No. 17 June 1988 Nicosia Cyprus

Review

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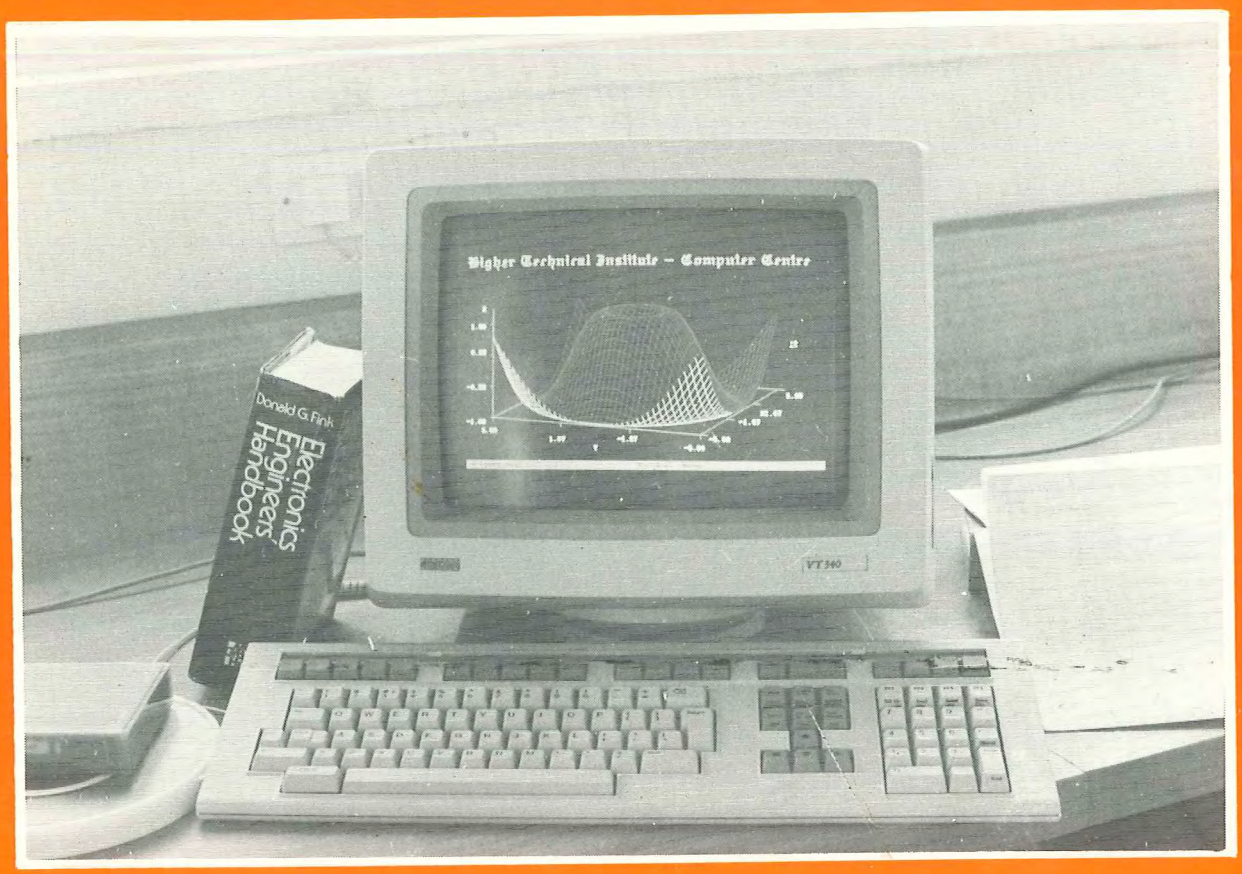

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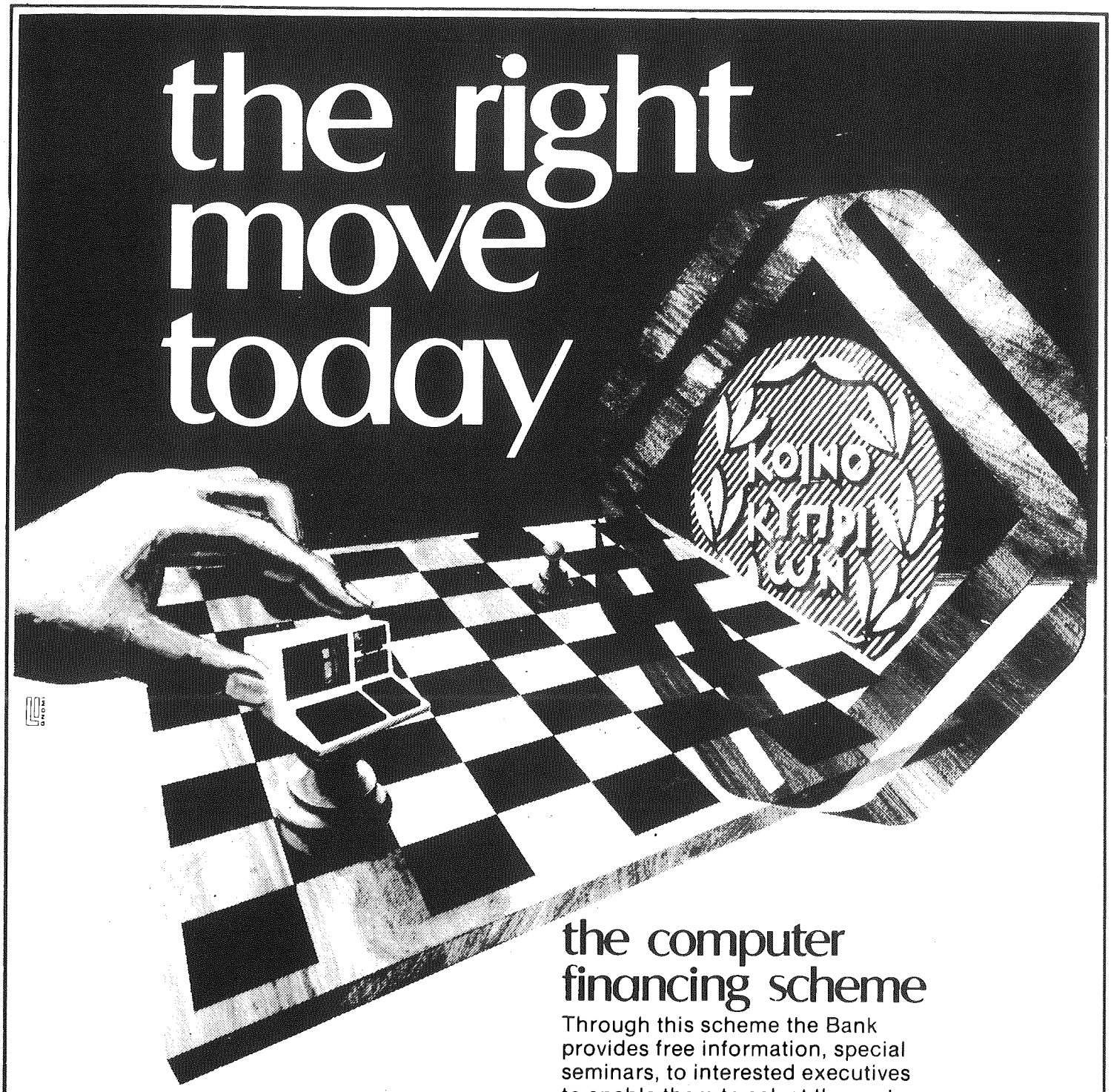

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H.T.I Computer Facilities

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CONTENTS

AN EXPERIMENTAL STUDY ON THE BEHAVIOUR OF REINFORCED CONCRETE BEAMS IN SHEAR

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1. INTRODUCTION

1.1 General

The equations (1,2,3) developed over the years predicting the shear strength of reinforced concrete beams are generally in adequate agreement with available test results. What cannot be claimed however is that these theories truly explain the calculated resistance. It may be worth mentioning here the opinion of a researcher of the sixties G.N.J. Kani (1) who claimed that "the main obstacle to the shear problem is the large number of parameters involved, some of which may not be known". In this experimental work it seemed logical to carry out tests on a limited number of beams with extensive instrumentation rather than a large series of simple "make and break" tests.

The experimental programme was designed therefore in the light of such requirements.

1.2 "Shear span/Effective depth" Ratio (av/d) — Arching effect

The behaviour of beams in shear can be classified in various ways. However the most common and popular parameter used to define the "boundaries" between the different modes of action has been the "Shear span/effective depth" ratio (av/d). This is shown diagrammatically in Fig. 1.

1.2.1 Arch action

In the case of short beams with av/d ratio less than 2.5 "arch action" is very common.

This phenomenon of "arch action" may appear when for some reason the transfer of bond forces is entirely destroyed along the full length of the beam. In such a case the beam will either fail suddenly or transform almost immediately into a "TIED ARCH". This means that the shearing resistance is provided by the inclined compressive thrust between the load and supports. In such a mechanism the main reinforcement acts as a simple tie with a constant force along the beam, and is anchored at both ends.

In deep beams with av/d less than 1.0 arch action is indeed present from the onset of loading and such beams will fail in a number of ways, such as anchorage failures of tension reinforcement, crushing failure at the reactions, flexural failure of the main reinforcement caused by yielding, or flexural failure in the form of fracture of the crown of the arch when the compression exceeds the concrete strength.

The most usual range of av/d ratios is between 2.5 and the lower limit for flexural failure. In other words in beams with av/d values greater than about 3 to 4 several flexural cracks develop and the beam segments between these cracks act as cantilevers which, with load increases begin to break off, to give an inclined extension (shear crack) to an originally flexural crack.

2. EXPERIMENTAL PROGRAMME

2.1 Choice of Beam Dimensions

Since the appearance of "arching" does not allow free shear transfer across cracks, the beams tested in this experimental programme were "normal beams" with av/d $>$ 2.5. In fact the actual value was about 3.44. This value allowed the formation of flexural cracks and also the transfer of shear across cracks. Fig. 1 shows the whole experimental set-up with the instrumentation employed. The development of crack displace ments as well as the longitudinal strains in the compression zone were the main parameters investigated and they were thoroughly traced at each loading stage and at different sections and locations in each of the tested beams.

2.2 Testing Details

2.2.1 Number of beams/casting/curing

In this work the results of three beams are reported, with different main steel percentages. The percentages used were ρ=0.60, ρ=1.1 and ρ=1.70. The beams had no shear reinforcement as the aim of this part of the work was to ascertain the influence of the main reinforcement on the shear behaviour of beams.

The beams were cast using two batches each batch vibrated internally with a heavy duty internal poker vibrator. In 24 hours the beams were demoulded and a curing compound was applied on the whole of their surface in order to seal in all the moisture. They were all tested in 28 days. Three 150 mm cubes were cast with each beam as control specimens. The mix proportions used were common in all three beams and these together with the materials used are shown in Table 1, whereas Table 2 shows the details of the high yield reinforcement used and table 3 shows the concrete details in both the fresh and the

hardened state.

2.2.2 Procedure of Testing and Measurements

The beams were simply supported as shown in Fig.1 and loaded with a central point load which was incrementally increased. At each load increment the following measurements were taken:

(a) Strains of concrete at sections S1 and S2 (Ref. Fig. 1) for the assessment of the movement of the N.A.
(b) Max. concrete compressive strain
(c) Steel strain
(d) Max. Deflection
(e) Crack width (when they appeared)
(f) Crack propagation

When a fair number of cracks with sufficient height appeared in the shear span the load was released and new instrumentation was affected with "demec-crosses" attached across the cracks in such a way as to allow the evaluation of the crack movements. As soon as the glue used for the demec crosses was dried, loading recommenced incrementally. Full sets of measurements as outlined above as well as measurements of the crack propagation using the "demec-crosses" were repeated at each load increment until failure.

2.2.3 "Demec-crosses" Instrumentation

After the shear cracks of a fair height formed, close to the support, the load was released and the "demec cross" instrumentation was performed on two cracks on either side of the central point load. The cracks chosen were the ones with the "best" shear appearance.

The instrumentation of the "demec crosses" is shown in Fig. 2. Lines AB and CD were drawn at 45^0 to the crack path. Points A, B and C, D were located on these lines at a distance of 25mm (half the gauge length) from point O on the crack as shown in Fig. 2. This meant that the original distances AB and CD prior to the recommencement of loading, were equal to the gauge length of 50mm.

Referring to Fig. 2, from basic geometry:-

$l^2=X^2+y^2$ ---(1)

Note: AB=CD=l=50mm

Now, $(l+\delta l)^2=(y+\delta y)^2+(x+\delta x)^2$ -----(2)

Subtracting equation (1) from equation (2):-

$2l\delta l=2y.\delta y+2x.\delta x$ ----(3)

Similarly along line CD:-

$2l'\delta l^2=2y.\delta y-2x.\delta x$ ----(4)

Subtracting now equation (4) from equation (3):

$$\delta x=\frac{1}{2x}(\delta l-\delta l') \text{ ----(5)}$$

Moreover adding equations (3) & (4):-

$$\delta y=\frac{1}{2y}(\delta l+\delta l') \text{ ----(6)}$$

Now since $l=l'=50mm$, $y=x=50/\sqrt{2}$

$\delta x=(\delta l-\delta l')/\sqrt{2}$ --------(7)

and $\delta y=\delta l+\delta l'/\sqrt{2}$ --------(8)

In equations 7 and 8 δx and δy are the shear and normal displacements respectively.

3. GENERAL OBSERVATIONS —RESULTS — CONCLUSIONS

3.1 General Observations

The general behaviour of the beams under load was similar and it was a classic shear behaviour. The first cracks occurred within the shear span. They were flexural cracks very close to the mid-span. With increased loading more cracks appeared with their height increasing continuously at each load increment. Eventually the nature of some of these cracks changed, gradually developing into shear cracks. (Refer to Fig. 3). At even higher loads new cracks of pure shear nature appeared close to the supports. Failure always commenced from one of these shear cracks "opening up" in a rather sudden manner, as one would expect in a typical shear failure. This wide shear crack extended from the level of the main reinforcement to the region near the loading plate.

Plate 1 shows the experimental set-up with a beam already cracked prior to the demec cross instrumentation of shear cracks. Plate 2 shows a close-up of a beam.

3.2 Results/Conclusions

3.2.1 Concrete Compressive Strains

The maximum compressive strain in the concrete was measured at mid-span on the front face of the beams, next to the position of application of the central point load. Readings at each load increment were obtained by means of a demec gauge of 200 mm gauge length. (Gauge Factor 8.1×10^{-6}).

The results are presented both in tabular form (Table 4) and diagrammatic form (Fig. 4). It can be clearly seen that the maximum concrete compressive strains were reduced with increased main steel percentage (ρ). Thus at a load of 33.2 KN (shear force 16.6 KN) there was approximately a 32% decrease in the maximum compressive strain of the beam with $\rho=1.70$ with respect to the beam with $\rho=0.60$. At the same load level the corresponding decrease of the

beam with ρ=1.1 was approximately 17%.

It must be pointed out however that the maximum concrete strains recorded at failure were considerably below the ultimate compressive strain in concrete suggested by codes of practice. Thus the 1207 microstrains for example recorded for beam B1 at a load level of 42.63 KN is indeed very low compared to the ultimate concrete strain of 3500 microstrains proposed by various codes of practice (e.g. CP110). The value of 1207 microstrains was not of course the absolute maximum, since the load at failure was higher than 42.63 KN. Obtaining concrete strains close to the failure load was however thought to be rather dangerous and concrete compressive strains close to failure were not recorded. Even allowing for this, the eventual development in other words of higher concrete compressive strains not recorded, these would still have been considerably below the ultimate strains proposed by codes. The reason is of course a simple one, the fact that these beams were designed to fail in shear and not in bending, thus not permitting the development of high stresses and strains in the compressive zone of the concrete.

3.2.2. Steel strains

Even though the necessary instrumentation was used for the monitoring of the tensile strain in the main reinforcement (by means of electrical strain gauges) the results were disappointing. The equipment malfunctioned in all cases, thus not permitting proper monitoring. However it must be mentioned that this was no great loss since the beams behaved in pure shear and the main steel reinforcement at failure was considerably below its yielding point.

3.2.3 Deflections

Since the beams were of the "shear type" their deflections were of small order. It can be verified however that the mid-span deflections decreased with increasing main steel percentage (ρ) as it can be seen from Fig.5. This of course was a result that was expected and no great importance is attached to it.

3.2.4 Normal and Shear Displacement

The influence of the steel percentage (ρ) on the magnitude of both the shear and the normal displacements of each beam at each load increment, was monitored by means of the cross-demec system devised. This method proved quite successful and indeed the results were both consistent and reliable at least as far as the shear displacements were concerned. The normal displacement readings showed a certain degree of scatter and no conclusion can be drawn as to the influence of the main reinforcement on these displacements.

Referring however to Table (5) and Fig. 6 it can be concluded that the main reinforcement plays an important role in the shear behaviour of beams. Thus it can be seen that the shear displacements were reduced with increasing values of ρ. For some reason not entirely clear the shear displacements of the beam with ρ=0.60 were only marginally larger than those of the beam with ρ=1.1 However the beam with ρ=1.70 exhibited considerably reduced shear displacements compared with the beam with ρ=0.60. (Decreases of up to 94% recorded - at a load level of 33.2 KN).

The results would have been considerably more conclusive had there been a larger degree of monitoring on more shear cracks. This was rather difficult due to the physical constraints of the whole test set-up. The major problem was the difficulty in sustaining the load constant especially at high loading levels. The monitoring of several cracks would mean a considerable amount of time spent at each load increment with perhaps creep effects starting to play a role in the whole experimentation. Availability of two extra 50 mm demec gauges and possibly one or two more persons assisting in the collection of readings could probably lead to the overcoming of such difficulties.

3.2.5 Movement of Neutral Axis (N.A)

Since the movement of the N.A. was not really one of the main parameters under investigation, it is not the intention of the authors to present a detailed account of this, even though a considerable amount of test results is available. However an isolated case (of strain readings along the depth of beam B3) is shown in Fig. 7. In this figure the strain readings at only three load levels are shown, at one of the four sections where readings were obtained. It is clear from this figure that the Neutral Axis of the beam moves upwards with increasing load.

3.2.6 Ultimate Shear Stresses

As it was expected the ultimate shear stresses increased with increasing values of ρ. Thus the experimental findings were:

τu=0.70N/mm^2 for beam B1 (ρ=0.6)
τu=0.73N/mm^2 for beam B2 (ρ=1.1)
τu=0.80N/mm^2 for beam B3 (ρ=1.7)

However what is perhaps interesting here is a comparison between the values given by a code of practice which deals with ultimate limit states. CP110 was chosen, and the corresponding values of the ultimate stresses specified by this code are:

τu=0.48N/mm^2 (ρ=0.6)
τu=0.62N/mm^2 (ρ=1.1)
τu=0.79N/mm^2 (ρ=1.7)

Cement*1	:	Fine Aggregate *2	:	Coarse Aggregate *	/Water
1	:	2	:	4	/0.75

NOTES

*1 The cement used was Ordinary Portland Cement

*2 The Fine aggregate consisted of 50% sea sand and 50% crushed sand

*3 The coarse aggregate consisted of 35% 10mm maximum size crushed aggregate and 65% 20mm maximum size crushed aggregate

Table 1 Mix Proportions & Materials

Beam	Bars	As mm^2	As $=\frac{As}{bd} \times 100$	Yield stress fy N/mm^2	Ultimate stress fu N/mm^2	% Elongation	% Reduction in area	E KN/mm^2
B1	2ø12	226	0.6	493	635	30	59	172
B2	2ø16	402	1.1	471	757	25	56	170
B3	2ø20	628	1.7	462	760	25	47	170

* A 20mm cover was achieved in all cases by means of plastic spacers

Table 2 Reinforcement Details

Beam	Concrete compressive strength (28-day)	Slump
B1	22 N/mm^2	75mm
B2	21.5 N/mm^2	70mm
B3	25 N/mm^2	60mm

Table 3 Concrete Details

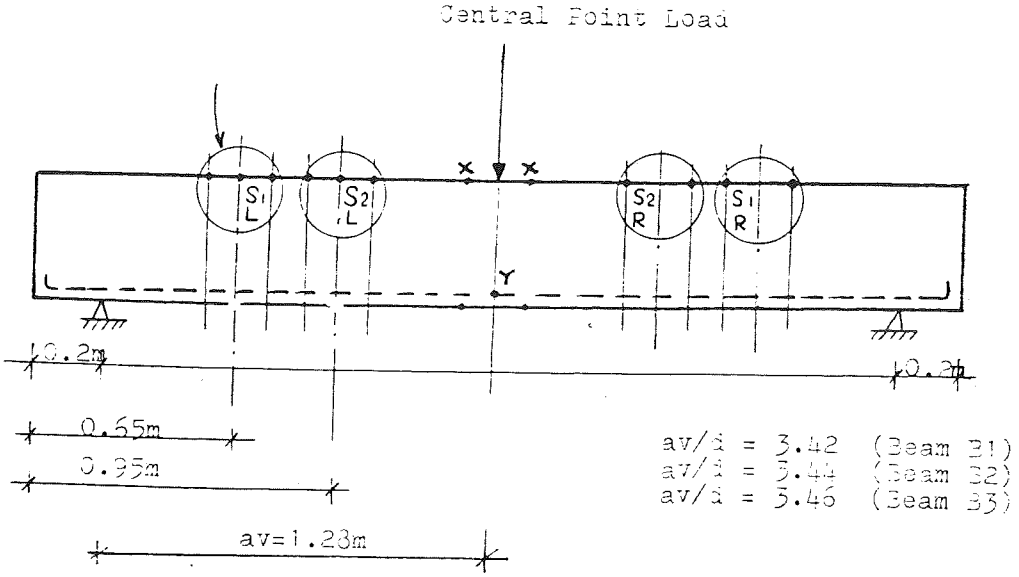
Shear Force		Maximum Concrete Compressive Strain ($x10^{-6}$)		
Proving Ring Divisions	KN	Beam B1 (ρ 06)	Beam B2 (ρ 1.1)	Beam B3 (ρ 1.7)
10	2.37	40	65	65
20	4.74	117	146	30
30	7.11	259	243	203
40	9.48	413	373	292
50	11.85	583	478	410
60	14.22	785	607	525
70	16.6	956	794	650
80	18.96	—	964	794
90	21.33	1207	1102	—

Table 4. Maximum Concrete Compressive Strain (Microstrains)

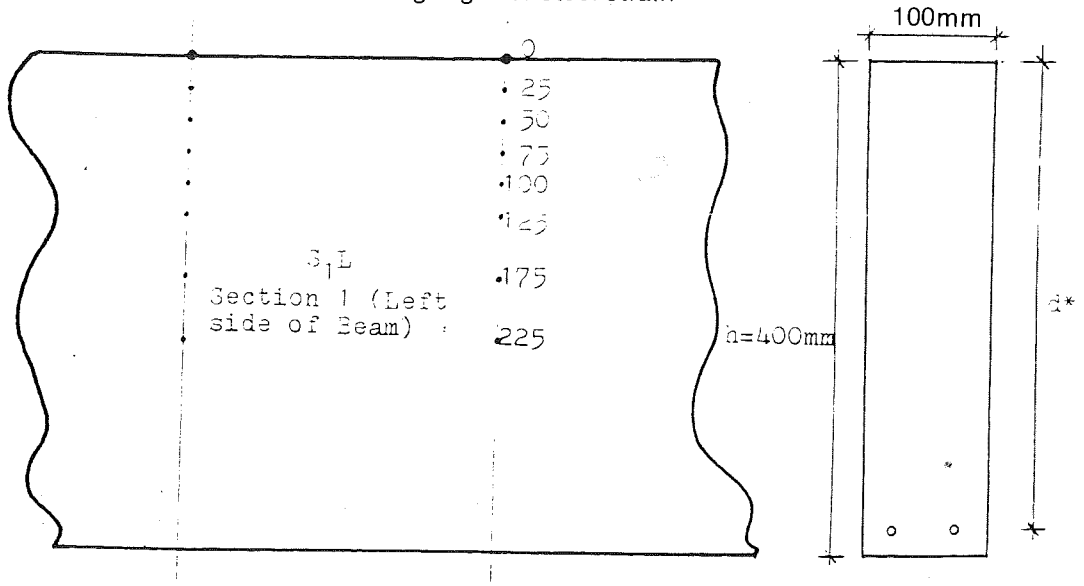
SHEAR FORCE (KN)	2.37	4.74	7.11	9.48	11.85	14.22	16.6	18.96	21.33	23.70
As / ρ=--- / bd	SHEAR DISPLACEMENTS x ($x10^{-3}$)									
0.6	15	20	29	37	45	54	65	97	144	
1.1	12	17	24	37	48	54	63	80	100	
1.70	13	11	14	20	23	30	34	45	99	

Note: The shear displacements were evaluated using equation 7 and are presented to the nearest whole number.

Table 5 Shear Force Vs. Shear Displacements



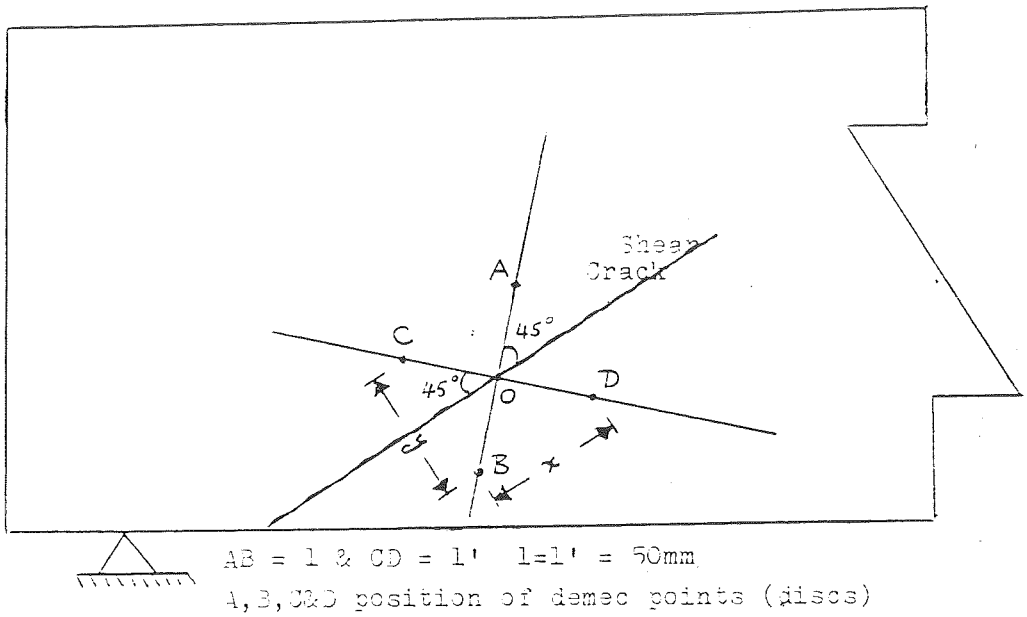
Notes: x-x Position of Demec points for max. concrete compressive strain
y Position of electrical strain gauge for steel strain



Demec Points for Assessment of Movement of Neutral Axis (N.A)

Cover=20 mm
*d=374mm (Beam B1)
d=372mm (Beam B2)
d=370mm (Beam B3)

Fig. 1 Experimental Set-Up/Instrumentation



AB = l & CD = l' l=l' = 50mm
A,B,C&D position of demec points (discs)
Fig.2a "Demec-Cross" Instrumentation

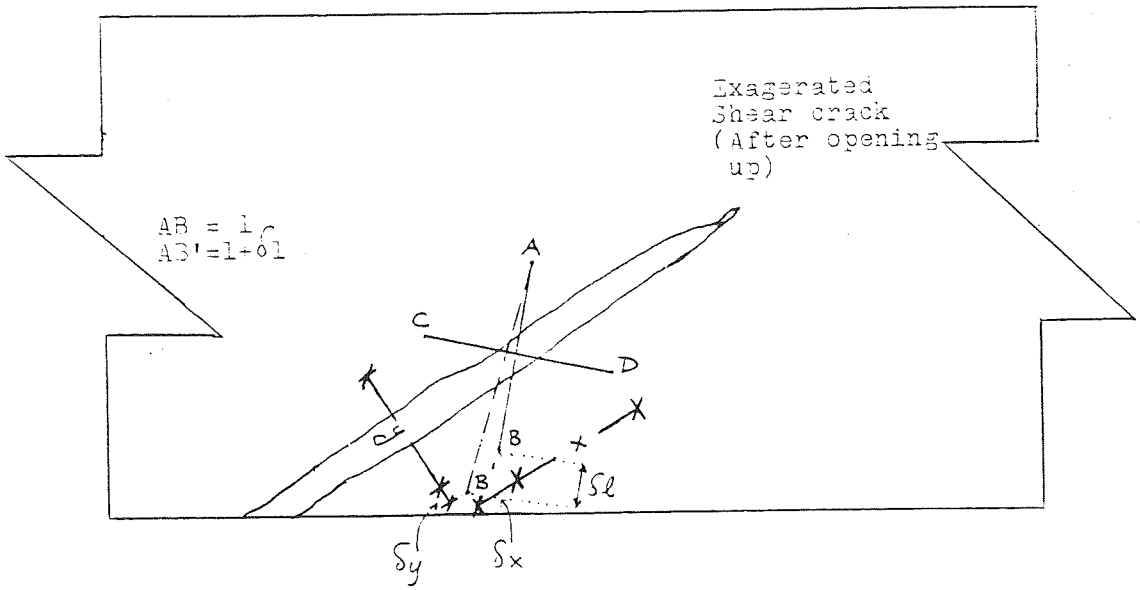


Fig. 2b Evaluation of Shear and Normal Displacements

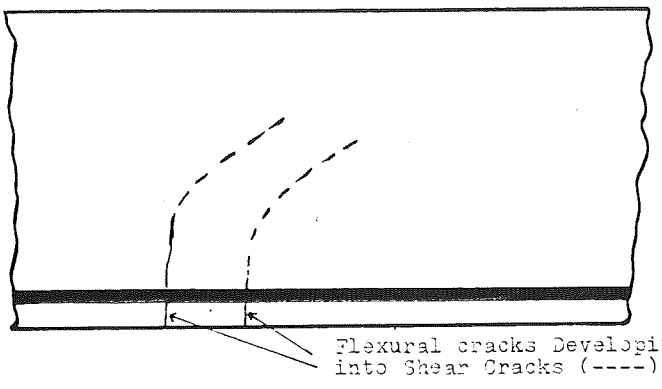


Fig.3a "Cantilevered" Concrete Segment
crack Development

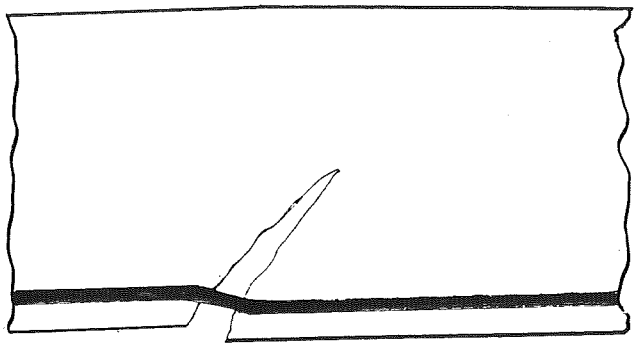


Fig. 3b Dowel Action of Main Reinforcement

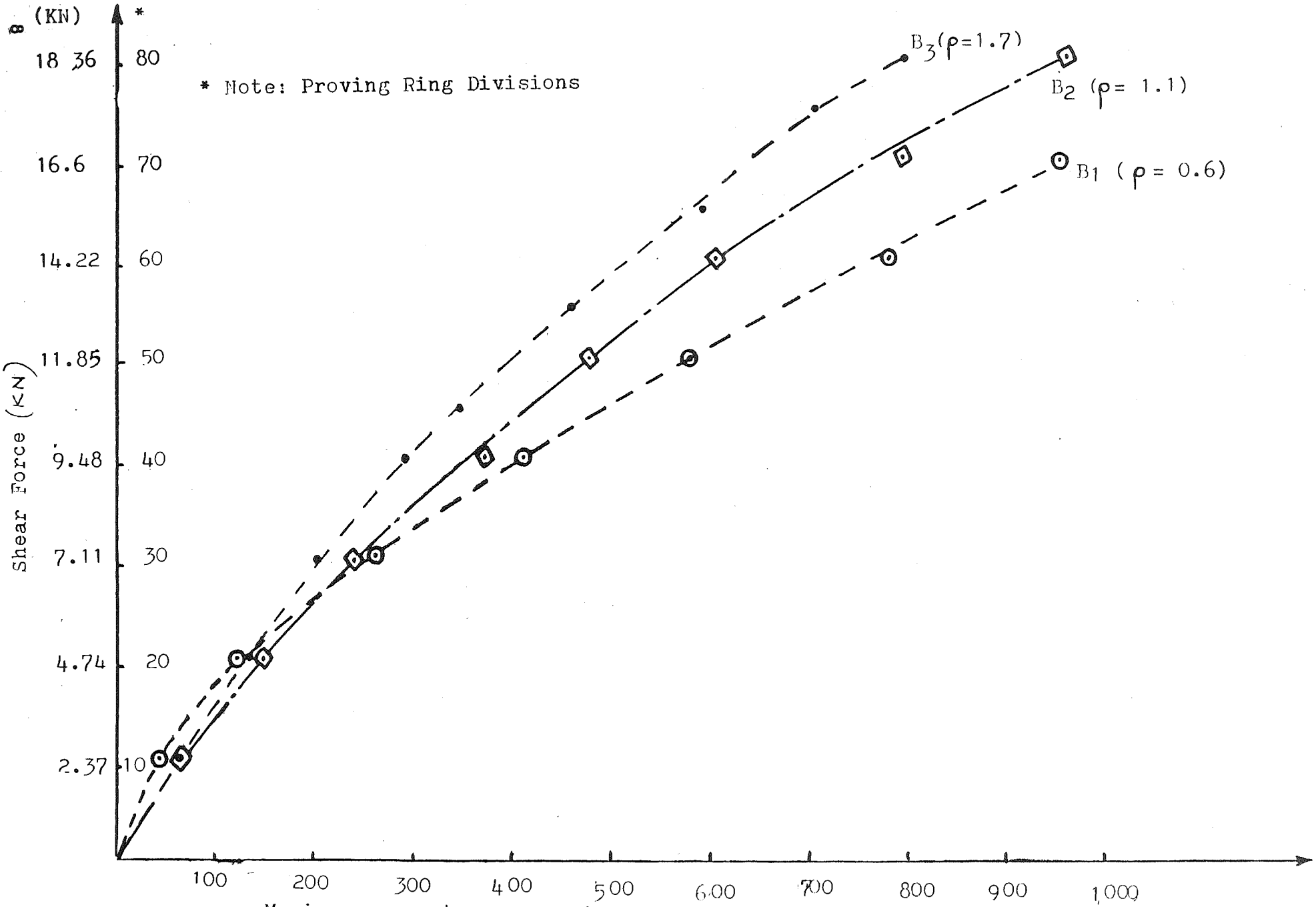


Fig.4 Shear Force VS. Max, Concrete Compressive Strain

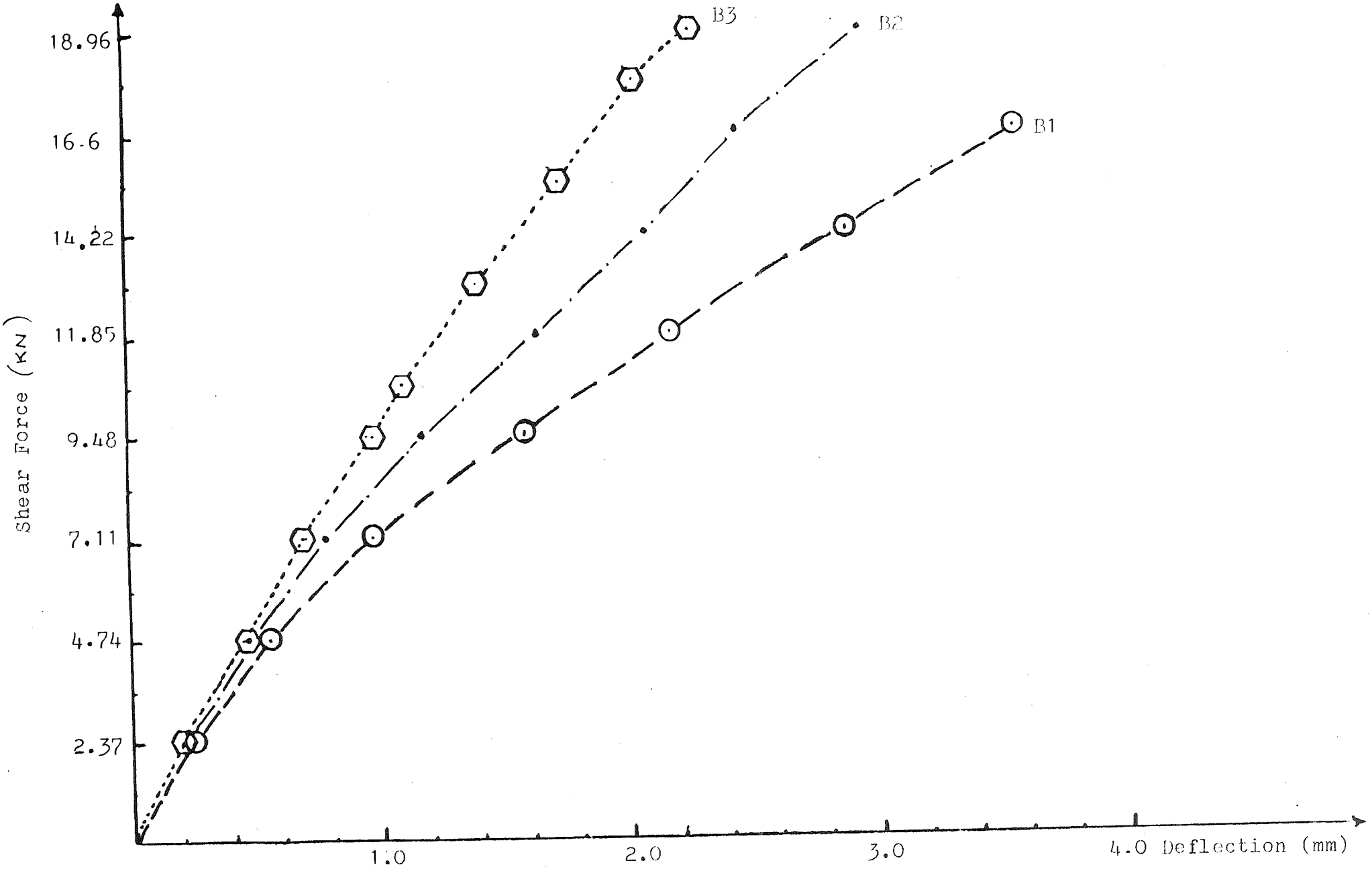


Fig.5. Shear Force VS. Deflection

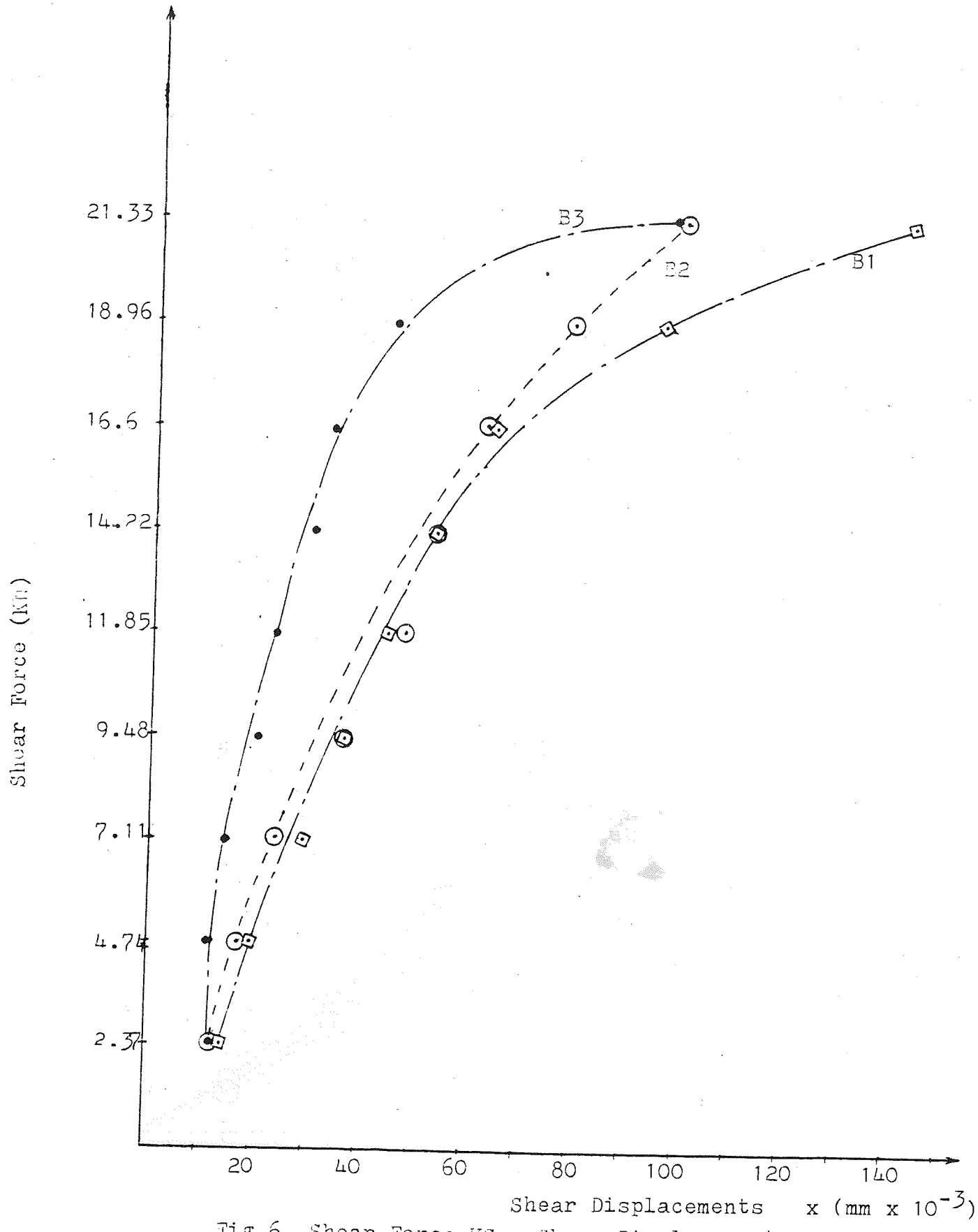


Fig.6 Shear Force VS. Shear Displacements

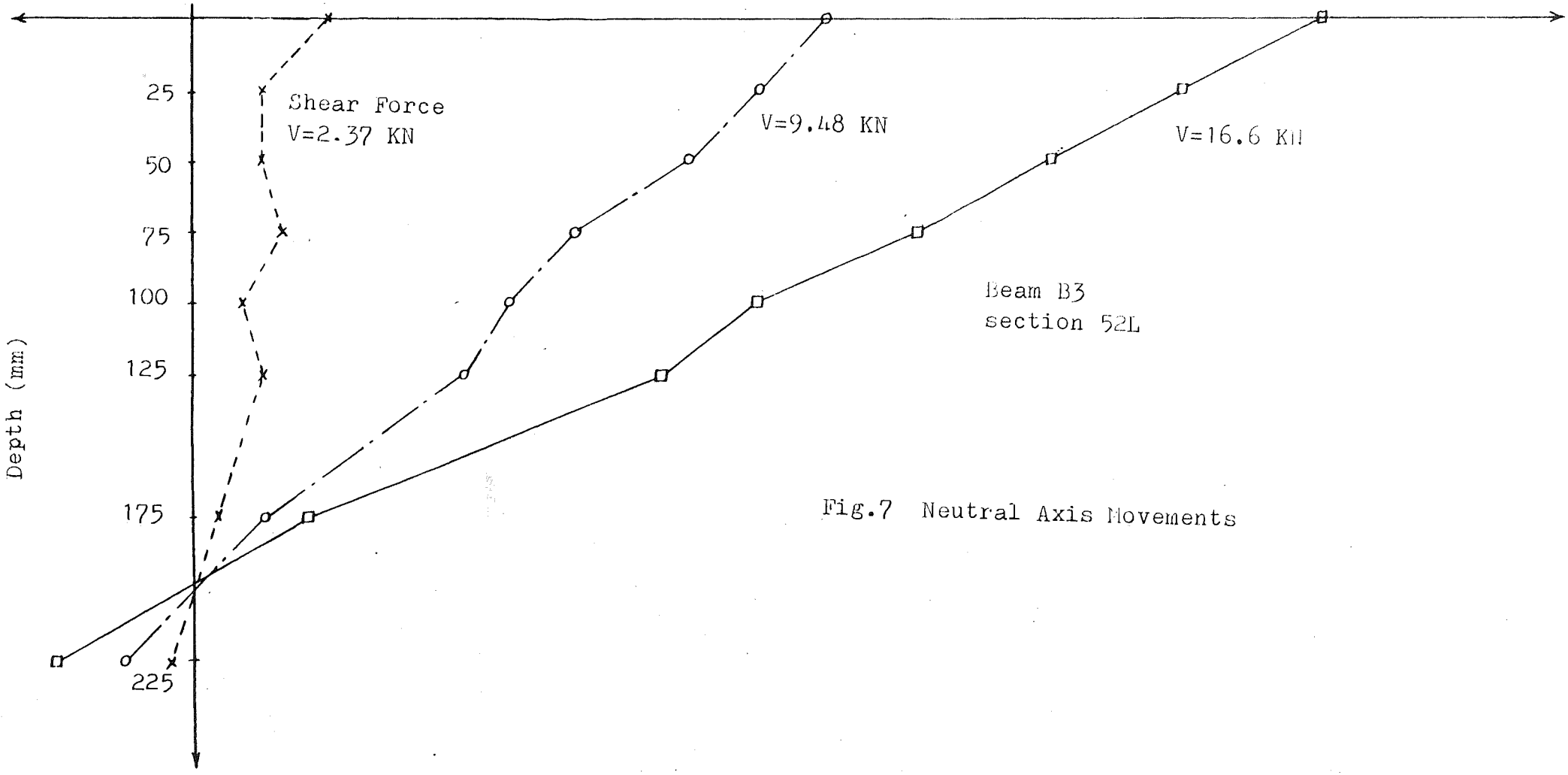


Fig.7 Neutral Axis Movements

For the first two, concrete grade 20 is assumed and for the last one grade 25.

It is therefore interesting to note that the larger the amount of the main reinforcement, the closer the two sets of results become. Indeed with a percentage of main reinforcement of 1.7 the experimental figure of $\tau u = 0.8$ N/mm^2 is almost identical to the figure specified by CP110 ($\tau u = 0.79$ N/mm^2). For the value of $\rho = 0.6$ the experimental value of τu is however considerably larger than the value specified by CP110 i.e. 0.7 N/mm^2 compared to 0.48 N/mm^2. On the basis therefore of these experimental results one could argue that the ultimate shear stresses specified by CP110 in the lower ranges of main reinforcement amounts, are on the conservative side.

Having perhaps overemphasized this argument, it must also be mentioned that it would certainly be unwise to suggest that larger values of τu can be used in the light of a few laboratory results. Even if these findings were the results of a much more extensive programme it would still be unwise and possibly dangerous, to recommend larger values of τu for use in Cyprus. The reason of course is the inadequate control over concrete quality in the construction industry. In a way it is regrettable to have to make such statements, but nevertheless this is a sad fact which the construction industry faces today.

ACKNOWLEDGEMENTS

The authors wish to express their sincere thanks to Mr. George Alexandrou Laboratory Assistant in the Civil Engineering Department of HTI for his total commitment to this project.

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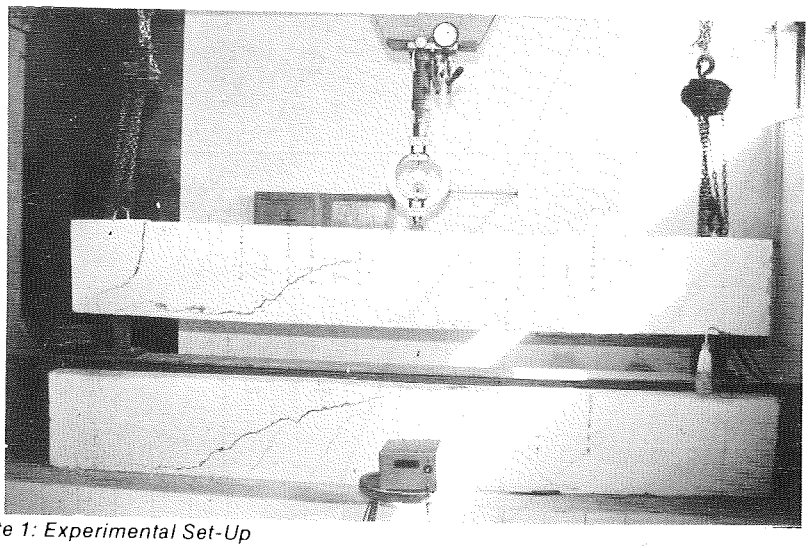

Plate 1: Experimental Set-Up

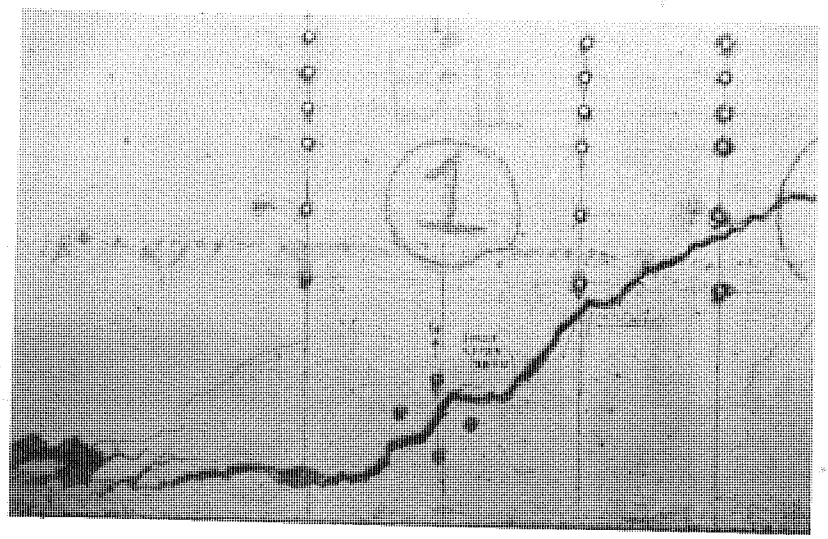

Plate 2: Close-up Shear Crack

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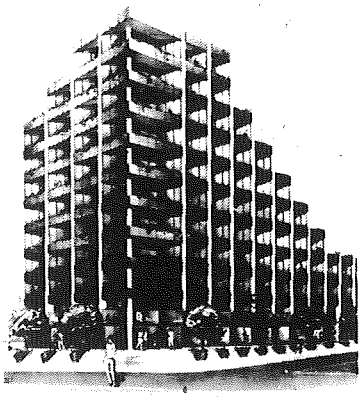

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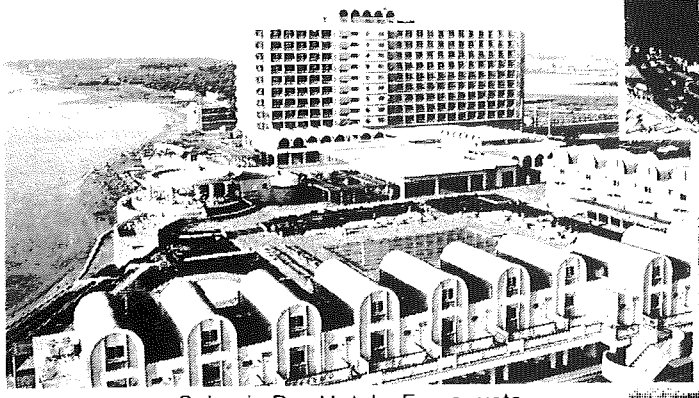

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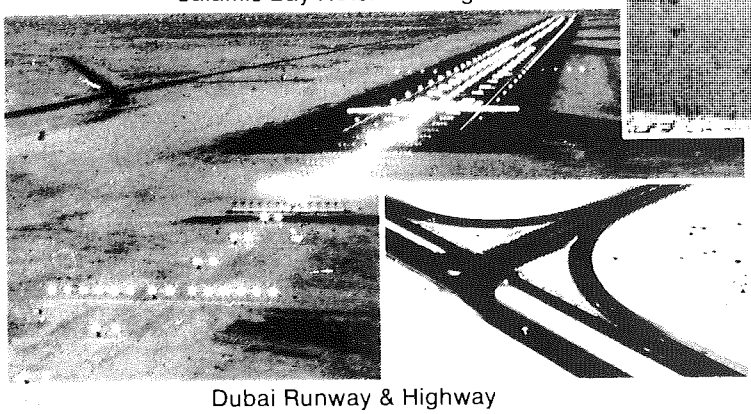

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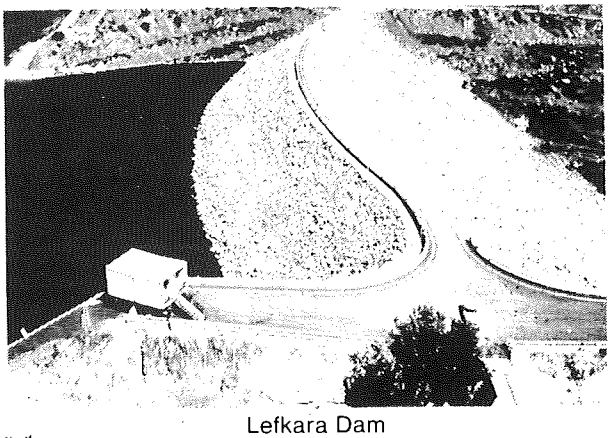
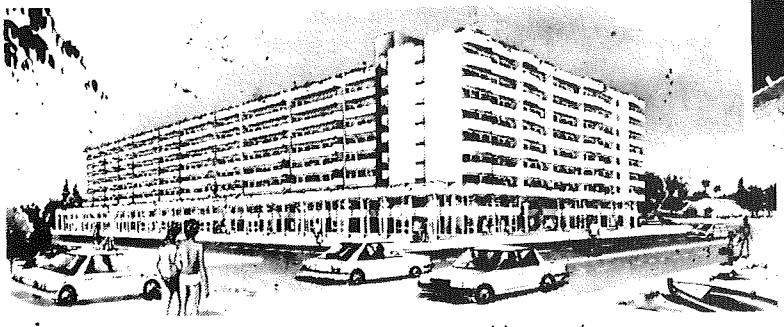


Lefkara Dam



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MANUFACTURING THE TRANSPUTER, EXPERIMENTING WITH PHOTONS AND THE TRANSPHASOR; WHAT'S NEXT?

Ch. Schizas, B.Sc., Ph.D., C.Eng., MIEE, MIEEE, FABAC, Lecturer HTI

The era of Transputer

All computer generations until the fourth one had a common characteristic by which they have been landmarked. This characteristic was integration and miniturization which for practical reasons could not go on for ever. The transistor was succeeded by the IC, the IC by the LSI, the LSI by the VLSI and the VLSI by the ULSI etc.

Far back in the mind of every electronic, computer and software engineer involved in the development of computers is the science —fiction vision of a machine that rivals animal inteligence — the machine brain. This vision let engineers and scientists dare work on some computer models whose prototypes were distant models of brain. We haven't seen the results of the fifth generation of computers yet, and computer experts are already talking about the "sixth generation" of computers.

The computers we use today outperform brains in certain areas. They apply a limited range of mathematical and logical rules to perform sequential calculations at speeds that leave real brains standing. They can even make inferences from symbolically represented knowledge to emulate a line of reasoning and to arrive at a conclusion. The essential computer process, however, is seguential ie. it does one calculation at a time, where the brain's network of neurons and interconnections tackle a number of different jobs at once, working in parallel.

There has been lately a new development that can free computers from the constraints of sequential processing and enable them to adopt the brain-line technique of parallel processing. It is the development of the **transputer,** an integrated circuit that combines a processor, memory and communication function in a single chip. Arrayed in clusters, they could form the basis of a new generation of parallel-processing computers.

New avenues are opened to the computer scientists by the new era of parallel processing It seems to be possible to develop a synergy between a multitude of interconnected and self contained processing, communication and memory functions that will give rise to a new level of machine intelligence where parallel computing will be able to deliver something more than the sum of its individual processes, and furthermore organize itself and figure out new rules in the process of learning.

The parents of **transputer** are the British semiconductor company Inmos, which was founded by the British government in 1978, and Mr Iann Barron, founder and chief strategic officer of Inmos, who developed the transputer initially in response to a need for more processing power. The first product on the market, a 32-bit microprocessor, came out in 1985. Today exist many transputer related products including a supercomputer module that can process 400 milion instructions a second. Many computer manufacturing companies are currently evaluating transputers for their processing power, on special boards produced mainly by Inmos. The main advantage of transputer-based processors today is that they can execute CPU intensive jobs cheaply. They are also particularly suited to simulation and signal processing in communications, military and aerospace applications.

One of the first companies to adopt transputer modules as add-ons in their computers is Digital Equipment all for their VAX range, using them in much the same may as floating point accelerators or auxiliary processors.

Even though transputers can execute classical programs written in third-generation languages, Inmos has developed a concurrent processing language called OCCAM after the old philosopher OCCAM who suggested that "entities should not be multiplied except by necessity".

Photonics and the Transphasor

Light is a better messenger than electricity; light can squeeze in far more information than electricity can.

The weightless photons that carry light can move faster than the electrons of electricity. Thanks to the laser, they can also, be sent in energetic yet coherent packages, carrying telephone conversations inside hair-thin glass fibres bundled into cables. The efficiency of optical fibres has improved as fast as that of chips in recent years. The most efficient method of storing information is optical. Lazers make and then read a pattern of tiny holes from the surface of a disc. Such optical discs store far more information than do the magnetic floppy discs that computers rely on. So far, it has not been possible cheaply to erase and rewrite the data on optical discs, so computers have stuck to the erasable mangetic media. Processing information

by light-beam is harder, since the photonic equivalent of the transistor is still on the experimental stage. A light computer could probably operate 1000 times faster than an electronic one.

The electronics revolution is young. The electron was identified less than a century ago and the microchip, on which today's information-technology industry utterly depends, has been around for fewer than twenty. It is believed that electronics will give way to a superior technology based not on electricity but on light. Physicist did not realize until early in this century that light came in the separate packets they now call photons. In the meantime, scientists have made amazing progress in manipulating photons; the photonics revolution has started with the lazer's first shot in 1960. Today, lazers can destroy ballistic missiles thousands of miles away. They can cut metal in factories and repair blood vessels in human eyes. Hospitals use laser beams guided through optical fibres to shatter people's kidney stones. A French inventor has replaced the strings of a harp with laser beams. Like transistors, lasers have entered the phases of minituarization; they can now be generated by a chip the size of a grain of sugar. This is paving the way for a wholesale switch from electrons to photons.

Why are photons better than electrons? Because, photons travel faster than electrons, have no mass, can be made to pass through each other unperturbed, and because light behaves both as a particle and as an electromagnetic wave, which means that optical devices could be based on much the same operating principles as those already used in electronics. The limits of electronics are approached every day. One is the speed at which electrons travel through semiconductor materials. So long as electrons remain the information carriers of computers, this sets an absolute limit on the speed and power of computing.

The trend so far for making computers faster and cheaper was by more and more integration. The number of components that can be fitted on a single chip has grown from about a dosen 20 years ago to 2,000,000 nowadays. This trend is saturated since engineers are running out of ways to etch into chips smaller and smaller paths along which electrons can run. As components get too close, the chips are affected by "crosstalk" which is the leakage of charges from one component to another. Photons are not affecting each other when they move along each other, making thus possible the previously mentioned approach of "parallel processing" the best candidate for achieving faster processing by performing a lot of operations simultaneously, instead of channelling all their calculations through one bottlenecked CPU. A chip could process several beams of light at once without their interfering with each other.

Considering how rapidly light has moved electronics out of two major areas of information technology: telecommunications and the storage of information, one should have no doubt that processing of data will be one of the next to be overtaken by photonics.

In communications, telephone companies are replacing their copper cables as quickly as they can afford to and replacing them with hair-thin optical fibres made of glass. Light is a better messenger than electricity. It wastes less heat and is immune to electromagnetic interference. Better still is light's enormous bandwidth. Because it spans so many frequencies, light can squeeze in far more information than electricity can. Nowdays using coherent transmission one can send in a single fibre 10,000,000 telephone conversations or 10,000 digital television channels at once.

Information storage in the optical way has been initially enjoyed by the music lovers through the optical disc which is replacing the magnetic disc at an increasing rate. Optical discs such as the compact suffer from one drawback: erasing them or writing new information on them is difficult. A new generations of discs called WORM (write once read many times) is coming up. These are sold blank, so the end user can store data on them, although the data once stored, is there to stay. Technology for a fully-erasable disc will be perfected very soon; at least two ideas for making them are already in good progress.

The progress by optical discs and fibres alone do not amount to a revolution. Photonics will create a revolution when the transistor is replaced by its equivalent in photonics.

A transistor, as we know it, is the basic element of computers. Transistor is a switch that denotes an ON or an OFF. Computers treat sequences of ons and offs to denote numbers or to denote true or false. The challenge for photonics is to invent a device that does for light what the transistor does for electrons.

At Britain's Heriot-Watt University and USA'S AT & T'S Bell Laboratories, small and primitive circuits are already running on light. The switches they use are essentially optical transistors. These devices are known as Bistable Optical Devices (BODs) or transphasors. Light emerges from them as a strong beam (ON) or a wek one (OFF). In principle a number of transphasors and a laser beam shining through them should form the ingredients for an optical computer.

— In understanding how a transphasor works, think of the as two partially-reflecting mirrors facing each other. If a beam of light is shone through them some of it gets trapped, bouncing backwards and forwards between the mirrored

surface. As these waves cross each other they can either interfere with and weaken the beam or align with it and reinforce it (This is the same principle used for measuring wavelengths). On its own, however, it is not a switch; combined with the phenomenon of optical bistability, first observed at Bell Laboratories in 1976, it can behave like one. The key is in the cavity between the mirrors which when filled with an ordinary medium like air can change the intensity of the beam passing out of the mirror in proportion to changes in the intensity of the beam shinning in. In a transphasor a family of "non linear" materials such as indium antimonide and zinc selenide are used. If a lazer beam shines into these materials, a slight change in its intensity can trigger the wave-reinforcement and make the beam coming out of the transphasor suddenly brighter, and make it stay that way until the trigger is released. In an optical computer, these devices would be the "chips", and the "wires" would consist of laser beams. Optical switches should, in theory, be able to operate 1000 times faster than electronic ones. But do not throw your electronic computer away just yet. For the present, transphasors are primitive. Even so, optical switching works and light looks like the wave of the future.

Meanwhile, even the biologists, and chemists are hoping to make computers. After all, one of the neatest of all computers is that which reads the instructions from 23 long molecules of DNA on how to build and then run a human body. Some biochemists hope to construct long polymer molecules with backbones of carbon that can act as switches and wires. They might then succeed in growing computers by genetic engineering. The science is sound; the technology is mountainously difficult, and indeed there is nothing beyond imagination.

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SUPERCONDUCTORS COME IN FROM THE COLD

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Introduction:

Superconductivity is the property of certain materials to lose all electrical resistance at very low temperatures. The phenomenon of super conductivity was discovered in 1911 by K. Onnes who found that mercury shows zero electrical resistance when cooled to about four degrees above absolute zero (4 K). It soon emerged that a number of metals (lead, zinc, aluminium etc) and alloys (bismuth and gold, carbides of molybdenium and tungsten etc) at a certain temperature called the transition temperature show a similar effect and they change into superconductors below this critical temperature. But in every case the critical temperature was only a little above absolute zero, attainable in practice only by immersing a specimen in liquid helium which boils at 4.2K at normal atsmopheric pressure. Having to reach such a low temperature was inconvenient but did not preclude what seemed at first to be an ideal application of the discovery, i.e making electrical motors and generators with superconducting windings without heat losses. Unfortunately the discovery that superconductors are loosing their peculiar properties when placed in a strong magnetic filed set a "stop" to the hope of the design of 100% efficient motor. Nevertheless superconductivity was a fascinating and unexpected phenomenon and this is the reason why it became an important subject of physical research.

About half a century after the discovery of superconductivity another finding renewed hopes of putting the effect to practical use. This was the possibility of making metallic alloys that would stay superconductors even when placed in very strong magnetic fields. Alloys of Niobium and tin are now used for the windings of powerful electromagnets minimizing heat losses and increasing their efficiencies. The energy saved by abolishing coil resistance more than pays for the cost of installing liquid helium refrigeration to keep the coil cold. But this was not yet the last word in the intriquing field of superconductors. Two years ago (april 1966) A. Muller and G. Bednorz at IBMS research laboratory in Zyrich reported some work on compounds of barium lanthanum copper and oxygen (BaLaGuo) which they show a sharp drop of resistance at temperatures around 30 K. much higher than the usual 4.2 K temperature required for most superconductors. Other researchers also claimed that they have prepared samples of the compound Yttrium-Barium Copper and oxygen (Y.Ba.Cu.O) showing superconductivity in the region of 90 to 100 K, eighty degrees or more above the temperature at which the ordinary superconductors make their transition to zero resistance.

Researchers in various laboratories are now believing, that they are on the verge of discovering a compound that will be superconductor at room temperature. Such a material would have tremendous applications in everything from electric pylons and computers to medical equipments.

The quantum theory of superconductivity

The classical theory of superconductivity was unable to explain certain experimental facts and it was replaced in 1950 by the quantum theory suggesting that superconductivity arises from interactions between conduction electrons and vibrations of the crystal lattice or phonons. The studies that followed led to the theory published in 1957 by J. Bardeen, L.N.Cooper and J.R.Schriefter. According to this theory conduction electrons in a superconductor tend to interact in pairs being scattered by phonons with the result that exchange forces come to act between the pairs. The exchange interaction is quantum mechanical in nature and consists in the mutual attraction of electrons. It has been found that exchange interaction is specially strong for pairs with opposite spins and momentum. Given certain conditions the attraction between these electrons may exceed their electrostatic repulsions by a wide margin. Because of this strong interaction conduction electrons in metals form a "bound system" which can not give up energy in small portions. This is why collisions with lattice ions do not affect the energy states of conduction electrons and the metal behaves as an ideal superconductor of zero resistivity.

In order to break up the bond between any electron and the remaining electrons of the "bound system" an amount of energy must be expended corresponding to the average energy of thermal lattice vibrations at the transition temperature. This is why at a temperature greater than the transition temperature superconductivity cannot exist.

The characteristic transition temperature T_c of elements depends on their isotopic make up. As a rule, T_c, decreases with increasing relative atomic mass of the element having several isotopes. Impurities added to a pure metal or lattice imperfections only slow down the transistion to superconductivity but do not stop it altogether. This is an indication that during a superconductivity transition the electrons cause

to interact with the crystal lattice of the metal.

Loss of electrical resistance is only one of several changes that take place when a superconductor is cooled below the critical temperature at which resistance disappears. There are also striking magnetic effects. It was found that below the critical temperature superconductivity may be destroyed by a sufficiently strong magnetic field. The magnetic field may be external or set up in the superconductor by the current flowing through it. At any temperature such that $T<T_c$ there is a minimum magnetic field flux density which is sufficient to destroy superconductivity of ordinary superconductors. It was also noticed that at a temperature smaller that the critical a superconductor placed in a magnetic field pushes away the magnetic flux lines of the field. This is known as the Meissner effect after its discoverer. The magnetic flux density inside a superconductor is zero provided of course the field strength is below its critical value and the superconductor behaves as an ideal diamagnetic material.

The transition to the superconductive state changes also the thermal properties of the substance. Among other things in the absence of a magnetic field and at the oritical temperature the specific heat capacity of a metal changes suddenly. In the presence of magnetic field the isothermal transition from the superconductive to the normal state is accompanied by a sudden change in the heat capacity and by the absorption of heat while the reverse transition is accompanied by the liberation of heat.

The phenomenon of electron tunneling where electrons are able to penetrate barriers which classical physics once deemed impossible is particular that when two superconductors are separated by a very thin insulating layer electrons are able to pass through the insulation aven when there is no electromotive force to drive them. If a driving voltage is applied oscillations are produced at a frequency which depends only on the voltage and the electronic charge and the Planck's constant. One implication is that if the frequency is measured the applied voltage can be calculated. This means that a Josephson junction as it is known could provide for the first time an absolute measure of the unit of potential, the Volt.

The quantum theory of superconductivity explains fully all the properties of superconductors including magnetic and thermal. The dependence of temperature on the isotopic make up of metals and that of threshold field strength on temperature deduced theoretically agree well with observations. This theory has also given criteria for the existence of bound states in a system of interacting electrons and of superconductivity.

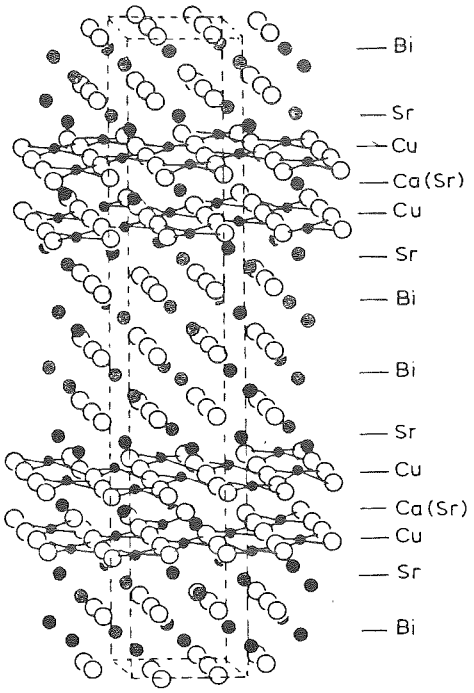
New superconducting materials

The recent activity on high temperature superconductors was sparked off in April 1986 when A. Muller and G. Bednorz reported some work on compounds of barium, lanthanum, copper and oxygen (BaLaCuO). They had found a sharp drop in the resistance of their samples at temperatures around 30 K. However to prove the existence of superconductivity the researchers needed to apply other tests. In particular they wanted to see if the putative superconductor would expel a magnetic field in the manner observed in other superconductors, the so called Meissner effect. By October of last year, Muller and Bednorz, working with M. Takashige from Japan had observed the desired effect. In relatively weak magnetic fields of flux desnity O.1 T the magnetization of the BaLaCuO sample falls sharply as it should for the Meissner effect at a temperature of 33 K. In the meantime other groups of researchers have also reported detecting superconductivity in these materials at 40 K and at 70 K in the same kind of compounds but under high pressures. Another most promising material is the compound Y-Ba-Cu-O discovered by Paul Chu and his team at the university of Houston showing superconductivity at 93 K about 80 degrees or more above the temperatures at which the established superconductors makes their transitions to zero resistance. Chu and his colleagues were not alone. At the beginning of March a team at Japan's research unit for metals in Tokyo anounced that it had prepared a Y-Ba-Cu-O (Yttrium-barium, copper and oxygen) which began superconducting at 100 K and had completed the transition to zero resistance by 93 K. Other researchers also confirm that Y-Ba-Cu-O shows superconductivity around 100 K.

The discovery that the Yttrium compound is superconducting at high temperatures is only the beginning of the story however. These compounds form different phases which have quite different structures and can be composed of the basic elements in different proportions. But only one of these phases may be superconducting with a structure that allows the electrons to cooperate via the lattice. Hence there is a reluctance among researchers to announce the mix of elements they have used to produce their particular version of the compound. Chu and his colleaques refer to two phases in their material one of which appears green under a light microscope and the other black. This was in a compound containing two parts of Yttrium and barium one part of copper and up to four parts of oxygen. Alex Zettl from the university of California at Berkeley says that he and his colleaques have made some "completely black

material thatis fully superconducting".

The new breakthrough in the intriquing topic of superconductivity came earlier this year when an entirely new family of superconducting materials were discovered. These are compounds of bismuth, strontium, calcium, copper and oxygen. One feature of these materials which belong to the family of "perovskites" turns out to be chains of atoms of copper and oxygen..... The



The absence of chains of metal and oxygen atoms in this structure indicate that they are not essential to superconductivity

newer materials whose superconductivity begins to manifest itself at around 130 K have a very different structure. They include strontium and calcium (Fig 1). The new bismuth materials were first made by a team led by Hiroshi Maeda at the institute of metallic material research at Tsukuba in Japan. Researchers at Du Pont at Wilmington Delaware have now unravelled the composition and structure of the bismuth base superconductor. The composition turns out to be $Bi_2Sr_3Ca_xCu_2O_{8+x}$ with x ranging from 0.4 to 0.9.

The new materials have different physical properties from the ceramic oxides. They break of in sheets, producing flexible flakes rather like mica. The bismuth compounds are also sensitive to the amount of oxygen present during their formation. This could make it easier to fabricate bismuth superconductors.

The researchers at Du Pont found that it is easier to make the bismuth compound than the perovskite materials. Perovskites become superconductors only if there is close control of the amount of oxygen present during processing. It is also necessary to put these materials through a second stage of processing by annealing them in oxygen. The bismuth compound is less sensitive to the conditions during manufacture. It is also less reactive with water-than the perovskite materials and so it will be more stable in the atmosphere.

Researchers have a long way to go before the new materials turn up on production lines and it is too early to say whether this new superconducting material will have practical applications.

Applications of superconductors

(1) Electromagnets with superconductor windings: One of the first practical applications of superconductors was in the construction of high efficiency electromagnets. An electromagnet of normal construction has the unvenviable quality of manifesting zero efficiency, for all the energy in the driving current is dissipated in the resistance were reduced to zero by using superconductive wire, the ends of the winding could connected together, leaving the energising current to circulate for ever without external help. This idea is so attractive from the engineering point of view that it is worth going to the expense of installing liquid helium refrigeration to keep the coil at near absolute zero. The energy saved by abolishing coil resistance pays for the cost of refrigeration. At any rate that is so in the applications for which superconducting solenoids are used. These include field coils for nuclear magnetic resonance, body scanners, chemical microwave spectrometers and large particle accelerators. The wires used for the windings are composite: The superconductiv alloy parts are bonded to copper conductors. If as can happen, a small part of the superconductor is overloaded and reverts to ordinary conductivity the copper acts as a temporary low resistance bypass until it cools down.

Superconducting coils have been proposed for use in hovertrains. The idea is to use superconductive electromagnets to suspend the train in the air only a short distance below an overhead track. In this way friction could be minimised and the train would flide along smouthly at high speed.

A less futuristic use of magnetic levitation is in a superconductive bearing. One consequence of the antimagnetic properties of a superconductor is that a magnet brought near to a piece of superconductor experiences a repulsive force. Given a suitably shaped superconductor this repulsion can keep the magnet floating in the air (fig. 2).

So if the magnet is an axle it can be rotated virtually without friction. On a small scale such a low friction bearing could be very useful in gyroscopes for navigational instruments where frictional drag is a source of error. On a larger scale a combination of superconductive coils and

floating axles would be useful in electric motors and generators.

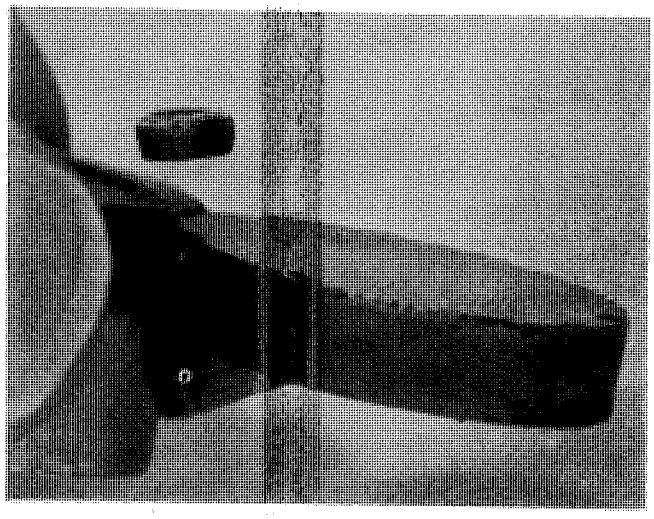


fig (2)

Electronic applications:

Resistance in communication engineering brings with it another penalty: noise. Any resistance in an amplifier generates noise which sets a lower limit to the amplitude of signal which can be detected. Below that limit the resistance noise drowns the signal. For satellite and deep space communications it would be attractive to reduce amplifier noise by incorporating into the early stages of receivers. Some liquid helium cooled devices are now in use; liquid nitrogen cooled amplifiers should enable the cost to be reduced and the field of application widened.

One amplifying device already achieved in liquid nitrogen high temperature form is the superconductive quantum interference device or SQUID. Such a device was first developed some 24 years ago as a magnetometer of unparallel sensitivity. It can detect for example submarines by monitoring the changes they produce in the earth's magnetic field in their vicinity or to monitor blood flow (blood is magnetic) when placed near a blood vessel. This prodiqious sensitivity was first apply in physics research laboratories. For example SQUID magnetometer have been used to search for the "magnetic monopoles", strange subatomic particles theoretically predicted but not yet detected. A free monopole passing through a SQUID would certainly change the flux associated with it in a distinctive and easily measured way.

SQUID systems are now form the basis of a new non invasive method of probing the human body, particularly the heart and brain, through sensing the magnetic fields generated by currents flowing in these organs. One envisaged application is the cryogenic computer. Worked out, notably by IBM, but shelved because of the liquid helium problem. The computer makes use of the fact that superconductivity can be destroyed by a magnetic field. This, a nuisance in power applications is a blessing for computing. It enables the resistance of a circuit to be switched from nothing to something small but finite which is the basis of a gate circuit. If gates can be made computing circuits are feasible. The absence of resistance in the superconducting state makes for high speed operation, and speed is a prerequisite for improving conventional computers in which operations are out in sequence and the duration of a sequence determine the speed of working.

High temperature superconductivity is an inexpensive and productive field of research. It is easy to make these materials, even in a school's laboratory at the cost of £1:, which explains why so many research groups in many countries have been able to set on the act so quickly. "Every day brings a new perspective on what you can do" says B Malozenoff the inventor of the SQUID, adding "research in superconductors is fun, every body is tired but they are all having a ball".

The prospect for superconductors are huge. They range from extremely fast computers, through medical equipments to trains that hover over magnetic trucks. More new ideas will come forward when ceramic oxide superconductors start to appear in the catalogues of scientific suplies and that may take only a month or two to deliver them. The nice thing about this latest breakthrough is that you dont need millions to join in the fun.

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FORTRAN ON THE H.T.I. P.C. NETWORK

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1. The Network and the Process

A network has several computers linked together sharing files and computing power. The H.T.I network has at its centre a computer called a **file server;** the primary purpose of the network is to make available to the user many more files than can be stored on one floppy diskette and to enable him to carry out file-based processes more easily than can be done on our single-drive computers. To start computing in this environment, we must **logon** to the network as well as boot our local computer.

To create and run a computer program requires an operating system, an editor, and a language system. The three functions are separate and based on files in FORTRAN. We use the computer's operating system MS-DOS (Microsoft Disk Operating System) to copy and save files and run the various stages in the creation process. We use the TURBO editor to create or modify the **source code** file, or FORTRAN program. We use the FORTRAN language system to **compile** our program (create a machine-Language program). The FORTRAN compilation system further consists of two phases, **compiling** and **linking,** and compiling on the PC is done in three stages with three programs called **passes.** Finally, the operating system runs or **executes** the machine language program.

These notes explain for someone completely new to the system the procedure for using the MS-DOS operating system and the network to: Logon to the network, Create and change FORTRAN program files, Compile and run FORTRAN programs, Logout from the network, and Perform various utility functions.

2. Logging onto the Network

Logging onto the network is a two-step process which includes booting our local computer:

(1) Insert the NETWORK START diskette into the disk drive and close the lever. This diskette is either next to the computer or available from the lab assistant (You may be asked to make and use your own copy).

(2) Boot the system. Either turn on the computer and display unit, or if the computer is already on and booted, **reboot** by pressing CTRL-ALT-DEL (Hold down all three keys simultaneously).

(3) After the computer has been booted, several messages will appear, then the prompt
Name?
Enter your account-name (e.g. 1E1) and press <RETURN> (the key, not spelling out the word).
When you get the prompt
A>
remove the NETWORK START diskette and insert your working diskette (the one on which you are keeping your FORTRAN program files).

You can now use the computer in front of you with additional access to the network; the processor is ready to accept your MS-DOS system commands.

3. Using the TURBO Pascal editor to create and change FORTRAN programs

First you must have booted your computer with the NETWORK START diskette. If you did not do this, go back to section 2 and carry out the booting process.

The TURBO system is on the **subdirectory** called FORTRAN. TO reach it do the following (you type the underlined portions; the computer does the others).

(1) A>D:
This makes D: our active disk drive.

(2) D>CD FORTRAN
This selects the FORTRAN directory.

(3) D>A:
Return to A: as our active drive.

Now we can get and use the editor.

(4) A>D:TURBO
This calls the Turbo Pascal system.

(5) Include error messages (Y/N)?
Type in "N" for No.
Do not reply "Y" because this means the use of a file TURBO. MSG, which is not available. A menu appears. Select W.

(6) >W
To say what file you will create or edit.

(7) Work file name: DEMO.FOR
Give the name **you choose** for your program. In this case it is DEMO. Be sure to end with. FOR.

(8) >E
Enter the editor. If you are creating a new file, start typing. If you are changing an old file, use the cursor keys to move to the desired spot in the file.

(9) When you are through with editing, type CTRL-K then D to exit from the editor.

(10) >S
To save the current version of the file. The editor also keeps a backup version (.BAK) of your file which can be renamed or copied if you want to keep the original version.

(11) >Q
To leave the TURBO system and return to MS-DOS. Your program is saved on disk.

4. Using the editor

When you have entered the editor, a STATUS LINE appears and stays at the top of the screen showing.

Line n Col n Insert Indent filespec

Line n, Col n show where the cursor is in the file.

Insert or Overwrite tells the typing mode (change with INS key).

Indent tells whether or not a new line starts in the same column as the previous one (change with CTRL-Q-I, hold down CTRL key while pressing Q, then release both and press I).

Filespec tells the location and name of your FORTRAN program file, e.g.
A: DEMO.FOR

To edit your program, you need to know the keys for several editor commands.

CURSOR MOVEMENT COMMANDS

Character left	Left arrow	To beginning of next line	RETURN
Character right	Right arrow	To beginning of file	CTRL-PgUp
Line up	Up arrow	To end of file	CTRL-PgDn
Line down	Down arrow		

INSERT AND DELETE COMMANDS

Insert mode on/off INS Delete character under cursor DEL

Insert line CTRL-N Delete character to left of cursor (backspace)

Delete line CTRL-Y

MISCELLANEOUS EDITING COMMANDS

End edit CTRL-K-D (hold down CTRL while pressing K, then release both and press D)

Auto indent on/off CTRL-Q-I

There are many other editing commands. They can be found in the TURBO Pascal manual, available from the lab assistant.

NOTES:

(1) While editing (changing) your program, you do **not** press RETURN to register a change in a line

(2) You may end editing from any point in the file by pressing CTRL-K-D.

(3) Your program file must be saved before leaving the TURBO system

(4) Remember that a FORTRAN program has rigid restrictions on the columns used.

A comment begins with 'C' in column 1.
A label is an integer in columns 1-5
The body of a statement must lie between columns 7 and 72
A continuation mark when needed is placed in column 6.
The current column number can be seen in the status line at the top of the screen.

(5) Be sure to end your file name with the extension .FOR.

5. Compiling and running a FORTRAN program.

Suppose you have created a FORTRAN PROGRAM file called DEMO.FOR. Next you need to compile and run it.

We must be logged onto the network and have chosen the FORTRAN directory as described above. We must have a FORTRAN source code file (our FORTRAN program); assume it is on drive A: and named DEMO.FOR. Let us continue with the procedure.

(1) A>D:FOR 1 begin the compilation process
Source file [.FOR]:DEMO
Object file [DEMO.OBJ]:<RETURN>
press RETURN key
Source listing [NUL.LST]:DEMO
Object listing [NUL.COD]:DEMO

Pass one No Errors Detected (if no syntax errors in program).

NOTE: If errors were detected, type or print the file DEMO.LST to learn what they were and where they occured. In this case you have to reenter the TURBO editor and correct the errors in the initial .FOR version of the file.

(2) A>D:PAS 2 second pass of compilation.
Code Area Size=05EC (1516)
Code Area Size=00E6 (230)
Data Area Size=0264 (612)

Pass two No Errors Detected

(3) A>D:PAS 3 third pass of compilation.
(Object listing is written as DEMO.COD for use if needed)

(4) A>D:LINK link functions, etc. to your code
Object modules [.OBJ]:DEMO
Run file [DEMO.EXE] :<RETURN>
List map [NUL.MAP] :<RETURN>
Libraries [.LIB] :D: where to find the libraries

(5) A>DEMO run DEMO.EXE assuming no errors

At this point you are running the machine-language program produced from your FORTRAN program. However, if at any stage you had an error, you must determine the source and correction for the error, then return to editing your DEMO.FOR file and repeat the compilation process.

IMPORTANT: Do not edit the .LST version that

showed the location of the errors. You must change and recompile the .FOR file.

6. Logout

When we have finished a computing session using the network, we must **logout** from the network before turning off our local computer.

Remove your working diskette from the disk drive and insert the NETWORK START diskette. Assuming you are at the prompt.

A>

on the screen, type LOGOUT (don't forget <RETURN>), then remove the NETWORK START diskette, replace it in its sleeve, and leave the computer and display as they are without switching them off.

7. Utility functions for MS-DOS and the network.

Like all microcomputer-based disk operating systems, MS-DOS and the network have many utility functions the commonest of which permit:

(1) file names to be read through DIRECTORY commands;
(2) files to be deleted or renamed, and
(3) files to be copied from place to place

This section is a discussion of these simple activities which are useful in the FORTRAN development process.

7.1 Directories

A disk has a directory describing the files contained on the disk and pointing the operating system to their locations on the disk. To view the directory, type DIR (try this on your working diskette).

Each file has an entry describing the file, its size, and when it was created. For example, we might see.

DEMO FOR 423 4-02-87 7:50a

telling us that the file DEMO.FOR is 423 bytes long and was created at 7:50 AM on 2 April 1987.

The network has many more files than can readily be handled with a single directory. Therefore, it has several directories called subdirectories, organized in a **tree structure**. The master directory, also called the **root** directory, contains or point to subdirectories. At any instant, there is one active directory. Initially it is the root directory. To change to another directory we use

CD pathname

For example, CD FORTRAN

makes the FORTRAN directory (a first-level subdirectory under the root) the active directory. Paths may go to several levels in depth. (See the CHDIR entry in the MS-DOS manual for a discussion of paths if you wish)

Each disk drive has a name. The disk drive on our PC is called A: and the network disk is called D: At any instant we have one active drive; its name appears to the left of the > prompt as A> or D>. Generally, we can carry out any MS-DOS command from any active disk by preceding the filename with the disk designation, as in D:FOR 1 to start the FORTRAN compilation process. However, the network requires some actions to be taken only with its drive as the active drive. We name the drive to make it active, as in steps (1) and (3) of section 3, above.

7.2 Deleting files from your disk

The FORTRAN compilation and execution process creates many files intermediate between your source code, e.g., SAMPLE.FOR, and the executable program, e.g., SAMPLE.EXE. Periodically you will want to delete files you no longer need. The command is

DEL filename.ext

or ERASE filename.ext.

For example, DEL DEMO.OBJ would delete the file used by Pass 2 in compiling DEMO.FOR. We can also use the asterisk (*) as a **wild-card character** in deleting files. Thus, ERASE *.OBJ will delete all files with extension .OBJ, or DEL DEMO.* will delete all files named DEMO, regardless of extension. When you are developing a FORTRAN program, it is a good idea to keep the .FOR, .BAK, .LST, and .EXE files until you are certain the program is correct, then keep the .FOR and .EXE files until you are certain you will never again need the program.

7.3 Listing a file on the screen

Any text file can be displayed on the screen. We can, of course, enter the editor and view the file as part of the editing process, but if all we wish to do is view the contents of the file, we can use TYPE filename.ext

For example,

TYPE DEMO.FOR

will display the source code of our DEMO Program. If the file is too long to fit on the screen, use CTRL-S to pause in the scrolling, the CTRL-Q to continue or CTRL-BREAK if you want to end listing at that point.

7.4 Printing

The network has its own printer and a program called a spooler to print the contents of files from all of the computers on the network. To print a file from your disk, type

CPRINT filename.ext

For example,

CPRINT DEMO.LST

would print the .LST annotated listing of the program DEMO.FOR. You can also print or type a file from another disk drive by

TYPE d:filename.ext

or CPRINT d:filename.ext

where d: is the drive designation, such as D:, the network drive.

7.5 Copying Files

The MS-DOS command for copying files is

COPY d:oldfilename.ext d:newfilename.ext

For example,

COPY A:FIRST.FOR A:SECOND.FOR

makes a new file, SECOND.FOR, on drive A: identical to an existing file FIRST.FOR. The default drive is the active drive, so if A: was our active drive, we could say simply

COPY FIRST.FOR SECOND.FOR

Generally the network will not permit us to copy or create files onto it.

7.6 Renaming files

Occasionally the need arises to rename a file. For example, you may want to create a variation of a program and still keep the original version as it is; you can do this by editing the .BAK version of the file which you rename accordingly before editing.

The command is generally:

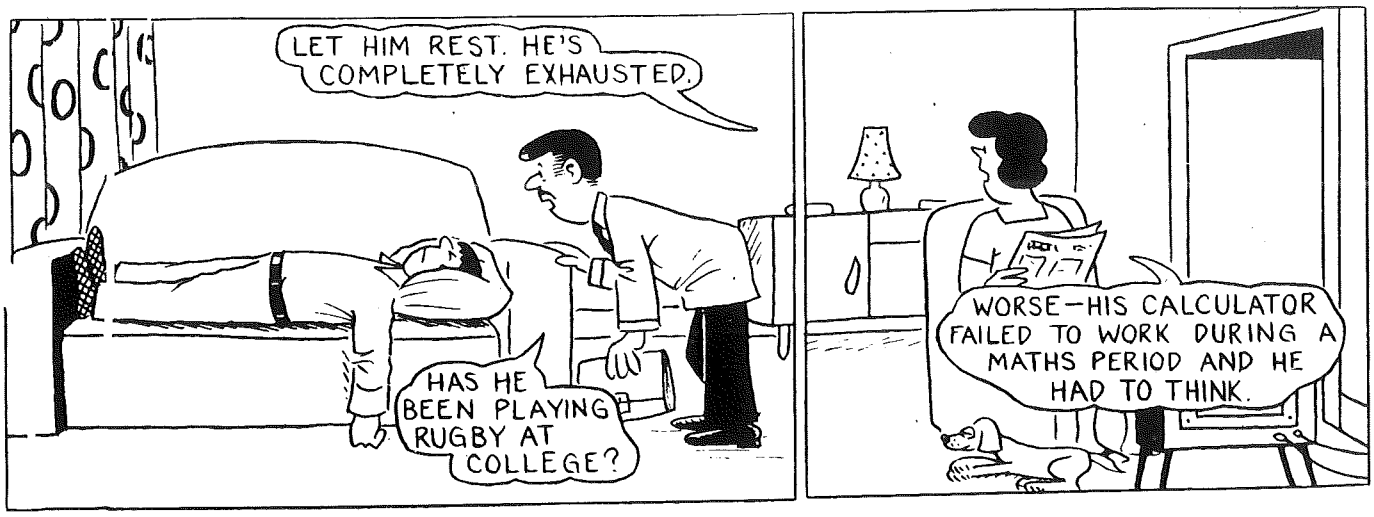
REN a:filename.ext a:new filename.ext

For the above example,

REN A:DEMO.BAK A:SAMPLE.FOR

renames the old file DEMO.BAK to SAMPLE.FOR on drive A:

In conclusion, we have demonstrated a few of the more important commands. The number of system commands on a computing system is really unlimited. Each system command is a program in and of itself and there are new programs written every day. You are encouraged to find and use the others listed in the MS-DOS manual, available from the HTI library or the computer laboratory.



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

COMPUTERIZATION IN CYPRUS

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During the past two decades, the number of computerbased information systems in private and public sector organizations has grown substantially. New computer products and services have invaded the market. It has been estimated for the United States that one-third to one-half of its current GNP is attributed to the production and distribution of information[1]. The same trend is also shown in other countries too.

Unfortunately, in Cyprus the Turskish invasion considerably slowed down for several years the introduction of computers to industry, government and in general to society.

The aim of this essay is to present in broad lines the computerization in the civil service, the semi-government organizations and the private sector. An attempt is also made to illustrate the impact of computers on the society of Cyprus with reference on problems.

Computerization in the Civil Service

1) Department of Data Processing Services (D.D.P.S.)

The Department of Data Processing Services functions under the Ministry of Finance and provides computer services for the entire Civil Service. The computer centre was first created in 1971 as the Treasury's Data Processing Centre. This was tranformed into a separate department in 1980, and was named the D.D.P.S..

This Department operates an NCR Criterion V8555-M which is on a rental basis. The computer facilities offered by main "customers" are the Ministries of Interior and Education, the Treasury, the Department of Statistics and Research, Inland Revenue, Central Stores and so on. In addition to the batch mode, on-line processing exists between the mainframe computer and the Inland Revenue department. This process was adopted only a year ago and facilitates considerably the job of the tax collectors. The linkage was effected through telephone lines.

All government Electronic Data Processing (EDP) personnel, which is around 40 people, belongs to the D.D.P.S. despite their detachment, in some instances, to user Departments, such as the Department of Statistics and Research and the Inland Revenue department. Plans exist to extend this facility to more Departments according to the progress that will be achieved in the implementation of computerization plans for the government.

2. Computers in other Government Departments

Although the majority of Government Departments rely for computer services on the mainframe computer of the D.D.P.S., a large number of Government departments have been authorised to install small systems (interactive multiuser minis or micros linked together in a network) for processing specific applications. Already in some departments the process of installation has finished.

In the Department of Statistics and Research the users are statistics officers. With virtually no background at all of computers they manage to run efficiently today many packages such as SPSS, Lotus 1-2-3, supercalc 3 and Word-processing. This situations exists also in some other departments such as the Water Development, the Agricultural Research Institute and others.

The use of word-processing has been introduced in a large scale almost in every government department. With this, better clerical methods have been developed giving efficiency the most important advantage.

The training of all the users has been effected either by EDP personnel or by software houses. Of course, this job has not been an easy one either because of the users' ignorance or their unwillingness to change the routine of their jobs.

With the policy, therefore, to install in many government departments mini or micro systems, decentralization will be acheved at last where the users will work independently with the various packages, under the guidance, of course, of the D.D.P.S. personnel.

3) Problems

The most important problems facing the D.D.P.S. are the following:

a) There are limited computer resources. For example, there are only 5 terminals for program development for all the EDP personnel. This surely delays program development and then the testing of programs. Very often this causes confusion, complaints, and delays in the implementation of computerization plans.

b) There are no generalized programs and good standards and this makes the life of a programmer difficult as far as writing and amending programs is concerned. Moreover, because of work pressure many times user guidelines are not written. This is very frustrating for the users who try to follow a particular system.

c) There are no Data Banks and Management Information Systems yet to allow management to use the powerful management information techniques for decision making and support.

d) A related problem resulting from the absence of central data bases is that of extensive duplications because of the creation of the same master files more than once by programmers detached in different departments.

4) Future Plans—Master Plan

The Government of Cyprus is fully aware of the decisive role which computers in general play in the successful handling of economic, social and administrative problems and is planning to embark on an ambitious project aiming at improving and extending computerisation facilities in the public sector.

This project, the so called Master Plan, was completed by Ernst & Whinney, a British computer consultant office, during June 1987. This work has been carried out in close co-operation with the Director of the D.D.P.S. and its staff.

The goals which are expected to be reached in the Master Plan include, among others the following[2]:

a. On-line techniques should generally be used, giving direct support to users' operations, particularly in their dealings with the general public. Thus, hardware with powerful on-line processing capabilities will be needed.

b. Improvements are needed in the systems development process, to acheve a higher standard of output and a rapid rate of progress.

c. New systems in the public sector are likely to have a radical impact on working habits and quality of service over the next decade. There are eighty areas where the experts have identified applications which are suitable for computer support. The 80 target applications will contribute to

1) quality of service to the public and to commerce;
2) effective application of legislation;
3) strength of internal control, accounting and planning procedures;
4) reduction in the costs of operation.

The applications they have analysed as deserving highest priority are the following:

- Vehicle Registration and Driver Licensing;
- Customs System;
- Tax Administration System (Inland Revenue);
- Central Accounting System (Treasury);
- Medical Records;
- Population Register.

Moreover, the following policies have been suggested by the experts for the rpovision of applications software and computer hardware:

a. Applications software:

1) where the Government's applications are not specialised, package-based solutions must be used;
2) systems analysis should always be carried out to establish user requirements;
3) software houses from the private sector should be used for software development, given proper supervision by the D.D.P.S. especially concerning precautions for confidentiality;
4) structured systems analysis techniques and software tools should be adopted.

b. Computer hardware:

1) use of modern on-line equipment, ranging from microcomputers through minicomputers to small mainframes;
2) decentralization of hardware, to avoid the risks of large computer installations and to gain the benefits of more flexible operating conditions and improved user service;
3) establishment of microcomputers in certain departments to support small-scale applications;
4) data communications facilities from the Cyprus Telecommunication Authority (CYTA) should be available in time to support the demands of large applications needing access from multiple locations.

The above goals imply radical changes in the attitude of Government to use Information Technology.

Semi-government Organizations

Most of the semi-government organizations have been computerized. Independent mainframe computer systems are installed at the offices of the Electricity Authority and the Cyprus Telecommunications Authority whereaw several other semi-government Authorities and Organizations obtain computer services (batch or interactive) from private Computer Bureaux and through small independent systems. These systems, mostly mini computers, are augmented by a number of micros installed at users' offices.

It could be argued that all Semi-Government Organizations work efficiently concerning computerization facilities. THis efficient operation not only reduces expenses and increases profits but also fulfils considerably the obligation to the citizens of this country who constantly and rightly, demand better, cheaper and quicker services. As a consequence, the bureaucracy has been diminished to a great extent.

In most cases, computers in the Semi-Government Organizations are used mainly for

payroll, stock control, billing, statistics, word-processing and so on. it is clear that in this area too, the computer is rarely used as a management tool for forecasting, planning and decision taking.

Private Sector

In the private sector the situation is even better. The biggest systems are installed at some Banking Institutions, Software Houses and Computer Suppliers. The services rendered are in most cases of the on-line real-time type covering through the telephone network the whole island.

First the Cyprus Popular Bank and soon after the Bank of Cyprus, have recently introduced the "AUTOBANK" which gives automatic services to people who are holders of the special card. The services provided are very useful and practical. A Holder can check the balance of his account any time of the day, pay his bills, receive cash, and so on. This has been a landmark in the process of computer services development in banking transactions.

In addition to the big systems referred to above there axists a substantial use of multiuser mini-computer systems and micros which are either stand-alone systems or linked together in Networks.

The majority of small computer systems are used by Banking Institutions, Hotels, Insurance Companies, Supermarkets, Suppliers of motor vehicles, Educational Institutions, Accountants, Commercial and Industrial Enterprises, Travel Agencies, and so on.

The proliferation of small computer Systems in the private sector is mainly connected with the substantial drop in hardware prices and the wide use of packages in most applications, including administrative, financial, statistical, educational, and other. This has reduced the costly requirement to employ analysts/programmers for the design, programming, and maintenance of applications.

Impact of computers on society

Computer-based information systems have an impact beyond the single organizations they are installed. They certainly affect the citizens of a country in matters of privacy, employment, productivity and other.

Privacy

Undoubtedly, one of the most widely discussed topics relating to society is the issue of an individual's right to privacy. The citizens of Cyprus do not have much to worry about this issue because there are no data banks where someone can retrieve confidential information — financial and other — concerning any particular individual.

Employment

Many people debate about the possibility of widescale unemployment in Cyprus because of computers. Undoubtedly, the computer industry has in fact created hundreds of jobs for those employed in the field itself. On the other hand, it is also true that with the implementation of information systems jobs have been modified or even eliminated[3]. Workers are trained to cope with the introduction of this new technology. The argument that this may reduce their interest and initiative concerning their jobs, and the job-elimination consequences of computers are still occupying scholars in never-ending debates. My personal view here is that computers have become indispensible and irreplacable in virtually all aspects of life and in fact contribute to the improvement of its quality.

Computer-based systems undoubtedly contribute decisively in increasing productivity. This is accomplished through the variety of information processing systems and office automation systems. Efficiency and accuracy of processing exists now in many fields where in previous time the manual carrying otu of tasks was not only slow but also involved considerable errors which affected productivity negatively.

Conclusion

Although the situation in Cyprus, as far as computers is concerned, leaves much to be desired, it is equally true that the importance of information is now fully appreciated by all sectors — Government and Private. Information is gradually assumed by people to be an important economic resource in the process of production and services regardless of the impact it has on them.

Because of the expansion of office automation, telecommunications and Management Information Systems, it is expected that computers will contribute to the success of any organization.

The Government of Cyprus is determined to utilize the achevements of Information Technology which will contribute favourably towards increased productivity and the provision of high level services to the citizens of the country.

HTI REGIONAL TRAINING CENTRE DESIGNATED A WHO COLLABORATING CENTRE

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Summary

In recognition of the Centre's ten year (1978-1988) contribution in the field of Maintenance and Repair of Health Care Equipment, the World Health Organisation, (WHO), designated the Regional Training Centre, (RTC), of HTI as a WHO Collaborating Centre in this area. This title is rarely given and only after diligent scrutinity of an establishment's record and achievements in a certain field. An overview of RTC's ten year achievements, which lead to the above recognition as well as that of a "Centre of Excellence" from the Commonwealth Secretariat, is given below.

Background

The RTC was established as a joint project between WHO and the Government of Cyprus in 1978 with the main terms of reference to run courses in maintenance and repair of Hospital and Medical equipment. The first course run was that of the Polyvalent (General) Technician. The usefulness and success of these courses, encouraged WHO, a few years later, to extend the number of courses run simultaneously from one to two and having in one academic year a total of four different courses. In the period 1978—1985 a total of six different courses, were planned and executed. These were:

Polyvalent Technician (10 months)

and 5 month Specialised Technician Courses on:

Diagnostic X-Ray Equipment
Clinical Laboratory Equipment
Electro-Medical Equipment
Operating Theatre Equipment
Dental Equipment.

In 1987 the first 10 month Medical Electronics Course was also held. Table 2 shows the number of students, totalling 319 and their respective countries (35) who attended RTC courses upto the present.

In the above period RTC also hosted short courses for WHO's Expanded Programme of Immunization, (EPI) on Refrigerator Repair and Solar Refrigerator Repair. These are courses for Maintenance and Repair of Refrigerators used in the field for the Cold Chain Vaccination programme.

Commonwealth Centre of Excellence

In 1985 the Commonwealth Fund for Technical Cooperation, (CFTC), recognizing the uniqueness of the RTC courses and their usefulness to its member states, designated RTC as a Commonwealth Centre of Excellence. Since then CFTC sponsored students also attend its courses.

Consultancy Work

RTC's activities gradually extended beyond that of training to include the hosting of WHO meetings[1],[9] in Cyprus. At the first meeting it was decided that RTC staff members should carry out surveys [2],[3],[4],[5],[6] to countries in the region in order to assess their equipment management situation and that of RTC graduates. North and South Yemen, Cyprus, Somalia and Sudan were studied in 1982.

A period of re-organization and consolidation then followed, with RTC being set up as a different entity within HTI and having its own fulltime staff. This at present numbers 5 Lecturers, 2 Laboratory Assistants and a Secretary.

In 1985 WHO/HQ at Geneva proposed that the Head RTC produces two WHO reports[7],[8] wich would be used as the vehicle to establishing a WHO Global policy on Maintenance and Repair of Health Equipment. Following these reports the First WHO Interregional Meeting on Maintenance and Repair of Medical Equipment[9] was held in Nicosia, 24—28 November 1986. This meeting was attended by 42 participants from well over 25 countries and other organisations. It has since become a landmark for establishing the WHO Global Action Plan in this field. RTC contributed with consultants and a paper [10] as well as hosting the meeting. Following this meeting the World Health Assembly at Geneva in May 1987, passed for the first time the following resolution concerning Maintenance and Repair.

RECOMMENDATIONS

Governments should undertake programmes for better management of supplies and equipment procurement, use and maintenance through:

- *establishing procurement procedures, guidelines and equipment standards;*
- *strengthening maintenance systems including maintenance facilities, and training centres for technicians;*
- *developing training courses and materials for service staff in the proper utilization and preventive maintenance of equipment;*
- *facilitating local production of spare parts*

wherever possible for widely used equipment;

- *and establishing standard drug lists.*

WHO Collaborating Centre

Following its training and consultancy work in the field of Maintenance and Repair, WHO, on July 2 1987, designated RTC as a WHO Collaborating Centre. This is a title given to establishments which have proven and contributed to WHO's activities unique work. Table 1 gives the terms of reference of the Centre.

RTC's consultancy work has continued since with the preparation of WHO's Global Action Plan document[11]. This is currently being considered for funding by various agencies such as the World Bank, UNDP, UK ODA etc. Many of the funding submissions based on the Action Plan document have been prepared by RTC[12],[13],[14],[15].

Conclusions

Although RTC has achieved a recognised international role in its field the current financial restrictions which are being faced by UN and other agencies, coupled with the wish by some groups of countries to establish their own training centres have affected the sponsoring of students for RTC courses. This negative development will force the re-orientation of RTC activities, with the possiblility of undertaking other training fields and of increasing its Cypriot involvement. This is now the challenge facing the Centre and HTI.

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(9) "WHO Interregional Meeting on Maintenance and Repair of Health Care Equipment", Nicosia, 24—28 November 1986, WHO/HQ Report, WHO/SHS/NHP/87.5.

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(12) Guidelines for consultants for country situation analysis concerning Management, Maintenance and Repair of Health Care Equipment, WHO/HQ, March 1988.

(13) "Development of national capacities in Management, Maintenance and Repair of Health Care Equipment in Countries of the African Region", WHO/HQ, February 1988.

(14) "Strengthening national policy formulation, Health Care Technical Services and Manpower Development in the field of Maintenance and Repair of Health Care Equipment". WHO/HQ, February 1988.

(15) "Proposal for Development of Self-programme Learning Materials related to Maintenance and Repair of health Care Equipment", WHO/HQ, March 1988.

Table 1

Terms of Reference for RTC acting as a WHO Collaborating Centre

1. To assist WHO in holding training courses on

maintenance and repair of health care equipment,

2. to provide consultancy services,
3. to develop and apply appropriate technology in relation to health and medical equipment services,
4. to assist WHO in collection and dissemination of information in the field of health care equipment.

RTC COURSES AND NO. OF PARTICIPANTS

SEPTEMBER 1978 - JULY 1988

Country	Sponsoring Body	Polyvalent	Hospital Lab.	Operat. Theatre	Electro-Medical	X-Ray	Dental	Medical Electr.	EPI 1/ RRT	EPI 2/ Logi.	TOTAL
1. Afghanistan	WHO	8	2					1	6	3	20
2. Bahrain	WHO		4	2	2	1					9
3. Cyprus	WHO	14	5	5	2	9	2			1	38
4. Dem.Yemen (S.Y.)	WHO	13	3	3	3	5		1	3	3	34
5. Djibouti	WHO								1		1
6. Egypt	WHO		4	3		2			4		13
7. Iran	WHO	2		3		1			1		7
8. Iraq	WHO				5	2			1		8
9. Jordan	WHO	5	1	1	1	2	1		1		12
10. Kuwait	WHO							1			1
11. Lebanon	WHO		1						2	2	5
12. Lesotho	WHO										
13. Libya	WHO									2	2
14. Morocco	WHO								1		1
15. Oman	WHO					1					1
16. Pakistan	WHO	8	2			1			4		15
17. Saudi Arabia	WHO			1						2	3
18. Somalia	WHO	8	2	1		2			9	3	25
19. Sudan	WHO	14	4	5	6	12	1	1	10	4	57
20. Syria	WHO	3	4	1	4	2	1	2	1	2	20
21. Tunisia	WHO									2	2
22. Uganda	WHO								1		1
23. Yemen Arab Rep.(N.Y.)	WHO	4	4	2		2	2	1	4	4	23
TOTAL WHO		79	36	27	23	42	7	7	49	28	298
24. Hong Kong	CFTC		1								1
25. Kenya	CFTC		1		1						2
26. Lesotho	CFTC				1						1
27. Malawi	CFTC				1						1
28. Maldives	CFTC							1			1
29. Malta	CFTC		1		1						2
30. Mauritius	CFTC						1				1
31. Papua New Guinea	CFTC	1									1
32. St. Lucia	CFTC						1				1
33. Tanzania	CFTC							1			1
34. Zambia	CFTC		1		1	1		1			4
TOTAL CFTC		1	4		5	1	2	3			16
Cyprus	PRIVATE					1					1
35. Greece	PRIVATE		1								1
Iran	PRIVATE	1									1
Kuwait	PRIVATE			1							1
Syria	PRIVATE		1								1
TOTAL PRIVATE		1	2	1		1					5
GRAND TOTAL		81	42	28	28	44	9	10	49	25	319

Notes: 1/ RRT = Refrigerator Repair Technician Course
2/ Logistics = Logistics of the Cold Chain

SINGLE PHASE THYRISTOR INVERTERS

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Lecturer HTI/RTC

1. Introduction

Thyristor Inverters are grouped into two main categories: 'Line commutated' and 'Forced commutated' inverters. The term 'commutated' and 'commutation' involve certain elements which need explanation and expansion. The two main elements are the fact that a thyristor is practically turned-off by applying a reverse voltage across it and that the nature of loads supplied by Power Electronics circuits is mainly inductive. In a simplified way 'commutation' is the process of turning off a thyristor. However in most of the cases the current through the thyristor to be commutated passes through an inductance which will oppose a rapid decrease of the current. For this reason commutation is usually related to a process of providing an alternative path for the current through the thyristor to be commutated. For the purpose of expanding some terms which have already been mentioned and for amplifying the differences between 'Line' and 'Forced' commutation, a 'Line Commutated' inverter will be examined briefly before the discussion of 'Forced Commutation'.

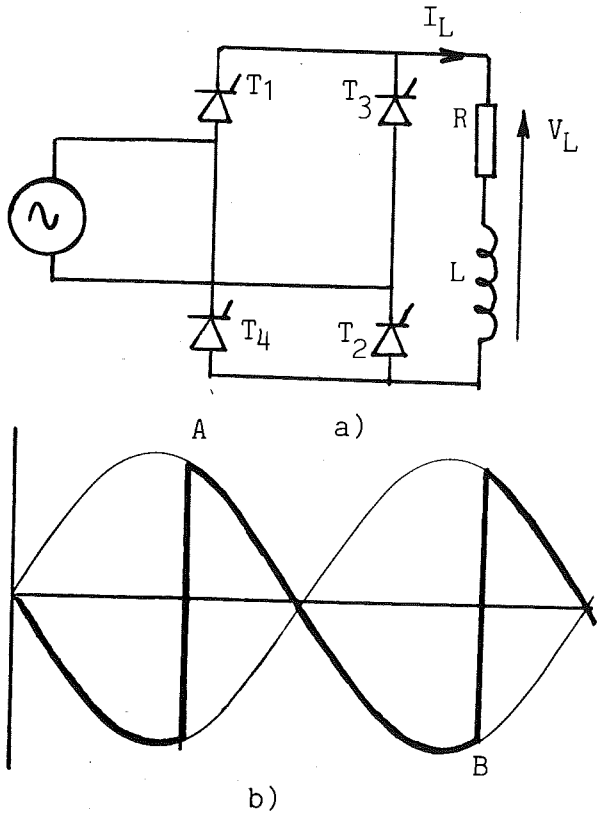

fig 1: Line commutated single phase thyristor inverter: a) circuit, b) waveforms

2. Line Commutation

The converter of fig 1 operates in the inverting mode since the firing angle is above 90^0 and the load is inductive. If the load is purely resistive then the converter can never operate in the inverting mode. The load inductance undertakes a regulating role which forces the waveform of the load voltage (V_L) to follow a shape dictated by the mains waveform. This results in an average negative load voltage. Since the load current I_L can flow only in the direction shown in fig 1(a) and V_L is negative, then the power flow is from the load to the mains, ie there is inversion. In other words the load acts as a dc source to feed the a.c supply.

The load can act as an energy source due to the energy stored in the magnetic field of the inductor. This condition is only temporary since this energy is of very limited value. Commutation of say thyristor T_1 at point B is possible because at this point T_3 is fired and the a.c supply voltage which is negative is applied across T_1 through T_3, ie T_1 is 'Line Commutated'.

3. Forced Commutation

In Forced Commutated inverters the main energy supply is a dc source. The output waveforms are completely different from those of fig 1b. However a variety of output waveforms is possible depending on the firing sequence of thyristors. Such output waveforms are shown in fig 2.

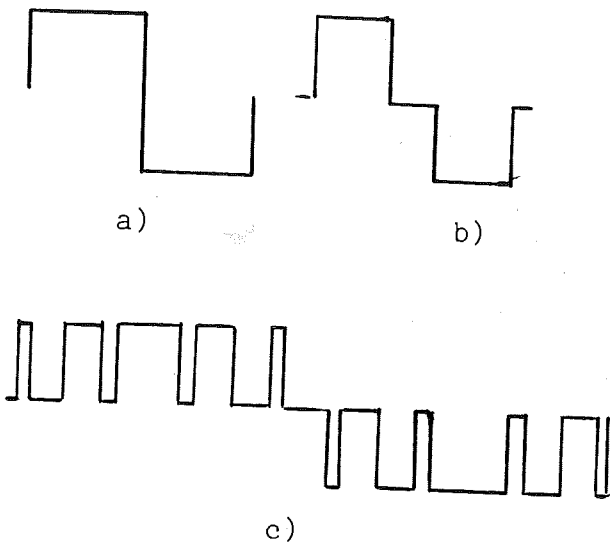

fig 2: Output waveforms of 'Forced Commutated' single phase thyristor inverters: a) Square wave, b) quasi-square wave, c) Pulse width modulated waveform.

The waveforms of fig 2 are full of harmonics which usually cause a lot of troubles. The square and quasi square waveforms have predominant low order harmonics and the pulse width modu ated, high order harmonics which can be filtered more easily.

However a pulse width modulated inverter has high commutation losses.

The three most common forced commutated thyristor inverters are briefly discussed herebelow:

3 a) **The Cente Tap Inverter**

When T_1 is fired capacitor C is charged to 2E by autotransformer action. When T_2 is then fired the capacitor voltage is applied across T_1, reverse biassing and turning it off. The capacitor discharges and charges in the opposite way ready to turn off T_2 when T_1 is fired. The inductor L is protective for the thyristors for preventing high di/dts within them which create hot spots. The two dioles provide a path for the reactive power from the inductive load to be fed back to the battery. The current in the primary is alternating thus giving rise to an a.c load voltage.

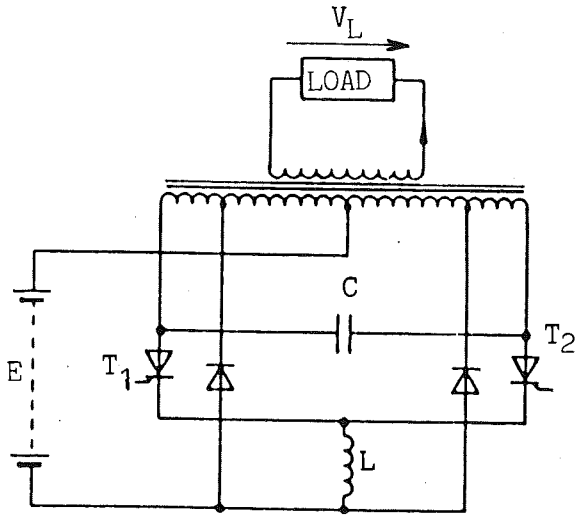

fig 3: A single phose. Centre-Tap thyristor inverter.

3 b) **The Complementary Impulse — Commutated bridge Inverter**

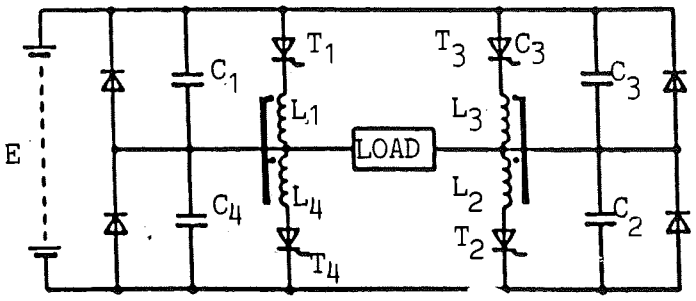

fig 4: A Complementary Impulse - Commutated bridge Inverter.

When T_1 and T_2 are on, capacitors C_4 and C_3 charge up to a voltage E. For the purpose of discription, only one leg of the inverter will be considered. When T_4 is fired, inductor L_4 is connected in parallel with C_4, thus L_1 and L_4 rise to a voltage 2E, by autotransformer action. This voltage reverse biases T_1, turning it off. The purpose of the diodes is for providing a path for reactive power to return from the load to the battery, or they can operate as 'freewheel' diodes during a required zero portion of the load voltage, as shown in fig 2.

3 c) **Impulse Commutated Bridge Inverter with Auxiliary Thyristors**

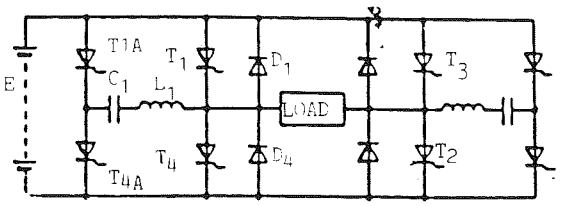

fig: 5 Impulse Commutated Bridge Inverter with auxiliary Thyristors.

Taking one leg of the bridge for the purpose of explanation, before the inverter is ready to operate C_1 is charged up. This charging is achieved by firing T_1 and T_4A. When it is needed to turn-off a main thyristor, say T_1, its auxiliary (T_1A) is fired. In such a case the LC circuit starts to oscillate. During the conduction of the corresponding diode (D_1), the main thyristor (T_1) is reversed biassed and turns off.

4. **Applications of single phase thyristor inverters**

The most predominat application of single phase thyristor inverters is in the speed control of motors. Uninterruptible and standby single phase supplies base their existance on such inverters. Induction and dielectric heating are rather new applications with increasing potential.

4.1 **Speed control of motors**

The speed of an induction motor depends on the mechanical load it drives, but it can be controlled by varying the amplitude and frequency of the supply voltage. Another way of controlling the speed is by varying the rotor resistance, in the case of slip-ring induction motors. Usually slip-ring induction motors are three-phase and if an inverter will be used to form a slip energy recovery system then such an inverter will be 3 phase. A system which provides both voltage and frequency control for single phase induction motors is given in fig 6 below.

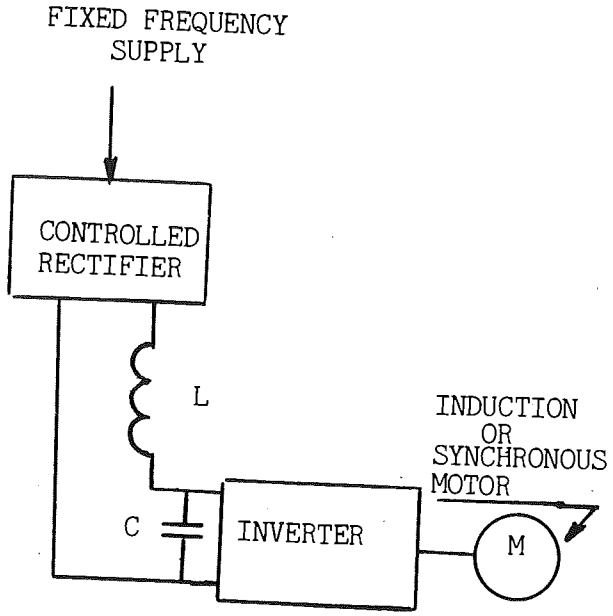

fig 6: Voltage and frequency control for induction and sunchronous motors.

The voltage of the arrangement of fig 6 is varied by the controlled rectifier and the frequency by the inverter. This arrangement can also be used for controlling synchronous motors. In such a case the frequency output of the inverter is controlled by the speed of the synchronous motor so that the motor runs at synchronous speed. Such an arrangement has similar characteristics to dc motors with the inverter representing the mechanical commutator of the d.c motor, which is actually a mechanical inverter.

4.2 **Uninterruptible power supplies**

Uninterruptible supplies are required in places such as computer rooms and operating theatres where a no-break ac supply is required. Such an arrangement is shown in fig 7 below:

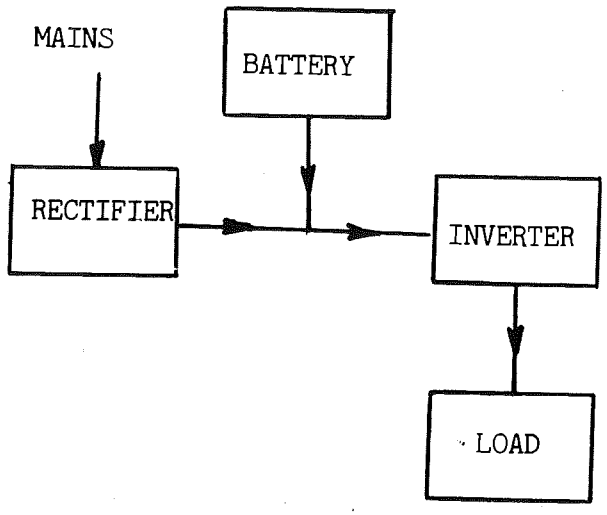

fig 7: An uninterruptible power supply.

4.3 **Induction heating**

The coil of the induction heater, shown in Fig 8, and the workpiece form a transformer with a single turn secondary winding which is the workpiece.

The workpiece is any metal which needs to be heated or melted. The system to be effective operates at high frequencies, of the order of KHZ. Energy is dissipated in the workpiece through eddy currents and hysteresis losses (for magnetic materials). This method of heating has many dinstinct advantages over traditional ways. To name some of them: Precise temperature control, clean enviroment, reduced oxidisation of workpiece and energy saving.

The field of inverters is a vast one with many theories troubles dangers and applications involved.

Only a limited number of applications have been briefly discussed in this article. Somebody dealing with Power Electronics in general has to be aware of certain dangers and problems.

To name only some of them:

a) Commutation circuits give rise to high voltages

b) High frequencies (induction heating) can cause personal jewellery or metal implants within one's body to overheat.

c) Harmonics are always present and are transmitted to the load, the mains and to the air (radio interference).

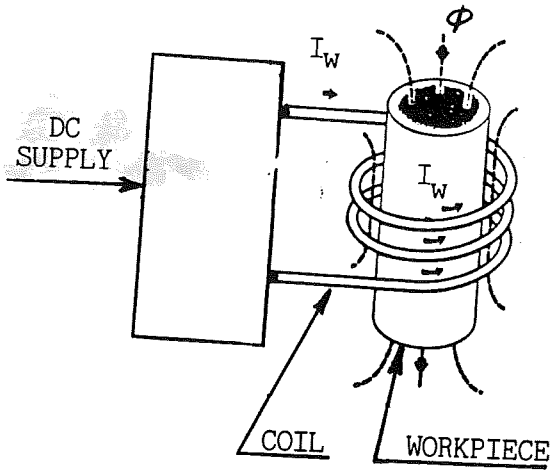

fig 8: Induction heater.

THERAPEUTIC APPLICATIONS OF MAGNETIC AND ELECTROMAGNETIC FIELDS

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Abstract.

Man and living organisms in general have evolved in their present stage of development under the continuous influence of the earth's magnetic field and, in this sense, every human cell has been "grooved" so to speak by such magnetic and other electromagnetic fields of the earth's environment.

Looking at it from a different point of view, matter is energy and therefore cells of humans and other species are therefore built by concentrated waves of electromagnetic energy.

In healthy cells this energy exists in a dual polarity of harmonious balance.

Any disturbance of these energy patterns is bound to have a great influence on living matter.

The article attempts to outline some of the numerous experimental work and results of various researchers relating to the Therapeutic Applications of Magnetic and Electromagnetic Fields with the hope that it will arouse the interest of practitioners in Cyprus.

Introduction

Matter is energy and at the sub-atomic level the relationships and interconnections of its energy patterns move at very high speeds, even if the integration of these energy patterns take up the appearance of matter as solids, liquids and gases.

The human cell, in addition to the concentrated energy wave patterns at the sub-atomic level, it also possesses specific electrical characteristics at the gross level, due to the difference in concentration of Sodium (Na^+) and Potassium (K^+) ions across the cell's membrane.

It is the belief of many researchers that any disturbance or imbalance of magnetic and electromagnetic fields, whether by reduction of the earth's magnetic field or man-made electromagnetic fields, results in ill health.

Application of magnetic and electromagnetic fields at certain points or parts of the body, under certain circumstances, restores health and many relevant experiments have shown that this is so.

Recently, attention has been focussed and intensified regarding the effects of such fields on living matter, although a brief historical study of the uses of magnets suggests that "these have been used for therapeutic purposes well before the times of Ancient Greece... even in deep antiquity...".

Main Topic

1. The Human Cell.

The human cell, at its resting state, has a voltage difference of -90 millivolts between compounds inside and outside of its semipermeable membrane.

This is due to the relative difference of concentration in Sodium (Na^+) and Potassium (K^+) ions in which, at the cell's resting state, the sodium concentration outside the cell is about ten times greater than the potassium ion concentration inside the cell.

Although it is said that there are about fifteen other ions in the fluid inside and outside the cell, the sodium and potassium ions are most influential.

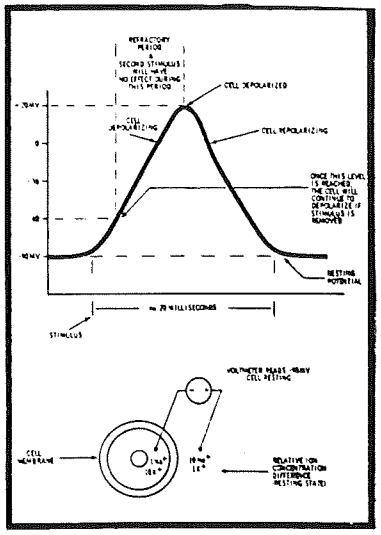
When the cell receives a stimulus above a certain reference or threshold level the membrane permeability to the sodium ions increases resulting in sodium ions flowing into the cell and the voltage inside the cell becomes less negative, (that is the potential increases in the positive direction).

An action potential cycle occurs.

At about + 20 millivolts electrical balance is achieved again, (the cell is then said to be depolarised), and now potassium ions diffuse out causing the cell to return to its normal resting potential.

It is by means of this method that electrochemical impulses are transmitted from cell to cell and action, via the control, (brain), takes place.

The figure below shows the action potential of a human cell when it receives a stimulus.



Now a stimulus may be a temperature change, an electrical or electromagnetic impulse, a chemical impulse or even a mechanical pressure and it is well known of course that stimuli in excess will disturb the balance, chemical composition and structure of cells resulting in disease and ill-health.

2. Influence of the earth's magnetic field on living matter.

The earth has a magnetic field and in fact behaves like a huge magnet of North and South Poles.

Many researchers such as Professors Kawai and Rikitare in Japan, Dr. Branches in France, Dr. Prince of U.S.A to name but a few believe that the strength of the earth's magnetic field is reducing at the rate of 5% every century.

In fact Dr. Prince suggests that in the long history of the earth its magnetic field has changed directions several times, (just it is possible to change the direction of the magnetic field of an artificial magnet).

From his investigations with Carbon 14 with marine and Terrestial Fossils, he believes that significant changes in all species of life takes place when the earth's magnetic field changes direction or polarity.

In fact the dissapearance of some species, (dynosaurs for instance), coincides apparently with the changes in polarity of the earth's magnetic field and new species appear.

Professor Nakagawa of Japan goes as far as to say that the weakening of the earth's magnetic field is creating a magnetic deficiency, (he calls it Magnetic Deficiency Syndrome), which is responsible for countless of illnesses.

Thus further investigation is necessary to ascertain the truth of the matter.

Some researchers began their investigations by studying events associated with the study of magnets.

Here is a brief outline of some of the relevant events.

a) The name "magnet" originates from the name of a Greek Shepherd by the name of MAGNIS.

Apparently whilst walking along a rocky area, he noticed that his iron mounted staff or stick was attracted by a rock which obviously was a natural magnet.

(Natural magnets develop from volcanic lava on which the earth's magnetic field is impinged during the cooling of the lava).

The story goes that this Shepherd Magnis put some pieces of the "magnetised stone" in his pockets and boots and he felt less tired than usual in his long walks.

b) A person by the name of Pliny in the 1st century A.D. spoke of the uses of magnets for the diseases of the eyes.

c) A French philosopher by the name of Marcel, in the 4th century A.D., recommends the use of magnets on necklaces for the relief of headaches.

d) Alexander of Tralles employed magnets for the relief of pain in joints, in the 6th century A.D.

e) Albertus Magnus, about the 11th Century A.D., claimed that magnets exercise powerful and therapeutic effects in many ailments.

f) In about the 17th century A.D., Father Hell, a famous astronomer, manufactured magnets of different shapes and sizes as to fit round human limbs such as the legs and arms.

g) In the 18th Century A.D. Abbe de Noble, Canon of Verneuil-Sur-Seine, is said to have made a careful study of magnets in the treatment of many ailments and diseases, and in 1777 he sent his findings/observations/investigations and results to the Royal Society of Medicine in France.

On studying his claims the Royal Academy of Medicine appointed two experts to look into his investigations and findings.

Having scrutinised all his claims and having made their own investigation the two experts reported to the Royal Society of Medicine of France and came so much in favour of the "use of the magnet", that the only reservation they had was ".. the risk of making the magnet a panacea...".

In their conclussions they add "... the magnet is destined to be at least as important in medicine as it is in physics...".

(And yet, it should be stated herein, that the same Society condemned, a few years later, the Mesmer's claims on "animal magnetism").

h) In 1880, Maggiorani announced the ".. positive results obtained by applying magnetic fields in the treatment of Ataxia, Hysteria and Diabetes".

i) Hector Henry and Gaston Durville, famous French Naturopaths, give relevant publications on their findings through investigations from 1900 to 1930 on the therapeutic effects of magnetism.

j) In the 1930's Professor Harold Saxton Burr points out, after many years of research, that the body exhibits electrical potentials and that".. these potentials reflect accurately conditions within both the body and mind including cancer".

(Professor Burr's work has been followed up more recently by Dr. R. Becker, Nobel prize winner in 1978, for his work on "the effects of electricity and electromagnetic radiation on living organisms"). Similar research has been carried

out by Dr. Battaharia, Dr. Sierra and others.

k) A.R. Davis and W. Rawls in 1936, observe, quite accidentally, significant changes in living organisms exposed to magnetic fields.

(More about Davis and Rawls work will be dealt with herein).

l) In the 1950's Nobel prize winner Szent Gyorgyi suggests that living cells "... behave like semiconductors and that proteins may be linked throughout the body allowing encoded oscillatory electromagnetic waves to flow along with them".

m) Paul Spiegler in 1962 publishes a paper under the title "The Biological Effects of Magnetic Fields" in which he gives many related work.

Numerous other researchers have contributed to the body of knowledge thus far on the biological effects of magnetic and electromagnetic effects and a German Jesuit Scholar in near Medieval Times, in his publication "MAGNETISMUS MEDICINALIUM", we are informed that "magnets have been used for therapeutic purposes well before the history of ancient Greece... in deep antiquity".

And so Scientists are now intensifying their efforts in "re-inventing the wheel".

Perhaps the "wheel" may be more refinely smooth.

3. Investigation, Experimentation, Observations and results of some recent researchers.

In 1976 four different research groups in Japan were set up to investigate the therapeutic effects of magnets.

One group was led by Professor Akio Yamada.

The second group was led by Professor Yamamoto.

The third by Kyoshi Kurushima and

The Fouth group by Professor Nakagawa.

The work of the last group is of interest and is as follows: Magnetic pellets were used of magnetic strength 1300 Gauss on eleven thousand six hundred and forty eight (11648) patients suffering from:

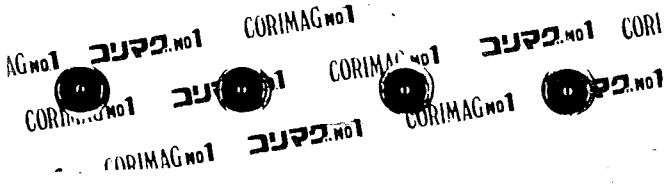
Lumbaco, Neuralgia, Rheumatism, Painful Muscles etc.

The Magnetic pellets were worn for four days.

(Gauss is the old unit of measuremnt of magnetic flux density. In the S. I. units, Tesla is the unit of measurement.

1 Gauss =0.0001 Tesla).

Some magnetic pellets are shown below.



In the experiment double blind tests were made, that is certain patients received unmagnetised pellets which, even the experimenters did not know about, until after the results were analysed.

In the analysed results it is stated that:

More than 90% of the patients reported very efficient or efficient treatment.

About 10% of the patients reported inneffective treatment.

In later experiments it was reported that more effective treatment was obtained after the seventh day of wearing the pellets.

The magnetic pellets had their South Pole (British North Pole) stuck to the plaster and their North Pole, (British South Pole), was making contact with the skin.

(Some explanation about the South Pole = British North Pole and vice-versa is necessary.

In some British books, especially the older books, the North Pole of a permanent magnet is defined as "The North pole of a magnet is that which if suspended by a string and left free to move will point towards the North pole of the Earth". But since Like Poles Repel each other, obviously it is the South pole of the magnet which seeks the North pole of the earth.

So in this article the correct designations will be given, and therefore, the North Pole of a magnet means the British South Pole and vice versa).

In an another experiment for the relief of Lumbaco pain, a group of researchers led by Dr. Yoshio Ooy, used belts containing magnets delivering 1500 Gauss and 200 Gauss.

Eighty patients were involved in the experiment with fifty patients wearing the belts containing the 1500 Gauss and thirty patients wearing the belts with 200 Gauss magnets.

The results were:

62% of the patients with 1500 Gauss magnets reported a marked improvement. The rest showed minor improvement.

Of those patients who wore the belts with 200 Gauss pellets 23% reported minor improvement and the rest reported no improvement.

Perhaps the experiments carried out by A.R. Davis and W. C. Rawls are very important and interesting and are mentioned herewith:

Earth worms were placed in three boxes.

One box marked A was placed near the South Pole, (British N. Pole). of a large Horse Shoe Magnet.

The second box marked B, was placed near the North Pole of the large horse shoe magnet.

The third box marked C was not placed in any magnetic field (other than the earth's magnetic field).

The tests were carried out repeatedly, many a time, for a considerable length of time and the results were persistent.

The results were:

The earth worms in box A near the South Pole of the Permanent magnet were full of activity and larger in size by 1/3, in 36 hours of exposure in the magnetic field.

The earth worms in box B near the North pole of the permanent magnet showed little or no activity and in fact many worms were dead.

The earth worms in box C in unmagnetised environment showed no change.

More refined tests followed with different magnetic intensities, different exposure times and different forms of bar magnets.

The results showed that living organisms near the South Pole revealed considerable increase in AMINO ACIDS and increase in size, activity and physical strength.

Those near the North Pole of the permanent magnet showed considerable decrease in protein Amino Acids.

Those in non-magnetised fields (except the earth's magnetic field), showed no change.

The same experiments were carried out also with seeds, whereby the factors of temperature, humidity and soil quality and quantity were identical.

The results were:

Those seeds near the South Pole of the permanent magnet were bigger with more vitality.

Those seeds near the North Pole of the magnet were much smaller.

Those in unmagnetised environment showed no change.

Experiments with vegetables, fruit, potatoes, eggs, mice, rats, snakes etc. showed similar results and the conclussion was:

"The size and weight of plants and living organisms was larger near the south pole of the magnets".

In Canada grain exposed to low frequency magnetic fields have shown, percistently, at least 10% more harvest.

Furthermore, investigations with owls, pigeons, ducts, dolphins, etc, have shown that these species are influenced by magnetic and electromagnetic fields of different frequencies in the electromagnetic frequency spectrum.

The Electromagnetic Frequency Spectrum is shown below.

10^{29}	10^{26}	10^{18}	1^{150}	1.75×10^{14}	10^{14}	10^{12}	10^{10} -10^{4}	50-0
Cosmic Rays	Camma Rays	X-Rays	Ultra Violet	Visible Light	Infra Red	Micro-waves Radar	Radio & TV	ELF

ELF means Extremely Low Frequency.

Owls are said to perceive the infra-red or heat emanations of their prey.

Geese are said to be disoriented by extremely low frequency broadcasts.

Bees and other insects are said to be sensitive and very much influenced by ultra-violet light.

Many birds, fishes and all humans are found to contain magnetic crystals $Fe_2 O_4$, the naturally occuring lodestone of ancient pilots.

In humans and other "higher level" species it is possible that "there is some means of conveying the orientation of these crystals to the Central Nervous System and hence to the sensory awareness of the creature itself.

4 Explanations or Hypothesis put forward concerning the way magnetic and electromagnetic field therapy works.

I) Professor Nakagawa's explanation, in summary.

Man and living organisms have evolved on this planet earth in the presence of the terrestial magnetic fields and the fields from the earth's environment.

Thus magnetic lines of flux, whether from the earth's magnetic field, solar radiation, thunderstorms, cosmic rays etc, have impinged their presence and influence on every living cell.

Such living cells are then bound to be influenced, somehow, by magnetic lines of flux.

Apart from the fact that the earth's magnetic field is reducing at the rate of 5% every century, man made magnetic fields such as from radio waves, electricity at home, microwaves, nuclear radiation and others, are possibly disturbing the "magnetically grooved cells".

In addition, man's environment nowadays in large houses and buildings, blocks of flats, blocks of offices etc, whose internal or even complete structures are made of metal, reduces the magnetic field of the earth and this reduction of the magnetic field influences the living cells and organisms.

Furthermore, he believes that cars, trains, ships and aircraft screen us from the "benefitial" action of magnetism and this magnetic deficiency, (which Professor Nakagawa refers to as Magnetic Deficiency Syndrome), is responsible for many human disorders principal amongst which are stiffness of the neck shoulders and back, lumbago with no radiographic evidence, chest pains without any precise cause, persistent headaches, drowsiness, giddiness, insomnia etc, etc.

And, he goes on to say that ".. The application of magnetic fields under certain conditions, removes these troubles in a great many cases".

II) Another researcher, Dr. Barnothy of the university of New York, in his publication in 1964 "Biological Effects of Magnetic Fields", writes of "Thermomagnetic Effects" and emfs induced in

the blood by electromagnetic and magnetic fields and these emfs, (causing minute current flow and thus electromagnetic waves), have therapeutic effects on many ailments.

(Blood is a good conductor to electricity. Blood flowing in blood vessels in the human body constitute a moving conductor. By Faraday's Laws on electromagnetic induction, when a moving conductor cuts magnetic lines of flux, an emf is induced in that conductor, in this case the blood).

III) A.R Davis and W. Rawls explanation on the therapeutic effects of magnetic and electromagnetic fields.

"Living cells are systems of electrical equilibrium and any change in this equilibrium will tend to deform or damage the cells".

As already mentioned a healthy cell at its resting state has a potential difference of -90 mV across the inner and outer compounds of the cell.

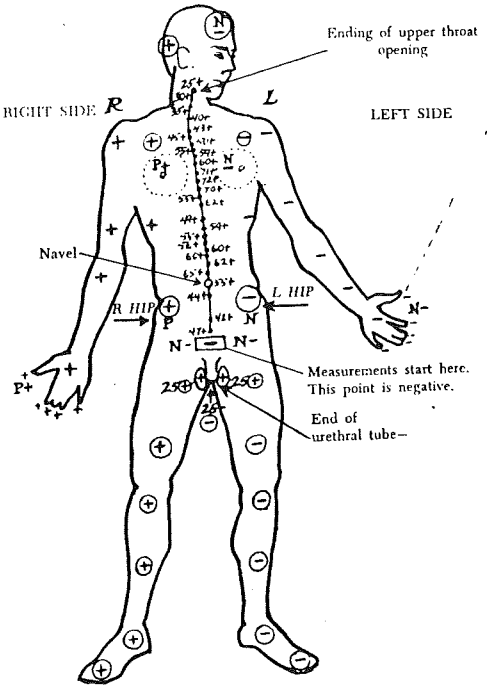
During injury where "internal repair" is going on this potential increases.

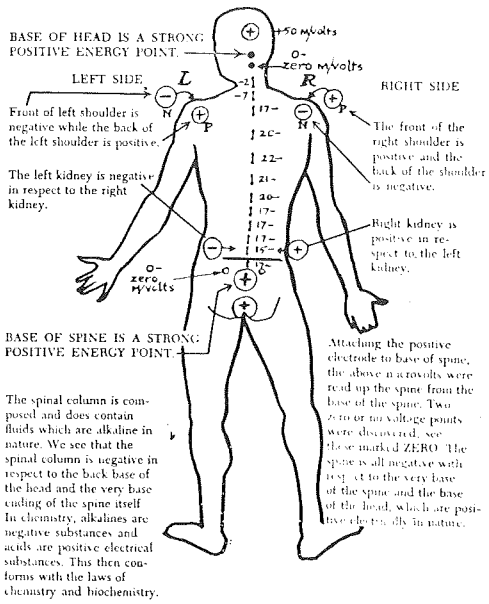
In cancerous cells on the other hand this negative potential is much less than normal and, in general, the application of a negative magnetic potential increases the negative biopotential between the inside and outside of the cells, resulting in self healing.

(The author has seen slides of Professor Watson's work on related investigation.

Professor Watson who carried out research on relevant work, found out that it is possible to repolarise the cancerous cells electronically with the result that the malignant growth reduces or disappears altogether. Such investigations were carried out on rabbits and recently research is focussed on humans).

Davis and Rawls charts of body potentials are shown below





IV) Dr. Battacharia and Dr. Sierra making their own investigations for several years agree with the observations of Davis and Rawls and in their book "Power of the magnet to heal", they say, in summary, that:

a) In different parts of the body the skin has an electric charge.

b) In some parts of the body this charge is positive, in other parts negative and in other parts zero potential.

c) The highest positive potential is found in the region of the heart at the frontal plane, and it is approximately 70 microvolts. (Remember it is not the potential across the Human cell but the potential at the skin with reference to a zero voltage point. See the sketches above).

d) The voltages at different positions of the body vary from person to person and there is a considerable change in the case of disease.

e) With the help of suitable magnets the correct potential can be restored.

f) In the majority of cases it is the "negative energy" that is required to:

Decrease pain,

Increase Curative Activity.

g) The important factors for the choice of magnets for therapeutic purposes are:

i. The strength of the magnet,

ii. The ratio of strength to mass of the magnet,

iii. The degree of retentivity, (i.e. the resistance to demagnetisation of the magnet).

V) Paths of least resistance on the human body.

This is another theory or explanation on the therapeutic effects of magnets.

According to chinese Medicine the skin contains a number of points having definite properties.

These points are grouped with lines called Meridians which are conceived as energy sources.

Researchers in the West have attempted to discover a physical reality of these points and Dr. Niboyet of Marseilles, investigated into the electrical properties of the Chinese points, as a subject for his Doctoral Thesis, in 1963.

With careful consideration regarding pressure of the electrodes as applied to the points of interest, presence of substances which may result in electrolysis on the skin, microscopic examination of the skin against injuries etc, that might interfere with the experiments and falsify the results, he experimented with these cutaneous points or Meridians and "... produced convincing evidence that these points, which in Chinese Medicine were conceived as points of energy, have a physical existence measurable in terms of electrical resistance". In the process of stimulation, (by acupuncture needles or electro-acupuncture or magnetic pellets etc), on these points, a copious secretion of endorphins in the brain is provoked, which results in pain relief and organic repair.

VI) Dr. Rudolf Stones explanation-The Polarity Therapy. It is the personal opinion of the author that Dr. Stones's contribution and explanation would be of paramount importance to those who wish to carry out research and investigations on Health and Disease and their relationships to electromagnetic energy fields.

The following is a quotation of his own writings.

Dr. Stone summarizes his philosopy of health and disease in his introductory book: "Health Building - The Conscious Art of Living Well", first published in 1962.

He describes something of his background when he says:

'For more than 45 years, I have been making research into energy fields in their relation to the healing art. Only I started with the life principle in the centre and worked outward in its application. I studied most of the ancient concepts of life and their approach to the life in man as an energy radiation principle in Nature in relation to the unit of life in man. It was called odic fluid, mesmerism, animal magnetism, and many other names. Man's constitution in the finer energy fields of mind, emotions, electromagnetic light waves, radiations and their effect on the chemistry in the cell as polarity energy of attraction and repulsion, is the reality behind these names.

'All cells are bipolar or they could not act and function. The law of polarity - of positive, negative and neuter energy-rules all matter as the principle of the three gunas from the (universal) mind downward. Attraction and repulsion is the manifestation of life, as in the sex-polarity of male and female through all creation of vegetation, animals and humans. Even metals have their positive and negative polarity, like the values of gold and silver which attract the sun and moon energies and are fine conductors for electronic construction. Much silver is being used for it nowadays.

'In this research, I have stumbled onto a science which blends the old concept of energies in the constitution of man and have linked it with the scientific research in space as the magnetosphere and electromagnetic lines of force in man's constitution. In my books and courses for doctors, I had drawings made which outline this in detail in relationship to the anatomy and physiology of the body. This relationship is the art of Polarity Therapy, based on the primary mind pattern energy in the brain which is duplicated in every oval[1] of the body as the five bases for sensory perception and motor function by which we live and act. Near as it is to us, nevertheless it is a lost art called the Spagyric Art by the great medieval doctor, Paracelsus von Hoenheim. He was taught its secrets in Arabia and in other parts of the then travelled worlds, even among shepherds and gypsies who lived near the grass roots of life with some strange traditions and secrets from the past. It became a lost art again after the great doctor passed on in Salzburg, Austria, on September 24,1541.

'His great contribution was the use of the electromagnetic energy waves to human chemistry. His research and knowledge in chemistry gave a great boost to that science, but the real secret of the electromagnetic energy connection to chemistry was lost to the world. Only chemistry in its grosser form survived and the world benefitted by it.

'Polarity Therapy is the name I gave to this art of correspondences of body spaces and functions, through attraction and repulsion of electromagnetic energy waves as the root of the five senses-sensory and motor-functioning in the body. Linking it with the cerebrospinal fluid radiation and circulation brought it into the realm of physiology and through the brain, the spinal cord and nerves and its meningeal coverings, made it a tangible asset in research and in the practice of the Healing Art. Polarity Therapy provides a definite location for the electromagnetic fields and their directive life-giving energy in man, which can be used as a definite art in therapeutics.

'When we are ill', he writes, 'and have pains, we think that it is the body which hurts and is sick, when in reality it is the life-breath or Prana Currents in the body (which operate it and sustain it), which are out of balance and coordination in their polarity function of attraction and repulsion. This negative and positive action throughout the system is the factor which makes

each cell contract and expand in its process of life: to take in nourishment - of solids, liquids, gases, warmth or energy - use it, and discard the waste products and ases and to radiate the heat (or caloric) energy for use and distribution.

'This seems a new idea or concept, because we approach and explain it from the modern basis of energy radiation, conduction and absorption, like electronic engineers would in their atomic research. This energy approach is prior to chemistry and mechanics. Energy in its threefold action of positive (+), negative (—), and neuter (0) polarity is prior to chemistry which deals with particles of matter and their chemical affinity-or antipathy-and which can result in new combinations.'

Dr. Stones was an initiate of a Perfect Maste in India Maharaj Sawan Singh, from whom he learned these and other higher spheres of thought.

[1] Dr. Stone refers here to the five ovals of the torso: the head, the neck, the chest, the abdomen and the pelvis.

Conclusion

The article gives a minute proportion of the work of some researchers, by way of a historical review, with regards to magnetic and electromagnetic fields and their effects on living organisms.

It would seem that the body has a system of data transmission, storage, acquisition of information in the form of magnetic and electromagnetic fields which are of dual polarity.

It is the balance of positive and negative polarities which make up the harmonious energy patterns that stabilises emotional structure and healthy mind.

Some scientists however express concern and caution about the use of magnets with strong magnetic field intensities and the duration of field exposure.

It is thought that the strength of magnetic pellets used to stimulate acupuncture points for instance should be in the region of half a gauss or less, this being the approximate strength of the magnetic field of the earth.

The work of H.S.Burr, Barnothy, Battacharia, Davis and Rawls, Stones and many others, relating to the therapeutic effects of magnetism/electromagnetism have provided those interested in relevant work with a lifetime of research into the gross and subtle energy patterns involved in Healing.

Many more researchers all over the world, too many to be quoted in this short precis, and many others unknown to the writer, are adding to the body of knowledge from which man will find the way to a healthier and happier life.

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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


δομικό πλέγμα
DOMOPLEX
για λιγότερο κόπο, χρόνο και χρήμα
• Σύγχρονη λύση προηγμένης τεχνολογίας, πρακτική, γρήγορη και οικονομική.
• Ψηλότερη αντοχή, οικονομία υλικού, μηδενισμός αποκομμάτων.
• Ειδικευμένοι πολιτικοί μηχανικοί και πλήρης σειρά προγραμμάτων κομπιούτερ (Domus) για στατικούς και αντισεισμικούς υπολογισμούς, στη διάθεση σας.
• Παγκύπρια διανομή από τα καταστήματα υλικών οικοδομής.
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VALUE ANALYSIS IN DECISION MAKING

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This method is also known as a Cost-Benefit Comparison. It may be used when deciding on which one, from a set of alternative schemes, to consider either for purchasing or for detail design and production.

Thus one may seek to:

(i) **Maximize Benefits**

- mostly for government and social projects.

(ii) **Minimize Costs**

- usually the objective of businesses in a competitive market

(iii) **Maximize Payoff (or Profit)**

Where, Payoff = Benefit - Cost

- usually the consumers objective

A. Mathematical Formulation:

Let:

{Dd}=Set of alternative Design concepts. D_1, D_2, ...Dd,...,Dn

{Aa}=Set of **Attributes.** A_1, A_2, ..., Aa, ..., Am

These are the factors which are important and will be taken into consideration when making a decision.

e.g. When making a decision on which car to buy (or design), one may consider as important attributes: km/lt; maximum speed; cost; comfortability; reliability; second-hand value etc.

Va=**Relative** Value or Importance of Attribute Aa. (Also known as the weighting factor).

The attributes may be graded on a scale such as 1, 3, 5, 8, 10, or any other suitable, linear or non-linear scale.

Pad=**Index of Performance Success** of attribute Aa applied to design concept Dd. This is also known as the **Utility Value.**

Bd=Assessed Benefit (Value) of proposed design d.

$$Bd = \frac{\sum_{a=1}^{m} Va\ Pad}{\sum_{a=1}^{m} Va} \qquad (1)$$

Cd=Estimated Cost of proposal D.

Bd=Assessed Benefit of proposal D, expressed in monetary term

i.e. $Bd = k\ Bd$ (2)

k=Conversion Constant

Pd=Pay-off (or Profit) of proposal D.

$Pd = Bd - Cd$ (3)

B. Example

EXAMPLE OF COST-BENEFIT COMPARISON AS AN AID TO DECISION-MAKING

Let three different design proposals D_1, D_2, D_3, of three different cars that one may be interested to apply a cost-benefit comparison with the objective of deciding on which one of the three is the "best" for further detailed design. This procedure could also be used by:

(i) A prospective buyer who is interested in evaluating them for purchasing, (ii) By an engineer in a company interested in evaluating them in order to determine which one is the "best" and thus propose it to the management for detailed design and production.

Let the attributes which are to be considered important and their corresponding relative values be as shown in table I.

TABLE I

a	ATTRIBUTE Aa	Va
1	A_1=Driver Comfort	10
2	A_2=Ease of Control	10
3	A_3=Reliability	8
4	A_4=Fuel Economy	5
5	A_5=Maximum Speed	3
6	A_6=Appearance (or Style)	3

A scale of 1, 3, 5, 8, 10 has been used.

In order to obtain the Index of Performance Success, we need to have a standard of comparison. This is the design (or model) that will ideally meet all the objectives and constraints. For each alternative idea (or design concept, or choice) the degree of satisfaction of each attribute may be evaluated as shown in table II.

TABLE II

			Performance of each Design		
a	ATTRIBUTE, Aa	OBJECTIVES	D_1	D_2	D_3
1	Comfort	----------	Good	Very Good	V. Good
2	Control	----------	Satisfactory	V. Good	V. Good
3	Reliability	40000 km trouble-free	40000	28000	40000
4	Economy	14 km/lt	11.2	7.7	7.0
5	Speed	160 km/hr	128	176	192
6	Appearance	----------	Satisf.	Good	V. Good

Using table II we can find the Index of Performance Success, as shown in table III.

TABLE III

a \ d	1	2	3
1	0.9	1.0	1.0
2	0.8	1.0	1.0
3	1.0	0.7	1.0
4	0.8	0.55	0.5
5	0.8	1.0	1.0
6	0.7	0.9	1.0

1. BENEFIT ANALYSIS

TABLE IV

			D_1	D_2	D_3
a	Attribute, Aa	Va	VaPa1	VaPa2	VaPa3
1	Comfort	10	9.0	10.0	10.0
2	Control	10	8.0	10.0	10.0
3	Reliability	8	8.0	5.6	8.0
4	Economy	5	4.0	2.8	2.5
5	Speed	3	2.4	3.0	3.0
6	Appearance	3	2.1	2.7	3.0
		39	33.5	34.1	36.5

Using formula (1) get:

$$B_1 = \frac{33.5}{39} = 0.860$$

$$B_2 = \frac{34.1}{39} = 0.875$$

$$B_3 = \frac{36.5}{39} = 0.936$$

Thus, based on a Benefit Analysis alone, design D_3 seems to be the best choice.

2. BENEFIT-COST COMPARISON

Let the estimated cost of each design be:

C_1=C£ 2,000

C_2=C£ 2,800

C_3=C£ 4,500

Thus considering the cost alone, design D_1 seems to have an advantage over the other designs.

Defining,

$$K \equiv Ci/Bi \qquad (2)$$

$$\text{or } K \equiv \frac{2800}{0.875} = 3200$$

the benefits in monetary units become:

B_1=3200x0.860=C£2750

B_2=3200x0.875=C£2800

B_3=3200x0.936=C£3000

From equation (3) the payoff in monetary terms is:

P_1=2750—2000=C£750

P_2=2800—2800=C£0

P_3=4500—4500=C£—1500

SUMMARIZING:

SELECTION ACCORDING TO MINIMUM COST $\Longrightarrow D_1$

SELECTION ACCORDING TO MAXIMU BENEFIT$\Rightarrow D_3$

SELECTION ACCORDING TO MAXIMU PAYOFF$\Rightarrow D_1$

NOTE: The value of K must be as defined in equation (2), otherwise we will not be able to assess the **relative** payoff.

EMINENT WOMEN OF SCIENCE, ARTS AND PHILOSOPHY IN ANCIENT GREECE

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This article is about historic figures of women in Ancient Greece who managed to emerge from the conventional straight-jacket of wife-mother-mistress, and make their mark in the wider world of arts, science and philosophy.

But what was the social and educational environment in which these women were born, raised and created?

Homer and the tragedians paint a picture of a moderately free social life for **noble, upper-class** women. They could certainly move and mix within their own circle.

Similar social conditions seem to have enjoyed women of aristocracy in the tyrants' courts, in pre-democratic Athens, in Lesbos and certainly in Sparta.

All women, even of the highest class, since the time of Homer, are pictured as occupying themselves with spinning, weaving and making clothes.

Information about **middle** - and **lower middle** - class women we have mainly from democratic Athens. Their lives seem to have been much more restricted. They married very early, too early in Xenophon's opinion, as early as the age of fourteen, (Lac. Pol. 1,3-6); the women seemed to have been confined entirely to their households, being occupied with raising children, making clothes with the help of their maids and protecting the house (Xen. Oec. 7.17-37).

There are some indications that women did receive in Ahtens elementary education, knew a little about the affairs of the state, and had a considerable influence on their husbands.

Women in Athens participated in family and state religious practices and ceremonies.

In democratic Athens middle-and lower middle-class women did not go out to work (Xen. Mem. 2.7. 2-12). They had no political rights; the law gave them only the right to divorce their husbands (by απόλειψις) as Alcibiades' wife did, and the right to give evidence under oath.

Women could not own property. For this reason the state took elaborate precautions to protect them against being left destitute, to secure marriages for orphans and girls without brothers, and to protect the elderly. (Arist. Ath. Pol:56, 6-7). Failure to secure marriage for womenfolk was considered discreditable. The requirement (after 451 BC) that citizens must have both parents citizens, and be formally married, ensured that almost all citizen girls would marry.

Young women were expected to be chaste and, therefore, they were excessively guarded. Older women, especially, widows had more freedom of movement and independence.

Poor women, especially widows, went out to work for pay. Known occupations include spinning for pay (Hom. Il. 12. 433-5), wet nursing, selling ribbons (Dem. 57. 31-35), selling bread; festival garlands (Ar. Thesm. 446-52).

Non-citizen women (foundlings, slaves, foreigners) could become either concubines, kept women, - a class recognized at law, (Dem. 23. 53-6) or courtesans (εταίραι), who were often highly educated and talented, and acted as the female company or musicians at men's social gatherings and symposia.

The **lowest** class were common prostitutes (πόρναι), who frequented the lodging houses of Peiraeus. The trade of keeper of girls (πορνοβοσκός) was followed by retired εταίραι.

It is interesting to note, however, that philosophers, like Aristotle, Plato and the stoics (Musonius) supported ideas of equality for women, and believed that women should have the same education and training as men (Plato:Laws; Arist.: Pol. 1.1 Nic. Eth. 8.12).

During the Hellenistic Age **royal** women enjoyed great influence and played considerable role in dynastic intrigues; **upper-class** women in Alexandria enjoyed considerable freedom (Theoc. Id. 15), and papyri (private letters) show widespread literacy among the Greeks of Egypt. Some social contacts between the sexes are portrayed in the society of New Comedy.

In such an unfavourable, male-dominated environment not only did some women strive for better education and wider knowledge but they also managed to excel and achieve outstanding performances in the arts, science and philosophy.

Unfortunately, the bulk of their work has been lost irrevocably it seems. What delails, however, we can glean from various ancient and modern sources, are enough to excite our imagination, and justify the reputation and acknowledgement that these women enjoyed in antiquity.

The first famous woman of letters recorded in history is SAPPHO (7th century BC). She came from an aristocratic family in Lesbos. Her poems are said by Tullius Laurea to have been arranged in nine (9) books. Her poetry portrays the society at peace: rural life, religious festivals, and

weddings. A woman's life is also her favourite theme: love and the subsequent feelings of hatred and passion, jealousy and joy, pleasure and pain are described with great intensity in a rhythm and sound of immediate appeal. Her poems are written in the Lesbian vernacular.

A circle of young girls, perhaps a cult in honour of Aphrodite and the Muses, formed around her to be taught music and poetry and they were the subject and audience of many lyrics which were full of affection and at times openly erotic. It is this open erotic kind of poetry that gave rise to the terms "Lesbian" and "Lesbianism" later.

Sappho and the slightly senior Alcaeus, were the first to create the personal, subjective lyric, which was later developed by the Roman poets such as Catullus and is still popular.

Her "epithalamia", marriage songs, were popular in antiquity; her most famous poems were: the Ode to Aphrodite and the Ode to Eros.

THEANO (6th century BC). She was probably the most distinguished of the group of women associated with the Pythagorean school of philosophy. The first was Aristoclea, the teacher of Pythagoras at Delphi.

Theano was a mathematician, who became a leading teacher with Pythagoras, and eventually married him.

Her philosophical work was supposedly concerned largely with the virtue of moderation in the ethics of personal life, and education, although she was also an expert on medicine.

Other women in this group include Damo, Pythagora's daughter, whose chief concern was with education of women, and Theoclea, who became a high priestess. In the 5th century BC Pythagorean women were associated with the origins of the Platonic School, Diotima, as a teacher of Socrates, and Perictyone, whose work "On Wisdom" is mentioned by Aristotle.

CORINNA (6th century BC). A lyric poetess from Tanagra in Boeotia. Very few fragments of her work survive. She wrote in Boeotian dialect in a simple style, poems on the legends of her native country.

Tradition has it that she has been a contemporary, a competitor and even a teacher of Pindar. But there is nothing in the fragments of her poetry or any contemporary source to confirm this influence.

According to an anecdote Corinna criticized the absence of myths from one of Pindar's early poems; when Pindar heard this, he went to the other extreme. Corinna then remarked that one should "sow by handfuls, not with the whole sack" an expression that became proverbial. According to another anecdote her self-satisfied provincialism exasperated Pindar to such an extent that he called her a sow.

TELESILLA (5th Century BC). A poetess from Argos. She wrote hymns and patriotic songs, but is mainly remembered as a saviour of her city during a siege by the Spartans. While all men were away fighting, Telesilla moved the women, through the power of her heroic verse, to take up arms and defend their city. Thus inspired they attacked and drove away the enemy. In gratitude for what she had done, her fellow citizens dedicated a statue to her in the temple of Aphrodite. The fragments of her poetry which survive are mostly hymns to Apollo and Artemis.

PRAXILLA (mid-5th century BC). A poetess from Sicyon. She was famous for her dithyrambic verses and hymns. Only some fragments of her poetry survived from two of her poems: Achilles and Adonis. The metre (-UU-UU-UU-U-U) was known as Praxilleian after the poetess' name.

AGNODICI (4th century BC). She is the first woman gynaecologist. Dreseed in men's clothing, she attended the medical classes of the famous doctor Herophilos and practised gynaecology disguised as a man.

Other doctors, jealous of her fame, accused her of corrupting women. In court she was forced to reveal her sex in order to save her life. Then new charges were brought against her of practising a profession restricted by law to men alone! eventually she was acquitted by the Athenian court.

History repeats itself in the case of Dr. Panajotatou Angeliki (1875—1954), the first female lecturer to be appointed at the medical school in Ahtens, who was forced to resign as hostile students refused to attend her lectures simply because she was a woman.

Agnodici's story reminds us of Dr James Barry (or Miranda Stuart) 1795—1865, who was born a woman but successfully disguised "his" sex all his life, and had a long career as a doctor with the British Army. Dr Barry's secret was revealed during the post-mortem examination.

ARETE OF CYRENE (mid-4th century BC). She was a philosopher, the daughter of Aristippus, the founder of the Cyrenaic school. She was taught philosophy by him and succeeded him as leading teacher after his death. She is credited with over 40 works none of which survives.

She taught her son, also called Aristippus, who developed the Cyrenaic theories of sensation as the means of physical knowledge and pleasure as the aim of all action.

In a different 4th century philosophical school, the Cynic, another woman, Hipparchus, was prominent, and is also raputed to have written tragedies and philosophical treatises.

ERINNA (4th or 3rd century BC). A poetess from the Dorian island of Telos (near Rhodes) was famous in antiquity for her poem "The Distaff" described in the lexicon by Suidas as a poem of 300 lines written in a mixture of the Dorian and Aeolic dialects. Erinna successfully imitated Sappho's style, writing in her local dialect. In "The Distaff" she describes with deep feeling the joys of childhood and games with her friend Baucis. She also wrote epigrams three of which survive in the "Palatine Anthology". She died when she was only 19.

HYPATIA (370-415 AD). She was the most famous woman of letters in the Hellenistic World. Hypatia was the daughter of the mathematician, Theon, who became Director of the University of Alexandria.

She established her reputation as a mathematician while studying at Athens under Plutarch the Younger and his daughter Asclepegeneia. On her return to Alexandria she taught mathematics and philosophy at the university. She taught geometry, astronomy, and the new science of algebra. She became a popular teacher known simply as "the philosopher".

She is known to have written a number of works, none of which has survived. Her commentary on the "Astronomical Canon" of Diophantus probably included original problems, while her algebraic work on the Conic Sections of Apollonius of Perga became of interest to mathematicians of the 17th century. She wrote a commentary on the Almagest, Ptolemy's astronomical canon, and with her father was co-author of at least one treatise on Euclid.

From her correspondence with Synesius of Cyrene, we learn that she invented two astronomical instruments, an astrolabe and a planisphere; apparatus for distilling water, and measuring its level; and a hydroscope or aerometer for measuring the specific gravity of liquids.

Hypatia belonged to the Neo-Platonic School of Thought. Christian fanatics incited by Cyril, the Patriarch of Alexandria, tortured her to death. Thus Hypatia brings up the rear of famous Greek women of Arts, Science and Philosophy.

It would have been an omission indeed if we had not included in this article two women who went down in history by sheer force of their personality and linked their names to arts. These are two εταίραι: Aspasia of Miletos and Phryne.

ASPASIA (5th century BC). She was from Miletos but became known in Athens.

In an age when Athenian women were confined to their households and were expected to lead a virtuous life, out of the public eye, spinning, weaving and making clothes, Aspasia, as an εταίρα and a foreigner opened her doors to Athenian intelligentsia as she was not bound by the same laws and customs that shackled Athenian women.

She was highly educated, very intelligent and an intellectual. She is mentioned as a teacher of rhetoric in Plato's "Menexenus". She was interested in politics and this excited jealousy and many insults and redicule as we can gather from Aristophanes' "The Acharnians".

Her house was a place where philosophers, artists and politicians talked freely. Socrates enjoyed talking to her and Plato mentions her as his teacher in the theory of love.

Aspasia became the mistress of Pericles since he could not marry her by his own law of 451 as she was a foreigner; she had a son by Pericles. Aspasia inspired and supported Pericles in his political aspirations to establish democracy in Athens and in his efforts to adorn Athens with the greatest works of art.

Aspasia was prosecuted for impiety and procuring but was acquitted after Pericles defended her in tears. (see "Cambridge Ancient History", Vol. V, note 8). Plutarch in his "Life of Pericles", which was, however, written 600 years later, claims that "she carried on a trade that was anything but honourable or even respectable since it consisted of keeping a house of young courtesans".

Six months after Pericles' death she married Lysicles, a cattle dealer, and had a second son.

PHRYNE (4th centrury BC). She was an εταίρα too from Thespiae of Boeotia, but seems to have lived in Athens.

Phryne had a perfect body and she is said to have been the model for Apelles' picture of "Aphrodite Anadyomene" and Praxitelles' statue of "Cnidian Aphrodite".

She acquired so much wealth that she offered to rebuild the walls of Thebes, on condition that the words "Destroyed by Alexander, restored by Phryne the courtesan", were inscribed upon them. Phryne was accused of profaning the Eleusinian Mysteries. Hypereides, the orator, saved her, when words were of no avail, by renting her robe and displaying her bosom to the judges who eventually acquitted her (Encyclopaedia Britannica).

Phryne was the only woman to be allowed to dedicate a golden statue of herself at Delphi for her perfect physical features were deemed to be a divine gift.

.....

The brief veriew above of the lives and achievements of prominent women of antiquity, who excelled in what were regarded as exclusive domains for men: arts, science, medicine and philosophy, undelines some interesting patterns:

(a) Women seem to have excelled and created mostly in societies where they enjoyed at least some social freedom and presumably education as in the case of Sappho and Hypatia.

(b) Women, like the famous εταίραι, unshackled by repressive laws and social customs could become great hostesses, cultivate the liberal arts: dancing, music, modelling, conversation. Εταίραι like Aspasia, and Phyne, were the driving and inspiring force behind many artistic, philosophical, cultural and political activities and movements.

(c) Whenever women encountered bitter social, educational and intellectual repression, they resorted to feminine ingenuity like Agnodici.

(d) Feminine achievement and intellect prospered mainly in societies where the arts, science and philosophy were being cultivated eg. in tyrants' courts, aristocratic and noble circles and families, democratic Athens. It is worth noting the fact that in Sparta where the educational and social goals were to create military geniuses instead of philosophers and artists, women, despite their considerable social freedom, did not excel in the arts and science.

(e) Some of the εταίραι also made a fortune like Phyne out of modelling or other liberal arts. They could perhaps be considered the forerunners of modern women of business, management and self-made female millionaires.

TEMPERATURE EFFECT ON ROLLER CONTACT BEARINGS

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1. Introduction

The rolling contact bearings are widely used today in high speed machinery because of the advantages they offer over other bearing types. Their premature failure has created greater demands on the integrity of operating components and operating conditions of the bearings.

Fatigue is usually taken as the predominant factor for failure in rolling contact bearings and for this reason the manufacturers quote the life of a bearing in terms of the load carrying capacity for a given number of revolutions. Loads may arise due to unbalance effects, unexpected thrusts, impacts, incorrect positioning of the bearing, thermal expansions, incorrect fitting , e.t.c.

There is, however, another factor giving rise to premature failure: The temperature effect.

2. Theoretical study on temperature effect

Rotating machinery designers are becoming increasingly interested in being able to predict the spacial temperature distribution within the bearing. Little investigation has though been done in rolling contact bearing temperature distribution.

Harris T.A. was the first to develop a technique for calculating operating temperatures. Palmgren's torque formulae were used for calculating the heat generated.

The heat generated can be expressed as:

$$Q = T \cdot \omega$$

where Q is the generated heat (W)
T is the friction torque ($=M_0 + M_1$) (Nm)
ω is the rotational speed (rad/s)

M_0 is the viscous friction torque and M_1 is the load dependent torque.

$M_0 = f_0 (vn)^{2/3} \cdot D^3 \times 10^{-7}$ (Nmm)
where f_0 is a factor for bearing type
n is the rotational speed (r.p.m)
D is the mean bearing diameter (mm)
v is the Kinematic viscosity of oil (mm^2/s)

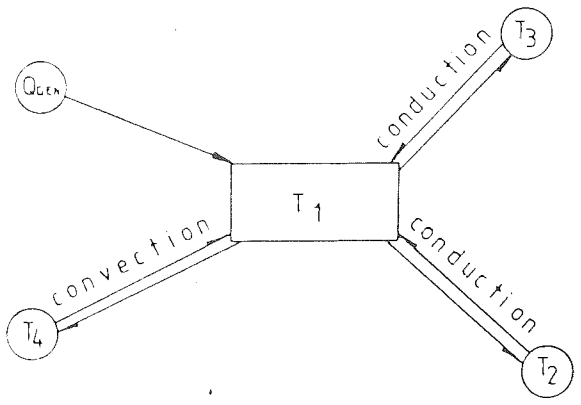
and $M_1 = f_1 \cdot g_1 \cdot P_0 \cdot D$ (Nmm)

where f_1 is a factor for bearing type
g_1 is a factor dependent on direction of load
P_0 is an equivalent static load for bearing (N)

The weakness of this method is that it requires values for the spacial division of the heat generated between the component parts of the bearing assembly. Reason B.R. suggested a distribution of heat in the bearing. The author used a test rig with a rolling contact bearing running in a bath of oil as an experimental datum against which predicted results, on spacial division of heat generated, were tested. The experiment gave the following distribution of generated heat in the bearing:

Roller contacts at the outer raceway: 40%
Roller contacts at the inner raceway: 40%
Roller contacts in the cage: 10%
Viscous churning of lubricant: 10%

The heat flow within the rolling bearing assembly is then analysed by the finite difference technique. This technique requires various points or nodes to be selected and the heat flow between them (including the required percentage generated heat value at the node) is analysed to give the temperature at each node. The heat transfer within the system is considered to be in a steady state.



In the figure above the heat flow for a temperature node, T_1, is illustrated where T_2, T_3 and T_4 are other nodes surrounding T_1. Q_{GEN} is the energy input at the node.

Heat flow into node = Heat flow out of node

Hence,

$$Q_{2-1} + Q_{3-1} + Q_{4-1} + Q_{GEN} = 0$$

Applying the modes of heat transfer,

$$\frac{K.A\ (T_2-T_1)}{L} + \frac{K.A\ (T_3-T_1)}{L} + A.h_c(T_4-T_1) + Q_{GEN=O}$$

where
K is the thermal conductivity of the material (W/m^0C)
A is the area perpendicular to the direction of flow (m^2)
L is the length of the nodal path (m)
hc is the convective heat transfer coefficient ($W/m^2\ ^0C$)

$(T_1 - T_2)$ is the difference in temperature level (°C)

For each node within the system an equation is formulated giving a system of equations to be solved with temperatures as the only unknowns, all other parameters being constants.

Tests carried out by the author on two test oils, SAE30 and SAE50 mineral oils, with different bearing speeds varying from 250 to 2500 r.p.m. and three pure thrust loads demonstrated that the above technique is successful.

The oil film thickness developed between the roller and the tracks is a function of viscosity, speed and load. It can be expressed in the simplified form of:

$$h = 1.845 \times 10^{-5} . F^{0.11} . n^{0.74} . e^{\frac{891.114}{t+110.562}} \quad (\mu m)$$

where

h is the oil film thickness (μm)
F is the axial load (N)
n is the rotational speed (r.p.m)
t is the temperature of bearing component in contact with the oil lubricant (°C)

From the above expression it is shown that as the temperature t is increased the oil film thickness is decreased.

3. Conclusions

Researches have shown that the bearing fatigue life is directly related to the oil film thickness. Therefore the temperature dependent viscosity coefficient of the oil film thickness between rollers and raceways is a major factor affecting the life of rolling contact bearings.

Heat generation is a function of bearing torque and angular speed. The bearing speed is the main factor affecting the rate of heat generation, torque tending to remain constant at higher speeds. This can be explained on the basis of the torque/lubricant viscosity relationship: as the bearing temperatures increase the lubricant viscosity decreases, thus, compensating for the speed increase giving an almost constant bearing frictional torque.

" Our bodies do not need to become tired, sick, exhausted and old. Change your 'image' of yourself; see yourself well, of course observing and practicing all the rules of health, and you will tend to be that which you visualize and practice".

Dr. NORMAN VINCENT PEALE

" As the day wears to evening and evening deepens into night, can you look back over the waking hours and recall something you have said or done that was really worthwhile? You can? That's good. You can't? Why?

FRANCIS GAY

" Almost every man thinks too poorly of himself. He undervalues his brain and his will and his stamina. He has no idea of what he can do — if he dares".

HERBERT N. CASSON

DESIGN OF TELECOMMUNICATION NETWORKS OF BUILDINGS

S. Savvides I Eng MIELecIE
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Abstract

The aim of this paper is to give some ideas about the design of internal telecommunication networks. Some basic regulations are given about the conduit framework, the wiring and the earthing systems. Some information about the plug and socket system of connection of telecommunication equipment is given also. Finally a typical design of an internal telecommunication network is given for a building housing shops offices and appartments. The design given is based on the requirements of the Cyprus Telecommunications Authority.

1. INTRODUCTION

The services of most modern buildings are complex and their planning demands increasing care, coordination and thought. Services must be so designed and neatly installed so that they will be easily maintained and reasonably extended throughout the useful life of the structure of the building.

Telephones should rank equally in importance with all other services. In some type of buildings the internal telephone network is more liable to re-arrangement than any other service. in this respect consideration shall be given at the design stage to facilitate such modifications at a later stage, without damage to the structure or it's decorations and finishes. The recent adoption of the plug and socket system of connections by the Cyprus Telecommunications Authority assists a lot towards the solution of this problem.

2. BASIC REQULATIONS

2.1 Conduit Framework

— The conduits used may be steel, plastic or asbestos cement.

— Telephone cables may cover 30% of the area of the conduit at the initial stage of the installation.

— Minimum conduit size to be used is 20mm. (Between distribution cases 25mm).

— Minimum internal radius of bend of conduits shall be equal to 4XD where D is the diameter of the conduit.

— The distance between termination boxes shall not exceed 15 meters.

— In the case that metal conduits are used these must be earthed.

2.2 Cabling

— A 3-core 0.5mm cable shall be connected for ordinary telephone service to every telephone socket. The two cores are for the speech and the one for earth. For special telephone service more cores may be required.

— Cable runs shall be continuous.

— No other service cables shall pass through the same conduit with telephone cables.

— Telephone cables shall be adequately separated or screened from sound and central antenna cables to avoid interference.

— The Insulation resistance of cables between them and earth shall not be less than 5MΩ at 250 V.

— For surface installed cables the minimum internal radius of bend shall be equal to 4XD were D is the overall diameter of the cable (for metal sheathed cables 6XD).

2.3 Distribution Cases

— The siting of the distribution cases shall be such so that these shall not be under the control of third parties. Areas recommended for the installation of the distribution cases are the entrance lobbies, corridors, risers, staircases and generally speaking commonly used areas of buildings.

2.4 Earthing Systems

Telecommunication equipment that operate on a high voltage (24OV) shall be earthed in accordance with the IEE Wiring Regulations.

On the other hand in a number of occasions different types of telecommunication earthing systems are required for certain internal telephone networks. The resistance to the general mass of earth shall not exceed 5 ohms for any telecommunication earthing system.

More analytically these telecommunication earthing systems are:

2.4.1 Operational earth

This is used in cases where Telecommunication equipment require an earth return for their operation. This is used in telecommunication networks of buildings especially when a Private Automatic Branch Exchange (PABX) is used.

2.4.2 **Electronic telecommunication equipment earth**

In a telecommunication network which includes electronic equipment such as Electronic Private Automatic Branch Exchanges (EPABX) a special earthing system is required for the effective operation and protection of the equipment.

This earthing system shall comprise one earth electrode with two earthing wires of minimum size of 10mm^2 terminated on it. These earthing wires are extended to the main distribution case, and from their to the distribution cases of the other floors. Each EPABX is then connected to the two 10mm^2 risers by two 6mm^2 earthing wires.

2.4.3 **Protection against lightning surges earth**

This type of earthing system is intalled in case where the telephone connection to the building is through overhead line which exceeds 100 meters.

3. PLUG & SOCKET SYSTEM OF CONNECTION

3.1 General

The plug and socket system of connection of telecommunication equipment offers a lot of advantages such as:

— Use of an exchange line from a limited number of telecommunication equipments from a lot of alternative positions. The equipments may be plugged in at any point where a telecommunication socket is installed.

— The telecommunication network is simplified and is also improved from the aesthetic point of view.

— The installation of the telecommunication equipment is faster and simpler.

— The fast isolation of the telecommunication equipment from the telecommunication network allows fast identification of faults.

3.2 Types of Sockets

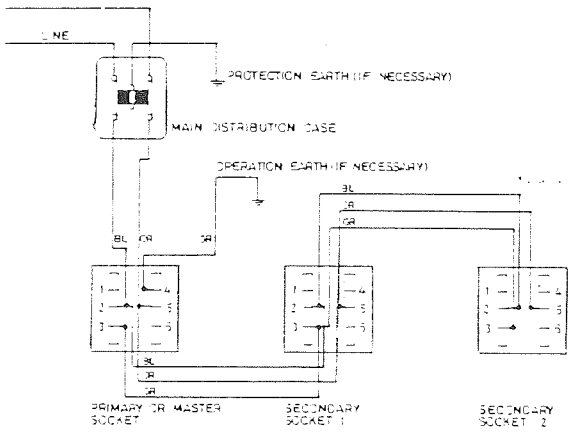
There are two types of sockets that may be connected on a telecommunication network. The **primary** or **master sockets** and the **Secondary sockets**.

Both types of sockets have 6 numbered terminals. The only difference between the **primary** or **master socket** and the **secondary socket** is that the **primary socket**

is provided with electronic components such as capacitor resistor and high voltage protective device for the network, while the **Secondary socket** is provided with the six numbered terminals only.

The first socket connected on a telecommunication line is of the **primary** or **master type** and all other sockets connected on the same line are of the **secondary type**. There is no limitation in the total number of sockets connected on a line.

A typical connection of three sockets on a Telecommunication line is shown on the diagram below.



TYPICAL CONNECTION OF SOCKETS ON A TELECOMMUNICATION LINE

The connections of various telecommunication equipments on a telecommunication line are shown in the following table.

S.N	TYPE OF TELECOMMUNICATION EQUIPMENT	CONNECTIONS ON SOCKET TERMINAL	COLOUR	TELECOMMUNICATION LINE
1	TELEPHONE	2	BLUE	Wire — B
		5	ORANGE	Wire — A
2	FASCIMILE	2	BLUE	Wire — B
		5	ORANGE	Wire — A
3	NEW TYPE TELEX	1	BLUE	Wire — B
		6	ORANGE	Wire — A

4. PLANNING THE INTERNAL WIRING OF A BUILDING

4.1 General

When planning the internal wiring of a building the following points must be considered.

— The location of the building in other words is the building situated in a commercial or residential area.

— The possibility of the future extension of the building.

— The type or types of telephone facilities required i.e., Direct Exchange Lines, PABXs, EPABXs, Telexes, Fascimile units etc.

— The internal wiring shall be so planned to offer flexibility easy maintenance and capability for future expansion.

4.2 Procedure to be followed

The following is a recomended procedure which may be used as a quidline when designing the internal telecommunication network of a building.

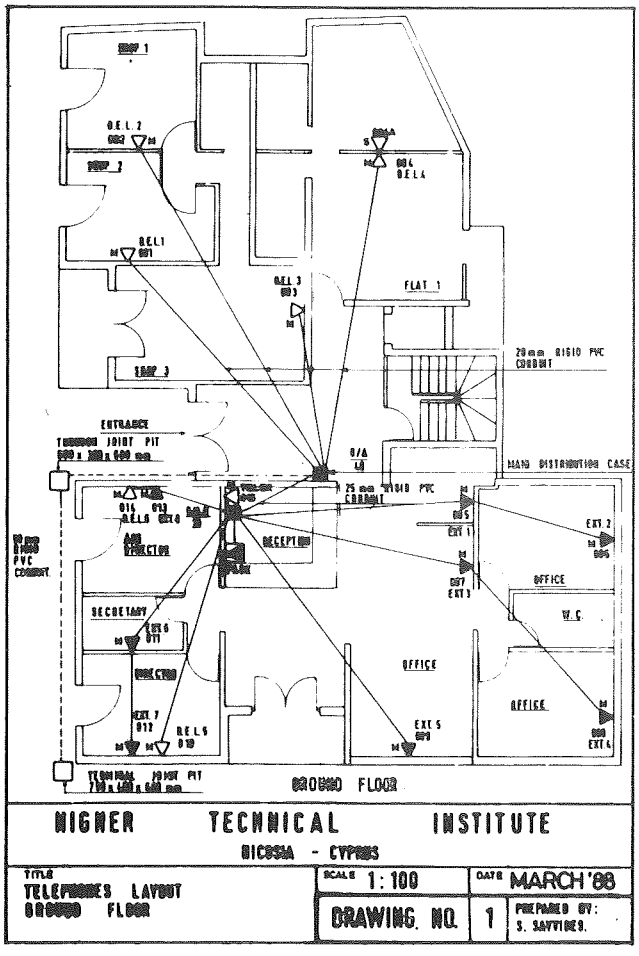
— Get acquainted with the building plans.

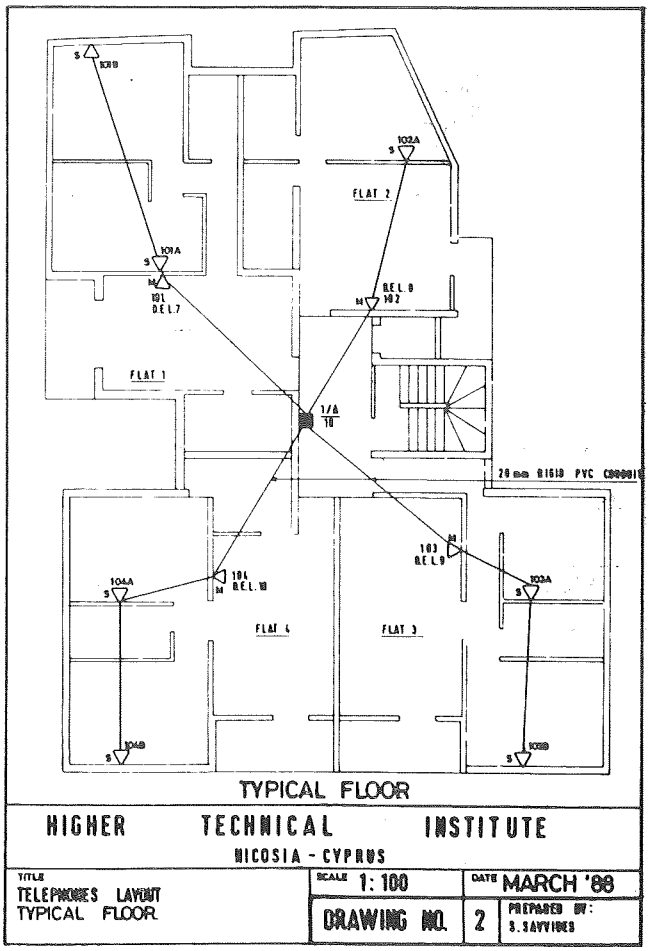
— Discuss requirements with Architect or Client.

— Spot the telecommunication points on the plans (e.g. Direct Exchange Lines, Extensions, Telexes, Fascimiles) see drawings Nos 1 and 2.

— Having in mind the above locate the Distribution Cases on the plans. See drawings Nos 1 and 2.

— Connect accordingly the telephone points to the respective Distribution Cases. See drawings Nos 1 and 2.





The work done by the heart per day is of the order of 25,000 kilogram-meters! Contemplate this fantastic matter.

— Size the Distribution Cases. It is recomended to install Distribution Cases with a capacity which will be double the initially required capacity. See drawings Nos 1, 2 and 3.

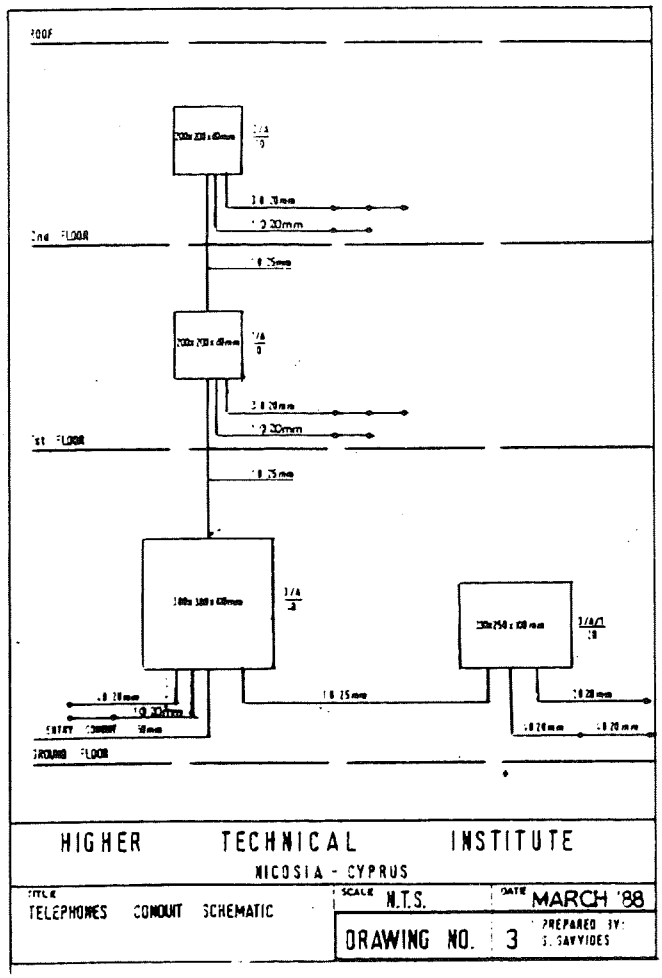
— Determine the Distribution Cables i.e the cables which will connect the Distribution Cases with the Main Distribution Case. It is recomended that the cable capacity selected shall be twice the initially required capacity. See drawing No 4.

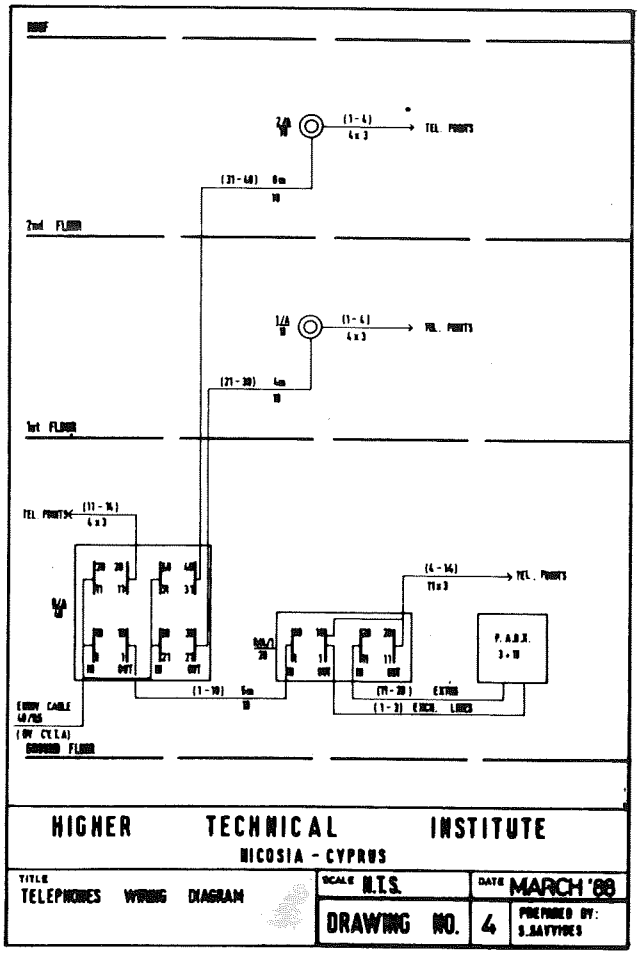
— Prepare the, Conduit Framework Schematic Diagram using the following tables, See drawing No 3.

TELEPHONE CABLES DATA

PAIRS	OVERALL DIAMETER (mm)	CROSS SECTIONAL AREA mm²
1*	4	12.6
2	4	12.6
3	4	12.6
4	6	28.3
6	7	38.5
10*	8	50.3
12	9	63.6
20*	11	95
40*	15	176.7
80*	20	314.2
160	30	706.9
320	39	1194.6

*Indicate that the cable includes eath wire





Why do sea waves "break"? If you will observe them closely you will notice that the crest does not break until the height above the quiet set level is $\lambda/2\pi$. That is they break when their height is about 1/6 the distance between them.

CONDUIT CAPACITIES

CONDUIT SIZE mm	CONDUIT AREA mm^2	30% OF CONDUIT AREA IN mm^2
20	314	94
25	491	147
32	804	241
40	1257	377
50	1963	589
75	4418	1325

TRUNKING CAPACITIES

TRUNKING SIZE mm	TRUNKING AREA IN mm^2	30% OF TRUNKING AREA IN mm^2	45% OF TRUNKING AREA IN mm^2
50X37.5	1875	563	844
50X50	2500	750	1125
75X25	1875	563	844
75X37.5	2813	844	1266
75X50	3750	1125	1688
75X75	5625	1688	2531
100X25	2500	750	1125
100X37.5	3750	1125	1688
100X50	5000	1500	2250

— Prepare the Wiring Schematic Diagram. See drawing No 4.

— Prepare the List of Connections. See drawing No 5.

— Discuss and agree access cable route with the Telecommunications Authority. Agree also the location of the Main Distribution Case. See drawing No 1.

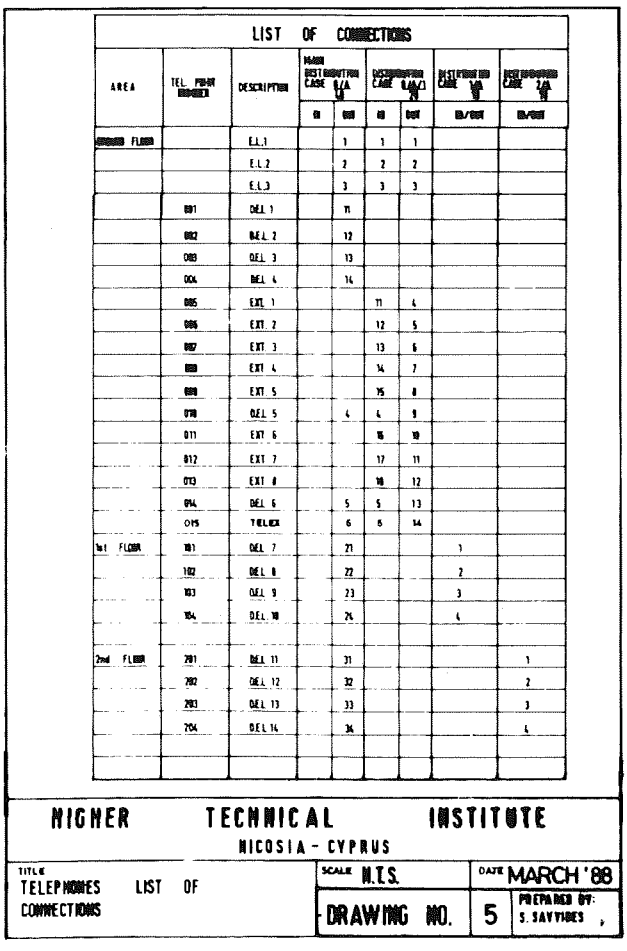
— Submit four sets of all the drawings prepared and an LRO plan for approval by the Cyprus Telecommunications Authority.

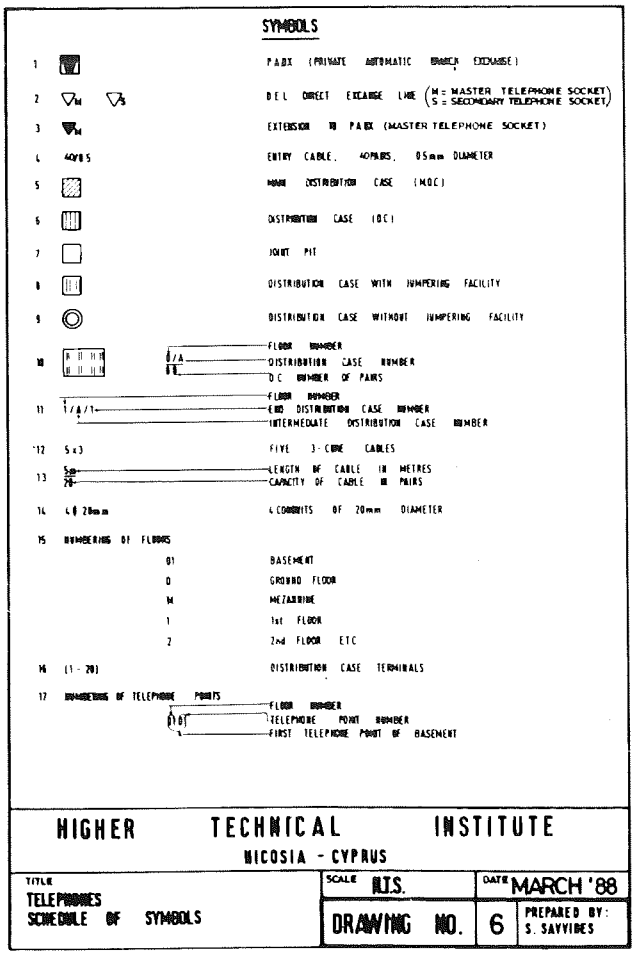
Note

All symbols used in the drawings are explained in drawing No 6.

References

Cyprus Telecommunications Authority Regulations January 1982 incorporating 1987 amendments.





"Those sciences are vain and full of error which are not born from experiment, the Mother of all Certainty".
LEONARDO DA VINCI (1452 - 1519)

ECONOMIC INSULATION THICKNESS

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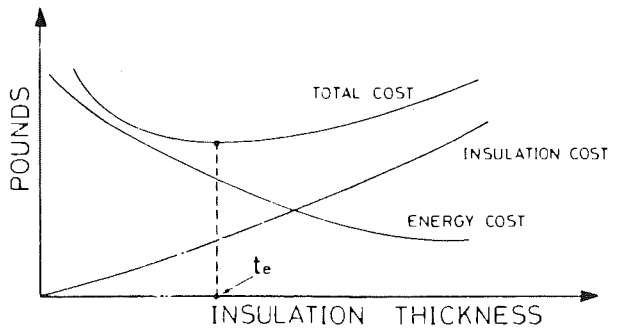
1. INTRODUCTION

Following the oil crisis of the seventies with the well known effects on the cost of energy, engineers and scientist start investigating for new ways to economise energy. One of these is the sector of building heating and air conditioning. The cost of that services in the developed countries present a high percentage in their annual expenditure.

Among other possibilities considered, engineers investigate the possibility to produce well insulated buildings so as to reduce the size of the equipment required in order to produce the required comford and consequently the operating cost. In some countries with high energy bills such as countries of the center Europe the heat resistanse of the building structure is even imposed by law.

What must be understood is that beyond a specific thickness of insulation, additional insulation is not cost effective, over the assumed usefull life of building and insulation. This specific thickness of insulation designated as te, is defined as the maximum insulation thickness at which the total investment in insulation and heating can be minimised over the lifetime of a building.

The cost of the installed insulation increases with thickness while the cost of fuel decreases. The total cost of insulation and heating is minimum at the economic thickness of insulation as shown in fig. 1. Further, the increase in cost of additional insulation beyond the economic thickness of insulation, is bigger than the decrease in heating cost.



The purpose of this article is to devire an equation for the minimum economic insulation thickness taking into account the life of the building, the cost and effectiveness of insulation and the existing building envelope thermal resistance.

At the end a computer program will be used to check and compare various types of insulation materials.

2. HEAT TRANSMISSION THROUGH BUILDING ENVELOPES

The heat loss through any of the building envelope part is defined as:

$$Q = (U.A) * (Ti-To) \quad (1)$$

$$\text{But } U = \frac{1}{RT} = \frac{1}{R+Ri}$$

So equation (1) can be written as:

$$Q = \frac{A*\Delta T}{R+Ri} \quad (2)$$

where

Q= heat loss, Btu/hr (kw)
R = Thermal Resistance of any part of building structure and air films, hr.Ft².F/BTU (m².⁰C/W)
U= Heat transmission coefficient, Btu/hr.Ft².F(W/m².⁰C)
RT = Total thermal resistance
Ri = Thermal resistance of insulation
A = Wall or Roof area, Ft² (m²)
ΔT = Ti - To, design temp. difference, F(⁰C)

The thermal resistance of the insulation is defined as:

$$Ri = t/k \quad (3)$$

where

t = Thickness of insulation, Ft(m)
K = Thermal conductivity of insulation, Btu/hr.Ft.F(W/m⁰.C)

Substituting in equation (1):

$$Q = \frac{A*\Delta T}{t/k+R} \quad (4)$$

3. ANNUAL HEATING COST

The yearly cost of fuel required for heating to satisfy the transmission losses through wall and roof can be estimated from the following equation:

$$E = \frac{24*Q*D*C_D*Pf}{n*V*\Delta T} \quad (5)$$

where

E = Yearly cost of fuel, £
D = Heating degree days for building Location
V = Calorific value of fuel used, Btu/gal (W/lt)

Pf = Cost of fuel, £/gal (£/lt)
n = Overall efficiency
Q = Design heat loss, Btu/hr (W)
C_D = Empirical correction factor for heating effect against 65F heating degree day.

For up to 5000 Farenheit heating degree days the following equation applies:

$$C_D = 0.87 \frac{D}{18500} \quad (6)$$

The total fuel cost for heating the building has to be calculated over the life of the building. The fluctuations in the yearly cost of the fuel over the lifetime of the building have to be taken into account. It is usually assumed that the cost of the fuel increases at a certain rate called the fuel inflation rate. The future expenses are then discounted at an assumed discount rate to the common basis of present worth, which is the amount that would have to be invested today to have the funds available in the future to meet all the future fuel expenses. The present worth factor (PWF) is obtained from tables or calculations and is then applied to the yearly fuel cost to obtain the present worth of the yearly fuel cost.

The present worth of the total fuel cost, CF, for the lifetime of the system is then given by:

$$C_F = E*(PWF) \quad (7)$$

where C_F = The present worth of the total fuel cost over the lifetime of the building, £

PWF = Present worth factor.

PWF can be obtained from tables or from the following equations:

$$RWF = \frac{1}{i-e} * 1 - \left[\frac{1+e}{1+i}\right]^N \quad \text{for } e \neq i \quad (8)$$

$$PWF = N*(i+e) \quad \text{for } e=i \quad (9)$$

where
e=Unitorm fuel inflation rate (%/100)
i=Uniform discount rate (%/100)
N=Lifetime of building, years

Combined equations 4,5 and 7 and simplifying, yields the following equation:

$$CF = \frac{24*A*D*Pf*C_D*(PWF)}{n*V*(t/k+R)} \quad (10)$$

4. COST OF INSULATION

The cost of insulation can be estimated by the following equation:

$$Ci = A*t*Pi \quad (11)$$

where: Ci=Initial investment required for building insulation, £
Pi=Cost of insulation, £/Ft³(£/m³)

Some types of wall insulation require a supporting frame structure. In that case the cost of the supporting frame has to be added to the cost of insulation.

5. ECONOMIC THICKNESS OF INSULATION

The life cycle cost for insulation and heating is given by:

$$C_T = C_F + Ci \quad (12)$$

Combining equations 10, 11 and 12, yields the following equation:

$$C_T = \frac{24*A*D*Pf*C_D*(PWF)}{n*V*(t/k+R)} + A*t*Pi \quad (13)$$

Differentiatiry equation (13) with respect to t, and setting it to zero to find a t at which C_T is minimum, yields:

$$\frac{dCt}{dt} = \frac{24*A*D*Pf*C_D*(PWF)}{n*V} * \frac{-1/K}{(t/K+R)^2} + A*Pi = 0 \quad (14)$$

$$\text{OR } K*n*V*A*Pf*(t/K+R)^2 = 24*A*D*Pf*C_D*(PWF) \quad (15)$$

Simplifying equation (15), rearranging the terms and solving for t which is now te will yield:

$$te = \frac{24*K*D*Pf*C_D*(PWF)^{1/2}}{n*V*Pi} - R*K \quad (16)$$

Equation 16 gives the economic thickness of insulation. It can be applied to any building type to determine the optimum amount of insulation in walls and roof.

6. COMPUTER PROGRAM

As can be seen from equation (16) many operations have to be done in order to optain the economic insulation thickness. The problem is even bigger if you try to compare the effect of various types of insulation. For this purpose a computer program has been written in order to make life easier. All the operator has to do is to input the information as required and then select the type of insulation from a table shown on the screen of the computer.

The effectiveness of the programm can be seen by using a sample building and testing it by using various types of insulation:

```
EXISTING BUILDING R-VALUE  = .35 Hr.Ft2.F/BTU

HEATING SYSTEM OVERALL EFFICIENCY = .85

CALORIFIC VALUE OF FUEL USED = 131000 BTU/GAL

COST OF FUEL = .45 £/GAL

e = UNIFORM FUEL INFLATION RATE (%) = .02

i = UNIFORM DISCOUNT RATE (%) = .05

N = LIFETIME OF BUILDING (YEARS) = 30

INSULATION CHOSEN IS EXTRUDED POLYSTYRENE

HEATING DEGREE DAYS = 1710

**>>  ECONOMIC THICKNESS OF INSULATION = 37.9047 mm

INSULATION CHOSEN IS URETHANE

HEATING DEGREE DAYS = 1710

**>>  ECONOMIC THICKNESS OF INSULATION = 27.74181 mm

INSULATION CHOSEN IS FIBERGLASS

HEATING DEGREE DAYS = 1710

**>>  ECONOMIC THICKNESS OF INSULATION = 101.9491 mm

INSULATION CHOSEN IS PERLITE

HEATING DEGREE DAYS = 1710

**>>  ECONOMIC THICKNESS OF INSULATION = 71.07098 mm
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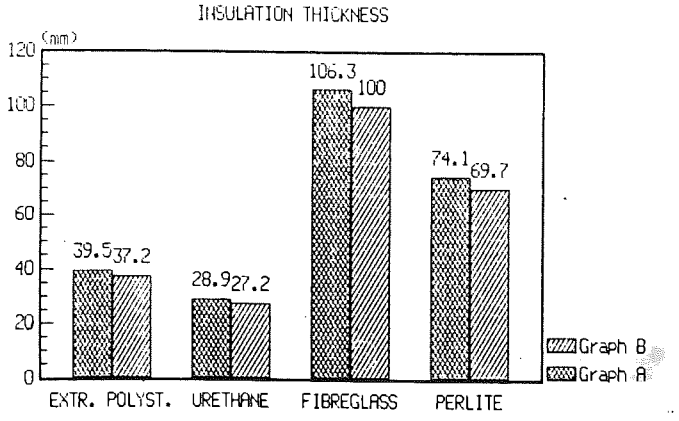

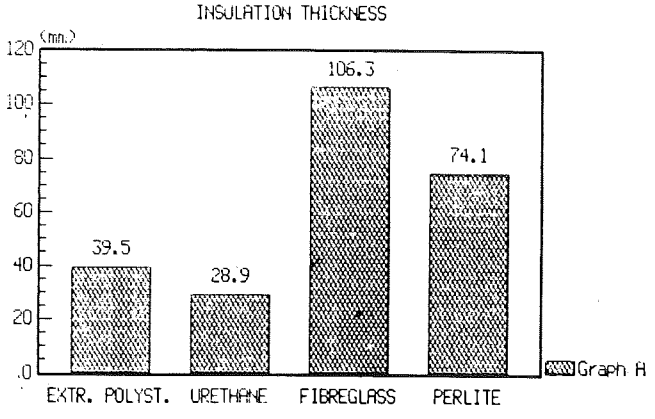

And graphically:

From the above graphical representation we can see that 39.5 mm of Extraded polysterene insulation has the same effect as 28.9 mm Unethame as 106.3 mm Fibreglass and 74.1 mm Perlite.

The existing building R-value used in this example is the value for a single 20 cm wall and the fuel is diesel oil.

Any of the parameters involved can be changed in order to see what is their effect on the insulation thickness. For the sake of an example if the Heating overall efficiency is somehow increased from 0.85 to 0.9 (by improving the combusting efficiency) the effect is as shown in fig. 3.

References:

1. ASHRAE JOURNAL
2. ASHRAE HANDBOOK OF FUNDUMENTALS.

RECENT EXPERT SYSTEMS

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Expert sytems together with their peripheral supplements have such a high rate of development that whatever is written will never capture the innovating aspects of this technology. Suffice it to say that the available information about these systems covers mostly the commercial types already in operation, while informatinon about recent systems developed by or for private companies is not readily available.

A sample of recent systems is enumerated below which we believe will illustrate the different approaches to expert systems design and development and the various problems the companies have faced in undertaking knowledge system development projects.

1. XCON (RI) and XSEL knowledge systems.

XCON, which was originally called RI, is an operational expert system that routinely configures Digital Equipment Corporation's (DEC) VAX-11/780 computer systems. XCON's input is a customer's order, and its output is a set of diagrams displaying the spatial relation-ships among the components on an order. These diagrams are used by the technicians who physically assemble the system.

DEC does not market precenfigured system instead, it offers a customer a wide selection of components to choose from. In 1979, for example, some 420 components were associated with a VAX-11/780. In effect, most of the systems DEC sells are one-of-a king systems.

DEC had made several unsuccessful efforts to develop a conventional program that would configure computers. The major problem was not so much that knowledge was illustructured but rather that it kept changing so rapidly. In late 1978 the company began a discussion with John McDermott of the Computer Science Department of Carnegie-Mellon University about the possibility of developing a knowledge based system that would solve the configuration problem. In two years time McDermott and his colleagues (from DEC Carnegie-Mellon University) developed and implemented XCON.

The 1st stage in the development of XCON involved creating a general design and then building a prototype system that would demonstrate the effectiveness of a knowledge system approach to DEC's configuration problem. The strategy for problem attacking was formulated together with a program with minimal knowledge of domain to demonstrate the approach. The OPSA already in existence and familiar to McDermott was used to develop the prototype to a capacity of 250 rules.

The prototype was tested and satisfied all the basic configuration problems it was given. McDermott decided in developing a prototype of a PDP-11 configuration system rather than focussing in the VAX-11/780 which choose proved extremely fortuitous since PDP-11 was a larger system with many more components. The initial prototype system was exparded from 250 rules to 750 and a component data base was expanded from an initial 200 components to cover all 420 components that would be involved in a VAX-11/780 configuration.

It may perhaps be of interest to describe how the system was developed from 250 to 750 rules. It was a classic case of how extensions can be driven by case studies. A case study was given to the computer, which produced recommendations which were in turn evaluated. As the expert and the knowledge engineer talked over the particular configuration, rules were directly or indirectly generated that assured that in the future that particular configuration would be correct and that also assured that similar configurations would be correct. The goal, to configure 75% of the orders with possibilities to be extended to accomodate additional cases was acheved inaugurating the XCON. The third stage was the validation of XCON which it was verified by a group of experts evaluating a number of 50 configurations produced. Some of the errors discovered were the result of inadequate descriptions of the components in the data base and from errors in the knowledge bases.

It is important to note that ten of these mistakes involved problems with specifications at a level of detail below that which human experts normally configure systems. By atempting to provide detail that human experts do not normally provide, XCON designers had made some minor errors.

The next stage was to consider how to integrate the system into Digital's organizational structure. Two functions were important. The first was how the system was to be controlled and monitored and the second involved determining how XCON was to be maintained and extended.

During implementation time, a problem report form was developed to assure that all errors resulting form the use of XCON were reported, investigated and corrected. 32% of the orders had problem that required action and which failure rate boshered some people at DEC. During the same period DEC and Carnegie-Mellon each added some additional features to the system

namely to allow customers to set specific constraints on the space in which the hardware was to be installed and certain components were dictated or eliminated in the basis of the customer's constraints.

OPS5 was reimplemented in BLIS5, a variation on LISP designed to be compiled into very efficient code achieving a reduction of the average configuration time of 1.5 CPU minutes. In reimplementing XCON on OPSD5, McDermott realised that the task was not so much a generate-and-test task, as originally supposed, but was in fact, a matching task that required only a little backtracking. Thus reconceptualization of the task allowed the designers to charge the way the rules were written, and they could thus reduce the total number of rules. The final stage in the development and implementation of XCON began in June 1987 when the system was put into place in all manufacturing facilities of DEC, and it has been in use and been maintained since that time.

At the same time DEC launched a new effort to develop a front-end for XCON to help salespeople in the field. SXEL will take the customer's original specifications and suggest what additional components may be needed to satisfy the customer's needs.

The development of XCON and SXEL illustrates a number of themes that run through the development of all recent expert systems. First, the system was not developed from scratch, but by means of an expert system building tool OPS4§5. This tool allowed to developers to create the initial prototype of 250 rules and to develop the entire first version of the system with some 750 rules. One unique feature of XCON is that, unlike most other recent expert systems, it does not use probabilities or centainty factors. A component is either included or omitted.

DEC's success has encouraged a number of other computer companies to develop computer configuration systems. We described the development of XCON in some detail and at length as it is a very good example of the procedures and problems a company encounters when it undertakes the development of a knowledge system.

2. GENESIS

This system was developed by Intellicorp and is currently used by more than 500 research scientists. Two different programs were developed, each a variation on an expert system to help a molecular geneticist design complex experiments to determine the nature of a particular DNA molecule. The programs were termed MOLGEN the core of which was an expert system building tool called Uruts, making use of a constrained natural language interfoce whose vocabulary is familiar to molecular biologists. The programs are focused on determining which of several skeletal plans would be most appropriate to a user's needs and alos help implement the details of a particular plan once it has been selected.

The resulting GENESIS package includes seven different expert systems.

SEQ, a nucleic acid sequence analysis, comparison, and manipulation tool.

GEL, for the managernent of large-scales DNA sequencing projects sizer, a tool for use in calculating fragment digests PEP, a tool for polypeptide analysis, comparison, and manipulation GENED, which facilitates the simplified entry of nucleic and amino acid sequences

QUEST, a data base search, location, and retrieval system.

Data from those data bases or from current research can then be manipulated by one or some combination of the GENESIS programs. The client may connect with a DEC20 computer, located in either Los Angeles or Paris, and accesses the GENESIS programs and data bases as needed.

Recently, Intelli Corp has begun offering the GENESIS package on a genetic engineering workstation called BION. The BION workstation represents a prototype of the sort of workstations that we expect will be built in the next few years.

DELTA/CATS-1

It stands for Diesel-Electric Locomotive Trounleshooting Aid/Computer Aided Troubleshouting System-1. They are used interchangeably to describe an expert system developed by the General Electric Company in Schenectady, New York. The system is designed to help railroad maintenance personnel maintain GE's diesel-electric locomotives.

This is a classical case where heuristics or the personal experience of 40 years of one expert was used to formulate a knowledge system that would allow GE to deliver knowledge to less expert personnel at the various railroad yards around the country.

The DELTA system uses a hybrid forward/backward chaining inference strategy. This strategy, together with troubleshooting rules, is used to isolate faults and to generate inquiries. In addition, there is a help system that uses a forwardh-chainer together with a rule-base engine taxonomy to respond to user requests for information, such as the location and identification of individual locomotive components, replacement parts classification, and description of repair procedures.

The basic expert system has been interfaced with a device that allows the system to print our diagrams and a videodisk player that allows the system to print out diagrams and a videodisk player that allows the system to display diagrams to show where particular components are located on the locomotive. The expert system helps the maintenance person figure out what the problem is and, if necessary switches over to the video system to show the uses how to make thw checks or measurements that will generate the information DELTA needs to make adiagnosis. Once the problem is isolated, DELTA, if reguested, will actually show a step-by-step procedure for fixing the problem.

DELTA/CATS-1 is currently being tested in the field while at the same time the development team is adding additional rules to create a full-scale production prototype system.

DRILLING ADVISOR

It is a prototype knowledge system developed for the French oil company Societe National Elf-Aquitaire (ELF) by Teknowledge Inc. The system is designed to assist oil rig supervisors in resolving and subsequently avoiding problem situations. The oil rig supervisor is familiar with the technology, equipment, and procedures involved in the drilling process, out occasionally requires assistance when special problems occur.

The prototype system was developed to solve one specific problem, namely down-hole sticking-which occurs when the rotary and vertical motion of the drill is impeded.

D.A. was developed by means of a tool called 5300 an EMYCIN like tool. It is a backward chaining, production rule system, that takes full advantage of EMYCIN's user-friendly interface and knowledge acquisition facilities.

Currently the knowledge bases of D.A. consist of some 250 rules. Approximately 175 of those rules are used in diagnosis, and the other 75 rules are used in prescribing treatment. The system has successfully handled a number of difficult cases that were not included in the set used during its development.

Current plans call for extending the Capabilities of D.A. and for intergating it into the actual drilling environment. A microprocessor-Based Electrophoresis Interpreter in 1980 Sholom M. Weiss and Casimir A. Kulikowski of the Computer Science Dept of Rutgers University and Robert S. Galen of the Pathology Dept of Columbia University, collaborated to develop an electrophoresis interpreter. This system was designed to take data from a scanning densitometer, a widely used laboratory instrument that does a serum protein dectrophoresis analysis.

This system was developed using Expert, a system building tool that Wass and Kulikowski have previously used to build expert systems for medical consultation. Expert, is an event-driven system like EMYCIN but it uses backward chaining and production rules. It is not designed to cover all possible cases that a scanning densitometer can encounter, it covers all common cases. Out of 256 cases the system's analyses were considered 100% acceptable. Once the electrophoresis interpreter proved itself, expert was used to translate the program into a microprocessor assembly language program. An instrument manufacturer interfaced the interpretive program to an existing program that prints out instrument readings.

Weiss and Kulikowski argue that by incorporating this small knowledge system directly into the instrument, they have made it much more acceptable to the medical community.

The above is only a short review of a number of best-known expert systems which illustrate current trends. Several companies have set up groups to develop and sell expert system building tools. Also a rapidly expanding trend is towards the development of small-scale knowledge-based systems ranging from 50-200 rules and focussed on solving small but difficult and bothersome problems. One of these small systems has been put on a microprocessor and incorporated into an instrument.

Life is composed of doing the things that need doing whether one feels in the mood to do them or not.

Sir BASIL HENRIQUES

" Scientific research has shown that an insufficient degree of everyday fun can actually destroy your emotional balance".

ROBERT MINES

EXPERT SYSTEMS FOR CLASSIFICATION

Ch. Solomou, BSc Msc MIEEE
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1. What is an Expert System?

"An expert system is a program that minics the performance of a human expert in some intellectual endeavour" (1), The expert system attains this high level of proficiency by enclosing the heuristic, informally framed knowledge of the human expert, along with the expert's method of reasoning in the subject domain.

The emphasis in the field of expert systems has shifted from research into the application of the technology to solve realworld problems. By far the most common function addressed by expert systems is classification. Classification refers to selecting an answer from a fixed set of alternatives on the basis of information that has been input. Although physics, engineering, operations research, computer science, and other disciplines offer an invaluable framework for addressing classification and other classes of problems, these sciences by themselves canont offer complete solutions. On the contrary, practitioners or experts admit that their profession is a mixture of art, intuition, and educated guesswork.

2. What Does an Expert System Program Do?

Once the knowledge and know-how of a human expert has been embodied in an expert system program, any user can then interact with it by answering the computer's questions and requests for data. Based on the user's input the program will recommend the best choice(s). The user can ask the computer questions as might be done with a human expert. The program can explain how it reached its conclusions, why particular data is needed and how the required data will be used.

The expert system will not forget to consider something or get bored. Any area involving decision-making problems that can be defined to the computer presents a good application for an expert system. Expert systems are especially useful in any situation where many people need ready and quick access to a body of decision-making knowledge. With an expert system, decision-making ability can spread around to others and remains available even after the human experts depart. Expert systems for classification are potential problem-solvers if "decision-makers" reach different conclusions when given the same information as input. Examples of expert systems that have been developed for classification problems are given below.

Tax Advising;
Assist in the Analysis of X-Rays;
Assist in Local Area Network Selection;
Assist in Real Estate Site Selection;
Product Performance Troubleshooting for Salesmen;
Teaching Mineral and Rock Identification;
Determining Best Shipping Methods and Routes;

3. Expert System Building Tools (ESBTs)

The time required to develop expert systems is decreasing due to the availability of expert system building tools. These tools make it possible to develop an expert system in much less time than would be needed with the use of traditional AI (artificial intelligence) languages such as LISP or PROLOG.

ESBTs are sometimes called "shell" programs because they themselves contain no knowledge about a problem, but instead enable you to create your expert systems rapidly. With ESBTs, you can "teach" the computer how to solve the problem by entering IF-THEN rules explaining the steps involved in the decision—making process.

An increasing number of ESBTs are now being rewritten in languages such as C to increase speed, reduce memory requirements, and increase their portability. Unfortunately there is a large variance among the attributes of commercial ESBTs. However, increasing competition is forcing ESBT vendors to make rapid improvements and changes in both their systems and prices. Low-priced ESBTs are usually suitable for building systems for classification and diagnosis only. The more expensive ESBTs have the widest applicability and can be used to develop systems for data analysis and interpretation, prediction and simulation, monitoring, planning and scheduling. For a detailed treatment of ESBTs refer to (2).

4. Typical Architecture of Rule-Based Expert-Systems

Contemporary expert system methodology separates domain expertise (dermatology, shipping methods and routes, stock trading, etc) from the strategies for representing and manipulating that expertise. This greatly facilitates debugging and modifying either subsystem.

The **knowledge base** is the subsystem which contains the expertise collected from one or human experts. Normally a knowledge base contains both declarative (e.g., that temperature is over 20 degrees) and procedural knowledge

expressed in rules of propositional implication (e.g., that IF temperature is over 20 degrees AND it is cloudy THEN it will rain with probability 0.7). The process of constructing a knowledge base, of determining how an expert system solves problems and implementing that knowledge on the computer, is called **knowledge engineering.**

The **inference engine** is the second subsystem. This is a program which uses the knowledge base as data. It is well separated and general so that the same inference engine can work on knowledge bases from different subject domains. Given a knowledge base of facts and rules, there are basically two possible strategies for working on them to solve some problem. One strategy focuses on the rules antescendants, the other on their conclusions. They are called **forward chaining** and **backward chaining,** respectively.

5. TOGA: An Expert System for Loss Prevention

TOGA (Transformer Oil Gas Analysis) is a successful expert system for diagnosis of power distribution transformer condition, based on chemical analysis of insulating oil (4).

"When a large power distribution transformer fails, its insulating oil becomes overheated and partially decomposes into gas. Different failures, causing different distributions and intensities of heat, trigger different gaseous concentrations. Prior to actual failure, incipient faults can cause similar localized overheating. By analyzing gases from the oil, and by physically inspecting transformers, engineers can accurately determine the type and likelihood of breakdowns - and can take appropriate preventive steps..."(3).

Prediction of a potential breakdown depends very much on the experience and capabilities of engineers, regardless of the fact that much of the skill and knowledge is codified in manuals, files, and standards. It is also a fact of life that experienced engineers depart from the company and are replaced by ones who have hardly any experience in detection of transformer failures. Development of TOGA was undertaken to automate the diagnostic process and thus provide **quick and consistent testing** of transformers.

5.1 Rate of Building and Testing.

TOGA was developed usng the RuleMaster ESBT. The size of TOGA is 300 production rules ("IF conditions THEN actions"). Development of the system required 12 man-months. TOGA uses external routines extensively for input, output, and processing. About half of the development time was spent on developing and testing these external routines. Much of the knowledge included in the system (in the form of production rules) was extracted from experts who did not have access to a published knowledge base.

5.2 Knowledge Sources.

For TOGA, all of the knowledge was derived from interviews with an expert in transformer diagnosis. Many papers had been published in the field, but there was no widely accepted and standardized procedures for transformer diagnosis. Thus, the only sources of knowledge were the interviews with the company expert.

5.3 Testing and Validation.

The test cases came from data bases of past transformer oil analyses. First, the expert carefully selected a set 40 cases to use as the learning set. These cases covered the spectrum of transformer faults, and were used both to refresh the memory of the expert (and thus define a complete set of production rules) and to test the prototype systems.

The TOGA validation data consisted of 859 transformer oil analyses from a year-old database. The expert had previously diagnosed these transformers and stored the results. The result was agreement with the expert's previous diagnosis on all but 4 of the 859 cases. This success was surprising, and, as a result, had made further rule development and refinement unnecessary. In fact, field testing was started immediately.

5.4 Delivery Computer Systems.

At present TOGA runs on an IBM PC/AT. It uses external programs extensively, to acquire data from a gas chromatograph, access data bases, and communicate with remote computers. In addition to the above software needs, the TOGA project has considerable data processing organizational content. Several organizations at different geographic locations (e.g., chemical analysis labs) are involved in the daily operations of TOGA (e.g., the chemical analysis lab transmits electronically oil test data to company headquarters. There, engineers execute TOGA and analyze the data).

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REDUCING DATA COMMUNICATION COSTS

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1. Introduction

Data communication is a necessary activity for organizations with decentralized operations. Normally, remote terminals need to connect with a central site either for file transfers, data-entry, enquiries, or updates. In the context of data communications, a terminal can be either an intelligent (page-or form-mode) terminal, a line concentrator, a modem-sharing unit or even a personal computer or main-frame. A communications link or line is the physical medium used to transfer data and may be either circuit-switched or packet-switched.

In a circuit-switched line, transmission bandwidth is preallocated when the connection is established, and is available for the entire duration of the call. The telephone system employs circuit-switching as it was designed with human-to-human communication in mind (human-to-human communication requires continous use of a low-speed channel). Thus, when data is transmitted over telephone lines, the charging method is based on the distance and connect time only and not on the amount of data sent. In many countries, the telephone network is the only medium available for data communication. Computer-based communications are usually bursty, i.e., a burst of data is sent quickly and then there may be silence for the next few minutes. As a result, newer data transport methods such as packet switching are now replacing the traditional circuit-switched method used by telephony, giving way to new charging methods.

In a packet-switched network, data is decomposed or assembled into fixed-length segments called packets. Transmission bandwidth is allocated dynamically when a packet in some network switching node needs to be transmitted to some other switching node. For packet-switched networks charging is based largely on the number of packets sent and very much less on distance and connect time.

For countries such as Cyprus, packet-switching is a relatively new technology and circuit-switching is currently the dominant data transport method. In what follows, we review the technology available for reducing the number of leased circuit-switched lines. We also review some of the products which can be used for transmission of data over X.25 packet-switched networks.

2. Reducing the Number of Circuit-Switched Links

The costs for communication lines can be reduced by employing one, or a combination, of the following methods.

— increasing the line data rate
— introduction of units which allow multiple low-speed devices to share a single high-speed link.
— data compression, which reduces the number of bits sent over a link over a given period of time.

2.1 Modems

When circuit-switched lines are used for data transmission, signal converters known as modems are always necessary. Modems modulate and demodulate a carrier signal to transfer data. Selection of modems depends upon factors such as the medium (wires, radio, satellite), modulation scheme (AM, FM, PM), speed (300, 1200, 2400, 4800, 9600 bits/sec), transmission method (synchronous or asynchronous).

CCITT (an international telecommunications standards committee) describes modems that follow some CCITT standards. For example, the CCITT V.22 standard describes a modem for a data rate of 2400 bits/sec. The CCITT V.32 standard describes a full-duplex modem for a data rate of 9600 bits/sec with automatic fallback to 4800 bits/sec when substandard line conditions are encountered Newer but more complex modulation methods have increased the data rate of synchronous modems even further. The CCITT V.33 standard describes a full-duplex modem for a data rate of 14,400 bits/sec and operation over leased lines only.

Replacing a 9600 bits/sec modem with one that runs 14,400 bits is like installing a bigger pipe to carry 50% more data in the same number of hours, or like having 50% more hours in the day.

2.2 Terminal Multiplexors

Multiplexors are hardware units which enable multiple terminals to share a single high-speed link. Terminals share a single link in order to reduce the cost of multiple lines (it is cheaper to use one high-speed line than several low-speed lines) and to improve utilization of a single link (e.g., while a terminal operator is busy entering data, some other terminal that is ready to use the link may do so). Multiplexors are divided by class into synchronous time-division multiplexors (STDMs) and asynchronous/statistical multiplexors.

2.2.1 Synchronous Time-Division Multiplexors

STDMs divide the transmission time into slots that are assigned periodically to the different terminals sharing the link. Data received from an attached terminal is delayed until its assigned

time slot comes around again. The effective transmission rate made available to each device through its subchannel is the speed of the output link divided by the number of terminals sharing the link. The disadavantage of STDMs is that when a terminal has no traffic its output time slot is wasted.

2.2.2 Statistical Multiplexors

Statistical multiplexors make possible the transmission of useful data only over the high-speed output link. Data from the attached terminals are stored into buffers thus forming blocks of data. The multiplexor serves the attached devices in rotation. When an attached device has a block of data for transmission, the multiplexor prepends the block with the id of the sending device before transmitting it over the high-speed shared output link. When the buffers of an attached terminal are empty, no data is transmitted for that terminal. In this way, output time slots are not wasted.

As it is quite unlikely for all attached terminals to start transmitting at the same time, the total input speed (the sum of the speeds of all terminals attached to the multiplexor) is normally greater than the speed of the shared output link. This implies that given a statistical multiplexor and a STDM, both with output links of equal capacity, then more terminals can be supported by the statistical multiplexor.

A potential problem here, is that if each terminal starts transmitting at its maximum rate, there will be insufficient capacity on the output link to handle it all. The remedy for this problem, are the large input buffers assigned to each of the attached terminals.

2.3 Data Compressors

Communication bandwidth is an expensive resource. It should not be surprising that users have a keen interest in reducing the total number of bits transmitted to get their work done. Data compression follows the principle that 8-bit characters can be represented, on the average, by 4 bits. Thus, the throughput potential of character compression is 2 to 1, since twice as many characters can be trasmitted in a given amount of time if they contain 4 bits rather than 8 bits.

For example, a 9600 bit/sec link with the capacity of carrying 1200 8 bit characters per second, should, after the addition of data compression technology, be able to handle a data flow of 2400 4-bit characters per second. Thus, if the 2-to-1 compression ratio is achieved, one 9600 bit/sec link would be able to do the work of two.

2.4 A Case Study

Metropolitan Life, a New York insurance company, decided to make data compression, statistical multiplexing, and 14400 bit/sec modems an integral part of their highly sophisticated nationwide data network. By installing the Datamizer data compressors with integral statistical multiplexor from Symplex, and 14400 bit/sec modems from Codex, they were able to eliminate more than 200 leased lines nationwide. They cut their line charges by 55%, saving over 2 million dollars in only the first 12 months after implementation. The new configuration enabled leased lines previously running 32 interactive interactive terminals to operate up to 96 terminals, with no degradation in response time.

Prior to the introduction of the above technology, the claims-processing business offices were connected with the central computer via 9600 bit/sec leased lines. Up to 16 terminals were connected to a single IBM 3X74 control unit. In turn, two 3X74 control units had access to the leased line via a modem-sharing unit.

Symplex, the supplier of Datamizer, claimed that the latter would bring about a 2-to-1 increase in throughput capacity on 9600 bit/sec lines. The investigation team at Met Life found this to be true. Installing the Datamizer allowed the company to double the number of control units (and therefore the number of terminals) connected through a single leased line. Simultaneous introduction of the Codex 14400 bit/sec modems (a 50% increase in output link capacity) allowed them to add two additional 3X74 control units. The net result was a 3—to-1 leased line reduction allowing support of six control units on a leased line. However, the team's original goal of achieving the 3-to-1 reduction was not completely achieved, since some business offices had only one or two lines to a data processing center.

3. Packet-switching Technology

As already pointed out, the fundamental difference between circuit switching and packet switching, is that in circuit switching charging is based on distance and connect time only, whereas in packet switching charging is based mostly on the amount of data exchanged and very much less on distance and connect time. In this section, we elaborate further on the issue of circuit switchin versus packet switching, comment briefly on the X.25 standard for public packet-switched networks, and conclude with a short survey of some devices that can be used for communication over packet-switched networks.

3.1 Packet Switching-When?

Use of packet switching for data communications should be given serious consideration whenever the following three conditions are true.

(1) A long distance (as defined by tariffs) separates the communicating sides.

(2) Utilization of a continous link is low (i.e.,

data is being transfarred over the link for only a small proportion of the time)

(3) In the case of a central site and multiple remote sites, the remote sites are widely separated from each other (e.g., when remots sites are branch office in different countries).

Condition (3) may, at first, be not so obvious. However, if the opposite were true, i.e., having remots sites located close together, the sites would then be able to share a link to the central site with the help of multiplexors, making packet switching ynnecessary.

As an example, consider a company with a central computer at the central office and two major branch offices. The distance between the central and branch offices is around 60 miles. Each branch office has 3 terminals for access to the central computer. An initial investigation has showed that data is being transmitted on the average on only 8% of the time. Moreover, the distance between the two branch offices is 70 miles (i.e., the two branch offices are not located close to each other. The example company, satisfies all three requirements for a possible adoption of, or conversion to, packet switching technology for data communication purposes.

3.2 CCITT X.25 Standard

The X.25 standard was defined by CCITT to standardize the format and meaning of packets exchanged by communicating sides over a public packet switched network. The standard also specifies procedures for connection establishment, data transfer, and connection termination. The X.25 standard was developed to prevent packet-switched networks from developing mutually incompatible interfaces. Put another way, if two communicating sides support the X.25 standard, they know the format, meaning, and proper sequence of packets that need to be exchanged.

The X.75 standard was defined by CCITT in order to interconnect together X.25 public packet switched networks from different countries. In this way, it is possible for an X.25 user to communicate with another X.25 user in a different country.

3.3 Devices for use with Packet Switching

Before data is transmitted over a packet-switched network, it is decomposed or assembled into segments called packets. During a file transfer, a file is decomposed into data packets. On the other hand, when an ordinary terminal logs on to a remote computer via a packet-switched network, any characters keyed in by the user are assembled periodically forming a data packet. At the computer, a received packet is broken up to produce the original characters. A device performing these character-packet transformation is called a packet assembler/disassembler (PAD).

Whenever a terminal (or a PC emulating some terminal type) needs to connect to a remote computer over a public X.25 network in a way that is transparent to both the terminal and the computer, PADs must be provided at both ends. In this way, both the terminal and the computer can send and receive characters (with assembly and disassembly being the responsibility of the PAD). With present technology, PADs are integrated in sophisticated modems that are used to dial-connect to the nearest switching node (hopefully only a few kilometres away) of the X.25 public network.

In most cases, sites have multiple terminals that need to be connected with the remote computer. What is really required for such a case is a hardware unit which operates in much the same way as an ordinary statistical/asynchronous multiplexor. The unit is able to act as a PAD for each terminal connected to it.

At start-up, the unit connects with the remote site over an X.25 public packet switched network. It assembles characters from all the terminals into blocks (in much the same way as a statistical multiplexor). In turn, the blocks are assembled together to form a single data packet. The packet is then sent to the remote site over the X.25 network. An identical unit on the remote site receives the packet and decomposes it into the original character blocks. This configuration is cheaper because there is no need to buy sophisticated modems with integral PAD for every terminal . Also, the packing together of data from several terminals can help reduce the number of data packets sent over the X.25 network.

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H.T.I. CALENDAR OF ACTIVITIES—

Academic Year 1987—88

D. Charalambidou-Solomi DES, BA (Hons), M.A.
Lecturer HTI

SEPTEMBER

• Enrolments began on 8 September: 64 students were enrolled for Electrical Engineering; 64 for Mechanical Engineering; 64 for Civil Engineering; 32 for Marine Egnineering and 36 for Computer Studies.

11 students were selected to attend the Medical Electronics Course at RTC; 4 students registered for the X-Ray Specialized Course with RTC. 18 students registered for the fifth and final year of the part-time evening Diploma Course in Mechanical Engineering.

• Lectures commenced on Monday, 14 September.

• A course on Microcomputers in Civil Engineering was held at HTI, 7-12 September.

The course was organised by the Cyprus Civil and Mechanical Joint-Group of Professional Engineers.

The course was attended by 19 local engineers.

Lecturers were E.J. Wright and Mr O.A. Chamberlain from City University, London.

• Mr John Michaelides, Senior Lecturer, Mechanical Engineering Department, participated in the U.N. International Workshop on Solar Heating and Cooling and Ohter Renewable Sources of Energy on an Invitation by the U.N.

The Workshop took place in Moscow and Ashkhabad, USSR from 21—28 September.

Mr Michaelides presented a paper on the Activities in Solar Heating and Cooling and Other Renewable Sources of Energy in Cyprus.

• On 25 September the Welfare Officer escorted HTI overseas students to the District Immigration Office to obtain Aliens Identity Cards.

He then took them for a visit to the Cyprus Handicrafts Exhibition.

• Dr. Themos Drakos was inaugurated to the Director's Office on 30 Spetember at a General Staff Meeting in the Amphitheatre of HTI.

The Director General of the Ministry of Labour and Social Insurance, Mr Chr. Christodoulou, introduced Dr. Drakos to his new Office, wished him every success and promised him every assistance in his new duties.

The Director General paid homage and spoke highly of the former Director of HTI, Mr George Christodoulides. The new Director in his inaugural speech sketched the progress and achievements of the Institute and briefly outlined the future plans and goals of HTI.

The Meeting ended with Dr. A. Mallouppas, President of the HTI Staff Association, wishing the new Director success in his new and difficult task and, on behalf of the HTI staff, pledged full-hearted co-operation.

Mr Andreas Kaplanis, Lecturer Electrical Engineering Department, returned after having successfully completed his studies for an M.Sc. degree at St. Bartholomew's Hospital, Medical College, London.

OCTOBER

• On the invitation of the Institution of Electrical Engineers (IEE), HTI Director participated in a meeting of the Overseas Board of the IEE in London on 6 October as a newly appointed member of this Board for the period 1987-1990.

• While in London for the IEE meeting, the Director visited the City University, the University College, the St. Bartholomew's Medical Electronics Teaching Hospital and the Microcomputer Unit.

• Mr Demetris Lazarides, head of the Civil Engineering Department, visited the City University of London on the invitation of the Civil Engineering Department of the City University. During his stay 26-30 October, Mr Lazarides discused and examined possibilities for future co-operation between the Civil Engineering Departments of both institutions. He also familiarised himself with the use of microcomputers in the teaching program for Civil Engineers.

• Mr George Iordanou, Head of the Mechanical Engineering department, was awarded a scholarship by the Italian Government and attended a specialized course on "Technology Transfer of Renewable Energy Sources". The course took place at Urbino, Italy, from 5-26 October.

Mr Iordanou made a presentation on the prevailing energy situation in Cyprus highlighting the adverse energy and technoeconomic consequences of the Turkish invasion.

• The IEE, Cyprus, in co-operation with HTI and the ITA organised two courses:

(a) Electrical services Installation and Maintenance, from 12-13 October.

30 participants attended the course.

(b) Introduction to Electrical Services Design, from 16-17 October.

41 participants attended the course.

Lecturers for both courses were Mr Peter Donachie and Mr Jack Avery from IEE, London.

Both courses were of 14 hours duration.

• On 23 October the Refrigerator Repair Technician Course began with 24 participants sponsored by WHO.
The course is conducted by RTC in collaboration with the Expanded Programme of Immunization (EPI) of WHO.

• The Self Instruction Centre of HTI commenced its operation for this academic year on 5 October.

• 13 Marine students completed their second year sea training in early October. Their sea training lasted 72 days.

• The 13 Marine students attended an intensive course on fire fighting and life saving techniques from 19—31 October at Hanseatic Marine Training School, Limassol.

• On 18 October the Welfare Officer accompanied overseas students of HTI on a full day excursion to Ayia Napa, Protaras, Potamos, Liopetriou and Halla Sultan Tekke.

• On 23 October moslem students of HTI were accompanied to a Nicosia Mosque by the Welfare Officer upon their request.

On the same day they also visited the Archbishop's Palace.

• Mr Spyros Spyrou, Lecturer RTC, was awarded a WHO fellowship on Calibration and Testing of Medical Equipment at the Department of Clinical Physics and Bioengineering, Glascow, Scotland.

Mr Spyrou attended the course from 10 October—2 November.

• Mr Diomides Liambrianides, Lecturer Electrical Engineering Department, has successfully completed his studies for a M.Sc. in Digital Systems at Hatfield Polytechnic, U.K.

NOVEMBER

• The HTI Director, on the invitation of the Institution of

Electrical Engineers (IEE), participated in a meeting of the overseas Board of IEE in London from 30 November — 8 December.

• During his stay in London, Dr. Drakos was also received by the Rector of the Polytechnic of Central London for discussions on future co-operation between the two institutions.

• On 19 November HTI celebrated UNESCO Day which has been established as an annual event in the HTI Academic Calender.

UNESCO Day was celebrated by a visit to Fikardou village. Staff and students were guided around the village by an officer of the Antiquities Department. The officer explained the restoration work carried out by her Department.

Staff and students offered voluntary work for the embelishment of the site.

On the occasion, the Director, staff and students of HTI sent a telegram of congratulations to the new Director-General of UNESCO, Professor Frederico Zaragora, on the assumption of his duties.

• Mr Nicos Papanastasiou, Lecturer in Mechanical Engineering, was awarded a scholarship by the Italian Government and attended a course on Renewable Evergy Sources onganised by SOGESTA, Urbino, Italy, from 3 November-3 December.

• The Institution of Electrical Engineers (Cyprus) in co-operation with HTI and the ITA organised a 20-hour course on Troubleshooting Microprocessor-based Systems.

The lecturer of the course was Mr Neal Hutchinson from the Microprocessor Unit, London.

The course was held 9-13 November and had 17 participants.

• The Cyprus IEE, HTI and ITA also organised a 20-hour intensive course from 9-13 November on Microprocessor Interfacing. The course has been developed by the Microprocessor Unit, London.

Lecturer was Mr Neal Hutchinson; 22 persons participated.

• The project on a graphical solution of a zener regulator circuit, undertaken by the Electrical Department of HTI, was completed on 21 November. It is now available for use by HTI students.

• A sightseeing tour of Nicosia was organised by HTI Welfare Officer for overseas students of HTI. The students visited the Archibishopric, Folk Art Museum, St. John's Cathedral, the Makarios Cultural Centre and the National Struggle Museum.

• On 30 November students and staff of HTI donated blood.

A' Mid-Semester exams were held between 9-13 November.

DECEMBER

• On 2 December, in Room 211, there was a show of a video film on Your Generation 1984/85 Faraday Lecture presented by Central Electricity Boad, U.K.

• The Secretary of the International Maritime Organisation (IMO), Mr C.P. Srivastava, visited HTI on 2 December.

Mr Srivastava was accompanied by the IMO Director and escorted by the Cyprus Minister of Communications and Works, Mr R. Michaelides, and other high-ranking officials of the same ministry.

Mr G. Iordanou, Head of Mechanical and Marine Department, briefed the visitors on HTI training and in particular on maritime engineering training.

Mr Srivastava promised educational aid in books and videotapes.

• Five members of the HTI clerical staff were trained in the use of wordprocessors from 9 November — 7 December.

• On 9 December, in Room 211, two short video films were shown between 13-14 hours: The Pioneer of Mass Transportation and The Revolution in Mechanical Engineering.

• On 13 December the HTI Welfare Officer organised an excursion for overseas students of HTI to Limassol, the Limassol Archaeological Museum, the Limassol Castle, the Kolossi Castle, Kourion and the Sanctuary of Apollo Hylates.

Overseas students from the Hotel and Catering Institute participated.

• On 16 December, in Room 211, two short films were shown between 13—14 hours: Planck, His Successors and the World Atoms and Albert Einstein Paths to Nuclear Physics.

• The Walfare Officer organised a party on New Year Eve for the overseas students of HTI and HCI at the HCI Canteen.

JANUARY

• From 28—30 January the Cyprus Civil and Mechanical Joint Group of Professional Engineers organised at HTI two courses:

(a) Application of Microcomputers in Civil Engineering.

(b) Application of Microcomputers in Mechanical Engineering.

The course was attended by 16 local mechanical engineers and was of 20 hours duration.

Lecturers for both courses were E.J. Wright and D.A. Chamberlain from the City University, London.

• The 31st Annual General Conference of the International Association for the Exchange of students for Technical Experience took place in Stockholm, Sweden, from 14-20 January.

Cyprus was represented at the Conference by the National Secretary of IAESTE-Cyprus. I.A.E.S.T.E-Cyprus offered 18 places for training in Cyprus and received 28 offers for training abroad.

• The X-ray Specialized Technician Course which started in September ended successfully in January.

• Mr Stylianos Kyzas, Instructor in Building and Carpentry, was awarded a scholarship by the Council of Europe, at the European Centre for training Craftsmen in Venice, Italy from 26 Jannuary — 1 May.

• Mr Ioannis Antoniou, Instructor in Mechanical Engineering, was granted educational leave without pay for one and a half year to pursue studies leading to B.Sc. in Mechanical Engineering at the Polytechnic of Wales, U.K.

• The HTI Welfare Officer organised an excursion to Troodos mountains for overseas students. 13 students participated.

• A' Semester-Exams were held from 18-29 Jannuary.

FEBRUARY

• Lectures for B' Semester commenced on 7 February.

• UNIDO expert, E. Chicken, visited HTI/RTC and reviewed the Cyprus situation concerning the maintenance and repair of medical equipment. He discussed with RTC staff possibilities for international and national involvement.

• The HTI Welfare Officer organised a visit to the Cyprus Archaeological Museum for the RTC foreign students.

• Dr. A. Mallouppas, Head WHO Collaborating Centre on Management, Maintenance and Repair of Health Care Equipment, visited WHO Headquarters in Geneva, UNIDO and IAEA Vienna from 15 February — 5 March.

Dr Mallouppas assisted in the preparation of guidelines for country situation analysis and drafting of proposals for extra-budgetary funding (WHO/UNIDO).

He also discussed with IAEA the possibility of setting-up training in Cyprus on Nuclear Medicine Equipment.

• Dr. T. Drakos, HTI Director, participated in a meeting in London of the Overseas Board of IEE as a Board member.

While in London the Director paid a visit to the City University, London.

MARCH

• The IEE, Cyprus in cooperation with HTI and the ITA organised two courses from 24—31 March on Advanced Trouble Shooting — 16 Bit Processors and the P.C. Both

courses were of 20 hours duration each; 34 engineers participated.

- On 17 march Mr Allie of the Commonwealth Fund for Technical Cooperation (CFTC) visited the RTC, Mr Allie reviewed with HTI present collaboration and identified future areas of activities.
- The HTI Coordinating Committee for Blood Donations arranged two blood donations by second and third year students of the Mechanical, Marine and Computer Studies Departments to the Blood Bank of Nicosia General Hospital.
- The Social Formal Dinner for third year students and HTI staff was held at the Philoxenia Hotel on 2 March.
- B' Mid-Semester exams were held from 24-31 March.

APRIL

- Dr. A. Mallouppas, head WHO Collaborating Centre on Management, Maintenance and Repair of Health Care Equipment, participated in the Fifth International Symposium on the Planning of Radiological Department organised by WHO and the University of Brescia.

Dr. Mallouppas read a paper on "Maintenance and Repair of Equipment".

- The HTI Welfare Officer organised an excursion to Troodos for all HTI overseas students and the Cypriot students living on HTI camp.
- Monday, 25 April, was Blood Donation Day for HTI staff and students.
- On 22 April the Soviet Cosmonaut, Boris Volinov visited HTI and gave a lecture as a guest of the HTI Astronomy Club on "Life in the Space Station Salyut". After the lecture the Soviet Cosmonaut answered questions and he presented the club with a book on Soviet Cosmonauts.

MAY

- Dr Mallouppas, RTC Head, went on study visits to Zambia, Zimbabwe, Kenya and Tanzania from 1-23 May, on behalf of the Commonwealth Fund for Technical Cooperation (CFTC), to investigate situations relating to management of Health Care Equipment.
- **Dr Mallouppas, RTC Head, visited Brazzaville from 23-27 May, where the WHO AFRO Office is situated, to discuss regional funding proposal of US. 5 million by UNDP of Africa, relating to Management, Maintenance and Repair of Health**
- Dr. T. Drakos, HTI Director, went to London to participate in a meeting of the Overseas Board of IEE as a Board member.

During his stay in U.K Dr. Drakos paid a visit to Luton College, Bedfordshire.

- On 13 May Mr Andreas Elia, Laboratory Assistant in the Electrical Department, was awarded his B.Sc. Degree in Electrical Engineering after two years of study at the Texas A&M University.
- The HTI Welfare Officer in collaboration with the M.I.M. Welfare Officer organised on 20 May an International Day of Activities of Tertiary Education Institutions.

The International Day of Activities included sports in the afternoon, a social Evening with dancing, singing, food and drinks.

An officer from P.I.O briefed the students on the Cyprus issue.

- On 15 May Industrial Training of second year students ends.
- Classes were suspended on Tuesday, 10 May, HTI Sports Day.
- The Joint Academic Accreditation Committee of the Institution of Electrical and Electronic Incorporated Engineers, (UK), after considering a detailed documentation submitted by the HTI, has decided that accreditation is granted to graduates of the Electrical Engineering Department. Thus, they are fulfilling the academic requirements for registration to the class of "Incorporated Engineer" (I Eng), of the Engineering Council (UK).

JUNE

- B' Semester Exams for first and second year students began on June 6. They are expected to finish on June 17.
- Diploma Project Orals will be held from 20-24 June.
- Mr Stavros Anastasiou, Senior Lecturer, Electical Engineering Department, was promoted to the post of Head of Electrical Engineering Department.

JULY

- Graduation Ceremony is set for Friday, 1 July, at 6.30 p.m. H.E. The President of the Republic, Mr George Vassiliou, will attend the Ceremony.

The Honourable Minister of Labour and Social Insurance, Mr Takis Christofides, will award the Graduates' Diplomas.

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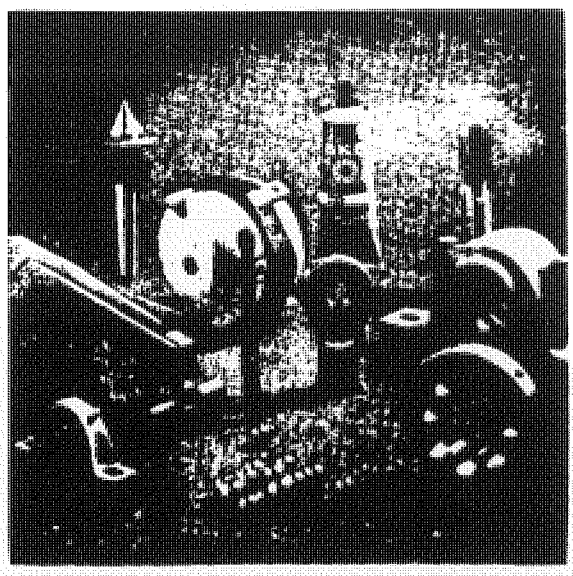

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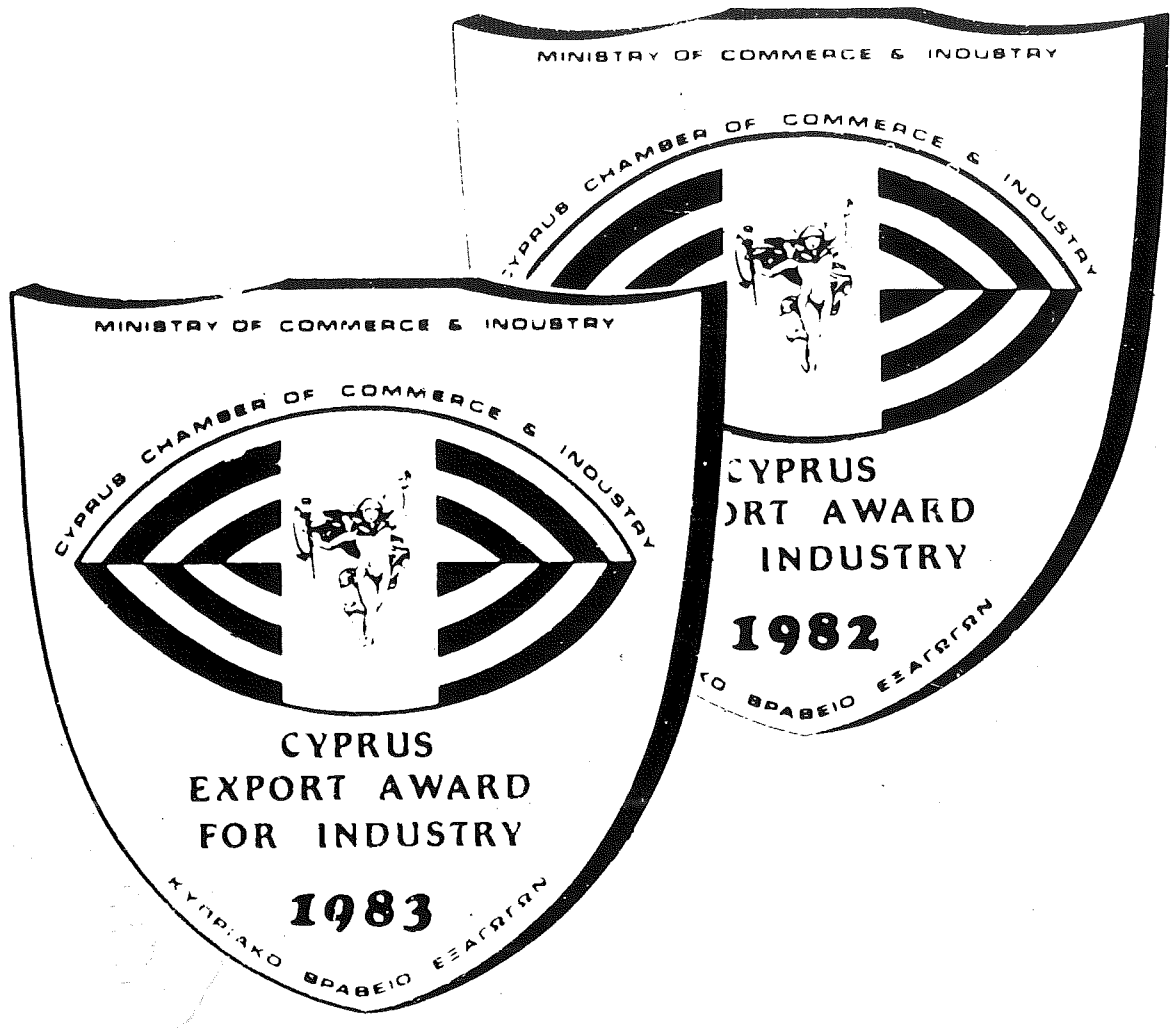

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