

**CAD/CAM LABORATORY FACILITIES AND
RESEARCH AND DEVELOPMENT ACTIVITIES
AT UNIVERSITI TEKNOLOGI MALAYSIA**

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Synopsis

This paper describes the activities and development of CAD/CAM laboratory facilities in Universiti Teknologi Malaysia. The activities includes teaching, post graduate programmes, research and development in mechanical engineering.

The paper also describes one activity of the development, which involve the interfacing of a micro-based ship design software with CADAM.

Introduction

In modern technology CAD/CAM is necessary in order to manufacture products in the most efficient manner, high quality and minimum cost. This can only be achieved through good communication between design, production and management. Thus the use of computers is required to handle data, do calculations and control machines.

In Malaysia CAD/CAM application is still not well established. Nevertheless Malaysia requires to improve her industrial manufacturing capabilities in order to compete with other industrialised countries and the application of CAD/CAM is seen as one solution.

Universiti Teknologi Malaysia is playing an active role in promoting CAD/CAM applications through her existing facilities. The activities ranges from basic engineering teaching right through research and development in advance fields such as robotics.

Development of existing software is also carried out by interfacing the software with CADAM. One example of the interfacing work done is illustrated in this paper. The work involves transferring data from a microcomputer based ship design software to CADAM where the data is manipulated to produce various 2D and 3D drawings.

Objective of CAD/CAM Laboratory Facilities in UTM

Education For Undergraduate Students

We have identified various undergraduate courses to be included in implementation of computer aided design and manufacturing. It is intended that CAD/CAM will be utilised as a tool to help students explore the various possible designs and analysis in their respective subjects. With the facilities, this can be done within a short period of time through rapid iterative process. The subjects includes design, manufacturing and tool management, production drawing, etc. etc.

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Post Graduate Programmes

The University in supporting the Malaysian Industrial Master Plan is playing an active role by providing manpower training and Research & Development infrastructure in the area of CAD/CAM.

To create awareness and to develop CAD/CAM applications within industry, various postgraduate courses has been planned. The post graduate courses includes:—

- Control and Industrial Automation.
- Energy Conservation and Application.
- Mechanical Design and Analysis.
- Computer-Integrated Design and Manufacturing.
- Computer Aided Engineering.

The courses stated above will require extensive application of interactive graphics based computer aided design procedures. To enhance the link between industry and university, the courses in Production will be jointly conducted with SIRIM and jointly supervised with Loughborough University, UK.

Areas of Research and Development Using CAD/CAM Laboratory Facilities.

The research and development in CAD/CAM is organised as joint staff and student projects within Faculty of Mechanical Engineering. The facilities will also be extended into interdisciplinary research with other faculties and other external agencies.

The areas have been identified that include,

- Design
- Production and Manufacturing
- Automation
- Engineering Analysis
- Data Based Management

The program should include the development of analysis software for specific type of design application. The interface program will allow the existing facilities to represent the model.

Creating Awareness on the Latest Development

As an institution of higher learning and an active user in CAD/CAM, UTM should make every effort to consistently organised short courses, workshops and seminars national and international levels. This is to create awareness in the latest development in CAD/CAM technology. Another aim would be to generate interest and interaction among the user groups to share experiences and problems in the area of CAD/CAM.

Consultancy Service

In supporting the local industry, Universiti Teknologi Malaysia, with existing CAD/CAM facilities and expertise is in a position to provide advice and consultancy services. Some of the research and development is geared to the requirement and need of the industries.

Development of Ship Design Software in UTM

Objective

The main objective of developing a ship design software in the Mechanical Engineering Faculty is to aid marine technology students to explore various possible designs which could not be covered in ship design and drawing classes. Through this, within a short period of time an less tedious work students realize the implication of changing the ship parameters on factors

such as economics, safety, requirements, etc. and output data could be obtained easily in printed form or in form of drawings and graphs.

CAD/CAM Application In Shipbuilding Process

Though this paper mainly stresses on the aspect of ship design software for educational purposes, it is also appropriate here to mention their practical application such as in shipbuilding yard and relationship of ship design to the general engineering design process.

The main areas of computer application in a shipbuilding process are design, production and management. The justification of using computer as given by Kuo¹ can be summarised as follows: -

- Manipulation of large calculations.
- Use of numerically controlled machines.
- Link between design and production.
- Interactive nature of design procedure.
- Planning and management Control.

The importance of computer and areas of application in shipbuilding is shown in Figure 1.

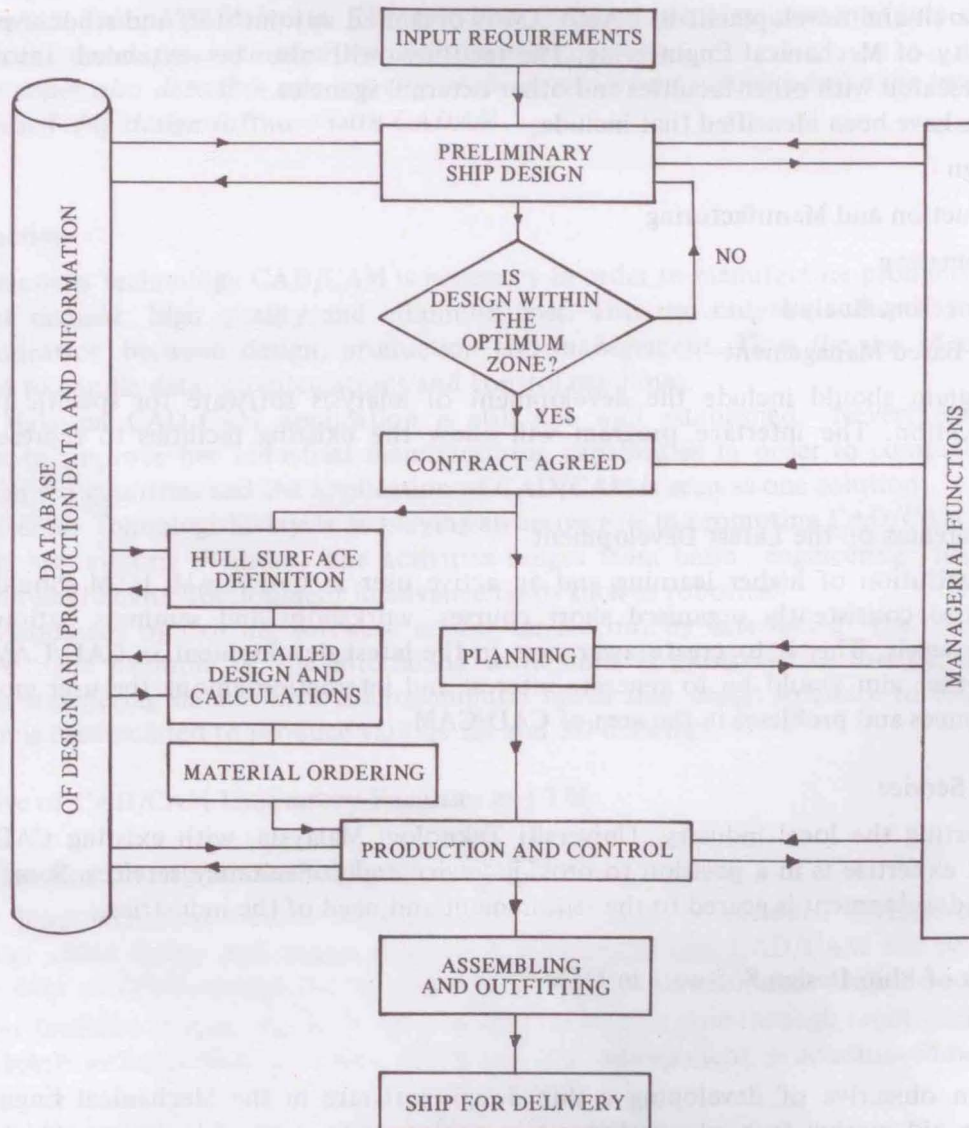


Figure 1 Shipbuilding process

In ship design, its process follows the same process as in general engineering design. This is defined by Shigley² :-

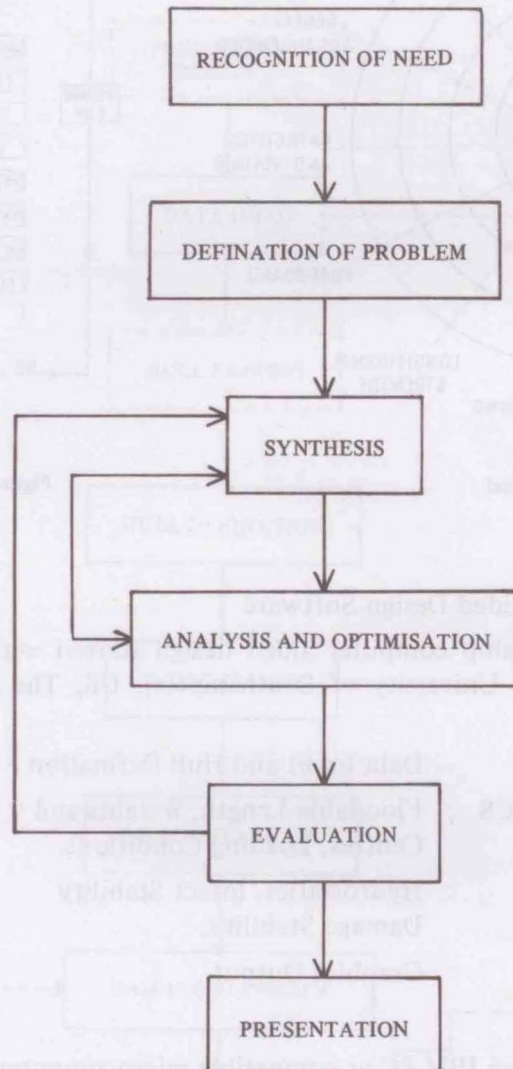


Figure 2 Design process

The iterative nature between synthesis, analysis and evaluation in order to achieve optimisation and at the same time fulfilling the requirements certainly requires computer software to be able to explore the various possible models. Or else the designer's work will be very tedious and time consuming.

In the case of ship design the model under consideration is the ship itself. Figure 3 is to illustrate the nature of iterative process and Figure 4 is an example of a flow chart in preliminary ship design. Here, synthesis is the selection of principal dimensions, hull form and general arrangement; analysis is the calculation of hydrostatics, freeboard, etc; lastly optimisation is the compromise of parameters to achieve an optimized ship design, taking into consideration such factors as economics, experience, safety, performance and requirements.

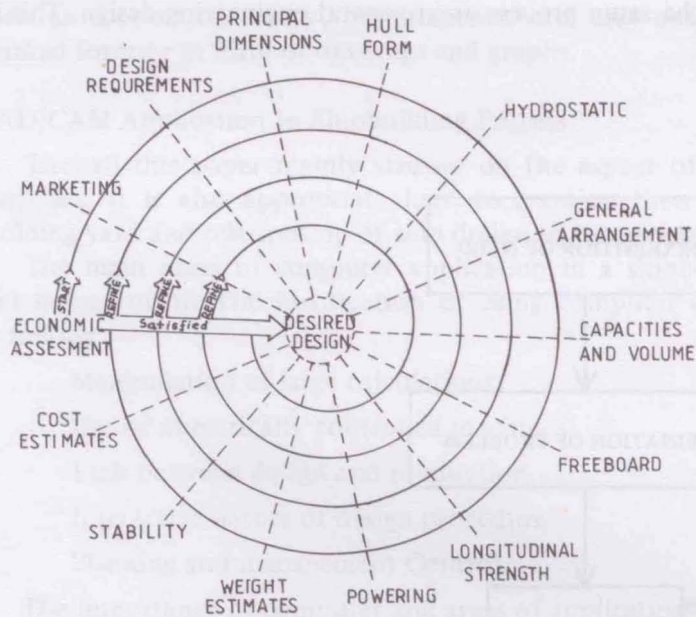


Figure 3 Design spiral

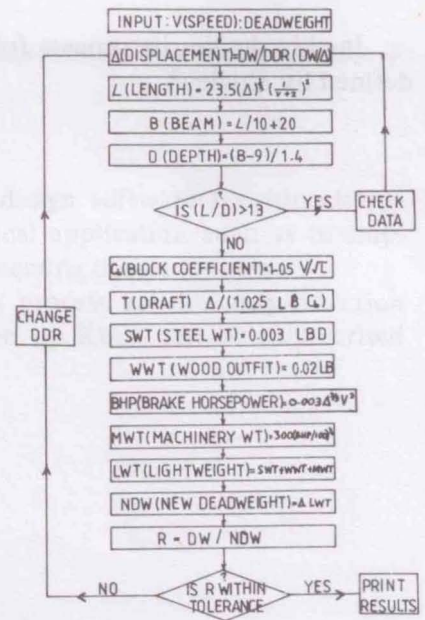


Figure 4 Preliminary design flow chart

Wolfson MTIA Ship Computer Aided Design Software

The development of UTM ship computer aided design started with the acquisition of WOLFSON's software from the University of Southampton, UK. The software program is in four parts:—

- | | |
|----------------------|--|
| HULL DATA | : Data Input and Hull Definition |
| SHIP CHARACTERISTICS | : Floodable Length, Weights and Centres, Loading Conditions. |
| ANALYSIS | : Hydrostatics, Intact Stability, Damage Stability. |
| OUTPUT | : Graphics Output |

The software can be run on an IBM PC or compatible microcomputer. Input to the software is the body plan offsets inputted via the keyboard or digitiser. Output is via screen, printer or plotter. Output in the form of ASCII file is possible for purposes of interfacing with other softwares.

Software Development

The next stage of development is the extension of the Wolfson's software to include the following programs. —

- Preliminary Design
- Graphics and General Arrangement Drawing
— Interfacing between Wolfson and CADAM.
- Ship Scantling and Strength
- Hull Fairing
- Powering

Some of the programs mentioned above are currently being undertaken as final year students projects.

Figure 5 shows the present status and future development of the software.

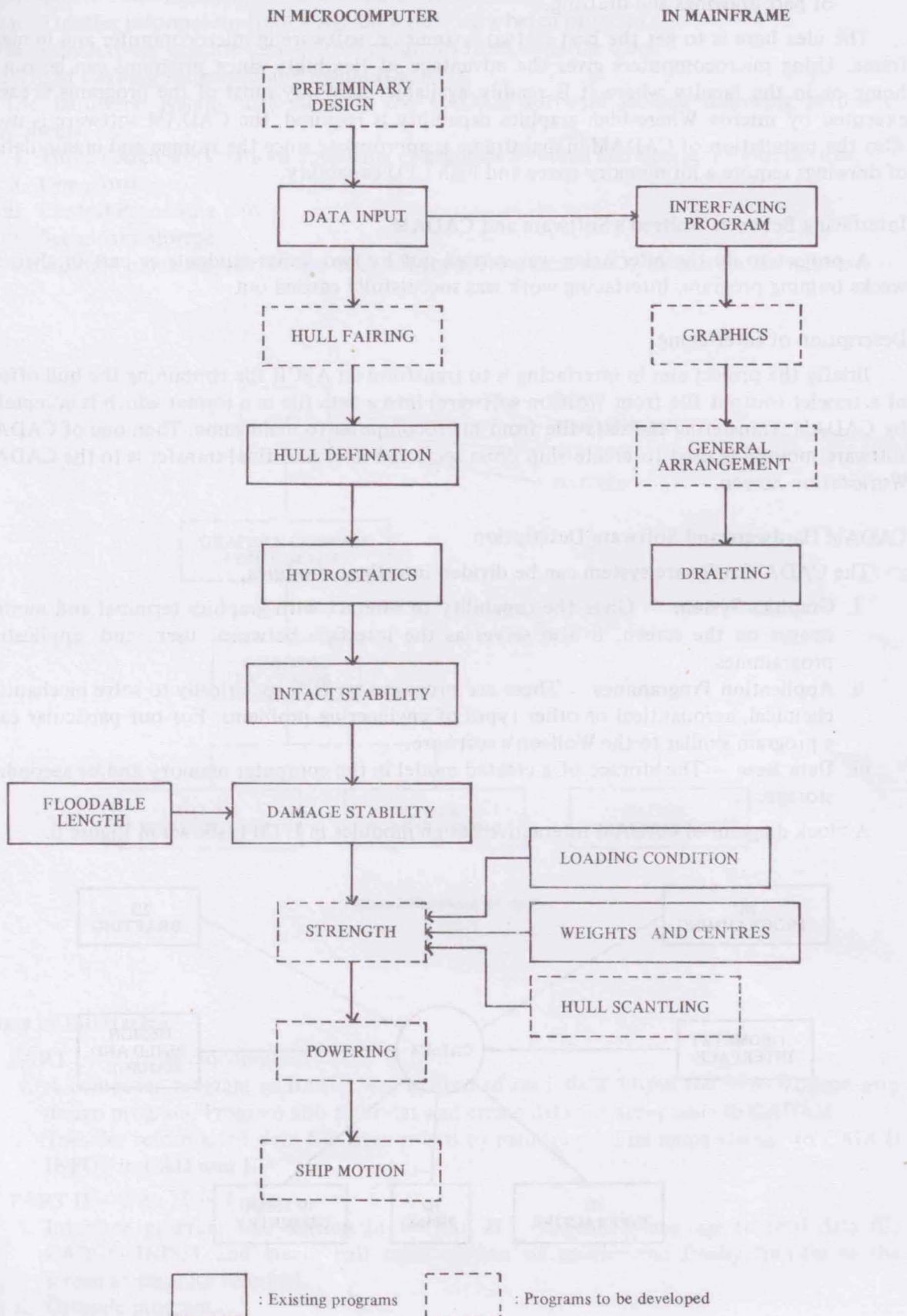


Figure 5 Present status and future development of software

Development of the software is in two ways:—

- i. Adding of new calculation programs in microcomputer.
- ii. Interfacing with CADAM to do graphics manipulation, storage of drawings, assembling of part drawings and drafting.

The idea here is to get the best of two systems i.e. software in microcomputer and in mainframe. Using microcomputers gives the advantage of flexibility since programs can be run at home or in the faculty where it is readily available. Any way most of the programs is easily executed by micros. Where high graphics capability is required, the CADAM software is used. Also the installation of CADAM in mainframe is appropriate since the storage and manipulation of drawings require a lot memory space and high CPU capability.

Interfacing Between Wolfson's Software and CADAM

A project to do the interfacing was carried out by two senior students as part of their six weeks training program. Interfacing work was successfully carried out.

Description of Interfacing

Briefly the project aim in interfacing is to transform an ASCII file containing the hull offsets of a trawler (output file from Wolfson software) into a data file in a format which is acceptable by CADAM; transferring the data file from microcomputer to mainframe. Then one of CADAM software module is used to create ship cross sectional lines and final transfer is to the CADAM Workstation Screen.

CADAM Hardware and Software Description

The CADAM software system can be divided into three modules. —

- i. **Graphics System** — Gives the capability to interact with graphics terminal and modify images on the screen. It also serves as the interface between user and application programmes.
- ii. **Application Programmes** — These are programs written specifically to solve mechanical, chemical, aeronautical or other types of engineering problems. For our particular case, a program similar to the Wolfson's software.
- iii. **Data Base** — The storage of a created model in the computer memory and/or secondary storage.

A block diagram of CADAM interactive design modules in UTM is shown in Figure 6.

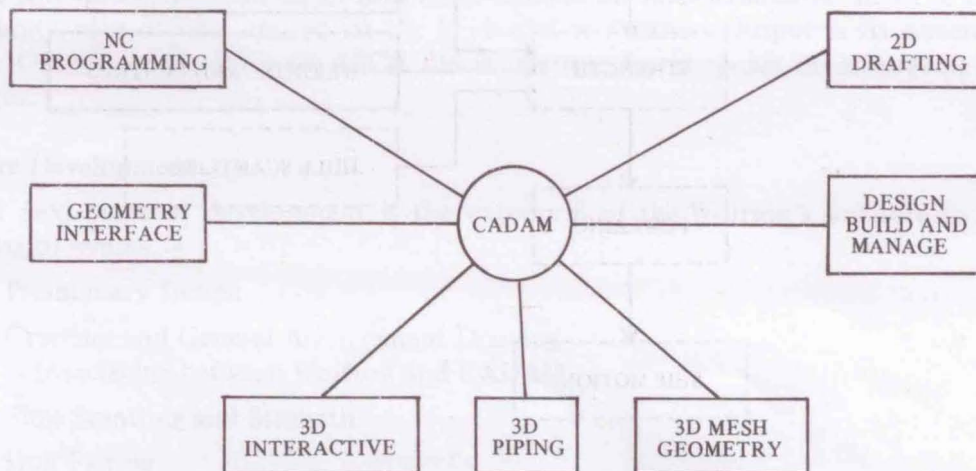


Figure 6 CADAM interactive design module

Detailed information can be found in the CADAM user manual. As the interface work requires programming to be done in geometry interface module, a brief description of it is given. The Geometry Interface allows. —

- i. Create CADAM model elements in a batch environment.
- ii. Transfer information from CADAM model via a batch program.
- iii. Interactively execute user-written programs from CADAM scope.
- iv. List drawing subgroups and model IDs.

The hardware system that supports the CADAM software include following hardware components: —

- i. Three design workstations consisting of graphics terminal and operator input devices.
- ii. One plotter.
- iii. Central Processing unit.
- iv. Secondary storage.

A simplified block diagram of the CADAM supporting hardware system is shown in below. —

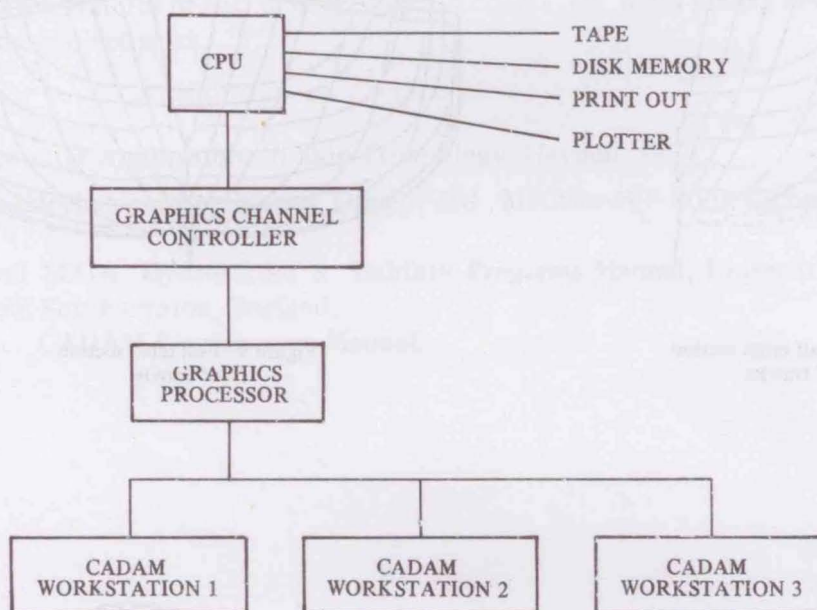


Figure 7 Hardware set up

Stages of Interfacing

PART I – With Microcomputer

- i. A computer program in BASIC was written to read data output file from Wolfson ship design program. Program also reformat and create data file acceptable to CADAM.
- ii. Transfer reformatted data file from micro to mainframe. File name change to CADCD INPUT in CAD user file.

PART II – With Main Frame

- i. Interface program was written in Fortran H – Extended language to read data file CADCD INPUT and create half cross section of trawler and finally transfer to the screen at graphics terminal.
- ii. Compile program.
- iii. Link the necessary subroutines with written program
- iv. Run program.

Result

The result of interfacing can be shown in terms of graphics. Figure 8 shows the half cross section of a trawler after completing the interfacing process. In CADAM the model could be extended to form a complete drawing using the 'Mirror' option as shown in Figure 9. 3D modeling allows isometric view of the model as shown in Figure 10. Figure 10 also shows the capability to do surfacing on the 3D model. Further drafting will be the production of 2D drawings of two other views namely profile and plan views which is still being carried out. All the drawings mentioned requires a large amount of memory space which is easily accommodated by the main frame and executed within a relatively short period of time.

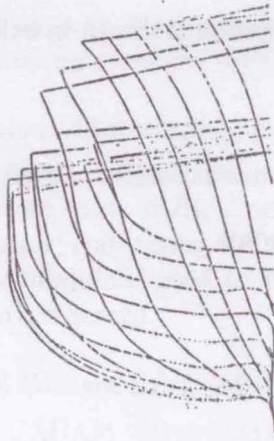


Figure 8 Half cross section of trawler

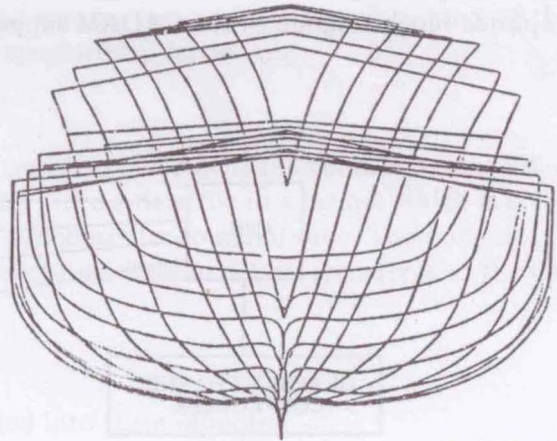


Figure 9 Full cross section of trawler

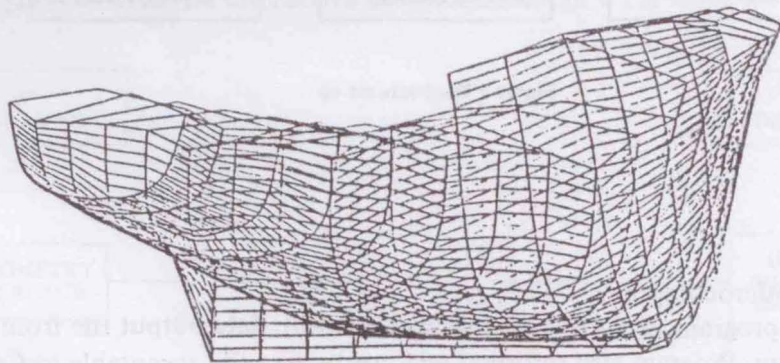


Figure 10 Isometric view of trawler

CONCLUSION

We have already laid down the plan for the full development of CAD/CAM. We have set the objective, target and specified detailed implementation program. We have also set the time frame within which these plans are to be achieved.

What is required now is to implement, monitor and readjust in order to steer the developments in the right direction.

Since this is a first attempt, it is also a learning process on our part. However with enough will, determination and perseverance, we are confident that the success we hope for will eventually be within reach.

We have illustrated an approach to the development of an existing microcomputer based ship design software and interfacing with CADAM. This approach gives the advantage of enhancement in graphics, capability of large storage and flexibility in manipulation of drawings for drafting purposes.

The initial stages of interfacing was successfully done and graphics capability is extended from 2D to 3D.

Acknowledgement

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