THE VERSATILE CONSOLE SYSTEM

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Introduction

The Versatile Console System (VCS) is a system of consoles, overhead assemblies and associated units of modular construction which, together with the seating arrangements and the operator himself, provides an integrated approach to help overcome the many man/machine interface problems that occur in a warship. The system is not new and does not employ any revolutionary principles, but has been tried and proven over the past 15 years. FIG. 1 is an example of a console for a ship presently under construction, and FIGS. 2 and 3 show the overall layout of equipments on the bridges of frigates before and after the adoption of VCS.

The purpose of this article is to describe briefly the main features of VCS, the reasons for its introduction, and the associated procedures followed to completion of console sketch designs.

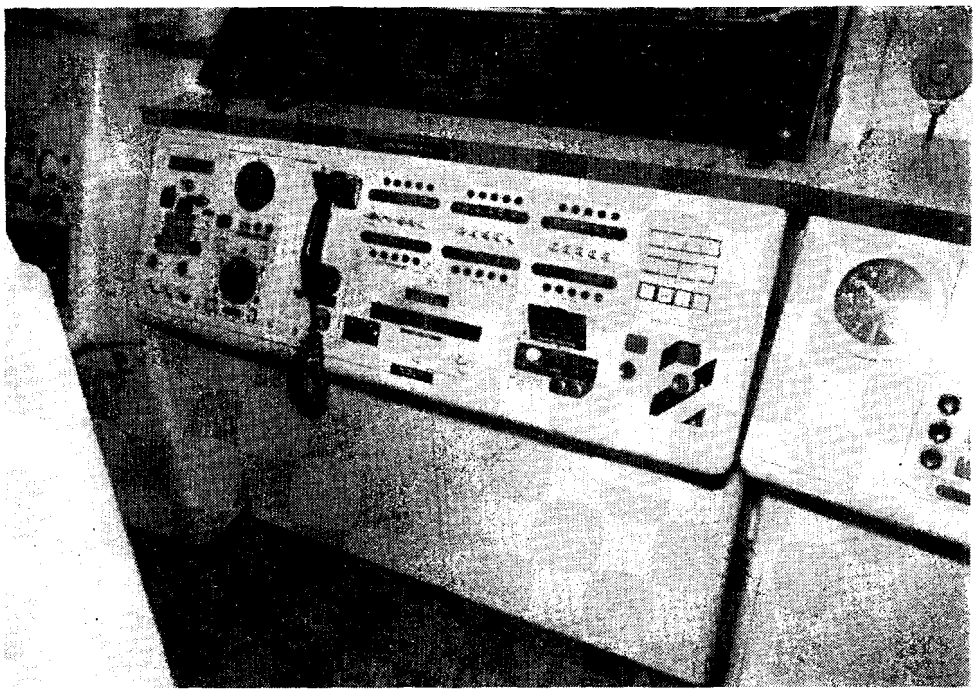


FIG. 1—TYPICAL VCS CONSOLE

Design Features

The system comprises consoles and assemblies incorporating within their frameworks numbers of 'boxes' into which are plugged various sizes and types of unit. A variety of shapes of consoles and assemblies may be constructed from the standard range of aluminium cast corners, brackets, and other components together with main frame and cross members. They range

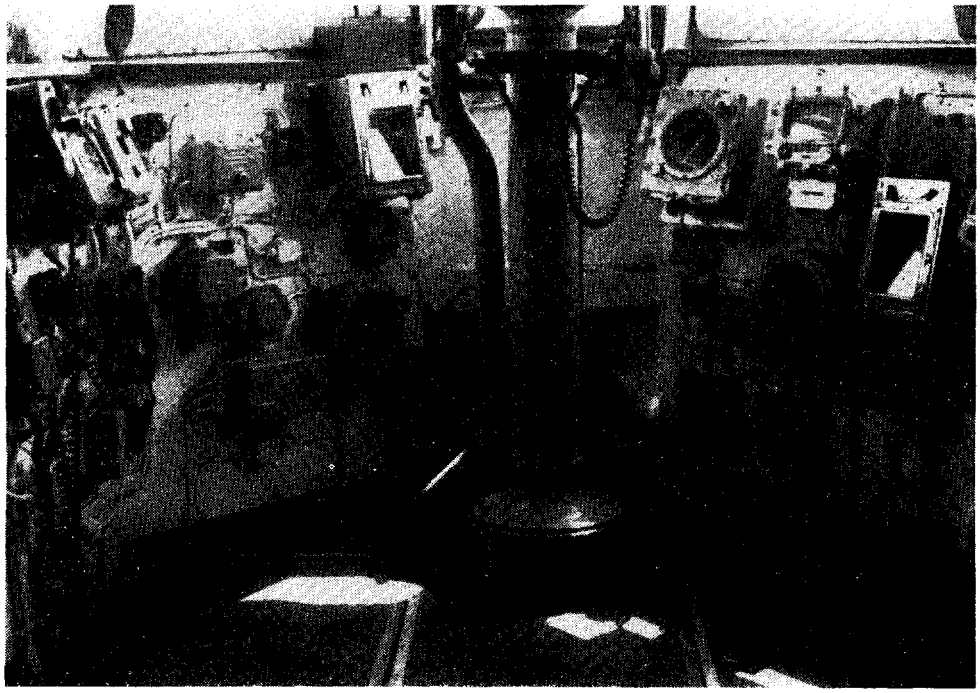


FIG. 2—FRIGATE BRIDGE BEFORE ADOPTION OF VCS

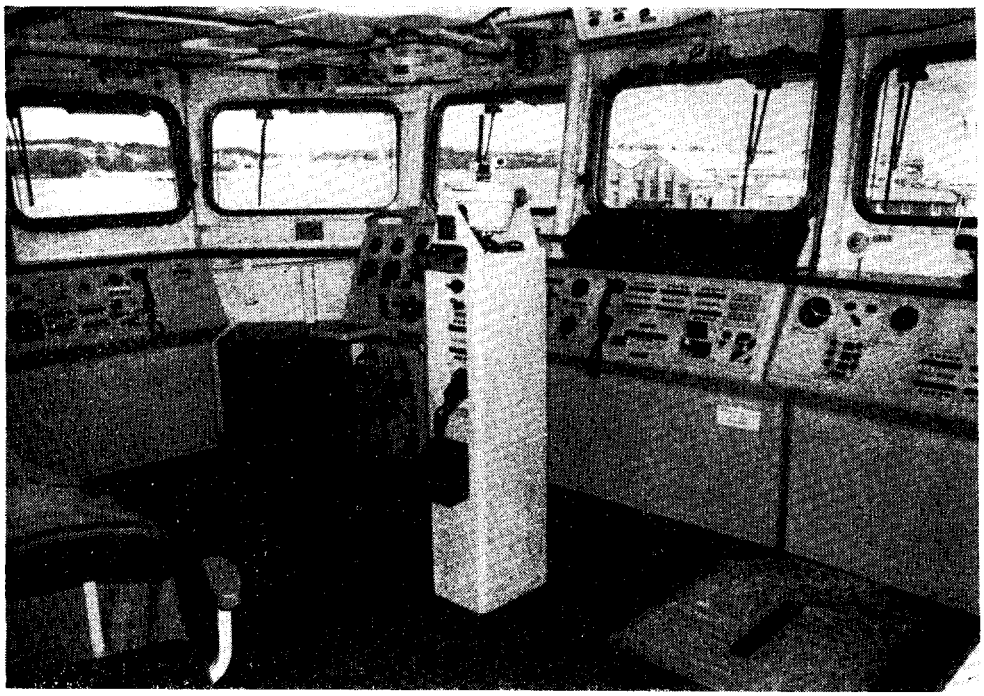


FIG. 3—FRIGATE BRIDGE WITH VCS FITTED

from the simple boxes of overhead assemblies, FIG. 4, to large consoles with desk sections, overhang and wing panels. Consoles may be designed for sitting, or for sitting and standing, see FIG. 5.

The basic unit size is designated 1 × 1 which has a front panel size of 152mm × 152mm (6in × 6in). The majority of individual units are of the 1 × 1 cell size, but many are multiples up to the largest size of 3 × 3. Large unit sizes are not however preferred, mainly because of the need to ensure adequate performance under shock conditions.

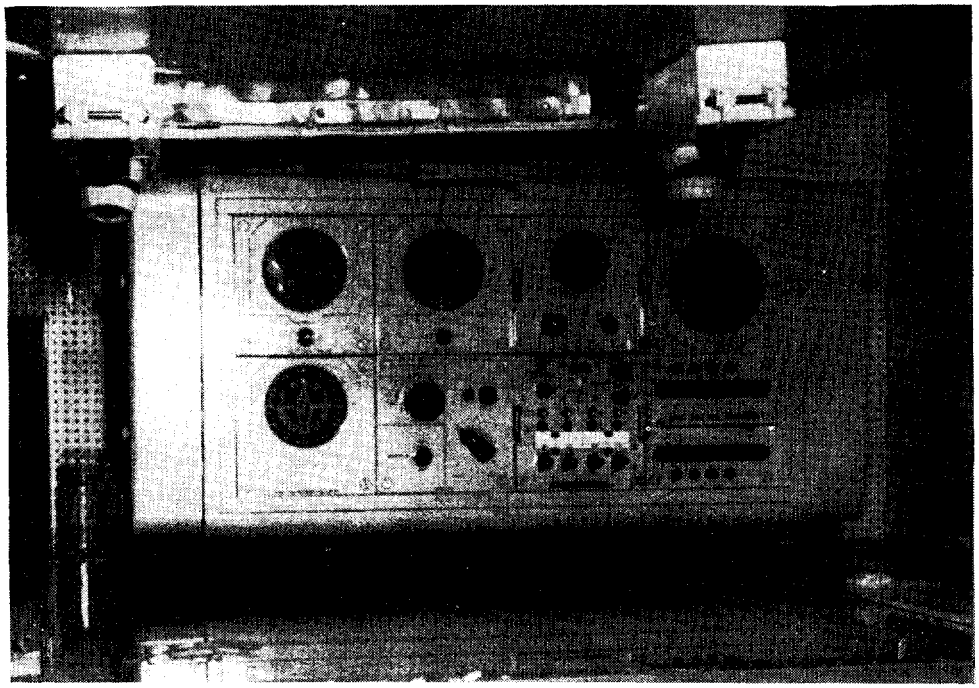


FIG. 4—TYPICAL VCS OVERHEAD ASSEMBLY

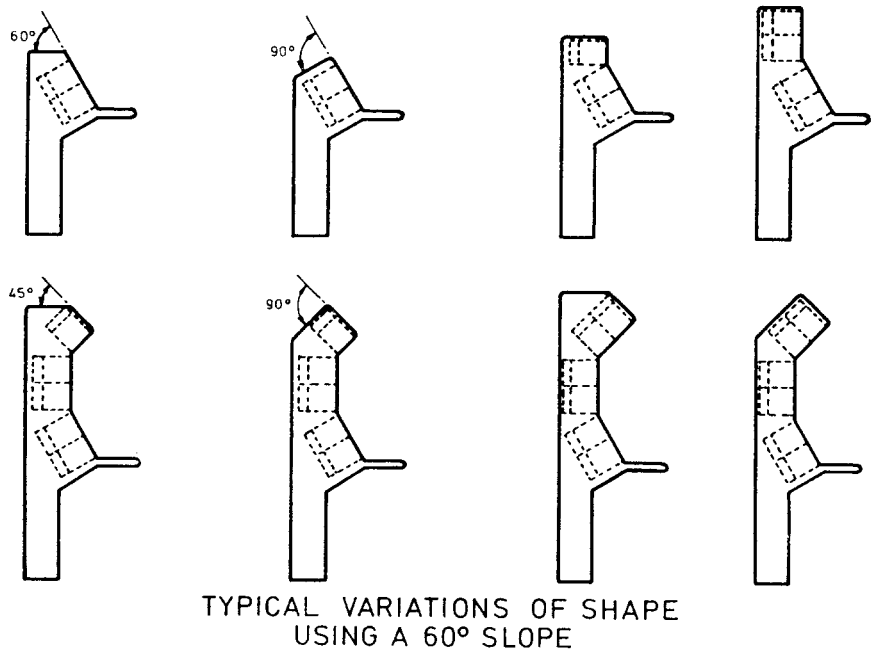


FIG. 5—EXAMPLES OF RANGE OF CONSOLE SHAPES

Three types of framework construction can be used, namely: 20 series, 30 series, and 1000 series. The 20 series is a light framework used for lower levels of shock protection, and the 30 series is a heavier frame construction used for shock levels up to 30g vertical acceleration. The 1000 series is a special light-weight method of construction which takes up a smaller space than the other methods and is capable of withstanding 70g vertical acceleration. It may be used for small assemblies not exceeding two basic size units either horizontally or vertically.

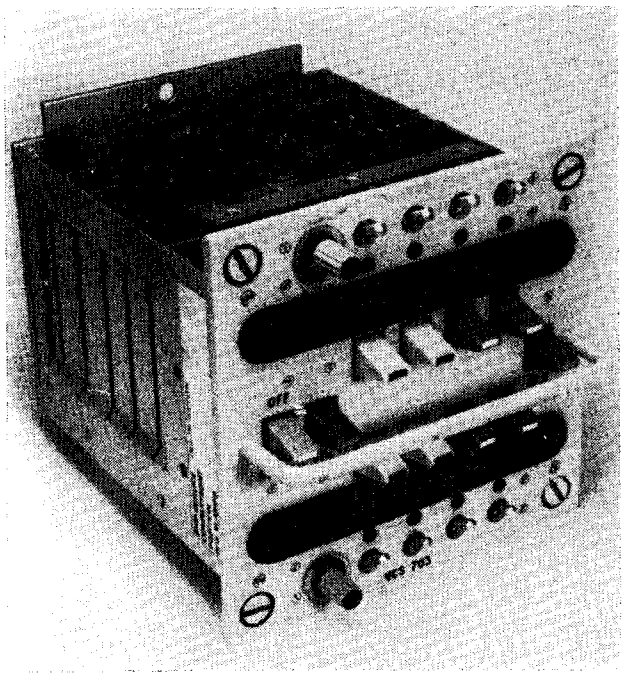


FIG. 6—TYPICAL VCS 1×1 UNIT

The method of construction used for VCS makes it unsuitable for use on weather-decks without additional cover or protection, or for siting in hazardous areas.

Almost all types of controls, indications, or circuitry may be built into the available sizes of VCS unit and to date over 530 different types have been manufactured. A typical example is shown in FIG. 6. To avoid impairing night vision performance, indication and tally strip illumination light levels for units sited on the bridge or in the operations room have a dimming capability provided by a separate VCS dimmer unit.

The individual units are secured into the box cells of the consoles by four threaded corner screws, and the electrical connections are made by plugs and sockets which are automatically mated as the units are inserted. When units are removed, they are therefore electrically dead and have no trailing connections.

Wiring looms connect from the back of the plugs to the terminal chamber which is usually sited at the base of the console. The ship's cabling normally enters through the base of the console, and connections are made to taper pin terminal blocks or screw terminal blocks.

Background History and Basic Philosophy

The concept of the Versatile Console System was proposed as a result of the findings of a study undertaken in 1959. The study was initiated because it had become apparent that existing arrangements, particularly for bridges and operational spaces, consisted of a wide variety of individual equipments which were not being fully integrated to take account of the total user requirements. Insufficient attention was given to ergonomic considerations when compartment layouts were developed, and to the rationalization of equipment designs.

The main aims of the design study were therefore to achieve the following:

(*a*) an ergonomically efficient presentation of controls and indications for the operator;
(*b*) flexibility of compartment layout and systems design;
(*c*) rationalization of equipment designs;
(*d*) easier shipboard installation;
(*e*) improvements in maintenance and logistic effort.

Ergonomic Considerations

The study for the fundamental physical design of the consoles, assemblies, and units made use of standard anthropometric data for male operators. From the beginning, it was considered essential that the operator, his seat, the desk section, and the controls and indications need to be treated as a

single entity. The operator must be able to use controls, see displays, and have adequate body support provided by the seat and the console.

Design parameters are based on catering for a 90 per cent. range of naval male personnel, i.e. from what is known as a 5 per cent. man up to a 95 per cent. man. A 5 per cent. naval man has a height of 1647mm (5ft 5in) and a weight of 54·6kg (8st 8lb); whereas a 95 per cent. naval man has a height of 1842mm (6ft $\frac{1}{2}$in) and a weight of 79·7kg (12st 7lb). These statistics are such that 5 per cent. of naval male personnel have heights and weights less than those for 5 per cent. man, and 5 per cent. have heights and weights greater than those of the 95 per cent. man. Comprehensive data for a whole range of body measurements is available in standard publications. It should be noted that, although body measurements are generally proportional, a 5 per cent. man may, for example, have a 95 per cent. man's waist measurement.

Three basic reference systems were considered for the console seating configuration. These were:

(*a*) fixed foot level with adjustable seat height;

(*b*) fixed eye level with adjustable seat height and a foot-rest;

(*c*) fixed seat level with adjustable foot-rest.

Option (*b*) is best as far as the operator is concerned but excessive console space has to be provided to accommodate the legs of the tall man. The compromise of a fixed seat level with a three-position foot-rest was adopted; this means that the seated eye level height varies by about 11·2mm (4·4in). Two seat designs, which match the console dimensions, are provided—one for the sitting arrangement and another for a dual sitting or standing requirement.

The basic brick size of the modular units was chosen as not so small that the console structure would be too complicated and expensive, and not too large so that a heavy structure would be required.

A study of the range of equipment designs existing before the introduction of VCS indicated the most useful unit size to be in the range 140mm ($5\frac{1}{2}$in) to 200mm (8in). A sub-division of the recommended console sizes, which were based upon anthropometric data, led to a basic unit size of 152mm (6in) × 152mm (6in) being adopted.

Design Flexibility

The console system design is required to provide a degree of flexibility to cater for changing operational roles and requirements. It can take up to ten years from the stage of user requirements being specified to the time that compartment and system arrangements are tried out in earnest during work-up at sea. Further changes in operational requirements also occur throughout the life of a warship, and practical and economic considerations place severe constraints on the number of alterations which can be undertaken. A system design, therefore, which provides a degree of flexibility and versatility enables limited changes to be made outside refit periods.

Rationalization of System and Equipment Designs

The number of different disciplines and trades employed in the shipbuilding industry make integration of ship systems difficult, and a design procedure which encourages all parties to perform the correct functions is essential. Equipment design by more than one department can also lead to a proliferation of equipment types and variants. The various ship, surface weapons, and underwater weapons departments which sponsor system designs produce equipments in the VCS form where appropriate, and common standards of VCS engineering ensure interchangeability and console design flexibility.

'Consolization' and modular construction are themselves both concepts that are used to advantage in many applications, but their effectiveness is improved when a standardized system is used over which a central control is exercised.

By keeping a comprehensive central register of all units, a check can be made that duplication and overlap of equipment types are kept to a minimum. It is a design aim that new unit developments should fulfil a wide range of applications. It is possible, for example, with recent improvements in component technology that a design developed to meet a new requirement can also be used to supersede two or three existing units. However, the benefits of reduced documentation and support have to be balanced against the possible high additional unit costs resulting from over-complicated designs.

Shipboard Installation

In addition to the benefits to the operator and the designer of a 'consolized' arrangement of standard plug-in units, there are also advantages to the installer and to the maintainer. The installation of electrical equipments in the form of consoles and assemblies is generally easier and cheaper than with a large collection of individual equipments. Mounting arrangements are simplified and overall space and weight savings can be made. Also, cabling is brought to centralized locations and interconnection between individual units is made in the console wiring instead of cabling run around the compartment. The use of external junction boxes can be minimized by utilizing terminal blocks within the consoles. System modifications can therefore often be accomplished within the console wiring, avoiding the more difficult and costly changes to ship's cabling.

Empty consoles and assemblies may be installed and cabled early in the build programme and this gives considerable advantages to shipbuilders.

Maintenance and Logistic Support

The modular, plug-in construction method provides a means of quick replacement of defective units which is very valuable under action or emergency conditions. Units of the same type are fully interchangeable and routine maintenance is easily managed by replacement of units by spares while the defective item can be repaired in maintenance rooms where proper facilities are available.

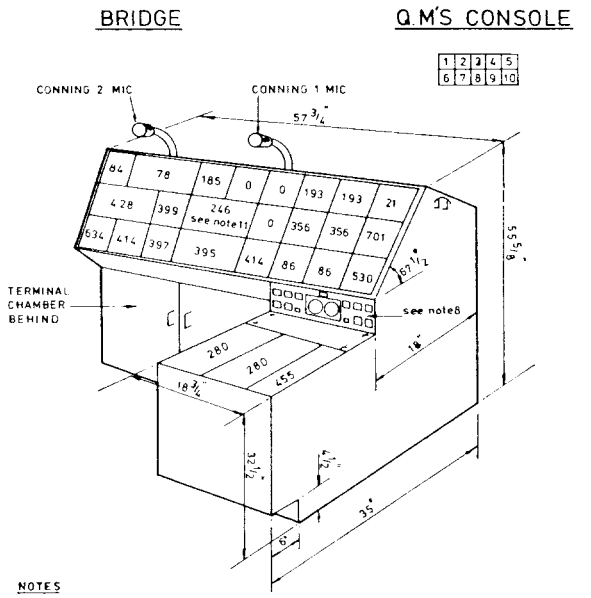
The overall standardization of VCS unit designs also allows the types and numbers of spares holdings to be maintained at reasonably low levels.

Console Design Procedure

The design of the VCS consoles and assemblies for a warship constitutes an important part of the overall ship design process.

When compartment layouts and ship system drawings are available, the preliminary VCS design can start to be developed. For a particular compartment the space available for consoles and assemblies is established by examination of the compartment layout drawing and, similarly, from examination of the system drawings the user facilities which have to be provided in the form of VCS units are determined. The two basic factors of space available and facilities required are often, of course, interdependent and one may have to be changed because of constraints imposed by the other.

When the space allowance for a console, and the facilities it has to contain, have been agreed, the VCS design group select a suitable type of console and prepare sketch design drawings. The sketch designs are produced in isometric drawing form, which it has been found is most readily appreciated by the users. They show the outline and angles of the main surfaces of the console,



NOTES
1. 30 SERIES CONSOLE.
2. APPROX WEIGHT OF CONSOLE 500 lbs.
3. LINK INDICATIONS SUPPLY TO Q.M'S O/H ASSY.
4. PRE-AMPS REQUIRED FOR CONNING 1&2 MICS. ARE TO BE MOUNTED ON A BOARD IN CONSOLE BASE.
5. TAPER PIN TERMINAL BLOCKS NS 5940-99-972-1419 TO BE USED IN CONSOLE BASE
6. 2 OFF CONNING STALK MICS 0558/462-4258 WITH NOISE CANCELLING INSETS 0558/952-2228 & ADAPTOR CAP NSN 5965 99 462 4280, MADE SW TO SPEAK WITH 2 MAKE CONTACTS
7. HEADSET STOWAGE AP 32070 TO BE FITTED WITHIN STOWAGE BOX WITH QUICK RELEASE COVER ALT STOWAGE AP 32070 FITTED TO RHS OF CONSOLE THESE STOWAGES ARE FOR HEADSET ASSOCIATED WITH VCS 530
8. EQUIPMENT AS SHOWN ON D.G.S/211/180 TO BE FITTED (INDICATOR LAMPS & SHAFT POSITION INDICATORS ETC.) ENGRAVING AS DETAILED ON DRWG
9. FOOTREST TO BE PROVIDED ON THIS CONSOLE.

VARIOUS NOTES OMITTED FOR CLARITY

FIG. 7—CONSOLE SKETCH DESIGN

the VCS units fitted, overall dimensions, fixing centres and weight, together with the ancillary fittings and attachments.

FIG. 7 shows a sketch design of a console for a ship presently being built. The design is either based upon the overall dimensions of a similar console previously fitted or developed from basic principles using anthropometric data (see FIG. 8). Practical engineering details, such as methods of mounting and the provision of ample space for cable entries and terminal chambers, have to be considered at this stage.

When overall size, shape, shock requirements, and mounting and cable entry arrangements for the console have been established and the units and spare unit spaces agreed, the next step is to lay out the positions of the units in the console. It is clearly necessary to have some knowledge of the systems and of the functions of the controls and indications that are fitted. Information has to be considered on:

(*a*) frequency of use;
(*b*) accuracy and speed of operation;
(*c*) effect on system of delay or error;
(*d*) association with other displays and consoles.

The following are some of the principles and guidelines observed when siting individual units:

(*a*) the most important and most often used controls are positioned within easiest reach;
(*b*) associated controls are grouped together;
(*c*) indicator or dial displays are placed with, and above, their associated controls;
(*d*) steering units are sited on the centre line of the console with tape repeaters sited directly above them;
(*e*) important controls which take a larger share of the load task are preferred to be used by the right hand;
(*f*) sockets for headsets (which are normally ancillaries and not VCS units proper) are located so that the leads do not trail across the face of the console.

These requirements invariably lead to conflicting claims for the prime positions and some degree of compromise has to be accepted. This is done, however, only after agreement with system sponsors as well as with user interests.

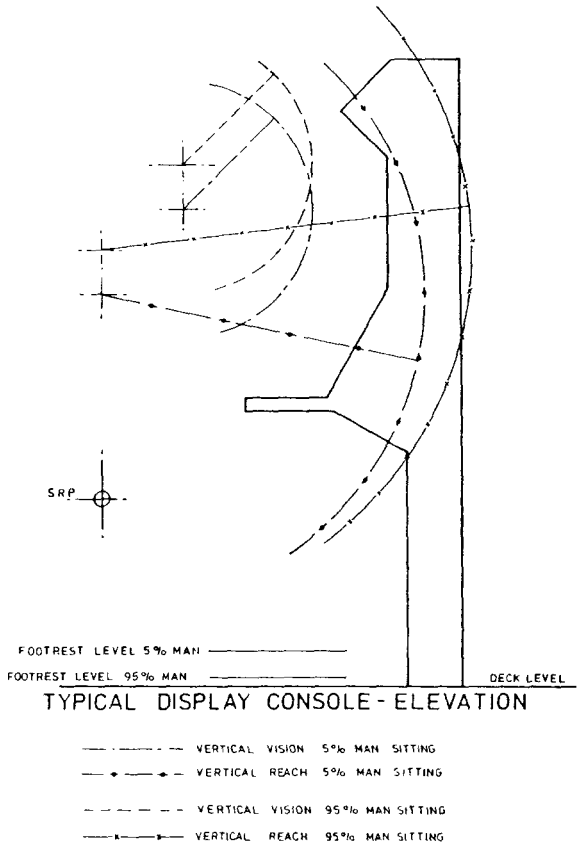


FIG. 8—CONSOLE ELEVATION SHOWING ARM REACHES, VIEWING DISTANCES AND FOOT-REST LEVELS

Often final agreement can be reached only at a mock-up inspection. The more important compartments are mocked up in detail in wood and hardboard (see FIG. 9) and these are used as the basic tool for finalization of compartment layouts and VCS console sketch designs.

Wherever possible, units from the existing range are selected but, if there is no suitable unit already in production, a new design has to be developed by the sponsor or the VCS design group.

When sketch designs have been agreed, the console wiring schedules are produced. The connection details of the VCS unit and the system drawings and specifications have to be made available to whoever is producing the wiring schedules, and a close liaison has to be maintained with system sponsors. With the sketch designs, wiring schedules, and the VCS engineering standards, sufficient information is at hand to start the detailed manufacturing drawings. Production of individual VCS units may proceed independently of consoles and assemblies; they are often produced by several manufacturers.

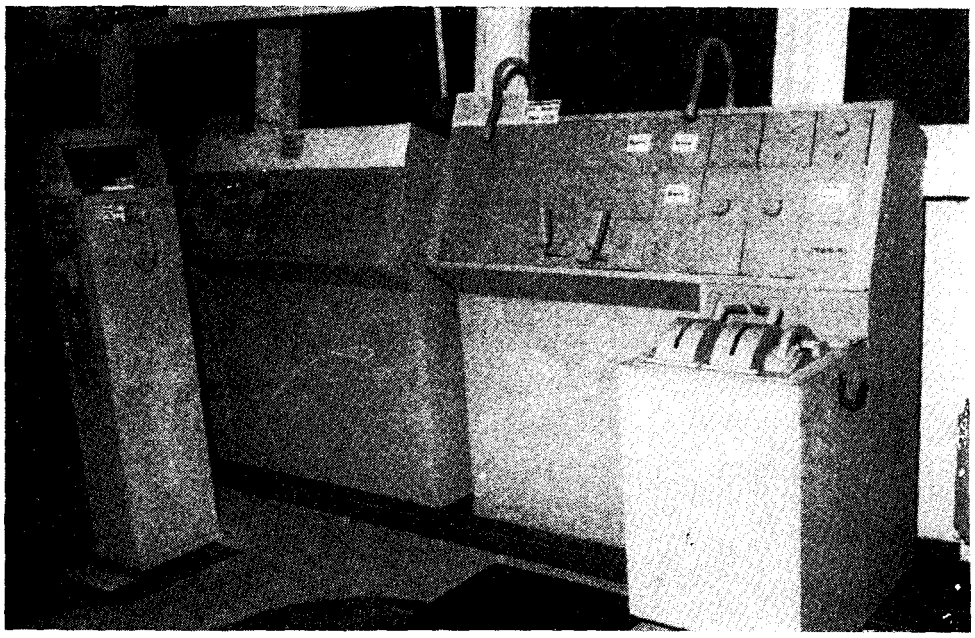


FIG. 9—MOCK-UP OF NEW CONSTRUCTION BRIDGE CONSOLES

Future Developments of the System

Although no changes in the basic concepts of VCS are planned, certain aspects of detail are being considered. These include making better use of the space available within the consoles, providing space saving and greater versatility by the introduction of a unit of smaller size, and the possible implications of metrication.

Use is already made of the space inside consoles for the accommodation of power units, transformers, and some other electrical components; and also cupboards, bookshelves and racking are provided where appropriate. Better use of consoles and assemblies could be made by fitting a wider range of electrical equipments, even those not requiring operator controls or indications. It is important that any components or sub-assemblies should be easily removable from consoles—either in the form of blank-faced units or as complete assemblies wired with connectors.

Continuing advances in electronics and component technology and the increasing demand for space limitation in warships have led to reconsideration of the size of the smallest basic unit. Electronic circuitry usually takes the form of printed wiring boards upon which are mounted the various components. A unit size of 6in × 2in lends itself readily to the mounting of such boards and also allows a few operator controls and indications to be fitted.

The cost of installation and the space taken up by electric cabling has caused serious study to be made of the possible advantages offered by the techniques of multiplexing of electric signals (i.e. the use of a single conductor pair to carry many individual circuits) and the use of fibre optic links. The Versatile Console System is ideally suited to make the best use of these opportunities as equipments are already concentrated within consoles at the centres of maximum information flow.

Conclusions

VCS does not provide a complete answer to the varied and complex ship control problems, but it gives considerable improvements over previous arrangements and has been a general success. It has not only tidied up the layout of equipments within ship compartments, but has also allowed the users to perform their tasks more efficiently.

Ease of maintenance and reduced logistics are also apparent, but the main benefits to the management of warship design and upkeep have been the disciplined approach to design procedures and rationalization of equipment types which use of the system encourages.

No changes are envisaged in the basic concept of VCS as it has proved to have a wide and general acceptance by the users (including several navies), by ship system design authorities, and by warship builders.

Note: The views expressed are those of the author and do not necessarily represent those of the Ministry of Defence.