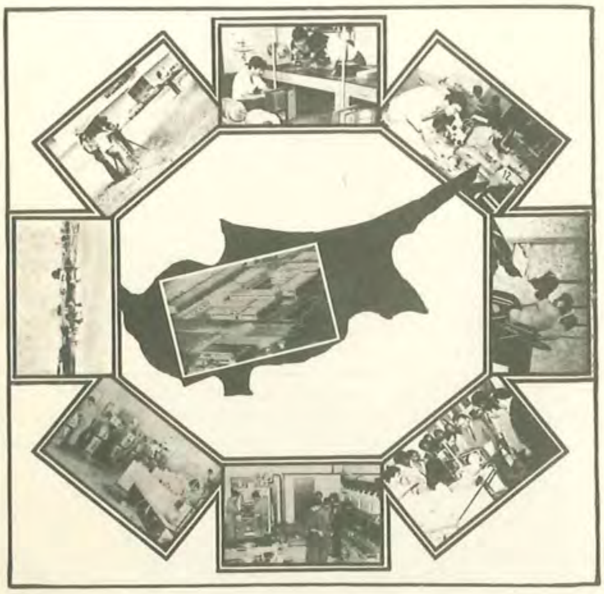
Review

No. 9 June 1980 Nicosia

Review

No. 9
June 1980
Nicosia

Editorial Committee :
A. Kaplanis Chief Editor
P. Vassiliou, Assistant Editor



Cover photo by Ionas Aggeli.

In the centre an aerial view of the H.T.I. is shown: the surrounding pictures indicate various departmental activities.

H.T.I. Review is published by the Public Information Office ln cooperation with the Higher Technical Institute, Nicosia. It accepts articles which promote and further new developments and knowledge in technology, especially with reference to Industries of Cyprus. Requests for further copies of the magazine and for information concerning the published articles should be made to General Editor H.T.I. Review, Higher Technical Institute, P.O.Box 2423—Nicosia.

Contents

The Higher Technical Institute (H T I) was established in 1968 as a Government of Cyprus project with assistance by the United Nations Special Fund (UNDP), the United Nations - Educational Scientific and Cultural Organisation (UNESCO), and the International Labour Office (ILO) Cyprus Government Executing Agency: The Ministry of Labour and Social Insurance.

Review

No. 9 June 1980 Nicosia

EDITORIAL

We present the nineth edition of the H.T.I. Review the main objectives of which are :-

(a) To consolidate the image of the H.T.I. Review as a vehicle for scientific and Technological publications appropriate for a country which strives to achieve higher rates of development.

(b) To Encourage members of staff to diversify their professional interests through purposeful R. & D. work and study papers, and

(c) To promote the aims, objectives, status and social and professional mission of the Tertiary Education in sub-professional Schools.

The articles presented in this issue are of the same level and character as in previous ones. Topics such as standardisation, Solar Energy, R. & D., microcomputers etc. are dealt with in a manner that enlightens the reader on applications and development.

Articles are written by members of Staff and Students of the H.T.I., although in this issue we host a contribution from a Professional Engineer, Officer of the Ministry of Commerce and Industry, who writes on Quality Control.

Staff handles topics for which they have substantial backround through Studies at the University and further experiences in Industry.

Such work is done over and above their normal work schedule, as lecturing staff at the H.T.I.

The H.T.I. is a Technical College of Sub-University degree standard accepting students who have successfully completed their Secondary Education and have passed the Institute's Entrance Examinations. Its professional aims are to train Technician Engineers who, as a class, are gradually being accepted on their own merit.

Now, a Technician Engineer, by definition of the Council of Engineering Institutions, (C.E.I.) " is competent by virtue of his/her education, training and subsequent experience to exercise independent Technical judgement in and assume personal responbility for duties in the engineering field.

His / her education and training is such that by the application of general principles and established techniques, he / she is able to understand the reasons for and purpose of the operations for which he / she is responsible.

The technician engineer performs technical duties of an established or novel character either independently or under the general direction of a chartered engineer or scientist...".

Appreciation by the Professional Bodies and the Public in general of the important role and mission of the Technician Engineer will, it is believed, contribute towards a more balanced distribution of the Secondary School Graduates to all levels of Education.

Upholding the status of the Technician Engineer will naturally strengthen the group of high level Technical Personnel who are the backbone of any developing and developed industry and on which the University Graduate Engineers can rely either for the implementation of the work they design or as collarobators in their work.

With this level of work the H.T.I. hopes to achieve the strengthening of this appreciation by the Professional Bodies and the public and to offer pride to its students that they have chosen a worthwhile profession and career of high social mission.

Editorial Commitee.

PROPERTIES AND APPLICATIONS OF FIBRE REINFORCED CONCRETE

by Dr. H. Stavrides
Lecturer H.T.I.

Synopsis

It is now well established that fibrous reinforcement of cement matrices can improve the tensile strength properties of the composite, and impart to it qualities of crack control, toughness, ductility and impact resistance. Several applications can benefit from these unusual properties of fibrous concrete. In this paper, the properties of fibres and of their fibrous composites, and some of their applications are discussed. The limitations of the fibre reinforced cement composites, the problems of production and control, and of durability are emphasized. It is suggested that the advantages of new materials can only be fully utilised by new design thinking.

Introduction

Although nearly every conceivable type of fibre has been tried out in cement or concrete matrix at one time or another, not all of them can be effectively and economically used –with a cement-based matrix. Obviously, each fibre is characterized by its own particular properties and limitations (Table 1), and the properties of the concrete will be modified accordingly. Naturally many applications can benefit from concrete having improved properties due to the fibre-reinforcement. However, only the significant aspects of the more important fibres and some of their primary applications will be discussed here. The most successful of all fibres, asbestos, is now a well-established industry and will not be considered.

Plastic fibres

Plastic fibres such as nylon and polypropylene have high tensile strength (550-850 N/mm^2) and ultimate elongation (15-25 %), but their low modulus precludes any reinforcing effect. However, their high elongation enables them to absorb large amounts of energy and the addition of plastic fibres can absorb 10-25 times more energy than the unreinforced mortar of concrete. In applications requiring high energy absorption, plastic fibres have, therefore, a special advantage.

The most successful form of polypropylene for use as fibre reinforcement is the fibrillated film fibres which are used extensively now as reinforcement in piles, and for non-load bearing elements.

For random dispersal, fibres are chopped into lengths ranging from 10mm to 100mm and added in the proportions of 0.2 % to 0.4 % by weight of total concrete. Usually 6000 to 26000 denier (1500 to 350m/kg) fibres are used, normally in 70mm lengths.

The most extensive use of polypropylene fibres at the present moment is in concrete piles. The superior impact resistance properties of the fibres arises from a purely mechanical bond between the fibre and the matrix. The fibres are made up from a number of fine fibrils – the matrix creeps into and interacts between the fibrils, and because of the absence of a physico-chemical bond, only minimum contact between fibre and matrix is necessary during mixing to ensure even distribution throughout the mix. The reinforcing properties of the fibre are influenced by its diameter (*i.e.* denier), the length of the fibre, the number of twists per unit length of twine, the amount of fibre content and its condition after mixing. Lengths shorter than 40mm are found to shred in the mixer, and become ineffective as reinforcement. The degree of mechanical bond achieved depends on the length of the fibre, its ability to fibrillate, the tightness of twist, the mixing time to give adequate dispersion and the abrasive action of the aggregate.

Full scale crushing tests on polypropylene reinforced piles have established their superior strength and impact resistance and this impact resistance is influenced by the fibre content and fibre length. The best impact results have been obtained when the fibres have been added in quantities ranging from 0.15 % to 0.25 % by weight (*i.e.* 0.4 % to 0.65 % by volume). Compared to the steel mesh reinforced pile, the fibre reinforced pile is able to resist cracking and disintegration better, and maintains its integrity after failure.

In addition to pile shells, polypropylene fibres are used extensively in non-load bearing corrosion-proof members (under the trade name "Caricrete"). In many conventional precast concrete components where steel reinforcement is incorporated purely for transportation and handling purposes, the use of plastic fibres can result in thinner, crack-resistant sections thereby saving materials and reducing transporation and erection costs. It can be used in cladding panels, and in floatation units which are made by coating blocks of polystyrene with a layer of caricrete of 19mm to 25mm thickness. The fibres have also been successfully used in repairing a river wall by guniting, and as a crack inhibitor in forming artificial lakes.

Glass fibres

Glass fibre reinforced cement (GRC) is being considered as a substitute for and an improvement of asbestos cement. Commercially, glass fibre is produced in three basic forms, namely, rovings, strands and woven or chopped strand mat. The individual filaments vary from 10 to 20mm.

Fabrication techniques play an important part in the strength of glass- fibre reinforced cements. The use of a high water-binder ratio is essential so that the slurry can be worked, the excess water being removed by suction or pressing techniques. In the suction-moulding method developed at the Building Research Establishment, a combined spray of slurry and chopped rovings is distributed over the surface of the mould. This is lined with a special high wet-strength paper or with Terylene cloth to retain the fines while the water is being extracted by suction. The pressing technique provides more efficient dewatering and better compaction of the composite but, as presently developed, it is principally suited to the production of flat sheets.

While the spray suction technique produces a two-dimensional random array of fibre reinforcements, conventional mixing with random dispersion of fibres can also be used. In both techniques, glass fibre lengths of 10 to 50 mm can be used. Both these methods have been used to produce cladding panels, window frames and other building components. Short lengths of pipes have also been manufactured by spraying glass fibre cement slurry on to a rotating mould.

One of the important property improvements achieved by glass fibre reinforcement is the spectacular increase in impact strength $20-25 \times 10^3$ J/m² compared to $3-5 \times 10^3$ J/m² for asbestos cement. It has also good resistance to thermal shock, and improved fire resistance, which makes it usable as cladding or permanent shuttering for structural concrete. Long-term modulus of rupture and impact strength tests on GRC samples show that considerable improvement in durability can be achieved by the use of alkali-resistant glass compared with conventional E glass. There is still a reduction in strength with time of storage in air, and a still greater fall when stored under water. However, these reductions in strength do not lead to total loss of strength. The use of high alumina cement and pulverised fuel ash in the matrix can further improve durability. Nevertheless, long term durability (10 to 15 years or an accelerated equivalent) must be demonstrated prior to acceptance of glass fibre reinforced cement composites as a construction material, particularly in load-bearing situations.

The cheaper borosilicate (E) glass has, however, been extensively used with high alumina cement (Elkalite) and gypsum plaster without danger of alkali attack on the fibres. One valuable property of Elkalite is its light weight. Comparing the weight of 139 kg/m² for a normal concrete panel 64 mm thick, a composite panel consisting of two-5 mm Elkalite sheets with a 51 mm polystyrene core weighs only 19 kg/m². This extreme lightness produces problems with sound insulation, and special precautions are required when being transported and for hoisting under windy conditions.

The strength of Elkalite in direct compression is about 74 N/mm² (41 to 48 N/mm² for good quality unreinforced concrete). In bending, the material fails at between 32 and 41N/mm². The impact strength is about 22.5 N/mm/mm², about ten times that of asbestos cement.

Other properties of particular interest are : fire and chemical resistance, permeability and water absorption. Permeability tests show that the material is, to all intents and purposes waterproof. No signs of dampness would result on the inside of a sheet subjected to rain blown in a 120 km/hr gale.

Elkalite has been used in several applications in the manufacture of boats, building panels, chimneys, pipes and similar products, permanent formwork, panel radiators, floor heating etc.

The advantage of gypsum plaster with glass fibres, apart from the lack of alkali attack, is that the setting time can be varied from a few minutes to several hours. The material attains its full strength within a few hours, and hence strength tests can be carried out as soon as the material has dried, and can thus be used as quality control.

Plaster boards have been made incorporating 10% by weight of glass fibre, giving a modulus of rupture of 103N/mm², and an impact strength of 72 Nmm/mm². A panel made by bonding two 12 mm thick glass fibre/plaster sheets, one flat and one corrogated, failed under a uniformly distributed compressive load of 24 KN/m².

It is in the secondary structural field of cladding panels (Elkalite) and partition systems (G.R.C.) that most progress is being made now. The outstanding fire resistance of plaster composites makes it also an ideal material for safes and fire-proof document cabinets.

Steel fibres.

The third type of fibre that has found extensive engineering application is steel. Most of the steel fibres available for use in concrete are obtained by cutting drawn wires, and fibres with different types of crimps, indentations and shapes to increase mechanical bond etc. Steel fibres with lower tensile strength (700 N/mm²) are also produced from low carbon flat rolled steel coils (e.g. USS Fibercon). Tests, however, show that the steel tensile strength has little influence on the first crack flexural strength, although it may have a significant effect on the ultimate flexural strength if the composite failure occurs by fibre failure rather than by fibre pull-out. The method of fibre production may, however, influence the cost of the fibre.

There are two main problems encountered in the use of steel fibres. One is the tendency for very fine fibres to ball or cling together forming miniature "hedgehogs" during mixing, and the need for careful introduction of the fibres into the mixer cannot be overemphasized. For maximum efficiency each fibre needs to be fully embedded in the matrix; fibres that have already formed into bunches or clumps are unlikely to be broken up by the type of mixing processes currently available. Such "balling" could lead to non-uniform dispersion of fibres with consequent reduction in strength and variation of test results. Mechanical dispensers pneumatic feeding and other methods of fibre dispensation are being developed now, and their use has shown that many of the problems associated with manual mixing can be satisfactorily overcome.

The problem of corrosion is something that needs to be carefully investigated, and tests are now in progress to study environmental effects on uncracked and cracked sections. The available evidence is limited and of short duration but shows that rusting of steel fibres is confined to the surface, and that the discoloration of surface areas is local and not offending. It appears that exposure conditions are not likely to affect seriously the strength and durability of steel fibre reinforced sections (Table 2) although long-term data are necessary to confirm satisfactory performance with time of steel fibres under exposed conditions.

Significant improvements in the first-crack flexural strength and ultimate flexural strength have been obtained through the use of short (6.4 to 63.5 mm) and small diameter (0.15 to 0.91 mm) steel fibres. However, property improvements can only be obtained by ensuring uniform distribution of fibres, and consolidation of the matrix material around the fibres. The efficiency of fibre distribution and hence, the strength development depends on the geometry of the fibre, the fibre content, the mixing and compaction techniques, the size and shape of the aggregate inclusions, and the mix proportions. The workability of the fresh fibrous concrete decreases rapidly with fibre content and fibre geometry, and the method of compaction the size of the mould and the fibre length and diameter will achieve different degrees of orientation of fibre in the hardened state.

In the present state of fibre development, composite failure occurs by fibre pull-out rather than by fibre yeilding, and only a small fraction of the potential strength improvement is currently being obtained. Obviously, the fibre-matrix bond is the most significant phase of the composite system that needs further development, although chemical cleaning, galvanising and mechanical indentations have shown considerable improvements in bond strength.

In spite of these problems a number of practical applications of steel fibre reinforced concrete have been achieved to date. The superior structural properties of steel fibre reinforced concrete have found it an ideal material for overlays and overslabbing for roads, pavements, airfields and bridge decks, and industrial and other flooring, particularly those subjected to wear and tear and chemical attack. There are several examples illustrating the use of steel fibre reinforced concrete in these areas. Guniting has been successfully applied with steel fibres, and this has opened up an entirely new field of applications in tunnelling, coastal construction, dams, remedial work in cooling towers etc.

Of all the fibres, steel fibres are probably the best suited for structural applications. Recent tests show that steel fibres can provide effective reinforcement against shear failure, and that fatigue strengths of 74 % and 83 % of the first crack flexural strength at 2 million stress reversal cycles could be obtained with a 3 % fibre content by volume. A practical structural application of steel fibres is in the deck slab of the two-storey car park at London's Heathrow Airport. The car park consists of a structural steel frame for the main deck, and a 62.5 thick steel fibre reinforced concrete slab with 3 % (by weight) of chopped steel fibres 0.25 mm dia. x 25 mm long. Load tests on the slabs showed that the slabs possessed adequate load capacity, safety factor and sufficient load recovery. Tests on concrete pipes also show that steel fibres can be used as reinforcement in place of conventional reinforcement.

One property of steel fibre reinforced concrete of particular interest is its better thermal loading resistance than ordinary concrete up to 1000°F because of its resistance to the formation of large cracks and disintegration by loss of large pieces that spall off due to temperature rise. Because of the dispersion of steel fibres in the concrete, there is an increase in thermal conductivity and this counteracts the effects of a temperature gradient. Coupled with the increased tensile properties of the material, this leads to increased resistance to thermal shock, spalling and cracking which are important considerations in the design of nuclear containment or primary vessels.

Other types of fibres used, include carbon, natural vegetable, animal etc. Pine needles were used in an experimental study at the HTI, with unfortunately not very promising results. Further investigations however are envisaged on this material, termed "coniferous reinforced cement" (C. R.C.).

Conclusions

In the present state of development, it is not possible to establish a "best" fibre for all conditions; indeed, it is unlikely that there shall be such a "unique" fibre for all applications. Fibres can be classified into two basic divisions: those having a higher elastic modulus than the cement matrix, which depend on stress transfer for their efficiency, and those with a lower elastic modulus. The former alone will lead to strong composites. Asbestos, glass and steel all have high elastic moduli, and can all be used at higher temperatures than the low modulus fibres like nylon and polypropylene which lose their load capacity around 100°C. The greater improvements in impact resistance and ductility at failure provided by glass, steel and plastic fibres are not reflected by asbestos, whose characteristic property is its high tensile strength.

As can be expected some fibres improve specific properties of concrete that cannot be achieved or achieved to the same degree or in the same manner by other fibres. For example, glass and asbestos fibres greatly improve the fire resistance of thin panels. On the other hand, steel wire reinforcement increases the normal conductivity of concrete and counteracts the effect of a temperature gradient; it controls cracking and spalling, and thus improves the fire resistance of the composite.

Bond failure still remains the critical problem with high modulus fibres, particularly steel, but there are advantages other than strength improvements to be gained by the use of fibres. It is in these unusual qualities such as improved resistance to impact and explosive loading, thermal shock resistance, wear, spall and crack control, and energy absorption that the material will find advantageous applications. Combinations of fibres may also offer other advantages.

All these qualities must be considered with the inherent problem of corrosion and alkali attack of steel and glass fibres respectively whereas plastic fibres are more durable. Unlike corrosion which depends on external environment, alkali attack is a function of the microstructure of the composite, and long term durability of 10 to 15 years or an accelerated equivalent must be established before glass fibre cement composites can be used as a construction material.

Coupled with the potential strength and stiffness improvements of the fibrous composites, there are problems of handing, mixing and quality control. Most fibres are not readily separated out, and some form of assisted feeding, pneumatic or vibratory, is needed to ensure a uniform distribution in the mix and the prevention of "balling". Other factors such as compaction, mould effects etc. all need to be considered.

It is likely that for some years to come the cost of fibre reinforced concrete will be substantially greater than that of conventional concrete. It would, however, be unrealistic to compare the cost of fibrous concrete with that of plain or reinforced concrete on cost of materials alone. Economics must be related to performance and serviceability – and this is one of the prime functions of design – and the additional cost of the new composite material should be considered in relation to the various economies that can be achieved.

It would equally be wrong to pretend that fibrous concrete will provide a universal answer for all concrete problems; nor is it likely to replace conventional structural concrete. Nevertheless, it has some very unique engineering properties, and we need to understand their behaviour as well as their limitations. New engineering materials lose their advantages by traditional design approaches. What probably is most needed is a new thinking in design and in the utilization of these materials.

TABLE 1. Typical properties of Fibres

Type of Fibre	Tensile Strength N/mm²	Young's Modulus N/mm²	Ultimate Elongation %	Specific Gravity
Acrylic	205– 415	2070	25–45	1.1
Asbestos	550– 965	$8–14x10^4$	=0.6	3.2
Cotton	415– 690	$5x10^3$	3–10	1.5
Glass	1000–4000	$7x10^4$	1.5–3.5	2.5
Nylon (high tenacity)	750– 850	$4x10^3$	16–20	1.1
Polyester (high tenacity)	725– 865	$8x10^3$	11–13	1.4
Polyethylene	=695	140–420	=10	0.95
Polypropylene	550– 750	$3.5x10^3$	=25	0.90
Rayon (high tenacity)	415– 620	$7x10^3$	10–25	1.5
Rock Wool (Scandinavian)	480– 750	$7–12x10^4$	=0.6	2.7
Steel	275–4150	$20x10^4$	0.5–35	7.8

TABLE 2. Strength retention of steel fibre reinforced concrete after exposure.

Exposure condition	% of original strength after exposure periods of		
	6 months	8 months	1 year
Sea-water			
Complete immersion	96	—	89
Partial immersion	81	—	90
Roof-top Weathering			
uncracked		100	
cracked		82	

References :

1. J. P. Romualdi & J. A. Mandel " Tensile Strength of Concrete Affected by Uniformly Distributed and Closely Spaced Short Lengths of Wire Reinforcement" A C I Journal Vol. 61 No. 6 1964 pp. 657–672.
2. R. N. Swamy and H. Stavrides " Some Statistical consideration of Steel Fibre Composites " American Cement and Concrete Research Vol. 6 pp. 201–216 1976.
3. R. N. Swamy, H. Stavrides and D. Theodorakopoulos " Shrinkage and Creep Characteristics of Glass Fibre Reinforced Cement Composites" Paper presented at the International Congress on Glass Fibre Reinforced Cement pp. 75–96 Brighton England Oct. 1977.
4. R. N. Swamy & H. Stavrides " Influence of the method of Fabrication on Strength Properties of Steel Fibre Concrete " Materiaux et Structures Vol. 9 No. 52 July-August 1976 pp. 243-253.
5. R. N. Swamy and H. Stavrides " Some Properties of High Workability Steel Fibre Concrete " Paper presented at the International RILEM Symposium on Fibre Reinforced Cement and Concrete London 1975 pp. 197-208.
6. R. N. Swamy/H. Stavrides & A. K. Bandyopadhyay. " The Ring Method of Measuring Restrained Shrinkage in Mortar and Concrete" A.S.T.M. Cement Concrete and Aggregates Vol. 1 No. 1 1979 pp. 13-20.
7. H. Stavrides Contribution to Conference on Fibre Reinforced Materials – Design and Engineering Applications. London March 1977 pp. 177-179.

I would rather prefer to be wronged than do wrong.

Plato

A REVIEW OF THE COMMONWEALTH AFRICAN ENERGY PROJECT GROUP MEETING

By I. M. Michaelides,
Lecturer in Mechanical Engineering.

Summary.

The Commonwealth Science Council (CSC) as part of its coordinated Research and Development Programme, formulated an African Energy Programme to promote the development of renewable energy resources in Africa and countries around Africa. This was done at a meeting of nominated government officials and experts held at Arusha, Tanzania, during 20–26 September 1979, the works of which will be reviewed with particular emphasis to the invlo-ment of Cyprus in the Programme formulated and the benefits acquired from the implementation of the Programme.

Introduction.

The Commonwealth Science Council began its life in 1946 as a liaison body facilitating the exchange of information between Commonwealth scientists. Today, it has become the main agency for collaboration between scientists in defined areas of common concern and operates from London. The main aim of the Council is to promote collaboration between member countries of the Commonwealth in increasing the capabilities of individual nations to use science and technologies for their economic, social and environment development. One of the fields of activities of the council is that of Alternative Energy Resources. The use of solar, wind and biogas energy at village level was the major emphasis of the Project Group Meeting on Alternative Energy Resources held in the Caribbean in September 1977 following discussions at 10 CSC, Colombo 1976. The 1977 meeting proposed 10 projects which have been supervised by a steering committee chaired at Barbados. Projects underway include several biogas generation schemes linked through a centre in Jamaica, a feasibility study on the use of surplus bagasse launched during the sugar harvest of February 1979 in Barbados, and the development of a kiln in Guyana for the efficient use of charcoal both domestically and industrially.

Further expansion of the CSC Alternarive Energy Programme initiated in September 1979 with the African Energy Project Group Meeting held in Arusha-Tanzania (20–26 September 1979) following a decision of a meeting held in London in April 1979.

The objective of the African Energy Meeting was to develop a regional collaborative programme on energy with particular emphasis on meeting rural energy needs with possible extension to urban section wherever applicable.

The meeting was attended by around seventy participants representing ten countries and a number of International organisations as follows:

i) Countries (No. of delegates in brackets): Botswana (2), Cyprus (2), Gambia (2), Kenya (3), Malta (2), Rwanda (2), Sierra Leone (1), Tanzania (38), Uganda (2), Zambia (3).

ii) Organisations (observers) : International Energy Agency, U.K. Overseas Development Administration, International Foundation for Science, UNIDO, UNDP, UNESCO, USAID.

Participating countries presented counting papers covering energy needs, consumption patterns, available sources of energy, potential of alternative energy resources to meet existing needs, past and current research and development activities in alternative energy resources, available facilities for data collection on the resources, social implications of introducing new energy technologies and possible areas of multilateral cooperation.

Project Proposals

Participating countries presented a total of ten project proposals for regional collaboration covering various fields of renewable energy resources. Cyprus presented two such proposals :–

i) Meteorological data solar/wind (Meteorological Service).

ii) Solar Heating and Cooling (Higher Technical Institute).

The Meeting agreed to :

1. launch a Commonwealth Regional African Energy Programme open to all African countries including Commonwealth countries around Africa ;
2. invite Kenya to provide the Regional Coordinator for the programme ; this will especially be advantageous in view of Kenya being the host for the 11 CSC meeting in September 1980 ;
3. submit a progress report by the Regional coordinator to the 11 CSC ;
4. review the programme in 2-3 years' time ; the venue and timing will be determined by the CSC secretariat in consultation with the interested members.

The CSC secretariat sought the collaboration of various international organisations in funding the programme.

Projects

Following is a brief outline of the projects agreed at the meeting; these projects will form the Regional African Energy Programme.

Project No. 1 :

WIND ELECTRICITY GENERATION :

Performance and evaluation

An evaluation of energy supply in rural areas will be carried out in order to determine the energy needs to be met from the wind. This will require sound meteorological data upon which, when processed will be based the design and construction of suitable wind generators.
No. of participating countries : 4 (actively : 1)
Estimated project cost : US$ 125,000
Project Regional Coordinator : Tanzania

Project No. 2 :

SOLAR CROP DRYING

The project aims to develop solar crop driers suitable for use in the rural areas of Africa by :

a) small scale farmers
b) large scale farmers and/or cooperative societies.

The following crops will be experimented : coffee, tea, pyrethrum, groundnuts, rice, sorghum, medicinal plants, papyrous reeds and fish.
No. of participating countries : 5 (actively : 5)
Estimated project cost : US$ 760,000
Project Regional Coordinator : Kenya.

Project No. 3.1 :

CHARCOAL PRODUCTION/UTILISATION :

Afforestation in marginal areas.

A survey will be carried to identify species of trees suitable for charcoal production; the fast growing species which are grown in marginal areas will be tested for their suitability in producing charcoal.

No. of participating countries : 2 (actively : 1)
Estimated project cost : US$ 86,000
Project Regional Coordinator : Kenya

Project No. 3.2 : BIOMASS : Improvement on the method of production and utilization of charcoal.

The project aims to the improvement on the efficiency of existing charcoal stores through design based on optimum conditions of combustion and heat transfer, as well as improvement on the method of production of charcoal and hence efficiency.

No. of participating countries : 4 (actively : 1)
Estimated project cost : US$ 68,000
Project Regional Coordinator : Zambia

Project No. 3.3 : BIOMASS: Improvement on the method of utilization of charcoal and wood.

The project will include theoretical analysis of charcoal and wood utilization, design of efficient charcoal and wood stoves, manufacture of prototypes, testing of prototypes, transfer of technology to the intended users.
No. of participating countries : 5 (actively : 1)
Estimated project cost : US$ 62,000
Project Regional Coordinator : Tanzania

Project No. 4 : SOLAR HEATING AND COOLING

i) Flat plate solar collectors locally manufactured (Cyprus) with suitable modifications for better performance will be tested; for this purpose, an experimental facility to test solar collectors will be set up. Other designs will be developed constructed and tested. The same practice will be followed for concentrating solar collectors.

ii) The solar energy storage problem will be studied and efficient storage systems will be developed.

iii) The collectors having the best performance and competency will be combined with the most efficient and competent storage system developed, in a solar heating application.

iv) A feasibility study will be carried out to investigate whether solar cooling is economically feasible using flat plate or concentrating collectors from those developed in (i) above.

No. of participating countries : 10 (actively : 4)
Estimated project cost : US$ 259,000
Project Regional Coordinator : Cyprus (Higher Technical Institute)

Project No. 5 : WIND ENERGY : Water pumping

The wind rotor characteristics and the wear of plastic pumps will be investigated; a variable coupling between the wind rotor and the pump will be designed and a self powered anemometer will be developed.

No. of participating countries : 8 (actively : 2)
Estimated project cost : US$ 194,000
Project Regional Coordinator : Kenya

Project No. 6 : BIOGAS : Biogas technologies for rural energy.

Biogas technologies for use in rural areas of Africa will be developed and promoted through investigations into user needs, feedstock for biogas plants, quality and utilisation of slurry from the biogas plants, storage, distribution and practical applications in cooking, lighting, refrigeration, soldering, conversion into mechanical power for water pumping, crop processing and electricity generation.

No. of participating countries : 6 (actively : 5)
Estimated project cost : US$ 194,000
Project Regional Coordinator : Tanzania

Project No. 7 : COLLECTION OF METEOROLOGICAL SOLAR/WIND DATA FOR RENEWABLE ENERGY RESOURCES STUDIES.

The project will involve two phases: (a) Acquisition of standard calibration solar instruments such as the pyranometers and the necessary field instruments for solar and wind measurements. (b) Collection of both solar and wind data and data evaluation.

No. of participating countries : 5 (actively : 3)
Estimated project cost : US$ 384,000
Project Regional Coordinator : Cyprus (Meteorological Service).

ENERGY POLICY

A working group composed of participants from all countries discussed the energy policy and agreed that every country requires a national energy policy and outlined the guidelines on which this policy could be based :

a) Inventory of all energy resources, including deficiencies.

b) Consumption patterns together with indication of foreign content in each and how, where possible, substitution by a local resource may be achieved smoothly.

c) Data collection and forecasting.

d) Merit ordering on basis of economics, reliability of supply or availability, diversity, indigenousness, type is renewable or non-renewable, environmental implications.

e) An indication of the role that technology is expected to play in achieving policy objectives as an essential guide to energy research, development demonstration and commercialization activities and presentation to energy policy makers of the options offered by technology.

f) Implications on the existing mode of life in order to identify need for training in production methods, use and acceptability *i.e.* how to cope with the problems of technology and market penetration.

g) Undertaking studies so as to arrive at an optional energy resources mix.

h) Conservation efforts which may include one or more of the following :
   - deliberately restricted consumption by changes in hours of service ;
   - speed limits ;
   - limited importation of certain types of vehicles ;
   - fuel rationing ;
   - changes in consumption patterns ;
   - architectural changes in the design of building, insulation of buildings, etc ;
   - educational and training programmes in conservation ;

- quality of maintenance of machinery and equipment (e.g. boilers, motor vehicles, etc) ;
- quality of use, e.g. driving of motor vehicles, housed equipment ;
- reafforestation and anti-desertification programmes ;
- promotion of efficient public transport ;
- development and utilization of energy – efficient technologies, e.g. wood, charcoal, solar, etc.;
- efficient utilisation of animal power.

i) Appropriate institutional analysis and set-ups so as to ensure that the national energy policy takes effect and benefits society as possible.

The group discussed potential areas for collaborative effort and tentatively drew up a list for possible attention as follows :

- information exchange on national energy policies,
- data collection, analysis and methodology,
- development of shared energy resources,
- possible pooling of energy resources,
- possible joint use of transportation systems,
- joint measures for the conservation of eco-systems affecting energy supplies,
- exchange of field experience and expertise,
- shared use of relevant facilities.

It was finally proposed to establish a regional centre for information exchange on energy policy but this was considered premature and left open for the future.

Conclusions.

The African Energy Project Group Meeting was very successful and achieved its objective *i.e.* to outline a modest programme for initiating regional collaboration on energy.

The participation of the Cyprus delegates was very beneficial and useful from the technical and other points of view and the implementation of the Programme will benefit greatly. The implementation of the Cyprus project proposals will offer the following benefits :–

i) Establishment of radiation centre in Nicosia to enable the measurement of solar energy insolation and publication of this data which will be very useful to the solar energy engineers. Wind data will also be collected which will be useful for wind energy applications.

ii) Establishment of solar collectors testing centre; this centre will be equipped with the appropriate instruments and devices necessary for the investigation of the performance of the solar collectors. This will enable the manufacturers of solar collectors to issue performance data for their products.

iii) Improvement of existing solar collectors locally manufactured for increased performance.

iv) Design and implementation of solar heating system for domestic application. This will enable us to identify the difficulties encountered in a solar heating system in Cyprus under local conditions and find out ways to overcome these.

v) Feasibility study to investigate whether solar cooling is economically feasible ; solar cooling is very interesting due to the fact that cooling demand is maximum when the solar radiation is at its peak.

In addition to the direct benefits from its own proposals, Cyprus will get the benefits from the experience and results of the other projects included in the Programme, by the exchange of information and expertise.

Happiness is Freedom and Freedom is the power of the psyche.

Thoukidides

I would rather be good, kind and just even if people think of me to the contrary, than being called good, just and kind when I am bad.

Saadi

FUSION POWER WITH BEAMS

by A. Z. Achillides
Lecturer H.T.I.

Introduction

Fusion the kind of nuclear reaction that converts mass into energy inside the sun and other stars is widely regarded as one of the most promising means of generating electric power for the next century and beyond. Many investigators now believe that the scientific feasibility of fusion power will be determined within the next decade. The period is crucial because several large " proof of principle " experiments should be completed in the 1980's.

The idea of fusing the nuclei of Hydrogen atoms to release energy for the generation of electricity is attractive for several reasons. One measure of the potential benefit from controlled fusion can be appreciated if one considers that a thimbleful of liquid heavy-hydrogen fuel would release as much energy as 20 tons of coal. Even more important thè fuel is readily available. Devterium is found in all natural bodies of water and Tritium can be synthesized by the reaction of fusion-generated neutrons with Lithium in a " blanket " surrounding the reaction chamber. If the materials for the walls of the reaction chamber were carefully selected, the fusion reactor would have fewer radioactive by-products than a fission reactor. In addition there would be no possibility that the fuel core would melt down, a conjectured type of failure that has helped to make a nuclear power plants the subject of controversy.

Nature has a way of coupling risk and reward, so that frequently those processes that have the greatest potential for benefiting manking are also those that can be achieved only with the greatest difficulty. So it is with fusion. After nearly three decades of effort fusion ignition, that is, the efficient burn-up of Devterium and Tritium, has been achieved in only one way : with a fission trigger (an atomic bomb) to generate the extremely high temperature and the degree of confinement necessary for the hydrogen nuclei to fuse.

The conditions necessary to gain any worth while net power from fusion reactions involving Devterium and Tritium are formidable : a temperature of about 100 million degrees Celcius and a combination of fuel-confinement time (in seconds) and fuel density (in particles per cubic centimetre), whose product is greater than 10^{14} The high temperature is needed to propel the nuclei to velocities sufficient to overcome their mutual electrical repulsion when they encounter each other. The required confinement time and particle density ensure that there are enough collisions for the reactions to proceed efficiently.

In the magnetic-confinement approach the fuel must be maintained at a fairly low density because of practical limits to the magnetic-field strengths that can be obtained. As a result confinement times of seconds or minutes must be achieved in order to get a substantial burn-up of the fuel. In the inertial approach the fuel is heated as it is compressed to an extreme density (typically 1000 times the normal density of the solid fuel). Under these conditions the fuel reacts so rapidly that the burning is actually a small explosion. Since the compressed fuel is restrained by its own inertia, it burns before it flies apart (in less than a billionth of a second).

Magnetic-confinement fusion can be likened to a furnace which requires ignition, refueling and the removal of impurities and which has a long burn time compared with the ignition time. Inertial confinement fusion requires an efficient, highly repetitative ignition system and a continuous supply of inexpensive fuel pellets, which are injected and ignited one at a time. In a hypothetical inertial-confinement reactor one ten-thousandth of a gram of fuel would be ignited every tenth of a second by a 100-trillion-watt pulse yielding an average thermal output of a billion watts. If now the ignition system is 20 per cent efficient, a power plant with an inertial confinement fusion reactor at its core would deliver 350 million watts of electricity, enough to power a city of 175000 residents.

A new technique for irradiating fuel pellets was developed in France, in 1970. The French firm Compagnie Générale Electrique (C.G.E.) had developed an especially pure form of neodymium glass for use in laser rods. This neodymium-doped glass could survive 40 Joule per square centimetre without breaking.

Using this glass C.G.E. was able to construct a laser plus laser amplifier chain which could generate 80 Joule in 2 nanosecond. When this laser was used at the Limeil laboratory to bombard a cylinder of frozen Devterium approximately one thousand neutrons were generated with each pulse. One of the important fusion reactions involves the plentiful form of hydrogen, devterium, and is referred to as the D-D reaction. In this fusion of devterium to form Helium it was known that neutrons are generated having an energy equivalent to 3.3 million electron volts. Experiments showed that the neutrons produced had about this energy indicating that the D-D fusion reaction had indeed occurred.

Lasers are in many ways the ideal solution for irradiating fuel pellets. These devices can generate extremely short pulses of radiation (lasting a billionth of a second or less) which can easily be focused onto the surface of a pellet from a distance with the aid of lenses or mirrors. Significant progress has been achieved in laser fusion research in recent years and large neodymium-glass and carbon dioxide lasers are under development with the aid of demonstrating fusion " break even " conditions before 1985.

Lasers however have two serious disadvantages ; they are inefficient and they tend to be expensive. For example neodymium-glass lasers the commonest high power lasers have an efficiency of only 0.2 per cent and their cost per unit of energy is currently about 500 dollars per Joule. The ultimate efficiency of Carbon dioxide lasers is estimated to be between 5 and 10 per cent. There is much debate as to the ideal wave length for a fusion laser and a vigorous search is under way to develop efficient short-wavelength lasers.

It was primarily the inefficiency of lasers that led to another method the " particle beam " approach to fusion.

In this technique a high energy electron beam is used as pellet igniter. An electron beam produced by a high energy accelerator, having on operating current between 10 million and 100 million Amper, could provide the necessary power of 100 trilion watts required for pellet ignition.

Today it is possible to produce a dense electron beam with a diameter of two millimetres by means of passive plasma forming techniques. The highest power densities achieved so far have been produced by workers at the Kurchator Institute in USSR. Rudakov has reported a power density of more than 10^{13} W per square centimetre.

In USA now G. Yonas et al are working on a small power reactor which will operate at 100 million watt of electric power and would require a pellet energy gain as small as 30. Such small units could achieve a high degree of flexibility in future sizing siting and installation of power reactors which might solve the energy crisis problem of mankind.

References :

1. Laser light for fusion fire : N. Basov, O. Krokhin. New scientist Sept. 30 1971.
2. Industrial research, Jan. 1975.
3. Laser fusion: W. D. Metz Science, December 1974.
4. Electron beam focusing and application to pulsed fusion. G. Yonas et al Nuclear fusion Vol. 14 No. 5 1974.

The Need for Hospital Technical Services

by Dr. A. Mallouppas,
Lecturer H.T.I.

Supervisor of the Regional Training Centre for the Repair and Maintenance of Hospital and Medical Equipment*

Summary

In the last two decades high level technology has become part of many aspects of modern life and medicine has been no exception. In modern medicine the advances in technology and in particular micro-electronics and computer techniques have made possible the faster, more efficient and automated methods of diagnosis, monitoring or analysis. However such equipment are no longer simple but require specially trained technical personnel to maintain and repair them. Unfortunately, while increasingly more complicated and expensive equipment are used in hospitals in the under-developed, developing and even some developed countries, the necessary skilled technical personnel needed in the hospitals to provide the technical back-up in order to keep the equipment operational have not been provided. As a result the benefits of using such equipment in many cases cannot be exploited and a great deal of badly needed resources are wasted. Hence the need for Hospital Technical Services.

1) Introduction

This article will aim to demonstrate the need for establishing hospital technical services and identify the present and future areas of training for Cypriot hospital technical personnel.

In the following sections the different methods of carrying out Repair and Maintenance in Hospitals will be discussed and the most suitable national scheme for Cyprus will be ascertained. The typical structure of a Hospital Workshop and the different functions of their personnel will be explained. The present and most urgent needs in technical personnel will be identified and possible future needs and expansions will be predicted.

In a modern major hospital the variety of equipment ranges from boilers, lifts, sterilisers, operating theatre equipment, intensive care, X-ray, nuclear medicine, laboratory equipment etc. With such a vast range of different types of equipment the need for technical personnel, physicists, chemists being permanently posted to major hospitals is beyong doubt. Along with the doctors and nurses they form a team without which a large modern hospital cannot function and meet its mission. It is therefore imperative to formulate the correct policy on maintenance and repair because if any part of the above mentioned team does not function properly then the efficiency and quality of service offered by the hospital will suffer.

2) Different Approaches to Maintenance and Repair

In the countries where a scheme for maintenance and repair exists there are mainly two approaches for implementing it

(i) The Centralised System

(ii) The Regionalised System

2.1) The Centralised System

This scheme is favoured by many under developed or developing countries whose primary desire is to minimise costs. It usually consists of a Central Workshop staffed by technicians and some engineers, usually located in the capital city, and who are in-charge of Repair and Maintenance for all the hospitals, clinics and medical establishments in the country. Such a scheme has the minimum initial capital cost in Workshops, test equipment and running costs. However in the long run it can be shown that it is the most expensive.

It is obvious, particularly in the case of emergencies and in countries where the communications system is not very good and distances are large that when repair is needed in a provincial hospital it cannot be done quickly. Also the complexity of to-day's equipment is such that the technical staff, usually few in number,

* This project is run in collaboration with the World Health Organisation.

cannot cope with the vast variety of equipment in Hospitals. Hence the seemingly cheap centralised arrangement in longer term costs is much more expensive due to equipment being idle or not working at all. Of course the main objective of saving people's lives and the efficiency and safety of the service, if costed, will show that this system is by far more expensive, even in the short term.

Unfortunately in Cyprus some years ago this centralised system was decided upon. This arrangement has been slightly changed recently with the establishment of a Central Workshop at Nicosia General Hospital (as a by-product of the wider agreement with W.H.O. establishing a Regional Training Centre at the HTI).

However the rest of the service primarily operates on a centralised basis. It is obvious that it takes time for engineers or technicians to travel to provincial hospitals in Paphos or Paralimni to repair major or minor faults. Time and travelling are expensive and so are people's lives.

Figure 1 shows the present system of a Centralised Workshop trying to serve all government hospitals (and in fact all government Electrical and Mechanical Services).

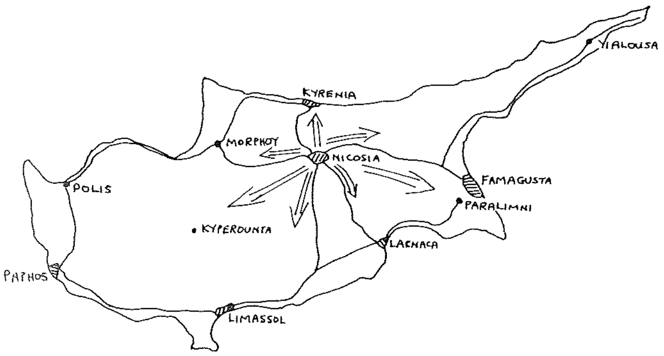


Fig. 1 Centralised System for Repair and Maintenance

Note :

1) Also approx. 20 rural clinics. Equipment available or proposed, see Appendix.
2) Small EMS workshops available in the main towns, however not attached to hospitals but responsible for all activities.

It is obvious from Figure 1 that the distances involved exclude the provision of the necessary every day technical back-up needed in today's modern hospitals and their ever increasing demands. Of course the aim is not just repair but prevention of breakdown by routine preventive maintenance which cannot be done in a Centralised System but only by personnel on the spot, attached to the hospital.

Preventive maintenance will extend the life time of equipment and contribute to a safe and efficient health service.

Therefore, although a centralised system is cheaper at the initial capital cost stage in the long run it is far more expensive and cannot meet the demands of a modern major hospital and hence provide an efficient and effective health service. Most countries which provide a comprehensive health service system adopt the Regionalised system in order to accomplish their goals.

2.–2) Regionalised System

The Maintenance and Repair scheme favoured by the developed countries is the Regionalised System and despite its apparent higher initial cost in real terms is much cheaper than the Centralised System. The saving in costs from far better maintenance, longer life and utilisation of equipment and their efficient operation will in a very short time produce enough savings to repay the initial capital cost. It is inconceivable for a country which wants to offer a comprehensive modern health service to be able to provide such a service without a properly trained, skilled and organised technical service, which is attached to the main hospitals.

Figure 2 shows a typical Regionalised System for Maintenance and Repair for Cyprus.

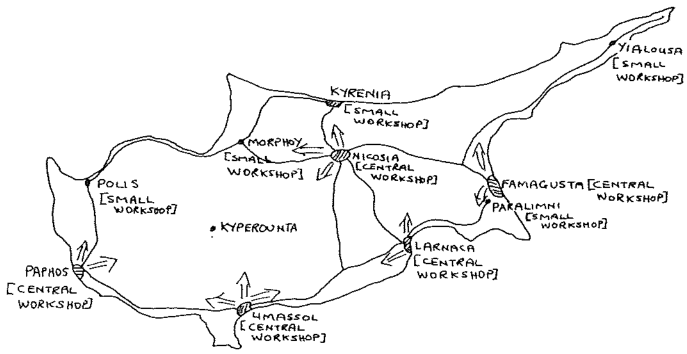


FIGURE 2 : Regionalised System.

Central Workshops must be established at the main district hospitals (i.e. Limassol, Larnaca, Paphos etc.) on the model of Nicosia General Hospital Workshop. The Central District Workshop will also provide the specialised or major repair work for smaller hospitals or clinics in their district. In the rural hospitals a small workshop with several general technicians to carry out minor repair and routine maintenance must be established. Because of the small size of the country Nicosia General Hospital Workshop can provide the very specialised engineers or technicians for equipment such as nuclear medicine, cobalt or such units. It is doubtful whether such sophisticated equipment will ever find their way into the other major hospitals but if any do, expert help can be asked from Nicosia.

From the evidence given so far it is clear that we must transfer to the Regionalised Scheme and hence must continue the first steps taken in that direction with the building of Nicosia General Hospital Workshop. From the reports received so far, although still having to overcome many problems, the establishment of this Workshop has drastically and considerably improved matters at NGH.

3. The Man power structure of a Central Hospital Workshop

Having decided upon the establishment of such centralised Workshops, as at NGH, one must consider their staff structure which will man them. As has been pointed out earlier a major hospital has a vast variety of equipment many of which are of specialised nature. However there are also many simple equipment and minor repair problems for which no specialised training is required. Taking these factors into account the staff of the Workshop must be such so as to be able to carry out the specialised repair and maintenance and attend to simple repairs and routine maintenance.

The proposed structure in Figure 3 is a typical one and can be used as the basis on which the different needs of each hospital can be formulated upon.

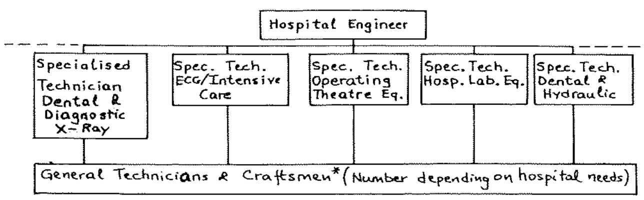


Figure 3 : Typical Structure of Central Hospital Workshop

Notes :

(1) One Specialised Technician can be trained in more than one specialisation i.e. E.C.G. / Intensive Care and Hospital Laboratory Equipment. (ECG = Electro Cardiograph).

(2) Other Specialised Technicians can be included, depending on needs such as on Cobalt Units, Nuclear Medicine, Physiotherapy etc.

3.–1) Hospital Engineer

The Hospital Engineer will be in charge of the workshop and would have a Technician Engineer qualification. Basically he will be an Electrical Technician Engineer with a Specialisation in Hospital and Medical Equipment and a good background in Mechanical Services. (N.B. such a course is proposed for the near future at the Regional Training Centre, RTC, of the HTI in collaboration with W.H.O.). Thus the Hospital Engineer would be given training of such a standard so as to be in a position to attend to the more sophisticated equipment, carry out modifications to existing ones or constructions within the capability of his training and administer the technicians under him.

* *Claftsmen :* For plumbing, masonry, carpentry etc. Their number to be decided on each hospital's needs

3.–2) Specialised Technician

This type of technician will receive specialised training at a suitable establishment (such as the RTC of the HTI) in one or more specialisations. The training will be such that repair and maintenance of a more advanced nature can be undertaken by him on the equipment of his specialisation. Also he will be in such a position to offer help to the Hospital Engineer or when given the outlines of a particular job to be in a position to carry it out with a minimum of supervision. This type of training will begin at the RTC from January 1981.

3.–3) General Technician

This type of technician will receive a general background training in hospital and medical equipment so that he will be in a position to carry out simple routine maintenance and repair. Also to assist either the Specialised Technician or Hospital Engineer and under their supervision to carry out work of a more complicated nature, including some aspects of preventive maintenance. Such training has been available at the RTC from September 1978 and has already contributed two general technicians to the NGH Workshop who are undergoing their on-the-job training. It is hoped that three more general technicians will graduate in July 1980.

3.–4) Service Contracts

There are equipment which are of such complexity and special nature that they can only be repaired by their manufacturer or engineers trained at the factories. Whenever quotations for such equipment are asked for it is always advisable to include a Service Contract clause which means that the manufacturer undertakes as part of the sale to train staff of the purchaser (Hospital Engineers) in the repair of the equipment. Although this will add to the price the savings will result from repair and maintenance done at home. It is very costly to bring engineers from abroad and many times for only minor repairs. Also such training will enhance the knowledge and capabilities of the country's Hospital Engineers, and thus improve the standard of health service provided.

4) Future needs

The complexity of some equipment is such that staff who operate them (nurses, doctors, etc) need to undergo short training periods in order to learn their correct operation. This is necessary in order to ensure the correct operation of equipment, their full utilisation and safety aspects. All this will improve the standard of service offered and the life times of the equipment. A convenient and natural host for such short courses for operational staff will be the Regional Training Centre of the HTI. Such areas of training should be identified and short courses given as soon as possible.

It is inevitable that in the near future more complicated equipment such as Computer Tomography, Laser Applications, further Nuclear Medicine techniques etc. will be introduced in Cyprus as the price of such equipment reduces and as part of the effort to improve the standard of health care. It will be inevitable also that training for service and operations staff be made available in time before the equipment is installed. Hence it must be foreseen that when new fields of medical care are embarked upon in the future that the training and service aspects are planned for and not forgotten. Again the RTC will be in the position to offer training facilities in these areas.

5) Conclusions :

It has been shown that in a modern health care system the Regionalised system for Maintenance and Repair is the most suitable from the point of view of safety, efficiency but also cost. A comprehensive Hospital Technical Service with trained Staff is absolutely necessary in order to provide the needed technical back–up for any major hospital. In major or district hospitals Central Workshops on the lines and man–power structure shown in section 3 are needed. The staff from these workshops, which will have a Hospital Engineer, Specialised and General Technicians, will offer their service to smaller hospitals and clinics in their region. The smaller units, depending on their size, will have a suitable number of technicians to carry out routine preventive maintenance and minor repairs.

It must be appreciated by everyone involved, technical personnel, physicists and medical staff, that they are part of a team and each one must contribute to the overall effort of curing people and be realised that if any part of this team fails to function properly then the hospital service will fail to meet its goal. As part of this effort it must be realised that staff operating equipment must also undergo short training courses in order to ensure the correct use of their equipment. Also people involved with future planning and procurement of equipment must plan that the staff to operate and service these equipment must be available when the equipment arrives in the hospital and hence training, where necessary, must be provided in time.

It is hoped that the Regional Training Centre, RTC, on Maintenance and Repair of Hospital and Medical Equipment established at the HTI, in collaboration with W.H.O., will help in this direction and contribute to the improvement of health standards not only in Cyprus but also in the countries of the Region.

Recommendations

The following suggestions are given for consideration and perhaps implementation by the responsible authorities:

1) To carry out an investigation as to the technical needs of major and rural hospitals and based on the results present a report suggesting the most suitable Regionalised system for maintenance and repair.

2) To continue with the training of hospital technical personnel at all levels with a view of posting them to the various Central Workshops to be established, following the investigation above.

3) To evaluate the different grades of hospital technical personnel and to determine a suitable salary structure for them as soon as possible. If this is not done then trained personnel will most likely be lost to private enterprise or transfer to other departments.

4) Proceed immediately with the establishment of similar workshops to that at NGH at the other major hospitals.

5) Identify areas where training of operating staff is needed, and in consultation with interested parties, formulate training courses for them.

6) Identify future areas of medical expansion and evaluate the technical back-up services that will be required so as to be ready at the appropriate time to give the necessary training to the technical and operating staff.

7) To consider implementing, where possible, the idea of Service Contracts with manufacturers and hence establish a nucleus of highly trained personnel who will attend to the more specialised and complicated equipment available.

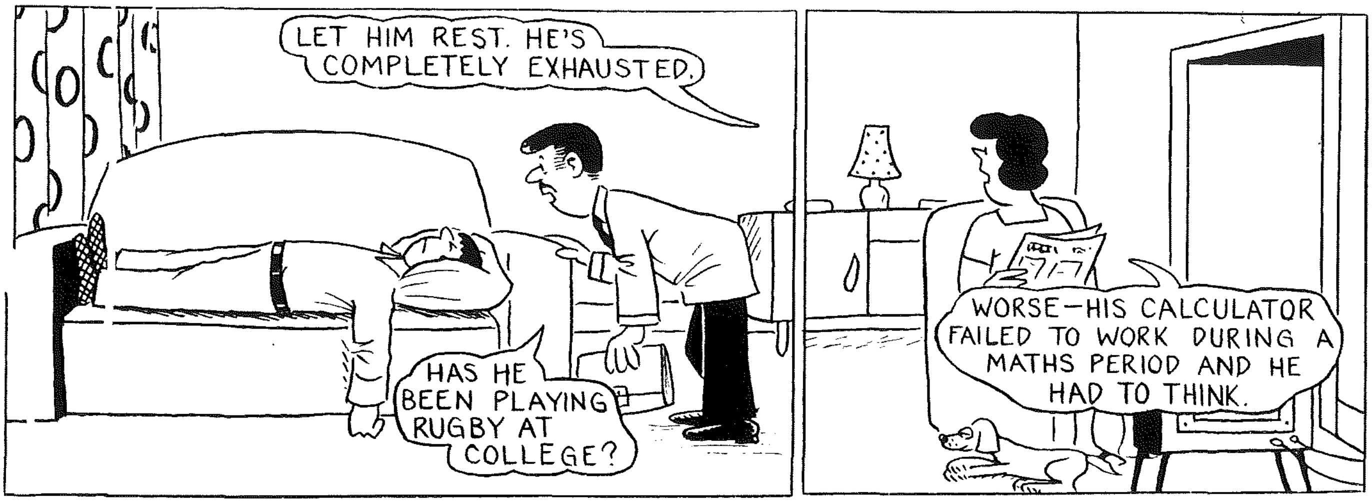
Appendix

Equipment proposed for Rural Clinics

1) Oxygen Regulators
2) Dental Unit
3) Electro Cardiographs, E.C.G.
4) Suction Pump
5) Simple Laboratory Analysis Equipment
6) Small X-Ray Unit
7) Kitchen Equipment

At present only items 1) & 2) are available in all rural clinics and E.C.G.'s in several. The rest are planned for in the future.

Note : Many more Dental Units are scattered all over Cyprus.



The Kingdom of God on earth is the love of all people, of all nations.

Tolstoi

The more I learn the more I discover my ignorance.

Kartesios

Bear malice for no one ; give help to the needy.
Be strict with yourself and linient to others.

Kong-Tse

PRODUCT CERTIFICATION

by S. Vassiliou

Quality Control Officer Cyprus Organization for Standards and Control of Quality (CYS)

Product certification is the process of certifying that a particular product is in conformity with a standard or technical specification. Such a process can be carried out by one or more of the following :

1) *First Party Certification* (Self-Certification) whereby the producer or the seller himself assures the buyer that his product is in conformity with the requirements of a specification or contract.

2) *Second Party Certification* whereby the buyer or user of a product certifies that the product is in conformity with the specification.

3) *Third Party Certification* (Independent Certification) whereby a competent independent organization provides assurance to the purchaser that the product complies with the relevant standard.

The first system is the oldest system and still widely used but the salesman's assurance that his product meets the requirements of the standard is considered as one sided. This is not always acceptable by the purchaser, who is more and more seeking other means of checking the quality of the product he is purchasing. He may for example establish a system for checking the product himself. This second system of quality assurance is widely used in trade and industry today in the form of various vendor assessment schemes.

The third system is rapidly gaining acceptance because the purchaser is more willing to accept certification systems operated by impartial organizations, not dominated by the manufacturers. On the other hand the manufacturer is not plagued with a multitude of differing assessments. Such a system gives to the purchaser greater confidence that the product he is purchasing meets the requirements of the specification and so allows him to relax his own assessment demands.

Third party certification varies according to the type of product involved, the manufacturing techniques available to the producer and the varying needs of the purchaser. To accommodate the varying circumstances different systems of certification have been developed. The principles of the main types of certification systems are described below.

A. *Type Testing :* This is a system under which a sample of the product is tested according to a prescribed test method in order to verify the compliance of a model with a specification. This is the simplest and most limited form of independent certification of a product, both from the point of view of the manufacturer and the certifying body. The advantages of this system are that the manufacturer can claim that his product has been proven to comply with the specification (which is better than no testing at all) and the costs involved are minimal. The disadvantages of the system are that only one sample of the product is tested for compliance with the specification and, therefore, it is not known whether subsequent production complies, or indeed if the original sample was representative of production.

B. *Type Testing Followed by Subsequent Surveillance Through Audit Testing :* This is a system based on type testing (system A) but with periodic retesting to check that subsequent production is in conformity. It involves regular checking of samples of the type tested models taken from the manufacturer's production or the open market.

The advantages of this system is that it provides some check on production conformity through continuing supervision. The disadvantage is that the cost to the manufacture is higher than for type testing alone.

C. *Type Testing and Assessment of Factory Quality Control Followed by Surveillance :* This is a system also based on type testing but with assessment and approval of the manufacturer's quality control arrangements followed by regular surveillance through inspection of the factory's quality control procedures and audit testing of samples taken from the factory and the open market.

The advantages of this system are that it provides a reliable and thorough-going system of verification that on-going production is in conformity with the specification. The disadvantages of this system are that it is more complex and the costs involved are higher than the previous systems, particularly where the factory is far away from the certifying authority. This is the system most widely employed by Certification Bodies and a certification mark is often placed upon the product in question.

The various elements of this certification system are as follows :

a) A suitable scheme of supervision and control.

b) Initial inspection of the factory to check the adequacy of the quality control procedures.

c) Issue of product, factory and quality control approval.

d) Routine inspections to check on factory quality control, and

e) Audit testing of samples.

D. *Batch Release Certification :* This is a system under which a batch of a product is tested and a verdict of the conformity of the whole batch with the specification is issued.

Such testing may take any of the following forms :

a) **Sampling**

According to this form of batch testing a representative sample, based on the acceptable quality level required and the batch size, is drawn at random and tested to all the requirements of the specification. The verdict on the conformity of the batch is made in accordance with established statistical principles.

The disadvantages of this form of testing are that it is relatively expensive and it states only whether a particular batch passes or fails. It does not take into account any quality control procedures and nothing is known about subsequent batches.

b) **100 % Inspection**

According to this form of batch testing each and every item in the batch is tested to the requirements of the specification.

The advantage of this form of testing is that it is relatively reliable. The disadvantages are that it is very expensive and not always possible, particularly in the case of destructive testing.

E. *Resident Representative Certification :* This is a system under which a representative of the certifying body is resident at the manufacturing company and examines all stages of quality control and witness all testing concerning the batch for which certification is required.

The advantage of this system is that a good knowledge is obtained about the quality control procedures of the company and it is relatively reliable. The disadvantages are that it is rather expensive and naturally demands a high staffing level of the certifying body. However, it is employed for large capital projects by such authorities as Insurance Companies and Defence Ministries.

As it can be seen all third party systems involve an element of testing as a necessary means of checking compliance with the specification, it is, therefore, fundamental to the integrity of these systems that the laboratories used are competent. It is important to appreciate that these systems have differing levels of confidence that a product meets the requirements of the specification. It is therefore necessary, when selecting a system for a particular product to take care to choose that system which best meets the practical and economic requirements in that particular case. In general, surveillance provide a good compromise between cost and confidence. The evidence that some kind of certification has taken place may take a variety of forms such as a mark, a label, a certificate, a published list of the approved or licenced manufacturers etc.

The various advantages of the Certification Mark Schemes are the following :

Advantages to the Manufacturer

1) Provision of an authoritative independent assurance that the product conforms to the specification.

2) Better image of the product which is of assistance in boosting sales.

3) Improved quality of products.

4) Reduced quality costs, and possibly deduction of vendor assessment.

Advantages to Purchasers

1) The purchaser has an authoritative impartial assurance that the product he is buying meets the requirements of a standard.

2) He is assisted in choosing the right product.

3) Confidence in his purchases allows a reduction in his own "goods in" inpection, and vendor assessment.

The Cyprus Organization for Standards and Control of Quality has so far carried out tests and issued certificates to clients for type and batch testing. It has now completed its procedures to operate Certification Marking Schemes, in accordance with system "C".

STANDARDIZATION

By G. KATODRYTIS,
Lecturer H.T.I.

1. Introduction.

Standardization is now accepted universally, since it forms the basis for an improved standard of living for all. Although the need and importance of Standardization is accepted universally nowadays, the idea of Standardization revealed only at the beginning of this century. The barriers for this late development in this field lie merely in the technological advance which started at the beginning of this century and the weaknesses of human nature. The momentum of technological advance together with the localised patterns of trade and the prevailing spirit of competition, suspicion and jealously made longterm technical agreements between manufacturers hard to formulate or to keep.

This article intends to give the reader the history of the development and promotion of Standardization Overseas and in Cyprus. It also covers the basic knowledge on Standardization and promotes the idea of Standardization.

2. The development and promotion of Standardization Overseas.

The first country which decided to promote the idea of Standardization was the United Kingdom with the foundation of the Engineering Standards Committee (Forerunner of the British Standard Institution) on April 1901. This committee published the first standard for rolled steel sections in 1903.

Germany followed with the establishment of the Standards Committee of German Industry (now the Deutscher Standards Normenausschuss – DNA) in 1917. The United States established the American Standards Engineering Committee (now the American National Standards Institute – ANSI) and France created the Permanent Standardization Committee in 1918 and then preceded with the foundation of the Association Francaise de Normalisation (AFNOR) in 1926.

Since then, many other countries followed with the establishment of Standardization committees which either adopted the standards of other nations (especially the British Standards) with Some modifications to cover their local needs or by forming their own standards.

It is obvious that the trade of products according to different standards of the various countries created problems and so there was a need for an international agreement on these standards. This need was enforced and became a must during the Second World War when in 1943 it was recognized between the allies that serious delays in war production were resulting from lack of screw-thread agreement. But even then this agreement was not achieved until after the war. At this point it should be noted that an effort for international agreement was done long before the formation of national standards bodies round the world, with the formation between 1904 and 1906 of the International Electrotechnical Commission (IEC).

In 1945, a conference was held in Ottawa between U.S.A., U.K. and Canada where through the famous " Declaration of Accord " agreed on unified screw-thread standards. That was a good start where the idea of international agreement was promoted and soon after the same three countries agreed on unification of basic engineering standards-limits and fits, drawing practices and metrology. In 1955 other Commonwealth countries were invited to participate in this movement and that was the foundation later of the International Organisation for Standards (ISO).

The ISO was created in 1946 and has its headquarters in Geneva. The first governing Council consisted of standards representatives of the United States, Russia and China, the United Kingdom and France as well as Australia, Belgium, Brazil, India, Norway and Switzerland. The works of ISO continued normally without the influence of any political believes, and in 1949 about fifty technical committees had been established covering all the basic and long-established activities and industries.

The " recommendations " which had come out of ISO committees were beginning to have their effect on trading practices and more industries were pressing to have their standard problems examined in an international forum. By 1959 due to the growing interest in international Standardization by the developing countries the ISO membership had risen to forty. In 1968 a co-ordinating bureau was set up with UNESCO and UNIDO ; this has responsibility for giving general advice on the promotion of Standardisation in developing countries and in training programmes.

3. The aims, principles and space of Standardization.

The first organization to define the aims of Standardization was the ISO some years ago. Since then, due to the advancing technology, increasing world trade and modern life, the first defined aims of Standardization have been modified as being to :

(a) simplify the growing variety of products and procedures in human life ;

(b) improve communication ;

(c) promote overall economy ;

(d) ensure safety, health and the protection of life ;

(e) protect consumer and community interests ;

(f) eliminate trade barriers.

The principles of Standardization have been defined by ISO as

a) *Simplification.* Standardization is essentially a continuing act of simplification reducing unnecessary complexity in manufactured goods as a result of the conscious efforts of society.

b) *Cooperation.* Standardization is a social as well as an economic activity and should be promoted by the mutual cooperation of all concerned. The establishment of a standard should be based on a general consensus.

c) *Implementation.* The publication of a standard is of little value unless it can be implemented. Implementation may necessitate sacrifices by the few for the benefit of the many.

d) *Selection.* The action to be taken in establishing standards is essentially one of selection. Decisions should be made on priorities, and thereafter steps taken to make the selected standards firm, or secure from change, for a certain period.

e) *Revision.* Standards should be reviewed at regular intervals and revised as necessary. The interval between revisions depends on the particular circumstances, but is normally between five and ten years.

f) *Determination of compliance.* When the performance on other characteristics of a product are specified, the specification should include a description of the test method to be applied to determine whether or not a given article complies with the requirements of the specification. When sampling is to be adopted, the method, and if necessary the size of sample and the frequency of sampling, should be specified.

g) *Legal enforcement.* The necessity for legal enforcement of national standards should deliberately be considered, having regard to the nature of the standard and the level of industrialization, the laws and the conditions prevailing in the society for which the standard has been prepared.

Dr. Val Verman, Director General of the Indian Standards Institution from 1947 to 1955, has proposed the concept of " Standardization Space " as a logical means of presenting standardization problems, represented diagrammatically in figure 1.

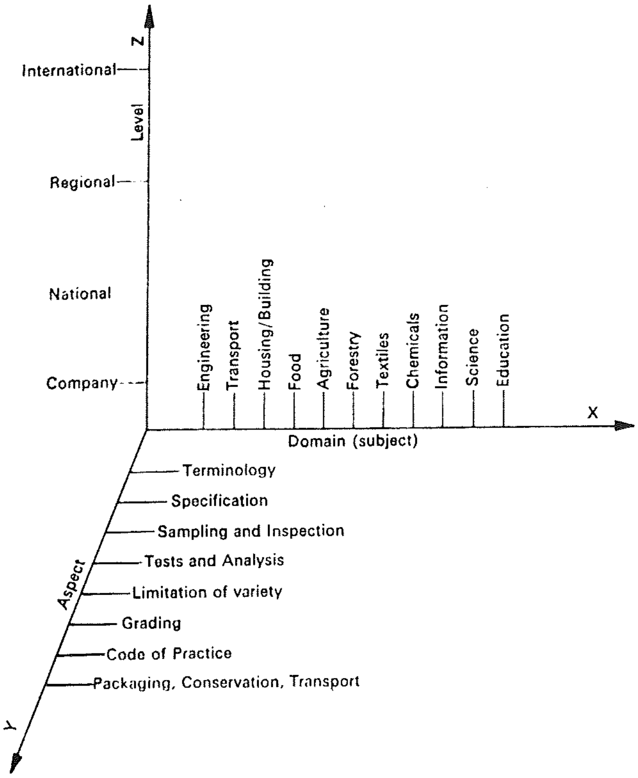


Fig. 1.

The X-axis represents the various domains of Standardization each domain consisting of numerous subjects which may be for instance, material objects, abstract subjects or symbols.

The Y-axis represents the various standardization aspects, which are groups of requirements or conditions which must be satisfied by a standardization subject if this is to be regarded as conforming to a standard.

The Z-axis represents the various levels that standards may be promulgated.

A standardization problem may consist of one level and various subjects and aspects, which occupies a defined volume of " Standardization Space." The diagram shows clearly the increase in the Standardization Space from the beginning of this century until now.

4. Standardization for the consumer and the mark of conformity.

There is no doubt that the consumer is the one to get the most benefit of Standardization. Standardization provides to the consumer goods which are cheaper to buy and can rely on good quality and safety. It is necessary though that the consumer is able to identify goods which conform to various standards. This idea of offering buyers a guarantee of quality is not new but it existed long time ago since the Middle Ages where craftsmen in order to protect their good name used to mark the products. Such markings, for instance the hallmarks for gold and silver, still exist now.

This sort of assurance is given to the consumers by marking the products which conform to standards by the marking of the standards body, together with the standards number and other basic information. The manufacturers which are permitted to use this mark of conformity on their products, should satisfy the conditions of the certification scheme of the standards body.

Such certification schemes are protected by law so that there is not any risk of misuse of the certification mark and consequently loss in confidence for the mark. Figure 2 shows the markings used by ISO, BSI and CYS.

Fig. 2.

5. Standardization in Cyprus.

The standardization and quality control in Cyprus was brought into legislation through the decision of the Council of Ministers based on Law No. 68 which was promulgated in 1975.

Following this decision, the Cyprus Organisation for Standards and Control of Quality (CYS) was established on 1st May 1976 and it operates under the jurisdiction of the Ministry of Commerce and Industry. According to the provisions of this law, the Organisation has responsibility for standards as such, together with the other related matters of quality (including testing and certification) and metrology (including calibration and standard reference materials). Also, the Organisation has exclusive authority to declare a specification as a Cyprus Standard and represents Cyprus and aid-operations at international meetings on standards matters.

Since then various amendments to the basic law and regulations have been made. The amendments to the basic law concern fees and charges for work by CYS in awarding licences to use the standard mark and the regulations made under law concern the operation of certification marking schemes and the designation as compulsory of various Cyprus Standards. In this way the protection of the consumer is ensured.

Standardisation work is carried out by technical committees according to the programme and priorities laid down by the Board of Governors of CYS. Requests for the drafting of new standards is made by various Government Departments, industrial concerns, the Consumers Protection Association and professional and trade associations. In laying down priorities the Board of Governors of CYS takes due account of the health and safety aspects of the proposed standards as well as their importance in the export trade.

Throughout the working period since 1976, CYS was being advised by U.N. experts on matters related to standards and quality control. The most important expert by UNIDO was Mr. H.A.R. Binney, former Director General of BSI who for a period of three years until June 1977, offered valuable assistance on issues related to standards. Another expert given by UNIDO is Mr. C. G. Lloyd, who joined CYS in October 1977, and still continues to offer at present valuable assistance and contributed significantly to the growth and development of the Organisation.

During 1976 about ten technical committees were operating, the first one to be formed dealt with the Clothing and Textile products showing the interest of the Government for the promotion of the export market on these products. The number of technical committees increased considerably since then reaching the total number of twenty one by 1978. By the end of 1978, fifty eight standards had been published and another fifty two were under preparation. Table 1, shown below, lists the number of the standards published and under preparation dards, and also the English translation of the German Standards (DIN).

Special projects are undertaken by the Organisation on various priorities. In these projects a survey is being done extensively and the results of this survey are very useful in the preparation of the Cyprus Standards which cover the local needs.

From the above, bearing in mind that the adoption and implementation of standards is a time consuming process with long term and radical results, it is obvious that the Organisation is doing very well for the development and promotion of Standardization in Cyprus.

The Council of ISO, following an application of CYS, has unanimously decided to accept CYS as the 68th member of ISO. As a result of this, the Assistant Secretary-General, Dr. R. W. Middleton arrived in Cyprus for a three-day visit. During his stay in Cyprus, he informed the Board of Governors on matters relating to the participation of CYS in the work of ISO and also during two staff meetings he explained the rights, obligations and the benefits which will arise from this membership.

With this membership, CYS Organisation will be expanded in an International scale participating in the work of the various ISO committees and activities.

References :

1. The aims and principles of Standardization by T.R.B. Sanders.
2. The story of Standards by C. Douglas Woodward.
3. A standard for standards – BSO : Part 1 : 1974.
4. CYS annual reports 1976–1978.
5. Cyprus trade and industry, quarterly journal of the Ministry of Commerce and Industry.

each year since the establishment of the Organisation. . .

Table 1.

Year	Published Standards
1976	14
1977	32
1978	22*
1979	17
1980**	1
Total	86*

* Ten standards for food which had been published previously have been revised.

** Standards published by March 1980. Sixty other standards are under preparation.

Since 1976, various Testing and Quality Control Centres have been established. These provide advice to manufacturers and also the various testings required for the certification of products and license for use of the Standard Mark of the Organisation (shown in figure 2). The various Testing Centres and the places where they are housed are the following :

1) Textiles Testing Centre – Government Laboratory.
2) Footwear Testing Centre – Higher Technical Institute.
3) Pumps Testing Centre – Higher Technical Institute.
4) Foodstuffs Testing centre – Government Laboratory.
5) Cement and Concrete Testing Centre – P.W.D.
6) Industrial Metrology Laboratory – Higher Technical Institute.
7) Metallurgical Laboratory – Government Laboratory.

Of great importance also is the CYS Library which is housed in the Ministry of Commerce and industry. The Library expanded especially in standards publications and at present possesses the whole series of ISO, B.S. stan-

Death is a change in the conditions of life.

A. Bezant

An Algorithm for Cutting the Surface of a Marine Screw Propeller by a Numerically Controlled Milling Machine

by A. L. Milnes

Expert in Naval Architecture

A difficulty always arises in addressing an unusually literate and numerate audience and this consists of striking the right balance between excessive explanation and undue brevity.

First – " Algorithms ". The word is a corruption of the name Al Kharismi (various alternative spellings) who was a distinguished Arab mathematician active in what is now Istambul during the 7th Abassid Caliphate i.e. about 825 A.D. For the present purpose an algorithm could be defined as a methodical step by step procedure which if followed will lead to the solution of a given problem or to an indication that no solution is possible.

This article is based upon the work of students at Portsmouth Polytechnic who were given the task of constructing an algorithm which would enable the shape of a typical marine screw propeller to be cut from a rough casting. The machine to be used was a MARWIN N.C. milling machine with (at present) 4 degrees of freedom i.e. translation in X, Y and Z and rotation in the X–Y plane. The machine has some fairly complicated electronics and teething troubles with this has made progress rather slower than might have been expected. A colleague – Mr. T. Russell who is a production engineer specialising in N.C. techniques and myself jointly supervised a group of students who have progressively advanced the solution of the problem to within (distant) sight of success.

Most people have a fair mental picture of the form of a modern marine screw propeller but in order to appreciate the shape more fully some of the terms used in describing a propeller are illustrated in Fig. 1.

Notice that the sections change from a conventional aerofoil form near the roots to a nearly symmetrical round back section near the tip. This helps to produce a reasonable compromise between ahead efficiency and astern performance. The term pitch is comparable with the pitch of a screw thread and in earlier propellers the face of the propeller (which is at the aft side) was a true helicoidal surface. The back of the propeller (which is towards the front of the ship) is now formed into more or less complex aerofoil, or segmental forms. The pitch of many modern propellers is not constant across the propeller disc, usually being reduced near the root to help reduce cavitation.

Propellers usually have " rake " which means that the blades slope aft as viewed from the side. They may also have " skew " which means that the blades are curved back rather like a Turkish sword.

In manufacturing a propeller a casting of e.g. nickel aluminium bronze is made and then finished to shape. To produce the propeller the propeller designer states an adequate data base, and much of the data is given in the form of ratios. Thus the diameter of the disc and the diameter of the shaft will be stated as dimensions but the pitch will be stated as a factor times the diameter and a pitch distribution function may be described by a curve as shown in figure 1. The outline of the blade may be defined by a drawn line with offsets expressed as a ratio of the maximum chord. About 10 section planes (at constant radii) are given in which the line may be defined in terms of x, y, co-ordinates with an origin at the maximum thickness line and x and y expressed as a ratio of chord.

The " surface" of the propeller is then not fully defined, but a series of points are stated – perhaps 200 on the face and 200 on the back, the intervening surface being obtained by joining these points by that overworked Naval Architecture concept " a fair surface ". Similarly the blade profile is obtained by passing a fair curve through the termination points of the chord lines.

My readers may be interested to hear how propellers are produced at present in a shipyard not too far from Portsmouth and you should at this point suspend disbelief!

The, as cast and fettled propeller, is machined on the boss faces and tooling position holes are drilled in the forward face of the boss. The propeller is then lifted on to the bed of an old boring machine which has been modified as an accurate measuring device. There are strong economic reasons for making the casting as " small " as possible to limit the amount of metal which must be removed in the machining process. An intensive inspection process is then started to find out if the blades are " in " the casting and the propeller designer may be called into consultation to see if one blade can be " moved " along the boss by a millimetre or so in order to ensure that the designed blade lies inside the casting.

The inspection process may occupy 300 + manhours. A drilling head is then mounted on the inspecting bed and with the aid of an accurate clock micrometer and modified dimensions supplied by the design office dimple holes are drilled with a 2mm pointed drill, so that the point of the hole lies on the surface of the blade – about another 300 manhours.

The propeller is then removed to a special booth which has high capacity air extraction fans and the metal lying between the dimple holes in ground away using hand held grinding machines — total hours 300 to 600.

This is a slow and expensive process.

In attempting to replace this process with an N.C. process several stages were identified.

These were:

(i) Translate the largely non dimensional data stated in an inconvenient form to a set of co-ordinate points with R constant and Z, Θ stated where Θ is the angular motion of the rotating table holding the propeller

(ii) Convert the data set from propeller surface points to cutter centre points

(iii) Expand the sparse design data set into a much richer set suitable for the N.C. Machine.

(iv) Consider the interfacing problems from computer to machine.

(v) Convert the set of data points which are at the intersections of a data web so that the entire intervening surface is defined.

At first sight (1) appears to be just trigonometry. Unfortunately however the pitch distribution function does complicate matters and quite early the central problem was seen to be defining an interpolating function between the data points. It is my impression that production engineers faced with this problem always think of circular arcs and straight line segments but probably this is libellous.

Getting a computer to deal with derivatives of circles proved so complicated that after a short time it was decided to use polynomials. But a number of serious problems emerged at once.

To explain : if we take a 7th order polynomial

$$\text{i.e. } y = a + a_1x + a_2x^2 \ldots\ldots a_7x^7 \qquad (1)$$

then substituting the first 8 data points generates eight simultaneous equations which can be compactly stated in matrix algebra terms

$$[Y] = [X] \times [A] \qquad (2)$$

where [Y] is a vector of values of Y – (8x1), (X) is an (8x8) matrix of x values raised to powers. 0 to 7 and [A] is a vector of the coefficients "a". This matrix equation can be readily solved for [A] Most computer languages include matrix algebra as a facility and even dealing with 8 of the designers 20 data points problems rapidly emerged concerned with the power of the computer to hold numbers and check re-inversions of [X] showed quite serious deviations.

Furthermore although polynomials have a number of very valuable mathematical qualities e.g. they exist everywhere are continuous everywhere, are not bounded above or below and this is true of all their derivatives, they exhibit some less valuable qualities from an engineering viewpoint. Having [A], equation (1) can be used to generate any number of (x,y) pairs and it soon became apparent that the undesirable qualities of these equations were present. Check plots of (x, y) from even a 7th order polynomial exhibited " snaking " and " hanging chain " effects. See fig. 2.

Consideration was given to using lower order polynomials on all the data points with a least squares fit but this would constitute interference with the designers data and was rejected.

In the end a very simple technique used repeatedly was adopted. The data points were taken in sets of 4 e.g. (x_1y_1) (x_2y_2) (x_3y_3) (x_4y_4) and a 3rd order polynomial fitted. Coefficients " a " being stored, the next set (x_2y_2) (x_3y_3) (x_4y_4) (x_5y_5) are taken and another set of 4 coefficients " a " stored. This is repeated up to $(x_{17}y_{17})$ $(x_{18}y_{18})$ $(x_{19}y_{19})$ $(x_{20}y_{20})$, resulting in a stack of 18 sets of 4 coefficients. Generation of the intermediate points is then carried out, e.g. the points between (x_3y_3) (x_4y_4) would use the coefficients " a " in the second entry of the stack and points between (x_4y_4) and (x_5y_5) would use the coefficients " a " in the third entry of the stack.

The generation of the path of the cutter centre can be found by differentiating the functions and modifying the co-ordinates or the basis of the slope and the cutter radius.

This technique proved successful and in 1977 a moderately complex aerofoil shape was cut. The data interface was by means of an 8 channel paper tape and it was apparent that this interfacing could not be used to cut the propeller since the paper tape reel was 150mm diameter for the one section, 2200 data points being used.

In the meantime micro-computers had become available at low prices and the bottleneck and difficulties of using the mainframe computer disappeared. The most recent work is now concerned with direct control from micro-computer to N.C. machines and the expansion of the designers sections to give intermediate surface definition.

At present (Dec. 1979) the direct control of an N.C. machine (not the Marwin) by a micro-computer looks promising but no more than that.

To obtain the intermediate surface between designers sections the following procedure has been proposed but not yet tested.

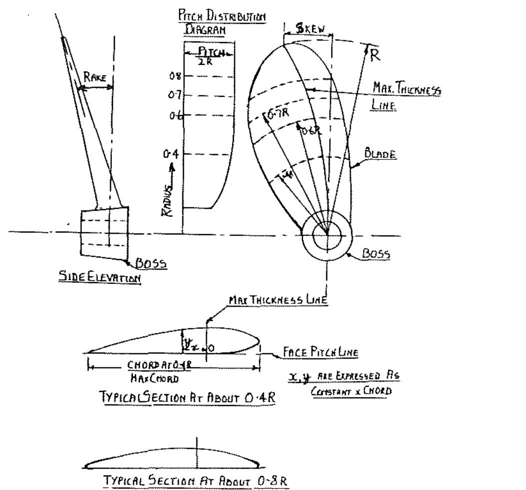
On completion of the curve segment equation interpolating procedure outlined above the computer momory contains a set of coefficient stacks each (18x4) if 20 data points are used to define every section. Considering for example the sections at 0.6R and 0.7R and looking at the coefficients occupying Row 3 of each stack, then we have
at 0.6R $a_{3,0}$ $a_{3,1}$ $a_{3,2}$ $a_{3,3}$
which represents the equation
$y = a_{3,0} + a_{3,1} x + a_{3,2} x^2 + a_{3,3} x^3$
and at 0.7R a similar equation will exist.
An alternative notation would be $f_{0,6}$ is such that $x \rightarrow a_{3,0} + a_{3,1} x + a_{3,2} x^2 + a_{3,3} x$
and $f_{0.6}$ can then be looked on as the sum of four separate functions i.e. $f_{0.6} = g+h+k+1$. where g is such that $x \rightarrow a_{3,0}$ h is such that $x \rightarrow a_{3,1} x$ and so on. Also $f_{0,7}$ can be written similarly. It appears that the separate functions g, h, k and 1 can all be interpolated between 0.6R and 0.7R and hence new functions can be generated e.g. $f_{0.65}$ is such that $x \rightarrow a_{3,0} + a_{3,1} x + a_{3,2} x^2 + a_{33,} x^3$ where the new coefficients are obtained by taking the mean of the corresponding a coefficients at 0.6R and 0.7R. This process is repeatable at all radii and the total surface is then defined. A problem which still seem in superable is to define an acceptable inspection procedure for the complete surface.

The inspection procedure for the manufacturing process described earlier consists of visual inspection for the faint dimple tips and the surface between is tested by palpation. This is a quite remarkably sensitive technique and I have occasionally wondered at the nature of the training process which has produced this ability to detect quite small deviations from a fair surface. Possibly it might be connected with post-pubescent experimental activity?

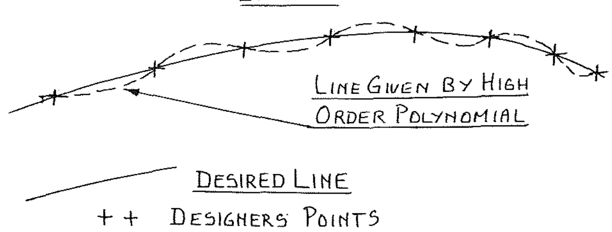
To produce a comparable inspection technique which can be cast into computer language has defied the ingenuity of staff and students at Portsmouth Polytechnic. Any suggestions?

Clearly there remains much to be done and almost certainly some hand finishing will remain in producing a propeller. There are also some areas of the algorithm which are poorly defined. An effort will be needed to produce a well organised total procedure with internal checking routines. Again the " dead " movements between cuts look as if they might prove troublesome. But certainly this problem has produced an interesting and useful group of student projects.

SOME PROPELLER TERMS

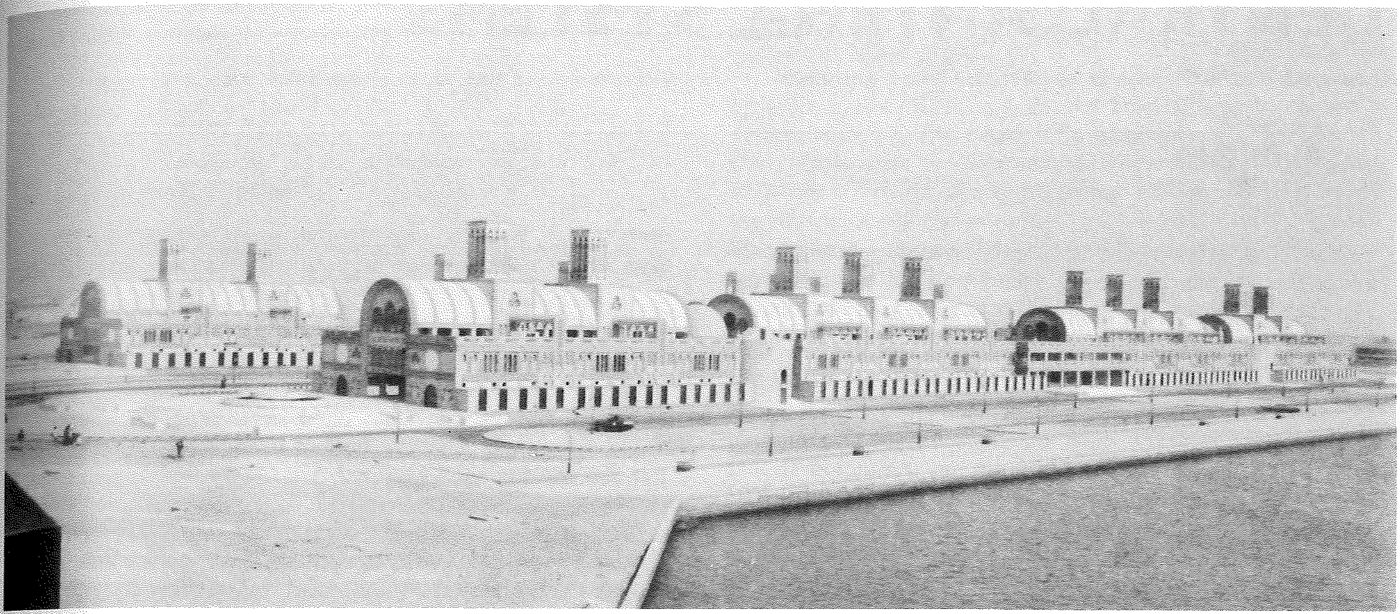


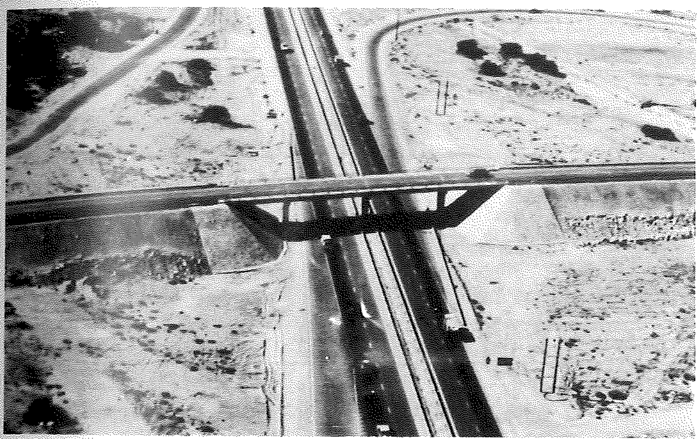
SNAKING

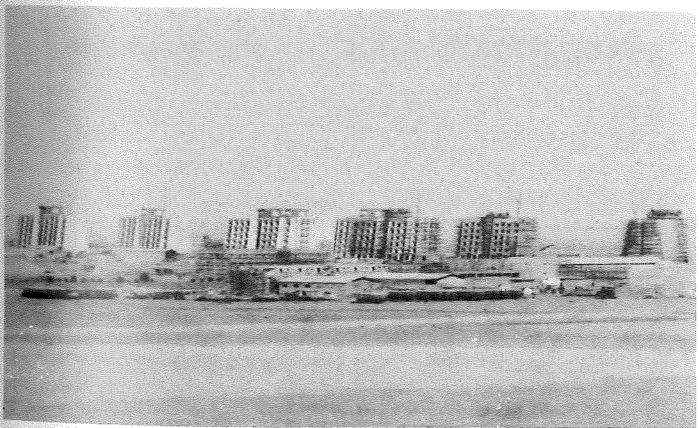


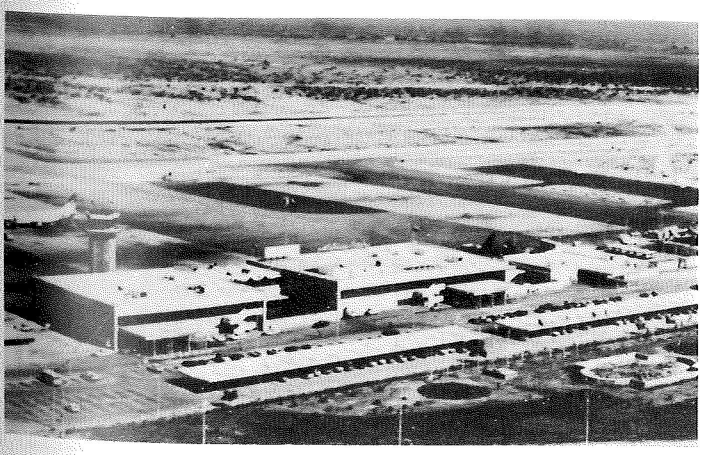
HANGING CHAIN

DEVIATION EXAGGERATED









CENTRAL ANTENA SYSTEMS

by C. Loizou
Lecturer H.T.I.

Introduction.

In an apartments-building it is advantageous to centralize the TV plant by using a common aerial. Thus the "forest" of antennas required otherwise, which disturb mutually and disfigure the building, are avoided ; the users are served better and the cost is lower.

One antenna is sufficient for each program to be received ; each antenna must deliver a signal of sufficient strength to operate the TV properly and the signal should be free of reflections. To achieve this the antenna must have a high gain and be possibly located in the optical range of the transmitter.

The distribution is carried out through a network of coaxial cables of nominal impedance 75 ohms from which the single outlets are derived with a given attenuation ; in this way the isolation at any signal frequency between any two system outlets (sockets) connected separately to a spur feeder is not less than 33dB. This is sufficient to prevent TVs from disturbing each other. To overcome this attenuation and that of the distribution network it will be necessary to amplify the signals initially and to the distribution itself. For good reception the output signal should be kept within certain levels and this could be easily done by means of an automatic gain control (AGC). This AGC will also prevent the TV from saturation ; in fact each output of the amplifier must deliver sufficient level so as the levels of the distributed signals at system outlets are within the limits given in table 1.

Table 1. Signal levels at system outlets

	Level		Max difference between channel levels			Remarks
	Max	Min	Adjacent channels	other in-band channels	between bands	
VHF and UHF systems (including signal adaptor systems)	mV	mV	dB	dB	dB	The rms voltage of each vision carrier at the peak of the modulation envelope for both monochrome and colour, when measured across a non-inductive resistor of 75 ohm, or referred to 75 ohm.
Band III	5	0.75	6	12	16	
Band IV	10	1.0	6	12	16	
Band V	10	1.5	6	12	16	

Note : Some receivers may be unable to handle the maximum signal voltages quoted above without introducing unacceptable cross-modulation. In these cases the signal voltage may be reduced by suitable attenuators at the receivers' inputs.

Television reception.

Television programmes in Cyprus are transmitted in three bands using 625 lines :

Band	Frequency range MHz	Channels
III (VHF)	174–216	6–13
IV (UHF)	470–614	21–38
V (UHF)	614–854	39–68

The various channels used in Cyprus are given in Table 2 together with the normal vision and sound carrier frequencies for each channel.

It is worth noting that only channel 6 (Troodos) transmissions are vertically polarized while all the substations use horizontally polarized transmissions.

Table 2. Channels and frequencies used in Cyprus for Bands III, IV, and V.

Channel	Carrier frequencies MHz		Transmitter Location
	Vision	Sound	
6	179.75	176.25	Troodos
11	204.75	201.25	Kakopetria
35	583.25	589.25	Kalo Chorio (Larnaca), Kampos, Palechori, Pera Pedi
38	607.25	613.25	Spilia, Tsada
59	775.25	781.25	Alona, Droushia, Lefkara, Nicosia, Moniatis, Phini
61	791.25	797.25	Agros, Armenochori, Xilias, Phyti
62	799.25	805.25	Kalavasos, Corfi
63	807.25	813.25	Kelokedara, Sanida, Ftericoudi

Installation requirements.

The initial and ultimate requirements should be ascertained as accurate as possible. On the basis of this information a specification, drawings and schedule of requirements should be prepared and should include, as appropriate :

(1) broadcast services to be received ;
(2) number and location of distribution points ;
(3) location of central equipment ;
(4) tentative proposals for the location of aerials ;
(5) agreement as to signal levels required at the outlets ;
(6) anticipation of future requirements.

If you are angry count up to ten. If you are outrageously angry count up to a hundred.

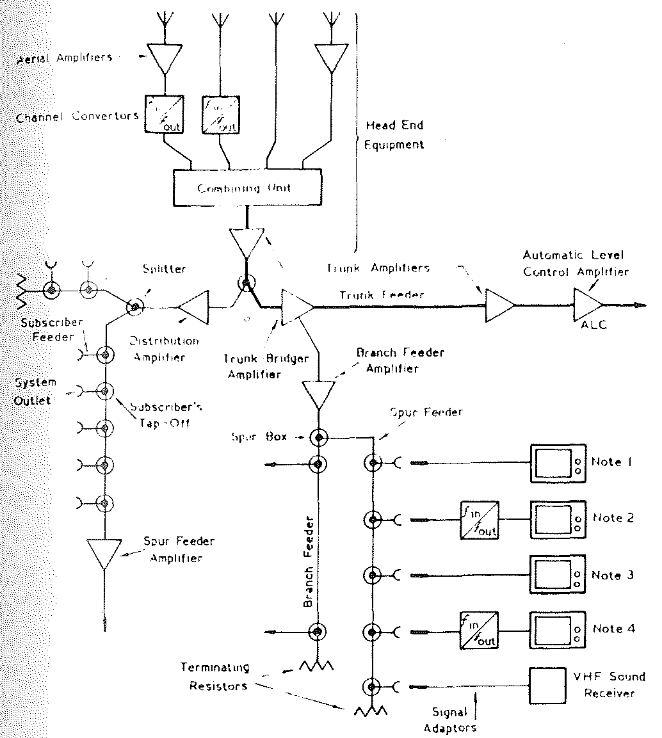
Thomas Jefferson

Distribution of television programmes in the VHF and UHF bands.

A typical system will include most, but not necessarily all of the following (see Fig. 1)

Fig. 1. Principal items of equipment employed in wired distribution systems.

(Not all the items shown are required in any one installation, the items required being dependent on the size, type and layout of the system).



Note 1. Wired receiver connected to HF system.
Note 2. Aerial receiver connected to HF system via an adaptor.
Note 3. Dual-standard (or VHF only) receiver connected to VHF system.
Note 4. VHF-only receiver connected to VHF system via adaptor.

(1) The aerial system for which it will generally be necessary to find the best position after the building has been completed.
(2) In weak field strength areas, low-noise aerial amplifiers located close to the aerials.
(3) Amplifiers and channel translators, converters and combining units.
(4) Trunk, branch and spur feeders.
(5) Equalizers (normally incorporated in amplifiers).
(6) Subscriber feeders and tap-off units.
(7) Subscriber outlet units.

It is normally impractical to feed several receivers from one aerial system without additional amplification. It is often necessary to translate the signal to a channel that is otherwise unused in the area in order to avoid interference. Care should be taken in the selection of channels used for distribution because of interference problems that can arise.

Typically, it is desirable too, in some cases to translate UHF channels to VHF to reduce the attenuation of the signal by the cable. When UHF channels are translated into the VHF bands, modification may be necessary to the receivers.

Splitting units are used to divide the signal between different cable routes and should be designed to ensure a correct match to the cable. Subscribers are connected to the spur feeders via a subscriber's box containing tap-off units that provide the right amount of signal to operate the receivers without introducing a mismatch on the feeder. The tap-off units also limit signals being fed back from a receiver into the spur feeder.

The subscriber feeder is terminated in an outlet unit that is fitted with sockets to provide for the connection of a television receiver.

For the distribution of television programmes in the VHF and UHF bands suitable cables must be used taking care to prevent stray pick-up and radiation. Double or solid-screened cables are usually necessary to ensure minimum radiation from the system and adequate protection from outside interference.

Equipment involved in a central antenna system.

The equipment involved in a central antenna system is the following:- receiving antenna, amplifiers, splitting units, tap-off units, socket outlets, cable feeder.

Central equipment is preferably accommodated in a separate room to which only authorized persons have access. The room should be dry, reasonably well ventilated and not subject to extremes of temperatures. Good artificial lighting and a mains socket-outlet separate from the power supply for the equipment should be provided for maintenance purposes. The floor should be constructed of, or covered with, non-conducting material.

In order to select the most suitable equipment for an installation, some of its characteristics should be known.
(1) *Receiving antenna or aerial.*

The strength of the signal received decreases rapidly with increasing distance from the transmitting station. This applies to a greater extent to UHF than to VHF and the screening effect of hills and tall buildings is also more serious on UHF.

The use of an effective aerial is therefore of the utmost importance if full use is to be made of the signal available. Apart from providing the receiver with an adequate input voltage, the aerial has other important functions. It often happens that the signal arrives at the receiving aerial not only by the direct path from the transmitting station, but also after reflection from one or more objects such as hills or tall buildings. Reflected signals arrive later and can produce multiple images on the screen. An aerial with good directional properties may be used to minimise multiple images on the screen and also to discriminate against unwanted signals from other transmitting stations using the same channel as, or adjacent channels to, those used by the wanted station.

The three most important electrical parameters to be considered in selecting an aerial are forward gain, directional properties and bandwidth. The directional properties of the aerial are of greatest importance in areas where reflected signals or interference from other stations using the same channel may occur.

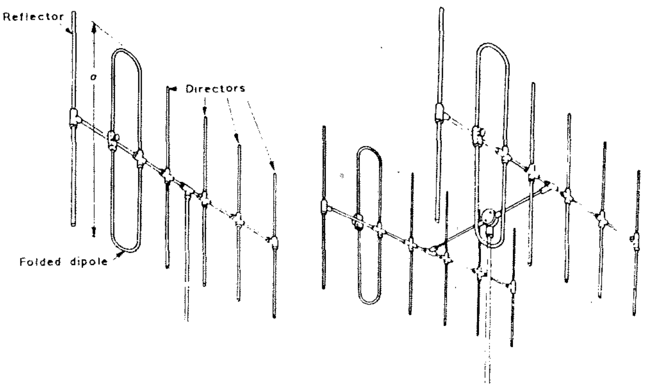
The design of multi-element aerials is highly specialized. This is particularly true of wide-band aerials for certain Band III applications and of all aerials for Bands

IV. Such aerials should therefore be obtained from a reputable manufacturer.

The advantages of a multi-element aerial are that it discriminates considerably against signals arriving from directions other than those making a comparatively small angle with the direction of maximum sensitivity and that it gives a greatly increased signal input to the receiver compared with that from a simple aerial. These properties are particularly useful where the field strength is low, or where interference is severe.

Aerials having at least three elements are almost invariably used in Band III and it is quite common to use five elements or more.

Example of a multi-element aerial is Fig. 2. Aerials for Band III are available to receive a number of channels (wide-band aerials), which is convenient when an area is served by two or more transmissions originating from approximately the same direction. Aerials are available to cover the whole of Band III.



Dimension *a* is approximately one-half the wavelength concerned. For Band III the dimension is 0.69m to 0.84m. The spacing between the elements depends upon the design of the aerial.

Fig. 2. Example of highly-directional aerials.

UHF aerials are invariably of the multi-element type and a single aerial may have as many as eighteen elements. An example of an aerial for UHF reception is given in Fig. 3. Wavelengths at UHF are, however, very short so that aerials composed of numerous elements are still light and compact. For satisfactory reception on UHF it is important that the type of aerial be chosen with care according to reception conditions at the site and to cover the channel(s) required.

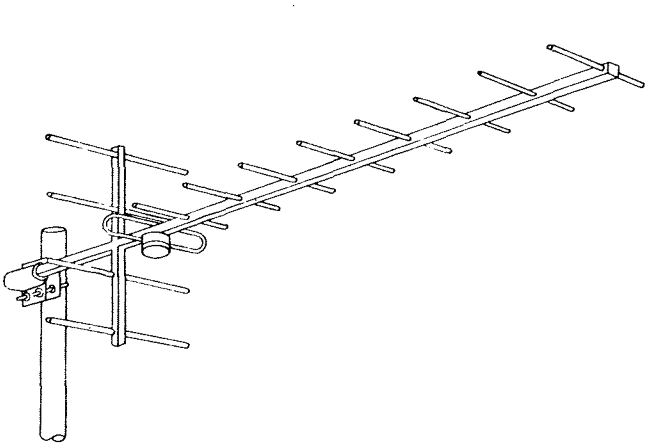


Fig. 3. Example of aerial used for UHF reception, Bands IV and V.

The position of the aerial is of considerable importance. All local obstructions between the aerial and the transmitter should be avoided as far as possible, and where reception conditions are difficult it may be advantageous to find the best position by experiment. For example, an aerial placed on the top of a tall building will generally give the strongest signal, but better reception may sometimes be obtained by placing the aerial in a lower position so the building acts as a screen between the aerial and a source of interference, such as a busy street. Similarly, multiple images may often be eliminated by a careful choice of position for the aerial and by proper use of its directional properties. Where practicable, aerials should be mounted well clear of other conductors including structural metalwork. The plane of polarization inside the building may not be the same as that of the transmitted signal and the aerial may need to be tilted accordingly.

The siting of UHF aerials, in particular, calls for extreme care. It may be necessary to experiment with the position of the aerial over considerable areas of the roof and it should be remembered that the high degree of directivity of multi-element UHF aerials necessitates accurate orientation of the aerial. Although a field strength meter will prove helpful in obtaining the optimum position for the aerial, the quality of the picture obtained on the receiver should always be checked before the final position is decided upon.

Where an aerial has been installed to receive a single channel it may be necessary to re-position the aerial to receive other channels or use a separate aerial.

Metal masts of TV aerials should be connected to earth by the most direct route using a conductor of minimum size 1.5 mm^2.

2) Amplifiers.

The TV distribution system requires rf amplifiers in order to permit the signal to lie within the limits specified in table 1.

The amplifier must have 75 Ω input and output impedances for matching purposes.

Normally rf amplifiers are equipped with AGC in order to maintain the output level constant for a reasonable input signal which depends on the sensitivity of the amplifier.

The amplifier increases the amplitude of the input signal so that it can be fed via quite high-loss attenuators to a number of receivers, each receiver being isolated by its attenuator from the remainder. The gain of the amplifier should be equal to the attenuation at each outlet, plus something extra to cover feeder losses etc. and it follows that the gain is determined by the number of outlets it is desired to serve.

Normally it is required to make a symmetrical type of distribution so that each column will require approximately the same strength of input signal.

Thus the required output from the amplifier can be determined and hence the necessary input according to the gain of the available amplifier. If the input from the aerial is not sufficient then a pre-amplifier is used.

Of course the calculated values are minimum and in order to assure strong signal under any conditions practically 10-20% allowance is given or the next available unit is chosen.

3) Splitting units.

They are used to divide the central line from the amplifier evenly into secondary lines. They are also called splitters and spur units.

These are usually resistive networks and in very rare cases LC networks are used.

In designing the distributors, the input and output impedances are taken to be 75 Ω in order to satisfy matching conditions.

Also for simplicity all TV distributors are designed as pure resistive elements, care being taken that the through line attenuation is a minimum (say 1.5 db per outlet) and attenuation to the TV socket outlets (say > 20 dbs) to reduce interference between TV receivers.

4) Tap-off units.

They are secondary line distributors where part of the signal is taken from the secondary lines to feed TV outlet sockets, ensuring the right amount of signal to operate the receivers without introducing a mismatch on the feeder. The tap-off units also limit signals being fed back from a receiver into the spur feeder. Their design characteristics are similar to those of splitting units.

5) Socket outlets and plugs.

It is essential that socket outlets and plugs used are not interchangeable with those used for electric light or power circuits.

They are available as single or double outlets without through loss and isolation for tee wiring and with through loss and isolation for loop wiring.

6) Cable feeder.

The most common types of TV distribution cables are:-
- (a) the 75 Ω RF (TV) coaxial cable
- (b) the 300 Ω RF (TV) twin feeder

Although the attenuation of the 75 ohms coaxial cable used in central antenna systems is higher than that of the 300 Ω twin feeder used for single TV installation, the 75 Ω coaxial cable is preferred in central antenna systems because its characteristics do not change in the presence of moisture or rain and furthermore the variations of weather do not deteriorate it as it happens with the twin feeder. The losses of the cable at 500 MHz should not be higher than 16-18 db per 100 meters.

A cabling plan having regard for the need for the segregation of the various services is required which is prepared in collaboration with those responsible for other services *i.e.* electricity, sound distribution, telephones etc.

Joints in cables should be avoided as a general rule. In particular, joints in radio frequency feeder cables should not be attempted.

Suitable junction boxes should be used for connecting cables, and where necessary, the ends of the feeder cables should be sealed to prevent ingress of moisture.

On completion of an installation, complete circuit diagrams of the equipment should be supplied. Plans should also be supplied showing for maintenance and record purposes the position of the various items of equipment, junction boxes etc. and the routes of all the cables and wires.

Design procedure.

In the following work VHF Band III is considered but the methodology can be applied for UHF Bands IV and V provided the correct signal limits and distributor attenuations are used.

When designing a central antenna system the following procedure is followed :

- (a) Study of given information and data.
- (b) Design of the network distribution and of the conduit network.
- (c) Calculation of the amplifier output.
- (d) Selection of the receiving aerial.

(a) The information and data given are
- (i) building plans
- (ii) TV points
- (iii) suppliers catalogues
- (iv) channel or channels of the TV system
- (v) strength of the received signal.

The signal strengths required for good reception are the following :-

Band III 55 dBμV/m or 0.562 mV/m
Band IV 65 dBμV/m or 1.778 mV/m
Band V 65 dBμV/m or 1.778 mV/m

The strength of the received signal can be measured with an RF meter, and the output level of the antenna itself must be such as to give reasonable TV signal into the amplifier input.

(b) The distribution network can have a symmetrical layout, as shown in Fig. 4.

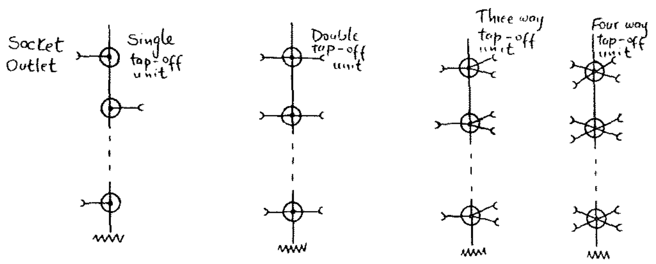


Fig. 4.

- (a) A knot column with one TV outlet at each knot.
- (b) A knot column with two TV outlets at each knot.
- (c) A knot column with three TV outlest at each knot.
- (d) A knot column with four TV outlets at each knot.

Each column must be supplied by such signal level so that the first TV point can never be overloaded.

If more than one columns are to be fed then a splitter has to be used. The columns can then be fed either by individual amplifiers or by a powerful amplifier common to all columns. If in a chain column there are users who need several outlets in their flats, then the TV outlet point can be replaced by a tap-off unit (for radial distribution) or if the points are required to be in series it is advisable to use sockets with through loss and separation feeding all the points. This insertion does not disturb very much the equilibrium of the plant. Of course if there are many users requiring additional outlets, the extra loss must be taken into account when choosing the amplifier unit.

Having considered all above, the complete distribution network showing on it the amplifier unit and its position can be drawn indicating also the various distributors used.

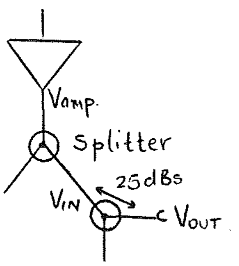
Each outlet point is marked in such a way that the first number shows the floor number and the second the number of the point of the floor. The conduit network, indicating diameters, is also drawn.

Finally a table is constructed showing each point with its number, the distance from the amplifier unit and the attenuation existing at each point.

(c) The procedure used to calculate the gain of the amplifier is the following :-

Care must be taken so that the RF power at each TV socket is not more than 5 mV and not less than 0.75 mV for VHF Band III. Considering 25 dB isolation attenuation between the TV socket and the feeder, then for the maximum RF signal allowed at the first point, the column must be fed by 89 mV (*i.e.* $20 \log_{10} \frac{V_{IN}}{V_{OUT}} = 25$ dB or

$\frac{V_{IN}}{V_{OUT}} = \frac{V_{IN}}{5mV} = \text{antilog}_{10}\ 1.25 = 17.78$

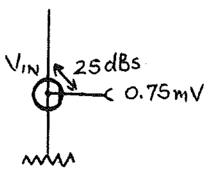


$\therefore V_{IN} = 89$ mV)

To determine the amplifier output, the total losses of the splitter and line to the first tap-off unit must be taken into account. Assuming a two way splitter having, say, 3.5 dB input/output loss and 1 dB feeder loss, then an amplifier output of 150 mV (max) is required *i.e.*

$20 \log_{10} \frac{V_{amp}}{89mV} = 4.5$ dB $\quad \therefore V_{amp} = 150$ mV

Now for the last TV point connected in a column, the minimum RF signal allowed is 0.75 mV. Thus the RF signal arriving Vin must be at least 13.5 mV. (*i.e.*



$20 \log_{10} \frac{V_{IN}}{0.75\ mV} = 25$

$\therefore Vin = 13.5$ mV)

To determine how many columns are required for an installation, the total losses of the distributors and line must be taken into account. The maximum permissible loss in each column is 16.4 dB

(*i.e.* $20 \log_{10} \frac{89\ mV}{13.5\ mV} = 16.4$ dBs).

Considering this loss we can determine how many tap-off units of each capacity can be served, if the through line loss of each one is known and if the line losses are approximately 1 dB per 5-6 meters of co-axial cable. Thus in the case of a double tap-off unit having 1.4 dB through loss then we can have

$\frac{16.4\ dB}{(1.4+1)\ dB} = 6.8$ double tap-off units or 12 TV outlets, by giving 10-20% allowance.

Normally manufacturers specify for their amplifiers the frequency range, the nominal gain in dBs for each band and the maximum output in dBmV for each band. This information must be used for the selection of the correct amplifier regarding frequency range and output voltage. Additionally the input to the amplifier must be of reasonable level to activate the amplifier without overloading it and this must be considered in conjuction with the sensitivity of the amplifier, the antenna output or pre-amplifier output (if required).

(d) The receiving antennas are designed to be self resonant, so the appropriate antenna for the concerned channel or channels must be chosen.

The antenna used in central systems is 75 Ω and is used to supply all TV outlet sockets, through one or more amplifier units.

The gain of the antenna must be selected, based on the strength of the signal received and the required input to the amplifier. In weak signal strength areas a high gain antenna will be required, sometimes associated with a low noise aerial amplifier.

If more than one antennas are required to be installed a minimum distance should be kept between them as suggested by the manufacturers to prevent mutual jamming.

Antennas should be earthed through an appropriate connection with the mast.

Example

Design a central antenna system for a 10 storey building, 4 flats per floor, one socket in each flat, to provide undistorted RF signal at each TV outlet socket.

Design

(a) The total TV socket outlets are:-
10 floors x 4 TV sockets = 40

(b) The central antenna system will be designed for channel 6 (181-188MHz).

(c) The strength of the signal received in the area, measured with a field strength meter, was found (say) to be 10 mV/m. (If below the typical figures given on p. then a pre-amplifier is required).

(d) To ensure 5 mV at the nearest TV point and 0.75 mV at the farthest, considering the cable loss as 1 dB for 5-6 m feeder, the through attenuation as 0.7 dB per outlet and the separation attenuation as 25 dB then based on the above considerations, each column must be fed by 89 mV. Of course in practice the exact through and separation attenuations will be obtained from the manufacturers data for the units to be used. In practice a range of units is available with different through and isolation attenuations.

The maximum permissible loss in each column is 16.4 dBs. Thus we can feed

(i) $\frac{16.4}{0.7+1} \simeq 9$ single outlet tap-off distributors or 9 TV points

(ii) $\frac{16.4}{1.4+1} \simeq 6$ double outlet tap-off distributors or 12 TV points

(iii) $\frac{16.4}{2.1+1} \simeq 6$ three-way outlet tap-off distributors or 18 TV points

(iv) $\frac{16.4}{2.8+1} \simeq$ 4 four-way outlet tap-off distributors or 16 TV points

Hence for a symmetrical distribution we can use 4 x 10 TV points knot columns with two TV outlets at each knot as shown in Fig. 5.

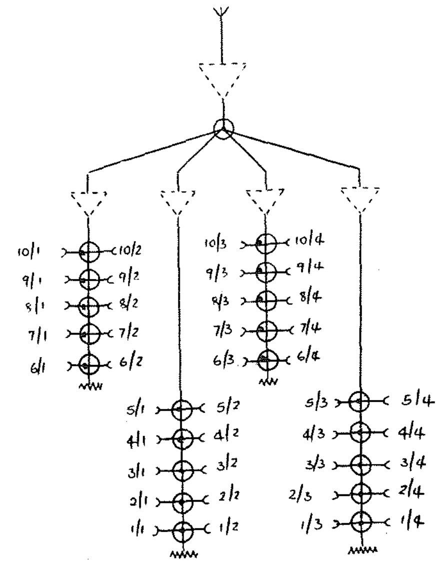


Fig. 5. A possible distribution arrangement

On considering the attenuation, the maximum and minimum attenuations are determined:-

The farthest socket outlet is 1/1. Its attenuation is:-

Due to the through attenuation of the tap-off distributors	4 x 1.4 = 5.6 dBs
Due to the isolation attenuation of the last tap-off distributor	1 x 25 = 25 dBs
Due to the losses of, say, 50m cable feeder	$\frac{50 \times 18}{100}$ = 9 dBs
	39.6 dBs

The nearest socket is 10/1. Its attenuation is:-

Due to the isolation attenuation of the first tap-off distributor	1 x 25 = 25 dBs
Due to the losses of, say, 10m cable feeder	$\frac{10 \times 18}{100}$ = 2 dBs
	27 dBs

Thus the minimum signal level required to feed each distribution column in order to have 0.75 mV at the farthest TV point 1/1 is

$$V\ (\text{min}) = 0.75\ \text{mV} \times \text{antilog}_{10} \frac{39.6}{20} = 71.6\ \text{mV}$$

and the maximum signal level required in order to have 5mV at the nearest TV point 10/1 is

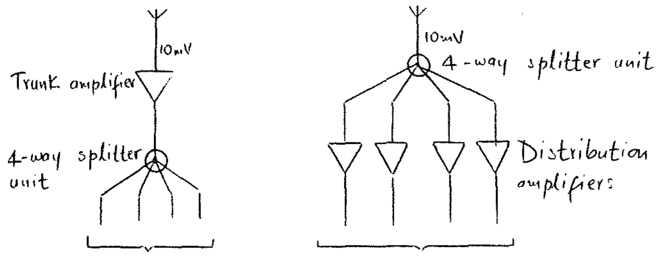
$$V\ (\text{max}) = 5\ \text{mV} \times \text{antilog}_{10} \frac{27}{20} = 112\ \text{mV}.$$

The required signal levels must be provided either by a powerful trunk amplifier feeding a 4-way splitter unit or by four distribution amplifiers connected at each one of the outputs of a 4-way splitter. (see Fig. 6)

(a) 4 distribution columns each requiring 71.6 - 112 mVs

(b) 4 distribution columns each requiring 71.6 - 112 mVs

Fig. 6



Considering the case of Fig. 6(a), assuming that the splitter loss between input/output is 8 dbs, then the amplifier must be able to deliver an output in the range 719 mV - 1125 mV.

since $V_{amp}(\text{min}) = 4 \times 71.6 \times \text{antilog}_{10} \frac{8}{20} = 719$ mV

and $V_{amp}(\text{max}) = 4 \times 112 \times \text{antilog}_{10} \frac{8}{20} = 1125$ mV

Now considering the case of Fig. 6(b) each distribution amplifier must be capable to deliver an output in the range 71.6 - 112 mV. In this case it is necessary to check the signal arriving at the input of each amplifier to be compatible with the sensivity of the amplifier.

$$\text{In this case } V_{IN}\ (\text{amp}) = \frac{10\ \text{mV}}{\text{antilog}_{10} \frac{8}{20}} = 4\ \text{mV}$$

which seems to be sufficient.

References :

1. BS 5603 : Part 1 Cabled distribution systems primarily for sound and television signals – specification for performance requirements for systems operating between 30 MHz and 1 GHz.
2. CP 1020 : Code of practice for the reception of sound and television broadcasting.
3. Fracarro Radioindustrie : TV Antennas – Community systems, July 1975.
4. How to achieve good reception from the new TV substations, CBC TV Times issue No. 400 by A. Michaelides, Senior Engineer CBC.

The source of vigour for the body and mind, is rest and relaxation.
Study and learn then the science of relaxation.

Pl. Drakoulis

COMPUTERS AND MICROCOMPUTERS

by S. Spyrou
Lecturer, H.T.I.

A brief summary of computer terminology and functions.

Introduction

There are a number of everyday items which we take for granted, items such as electric lighting, radio, telephone, cars and aeroplanes, but can we imagine life without them ? All these things and a few more thousands are the result of discoveries and technological development which had a great effect on our way of life. The invention of the computer, however, and its revolutionary development will probably have the greatest effect.

What does the computer effectively do ? Can it substitute the human brain ? Can it ever develop to the stage where it can take over decision making from humans ? Are we developing something which we will not be able to control in the future ? Scientists and technologists do not seem to worry about these questions, but sociologists and psychologists are disturbed by the impact of computers on society and the science fiction writers are trying to predict.

No attempt will be made here to answer all these questions since all the answers are not yet known, but let us examine briefly how the computers were developed and what are the things they can do. An attempt to explain computer terminology and the function of the various components will also be made.

The computer can do some of the things which the human brain can do, such as solving arithmetical and mathematical problems. It can take " decisions " by choosing to follow one course of action instead of some other. It can " predict " certain future situations. It can drive a car or pilot an aeroplane. In medicine it can partly replace doctors in diagnosis and suggest possible therapy actions.

These are only a mere few of the things a computer can do performing them in a much faster time than the human brain and without errors. It does sound very impressive but the computer has great handicaps. It cannot take initiative, it can not dream up or imagine other possible answers. There is no flexibility in decision making, since it needs to be told and be programmed by a human at some stage. It has no feelings and no intuition. It all amounts to the fact that humans can say " Its only a machine...", but is there going to be a day when the computers will say " Its only a human...".

Computer history

Computers were developed from the mechanical and later electromechanical calculating machines which were built for the first time about 300 years ago.

The first commercial computers operating during the years from 1954 to 1959 were called " First Generation " computers and their technological basis was circuitry consisting of wires and thermionic valves, these being hollow, evacuated glass envelopes through which the electrical pulses flow – a non-solid state era –, since the electrical signals were flowing in vacuum. The main characteristics of these machines were the comparatively large size as compared to present day computers, the generation of a lot of heat which was the main cause for frequent breakdowns. The internal storage capacity was small and the models produced were not compatible with each other. The processing speeds were measured in milliseconds (10^{-3} seconds).

Most of the disadvantages of the " First Generation " computers were not present in the " Second Generation " computers (1959–64) since the transistor and the semiconductor diode took over from thermionic triodes and diodes and the printed circuits superceeded the wires. The electrical signals did not have to flow through space and long wires and the processing speeds were measured in microseconds (10^{-6} seconds). The " Solid State " computers were considerably smaller in size ; the heat generation and frequent breakdowns were reduced, the internal storage capacity was increased and core storage replaced magnetic drums and delay lines.

The " Third Generation " computers took over since 1964. The technology employed for these computers was different. The discrete components were replaced by " discrete circuits " or integrated circuits " (I.C.s) most commonly referred to as " chips." The characteristics of the " Third Generation " computers were the compact size, the reduction in heat generation and power consumption, the increase in internal storage capacity and the facilities for remote communication and multiprogramming. The operating speeds are now in nano seconds (10^{-9} seconds).

Development of the third generation computers was continuous with increase in processing power, reduction in size and reduction in costs. The reduction in costs and size were the decisive factors for the phenomenal spreading and application of computers.

By early nineteen sixtees the Electronics Industry gained enough experience in the manufacture of IC's, which led to the development of very large scale integration (v.l.s.i.) chips, whereby millions of components are enclosed in discrete circuit packages – a development which made microminiaturisation a reality.

The greatest impact of the integrated circuits was on the " desk-top " or " pocket " calculators, which were direct replacements of the older calculating machines. In 1967 Texas Instruments patented a device which was the first one-chip, four function calculator. Since then the development was revolutionary, the costs were reducing considerably as production was increased.

One of the semiconductor companies researching into more powerful calculator chips was " Intel Corporation " and in 1971 they produced what they thought was the ultimate calculator chip whose designation number was 4004. When the product was finished, they discovered that it was far too powerful to be used as a calculator. It had the capabilities of the central processor unit (c.p.u.) of larger computers ; this was the birth of the first " true micro-processor." The 4004 was a chip measuring 0.117 by 0.159 inch, made up of 2,250 transistors. The 4004 was a milestone in the development of microelectronics, because as soon as it was announced the " Big Boys " of the semiconductor industry poured billions of dollars into research schemes to match Intel Corporation, but before they could bring out anything. Intel announced their new product the 8008 which was setting up new standards. Intel's lead however, was only for a while and other companies were catching up producing similar and even better microprocessor chips. The market was expanding considerably and the costs reducing vertically.

The new microprocessor chip can be employed with a handful of other integrated circuits to produce a small computer powerful enough to be compared with the bigger computers; some of these smaller computers or minicom—puters being so powerful and compact that they directly replace big mainframe computers which were in productipn four or five years ago.

The increase of the microprocessor power has reduced the size of the computer and a new name that of the " microcomputer " is born. Other names which are given to the microcomputer are " Home computer " and " Personal Computer."

Computer Definitions and components

The idea " microprocessor " has been introduced without actually stating what it is. A manufacturer has defined the microprocessor as " A very large scale integrated circuit which by the action of a sequence of instructions, externally programmable, can fulfill a wide variety of different electrical functions." It sounds very academic but in order to understand this statement it is necessary to take the story from the begining by considering the concept of computers as a means of obtaining a set of results from given data.

There are two basic types of computers the digital and the analog. The digital computer processes discrete numerical digits *i.e.* zero's and one's and the analog computer processes analog signals such as rates of flow, temperature variations etc. by means of analogy *i.e.* electrical voltage variations which are directly proportional to these physical quantities. The digital computer is employed extensively in business and industry and the analog in pure scientific work.

The idea of the an automatic computer refers to the situation where information and instructions are fed into the computer and without any operator intervention the computer gives out the results.

Basically all digital computers are made up of three basic units. The central processing unit, including the main memory, the imput and the output devices. In addition to these a computer system has a backing storage whose capacity is very large compared to the main memory, it serves as a " library " *i.e.* the computer stores its references.

The central processing unit (c.p.u.) of the computer is the " brain " or control centre of the computer. The input and the output devices are the means by which humans can communicate with the machine. They are the " translators " of the system, slimilar to an interpreter at a meeting where the participants speak and understand different languages. The meeting would be a failure if the interpreter was not there. In such a meeting the first would make a statement or ask a question the interpreter will translate in the language which the second can understand. The second would think about it and answer in his own language, the interpreter would then translate back to the first and, hopefully(!), they would understand each other.

In a similar way the computer operator will sit in front of an input device, which can be a keyboard, enter the information by pressing the keys. The input device will convert this information in the machine language, which is a train of electrical pulses. The machine will take this information and process it within the C.P.U. The answer is given out from the CPU, in machine code, to the output device which will translate to a form understandable by humans e.g. the output device can be a printer giving a print out of the answer. The C.P.U. consists of three basic units the main storage, the control unit and the arithmetic/logic unit.

The functions of the main storage unit are to keep the data and instructions as given via the input device, to hold the intermediate results and to handle the final results and feed them to the output device. It is the " memory " of the system.

The functions of the arithmetic/logic unit are to perform the various arithmetic and logic functions. It is the " calculator " of the system.
The functions of the control unit are to obtain the instructions from the memory, interpret them line and line and give appropriate commands to all the other units according to the instructions. It is the " controller " of the system.

A typical computer system is shown in Fig. 1.

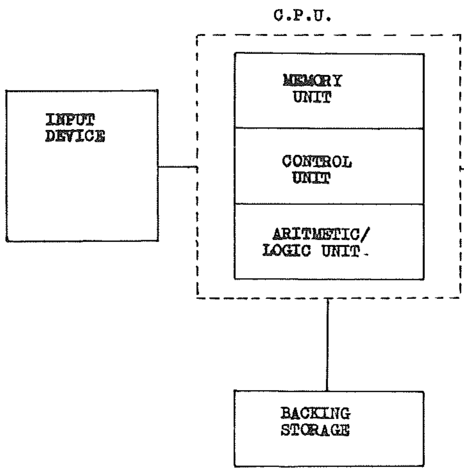


Fig. 1 The basic computer configuration

Microcomputer Definitions and components

The basic components of a microcomputer system are the same as those of the computer described before; these can also be devided into hardware, software and firm ware.

Hardware

Hardware consists of the cabinets which contain the circuitry, power supplies, input and output devices. It is the physical machines which we see.

Software

Software is the set of instructions which enable a computer to follow the operator's instructions. Inside the microprocessor there is a device which temporarily stores the instructions, (often called the program counter). When all the data and instructions are entered and the microcomputer is instructed to " start," the counter addresses the first memory location and the contents are transferred to the microprocessor for action. When this is executed the next memory location is taken and the process repeated until all the instructions are finished. Thus to program a computer it is necessary to use a code or language which is understood by the machine. There are three levels of languages which can be used *i.e.* machine language, assembly language and high level language.

In our present personality we live only once. Yet our lives are full of hatred, worry and even pain to varying degrees.
Children of one God, let's make this world a better place to live in.

Voltair.

The Machine language is a low level language, the program is written in digital form and it is entered into the computer's memory one digit at a time. It is a complicated and laborious method, but the results are processed much quicker.

In the Assembly language the computer can be programmed using alphanumerics instead of just plain binary numbers. It is possible to code the instructions into 3 or 4-letter groups and the computer will translate these into machine-language instructions before it acts on them. Mnemonics are used to remember these instructions since they are usually shortened words. Examples are LDA – Load Accumulator and HLT – HaLT.

High level languages use English – like statements and commands for instructing the microcomputer. A number of languages have been developed such as BASIC, FORTRAN, COBOL, APL etc.

Examples of instructions are READ A, PRINT, END etc. High level languages are widely used each having certain advantages over the others depending on the particular application. FORTRAN, for example, is a powerful language for scientific and engineering work but it is not very useful for bussines.

Software is also available on magnetic tapes or other storage media and it is used to tell the computer how to do a specific job *i.e.* to work out the average mark of a class examination.

Firmware

Is software which cannot be easily modified e.g. a hard wired program.

Setting-up a microcomputer system

The C.P.U. of the microcomputer consists of the microprocessor I.C. and other I.C.'s which are required to interface it with the rest of the system ; all these i.c.'s are contained in most cases on a single p.c.b. There are a number of available microprosessor i.c.'s (8080, 6800, Z–80 etc.) each having its own set of built-in instructions, which it will inherently perform; this is called the " instruction set."

The C.P.U. printed circuit board is connected by means of wires to the memory system, the various input and output devices and other back-up memory storage, the later two also known as peripheral devices.

The master wiring diagram of the microcomputer is called the " system bus " which physically consists of a number of wires. The most widely used bus is the S-100 which consists of 100 wires, each one carrying a specific signal. Each p.c.b. within the microcomputer has a connector which matches with the bus. Various manufacturers produce microcomputers which use the S-100 system and their equipment is compatible. The advantage of adopting a common bus system lies in the fact that additional units, made by different manufacturers, can be easily interconnected.

The internal memory of microcomputers varies from 4 K bytes to 64 K bytes, but some sophisticated types can be upgraded upto 256 Kbytes. (Each K represents 1024 byte segments, thus a 64 KB memory system has 65,536 memory addresses). In practice the internal memory is divided into user-accessible memory and the non-accessible memory (firmware).

In general the firmware includes the manufacturer's system software which is the " file " of the operating system, the BASIC language interpreter being an example. Physically it consists of ROM's (Read Only Memory), PROM's (Programmable ROM) and EPROM's (Erasable PROM) which are I.C.'s on a special p.c.b. or plugged onto the microprocessor p.c.b. The non-accessible memory provides an easy means of extending the microcomputer's function, a FORTRAN interpreter, for example, can be obtained on a ROM containing p.c.b. and plugged into the bus system. This portion of the memory cannot be erased, except in the case of EPROM, and it is of the non-volatile type *i.e.* it will not be destroyed when the power is switched off.

The user–accessible memory is the RAM (Random Access Memory) of the system. This is erased easily and usually is volatile. This is the portion of the memory where the user can store its data and instructions, thus by having

I am good to all people, whether they are good to me or not.
Hence all seem good, just and kind to me.

Lao-Tse

a larger memory the more flexible and powerful the system is.

Peripheral divices can include keyboards, video display units (V.D.U.), teletypes, cassette tapes, floppy disk drives, printers, paper tape, music synthesizers, speech input/output. These devices and controllers are connected to the microcomputer directly plugged-in on the bus or through Input/Output (I/O) ports and connectors.

From the foregoing a minimum working system would require the following items:

(a) A keyboard which must be suitable for entering alphanumeric characters. There are various types of formats developed but the most widely used are the ASCII, EBCDIC, and Baudot. The ASCII (American Standard Code for Information Interchange) uses of 7-bit code ($2^7 = 128$ characters) plus a parity bit, where each character is a particular combination of bits. The EBCDIC is an 8-bit code. ($2^8 = 256$ characters) used for more complex work. The Baudot code, which was originally developed for telegraphic purposes, uses a basic set of $2^5 = 32$ codes with a letter and a number key to precede characters of one or two sets.

(b) A Video Display Unit (V.D.U.) which is similar to a television screen on which characters and graphic lines are displayed. It is utilised to check the inputs, before entry, and to display the outputs.

(c) A C.P.U. consisting of one or more microprocessor i.c.'s and associated circuitry to interconnect it with the rest of the system. The C.P.U. can be one single p.c.b. which may also contain the non-accessible memory of the system where the computer's basic functions are stored.

(d) Memory. The user-accessible memory where the user stores his instructions and data (RAM memory).

In addition to the above the system will be enhanced by adding external storage systems such as tape cassettes, floppy discs or mass storage disks where the user can store programs, files and data. A printer is always a desirable feature because it will produce a hard copy of the input and output information. Graph plotters are, also connected up, mainly when the work carried out is concerned with engineering and science.

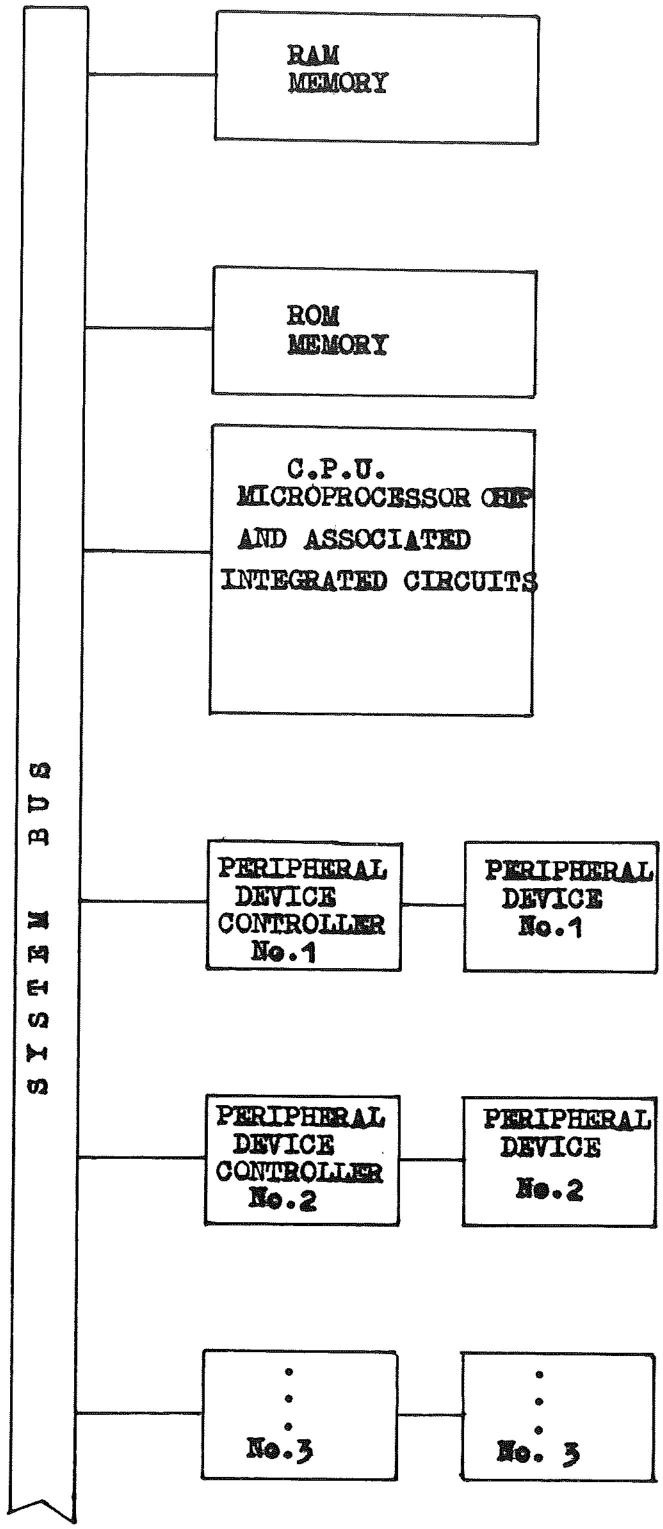


Fig. 2 Microcomputer system

Applications

The applications of microcomputers range form specialised professional work to hobbies. They find their way in offices and shops where they are used for book-keeping, stock control and cash controllers. In design and reasearch establishments they aid researchers and designers by storing for them masses of information and process new programs quickly.

At home the microcomputer is used to play games (Star Trek, combat games, chess, tennis etc.) or to create and play music. For more advanced home enthusiasts a microcomputer can be used to control heating and cooling or even to automatically open and close windows and doors. There are stories of hobbyists who program their home computer to remind their wives that breakfast should be served at 06.30'.00" or dinner at 18.30'.00". The microcomputer has produced a new cult, the " Home Computer Hobbyist " who, like the radio amateur hobbyist, is equally fanatical with his " work " and likes to talk his own strange language in his attempt to remember the computer language.

It appears that the new " mighty midget " will replace its " Big Brother," the mainframe, since recent developments in the memory systems have given it enough power and enough flexibility to " remember " things and " execute " complicated functions at enormous speeds. Will we be able to have a small computer the size of the human brain which will match in complexity of thought and functions the human brain ? Can we produce microcomputers which have " feelings " or are we going to lose the sense of human feeling, and become a cheap low powered, limited sophistication computers? Are we approaching the day when the computer " thinks " ... " He is only human...".

THE WAY TO GOOD QUALITY PRODUCTS

by C. K. Tavrou
Lecturer in Production Engineering

Introduction

The aim of this article is to give the essential elements for achieving a product with good quality.

If a manufacturer wishes to remain in business by selling his products, the quality of the goods must be up to the expectations of the consumer. The expectations of the consumer usually depend on the price of the product. Another reason for a manufacturer to produce a good quality product, is due to the competition with other manufacturers of similar products. In this case, however, sometimes the quality of the product may have to be reduced if the competitors' products are of much lower quality. This will in turn reduce the cost of production and increase the profits of the company without affecting their sales.

These and other important reasons make the systematic control of quality of a product essential in today's world where quality is what matters most.

Policy and Objectives

When a company decides to use a systematic approach to improve and control the quality of their product, it is necessary to state their policy and objectives. These should be clear enough, so that at any time it will be possible to detect any deviations from them and take corrective action.

The quality policies may vary according to the specialization of the individual company, but there are some fundamental matters that should be included in all cases. Some of these are the quality levels of outgoing products, the products liability, relations with customers, relations with vendors and relations with personnel.

The objectives should give the specific goals of the company's operations. The objectives should be quantitative as for example to reduce scap to 3 % by the end of the year or reduce the cost of inspection etc.
The policy and objectives should always be written as they are better thought out in this way and can always refer back to when the need arises for comparison with the actual situation.

Organization for quality

A fundamental part of organizing for quality is the identification of the essential quality control work elements and the assignment of clear instructions for getting them done. In a manufacturing company, the following areas are essential when organizing for quality.

Acceptance. To organise for acceptance which will be the decisive process as to whether a certain product will be accepted or rejected. Inspection plans should be prepared for this work *i.e.* choose control stations, define work to be done at each station etc. The specifications for the product should also be prepared so that at any time during the manufacturing process, the quality could be checked.

In some manufacturing companies, the acceptance responsibility is shared between the production and quality control departments but in others the quality control department alone takes the responsibility. The second case is better as in many occasions the production people may reduce the quality of the product for the sake of increasing production output and reduce production costs.

Quality improvement. The improvement of quality is another important function which has to be considered during the organization for quality. An important part of quality improvement work is to prevent the repetition of defects by eliminating the cause. An effective way of eliminating the causes of failures is to divide the work into two parts. The first should be taken care of by persons which will indicate the quality problems, to explain the possible causes, to initiate investigations and propose remedies to eliminate causes of defects. A second party should carry out the investigations, to indicate the causes of defects and suggest remedies designed to eliminate the causes of defects.

Co-ordination. For a good quality organization, the co-ordination between the various company functions has to be achieved. This may be done through the company head, through committees or through a special department which may be the quality control department.

Manufacture and inspection

For a good quality product, it is necessary to use capable machines. This means that the accuracy of the machine to be used, is greater than the specified tolerances of the product.

Flow charts, maintenance instructions, setting up instructions etc. should also be prepared for the manufacture of a product as well as some means of recalling the process or the machine that produced a certain component if the latter proves to be defective at a later stage.

During production, inspection has to be carried out at certain stages to ensure that the final product will have the specified quality. Inspection may be done by samples or one hundred percent, depending on the type of product. From the results of inspection, investigations should be carried out when necessary and decisions for corrective actions should be taken.

The inspection during the production flow is divided into three distingt categories.

(i) The incoming inspection, which covers the inspection of all goods received by a company to use during production. These may either be in the form of raw material, semi-finished or finished components. Inspection by samples or one hundred percent may be used depending on the importance of the component.

(ii) In-process inspection, which is the inspection carried out during the manufacture of the product. This inspection is done in the forms of first-piece inspection, patrol inspection and continuous inspection. First piece inspection should be carried out at the beginning of a manufacturing process or after resetting of the machine. The patrol inspection should be carried out by inspectors visiting each machine at intervals to ensure that the most recently manufactured components comply with the quality requirements. Continuous inspection is carried out on the components as they are manufactured and is usually done by the machine operators at certain stages of the manufacturing process.

(iii) Final inspection, is carried out on the finished product and before is shipped to the consumer, to ensure that it complies with the quality specifications.

The amount and level of inspection in a company will depend on the specialization of this company. It should be brought as an example that whenever the safety of human lifes is concerned, extensive inspection is necessary to avoid errors that may cost peoples lives.

Before closing this article, it should be made clear to the reader that the above, merely touch some of the major topics on the quality control subject. For further reading, there are books with extensive work on this subject that can easily be made available from the usual sources.

References :

1. Quality Control Handbook (Third edition) J. M. Juran.
2. Safer products through quality control, by Lennart Sandholm.

Learning Theories and Educational Practice

by G. Philippou
Lecturer, H.T.I.

Abstruct : Educational practice was influenced by the prevailing learning theories at all times and in all societies. The role of learning theories became more marked in the present century because of universal education and the increasing demands for economy and efficiency.

An attempt is made in this paper to describe the development of psychological learning theories during recent times and their impact in educational practice. The main beliefs of J. Bruner and R. Gagne', the main exponents of Gestalt and Behaviorism, are presented and compared.

Behaviorism was at its peak in the United States during the first quarter of our century. Watson, Guthrie, and Thorndike developed the Stimulus-Response theory according to which all learning occurs through classical conditioning. Complex new learning occurs by building up a serial combination of simple S–R reflexes. The S–R bonds are strengthened by repeated association. Apart from the power of repetition Thorndike realized the importance of reinforcement in the form of satisfiers and annoyers, and he stated his law of " exercise and effect." (Hill, 1971 p.58).

The impact of " connectionistic " views, and particularly of Thorndike, in educational practice was spread in the 1920s. As a result the subject matter was exhaustively analysed into a large number of separate and often unrelated combinations of processes, rules, types of problems etc. and the learner was drilled on each item without any attempt for sequence or systematic organization. Naturally memorization was taken as synonymous to learning.

Gestalt Psychology was first developed by a group of theorists in Germany *i.e.* Wertheimer, Kohler and Koffka. These theorists stressed that the whole is more in significance than the sum of its constituent parts. They emphasized the importance of integrated whole systems separate but dynamically interrelated. Learning is not a matter of adding new traces, but it is primarily a matter of changing one Gestalt – perception of a whole system, situation, or problem – into another.

Concerning educational practice they insist on systematic organization, on carefully sequenced presentation, on meaning and understanding. As a result the attempt is now to develop in the learner methods of thinking, to provide him with general principles, with ideas of procedures, with meanings and relationships. Theoretical proof and problem solving receives due attention.

The origins of the two schools briefly described above can be found in Plato's *Idealism* and Aristotle's *Empiricism*. Contemporary research findings, the addition of new concepts and the general advancement of psychology resulted in modified and refined versions of the old theories to suit contemporary needs.

Jerome Bruner provided a new framework to Gestalt (or Field, or Cognitive) learning theory in his small but very influencial book " The Process of Education " published in 1960. The new psychology of learning was developed around the term " learning by discovery " and it embodied a dynamic version of the developmental theory in conjunction with a contemporary form of classical rationalism. For Bruner learning proceeds through three levels:

(i) *the Enative level* where the learner manipulates directly specially prepared materials to develop an intuitive grasp of regularities and properties;

(ii) *the Ikonic level* where the learner deals with mental images of objects but does not manipulate them directly;

(iii) *the Symbolic level* where the learner is strictly manipulating symbols and no longer mental images of objects.

Proceeding through each of those stages the learner observes relationships and regularities which are internally integrated with previously known ideas in order to establish a coherent whole. What is discovered is rarely something outside the learner. It should be made clear here that Discovery is viewed as a process of working rather than a product to be discovered. Emphasis lies on the necessity for the learner to be actively participating in the process.

Bruner (in D. A. Aichele a R. Reys, 1971, p.168) draws the analogy of the speaker and the listener. Just as the speaker is constantly engaged upon the sequence and organization of his thoughts, the learner must be active in reorganizing his experiences and searching for new meanings, similarities and relationships. In a lecture the student plays the role of a passive listener and he may even fall asleep. To be effective in holding his audience a wise lecturer avoids long monologues, adopts an interrogative mode when possible thus sharing in a sense some of his role.

Emphasis upon discovery had the effect of producing a more active approach to learning. But according to an old axiom every successful advanced thesis seems to generate its own antithesis.

Robert Gagne ranks among the top antagonists of J. Bruner. He adopted an approach to instruction which may be interpreted as the antithesis to discovery and a new refined version of Behaviorism. Such an approach is called " guided learning," " expository learning," or " reception learning." Gagné begins with a clear statement of the instructional objectives which have to be observable and measurable. The terminal student behavior is then task analysed by finding out the prerequisite tasks and prerequisites to these prerequisites, thus building up a complex pyramid. Upon completing the whole map of prerequisites he administers a pretest to determine which knowledge has already been mastered. The pattern of responses to this diagnostic test identifies precisely what is to be taught. Gagné has developed a model for the discussion of the different levels of such a hierarchy. If the final capability is *problem solving*, the learner must know certain *principles*, to understand principles one needs to know specific *concepts*, but prerequisite to these are certain *associations or facts*.

For Gagné the emphasis is on systematically guided learning, the key is the careful sequencing of instructional experiences so that any unit taught is clearly related to those preceding it. The continuity between the learners existing cognitive structure and the material to be learned makes the new material meaningful.

In reception learning the entire content of what is to be learned is presented to the learner in final form. The learner is expected to discover nothing by himself, he is only required to internalize or incorporate the material so that he will be able to reproduce it in some future date. Reception learning, its proponents claim, can be made meaningful in the process of internalization. After discovery learning is completed, they add, internalization occurs in much the same way. The antithesis is between meaningful and rote learning, and discovery learning can be rote learning.

Objectives. To the question " what are the ends of education ?", different answers are given by supporters of different educational theories.

Bruner puts the emphasis upon the kinds of processes learned by the student in contrast to the specific subject–matter products he may acquire. Knowing he argues is a process not a product. This seems to be particularly true at the level of higher education. A body of knowledge embodied in a series of volumes is the result of much prior intellectual activity. To instruct someone in any discipline is not a matter of getting him to commit results to memory, but to teach him how to participate in the process that made possible the establishment of this knowledge. It is highly important that the learner will develop a knowledge-seeking and knowledge-getting ability, some general strategies or heuristics.

Gagne realizes that strategies are important and agrees about the priority of processes over products. He claims, however, that objectives of instruction are intellectual skills or capabilities that can be specified in operational terms, can be task analysed, and then can be taught. He believes that " to be an effective problem-solver, the individual must somehow have acquired masses of organised skills " (cited in Shulman 1970; p.35).

Ausubel, another representative of " guided learning " theorists, strongly rejects the idea that any kind of process, be it strategy or skill, should hold priority among the objectives of education. On the contrary he insists on the mastering of well–organized bodies of subject matter as the most important goal of education.

Two points need to be emphasized at this stage:

(a) The psychologist's preferred theory of learning is not the only factor determining his view on educational objectives.

(b) There is an inherent difficulty in comparing results achieved by different instructional methods. Since they aim at distinctly different goals it becomes practically impossible to conduct a comparative educational experiment.

Entering Characteristics. What the student brings with him to the instructional situation will now be examined with reference to readiness.

The modern conception of readiness has been dicidedly shaped by the work of Jean Piajet. For Piajet the child is a developing organism passing through biologically determined cognitive stages. These stages appear in a fixed order and they are more or less age-related. Piajet sees development taking place in a sequence of successive disequilibria followed by adaptations leading to new stages of equilibrium etc. Since disequilibrium is uncomfortable the individual seeks to accomodate to new situations through active modification of his present cognitive structure. In effect good instruction will begin by careful consideration of the learner's cognitive structure, followed by creation of new situations of minimal degree disequilibria urging the student to accomodate to them and so on.

Bruner accepted Piajet's views and carried them a step further. His statement that " any subject can be taught effectively in some intellectually honest form to any child at any stage of development " (Bruner, 1960 ; p.33), shoked many educators. It becomes meaningful, however when considered within the context of the whole chapter on readiness. It is suggested that we must modify our conception of readiness so as to include not only the child but the subject matter as well. Just as the child is developing through stages in which his preferred modes of representation are the enactive, ikonic, and symbolic,' the basic principles or structures of a discipline can be presented manipulatively, as visual representations or, as formal symbolic expressions. Hence the basic duty for the educator is to translate the fundamental principles of the subject matter to be taught into the learner's logical forms. This is the theory behind Bruner's " Spiral Curriculum," in which the child is introduced to the principles of each discipline quite early in his life and returns to them at higher stages always expanding and relating them to other topics and disciplines.

For *Cagne, Ausubel* and the theorists suggesting guided learning the problem of readiness is quite simple; It is only a function of the presence or absence of the prerequisite knowledge. A student is clearly ready to proceed to a certain task when he is capable of performing all prerequisite tasks. Ausubel put it quite directly : " the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly." (cited in Shulman, 1970, p.47).

Transfer has been described as the most important single concept in any educationally relevant theory of learning. Obviously without transfer the learner would be expected to practice exactly and only what he has been taught.

Bruner emphasizes the transfer of broad learning principles from one topic or domain to another. The success of this process depends largely upon mastery of the structure of the subject matter. Bruner (1960 ; p. 17) refers also to specific and non–specific transfer of training. Specific training refers to applications of acquired knowledge to similar tasks, it is an "extension of habits or associations." Non-specific transfer refers to broad inquiry competencies, strategies and heuristics.

Gagne is in clear contrast to Bruner on this issue. He maintains that transfer occurs in the case of " specific identical elements " within developmental sequences. If the new situation requires a behavior substantially different from the capability mastered earlier, then no transfer will occur. He also qualifies the term by drawing a distinction between lateral and vertical transfer. Lateral transfer refers to the manner in which learning of capabilities in one domain can facilitate the mastery of some parallel capabilities in another domain. Vertical transfer refers to the manner in which learning of a subordinate capability serves to facilitate the mastery of some subsequent task in the same hierarchy.

Summary and Conclusions.

Instruction has always been sensitive to shifts in psychological learning theories. The present century witnessed the development and refine-

All people on earth seek happiness ; few are those who are in search of truth because people don't realise that in finding truth they will find happiness.

Paris Hadjipetrou

ment of a number of learning theories which can roughly be classified under either Behaviorism or Gestalt theory. Each one of these schools has been successful in explaining at least some facts. This is probably the reason why modern theorists are not strictly loyal to one preferred school of psychology.

The contemporary teacher should not expect clear-cut answers to his practical questions from any theory of learning. He is provided by a wealth of emperical and theoretical evidence and by general guidelines and methods. Each teacher has to answer the following crucial question by himself: for this particular group of students under these specific conditions what is the optimum procedure to achieve the predetermined goals ? To answer this question the teacher has to consider carefully the entering characteristics of the students, the subject matter, the objectives to be reached and their possible interactions. Learning theories will provide valuable help in this process although frequently the teacher will find out that a combination of the existing methods is most suitable in real practice.

References

1. Bruner, J. *The Process of Education,* Harvard University Press, Cambridge : 1960.
2. Bruner, J. " On the Learning of Mathematics – A Process Orientation." In Aichele, D.B. and Reys, R.E. Eds. *Readings in Secondary School Mathematics,* Prindle, Weber & Schmidt, 1971.
3. Hill, W.F. *Learning. A Survey of Psychological Interpretations.* Chandler Publishing Co, 1971.
4. Shulman, L.S. " Psychology and Mathematics Education." *Mathematics Education.* Sixty-ninth Yearbood of the NSSE. Chicago University Press, 1970.

FIRE ALARM SYSTEMS

By S. Savvides,
Instructor H.T.I.

Fire alarm systems are generally installed for one or more of the following reasons :

1) Safeguard life.
2) Minimise fire damage to buildings.
3) Minimise fire damage to goods.

The earlier a fire is detected and the alarm sounded, the less the danger to life and property.

Fire Alarm Systems are divided into Manual and Automatic systems according to the way they are actuated.

A. MANUAL FIRE ALARM SYSTEMS.

Manual systems are simple and they are energised by break glass type switches installed in exit routes. In case of fire the switches are actuated by the personnel present and give continuous alarm to all the premises.

Manual systems are insufficient because they rely on human beings to give the alarm, this being impossible during unattended hours. Also by the time a fire is noticed by people it may have already spread considerably.

Manual systems are classified as :

1) open systems
2) closed systems
3) Monitored systems

1) *Open type system.*–(Fig. 1).

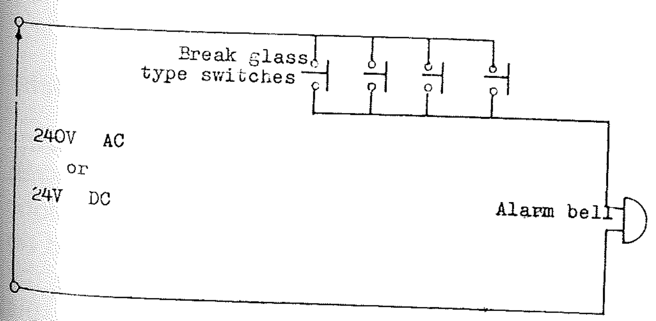


Fig. 1.

The system makes use of the normally open contacts of the break glass type switches. It has the disadvantage that the circuit may become defective with an open circuit without any indication and so it will fail when it is required to operate.

2) *Close type system* (Fig. 2).

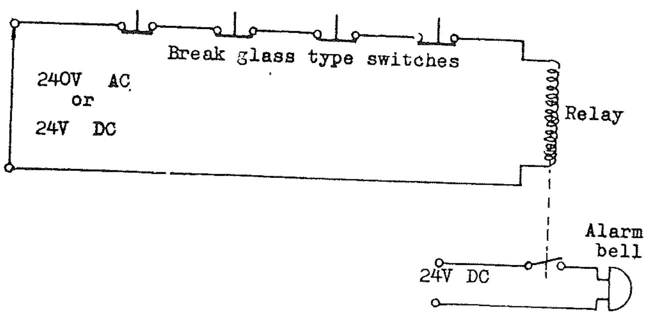


Fig. 2.

The system makes use of the normally closed contacts of the break glass type switches and employs a relay which controls the supply to the fire alarm bell. This system continuously monitors the circuit against open circuits.

3) *Monitored systems* (Fig. 3).

Both open and closed circuit systems can have fault situations which are not indicated. The open circuit system does not show if a further open circuit occurs in the wiring. The closed circuit system does not indicate if the wiring to a switch, or elsewhere has a short circuit. To avoid this a monitored system may be used.

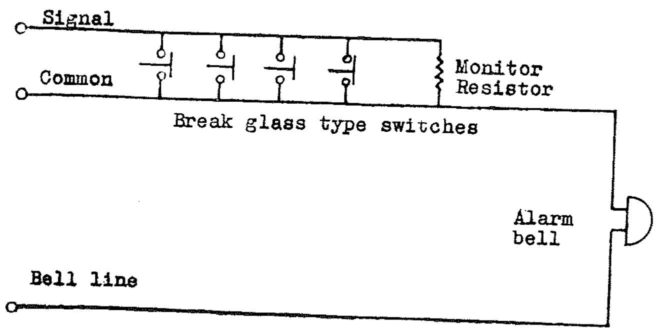


Fig. 3.

Using the above system, a current is fed via the resistor from the signal line to the common line, and if necessary from the bell line to the common, so that all lines are carrying a low monitor current at all times.

This is a simplified diagram of the most preferred method of providing a monitored system, as specified in the most recent types of control equipment made to BS 3116 Part 4.

B. AUTOMATIC FIRE ALARM SYSTEMS

Manual systems are effective when persons are present to give an alarm but if protection is required when the premises or part of them are unoccupied or infrequently visited as at night, during the weekends or at holidays, then automatic systems are necessary. Such systems may be activated by smoke, heat or flame detectors or manual break glass switches. Automatic systems can be combined with other services like the Fire Brigade Authority to give fire alarm to these services. They can be used also to switch on emergency lighting and actuate door release units to separate the building physically into sections to minimise spread of fire.

The systems usually operate on 24V DC supplied by a battery continuously charged by a separate circuit supplied directly from the mains.

To understand the operation of automatic systems, it is necessary to study the different types of detectors in use. The following diagram shows the three main groups of detectors *i.e.* smoke, flame and heat and the stage at which each type is initiated by fire.

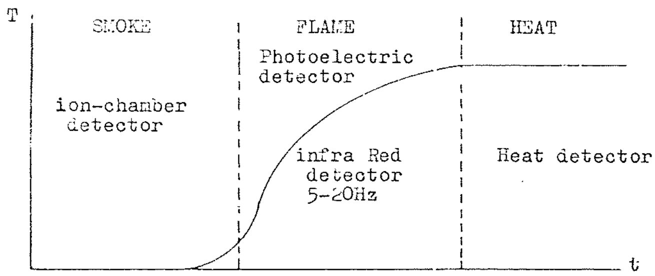


Fig. 4.

At the beginning of a fire the main product generated is smoke, then flame is present as fire spreads out and finally high temperatures occur.

1. Smoke Detectors:

(i) *Ion chamber smoke Detector.*

This type of detector relies for its operation, on the fact that adjacent to radioactive materials, air molecules become conductive due to local ionisation effected by the ejected alpha particle.

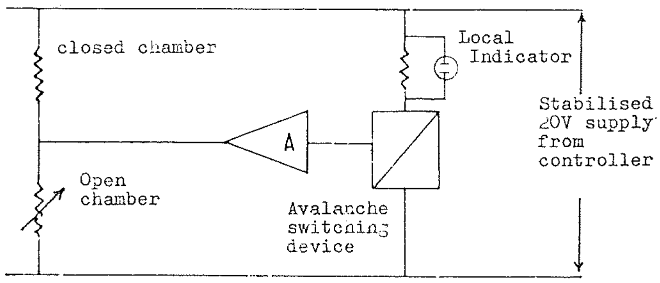
Two chambers are built into the detector, one which is closed to air circulation, and one which is open. Both chambers contain small radioactive sources such as americium 241 which enable a current to be passed through both chambers arranged in series, and the junction of the chambers is monitored by an electronic circuit.

As long as conditions in both chambers are the same the detector does not alarm, however, the introduction of long chain aerosols, and particulate matter (smoke) into the open chamber, inhibits the current carrying capability of the local ionisation, effectively increasing the resistance of the open chamber.

This produces unbalance between the chambers and the consequent electrical movement of the junction causes the associated electronic circuit to move the alarm mode.

The electronic circuit in the detector is arranged to operate either a relay direct, or transistor circuits to bring up alarm signals at a control panel, sound audible alarms and signal remotely to the Fire Brigade. When the detector is operated, a local indication, by lamp or L.E.D. (Light Emitting Diode) is provided at the detector to indicate which detector is operated.

Simplified schematic of smoke Detector (Fig. 5).



(ii) *Photoelectric smoke Detectors.*

These consist of a light source and a photoelectric device. Between them is a labyrinth of black plates so that under clear air conditions no light reaches the photoelectric diode and no signal output is produced. In case of fire the smoke which rises to the ceiling, enters the labyrinth and due to light scatter due to the smoke particles, light will reach the photoelectric diode which then gives a signal output to the control unit which will then give the fire alarm.

Installation of Smoke Detectors.

Maximum height above ground 10.5m.

Sensing element 25–600 mm from ceiling or roof.

Spacing Table.

Maximum Floor Area for one detector	Maximum distance apart between detector centres		Maximum distance of detector centre from any outside walls or dividing partitions	
	In general	In corridors	In general	In corridors
$92m^2$	12m	18m	6m	6m

Note : If the building has a pitched roof or north light roof one row of smoke detectors must be installed in the apex of each roof or north light roof.
In such cases the maximum horizontal distance of detector centres from any outside wall can be increased to 9 m.

2. Heat Detectors.

Heat detectors are classified as Grade 1, 2, 3 according to their response to rise of heat.

(i) Fixed Temperature heat detectors, depend on the fusion of low melting point alloy or on bimetallic principles and they are installed in places subjected to rapid temperature rise such as rooms containing ovens, heating plants, boiler rooms, etc.

(ii) *Combined Rate of Rise and Fixed Temperature.*

Modern heat detectors are solid state. Others operate on the principle of two bimetal strips which rotate inside an inverted metal dome with rotating contacts responding to excessive rate of rise of temperature. They have also a maximum fixed temperature point of 135°F (57°C) and 200°F (93°C) respectively.

Installation of Heat Detectors.

Maximum height of roof or ceiling above floor.

Grade 1 Heat Detector 9 m. ....
Grade 2 ,, ,, 7.5 m.
Grade 3 ,, ,, 6 m.

Sensing elements of heat detectors shall be situated not less than 25 mm and not more than 150 mm below the ceiling or roof.

Spacing table.

Maximum floor area for one detector	Maximum distance between detector centres		Maximum distance of detector centre from any outside wall or partition	
	In general	In corridors	In general	In corridors
$50m^2$	10m	15m	3.5m	7.5m

Note : For pitched roof or north light roof one row of detectors must be installed in the apex. Maximum floor area for detector can be 55 m and maximum horizontal distance of detector centres from any wall 5.5 m.

3. Flame Detectors.

(i) *Infra Red.*

These Detectors differ significantly from smoke detectors due to the fact that they do not depend on the physical transport of matter from the fire to the detector. They detect the electromagnetic radiation which travels from a flame with the speed of light.

Due to the presence of light from many sources, such as artificial, or sun light, special precautions are taken to avoid false alarms.

(a) The detector should not detect the long wavelengths from hot or overheated bodies but respond to the short wavelength radiations.

(b) The characteristic radiation of flame flicker is in the range of 5 to 30 Hz. The detector will not respond to steady radiation from a hot object, but does respond to that of fire flames.

(c) An integrating circuit prevents the detector giving alarms in cases of momentary flickering.

Note: A certain intensity of light is necessary to energise the detector.

(ii) *Infra scan.*
This is 24V D.C. flame detector designed to be installed in interior places and by means of a rotating mirror progressively scans the area under control.

(iii) *Infra stat.*
Is a flame detector designed to scan a fixed area adjusted to its " vision."

Installation of Flame Detectors.

The Flame detectors must be so installed as to have the best view of the area under protection.

The infra Red detector is an additional device where fuels are likely to burn quickly.

- The protected area per detector is 500–1000m[2]
- The best height of the detector is 10–15 m.

4. Break glass manual callpoints.

The human nose is an excellent fire detector. When people are present break-glass manual callpoints provide an easy, quick and reliable way in which the start of a fire can be notified. For this reason automatic fire alarm systems may employ automatic fire detectors and manual break glass callpoints.

– Figure 6 indicates the schematic diagram of an automatic fire alarm system.

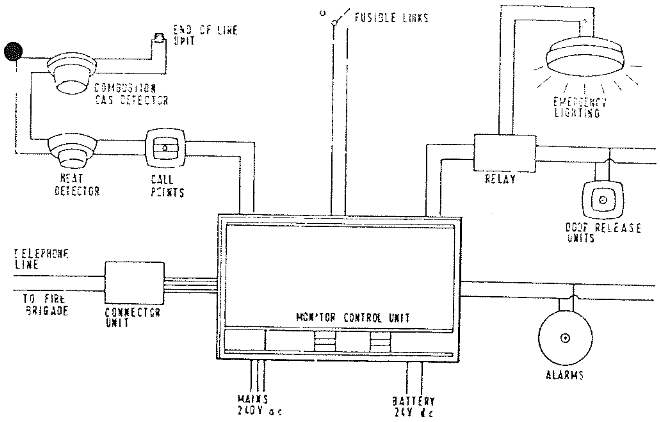


Fig. 6

C. STANDARDS AND RULES GOVERNING THE FIRE ALARM INSTALLATIONS

1) British standard code of Practice for Installation and servicing of Electrical Fire Alarm systems (CP1019 : 1972) which describes the essential practices and features in design, instal–lation, commissioning and sevicing of fire alarm systems.

2) British standard B.S. 3116 for Automatic Fire Alarm Systems in buildings.

Part 1. Heat Sensitive (point) detectors.
Part 2. Heat sensitive (line) detectors.
Part 3. Smoke sensitive detectors.
Part 4. Control/indicating equipment.

3) Rules of the Fire Offices' Committee (U.K.) for Automatic Fire Alarm Installations.

Some important F.O.C. (Fire Offices Committee) Rules, are given herewith.

- Shafts for elevators, lifts, hoists, enclosed chutes through floors and staircases must be protected at the top. The detectors must be installed within 1.5 m from the above openings.
- A clear space of at least 0.6 m must be maintained around every detector.
- The indicator panel together with a plan of the premises showing positions of staircases or entrances must be located in an accessible place where it can be readily seen by the firemen or other persons responding to an alarm.
- Every installation must be provided with at least one local alarm bell of weatherproof construction not less than 150 mm diameter and fitted on the outside wall of the premises protected. This bell is installed near the indicator panel.
- Batteries must be kept in a locked cabinet adequatly vented readily accessible for inspection and in a cool dry place.
  An adequate electrical power supply must be available at all times which must normally be obtained from either :

  (i) A.C. mains derived from a public supply.

  (ii) A secondary battery continuously charged from A.C. mains.

In either case a stand by supply must automatically be available in the event of failure of normal supply. This must consist of a secondary battery maintained fully charged.

- As far as is applicable all wiring and connections shall comply with the latest edition of the Regulations of the Institution of Electrical Engineers for the Electrical Equipment of Buildings. The methods adopted in wiring automatic fire detectors must be such that :

  (i) One break of wires will not prevent the fire alarm being given (e.g. a ring circuit). or

  (ii) A monitoring current flows through the wiring and either a break or short circuit in the wiring is automatically indicated by a visual and audible warning, either in the form of a fire alarm or fault alarm, or

  (iii) The continuity of the wiring of each zone of the installation can be checked by providing an end of line unit incorporating a self resetting switch located either on the end of line unit or on the control unit or indicator panel. This arrangement must be such that the continuity test can be made without severing the connection to the central fire alarm depot or public or private fire brigade control unless a fault sounding alarm is automatically brought into operation.

- Audible and visual alarms associated with each zone of detectors must be so connected that the failure of any one alarm can in no way interfere with the giving of a correct alarm in other zones.
- The insulation resistance to earth of detector circuits must be such that when tested at 500v.D.C. with all poles electrically connected together it is not less than one megohm.
- Cables used for the wiring of detector circuits must be:

(i) Enclosed in screwed metal conduit which must be galvanised if used in wet places.

or

(ii) Single or multi-core mineral insulated copper sheathed cable conforming to British Standard 6207 Part I: 1969 having copper conductors not less than 1.0 mm^2 cross sectional area which must be covered with polyvinyl chloride if used in wet places

or

(iii) Polyvinyl chloride insulated and sheathed armoured cable with wire armour complying with British Standard 6346: 1969.

- Cables in conduit must conform to one of the following specifications:

(i) Single or multi-core vulcanised rubber insulated cable conforming to British Standard 6007 : 1969 (7 : 1953) or single or multi - core polyvinyl chloride insulated cable conforming to British Standard 6004 : 1969 (2004 : 1961) having tinned copper conductors of not less than 1.0 mm^2 cross sectional area

(ii) Single or multi-core polyvinyl chloride insulated, polythene taped and polyvinyl chloride sheathed cable having tinned copper conductors of not less than 0.5 mm^2 cross sectional area

- Loop wiring shall be used as far as is practicable. Joints should be avoided, but when necessary must be in dry places only. Such joints must be soldered, insulated and protected to an extent not inferior to the component cables.
- Any connection to an A.C. mains supply must be taken directly from the main power intake to the building and arranged such that it cannot be switched off in error or confused with lighting or other power supplies. A separate fused isolation switch suitably labelled must be provided.
- An efficient earth connection for control units and/or indicator panels which are connected to an A.C. mains supply must be provided and suitably bonded to a recognised "earth" point in the premises.

D. SERVICING AND MAINTENANCE

Modern fire alarm systems are designed so that very little servicing is needed. Batteries of alarm systems require regular attention, but beyond this, only simple checks and tests are necessary.

However, detectors, sensitive to smoke will gradually become dirty and after a period of a year or two will require cleaning.

Risks change, as do the layouts of rooms and occupancies. For a purpose so vital as fire protection, it is necessary for all installations to be re-examined periodically to see that they are still appropriate and to check that they are still functioning correctly in all respects. This is in addition to the daily and weekly checks that should be carried out by the user.

References:

1) AFA MINERVA (Fire alarm system's manufacturers) Technical Information

2) F.O.C. (Fire Offices Committee) Rules.

Navigation and Shiphandling

By N. L. Charalambous
3rd Year Marine Officer's Course

Before departure from any port the Captain must decide what course or courses he will steer to bring him to next port. This he does by reference to charts, which show the relevant sea areas and adjacent land areas, and by reference to the " Admiralty Pilots " handbooks produced by the Admiralty which contain a wealth of information regarding all aspects of navigation.

Having left port and set course the Captain then keeps a check on the ship's position – and thus its progress – by obtaining " fixes " at frequent intervals. There are various methods of fixing the ship's position as follows :

(a) When in sight of land bearings of prominent headlands, towers, lighthouses, etc., are taken and plotted on the chart.

(b) When out of sight of land observations of the sun or stars are taken and from these observations position lines are calculated and then plotted on the chart.

In foggy weather, when such observations are not possible, a navigator may have to rely on a D.R. or deduced reckoning position. This is simply a position deduced from the course steered and the distance steamed along such a course. If this position is corrected to allow for the effect of Leeway, the effect of the wind, and or tides and currents then the position so obtained is known as the Estimated Position or E.P.

In earlier days navigators relied upon the three L's for finding their way about. These were :–

Latitude – obtained from observations of the sun's altitude at noon.

Log – a device to measure the distance steamed through the water.

Lead – sounding by leadline to find the depth of water.

Modern devices now make life much easier for today's navigator. Modern ships are invariably fitted with the following :

A Gyro Compass is based on the gyroscope adapted to make it North-seeking and thus reliable as a compass.

Radar is a device which emits a continuous series of pulses reflected back to the receiver by various objects within range of the equipment. The 'echoes' are displayed on a screen or plan position indicator which shows the beaming and range of the object.

A Decca navigator is a position fixing system developed during the Second World War.

A Decca chain consists usually of a master station and three shore stations which are situated between 60 and 100 miles from the master. The transmission from these stations are received on board by a special receiver, which measures the difference in phase of the signals and displays the result on meters or dials. Readings from these dials may then be plotted on special charts to give a fix. It is a very accurate method.

A Radio direction Finder is a device to receive radio signals emitted by various stations around the coasts of the world. Bearings of two or more stations are required to produce a fix.

Echo-sounding machines transmit pulses to the seabed and the interval between transmission and reception of the reflected wave is automatically measured. This time lapse is converted to indicate the depth either on an illuminated scale or on a graph.

Having safely completed his voyage the Captain arrives off his next port of call and prepares to enter. Invaliably he will take a pilot, this is becoming increasingly obligatory. Pilots are experienced ship handlers and are thorougly familiar with their local areas. In many ports tugs will assist the ship to her berth where she will be secured with heavy lines and wires fore and aft.

Should there not be a suitable berth alongside or indeed any berth at all then the ship will have to anchor. The Captain must then decide just where he will do so and, knowing the depth of water, how much cable he will let go. A ship is held at anchor not by the anchor alone but by both anchor and cable. An anchor cable is marked in lengths called shackles, each shackle being is fathoms long.

Distance at sea is measured in nautical miles. A nautical mile is 6,080 feet, which is equivalent of 1 minute of longitude measured at the Equator.

One tenth of a nautical mile is called a " cable " and is generally taken as 100 fathoms. In older times it was about the length of a ship's anchor cable.

A fathom is six feet and has been the unit generally used on Admiralty charts for showing the depth of water Measurements are now being revised to conform with the metric system.

The coast lines of all countries are " signposted " with lighthouses lightvessels, buoys and beacons. Each country collects the necessary funds from the ships using her waters.

The School Ship

By N. L. Charalambous
3rd Year Marine Officer's Course

In 1837 Willcox and Anderson obtained a charter to carry mail to the Iberian Peninsula and as a result formed the Peninsular Steam Navigation Company.

The quarterings of today's house flag are still the blue and white of Portugal and the red and yellow of Spain.

In 1840 the name was changed to Peninsular and Oriental when a Royal Charter was granted for the carriage of mails to Inda.

In 1856 Sir William Mackinnon founded a company to run a mail service between Calcutta and Rangoon – the British India Steam Navigation Company.

Until 1914 P. & O. and B.I. had been operating in the same waters and the increasingly close association lead to the merging of the two companies.

In 1971 the member companies of the P. & O. group were absorbed and educational cruising is now organised within the Passenger Division.

The " Dunera " and " Devonia," both former troop-ships, were employed as school ships for seven and six years respectively until their withdrawal from service at the end of 1967. During that time they carried many thousands of students and cabin passengers ; they were joined in October 1965 by " Nevasa," withdrawn from service at the end of 1974, and " Uganda's " service dates from February, 1968.

The " Uganda " was built to the order of the Company by Barclay Curle & Co. Ltd., in 1952 and was employed until late in 1966 as a passenger mail – ship on the UK/East and South Africa service. Her conversion to a school ship was given to Howaldtswerke A.G. Yard in Hamburg at a cost of 2.7 million pounds. The conversion allows for the carriage of 315 cabin and 944 dormitory passengers, the latter in 44 dormitories. The school accommodation includes 14 classrooms seating 359 and an assembly hall for about 400.

Cabin accommodation which is available for adults passengers consists of well appointed and roomy cabins with fine public rooms – music room, dining saloon, smoking room, bar, card room and writing room, ample deck space and private swimming pool. A full entertainment programme is organised and cabin passengers are also invited to join in many of pupils' activities, such as lectures in the assembly hall.

Some other ship's facilities offered especially for students are ample deck space for physical education and games, dispensary and hospital wards, map and information room, heated swimming pool, tuck shop, laundrettes, student common room hair drying room, and library.

Facts of interest.

Gross tonnage	17,029
Overall length	539 feet 9 inches
Breadth	71 feet
Draft	25 feet
Code signal	GFRQ.

" Uganda " is powered by twin screw single reduction turbines, giving 11,200 shaft horse – power and a service speed of 16.5 knots. There are three Babcock and Wilcox oil-fired boilers.

There are three turbo generators each with a capacity of 390 KWS. In addition, there are two diesel engine alternators each of 440-volts 3-phase 50 cycles per second. The electricity generated is 220 volts D.C. and 230 volts A.C.

" Uganda " can carry 3,600 tons of fresh water, and has partial air conditioning and forced draught ventilation suitable for all climates. Antiroll stabilising tanks are fitted. She is registered in the United Kingdom and meets International Safety Standards for new ships developed in 1948 and 1960 and meets the 1966 fire safety requirements.

Without Freedom there is no progress but only mechanisation and spiritual death.
Sri-Ram

Study, learn and understand science and virtue but don't show off over it. Of course you wouldn't show off if you truly understand science and virtue.
Dion. Solomos

Don't judge things from their apparent value but from their real value.
Krisnamourti

H.T.I. CALENDAR OF EVENTS
Academic Year 1979-80

By Ms D. Charalambidou, Lecturer H.T.S.

September

Wednesday 10th September means commencement of lectures at the Higher Technical Institute. Four hundreds and sixty one, (461) students were enrolled including 16 foreign students. The Electrical Part-time Course continues with 20 students on its third year running.

The H.T.I. houses for the second year the W.H.O. course for Medical Technicians which is sponsored by the World Health Organisation (W.H.O.). Twelve (12) students on this course out of the 14 are foreigners. This brings the total number of foreign students enrolled for the academic year 1979-80 to 28.

The hustle and bustle of students, in the corridors tells you that the new academic year has been launched.

The Clubs and Societies vie to enlist new members from among the freshers.

The Astronomy Club organises its first activity. Mr. A. Achillides briefs his " disciples " on the London International UFO Conference which he attended.

The Film Club and the Film Committee are set up for the first time.

October

The atmosphere in the H.T.I. becomes more lively with the return of this year's Third Year Marine Officers, 3MO. They came back after spending 4 months on board as part of their training. They are eager to relate their seafaring tales and adventures. The other students are goggling at them half-credulously.

The Hon. Minister of Labour and Social Insurance, Mr. Aemilios Theodoulou, honours a meeting of the Astronomy Club on 8th October.

On the 23rd HEHOC – The Hobby Electronics and Home Computer Club makes its first appearance.

On October 10th a Methodology of Teaching Course was organised by the HTI in cooperation with the Paedagogical Institute. About 35 members of Staff were registered. Mainly the course aimed at making the H.T.I. staff aware of modern teaching techniques, syllabus and lesson planning. The course was held every Tuesday afternoon from 3-7p.m.

November

The big event of the month is undoubtedly Unesco-Day on the 8th November.

The Institute stood deserted as both students and staff set out for the ancient site of Tamassos near Politiko village.

The silence reigning over the " King's Tombs " was broken for a couple of hours as the students tried to descend in the graves groping their way in and out of the historic monuments.

Then the procession of buses carrying students and staff headed for Machaeras Monastery. Some made their way as pilgrims to the church where they lit a candle while others, who wished to tax their walking strength, followed a meandering path which led them to the hiding place of the freedom-fighting hero, Gregoris Auxentiou. There they paid their respects and placed a laurel-wreath over his grave.

Duty over – they scattered around in groups eating, drinking and dancing. The students rivalled the staff in song and drink.

But Unesco-Day for HTI Staff means offering a helping hand to the community. Last year students and staff flocked to the Tekke Moslem Shrine and helped to clear up and tidy the surrounding grounds. As this year Unesco-Day coincided with the International Year for the Child representatives of students and staff paid a visit to the refugee Elementary School of Anthoupolis, donated an Encyclopaedia and promised to help with the improvement of the grounds of the school.

On November 11th the Heads of the Departments leave for Britain on a study tour of several educational establishments in order to inform themselves in recent developments in the training of technicians and engineers. One major development in this field is the new TEC system of education which constituted part of their study.

December

Christmas festivities have always been the outstanding feature of December. This year a joint staff-student committee organised a Christmas party for both students and staff in the students' canteen. They all mingled together, glass in hand, chatting, drinking, singing and making merry. This helped to drown down fatigue, mental strain which are unavoidable as the end of the first semester draws near.

The Staff held their traditional Christmas party at Montparnasse, where they dined under candle-light and danced to the lively music of Stelios Argyris' band.

The Students' Christmas party was held at Isadoras Night Spot.

On December 20th the Film Club held a film show and a reception in honour of all foreign students attending courses at the Institute thus trying to cheer then up as most of them could not afford to fly home for their Christmas vacations.

January

A very hectic time. The nightmare of exams grips every one. Once over – Life finds its usual tempo at H.T.I.

HTI Lecturer Dr. A. Mallouppas left for Hungary on January 7th to attend a W.H.O. course on Repair and Maintenance of Biomedical Equipment. He returned on March 14th.

February

Valentine Day passes unnoticed at the H.T.I. Only very few cards were received.

March

Suddenly the academic life of H.T.I. is interrupted by the students' strike.

The advent of spring revives the students' last year struggle for appropriate placement of H.T.I. graduates with Government Technical Departments and for the revision of the law for the Registration of Civil Engineers and Architects in order to enable them to practise as Technicians.

The strike went on longer than last year's. It ended on April 18th with the Government promising to call some experts from abroad to advise them before taking any steps to meet the students' demands.

On March 14th Dr. Douglas Balcomb, an energy expert, specialising in passive solar systems, gave an interesting talk accompanied with slides at the HTI. He was invited by ERG.

April

Easter vacations find the students still on strike. On April 18 the students decide to end the strike and agree to return to their lectures.

The Institute revives again. Students and staff are determined to make every possible effort to make up for the loss of lectures.

On April 1'6 a documentary exhibition on the Life and Work of Albert Einstein was mounted at the Institute with the co-operation of the Goethe Institute to mark 100th anniversary of the birth of the great physicist. The exhibition was opened by Mr. Mikis Sparsis, Director-General, Ministry of Labour and Social Insurance.

On April 18 Dr. R.F. Rauschenback, Director of the Goethe Institute, gave a lecture on Einstein accompanied with slides at the HTI amphitheatre.

May

An extremely busy time for both students and staff. The strain of catching up after the loss of the 6-week strike is making its impact. Still both students and staff are carrying on bravely. They even find time for extracurricular activities and some festivities.

On May 7 Mr. P. Markou gives a lecture on Findings of UFO Research as the guest-speaker of CICAP.

The highlight of this month is Sports Day celebrated this year on May 21st. The whole day was taken up by various sports activities like Seven-A-Side, Chess, Softball, Volleyball, Basketball and Football.

A joint staff-student committee organised a barbecue lunch. Food and drink were plentiful. Students and members of staff mingled together chatting and singing. One of the guests Mr. Lellos Demetriades, Mayor of Nicosia, joined the students in their songs and jokes.

In May many secondary schools pay visits to the H.T.I. The students are guided round by staff members. During the last academic year about 1550 students from 30 different schools visited the Institute.

On May 22 Mr. St. Atteslis gave a lecture on Life in other Planets as a guest of the Astronomy Club.

The Methodology course came to an end on May 6th.

June

A nightmarish time for both students and staff. Everyone is haunted by exams : short tests, semester exams, final exams, entrance exams.

Still summer vacations are not very far. A cheerful note is heard from time to time when conversation turns on holiday plans.

The third-year students are looking forward to the Graduation Ceremony which is to be held on July 11.

A country is in more danger from its own people than its enemies.

Spinoza

SERVICES OFFERED TO INDUSTRY BY THE H.T.I.

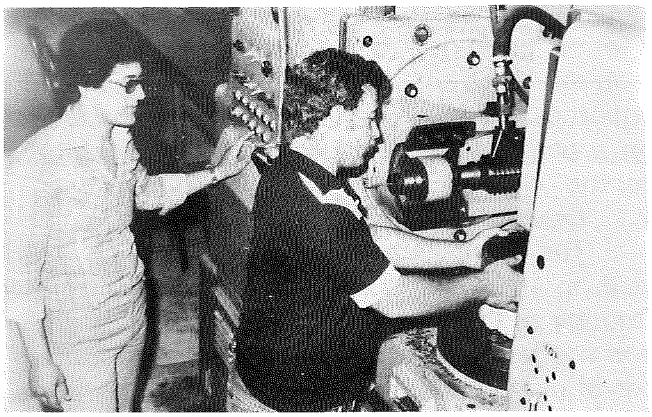
In addition to the Full time courses in Civil, Electrical, Mechanical, Marine Engineering and Medical Laboratory Technicians, the H.T.I. offers the following services to the Cyprus Industry.

1) Training on Gear Cutting

An Expert is currently employed in setting up a Training Centre in Gear Cutting. The aim of this project is to introduce some of the more advanced gear-cutting techniques to the Cyprus Industry.

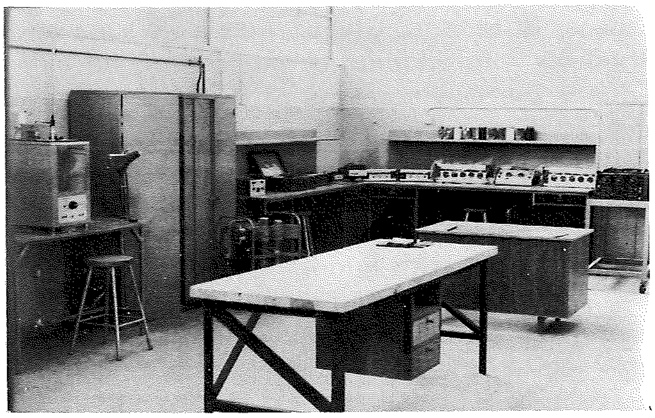
Apart from the participation on such training by students of the Mechanical and Marine Engineering courses, short course are envisaged for students from Industry in collaboration with the Industrial Training Authority.

Advanced and Sophisticated machinery and relevant Test Equipment are being installed, such as a Hobbing Machine, (shown in picture below), a Gear Shoping Machine, Optical Comparator, Gear Rolling machine and other testing equipment to ensure effective training in Gear Cutting.



2. Calibration Laboratory

In Co-operation with the Cyprus Standards Organization, a calibration Laboratory is established at the Metrological wing of the H.T.I. under the supervision of a UNIDO expert.

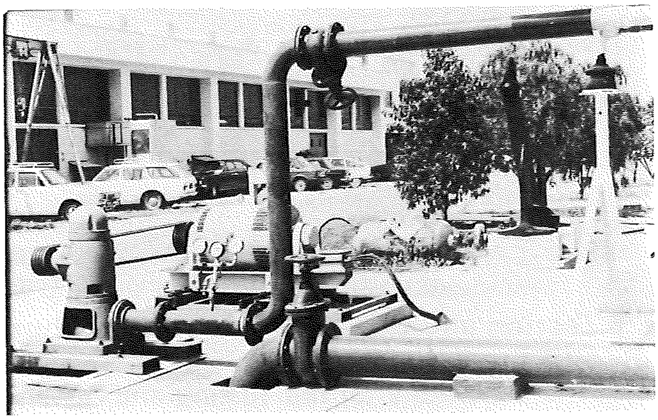


The laboratory, which is intended to offer its services to the Cyprus Industry, will be used for the Test, calibration of relevant instruments and measurements.

3. Water Pump Testing Station

This station has been designed and constructed by the Mechanical Engineering Department on behalf of the Cyprus Organisation for Standards and Control of Quality, (CYS), and its purpose is to test deep-well axial flow turbine pumps of local manufacture, according to ISO 2548.

Modern and sophisticated equipment for such tests are employed and no doubt the station will contribute towards the improvement of the quality of locally manufactured water pumps, a vital factor for the promotion of sales and marketing of such products.



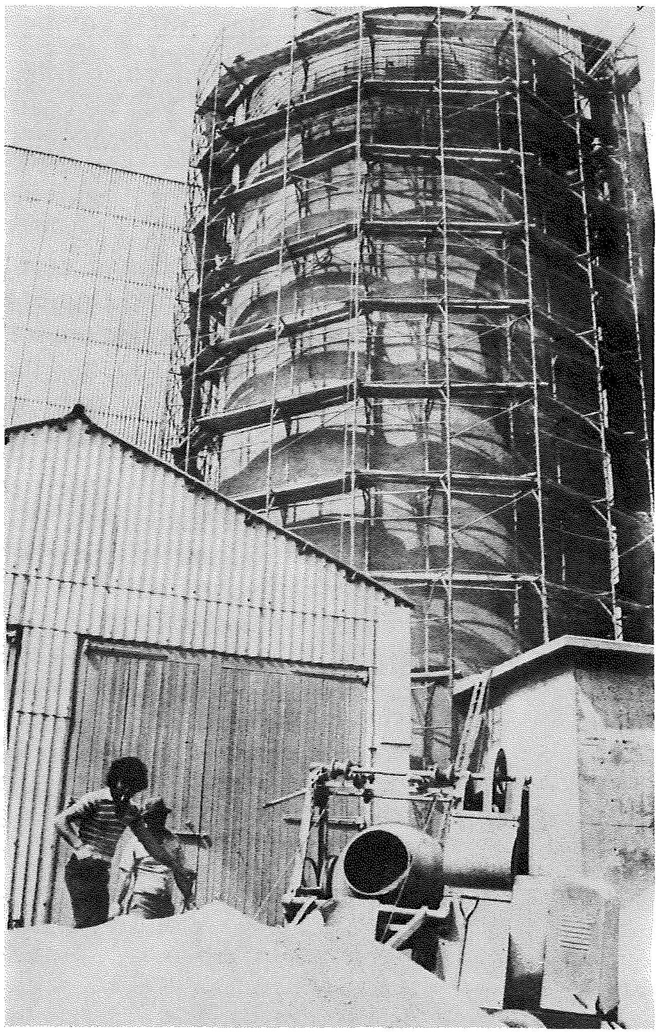
4. Testing of Concrete cubes, Concrete materials, Soils road materials and industrial Steel reinforcement.

The Civil Engineering department with its fully equipped laboratories can undertake tests for compressive strength of concrete cubes and blocks as well tests on the admixtures by means of which certain properties of concrete mixtures may be improved.

Tests on aggregates such as grading of aggregates and their properties i.e, crushing and impact value, specific gravity etc., can also be carried out for industry.

The department also can undertake tests on Soils such as triaxial, shear box C.B.R. tests etc.

Sophisticated test equipment is also available for tests on steel reinforcement to determine important properties such as Yield stress, Ultimate stress, Young's Modulus of Elasticity, percentage Elongation and percentage reduction in area.



5. **Testing and Quality Control of Leather and Leather Products.**

The Laboratory for the Testing and Quality Control of leather and leather products was set up with the aid of the United Nations Development Fund for the purpose of improving and updating the knowledge, new Techniques and the quality of the footwear for export and the Cyprus market.

6. **Consultancy Service**

The departments of Civil Electrical and Mechanical Engineering of the H.T.I. offer consultancy on a fee-paying basis through the Industrial Extension Services of the Ministry of commerce and Industry.

Already such consultancy has been undertaken, successfully, for large projects in Cyprus and for countries of the Middle East.

7. **Endorsement courses**

Various short courses of about 150-200 hours duration have been carried out under the scheme and policy of the H.T.I. on Life-Long-Education, which directly assist in furnishing further service to the Cyprus Industry.

(a) Off peak utilization of electricity.
(b) Concrete mix design.
(c) Basic Workshop in methology and inspection methods.
(d) Gas welding, brawzing and arc welding.
(e) Quantity Surveying.
(f) Environmental Engineering.
(g) Lift Technician Courses.
(h) Design and Installation of Telephone networks.
(i) Technical Teachers Training.

Participants to the above short courses were mainly Technicians, Technician Engineers and Staff of the H.T.I.

These courses may be repeated, or other short specific Training Schemes for the Cyprus Industry may be undertaken, if the demand justifies the commencement of such work.

THE H.T.I. AS A REGIONAL TRAINING CENTRE

At various stages of the Intitute's development UNESCO has raised the question of formally promoting it into a regional training centre for citizens from neighbouring countries.

Although this project has not proceeded on a formal basis due to the financial commitments required both of UNESCO and participating countries, the Institute is, in an informal way and on a peace meal basis, turning into a regional centre.

1. **Overseas Students**

The Institute offers one scholarship each year, to an overseas student who comes from a Country of the British Commonwealth ; in addition it offers the possibility of accepting a number of overseas students on a fee-paying basis. By policy decision the HTI may offer up to 25% of its places to overseas students provided they pass the Institute's entrance examination which is conducted at various centres abroad.

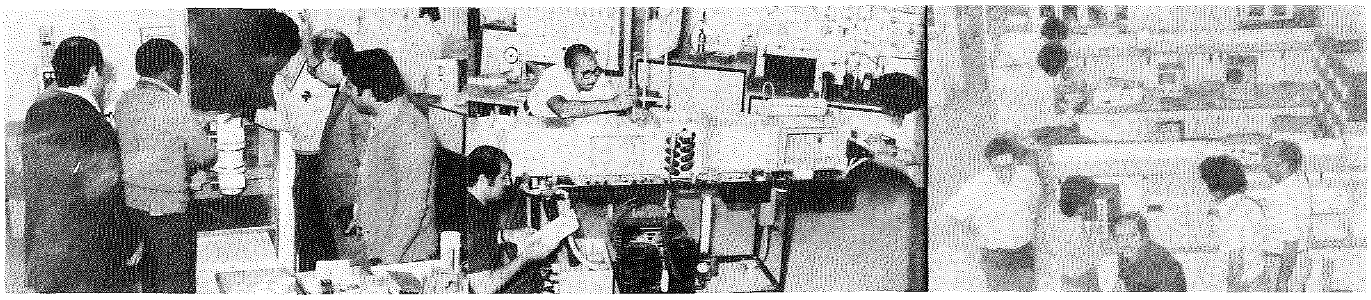
The number of overseas applicants has increased from year to year and the Institute's entrance examination is now conducted in Greece, Botswana, Ghana, Kenya, Nigeria and Rhodesia. In addition to those applying individually the Governments of Botswana, Kenya and the Seychelles have asked that places be allotted to Government-sponsored students from their countries, and twelve places are also reserved for Zimbabwean students sponsored by the Commonwealth Fund.

As overseas students often face difficulties in passing the entrance examinations due to the difference in their educational system, in order to assist them further, the HTI is considering the possibility of offering in future a special preparatory course for overseas students.

II. Course for Technicians in Repair and Maintenance of Hospital and Medical Equipment (in Collaboration with the World Health Organisation)

The regional character of the HTI was further enhanced by the undertaking in August 1978, of a five-year joint project between the Cyprus Ministry of Health and the World Health Organisation. The purpose of the project is to train Hospital Technicians in the repair and maintenance of hospital and medical equipment. Training is based mainly at the HTI with some on-the-job training at Nicosia General Hospital. The countries from which the students may be chosen cover a very large area of the world, stretching from Pakistan in the East, to Somalia in the South and Tunisia in the West. The five year joint project envisages three types of courses. The first, which began in September 1978, is for the training of General Technicians and will be followed by courses for Specialised Technicians and Hospital Engineers in January 1981. Attending the second course are 14 students from 7 different countries, (Afhanistan, Pakistan, Iran, Jordan, People's Republic of South Yemen, Somalia, Sudan ,Syria and Cyprus).

A medical equipment laboratory has been specially set-up for the training proposed and will be further extended. With this course the HTI hopes to contribute to the improvement of the Hospital Technical Services of Cyprus and the other countries involved.



Happiness is to do your duty well. The more difficult your duty the more happiness you will have.

N. Kazantzakis

It's not our fluent speech and good words that count but our good deeds to help others.

Sri-Ram

We were born to love and not to hate our fellow man.

Dante

There is no sacred war. Unavoidable, perhaps, but never sacred.

P. Kanellopoulos


Διεθνης προτιμηση
για ελαφρο και γευστικο τσιγαρο
ΔΙΠΛΟ ΦΙΛΤΡΟ...
...ΠΙΟ ΕΛΑΦΡΟ
DOUBLE FILTER
SENIOR SERVICE
EXTRA MILD
B·A·T
B·A·T (CYPRUS) LTD.
ΜΕΛΟΣ ΤΟΥ ΣΥΓΚΡΟΤΗΜΑΤΟΣ ΤΗΣ BRITISH AMERICAN TOBACCO · ΤΗΣ ΜΕΓΑΛΥΤΕΡΗΣ ΚΑΠΝΟΒΙΟΜΗΧΑΝΙΑΣ ΣΤΟΝ ΚΟΣΜΟ