	Ability of skills demonstrated with many mistakes	Attempts are logical but some ability of skills demonstrated	Failure to demonstrate ability of skills, student still lacks required skills

1.11 Lesson planning

Lesson planning is a special methodology that serves as a guide for proper planning on a particular subject the teacher intends to teach. It helps the teacher to organise the information in such a way that he/she teaches effectively and for the students to learn easily. Therefore, it identifies the most suitable method of instruction. It also keeps the teacher focussed on important information to transfer to the learners. At the same time, it makes it easier for the students to meet the learning objectives whether it is the learning of knowledge or development of special skills and abilities. An example of a lesson plan on ropes in (Table 3) below is an illustration of what a well-prepared lesson plan should consist of. It also makes it easy for a substitute teacher to present any lesson, almost the same way the rightful teacher would have done it. According to recent findings by Polytechnic of Namibia (2005), a well-prepared lesson plan should at least consist of the following parts.

a) Introduction:
- Main aim of lesson (what the teacher intends to teach)
- What preparation will be required for the lesson (teaching methods/training aids, material, training area etc?
- How the teacher will start to motivate his students for what is to follow in the lesson

b) Development:
- Division of the lesson body into logical steps and how these steps will be presented
- What student participation is intended and the work they will pursue

c) Conclusion:
- The extent to which the work covered should be briefly summarised
- How the teacher intends to round up of the lesson

d) Evaluation of the lesson:
- Would you deliver this lesson using the same strategies, examples, activities etc?
- What means will you use to evaluate whether the students have met the required learning/training outcomes after the lesson

Table 3: Example of a 7 Class hour lesson plan on ropes.

Level: Deck officers Class 6	**SUBJECT:** Seamanship (practical skills)
DATE: 26th January 2007	**TOPIC:** Ropes
LOCATION: NAMFI (Namibian Maritime and Fisheries Institute)	**DURATION:** 280 minutes
TYPE OF LESSON: - Illustrated talk with questions and answers - Practical demonstrations with classroom exercises	**RESOURCES REQUIRED:** - Seamanship classroom 1 - Natural, synthetic and wire ropes - Whiteboard with markers - Videotapes, site visits, notes - Incomplete handout for homework
AIMS: - To acquire knowledge and skills in main types of ropes	
LEARNING OUTCOMES: At the end of this training students should be able to: - Identify main categories of ropes - Demonstrate care and storage of ropes - Demonstrate the coiling and uncoiling of ropes - Identify different fibre ropes - Apply knowledge and skills gain to workshop task/test	
CONTENT OF LESSON	**DURATION** (minutes)
Introduction - Introduce the students and give a brief overview of ropes in general - Explain different forms of rope construction - Explain the degree of twist in ropes and the best forms of rope identification	60 min. 120 min.
Development - Introduction to ropes, main categories of ropes and main applications at sea, fibre ropes, steel wire ropes, care and storage of ropes, coiling and uncoiling of different categories of ropes - Demonstrate main uses, construction etc. - Let the students practice construction, care/storage, coiling etc.	60 min.
Conclusion - Let them do more exercises and classroom practices	40 min.
Evaluation - Illustrated talk with questions and answers (videotapes, site visits, homework, test) - Practical demonstrations with classroom exercises	

5 FUTURE DEVELOPMENTS

1.12 Trawl model designing and flume tank simulations

Trawl nets are very large and it is very difficult to get an overall view of how they work under water in reality. Underwater cameras can be used to observe the performance of trawl nets under water, but it is a difficult and expensive operation. According to Palmason (2006), it is a relatively cheap and easy exercise to make trawl nets to small scale and view them in a flume tank. By so doing, improvements or modifications can be made on both old and new trawls, for better working results, more yield and/or efficiency.

The basic procedure when designing a trawl model to small scale, is to perform mathematical calculations to find out the twine surface area of trawl, correct line length, mesh sizes and circumference of trawl before scaling it down. During this exercise, the Pythagoras theorem in the Fisherman's Workbook by Prado (1990) and the Fishing Gear Technologist computer programme by Palmason (2002) for gear design was used to find the main dimensions of bridles, sweep lines and cables. The gear calculation programme in (Figure 2) below is a faster means to make all necessary calculations of trawl designs and it saves a lot of time.

In order to improve the understanding and practical skills of Namibian fishermen, it would be beneficial to incorporate trawl model designing in the new fisheries curriculum. One objective of this project is to incorporate trawl model designing and simulation in the new fishing technology and seamanship curriculum on both Class 6 and 5 levels. It may also allow NAMFI to prepare tailor made courses to existing skippers and mates.

As an example of training that could be presented on the subject, a common bottom trawl (Ice Champ-74) used in the Namibian hake fishery was scaled down and tested. Figures 2 and 3 below show the design of original dimensions to full scale and line length of the model before it was scaled down.

A flume tank with a fibreglass shell having a total area of 5 m^2 with an observation area of 2, 8 m^2 was used to simulate the Ice Champ-74 model at the Sudurnes Comprehensive College in Reykjanesbaer, Iceland. The tank holds about 3640 l of water that is circulated by a pump of 5 kW (6, 7 HP)3 that creates a current to simulate towing a trawl. Therefore, the most convenient scale to select when scaling down trawl models for simulation purposes depends on the size of the flume tank that will be used. For that reason, the most suitable scale for the Ice Champ-74 model in Figure 4 below was 1:23.

[3] (kW) Kilowatt, (HP) Horse power

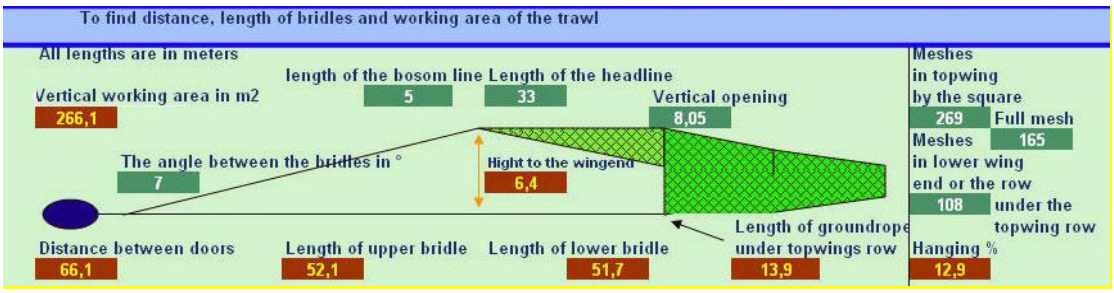

Figure 2: Line length and main dimensions of Ice Champ trawl to full scale

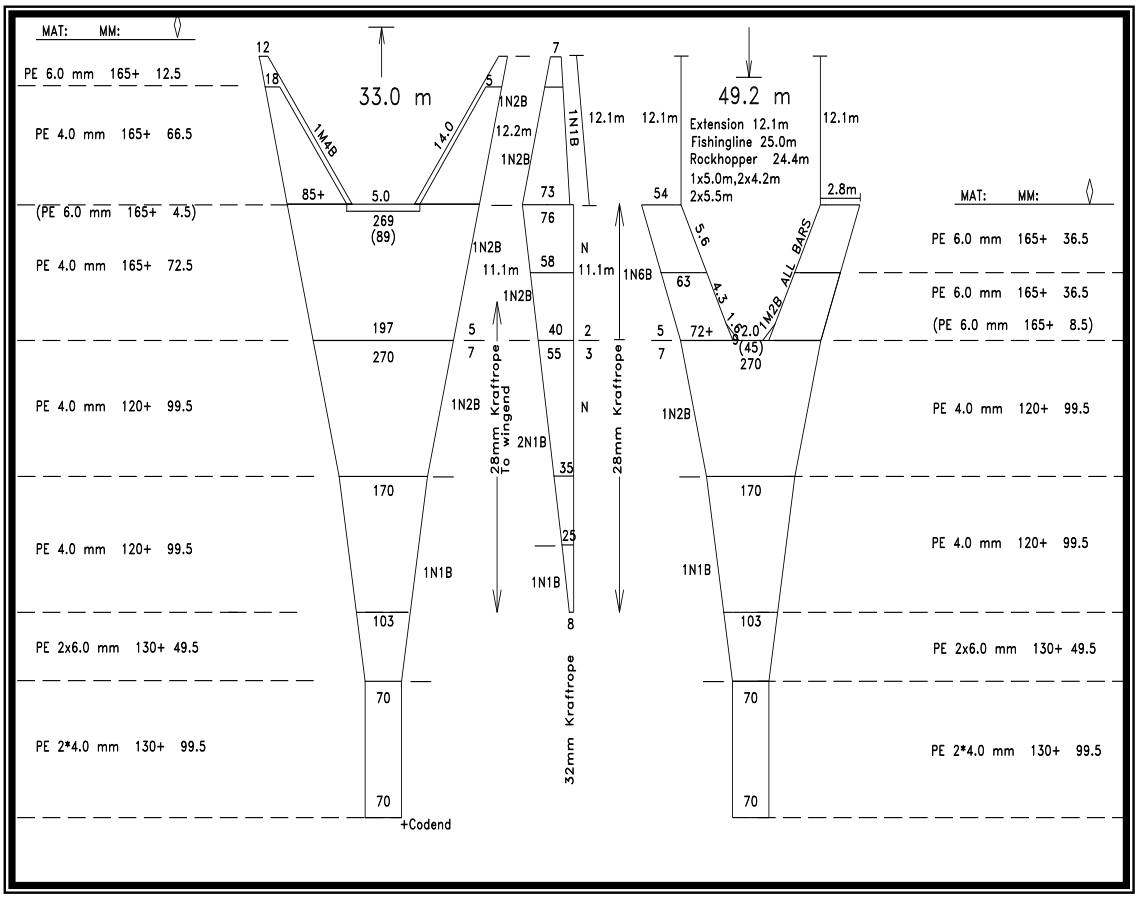

Figure 3: Technical drawing of Ice Champ trawl to full scale by Hampidjan Namibia, 1999

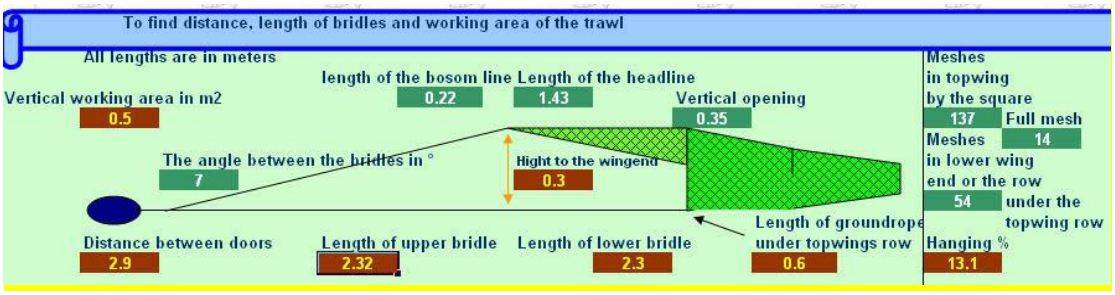

Figure 4: Line length and main dimensions of Ice Champ trawl model

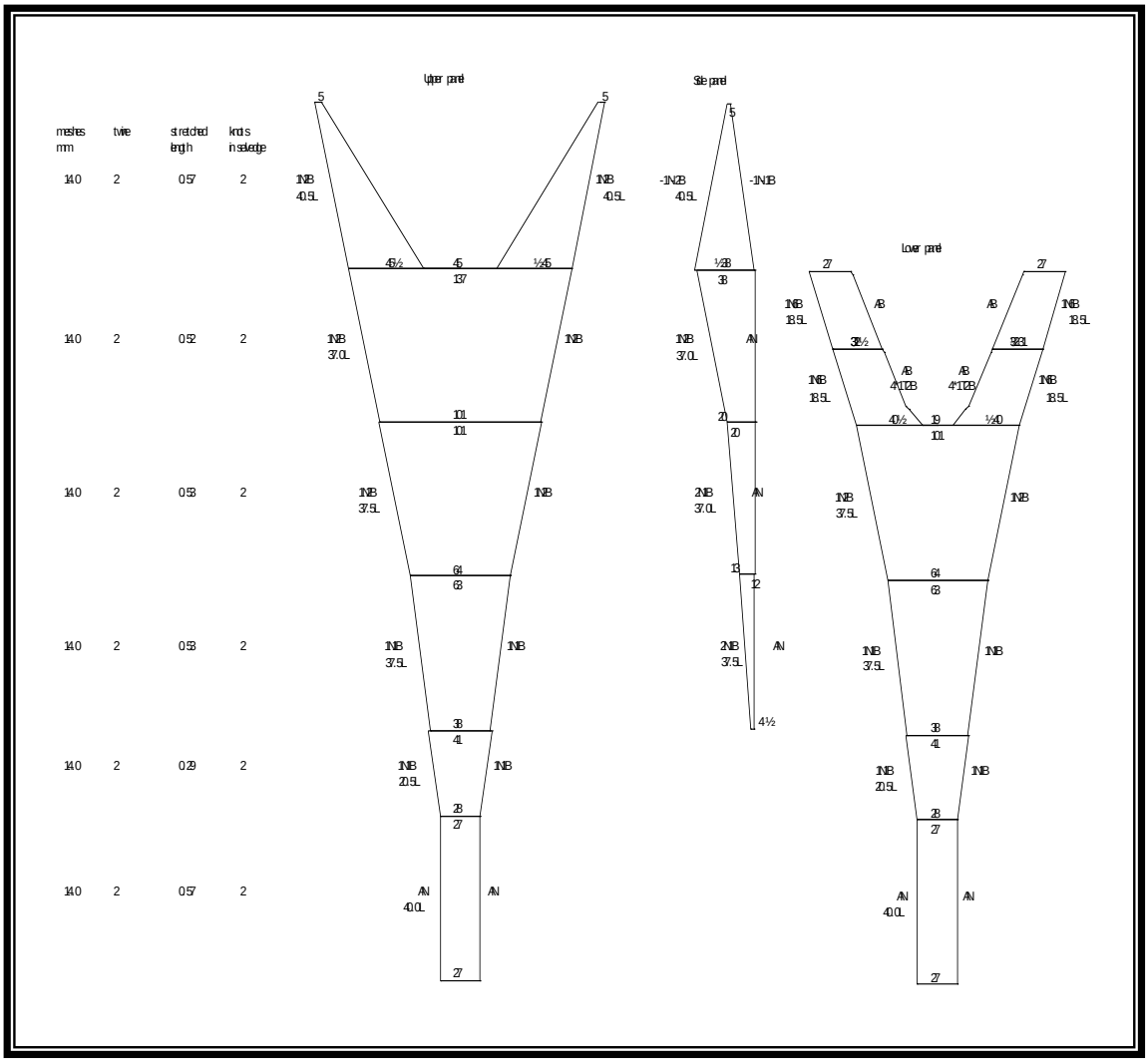

Figure 5: Ice Champ model design to scale 1:23 by Gurirab J., 2007.

Since it is a very useful teaching aid, it could help our students to get an overview of how trawls operate underwater in different circumstances and what parameters could be tested. During this project, a bottom trawl net used in Namibia for the hake fishery was scaled down and tested to illustrate an example of an exercise that could be carried out during fishing gear design and modification courses at NAMFI. Results from the flume tank simulation showed that even greater vertical opening could be

obtained if the bosom of the square is slightly reduced and the wings widened. With a hanging ratio of 45% on model, Table 4 and Figure 6 below show the results from a test that was carried out to estimate the headline height on various towing speeds. My conclusion was that the model seems to work well even on speeds up to 3.5 – 5 knots but could be adjusted depending on the working conditions for even better results and door spread.

Table 4: Headline height of the Ice Champ – 74 model at different speed intervals.

Speed (knots)	Hanging ratio	Headline height (m)
1	45%	23.4
2	45%	11.7
3	45%	7.82
4	45%	6.1
5	45%	4.6

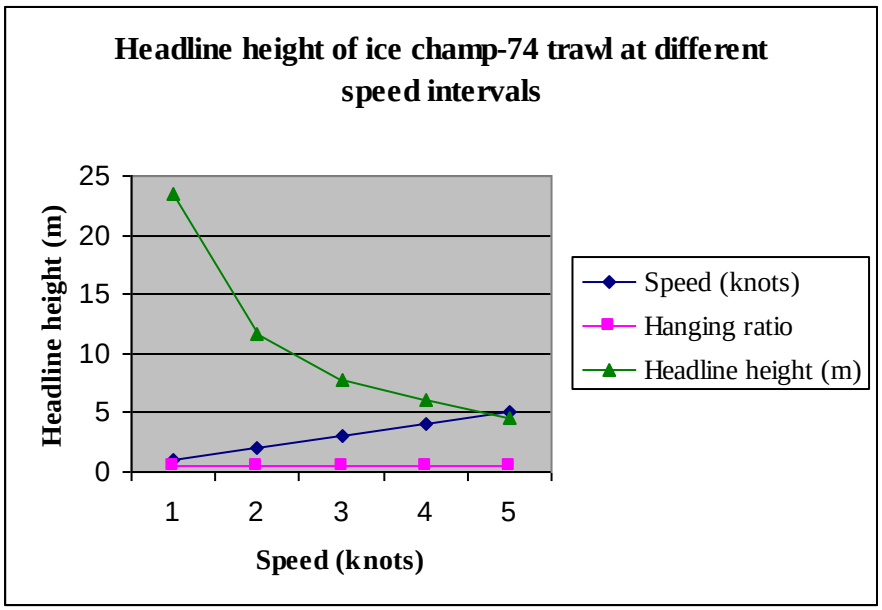

Figure 6: Headline height of Ice Champ - 74 model at different speed intervals.

Flume tank exercises may also help skippers and mates to improve the efficiency of their gear and fine-tune the whole set-up according to their fishing conditions. Figure 7 below gives an illustration of the Ice Champ-74 trawl model, tested in a flume tank after it was scaled down to scale 1:23.

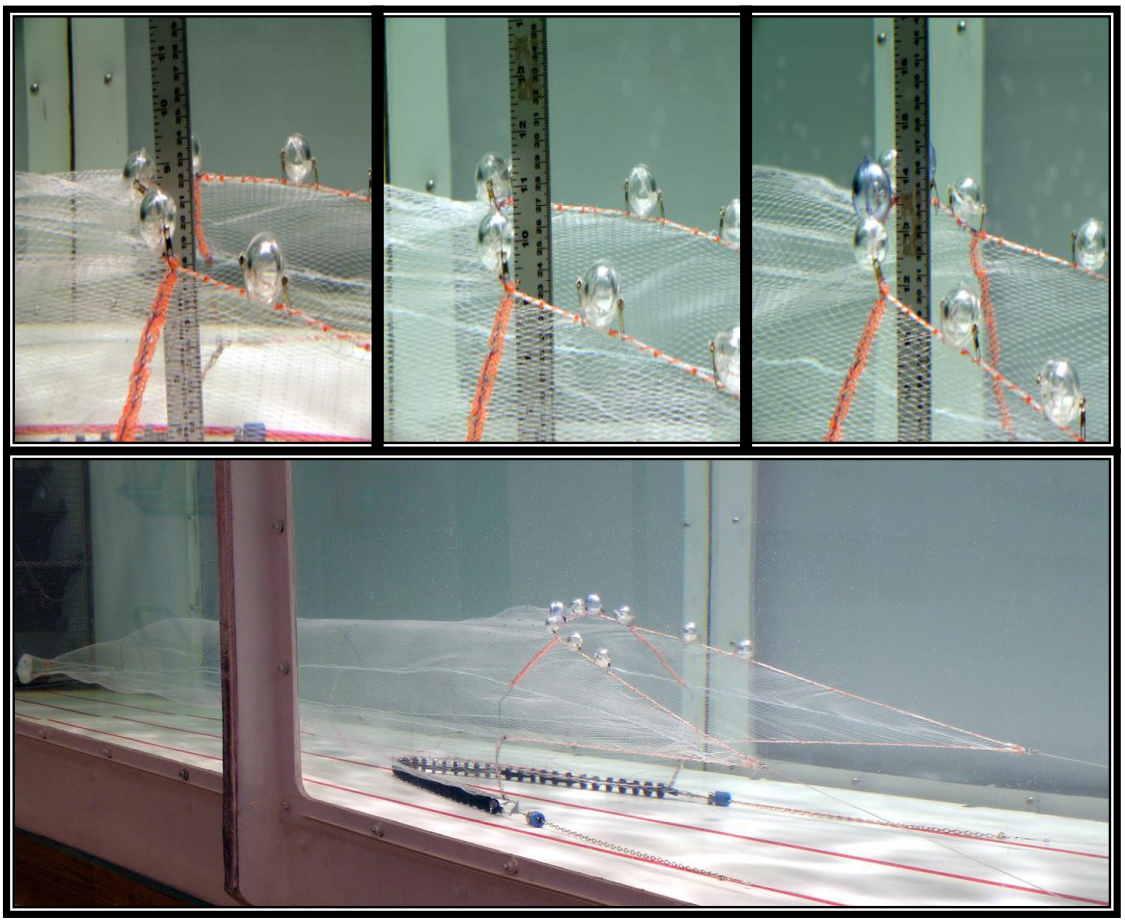

Figure 7: Ice Champ-74 model simulation by Gurirab J. and Palmason L., 2007.

1.13 General aims and training outcomes of model designing and simulation

After a practical flume tank exercise as shown, students should be able to:

- Understand behaviour of gear underwater e.g. when increasing or reducing current speed through net: what are the effects?
- Understand best operating conditions of trawl and its equipment e.g. otterboards, trawl opening etc.
- Understand and set gear to have symmetrical alignment when in operation
- Identify problems on gear e.g. trawl door operation, tilt on doors, angle of attack etc.
- Select correct material and accessories when assembling fishing gear e.g. plastic floats, rubber disc for footrope etc.
- Demonstrate the required skills in making trawl models to scale
- Demonstrate the ability to make improved modifications on fishing gear
- Set-up trawl gear to fit his/her working conditions and test it for e.g. correct hanging ratio, length of bridles, best buoyancy etc.
- Test and identify problems on fishing gear that might affect yield
- To simulate trawl in flume tank to solve problems and make adjustments

6 CONCLUDING REMARKS

The training curriculum will clearly outline the outcomes of training in each of the study units. It is of importance that more emphasis is placed on practical training and exercises. Therefore, during the development of this new fisheries curriculum, mandatory requirements for fishermen were taken into consideration. Demands of the fishing industry are dealt with in this new curriculum and students are expected to put their knowledge and skills into good practice. It is expected that improvements will be noticed in net mending, gear design and modifications. In addition, fish handling issues should improve and students should have better understanding of responsible fishing. With an addition of more fishing experience, this could lead to more skilled and confident Namibian fishermen.

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Finally to all my colleagues at NAMFI, all people from all occupations (no names mentioned, no names forgotten) whom or without their help this project could not have been done. I love you all and thank you very much for your kind assistance.

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APPENDIX 1: EXISTING FISHING TECHNOLOGY SYLLABUS

NAMIBIAN MARITIME AND FISHERIES INSTITUTE
FISHING TECHNOLOGY SYLLABUS' 2003
DECK OFFICERS CLASS 5

1. **Fishing Technology**
   General introduction: Formulae and tables
   Netting materials for fishing gear: Materials and accessories
   Fishing vessel types and fishing methods
   Long line
   Purse Seining
   Trawl gear
   Fishing gear design, construction and assembly
   Ordering equipment
   Equipment for deck and wheelhouse
   Electronic fishing

2. **Fish handling**
   Spoilage and Refrigeration
   Icing
   Mechanical refrigeration with ice
   Refrigerated Sea Water
   Freezing at Sea
   Staff hygiene requirements
   Requirements during the handling of fishery products
   Cleaning and disinfecting requirements
   Pests and control
   Monitoring hygiene
   Setting up your HACCP-based control system

3. **Fishing Biology and Fishing Ecology**
   Definition of biology
   Biology and marine environments
   - Chemical characteristics of seawater
   - Physical characteristics of seawater
   - Fundamental properties of organic life: Respiration, reproduction, and locomotion of marine beings
   - Coast region and oceanic region
   - Biological cycle of the sea
   - Rational exploitation of marine resources
   - The problem of over fishing
   - Efforts and yields
   - Ways of reducing efforts

   - Selectivity of fishing gear and tackle
   - The Namibian Fishery: The resources of the sea

- Fishing areas at continental shelf of Namibia
- Biology and ecology of the zoological groups of commercial interest

4. **Responsible Fisheries Practices**
   Sensible/rational use of the fishing ground
   Conservation/protection and management of the fishing resources

5. **No pollution**
   Knowledge of precautions to be prevents pollution
   Marpol procedures

6. **Ability to be safe working leader personnel on board**

7. **Namibian fishing legislation**

APPENDIX 2: DETAIL SYLLABUS FOR CLASS 6/MATE II/SKIPPER II/

Course co-ordinator: Head of Navigation Department (HOD)	**Module instructors: Johnson Gurirab/Tobias Nambala**
Aims:	***On completion of this course the student should know the following:*** 1. How to carry out trip planning orders from superiors and prepare fishing activities 2. Name all the main fishing gear types used in Namibia 3. Understand importance and name material and equipment use to make fishing gear, their characteristics, physical properties and area of use 4. Understand the use of the following materials and accessories: twine,netting,rope,wire,chain,shackles,bobbins,floats and lead 5. Measuring all parts of a set of fishing gear, using correct measuring devices, cut netting, wire, rope and chain according to plan 6. Sew or shim together two panels of netting/net sections, marking ropes and wires 7. Fix netting to ropes & wires to form the frame of a set of fishing gear 8. How to construct footropes from appropriate elements, as well as attaching buoyancy aids where needed and using lead or other materials as necessary to add weight to fishing gear 9. Know good hygiene/cleanliness methods and the treatment of fish before stowage on board 10. Know the effects of poor fish handling practices on board 11. Understand the importance of responsible fishing practices and adhere to it 12. Follow national and international rules regarding fishing operations and environmental pollution 13. Be a safe working leader on board
Training outcomes:	***After completing this course the student should be able to:*** 1. Identify netting material, know the physical properties, appropriate application/uses 2. Classify fishing vessels and know the main methods of fishing used in Namibian waters 3. Make free hand drawings and name the different parts of fishing gear in question 4. Know the importance of electronic fishing aids (fishing acoustics) and state how echo signals are interpreted 5. Describe setting and hauling operations of the main fishing gear types used in Namibian waters 6. Name and explain the dangers/precautions to take during the setting and hauling operations of fishing gear 7. Calculate breaking strength and safe working load of natural, synthetic, steel wire ropes, blocks and tackles 8. Name and explain different care and preservation methods of the catch 9. Know what are the different staff hygiene requirements, cleaning and disinfecting requirements 10. Name main fish species harvested in Namibian waters, their internal & external anatomy and how to measure body length 11. Know how to make different fisherman's knots, bends and hitches and explain the use of each knot 12. Demonstrate the ability to mend netting panels of equal mesh sizes, repair/rig netting panels and have good splicing skills 13. Demonstrate ability to rig pilot ladders, Bosun's chairs, stages and know the applications of each
Entry standards:	Atleast 18 years of age or older, Grade 12 and or approved sea going service as a cadet or able seaman as stipulated in the NAMFI Operational Manual

Maximum students:	Maximum 15 students	**IMO reference:** STCW-95 and STCW F-95 Conventions
Source of syllabus:	Namibian Maritime and Fisheries Institute	
Reference material:	National maritime and fisheries regulations (Marine resources act'2000), Fisherman's workbook/John Prado/1990, Instructors material/2000/2001/2003/2006, Worlds best fisherman's knot book/Bill Nelson, The Ashley book of knots/Clifford W. Ashley, Fish catching methods of the world 3rd and 4th ed., Netting material for fishing gear 2nd ed. Gerhard K./1982, Net work exercises/Garner J., Commercial fishing methods: an introduction to vessels and gear 3rd ed./Sainsbury J.C./1971,1996	
Methods for evaluating competence:	**1. Methods of teaching:** ▪ Direct classroom lectures/discussions ▪ Group work, self study, assignments, practical demonstrations ▪ Field trips or visits **2. Continuous assessments**: (will contribute 20% of final examination mark) ▪ Written tests ▪ Oral tests ▪ Practical tests ▪ Other assessments **3. Final examination: Fishing technology:** *(Note that during the final fishing technology exam, all students shall be required to give written answers to questions).* ▪ Written tests ▪ Oral tests ▪ Other assessments **4. Final examination: Seamanship:** *(Note that during the final Seamanship exam, no student shall be required to give written answers to questions, it will strictly be conducted in practical form).* ▪ Oral tests ▪ Practical tests	

01	**Course plan**	Fishing Technology & Seamanship Curriculum (Syllabus)
02	**Time table**	Prepared semesterly – 6 months
03	**Objectives**	To enable all students to acquire knowledge and skills in both theoretical and practical Fishing Technology, this will further be supplemented by on-job-training onboard sea going fishing vessels.
04	**Entry requirements**	Atleast 18 years of age or older, Grade 12 and or approved sea going service as a cadet or able seaman as stipulated in the NAMFI Operational Manual
05	**Course certificate**	Deck Officer Class 6/Mate II/Skipper II/
06	**Target group**	High school graduates wishing to begin a career at sea, Ratings, Fisherman and Deck officers
06	**Participant number**	Maximum 15 candidates
07	**Teaching facilities/Resources**	Fishing Technology classrooms 1,2,3 and 4/Chalkboards/Whiteboards/Handouts/Computer screen projectors/ Videotapes/Practical workshop demonstrations and exercises(Hands & eye co-ordination)

Subject:	Level:	Prepared by:	Edition date:
Fishing Technology and Seamanship	Class 6 Mate-II/ Skipper-II/	Johnson Gurirab	December 2006
Duration/class session:	**Time frame/Semester:**	**Type of document:**	**Approved by:**
1 class hour = 40 minutes	20 weeks = 120 Class/hours	Course Syllabus	

Competence	Knowledge, Understanding and Proficiency	Modules and Reference to Books, Chapter and Pages	Teaching Week	Class hours
Topic	**Sub-topics**			
1. Netting material and equipment for fishing gear	**Ropes and twine: General introduction, formulae and Tables, Density of materials, Safe working load, breaking load and safety factor**	**Instructor material: Fishing technology handbook/Tobias Nambala page: 9 – 44 Fisherman's workbook: John Prado 1990 Pages: 3 – 40**	**Week 03**	**6 hrs**
	Synthetic, vegetal fibres ropes and commercial names ▪ main categories ▪ construction ▪ identification ▪ Calculation of Rtex, Runnage, tex, Td, Nm ▪ Netting yarns & numbering systems ▪ Choice of netting materials for fishing gear	**Instructor material: Fishing technology handbook : Tobias Nambala page: 46 - 55**	**Week 04**	**2 hrs**
	Wire Rope/ handling ▪ Calculate safety factor ▪ Care and storage ▪ Breaking strength (BS) – calculations ▪ SWL calculations ▪ Basic calculations in respect of safe working ▪ Safety Rules for Handling wire ropes ▪ Inspection of the rope ,International Standards	**Fisherman's workbook: John Prado pg. 29 - 35**	**Week 04**	**2 hrs**
	Splices ▪ Fibre rope splices ▪ Wire rope splices	**Instructor material: Seamanship pages: 1 - 85**	**Week 04-05**	**4 hrs**
	Knots, Bends and Hitches ▪ Types of knots, bends, how to shorten a rope , Joining two cords, Loops, Knots for mooring,	**Instructor material: Seamanship pages: 1 - 85**	**Week 05**	**4 hrs**

	Marrying ropes **Deck equipment** ▪ Purse seine winches and drums ▪ Power block, Net haulers, Line haulers ▪ Trawl winches and drums	**Instructors material pages: 14 – 20** **FAO editions, Lecturer material page: 3 - 13** **Instructor material: Seamanship pages: 1 - 50**	**Week 06**	**2 hrs**
2. Introduction to net mending	**Net webbing: Meshes and Definitions** ▪ Direction in netting ▪ System of measuring net meshes ▪ Net mending and repair ▪ Mounted height of a net ▪ Joining panels of netting ▪ Mounting panels of netting ▪ Knots and edges or selvedge's ▪ Definition of cuts, Cutting rates and tapers ▪ Knotted ▪ Braiding technique, Plaid technique ▪ Knotless ▪ Raschel – technique	**Classroom practical exercises/ Demonstrations** **Videotapes** **Site Visits** **Instructor material: Seamanship pages: 1 - 85**	**Week 06-09**	**20 hrs**
3. Fishing vessel types and fishing methods	**International standards for classifying fishing vessel types and fishing methods:** ▪ Definition and classification of fishing vessel types and methods (Pots and traps, Purse seining, long lining and trawling) ▪ Draw and name the different parts of fishing gear ▪ Describe setting and hauling operations of fishing vessels ▪ Dangers of different fishing methods during operation ▪ Precautions to take during fishing operations on board	**Instructor material: Hauling and setting methods of Namibia: Pedro Riveiro**	**Week 09-12**	**20 hrs**
4. Rigging fitments and their strength	**Materials and accessories and their uses** ▪ Rigging fitments for fishing methods ▪ Floats for different fishing gear ▪ Elements of trawl ground ropes: steel bobbins, ▪ rubber bunts, spacers, rings and 'G' links	**Instructor material: Seamanship pages: 35 - 85**	**Week 12**	**2 hrs**

	▪ Chains, thimbles, tackles and derricks ▪ Steel accessories for joining: shackles, links and clips ▪ Rigging stages, bosun's chairs and pilot ladders ▪ Safe working load and breaking strength	**Instructor material: Fishing technology handbook : Tobias Nambala page: 76 – 80**		
5. Introduction to fishing gear calculations	**Fishing gear calculations** ▪ Estimating the length of warps and trawling depth ▪ Spread of otter boards, length of sweeps and bridles ▪ Length of trawl ▪ Estimating the weight of netting ▪ Calculating the twine surface area ▪ Rough estimation of buoyancy ▪ Horizontal hanging ratio (E) ▪ Vertical hanging ratio (Ve) ▪ Length of stretched netting ▪ Height of stretched netting ▪ Effective height ▪ Number of meshes in length ▪ Number of meshes in height ▪ Drum capacity of trawlers ▪ Power of trawlers ▪ Trawl winch horse power ▪ Estimating the diameter of trawl warps ▪ Trawl warp, otterboards and trawl net resistance ▪ Selective modification of trawling gear	**Instructor material: Fishing gear calculations: Formulae and tables: Pedro Riveiro**	**Week 13-14**	**10 hrs**
6. Interpretations and modifications of fishing gear designs	**Fishing gear drawings and plans** ▪ Symbols used for fishing gear plans ▪ Make drawings of fishing gear designs to scale ▪ Make modifications on fishing gear ▪ Flume tank: Observations	**Net makers workbook/Larus Palmason** **Instructors material/handout**	**Week 14-17**	**20hrs**
7. Rigging a bosun's chair and/or stage and pilot ladder	**Rigging fittings** ▪ Introduction to rigging fittings and its applications ▪ Choice of material to use ▪ Marking and measuring instruments ▪ Rig a bosun chair and/or stage and a pilot ladder	**Fisherman's workbook: John Prado pg. 88 - 96** **Classroom practical exercises/ Demonstrations**	**Week 18**	**6 hrs**
	▪ Echo sounders and their use for fish finding	**Fisheries acoustics theory and practice**	**Week 19**	**4 hrs**

8. Fisheries acoustics	▪ Net sounders/Net sensors ▪ Interpretation of Sonar signals	**2nd ed./John Simmonds and David Maclennan Fisheries acoustics /Pall Reynisons/MRI/Iceland Instructor material: Fisheries acoustics/ Instructor material: Fishing technology handbook : Tobias Nambala page: 51 - 55**		
9. Selectivity devices for fishing gear	**Selectivity of fishing gear** ▪ Importance of gear selectivity ▪ Selectivity properties of a grid ▪ Selective properties of square mesh panels	**FAO Fisheries technical paper 222/267 Instructor material: Fishing technology handbook : Tobias Nambala page: 59 - 74**	**Week 19**	**2 hrs**
10. Fish handling and preservation	**Fish handling and preservation** ▪ Care and preservation of the catch ▪ Chilling, freezing and cold storage ▪ Icing and amount of ice ▪ Treatment of fish before storage ▪ Mechanical refrigeration with ice ▪ Guide to hygiene in fish industry	**European Union, Council Directives 91/493/EEC of 22 July 1991 (Fish hygiene)**	**Week 20-21**	**8 hrs**
11. Fish biology	▪ Technical terms/scientific names and measurements of fish ▪ Internal & external anatomy of the main commercial species of Namibia ▪ Life cycle of fish ▪ Senses, reproduction and respiration ▪ Growth and age determination	**Instructor material: Seas of Southern Africa page: 35 - 45 Instructor material: Fish biology page: 1 - 23**	**Week 21**	**4 hrs**
12. Namibian fisheries regulations	**Namibian fishing legislation** ▪ Marine resources act'2000 ▪ Fishing logbooks ▪ Marpol (No pollution)	**Ministry of Fisheries and Marine resources of Namibian (Marine resources act of 2000)**	**Week 22**	**4 hrs**

APPENDIX 3: DETAIL SYLLABUS FOR CLASS 5/MATE I/SKIPPER I/

Course co-ordinator: Head of Navigation Department (HOD)	**Module instructor: Johnson Gurirab/Tobias Nambala**
Aims:	***On completion of this course the student should know the following:*** 1. Plan a fishing trip according to the species to be caught, method of capture and fishing area selected 2. Supervise and control the construction, assembly and repair of nets, long-line tackle and fishing equipment according to the information provided 3. Find the fishing zone and assess its yield using oceanographic data and information obtained from electronic equipment 4. Know the importance of responsible fishing practices and adhere to it 5. Know what(technical name) to order and how to order fishing gear material and accessories 6. Should be able to identify suppliers of fishing gear, when need arises 7. How to plan and manage fishing activities, assess yield, optimize and control production and implement responsible fishing practices 8. Name and describe all the main fishing gear types used in Namibia 9. Know the impact of fishing gear on the ecosystem 10. Know the importance of material and equipment use to make fishing gear, their characteristics, physical properties and area of use 11. Know the appropriate uses and strength of the following materials and accessories like twine,netting,rope,wire,chain,shackles,bobbins, floats and leads 13. Know when, why and how to perform different fishing gear related calculations during fishing operations, gear designing etc. 14. Capable of measuring all parts of a set of fishing gear, using correct measuring devices, cut netting, wire, rope and chain according to plan 15. Capable of sewing or shimming together two panels of netting or net sections, marking ropes and wires 16. Capable of fixing netting to ropes and wires to form the frame of a set of fishing gear 17. Capable of constructing footropes from appropriate elements, as well as attaching buoyancy aids where needed and using lead or other materials as necessary to add weight to fishing gear 18. He should now how to solve fishing gear related problems on board 19. He should be able to have an overview of the behaviour of fishing gear underwater, related to the behaviour of target specie 20. Know how to design scale-down trawl models and how to test them in a flume tank to obtain best results 21. Know how to use and interpret fish finding equipment (fishing acoustics) 22. Know good hygiene/cleanliness methods and the treatment of fish before stowage on board 23. Plan and manage the handling, processing, refrigeration and stowage of the catch using the appropriate means and procedures to prevent its deterioration 24. Know the effects of poor fish handling practices on board and take necessary precaution to avoid it 25. Avoid environmental pollution 26. Follow national and international rules regarding fishing operations 27. Be a safe working leader for the personnel on board
Training outcomes:	***After completing this course the student should be able to:***

	1. Know the main categories of ropes and the physical properties and the uses of each 2. Know all commercial fishing methods used in the world in relation to vessel type used 3. State the basic importance and operation of fishing acoustics 4. Have an idea on how to interpret echo signals from fishing acoustics 5. Describe the importance of gear selectivity and know the selectivity devices in use 6. Describe the biological cycle of the Namibian continental shelf 7. Identify fishing grounds in relation to the target specie 8. Know the external and internal anatomy of main fish species harvested in Namibian waters 9. Describe sustainable harvesting of fish and the effects of over fishing 10. Know the main requirements to adhere to in relation to the fisheries legislation of Namibia 11. Describe some precautions to be taken to avoid pollution 12. Briefly name and explain good fish handling practices, taking in considerations the staff hygiene requirements 13. Describe the importance of cleaning and disinfecting fish processing plants 14. Define HACCP and how it can be applied to sustain good quality of fish in fish processing plants on board fishing vessels 15. Design, construct, maintain and repair fishing gear 16. Perform necessary fishing gear calculations 17. Design scale models of fishing gear for flume tank testing, to solve problems or make new modifications on gear
Entry standards:	Meet all entry requirements as prescribed in the NAMFI Operational Manual of Maritime Training Holder of Class 6 certificate of competency With atleast 18 months sea going service
Maximum students:	15 students **IMO reference:** STCW-95 and STCW F-95 Conventions
Source of syllabus:	Namibian Maritime and Fisheries Institute
Reference material:	National maritime and fisheries regulations (Marine resources act'2000), Fisherman's workbook/John Prado/1990, Instructors material/2000/2001/2003/2006, FAO/catalogue of small-scale fishing gear 2nd ed./1987, Worlds best fisherman's knot book/Bill Nelson, The Ashley book of knots/Clifford W. Ashley, Fish catching methods of the world 3rd and 4th ed., Netting material for fishing gear 2nd ed. Gerhard K./1982, Net work exercises/Garner J., Commercial fishing methods: an introduction to vessels and gear 3rd ed./Sainsbury J.C./1971,1996, Klust G. 1982: Netting Materials for Fishing Gears 1 Long Garden Walk, Farnham, Surrey, England, Fishing News Books Ltd., Libert L. 1987, Mending of fishing nets 2nd ed., 1 Long Garden Walk, Farnham, Surrey, England, Fishing News Books Ltd., Sainsbury J. C. 1996, Commercial Fishing Methods 3rd ed. 1 Long Garden Walk, Farnham, Surrey, England, Fishing News Books Ltd., Miller M, Fishing Gear Technology 1 (http://cfcc.net/faculty/mvmiller/FishinggearI/132-Syllabus-03.doc) (15.12.2003), Palmason L.2006: Net makers workbook, Fishing gear design software and flume tank analyses Keflavik – Sudurnes Comprehensive College**,** Hreinsson E. Fishing gear design software (Design CAD Pro 2000) Isafordur - Marine Research Institute
Methods for evaluating competence:	**1. Methods of teaching:** ▪ Direct classroom lectures/discussions ▪ Group work, self study, assignments, practical demonstrations (Classroom practical exercises)

	▪ Field trips or visits **2. Continuous assessments**: (will contribute 20% of final examination mark) ▪ Written tests ▪ Oral tests ▪ Practical tests ▪ Other assessments **3. Final examination: Fishing technology:** *(Note that during the final fishing technology exam, all students shall be required to give written answers to questions).* ▪ Written tests ▪ Oral tests ▪ Other assessments **4. Final examination: Seamanship:** *(Note that during the final Seamanship exam, no student shall be required to give written answers to questions, it will strictly be conducted in practical form).* ▪ Oral tests ▪ Practical tests

01	**Course plan**	Fishing Technology & Seamanship Curriculum (Syllabus)
02	**Time table**	Prepared semesterly – 6 months
03	**Objectives**	To enable all students to acquire knowledge and skills to the highest level, so they can be potential/key players in the fishing fleet of Namibia.
04	**Entry requirements**	Applicants should be holders of a Class 6 Mate II/Skipper II certificate of competency and should have completed the required basic maritime safety and survival-training course. The applicants are also required to complete atleast 30 months sea going service as an officer in charge of a navigational watch on board any sea going fishing vessel. (National regulations on the standards of training, certification and watch keeping of seafarers, Namibian Directorate of Maritime Affairs)
05	**Course certificate**	Deck Officer Class 5/Mate I/Skipper I/
06	**Target group/Audience**	Ratings, Old Fisherman wishing to upgrade from Grade qualification to Class and holders of a Deck officers Class 6 certificate of competency with appropriate sea going service
07	**Participant number**	Maximum 15 candidates
08	**Teaching facilities/Resources**	Fishing Technology classrooms 1,2,3 and 4/Chalkboards/Whiteboards/Handouts/Computer screen projectors/ Videotapes/Practical workshop demonstrations and exercises(Hands & eye co-ordination)

Subject:	**Level:**	**Prepared by:**	**Edition date:**
Fishing Technology and Seamanship	Class 5 Mate-I/ Skipper-I/	Johnson Gurirab	December 2006
Duration/class session:	**Time frame/Semester:**	**Type of document:**	**Approved by:**
1 class hour = 40 minutes	20 weeks = 120 Class/hours	Course syllabus	

Competence	**Knowledge, Understanding and Proficiency**	**Modules and Reference to Books, Chapter and Pages**	**Teaching Week**	**Class Hours**
Topic	**Sub-topic**			
1. Introduction to fishing gear technology	**Netting equipment and materials for fishing gear:** ▪ Weight in water for materials ▪ Numbering systems ▪ Choice of netting materials for fishing gear ▪ Calculation of Rtex, Runnage, tex, Td, Nm ▪ Meshes and panels, Cutting rates ▪ Capacity of the winch drums ▪ Stretched mesh & mesh opening ▪ Hanging ratios: definition and calculation ▪ Estimation of weight of netting ▪ Calculating twine surface area of a trawl ▪ Surface covered at different hanging ratios ▪ Purse seine winches and drums ▪ Trawl winches, Trawl net drums ▪ Power block, Net haulers, Line haulers ▪ Pot/trap haulers ▪ Fuel consumption of engine, speed of vessel ▪ Ice, capacity of holds and tanks, fresh water ▪ Bait: quantity required, Speed of operation	**Instructor material: Fishing Technology Handout/Pedro Riveiro** **Instructor material: Fishing Technology handbook/Johnson Gurirab** **Instructor material: Fishing Technology handbook/Tobias Nambala: Page: 9 – 44** **Fisherman's workbook: John Prado 1990 Pages: 3 – 40** **Net maker's Workbook: Fishing gear Technology and Technical drawing/ Larus Palmason**	**Week 03-04**	**10 hrs**
2. Fishing methods and fish behaviour	**Locating and identifying fish schools:** ▪ Pots/Traps and fish behaviour ▪ Long lining and fish behaviour ▪ Purse seining and fish behaviour ▪ Trawling and fish behaviour ▪ Dangers/Precautions to take of different fishing	**Fisheries acoustics theory and practice 2nd ed./John Simmonds and David Maclennan** **Fisheries acoustics /Pall Reynisons/MRI /Iceland**	**Week 04-07**	**20 hrs**

	methods during operation			
3. Fishing gear designs, construction and assembly	**Fishing gear calculations and gear design** ▪ Trawl gear selection, design and construction in relation to fish behaviour, vessel power and fishing conditions ▪ Long line design ▪ Fishing tackle/Long line tackle ▪ Purse seining design ▪ Trawl gear design ▪ Cutting rates (nets) ▪ Piece of netting link ▪ Nets maintaining and storage **Technical drawing of fishing gear** ▪ Gear design calculations ▪ Manual drawing of fishing gear designs ▪ Read fishing gear designs, understand all symbols ▪ Enlarge and reduce designs according to scale **Computer aided drawing (CAD) of fishing gear** ▪ Use computer programmes to draw fishing gear to scale ▪ Enlarge and reduce designs according to scale ▪ Modify gear designs using CAD programmes	**Net maker's Workbook: Fishing gear Technology and Technical drawing/ Larus Thor Palmason** **Fishing gear design, Modelling and Simulation/ Larus Thor Palmason** **Net maker's Workbook: Fishing gear Technology and Technical drawing/ Larus Thor Palmason** **Net maker's Workbook: Fishing gear Technology and Technical drawing/ Larus Thor Palmason**	**Week 08 - 09** **Week 09-11** **Week 11-12**	**10 hrs** **10 hrs** **10 hrs**
4. Model designing and flume tank simulations	**Model designing for flume tank observations** ▪ Make trawl models to scale for testing ▪ Testing gear for operation and under water performance ▪ Problem solving on fishing gear for best working conditions	**Fishing gear design, Modelling and Simulation/ Larus Thor Palmason**	**Week 13-16**	**20 hrs**

5. Fisheries Acoustics	**Fish finding and monitoring equipment:** ▪ Acoustics /Echo sounder ▪ Net sounder/Trawl eye/Head line, Codend sensor ▪ Sonar ▪ Radar	**Fisheries acoustics theory and practice 2nd ed./John Simmonds and David Maclennan** **Fisheries acoustics /Pall Reynisons/MRI /Iceland** **Instructor material: Fisheries acoustics/Johnson Gurirab**	**Week 16-17**	**10 hrs**
6. Fish handling and storage	**Cleaning and disinfecting the processing plant** ▪ Cleaning and disinfecting processing equipment ▪ Soap and disinfectant dispensers ▪ Processing plants and changing rooms ▪ Cleaning agents and disinfectants ▪ General pests and pest control **Hygiene and personal protective equipment** ▪ Guide to Hygiene within the Fish Industry ▪ Staff hygiene requirements, Staff health, Personal hygiene ▪ Cleanliness and clean clothing ▪ Recreation areas/Hygiene zone ▪ Staff hygiene in the workplace ▪ Training (knowledge and understanding) ▪ Hygiene requirements for processing plants and equipment ▪ Monitoring hygiene ▪ Requirements during the handling of fishery products ▪ Incoming products /Production ▪ Headgear Overalls Sleeve protection Apron ▪ Boots,Clogs,Working gloves ▪ Washing and disinfecting Hands before entering the processing plant ▪ Wash/disinfecting working boots ▪ Mouth protection **Fish Handling and treatment before storage** ▪ Bleeding ▪ Gutting ▪ Heading ▪ Washing ▪ Whole (heading and gutting)	**Instructor material: Fishing handling Handout/Pedro Riveiro** **European Union, Council Directives 91/493/EEC of 22 July 1991 (Fish hygiene)** **Site Visits** **Site visits** **European Union, Council Directives 91/493/EEC of 22 July 1991 (Fish hygiene)** **Site Visits**	**Week 18** **Week 18** **18-20**	**2 hrs** **2 hrs** **12 hrs**

	▪ Filleting ▪ Peeling ▪ To scale (the fish) ▪ To flake off (the skin) ▪ Freezing ▪ Preservation of the catch ▪ Chilling ▪ Freezing and cold storage ▪ Systems for freezing at sea ▪ Icing (Amount of ice) ▪ Type of ice ▪ Crushed ice ▪ Flake ice ▪ Tube ice ▪ Stowage in ice ▪ Mechanical refrigeration with ice ▪ Fish room conditions ▪ Boxing at sea ▪ Super chilling ▪ Refrigerated sea water ▪ Cleanliness **Processing equipment** ▪ Classification of machinery ▪ Heading and gutting machine ▪ Fillet machine ▪ Peeling machine ▪ Freezing tunnel (slow freezing) ▪ Cupboard-plate freezing (fast freezing) ▪ Packing and strapping machine ▪ Stowage	**Instructor material: Fishing handling Handout/Pedro Riveiro** **European Union, Council Directives 91/493/EEC of 22 July 1991 (Fish hygiene)** **Instructor material: Fishing handling Handout/Pedro Riveiro** **Site Visits**	**Week 20**	**2 hrs**
	HACCP ▪ What does HACCP mean? ▪ Setting up your own HACCP control system onboard ▪ Procedure and daily checklist on HACCP	**European Union, Council Directives 91/493/EEC of 22 July 1991 (Fish hygiene)** **Site Visits**		

7. Responsible fisheries practices	**Sustainable/rational exploitation of marine resources** ▪ Biological cycle of the sea ▪ Fishing grounds along the continental shelf of Namibia ▪ Fishing grounds, restricted fishing depth and close seasons ▪ Regions, Districts Systems, Areas/zones ▪ Fishing methods, Involvement/participation of local fisherman ▪ Over-fishing problems, Effort and performance ▪ Fishing guard, fishing patrol, protection officers ▪ Undersized fish, By-catch, Discarding the catch	**Instructor material: Fishing Technology Handout/Pedro Riveiro/Johnson Gurirab** **Instructor material: Seas of Southern Africa page: 35 - 45**	**Week 21-22**	**10 hrs**
8. Namibian fisheries legislation	**Fisheries legislation/regulations of Namibia** ▪ Legal mesh size regulations ▪ Fishing guard, fishing patrol, protection officers ▪ Duties of inspectors and observers ▪ Total allowable catches (TAC) ▪ Catch quota ▪ Penalties on Discarding the catch and other offences ▪ By-catch ▪ Over fishing ▪ Fishing logbook ▪ Fishing logbook	**Ministry of Fisheries and Marine resources of Namibian (Marine resources act of 2000)**	**Week 22**	**5 hrs**

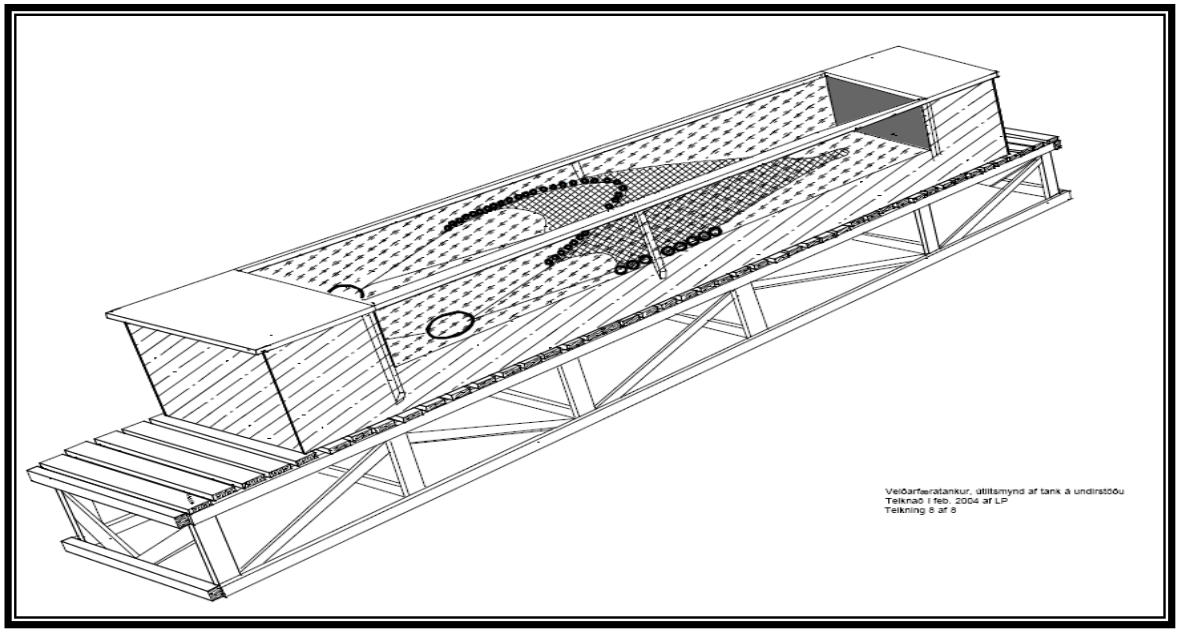

Figure 8: Flume tank illustration by Larus Palmason, Feb. 2004

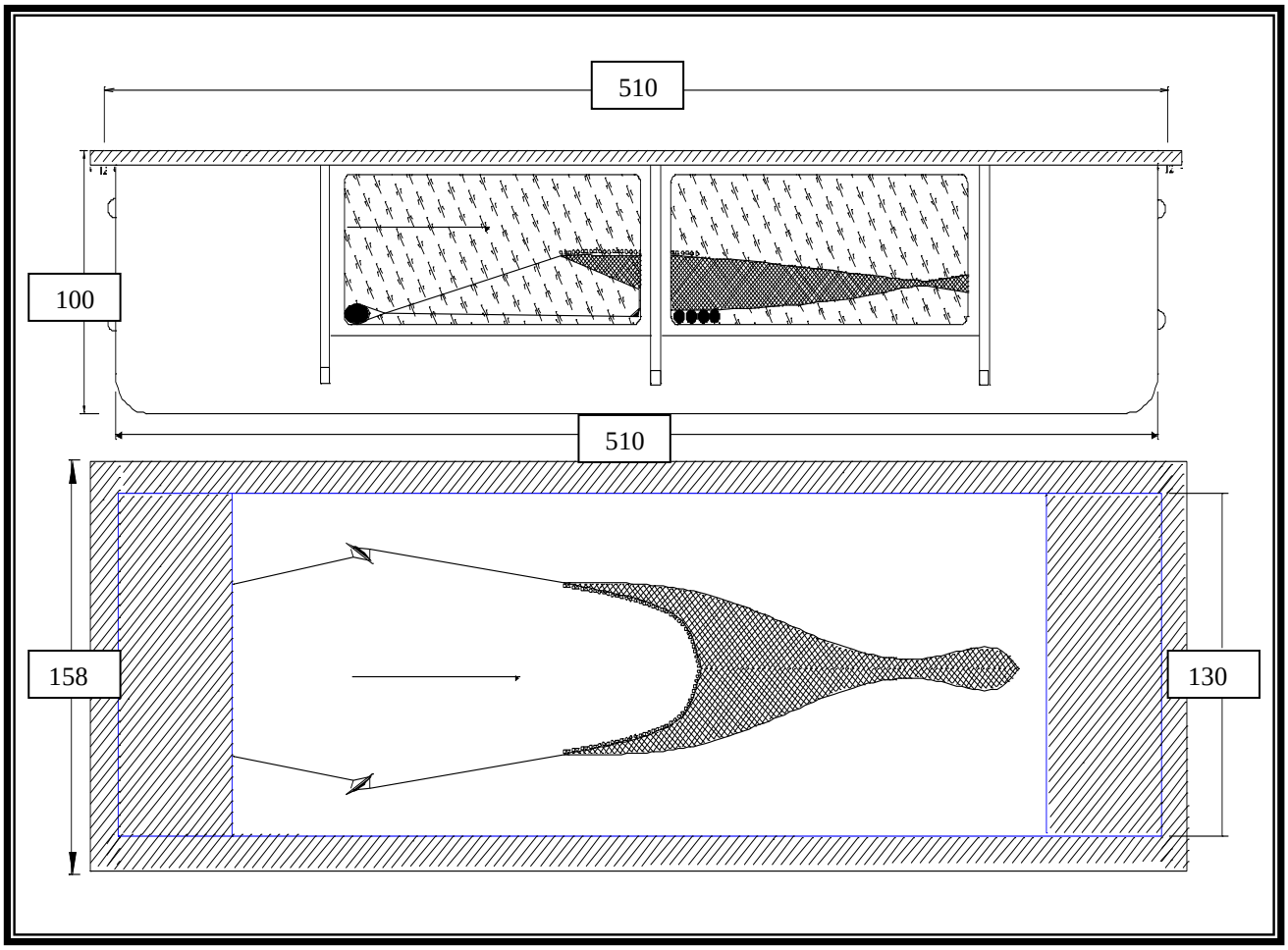

Figure 9: Flume tank simulation by Larus Palmason, Feb. 2004