Review

Number 24 September 1995 Nicosia Cyprus

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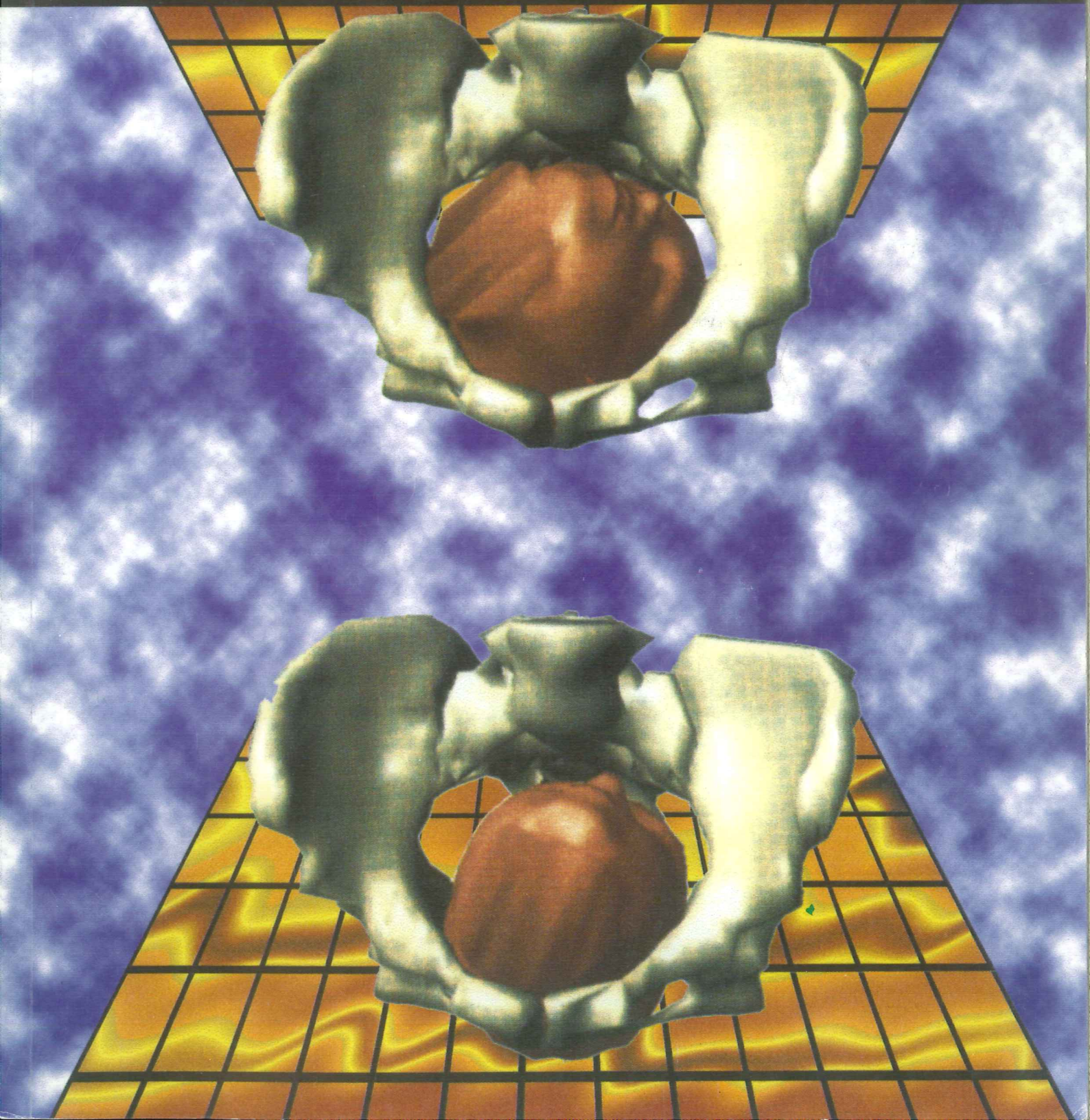

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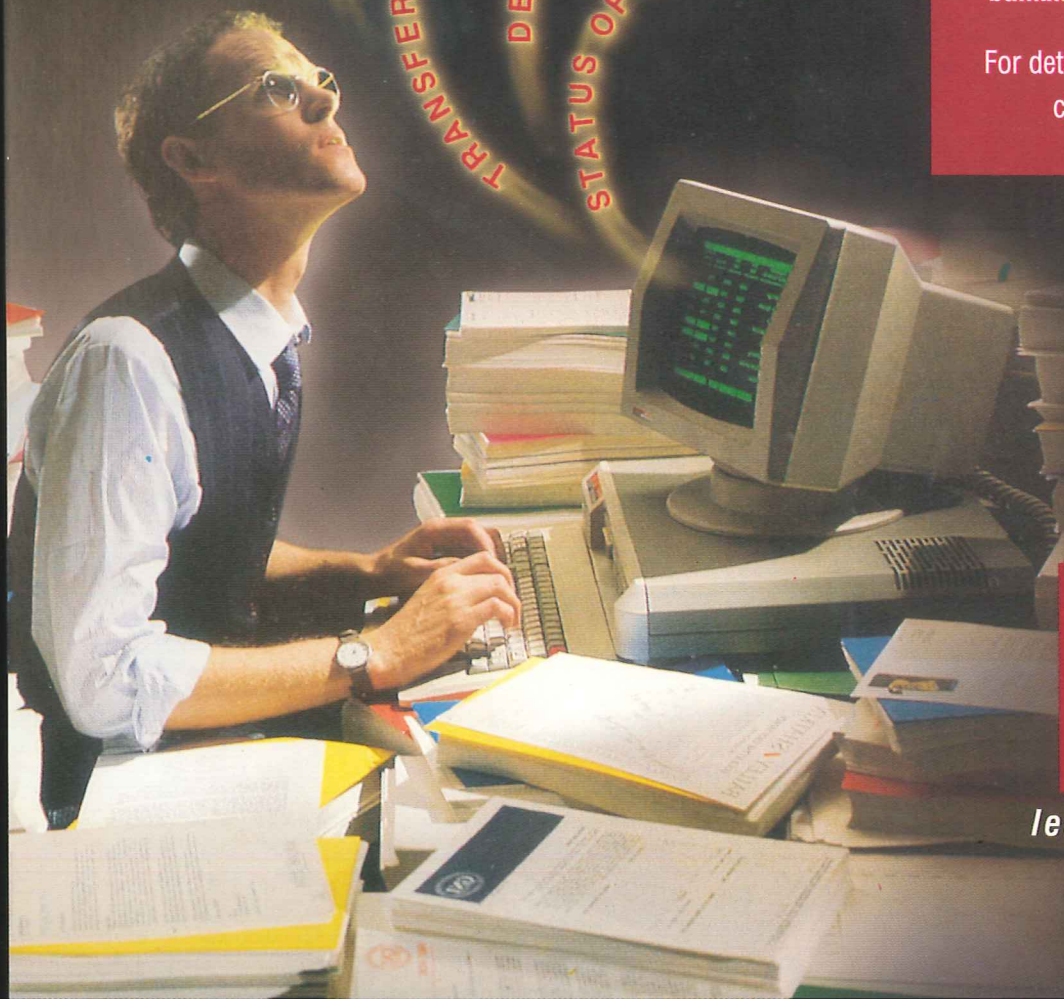

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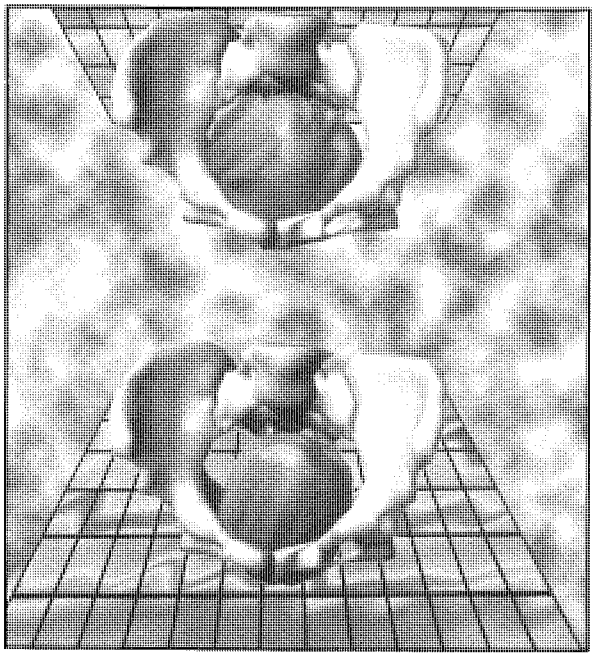

HTI is collaborating with the European Union on the research project «KIT - Programme of International Scientific Cooperation in the Field of Information Technology». The cover shows a part of results of the delivery simulation of a child which is a part of that project. *Cover design* by student K. Procopi (2CS). More information on pp. 57-63.

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1995 HTI Graduation Ceremony

The 1995 Graduation Ceremony of the Higher Technical Institute was held on Friday, 30 June at the Cyprus International Conference Centre in Nicosia.

The President of the Republic, Mr Glafcos Clerides, graced the ceremony with his presence and awarded the Presidential Prize to Mr Marios Panayiotou, the graduate with the highest overall performance. The President announced a donation of £2000 from his personal budget in aid of the needy students of the Institute.

The Minister of Labour and Social Insurance, Mr Andreas Moushouttas, honoured HTI by attending the ceremony and awarding the diplomas to the one hundred and fifty-five graduates.

Present were also the Director General of the Ministry of Labour and Social Insurance, Mr Nicos Symeonides, members of Parliament, members of the diplomatic corps and other dignitaries. The political parties, trade unions and professional bodies were, also, represented.

The HTI Director, Mr Demetrios Lazarides, awarded the prizes sponsored by industry and professional bodies to the graduates who excelled in their studies in the academic year 1994/95.

The President of the Students Union, Mr Ioannis Papadopoulos, addresed the gathering highlighting the successful academic work of HTI and called for the need to create the post of Technician Engineer within the structure of both the Civil Service and the semi-government organisations in order to offer better prospects to HTI graduates and help to differentiate them from the graduates of the Secondary Education.

Mr Papadopoulos thanked the Government for its decision to finance the building of an HTI Sports Centre and a new library equipped with modern facilities.

The President of the Students Union concluded by reinstating the determination of the HTI student population to struggle for the freedom of the occupied part of the island from the Turkish yoke and added «we should be ready to sacrifice our lives for this homeland which our ancestors have preserved Greek for three thousand years».

The main speaker was the HTI Director who thanked the President and other dignitaries for attending the 25th Graduation Ceremony of the Institute.

Mr Lazarides outlined the achievements and future targets of HTI. Firstly, he underlined the fact that HTI is the lifeblood of the Cyprus Industry and that it contributes greatly in the technological upgrading of the industry as well as in the upgrading of our defence programme as a great number of HTI graduates join annually the ranks of the National Guard.

In addition to its three-year diploma programmes, Mr Lazarides pointed out, HTI has organised 28 short professional courses which were attended by 610 professionals. These courses were organised with the financial support of the Cyprus Industrial Training Authority and by liaising with other professional bodies

The HTI Director, Mr D. Lazarides, welcoming the President of the Republic, Mr Glafcos Clerides, to the Graduation Ceremony.

and educational institutions both at home and abroad.

Next, Mr Lazarides reviewed briefly the successful course of HTI since its establishment in 1968 and drew attention to the fact that HTI has been called «the pride of Cyprus» not by accident but because it had an outstanding academic success.

«This praise-worthy achievement», Mr Lazarides continued, «is largely owed to the vision, foresight and hard work of the pioneers and their successors: the various Ministers and Director Generals of the Ministry of L. & S.I., the directors and staff of HTI». «Thanks to the work of all these people», Mr Lazarides added, «the HTI Diploma has become the yardstick against which all other similar qualifications are to be measured for evaluation purposes» by the decision of the Council of Ministers issued on 23 March 1979.

However, there is still scope for further improvement Mr Lazarides said, and if HTI is expected to keep abreast wth educational and technological changes it needs to being continuously upgraded.

Nowadays, Mr Lazarides went on, there is foremost the need for a legal framework which will enable HTI to operate as a Tertiary Educational Institution and, also, the necessity of passing new legislation or appending the existing one in order to ensure the professional recognition of the status of HTI graduates both in the private and the public sectors.

Admittedly, Mr Lazarides said, if HTI is expected to continue to contribute effectively in the efforts of the Cyprus Government to upgrade its defence programme, enhance its industry and succeed in joining the European Union smoothly, the HTI academic programmes, equipment, library and sports facilities need to be continuously improved, modernised and upgraded.

In the meantime, Mr Lazarides emphasised, HTI continues to offer education of excellent academic standard, consultancy services and testing facilities and above all, it encourages its staff to occupy themselves with applied research by co-operating with European Union institutions on major E.U. projects. Five such projects are already under way.

The Director concluding his speech thanked all those who supported the work of HTI by offering donations, prizes and scholarships. On behalf of the Ministry of L. & S.I., the Government and the HTI staff, he wished the graduates a successful professional career and happiness in their personal life.

TRADITIONAL VERSUS CONTEMPORARY ARCHITECTURE

for Energy Efficient Buildings

Dr Despina Serghides, AA Dipl., RIBA II, AA Grad., PhD
ISES - Cyprus President, Senior Lecturer, HTI

ABSTRACT

Cypriot architecture has evolved to produce buildings which are at harmony with the culture and nature of the island. International influences have moved architecture away from these traditional values. This paper describes the traditional architectural solutions in Cyprus and compares these to the modern approach, showing that the two could be reconciled for the production of energy efficient buildings.

CULTURE, WAYS OF LIFE AND BUILDING

Traditional integral approach and continuity

Traditional buildings were erected, as the product of a diversity of influences acting together, all of them closely related to each other. They were meeting the requirements of culture and everyday living conditions, demands and restraints be they topographic, social, constructional, climatic, functional, stylistic or financial. The complex relationship between these factors is reflected in the form of the house where their presence will be in accordance with their importance.

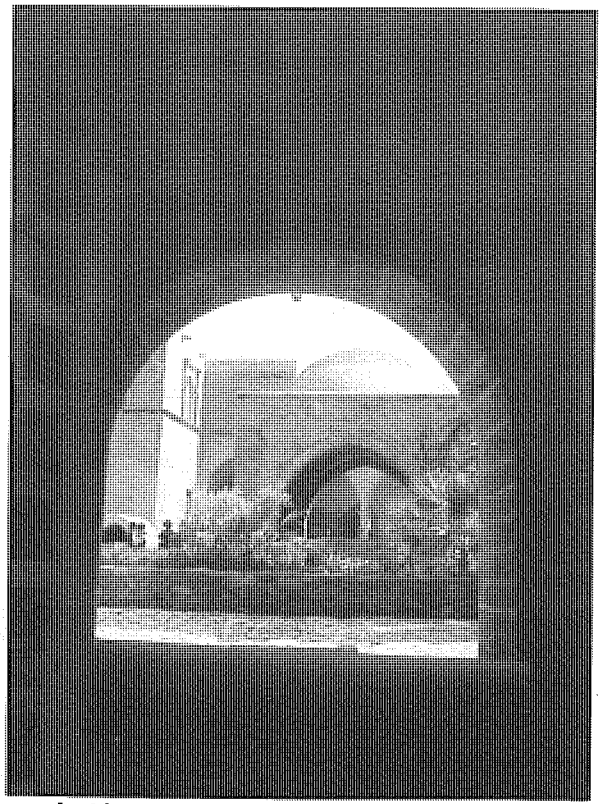
Traditional houses evolved as a result of an integrated design approach based on a trial and error process transmitted through generations. It is gradually corrected and adapted to meet the needs of the people the conditions of the environment or even to assimilate foreign influences.

For centuries Cyprus has oscillated between international influences and local themes. However, a strong traditional core model has emerged which blended external attractions and shaped a variety of architectural types. This reveals an identity and local meaning as the threat of continuity through the combination of domestic and imported elements.

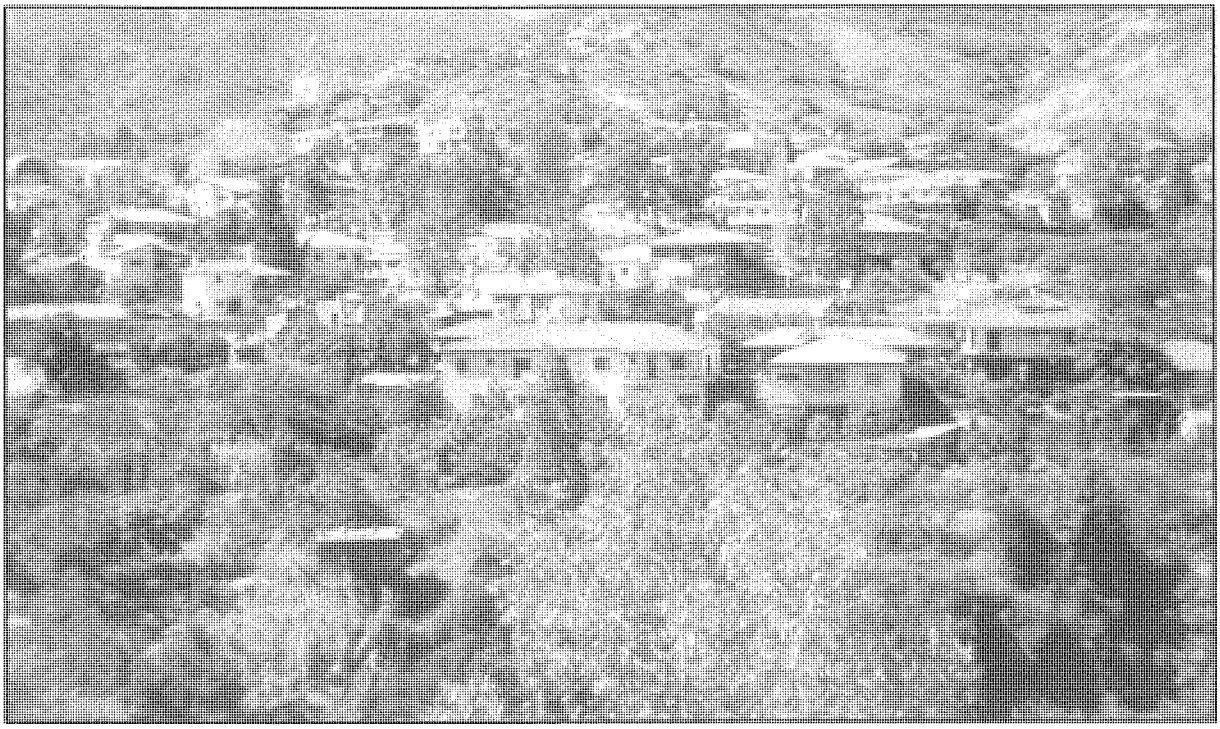
Disruption of continuity and cultural alienation

The mass media, the faster pace of life, colonialism and the consequent independence of the island which coincided with the abrupt, oversweeping modern movement and the irrational tourist development, all inflicted sudden changes. These could not be accomodated in the determining factors of the core traditional model which requires an extensive temporal inertia until the trial and error process produce new normative patterns. Instead they lead to the lowering of the quality of life and a distortion of the character and identity of the island.

Emphasis was given to stylistic and new typological and morphological standards, which prevailed upon indigenous traditional values.



Architecture in Cyprus has oscillated between international influences and local themes



Traditional buildings were meeting the requirements and restraints of culture and living conditions be they topographic, social, constructional, climatic, functional, stylistic or financial

There was a tendency to disregard all other considerations and to sweep aside all local specific conditions such as climate, social and cultural patterns. Architects are faced with the dilemma of designing quickly for a society divided between, a fraction seeking the fulfilment of a private, traditionally driven life and those advocating modern design and progress. Time pressure, financial considerations, image and fashion together with strict planning and design regulations do not offer the architect flexible design solutions.

Unfortunately, designers frequently sought a resurgence of past forms by imposing traditional patterns on new buildings in the form of textured arcades, facades, and misplaced traditional elements and ornaments. In an effort to give the illusion of Cypriot identity, the essence of Cypriot architecture is bastardized.

Other designers have completely ignored the past and transposed plans from the west that are better fitted to industrialised societies. These designs have been transposed to the Cypriot environment with no effort at social or climatic adaptability. They indulge in the transfer of technology and foreign ideas to the detriment of the local population resulting in cultural and architectural alienation.

Both ideologies fail to respond efficiently to the island's society which is in a state of transition searching for a new identity and a suitable built environment.

Echoing the past is not recommended and turning to the west for architectural solutions that are inappropriate for the island are also misleading.

As far as the thermal problems of buildings are concerned, in conventional forms of architecture, it would be wrong to permit special technicians to design and calculate certain installations that will correct the interior conditions. There is also a tendency today to apply passive heating or cooling systems to projects that are incorrectly conceived. Adopting such strategies ignores the fact that the environmental functions of a building depend on the initial decisions taken on the project as an integral part of many others.

TOPOCLIMATIC CONDITIONS - NATURAL AND MAN-MADE LAWS

Natural laws

In addition to the socio-cultural setting, vernacular architecture was also a direct response to the possibilities and limitations, of the natural environment. Traditionally the anonymous designer has endeavoured to understand nature

in order to create a healthy environment, through a respect for the natural and acquired conditions and laws which particularly marked that location. Climatic characteristics played the leading role amongst the determining factors of the vernacular architecture. They affected and shaped the character of the built environment so that the inhabitants learned to live in peace with nature and not confront it.

Acquired and man-made laws

In contemporary houses, acquired cultural, social and man-made laws prevail. The recent urbanisation movement of the last three decades (1960-90) theatens to destroy the qualities and values reflected in ecologically sound buildings, whose elements are sympathetic to the idea of close links with nature.

Building codes, regulations, and centralised planning are amongst the factors responsible for the form of our built environment both on the architectural and urban levels limiting adaptation to a location.

This prevents the creation of individual architecture which is organically united with the the nature of the area.

Every location has absolutely individual characteristics which are part of the conditions for such buildings.

Return to nature

Social and man-made laws change but nature with its peculiarities of climate and landscapes on the whole remains permanent.

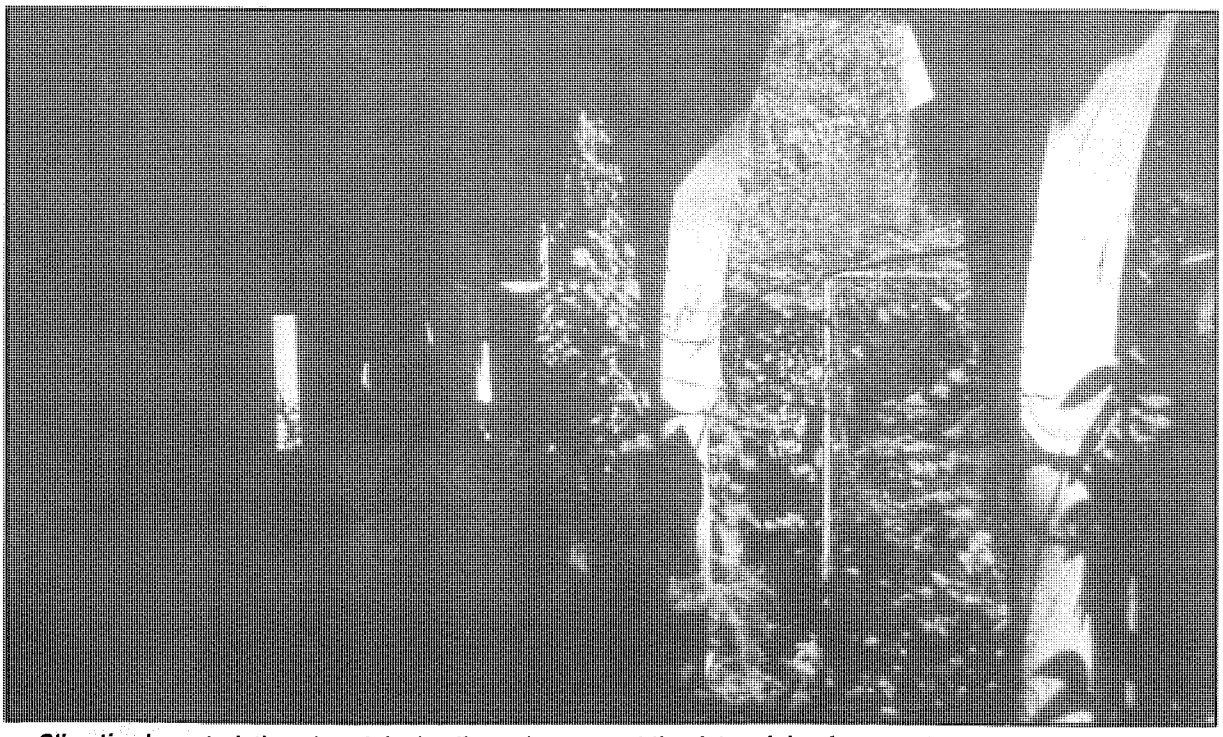
Yet nature must be viewed by the designer as a system, a complex of features interrelating and dependent on each other which if combined in different ways in the different situations, require specific architectural solutions.

Each natural situation demands a scrutiny of its specific characteristics so as to utilize the geographical climatic resourses to control or isolate environmental aspects. The optimal microclimate in the building and its surroundings is sought and dwellings should evolve as an integral part of the ecological system.

In searching for ways to revive the unity between nature and architecture, vernacular architecture could be used as a source of inspiration to achieve an organic solution to the design of the house and its natural surroundings.

Vernacular and traditional architecture achieved a beauty which derives from the natural environment and inherently provides aesthetic qualities, climatic adaptability and economic feasibility.

An in depth study of indigenous structures could reintroduce the principles of bioclimatic



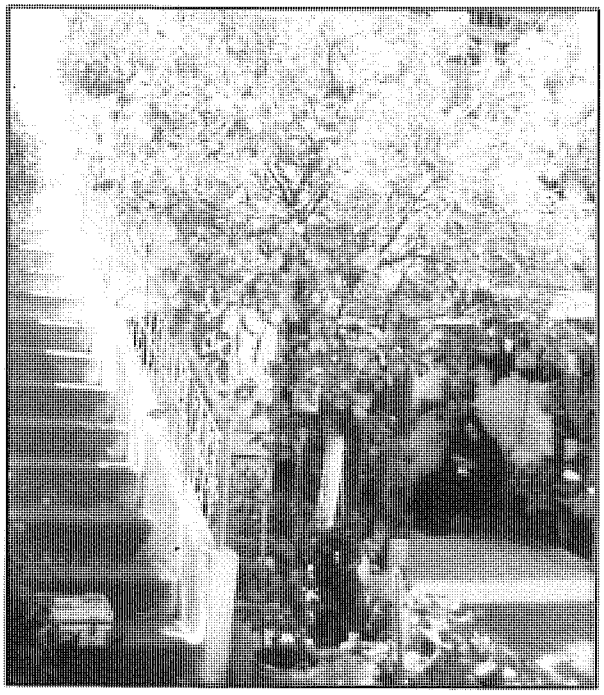
Climatic characteristics played the leading role amongst the determining factors of vernacular architecture

design which could well be adapted to our present architecture.

Furthermore regulations must be reviewed in order to provide a more flexible framework to accommodate these principles and allow each case to be evaluated on its own merits by the designer.

RECONCILIATION OF TRADITIONAL AND CONTEMPORARY

It is true that we cannot go back to the morphological structures or indeed life style of the traditional house as the ideal model. Athough this form of building fulfilled social and cultural



The inhabitants learned to live in peace with nature and not confront it

needs and responded to the comfort requirements at the time, it is no longer valid in the light of today's economic situation and lifestyle. Attempts to return to traditional forms in the design of buildings, assuming that they can retain their intrinsic qualities as climatic modifiers and comfort creating environments, is fallacious. There is an ideological tendency revealing itself all over the world in the production of vernacular souvenirs which perform no better than their modern counterparts.

The pace of life cannot be altered or halted. External influences and technological advances cannot be ignored or rejected. Human needs and especially comfort criteria are different today from those of our predecessors but even so they tend to be similar even in different cultures.

It is possible to support the development of a contemporary local architecture through the restoration of design complexities compatible with indigenous culture, social needs, and specific needs of the inhabitants within an approach centred on climatic conditions which contribute to the promotion of passive low-energy design.

The conditions of the locality is what is left as the only constant undoubtful reference on which to base the formation, selection and application of appropriate design criteria. This approach combined with renewal of interest in those aspects of architecture which contributed to thermal comfort in a building is likely to reconcile the traditional with the contemporary.

REFERENCES

1. Antiquities Department, *Cyprus,* Ministry of Interior, Republic of Cyprus, Nicosia 1967.
2. Bowen, A., and Yannas, S., (Eds), *Passive and Low Energy Ecotechniques Applied to Housing,* PLEA 84' Mexico, Pergamon Press, 1984.
3. Bowen, A., and Wagner (Eds), *Passive and Low Energy Alternatives,* The First International PLEA Conference, Pergamon Press, Oxford, 1982
4. Fernandes, E. de Oliveira and Yannas, S., (Eds), *Energy and Buildings for Temperate Climates - A Mediterranean Regional Approach,* Proceedings of the PLEA 88 Conference, Porto, Pergamon Press, Oxford, 1988.
5. Georgiades, Kl., *Istoria tis Kyprou,* Nicosia
6. Serghides, D.,

(i) *Planning for Tourism in Cyprus,* AA Planning Dpt., 1974.

(ii) *Prototype Solar Building for Cyprus,* Graduate School, Energy Studies AA 1988.

(iii) *Building Analysis - A Traditional Cypriot Building,* Graduate School Energy Studies, AA 1987-88.

(iv) *Open Spaces as Building Components,* Graduate School Energy Studies, AA 1987-88.

(v) *Architecture and Bioclimatic Design,* HTI, 1989.

7. Vinod, G., (Ed), *Energy and Habitat,* School of Planning and Architecture, New Delhi, Wiley Eastern Ltd.

Decadence and Technology: A Love-Hate Relationship

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INTRODUCTION

This article will attempt to examine the response of the English decadent poets to technology and artifice in the eighteen-nineties. By "decadent poets" I mean the coterie of young men who made their mark in the 1890s and who were labelled or liked to label themselves as aesthetes or decadents. These young poets looked to France for inspiration and adopted two aesthetic doctrines: "l'Art pour l'Art" and "Art superior to Nature". These aesthetic doctrines differentiated them from the other literary movements operating at the end of the nineteenth century in London: the anti-decadents (imperialists), the socialists, the realistic school and the Irish revival movement. The most representative decadent writers were: Oscar Wilde, Ernest Dowson, Arthur Symons, Lionel Johnson, John Gray, Theodore Wratislaw, Francis Thompson, Richard Le Gallienne and John Davidson.

ART VERSUS NATURE

Admittedly, the antinomy of art versus nature (life) is as old as the hills. For example, the Greek epigrammatists dealt in some detail with this issue and in two epigrams: Meleager XII, 257: 410 and Strato XII, 190:378 the implication is that art is superior to nature. Catullus and Baudelaire removed nearly all nature from their poetry. Moreover, Baudelaire, whose work is considered fundamental in the development of the nineteenth century Decadent Movement or decadent pose or mood, as some critics like to call it, places categorically the artificial over the natural in his influential essay *Eloge du Maquillage* (1863). According to Baudelaire while crime is natural, virtue is artificial, therefore, the application of make-up is a praiseworthy attempt to rise above the natural. Baudelaire's claim regarding make-up triggered off an intense interest in the artificial and all arts: the mask, paintings, dance, the ballet and the theatre. Art is valued above nature and life and it is given a reality of its own as in the following poem by A. Symons:

My life is like a music-hall,
where, in the impotence of rage,
Chained by enchantment to my stall,
I see myself upon the stage
Dance to amuse a music-hall.

'Tis I that smoke this cigarette,
Lounge here, and laugh for vacancy,
And watch the dancers turn; and yet
It is my very self I see
Across the cloudy cigarette.

Prologue (1897)

By the middle of the nineteenth century when Baudelaire published his influential collection of poems *Fleurs du Mal* (1857) and his *Eloge du Maquillage* (1863) technology had made great strides: one could bring to mind Stephenson's locomotive (1814); the Liverpool-Manchester railway line (1830); the invention of telegraph (1835); Daguerre's first photograph (1837) and Bassemer steel process (1857) (Stonyk, 1983: 281-299). These significant technological achievements and, in particular, the railways had visible and deeply - felt effects on the environment, trade, life and social structure. While in France the French Revolution, the Terror and the Napoleonic era brought into power the bourgeoisie, the technological and industrial changes brought into power the middle-classes in England. Both the artists in France and the artists in England were proned to "épater" the bourgeois. In their effort to shake the social and religious norms of the middle classes the artists, who adopted

Gautier's motto of "l'Art pour l'Art", employed technology and the artificial to attack the class, which thrived on and owed its power to technology and industry.

This paradox is exemplified in J.K. Huysmans' novel *A Rebours (Against Nature)* which was published in 1884 and as A. Symons pointed out it served as "the breviary of the Decadence". Huysmans' hero, Des Esseintes, tries to lead a totally artificial life which culminates with taking food by injection, "a slap in the face of old Mother Nature" (1959:290) and Huysmans concludes "taking nourishment in this way was undoubtedly the ultimate deviation from the norm" (1959:208). By 1884 when Huysmans published his novel, technology had made miraculous leaps: Lister's aseptic surgery (1865); Mendel's genetic experiments (1865); Field's transatlantic cable (1866); invention of dynamite (1867); opening of Suez Canal (1869); invention of telephone (1876) and Edison's phonograph (1877) (Stonyk, 1983: 281-299). Consequently, it is no wonder that some of the decadent artists in their efforts to batter the society and voice their dissatisfaction with its values and in their search for something "nouveau", something strange, would embrace the new challenges and new perspectives which technology offered so dramatically.

RAILWAYS

However, the technical invention which captured the artists' and people's imagination was the locomotive and the railways. Huysmans employs the locomotive in his effort to create an aesthetic stand point for the slogan of the decadents that "Art is superior to Nature": The locomotive, Huysmans argues, is "an animate yet artificial creature that is everbit as good from the point of view of plastic beauty" (1959:37), consequently, as woman is the most exquisite work of nature, the locomotive becomes the most exquisite achievement of technology. In England the two railway booms of 1835 and 1845 and the six thousand miles of railway lines by 1850 scarring the countryside and the cities were bound to haunt the artists' imagination as the dark, satanic mills did in Blake's time. For example the speed, smoke, noise and change of scenery are captured by A. Symons in *In the Train, City Nights* (1896):

The train through the night of the town,
Through a blackness broken in twain
By the sudden finger of streets,
Lights, red, yellow, and brown,
From curtain and window-pane,
The flashing eyes of the streets.

Night and the rush of the train,
A cloud of smoke through the town,
Scaring the life of the streets;
And the leap of the heart again,
Out into the night, and down
The dazzling vista of streets!

Some of the young poets of the eighteen-nineties responded positively to artifice and artificial, especially to make-up and green-house flowers. Artifice exerted a special fascination. We have to remind ourselves that in the 1880s, we have technical discoveries like radio waves (1885); internal combustion engine (1886); Edison's kinetoscope (1887) and later the patent of the diesel engine in 1895 which imposed new prospects and challenges to scientists and engineers but also to the artists. By the decade of the eighteen-nineties the ugliness of technology started to recede as machines were increasingly switching from coal and steam to electricity and the internal combustion engine minimising thus the smoke, soot, cinders and the ugliness associated with the machine. Thus Lewis Mumford, in order to emphasise the difference in cleanliness, attractiveness and technology potential, calls the first part of the nineteenth century the **Paleotechnic** era while he places in the 1880's the beginning of the **Neotechnic** era (Sussman, 1968:10)

ARTIFICIAL FLOWERS

It is no surprise that the artificial flower became the symbol of the decadent artists. Oscar Wilde flaunted his green carnation while Theodore Wratislaw celebrated greenhouse flowers and orchids. Wratislaw, in order to express the decadent artists' dissatisfaction with the traditional mode of celebrating nature and, in par-

ticular, to underline their disagreement with the Romantic era emphasis on nature, exclaims: "I hate the flower of wood or common field", thus, echoing Callimachus' dissatisfaction with the epic tradition and his turning towards the more personal, short lyric forms like the epigram, the elegy, and the mime:

εχθαίρω το ποίημα το κυκλικόν,

..σικχαίνω πάντα τα δημόσια.

(XII, 43:300)

Wratislaw goes on to dismiss the lily, the traditional symbol of purity, and the rose, the traditional symbol of conventional love. He prefers artificial flowers, the symbol of decadence:

The silver lips of lilies virginal,

The full deep bosom of the enchanted rose

Please less than flowers glass-hid from frosts and snows

For whom an alien heat makes festival.

Hothouse Flowers (1896)

In his poem *Orchids* (1896) Wratslaw's greenhouse orchids become a symbol of sin, languor, strangeness in beauty and art as aspiring to the condition of music. The orchid symbol draws also on Pater's *Conclusion* with its emphasis on maintaining ecstasy and "in getting as many palsations as possible into the given time" of our ephemeral life:

Bathed in your clamorous orchestra of hues,

The palette of your perfumes, let me sleep

While your mesmeric presences diffuse

Weird dreams: and then bizarre sweet rhymes shall creep

Forth from my brain and slowly form and make

Sweet poems as a weaving spider spins,

A shrine of loves that laugh and swoon and ache,

A temple of coloured sorrows and perfumed sins!

The artificial flower can be regarded as an indirect celebration of technology and technical achievement. Admittedly, many an artist in the 'nineties hated technical and industrial progress and would have agreed with Baudelaire: "Theory of the true civilization. It is not to be found in gas or steam or table - turning. It consists in the diminution of the traces of original sin. " (*Intimate Journals,* 1990).

However, these artists regarded their refuge in artificiality as an escape from reality. The reality was not pleasant for the English decadent artists who hated materialism, progress, the Empire, the evangelical and puritan outlook of the middle class society. Yet, they flirted with artifice and embraced it as an escape from reality. Natural flowers for the decadent artists stand for the visual world, the bourgeoise society, the Romantic idea of nature and formal art: "The one certainty is, that society is the enemy of man, and that formal art is the enemy of the artist". (Symons, 1904:85)

Symons in 1896 like Huysmans attempts to create an aesthetic set of values for decadence and its credo that "Art is superior to Nature": "There is no necessary difference in artistic value between a good poem about a flower in the hedge and a good poem about the scent in a sachet".(Thornton, 1970:57)

Yet, there were many a critic and artist like John Morley and Robert Bachanan who would agree with Alfred Lord Tennyson that with such aesthetics: "So prone are we toward the broad way to Hell!"

LONDON

Another visible effect of technology and industrialisation was the growth of cities. London grew into a megalopolis. What captured the imagination of the artists of the 'nineties was its size, artificial lighting and corruption. Again here we have French precedent, the most notable being Baudelaire's *Tableaux Parisiens.* Both the decadent poets and the anti-decadents like Henley and Kipling were fascinated by London. The decadent poets were attracted to its artificial light, its prostitutes, its ballet dancers, the madmen, and the undercurrent sense of sin, decline and perversity.

Richard Le Gallienne, as an outsider, coming from the province, was attracted to "The iron lil-

ies of the Strand". He was sensitive to the permeating powers of evil which work unseen like "Poor worms that have not eyes or wings." Le Gallienne is also aware that the great wealth of London has been acquired by suffering, oppression and deaths both at home and abroad. The suffering of women and children in mines and mills, the oppression of the people of the colonies and the unspeakable conditions of the slum life were hot issues during the nineteenth century. Thus Le Gallienne captures the sense of corruption and suffering and the seamy side of technical progress and "laissez faire":

From out corruption of their woe
Springs this bright flower that charms us so,
Men die and rot deep out of sight
To keep this jungle-flower bright.

A Ballad of London (1895)

Le Gallienne associates London with the decadent outlook of the fin-de-siecle literature of decline and death and the emphasis on life as being ephemeral. London and Paris, the leading European cities, will have the fate of Sidon, Tyre and Babylon which "Time hath gathered":

Time and his moths shall eat up all.
Your chiming towers proud and tall
He shall most utterly abase,
And set a desert in their place.

A Ballad of London (1895)

On the other hand, John Davidson laments the spread of the city and the devouring of "the old demense" and rural life in his poem *A Northern Suberb* (1897). Vanished are

The busy farm, the quiet grange,
The wayside inn, the village green.

Davidson describes with realistic details the lamentable effect of industrialisation on the landscape and people:

In gaudy yellow brick and red,
With rooting pipes, like creepers rank,
The shoddy terraces o'erspread
Meadow, and garth, and daisied bank.

The living conditions of the working population in the slums are appalling and reveal the ugly face of technical progress which the socialists and the realists treated in their work; the nightmarish view of life can easily drive one to suicide as it did Davidson:

With shelves for rooms the houses crowd,
Like draughty cupboards in a row -
Ice-chests when wintry winds are loud,
Ovens when summer breezes blow.

Davidson's view of life in the northern suburbs of London contrasts sharply with Lord Alfred Douglas' view of London at night, yet the nightmare is present in both. The nightmare is in both poems a by-effect of technology:

See what a mass of gems the city wears
Upon her broad live bosom! row on row
Rubies and emeralds and amethysts glow.
See! that huge circle like a necklace, stares
With thousand of bold eyes to heaven, and dares
The golden stars to dim the lamps below,
And in the mirror of the mire I know
The moon has left her image unawares.

Here, London, like Baudelaire's dark mistress, or Wilde's Salome, is a courtesan bespankled with gems and oozes mire, depravity and debauchery. It is a symbol of decadence. London is the product of man, neither of God nor Nature. It is another form of artifice, as Max Beerbohm put it in his *A Defence of Cometics:* "Artifice is the strength of the world" (Thornton, 1970:37). Oscar Wilde was wittily laughing at his own age with its fascination and revulsion of artifice: "The first duty in life is to be as artificial as possible. What the second duty is no

one has as yet discovered" as he put it in his *Phrases and Philosophies for the Use of the Young.* (Thornton, 1970:37). The image of the courtesan is sustained all through the poem:

That's the great town at night: I see her breasts,

Pricked out with lamps they stand like huge black towers,

I think they move! I hear her panting breath.

And that's her head where the tiara rests.

And in her brain, through lanes as dark as death,

Men creep like thoughts ..... The lamps are like pale flowers

Impression De Nuit: London (1899)

A. Symons attempted to form an aesthetic credo for decadence and he tried to incorporate in his aesthetic theory both the beauty of the artificial as we noted above and the beauty of the city - both products and symptoms of the technological revolution and progress. Thus in the second edition of his *Silhouettes* (1896) Symons professes: "I prefer town to country; and in the town we have to find for ourselves, as best we may, the decor which is the town equivalent of the great natural decor of fields and hills. Here it is that artificiality comes in; and if any one sees no beauty in the effects of artificial light, in all the variable, most human, and yet most factitious town landscape, I can only pity him, and go on my own way." (Thornton, 1970:57).

Symons' phrase "I can only pity him, and go on my own way" underlines the emphasis on the individual ego and its emotions and aesthetics which can be argued are a result of technological change, industrialisation and growth of big cities. Friedrich Engels in his *The Condition of the Working Class in England* (1845) says: "The disintegration of society into individuals, each guided by his private principles and each pursuing his own aims has been pushed to its furthest limits in London. Here indeed human society has been split into its component atoms. " (Norton Anthology, Vol. 2: 1625-1633).

Thus, the decadent artists who, on the whole, attempted to get rid of nature, god and morality embraced readily artifice and technological change for it satisfied their need for something "nouveau", something strange and the deviation from the norm. Thus, they excluded natural flowers, action, birth and regeneration. On the other hand, they embraced make-up, trains, artificial flowers, artificial light perfumes, and cities, which are ingrained with a sense of decline, languor, melancholy, ennui and degeneration. It is characteristic fin-de-siecle feeling that even the London lamps are depicted as "pale" flowers and "iron lilies" the one image implying melancholy and decline and the other implying sterility and lack of regeneration. On the whole, the appeal of the city is noctrunal, both in poetry and the visual arts.

WOMAN

It is no accident that Lord Alfred Douglas, the paramour of Oscar Wilde, chose the image of the courtesan to embody his impression of London by night. Indeed, there is a marked interest in the woman of free morals in the poetry of Baudelaire and the poetry of the English 'nineties. The decadent artists of the nineteenth century felt that Patmore's *Angel of the House* could not represent their age and sought more powerful female symbols like the biblical femme fatale in Herodias and Salome or even in monsters like the Sphinx or even in carcasses and in unnatural, incestuous love relations: homoeroticism, satanic and sacrilegious affairs. These powerful females represented the fear of the artists of technology and of the new woman who loomed menacingly and threatened to destroy the social and religious norms of the bourgeois society.

The decadent poets of the 'nineties, with the exception of Wilde who chose Salome and the Sphinx, chose the prostitute, the dancer, the nun and the little girl with whom they identified themselves. Thus we have the Noras of the pavements, the Juliets of a night, the Cynaras, the dancers and ballet girls of the Empire and the bargirls. With Ernest Rhys, who qualified and practised as a mining engineer, they celebrated *The Philosophy of the Pavement* (1898) and with Symons they celebrated the adoration of a woman's body: "It is her flesh that I adore" (*Idealism*, 1897) and with Dowson they celebrated "the kisses of her bought red mouth" and "cried for madder music and for

stronger wine" (*Cynara,* 1896). It is a decadent symptom that the artist sought only females who are sterile like the prostitute, the nun, the dancer and the child and avoided female symbols of fertility like the mother, the wife, mother earth and mother nature.

The interest of these artists in the woman of free morals in particular is not a surprise if we consider the great numbers of prostitutes in London and other cities which were a by-effect of industrialisation, the uprooting of the population from the rural areas, the cramming of the working class people in slum-huts and the appalling poverty. In 1850, 8,000 prostitutes were known by the police operating in London. In the city of Leeds there were 98 brothels and 451 taverns but only 2 churches and 39 chapels (Norton Anthology, Vol.2:929). As Davidson underlines the living conditions of "the tenants of the alleys of the workhouse and the jail" were degrading:

In the gutters and the ditches
Human vermin festering lurk —
We, the rust upon your riches;
We, the flaw in all your work.

Waiting (1899)

Admittedly, technological progress has always been a mixed-blessing. It seems the decadent poets sensed this dual quality of technology and some of them managed to capture both the attraction and revulsion. In particular they sensed the lurking evil, the under-current perversity and lack of transcendence in machine and mechanisation. Their choice of the femme fatale like Salome and Herodias mirrors the strength and power of technology and the bourgeoise society but also its fatal danger to imagination and spiritual values. The incestuous and homoerotic element of Baudelaire, Swinburne and Wilde aim at shocking the middle-classes but also satisfy a need for new, intense experiences beyond the social and religious boundaries of the norm.

In my opinion Pater's call for being "forever curiously testing new opinions and courting new impressions" *in his Conclusion* parallels the scientist's search and testing of new theories, new materials and new processes. The words "testing" and "new" are images taken from the nineteenth century orgasm of new inventions and discoveries. Moreover, it is characteristic of transitional periods like the Hellenistic era, Catullus' age and Baudelaire's age. Besides, decadent explorations into forbidden areas of morality and religion were considered as posing as serious a threat as Darwinism, machine and mechanisation to social, family and religious norms. Both the scientist (as inventor, engineer or as sociologist) and the decadent artist were a threat to certain traditional beliefs and notions. For example Symons seems to be mocking Ruskin, Darwin and Shopenhauer, who considered woman as base and inferior to man, but also the religious doctrines and social conventions, which wanted woman as a pure, selfless helpmate to man with no rights or claims to education, property or politics:

I know the woman has no soul, I know
The woman has no possibilities
Of soul or mind or heart, but merely is
The masterpiece of flesh: well, be it so,
It is her flesh that I adore,

Tyrrannously I crave, I crave alone,
Her perfect body, Earth's most eloquent
Music, divinest human harmony;

Idealism (1897)

Undoubtedly, it was as a result of the technological revolution that woman found herself on the workfloor, in mills, and mines. In turn, the woman demanded property rights, equal educational opportunities, political power and suffrage for women. Thus, the conscious choice of the decadent artists of powerful, monstrous, mythical females mirrors, on the one hand the power and fascination of technology and the bourgeois society with its drive for progress, administration and the empire, but also the emergence of the new woman with her radical demands which threatened the bourgeois society which created her. Moreover, the woman

of free morals was an outcast, an outsider, like the decadent poets who were considered "a pack of satyrs" (*Saturday Review,* 1886). The poets unable to identify themselves with their milieu or the mainstream of the traditional art of their country found refuge in drugs, alcohol and absinthe. Thus Symons sings of *The Absinthe Drinker, Hallucination* and *The Opium Smoker* while Dowson sings of *Dregs* and *Absinthia Taetra.*

Some other artists like Dowson chose to ignore completely technology and its inventions and found refuge in a fantasy world where flowers are "pale" and roses are withering and falling, adoring a little girl who is not permitted to grow. In their poetic waste land there is a constant twilight, silence, melancholy, autumn, weariness and old age. Dowson persistently ignores technical progress, its achievements and its miseries and is repeating over and over:

They are not long, the days of wine, and roses:

Out of a misty dream

Our path emerges for a while, then closes

Within a dream.

They Are not Long (1886)

Another artist who chose to ingnone the technical world and remained wrapped up in his decadent ego was Audrey Beardsley, the artist of *The Yellow Book* and *The Savoy* who found an escape in the black and white fantasies of his art.

CONCLUSIONS

Admittedly, decadent poetry focuses on man, individual emotions and feelings and on imagination. It is anthropomorphic and esoteric and often nihilistic as it lacks hope and transcendence. Artifice and technology are employed as a tool in the decadents' attempt to dethrone Nature, God, and morality from the domain of poetry. However, the very use of artificial flowers, perfumes, trains and artificial lighting implies an indirect tribute to the technical progress of their age.

Moreover, London and the prostitutes are employed to underline the seething moral decadence of the bourgeois society. The attempt of Symons, and Wilde to some extent, to incorporate artifice in their aesthetics, is another indirect glorification of technology. The conversion of Huysmans, Verlaine, Wilde, Dowson, Johnson, Gray and Beardsley to Catholicism can be regarded as a rejection of technology, machine and mechanisation. Davidson's suicide and Symons' madness, the two poets who seem more aware of technical progress, artifice and their adverse effect on individuals and the labouring classes, can be considered as the killing of the artist's soul by the society and its technical achievements. Indeed, the relation of Decadence to technology is a love-hate relationship. They are both products of the bourgeois society but also impose a serious threat to its values whether moral, aesthetic or religious.

REFERENCES

1. Baudelaire, Ch., *Intimate Journals,* trans. Chr. Isherwood, London: Picador Classics, 1990.

2. Baudelaire, Ch., *Selected Writings on Art and Literature,* trans. P.E. Charvet, London: Penguin Books, 1992.

3. Baudelaire, Ch., *The Flowers of Evil,* trans. J. Mc Gowan, Oxford: Oxford University Press, 1993.

4. Dowson, E., *The Poems of Ernest Dowson,* ed. A. Symons, London: The Bodley Head, 1905.

5. Huysmans, J.K., *Against Nature,* London: Penguin Books, 1959.

6. Stonyk, M., *Nineteenth - Century English Literature,* London: Macmillian Press, 1983.

7. Sussman, H.L., *Victorians and the Machine,* Cambridge, Massachusetts: Harvard University Press, 1968.

8. Symons, A., *Selected Writings,* ed. R. Holdsworth, Manchester: Carcanet Press, 1989.

9. Thornton, R.K.R. (ed), *Poetry of the Nineties,* London: Peuguin Books, 1970

10. *The Greek Anthology:* Books V & XII, trans. W.R. Paton, London: Heinemann, 1980.

11. *The Norton Anthology of English Literature* Vol. 2, 5th ed, London: Norton, 1986.

Concentrating Solar Collectors Intercept Factor

A Simplified Estimation Method

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ABSTRACT

One of the parameters used for the evaluation of a concentrating solar collector performance is optical efficiency. This depends on the properties of the various materials employed in the construction of the collector, the collector dimensions, the angle of incidence and the intercept factor. The intercept factor depends on the size of the receiver, the surface angle errors of the parabolic mirror, and solar beam spread. For the evaluation of the intercept factor a closed-form expression developed by Guven and Bannerot [1985] is employed. A simple program written in BASIC is presented which numerically evaluates the above expression using the Simpson integration method. The results of the program are compared with the results obtained by a detail ray-trace computer code (EDEP) and a simple program developed by Guven [1987] using the trapezoidal integration method.

It is shown that the results obtained by the new program approximates the results of the ray-trace model, EDEP, extremely well. In addition the deviation is less than the results obtained by the trapezoidal integration method.

INTRODUCTION

In order to obtain temperatures higher than about 100°C, with low density solar radiation, concentrating collectors are used. A particular type, the parabolic trough collector (PTC), is currently receiving considerable attention. Typical applications of PTC's vary from hot water production (typically 60°C) to steam generation used for power and industrial process heat applications (up to 350°C).

Concentrating solar collectors are structurally simpler than other types of collectors (i.e. flat plate collectors) although some form of tracking must be employed and the parabolic surface must be accurate, to ensure efficiency.

THE INTERCEPT FACTOR

The performance of a concentrating solar collector depends on many parameters. One of them is the optical efficiency which is defined as the ratio of the energy absorbed by the receiver to the energy incident on the concentrator's aperture. The optical efficiency depends on the optical properties of the various materials involved, the geometry of the collector, and the various errors encountered in the construction of the collector. These errors affect the intercept factor which is defined as the ratio of the energy intercepted by the receiver to the energy reflected by the focusing device (parabola) [Sodha et al., 1984]. Its value depends on the size of the receiver, the surface angle errors of the parabolic mirror, and solar beam spread.

The errors associated with the parabolic surface are of two types, random and nonrandom [Guven and Bannerot, 1985]. Random errors are defined as those errors which are truly random in nature and, therefore, can be represented by normal probability distributions. Random errors are identified as apparent changes in the Sun's width, scattering effects caused by random slope errors (i.e. distortion of the parabola due to wind loading) and scattering effects associated with the reflective surface. Nonrandom errors arise in manufacture/assembly and/or in the operation of the collector. These can be identified as reflector profile imperfections, misalignment errors and receiver location errors. Random errors are modeled statistically, by determining the standard deviation of the total reflected energy distribution, at normal incidence [Guven and Bannerot, 1986] as shown in equation 1.

```
10 CLS
20 INPUT "COLLECTOR RIM ANGLE (Deg) ="; PHR1
30 INPUT "RANDOM ERROR DISTRIBUTION 'Sigma *' (rad) ="; SIGMA
40 INPUT "TRACKING ERRORS 'Beta *' (rad) ="; B
50 INPUT "RECEIVER MISLOCATION & REFLECTOR PROFILE ERRORS 'd *' (mm) ="; D
60 CLS
70 LOCATE 12,25:PRINT "*****  Calculating  *****"
80 Z2#=0:Z3=0
90 PI=3.141592654#:H=.017453292#
100 PHR=PHR1*PI/180
110 DEF FNY(X)=(Y1-Y3)/(1+COS(X))*((1+COS(PHR))/(2*SIN(PHR)))
120 A2=4.442882938#*SIGMA*(1+COS(PHR))
130 FOR J=0 TO PHR STEP H
140 A1=(SIN(PHR)*(1+COS(J))*(1-2*D*SIN(J))-PI*B*(1+COS(PHR)))/A2
150 A3=(SIN(PHR)*(1+COS(J))*(1+2*D*SIN(J))+PI*B*(1+COS(PHR)))/A2
160 IF A1<1.4 THEN GOTO 170 ELSE GOTO 190
170 Y1=3.289312E-04+1.07807*A1+(.3072294*A1^2)-(1.03541*A1^3)+(.6269128*A1^4)-(.1351781*A1^5)
180 GOTO 200
190  Y1=.3904674+.7511418*A1-(.2906135*A1^2)+(1.847557E-02*A1^3)+(1.023394E-02*A1^4)-(1.444951E-
03*A1^5)
200 IF A1>2.8 THEN Y1=1
210 IF A3<1.4 THEN GOTO 220 ELSE GOTO 240
220 Y3=-.00032899312#-1.07807*A3-(.3072294*A3^2)+(1.03541*A3^3)-(.6269128*A3^4)+(.1351781*A3^5)
230 GOTO 250
240 Y3=-.3904674-.7511418*A3+(.2906135*A3^2)-(1.847557E-02*A3^3)-(1.023394E-02*A3^4)+
(.001444951#*A3^5)
250 IF A3>2.8 THEN Y3=-1
260 T1=0
270 X=H
280 T2=FNY(X)
290 K=PHR1-2
300 FOR I=2 TO K STEP 2
310 X=X+H
320 T1=T1+FNY(X)
330 X=X+H
340 T2=T2+FNY(X)
350 NEXT I
360 Z1#=(FNY(0)+(2*T1)+(4*T2)+FNY(PHR))*(H/3)
370 Z2#=Z2#+Z1#
380 Z3=Z3+1
390 NEXT J
400 Z2#=Z2#/Z3
410 CLS:BEEP
420 PRINT "For Sigma*=";SIGMA;" (rad) Beta*=";B;" (rad) and for d*=";D;" (mm)"
430 PRINT "Gamma ="USING "#.#####" ;Z2#
```

Fig. 1 Listing of program "GAMMA"

$$\sigma = \sqrt{\sigma^2_{sun} + 4\sigma^2_{slope} + \sigma^2_{mirror}} \qquad (1)$$

where: σ_{sun} Standard deviation of the energy distribution of the Sun's rays at normal incidence.

σ_{slope} Standard deviation of the distribution of local slope errors at normal incidence.

σ_{mirror} Standard deviation of the variation in diffusivity of the reflective material at normal incidence.

Nonrandom errors are determined from a knowledge of the misalignment angle error β (i.e. the angle between the reflected ray from the centre of Sun and the normal to the reflector's aperture plane) and the displacement of the receiver from the focus of the parabola (dr). As reflector profile errors and receiver mislocation along the Y axis essentially have the same effect a single parameter is used to account for both. According to Guven and Bannerot [1986] random and nonrandom errors can be combined with the collector geometric parameters, concentration ratio (C) and receiver diameter (D) to yield error parameters universal to all collector geometries. These are called "universal error parameters" and an asterisk is used to distinguish them from the already defined parameters. Using the universal error parameters the formulation of the intercept factor γ is possible [Guven and Bannerot, 1985]:

$$\gamma = \frac{1+\cos\phi_r}{2\sin\phi_r}\int_0^{\phi_r} Erf\left(\frac{\sin\phi_r\,(1+\cos\phi)\,(1-2d^*\sin\phi) - \pi\beta^*(1+\cos\phi_r)}{\sqrt{2}\pi\sigma^*\,(1+\cos\phi_r)}\right)$$

$$-Erf\left(-\frac{\sin\phi_r(1+\cos\phi)\,(1+2d^*\sin\phi) + \pi\beta^*(1+\cos\phi_r)}{\sqrt{2}\pi\sigma^*\,(1+\cos\phi_r)}\right)\frac{d\phi}{(1+\cos\phi)} \qquad (2)$$

where:

φ_r Rim angle

σ^* Universal random error parameter ($\sigma^* = \sigma C$)

β^* Universal nonrandom error parameter due to angular errors ($\beta^* = \beta C$)

d^* Universal nonrandom error parameter due to receiver mislocation and reflector profile errors ($d^* = dr/D$)

PROGRAM DESCRIPTION

For the evaluation of the intercept factor a computer program called "GAMMA", was developed.

The principle of operation of the program, written in BASIC, is that the two error functions within the integral are estimated for one degree steps of angle φ and then the integral is numerically evaluated using the Simpson integration method. The listing of the program is shown in Fig.1 whereas the program flow chart is shown in Fig. 2.

The program works as follows:

First the required input parameters are defined, lines 20-50, followed by the definitions of the constants π and H (step size equal to one degree in radians) and function y(x), line 110. Then the two error functions are evaluated in steps of one degree and the integral is numerically integrated by using the Simpson integration method, lines 260-400. Finally the input and output from the program are given in lines 420 and 430 respectively.

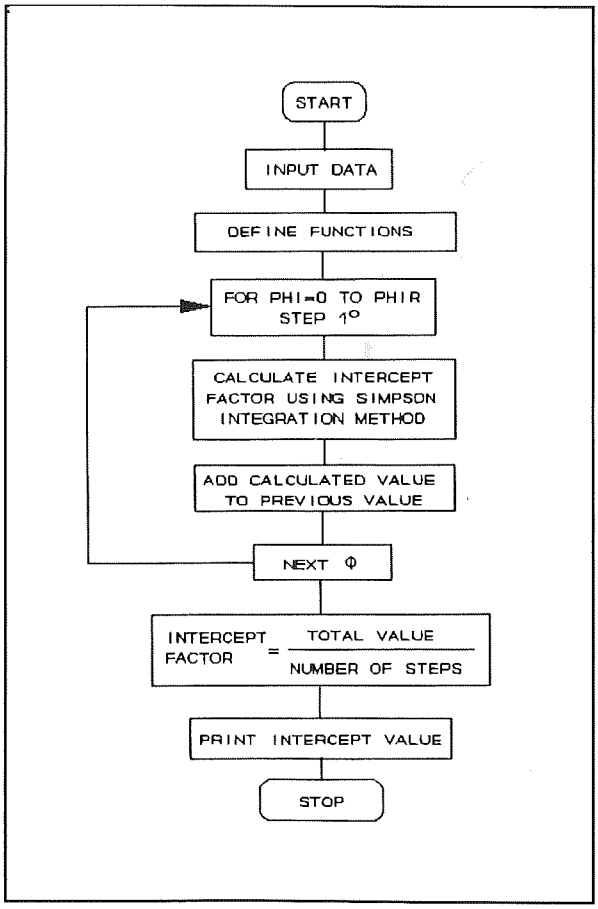


Fig. 2 Program "GAMMA" flow chart

The error function (Erf) is defined as:

$$\text{Erf}(y) = \frac{2}{\sqrt{\pi}} \int_0^y e^{-t^2}\, dt \qquad (3)$$

For the solution of this equation the values given for the normal probability function can be used.

In this case the y values must be multiplied by $\sqrt{2}$ and then evaluate the normal probability integral. For example, for the evaluation of Erf (2.3), $y = 2.3\sqrt{2} = 3.25$. From normal distribution tables, for y=3.25, F(y)=0.9988. Therefore Erf (2.3)=0.9988. The value of the two Erf functions used in the program were calculated by the two fifth order polynomial fits, of the normal probability distribution, one for the range 0-1.4 and one for 1.4-2.8 (lines 160-250). This was done for more accuracy.

As an example, for a carefully fabricated collector[Guven and Bannerot, 1986]:

σ mirror = 0.002 rad and σ slope = 0.004 rad. Standard deviation of the Sun's intensity distribution can be taken as 0.0025 rad. Therefore:

$$\sigma = \sqrt{(0.0025)^2 + 4\,(0.004)^2 + (0.002)^2} = 0.00861 rad$$

β = 0.2°= 0.0035 rad

dr = 3mm (approximately)

The β value used is the maximum error reported from a tracking system developed by the author [Kalogirou et al., 1992].

By using these values the program results in γ = 0.9506

RESULTS / CONCLUSIONS

The results of the program together with values obtained by using a ray-trace technique program, namely EDEP, and another program developed by Guven [1987] using the trapezoidal integration method to solve Equation (2) are shown in Table 1.

It can be seen from Table 1 that the program GAMMA presented here calculates γ closer to the EDEP results which are considered as the most accurate. The maximum percentage difference between EDEP and GAMMA, as shown in Table 1, is 3.1% whereas the corresponding difference between EDEP and the program developed by Guven [1987] is 6.1%. Therefore it can be concluded that the present program can accurately be used to evaluate the intercept factor of a concentrating solar collector.

Table 1 Comparison of intercept factor obtained from different programs

φr	σ*	β*	d*	(EDEP) (1)	Guven (2)	Present (3)	Percentage difference	
							1 and 2	2 and 3
90°	0.1	0.1	0	0.99928	0.99859	0.99905	0.069	0.023
			0.075	0.99761	0.99420	0.99611	0.342	0.150
			0.15	0.99085	0.98084	0.98656	1.010	0.433
			0.225	0.97394	0.94786	0.96196	2.678	1.230
			0.3	0.94018	0.88260	0.91094	6.124	3.110

REFERENCES

Guven, H.M. and Bannerot, R.B. 1985. Derivation of Universal Error Parameters for Comprehensive Optical Analysis of Parabolic Troughs, *Proceedings of the ASME-ISES Solar Energy Conference,* Knoxville, USA, pp. 168-174.

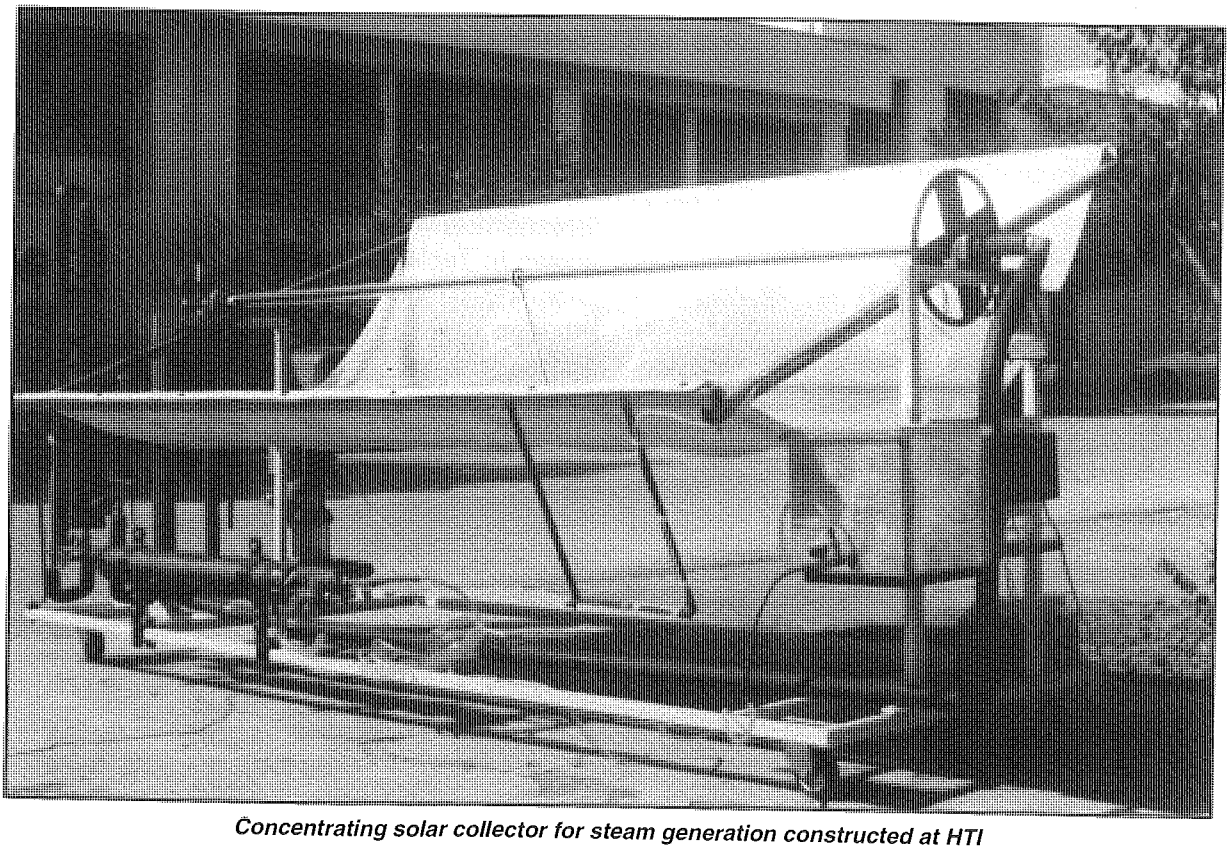
Guven, H.M. and Bannerot, R.B. 1986. Determination of Error Tolerances for the Optical Design of Parabolic Troughs for Developing Countries, *Solar Energy,* no. 36, pp. 535-550.

Guven, H.M. 1987. Optimisation of Parabolic Trough Collector Design for Developing Country Applications Using a Closed-Form Expression for Intercept Factor, *Proceedings of the ASME JSME-JSES Solar Energy Conference,*

pp. 669-675.

Kalogirou S., Lloyd S, and Ward J. 1992. A Tracking Mechanism for Medium to High Concentration Ratio Parabolic Trough Collectors. *Proceedings of the Second World Renewable Energy Congress,* Reading U.K., vol. 2, pp. 1086-1091.

Sodha M.S., Marthur S.S. and Malik M.A.S. 1984. *Reviews of Renewable Energy Resources,* Vol.2, Wiley Eastern Ltd



Concentrating solar collector for steam generation constructed at HTI

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A TQM Study: Diagnostic Phase

(Based on a National TQM Survey in Cyprus)

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INTRODUCTION

In practice, a Total Quality Management (TQM) implementation process consists of four phases [1]:

I Diagnosis and preparation

II Management focus and commitment

III Planned improvement

IV Review, reinforcement and re-start.

Quality improvements can be successful at the implementation level only after the need and problems have been identified and correctly evaluated at the diagnostic level. This paper focuses on phase 1, defining the methodology and techniques adopted to identify and evaluate the status of TQM in Cyprus and then recommends actions that the Cyprus Manufacturing Industry (CMI) should take before Cyprus joins the European Union (EU).

THE SURVEY

The above identification and analysis have been made by means of an extensive National Quality Survey, based on a specially designed questionnaire, which targeted 60 manufacturing industries. This kind of research survey study, conducted by the author and supervised by the University of Glamorgan (UK), has never before been conducted in Cyprus [2]. Its survey results are unique to the subject area in Cyprus and valuable to other developing countries or organizations that might share the same needs and problems and wish to follow the same road to success.

It is time now to address and answer the five crucial questions What, Who, How, When and What through the following steps of the diagnostic phase of TQM implementation:

1. Understanding the meaning and the need

The major concepts of TQM (its meaning, evaluation and applicability) have been clearly defined, understood and discussed through a literature search: This was to enable the researcher to define very clearly the aims and objectives of the research, to assist later to formulate the strategy for the investigation and, finally, to recommend actions based on the investigation and TQM knowledge.

2. Benchmarking

Under this topic, an investigation was made to identify the current status of Cyprus manufacturing Industry and the Quality Standards of other Competitor countries (mostly European). This was to find out where we are now and where we want to go.

3. Research Design and methodology

a. The research:

A survey was determined as the best method to identify and evaluate the current problems and needs of CMI.

b. Questionnaire formulation:

According to various authors [3,4,5] the best method of conducting a survey of this nature is to produce a questionnaire which is completed during a personal interview between the interviewer and the company representative. This was the method adopted by the author.

A draft questionnaire was prepared to meet the aims and objectives of the survey, although other similar surveys, questionnaires and TQM literature contributed valuable information and techniques [6,7,8]. The draft questionnaire was discussed and reviewed with senior representatives of interested parties.

This was followed by a pilot implementation of fifteen enterprises to test the reliability, suitabil-

ity and effectiveness of the questionnaire.

The final questionnaire released to all industries included all aspects and concepts of TQM: Systems, Tools, and People.

c. The sample:

The size of the sample and selection of enterprises were of vital importance. Sixty enterprises were randomly selected and interviewed from of larger list containing enterprises from the five largest manufacturing sectors: clothing, leather and footwear, drinks and food processing, metal industry and furniture.

d. Conducting the survey:

At the great majority of enterprises personal interviews were conducted. For the rest of the cases there was a small introduction/ discussion between the two parties followed by the request to mail in the completed questionnaire.

The above mentioned approach is the best-with three major disadvantages: it is expensive, time consuming, and is valid only insofar as the researcher does not lead or guide the interviewees in their answers.

4. Computer customization and data analysis

Upon the formulation of the questionnaire and during the execution of the survey, the computer (equipped with a carefully selected statistical package) was programmed to accept and analyze the results of the survey (answers/ choices of the questionnaire).

5. Presentation and discussion of the results and findings

All the answers delivered by the computer in a numerical and bar chart form, (400 pages) were further analyzed, tabulated, grouped together and presented in a graph form to show their common characteristics.

This was followed by discussion of quantitative and qualitative results with recommendations. For uniformity each topic followed the same methodology: Presentation of the results/ findings in graph form, followed by discussion and recommendations related to each topic.

In many cases, solutions and recommendations were given in a flow chart or diagram and the entire survey summary was presented in a cause - and - effect diagram. That huge C & E diagram consisted of more that 500 causes identified and discussed during the survey. Figure 1 illustrates in a flow chart the actual sequence of research process and samples of each document extracted from the research report.

6. Conclusions and recommendations

The last exercise was to summarize conclusions and give recommendations on a national and company level, which could apply as well to a wider audience.

7. Results announcement

A presentation of the official results was given in a press conference to which senior offices and representatives of participating companies were also invited. Research results were also presented by the author on Cyprus television.

EXTRACTS FROM THE SURVEY

The decision to join EU has been taken by both parties and by 100% respondents and assumed to be realised within 2-3 years time. But is Cuprus ready to join EU? Can Cyprus compete with the Quality levels of the EU?

- The answers to these two crucial questions were not so encouraging 3½ years ago when the first survey was conducted. Looking at Figure 2, 41% responded that the quality of Cyprus products was the same as EU products, while 59% gave a negative answer. Furthemore, only 12% answered that CMI is ready to join the EU (Figure 3).
- The same crucial questions were asked to the same persons from the same enterprises in June 1995. So the first historical data were reported and trends could be easily established.

Looking at Figures 2 and 3 the results are disappointing. The readiness and the Quality of Cypriot products compared with EU are detiorating in spite of the fact that we are closer to EU entry. When managers were asked to compare their company products with EU the results were very encouraging as shown in Figure 3. Of course,

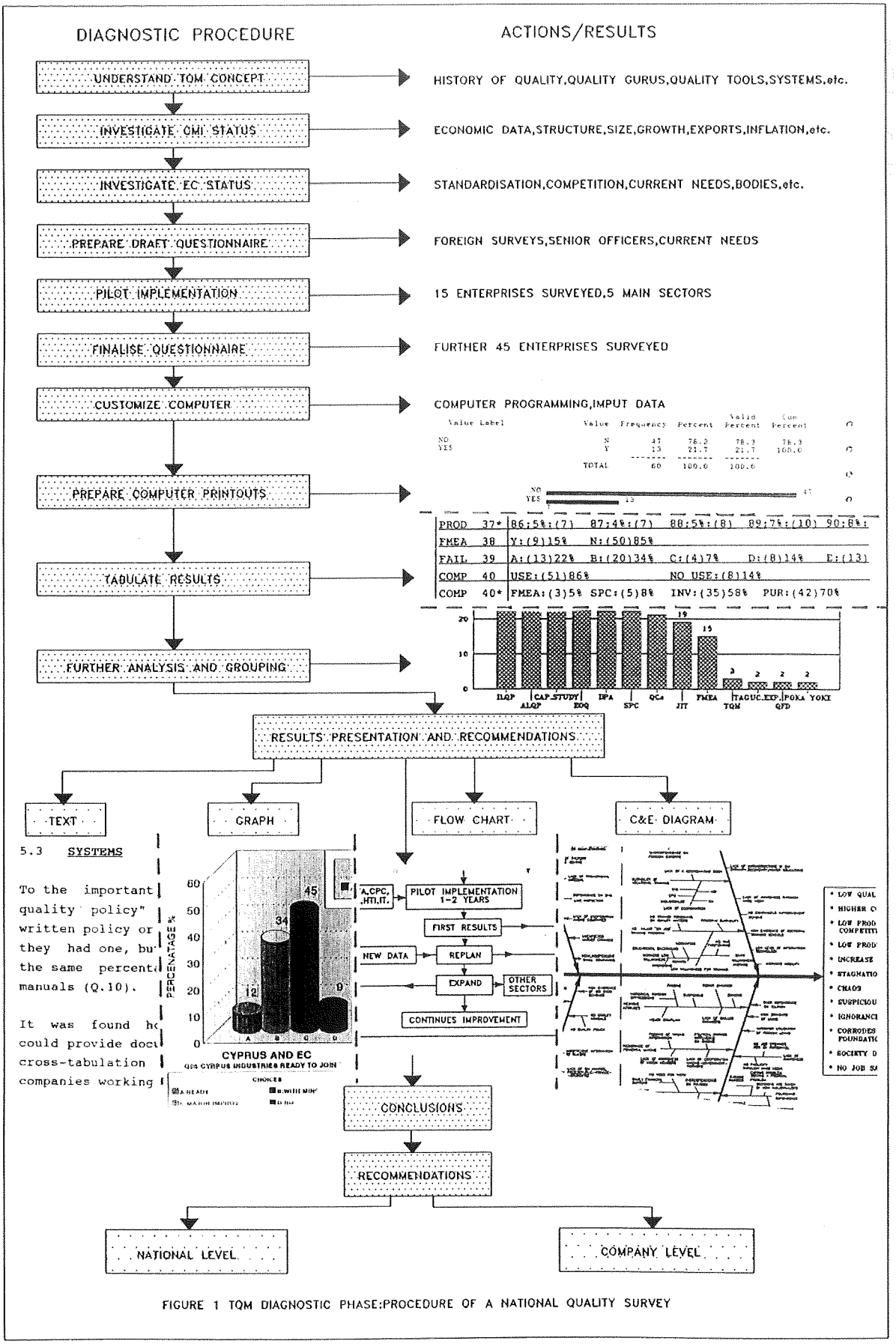

FIGURE 1 TQM DIAGNOSTIC PHASE:PROCEDURE OF A NATIONAL QUALITY SURVEY

Fig. 1 TQM Diagnostic phase: procedure of a national quality survey

this is a normal phenomenon where individuals tend to overvalue their own products.

Two out of five sectors (evaluated) are in a desperate condition. Footwear and clothing manufacturers in their majority raised their hands and gave up (Twelve percent of the respondents closed or postponed their activities). The whole image is completed by looking at Figure 4 where trends are illustrated by comparing the number of employees and income, for the year 1991 and 1995.

Some important recommendations to small or developing countries are summarized below:

- The new slogan is: "seek out Quality, not cheap products". EC countries rank quality as the first or second priority and then prices [9].
- Lack of Quality policies, manuals and systems, standards, legislation, personnel and attitudes causes several serious problems to producers and customers alike. There is no methodology regarding how Quality is perceived, executed and maintained.
- At every stage the anticipated resistance to change must be seriously considered. The following four opposing forces should be weakened or preferably reversed before any large scale implementation can take place: Culture, System, Dependency on political parties, Union power.
- When there is insufficient and incorrect communication between customers and suppliers and above all when there is no assessment system and standard of conformity, qualitative judgement of quality delivered by the suppliers is impossible.
- Record keeping is vital for performance measurement and improvement.
- Small and developing countries like Cyprus should concentrate on testing, certification and expansion of testing and technology centers rather, than preparing new standards. They can always adopt accepted international standards. This is the approach adopted by CYS 6 months ago.
- Quality should be built into the process and thus eliminate dependance on end-line inspection to achieve quality.
- If an enterprise is using the right systems and has a positive culture, but lacks the tools (especially SPC) and methods, it cannot proceed. Conversely, if methods and techniques are familiar to some members of the company, improvements can be made.
- If enterprises are not designed for quality, and spend their time on fire-fighting, fixing, rework, inspecting and detecting they will not be competitive.
- A key element for success is advocating the meaning of Quality in the sense "Customers need satisfaction". Each enterprise should identify who the customer is, what his requirements are and how these requirements can he satisfied.
- Although there is a proliferation of training programs, the appropriate training at all levels of an enterprise should be implemented. The characteristics of insufficient training are demonstrated below:

a. Lack of professionals on Quality matters.
b. Overdependence on foreign experts.
c. Lack of coordination between training establishments.
d. Unsuitability of training.
e. Lack of fees/funding.
f. Non-existence of "On-the-job training"
g. Unwillingness/motivation for training.

- A Business cannot run effectively without quality cost data and measurement of performance. These data could include Quality costs, production, failure rates, customer complaints, SPC charts and tables etc.

CONCLUSIONS

In a Total Quality environment most staff and employees should be ready to become actively involved in a task force for Quality improvement, working in teams and using communication skills.

Each Quality problem identified carefully through diagnostic phase, should be analyzed and evaluated by a team. That team/committee should devise an action plan / strategic plan, using all data available from the diagnostic phase. All data must be summarized in a way to ensure that decision makers actually do make decisions from them.

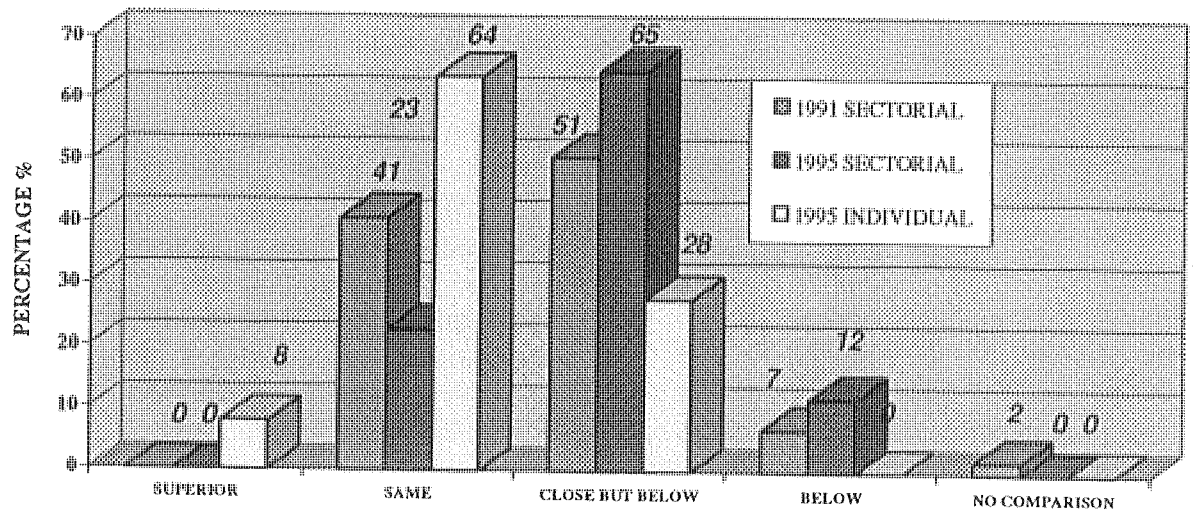

Figure 2 Quality of Cyprus products compared with those of EU

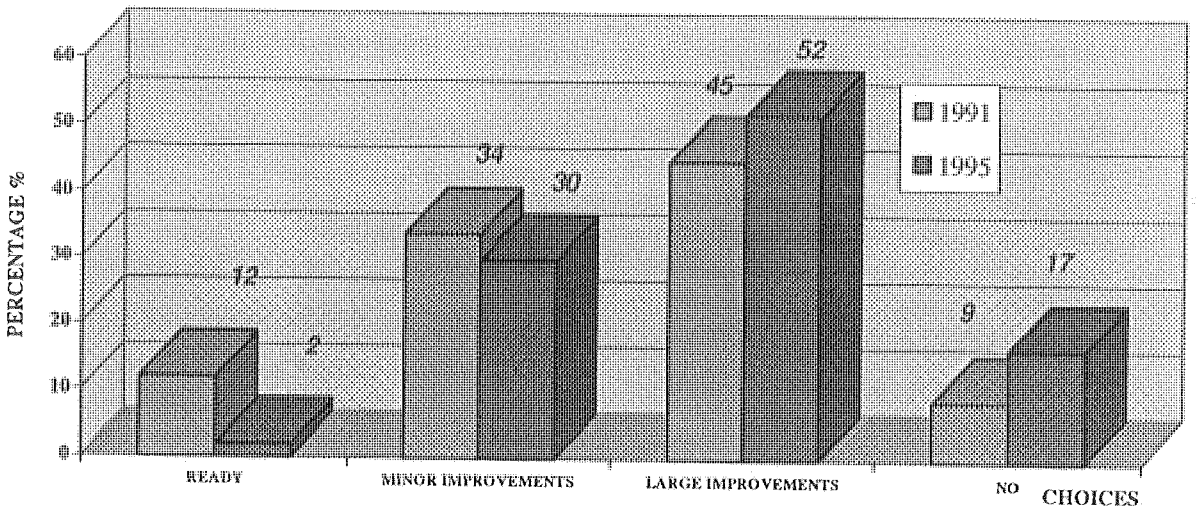

Figure 3 Readiness of CMI to join EU

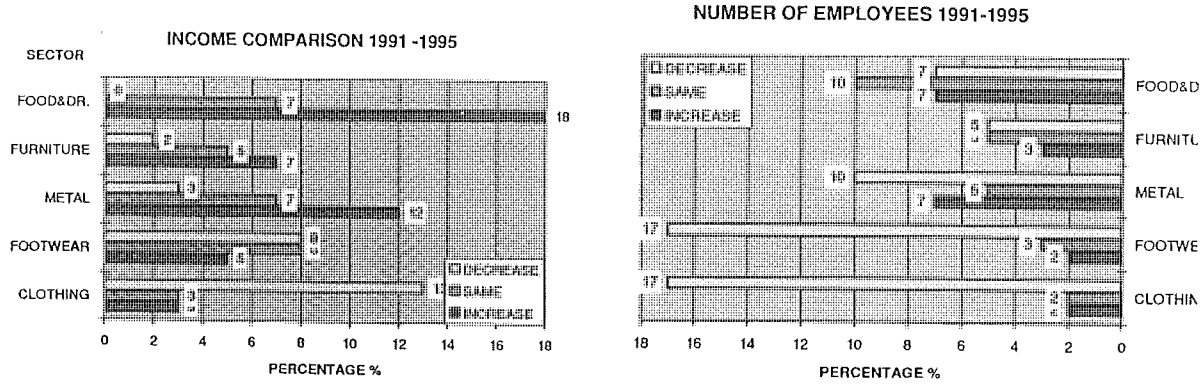

Figure 4 Cumulative statistics on income and employment for 1991 & 1995

We wish to stress the importance of the diagnostic phase as a prerequisite and foundation for successful implementation of a Total Quality environment, and thus conclude with the words of Dr. W.E. Deming:

"If you wait for people to come to you - you'll only get the small problems. You must go and find them. The big problems are where people don't realize they have one in the first place".

REFERENCES

1. Smith S.: *How to take part in the Quality revolution,* P.A. management consultants, UK 1990, pp. 50-57.
2. Angeli I.I.: *Evaluation of the status of Total Quality Management in Cyprus Manufacturing Industry,* MPhil Thesis, University of Glamorgan, UK 1993.
3. Camp C.R.: *Benchmarking,* ASQC, Quality Press, 1989, pp. 76-118.
4. Hague N.P.: *The Industrial Market Research Handbook,* Kogan Page, 1984, pp. 203-243.
5. Lerey C.D.: *"Survey Survey" Reinforces a TQM environment,* Proceedings of the 1991-ASQC Quality congress, Milwaukee, USA.
6. Lawewood Research 1990: *Survey of Service Quality and Total Quality Managements,* Sponsored by the Quality Consortium.
7. Benchmark Partners, Inc.: *National Quality Survey (NQS),* 1991, USA.
8. Dale B.G.: *Starting on the road to success,* The TQM magazine, IFS publications, vol. 3, no.2, UK 1991, pp. 125-128.
9. Ryan J.: *Different Lands - Different views,* Quality progress Magazine, ASQC, vol. 2, no.11 November 1991, pp.25-29.

Note: ***The complete results and findings, the C & E diagram and the questionnaire used (103 questions 18 pages) can be sent to you on request. Write to I.I. Angeli, Higher Technical Institute, Mechanical Engineering Department, PO Box 2423, Nicosia, Cyprus (Tel. (02) 305050, Fax (02) 494953).***

Artificial Neural Networks in Marine Propeller Design

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ABSTRACT

Various neural network systems were developed for examining propeller performance data that were derived experimentally. This study is aiming to establish an accurate mapping, thus facilitating propeller selection during the design process. Different neural network architectures and learning rates were tested, aiming at establishing a near optimum setup. It is evident from the findings so far, that this technology can be used effectively in modeling the performance of a series of marine propellers and thus may be used for propeller selection, and for extrapolation to new designs.

INTRODUCTION

The power of neural networks in modeling complex mappings, and in system identification has been demonstrated (Kohonen 1984, Kosko 1988, White 1989, Ito 1992, Nabhan and Zomaya 1994). This work encouraged many researchers to explore the possibility of using neural network models in real world applications such as in control systems, in classification, and in modeling complex process transformations (Eberlein 1988, Guez 1988, Barnes et al. 1991, Beaufays et al. 1994, Chen et al. 1994, Pattichis et al. 1995).

The aim of this study is to investigate the suitability of neural networks as tools for propeller selection during the design process. Marine propeller design is laborious and intensive, requiring extensive experimentation in order to establish the actual performance of a propeller. This becomes even more difficult to examine, when cavitating conditions exist. An effort to model the performance characteristics of a series of propellers under various conditions including cavitation was made. Various neuronal architectures and learning procedures have been tried. The propellers modeled are the USN propeller series as reported by Denny et al. (1989). These are commercially available marine propellers, which were tested on actual sea conditions using a suitably modified USN 10,8m boat.

In propeller literature (Lewis 1988), it is customary to present experimental data as a series of charts of thrust coefficient (K_T), torque coefficent (K_Q) and efficiency (η), versus the advance coefficient (J), for different values of the pitch to diameter ratio (P/D), the blade area ratio (BAR), the number of blades (z), and the cavitation number (σ). In this study we have used a similar approach for the propeller input /output mapping. We used five inputs, namely the values of J, P/D BAR, z and σ, and three outputs, namely K_T, $10K_Q$ and η.

DESCRIPTION OF THE MODEL

Threes groups of networks have been tried using Neuroshell2 neural network package. These are: i) Standard feedforward multilayer architectures of three, four and five layers (including the input and output layers), in which all neurons of a previous layer are fully connected to the next layer, ii) Three variants of recurrent networks with dampened feedback (Jordan-Elman nets), and iii) Three variants of proprietary Ward networks (involving multiple hidden slabs of different activations in each).

For each one of these basic architectures, different size layers have been used. These are shown in Table 1.

For the case of the 3-layer network, eight different models have been investigated, aiming at finding the optimum structure that will give the least Root Mean Square (RMS) deviation between the predicted and measured values of K_T and K_Q. It has been found that a simple architecture of 5-11-3 can produce adequately accurate results. This is demonstrated in Fig. 1 which displays a bar chart of RMS deviation for different architectures, for the specific case of estimating K_T. Similar graphs can be obtained

Table 1 Neural network architectures used in the simulations

ARCHITECTURE	MODELS								
3-LAYER	5-2-3	5-5-3	5-10-3	5-11-3	5-11-3	5-15-3	5-20-3	5-25-3	5-30-3
4-LAYER	5-5-5-3	5-10-5-3	5-10-10-3						
5-LAYER	5-5-5-5-3	5-10-10-10-3							
JORDAN-ELMAN Type 1	5-5-5-3	5-5-10-3	5-5-15-3	5-5-20-3	5-5-20-3				
JORDAN-ELMAN Type 2	5-5-5-3	5-10-10-13	5-15-15-13	5-20-20-23	5-20-20-23				
JORDAN-ELMAN Type 3	5-5-5-3	5-5-10-3	5-5-15-3	5-5-20-3	5-5-20-3				
WARD Type 1	5-5-5-3	5-10-10-3	5-20-20-3						
WARD Type 2	5-5-5-5-3	5-10-10-10-3	5-20-20-20-3						
WARD Type 3	5-5-5-3	5-10-10-3	5-20-20-3	5-30-30-3	5-30-30-3				

for the cases of 10 K_Q and η. Four and five-layer topologies have also been included. It is observed, however, that despite their more complex structures, they were not as good mappers as the simpler three-layer structures. It is noted from this figure that the simple architecture of 5-11-3 produced the smallest error. This is the same hidden layer size (11 neurons) as suggested by Kolmogorov's theorem (Hecht - Nielsen 1987).

all other layers a logistic sigmoid has been employed. The weights were intitialized to a value of 0.3. The 5-layer nets were practically very difficult to train and they could not converge fast to a low error. In the Jordan - Elman and Ward networks different activations in different layers have been tried. A general observation was that even though these nets were fast in dropping the RMS down to a low value in relatively few epochs, they could not ultimately meet the required criterion for training termination (average error less than 0.004), and hence they could not produce such a good mapping, or at least as good, as that of the simpler structures. The training data set had 248 patterns while the test data set had 53.

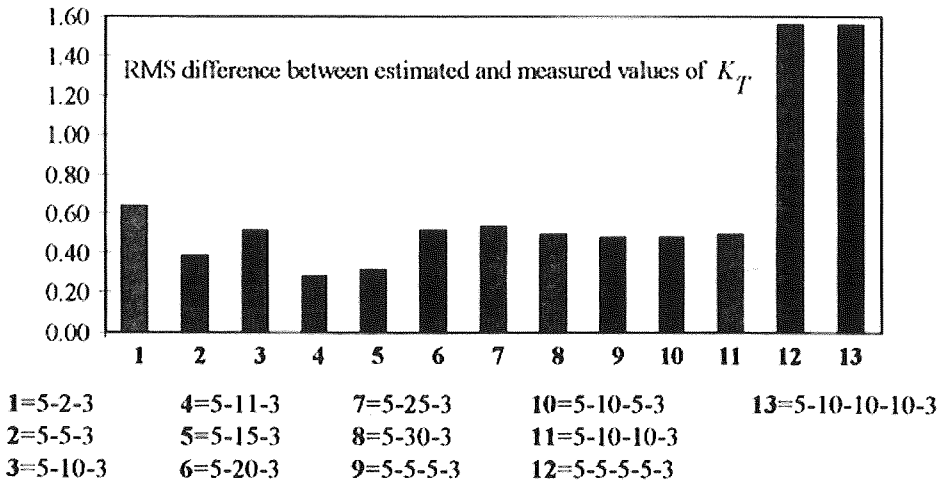


Figure 1 RMS difference between experimental and network predictions for K_T

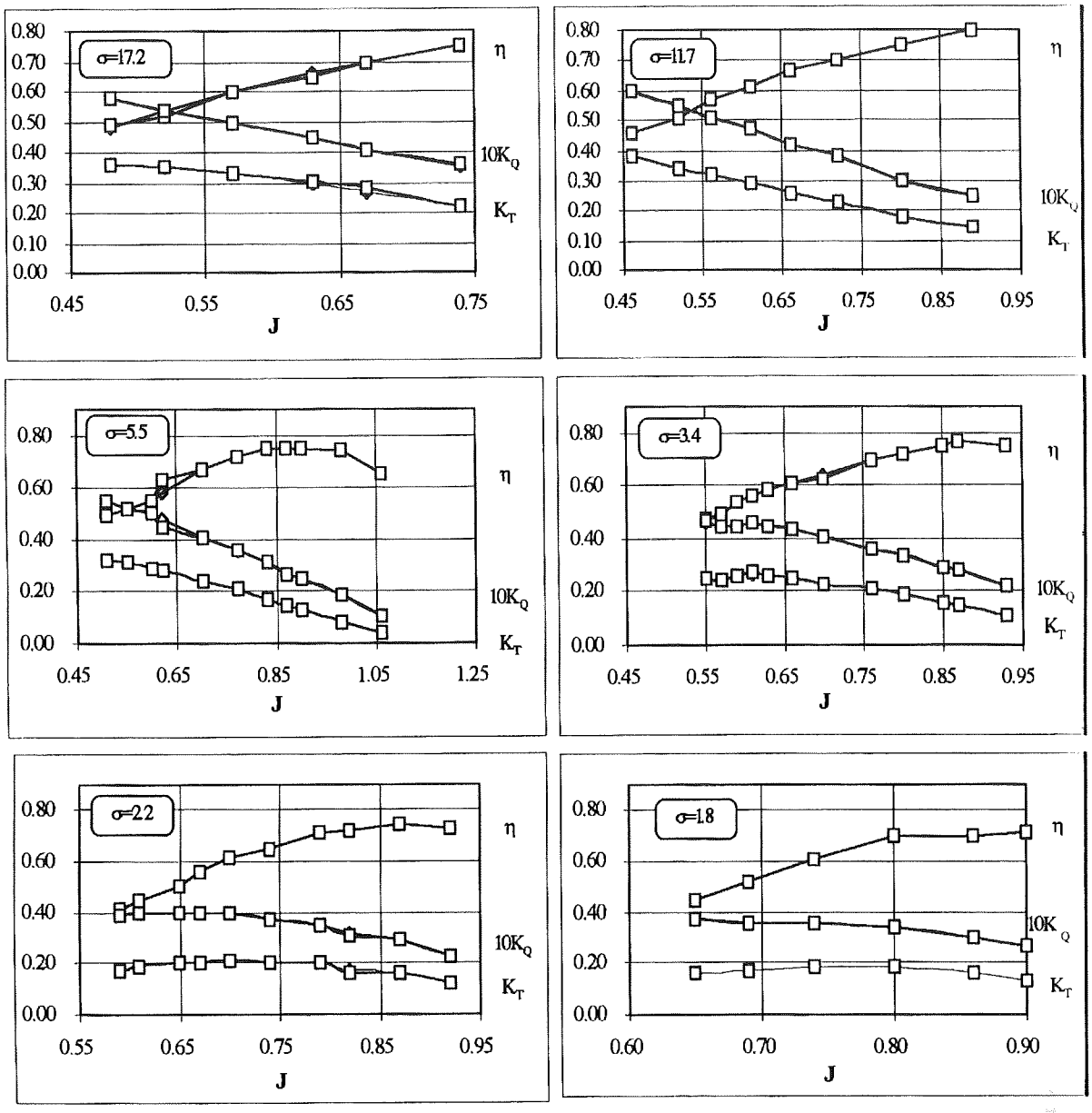
For all the networks described in Table 1, five input neurons have been used corresponding to the values of *J, P/D, BAR, z,* and σ of the five-element input vectors of the training data set. The output is a three neuron vector. Each element of the output vector corresponds to the values of K_T, $10K_Q$, and η. For the three, four, and five-layer standard nets the back-propagation learning algorithm has been employed (Werbos 1974, McClelland et al. 1986). The gain was set to 0.1 and the momentum coefficient to 0.1. The input layer activation transfer function was chosen to be linear, while in

RESULTS / DISCUSSION

Considering all networks attempted, it is noted that the best mapping was obtained with the simple 5-11-3 topology employing the standard

backpropagation learning strategy. The more complex structures were not only more calculation intensive, they also produced inferior mapping. In fact the large Jordan - Elman and

Fig. 2 shows predicted and measured values of K_T, $10K_Q$ and η versus J and σ of a typical case (z=4, BAR=0.72, P/D=1.058). It is easily



□ = Predicted Values ◇ = Measured Values

Figure 2 Predicted and measured values of K_T, $10K_Q$, η versus J and σ. Case of (z=4, BAR=0.72, P/D=1.058).

Ward structures, as well as the 5-layer back propagation nets were unable to perform safisfactorily the required mapping for the selected values of activations, gains and momentums. The simpler Jordan - Elman and Ward structures were fast converging to the required criterion that was set for training termination, but could not achieve good mapping when compared to the bakcpropagation nets.

noted that the matching between predicted and measured values is excellent. In fact it is so close, that the two lines (measured and predicted) are not distinguishable.

The trained network was also tested on unknown values of J. These values were selected to fall both within the normal range of J that was used in the training set, as well as slightly outside (both on the high and low value sides

of the normal range). It was observed that the prediction of the net was just as good as that obtained for the complete training and test set of 301 patterns discussed previously and shown in Fig. 2.

CONCLUSIONS

It has been shown that this method can achieve good mapping and may be used in actual design work for propeller selection. Further extensions could be the incorporation of actual propeller data from sea trials into the system, aiming at building a versatile expert system for propeller design. Furthermore, the technique may be considered for application in other complex fields of naval architecture, such as for the prediction of a ship's wave making resistance.

NOMENCLATURE

BAR = Blade Area Ratio

h = Total static head at propeller centerline

J = Advance coefficient = V_a/ND

K_Q = Torgue coefficient = $Q/\rho N^2D^5$

K_T = Thrust coefficient = $T/\rho N^2D^4$.

N = *Propeller angular speed [revs/sec]*

V_a = Speed of advance

z = number of propeller blades

p = Propeller pitch

K/D = Propeller pitch ratio

Q = Torque

T = Thrust

η = Propeller efficiency = $K_TJ/2\pi K_Q$,

ρ = *Water density*

σ = *Caviation number* = $2gh/V_a^2$

REFERENCES

Barnes C., Brown S., Flake G., Jones R., O' Rurke M., Lee Y. C. (1991), «Applications of neural networks to process control and modelling» *Proceedings of ICANN-91,* 321-326.

Beaufays F., Abdel-Magid Y., Widrow B. (1994), «Application of neural networks to load -frequency control in power systems», *Neural Networks,* Vol 7. 1:183-194.

Eberlein S. (1988), «Decision making net for an autonomous vehicle *«Neural Networks Supplement: INNS Abstracts, 1,* 333.

Chen Q. Y. Thomas W.D., Nixon S.M. (1994), «Generating - shrinking algorithm for learning arbitrary classification», *Neural Networks,* Vol 7.9:1477-1489.

Denny B.S., Puckette T.L., Hubble E.N., Smith K.S. Najarian F.R. (1989), «A new usable marine propeller series», *Marine Technology,* Vol. 26. 3:173-191.

Guez A., Eilbert J. and Kam M. (1988), «Neural network atchitecture for control», *IEEE Control Systems Magazine,* 22-25.

Hecht - Nielsen R. (1987), «Kolmogorov's mapping neural network existence theorem», *Proc. IEEE International Conference on Neural Networks.*

Ito Y. (1992), «Approximation of functions on a compact set by finite sums of a sigmoid function with and without scaling», *Neural Networks,* Vol 4. 817-826.

Kosko B. (1988), «Bidirectonal associative memories», *IEEE Transaction on Systems, Man and Cybernetics.* SMC 18:42-46.

Kohonen T. (1984), «Self-organisation and associative memories» *Berlin: Springer - Verlag.*

Lewis V.E. (1988), «Principles of Naval Architecture», *Society of Naval Architects and Marine Engineers.*

McClelland J. L. Rumelhart D.E. and the PDP Research Group (1986), «Paraller Distributed Processing: Explorations in the microstructure of cognition», *Cambridge, MA. MIT Press.*

McCulloch W.S. ans Pitts W. (1947), «How we know univesrlas: the perception of auditory and visual forms», *Bulletin of Mathematical Biophysics* 9:127-147.

Nabhan M. T. ans Zomaya Y.A. (1994), «Toward generating neural network structures for function approximation», *Neural Networks,* Vol 7. 1:89-99.

Pattichis C.S., Schizas C.N., Middleton L. (1995), «Neural network models in EMG diagnosis», *IEEE Transactions on Biomedical Engineering,* vol 42, 5:1-11, 1995.

Werbos P. (1974), «Beyond regression: New tools for prediction and analysis in the behavioral sciences», *PhD Dissertation,* Harvard University.

White H. (1989), «Learning in neural networks: A statistical perspective» *Neural Computation* 1:425-464.

Cypriot Women in the Labour Force

their Participation, Earnings and Status

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ABSTRACT

During the last thirty years there has been a considerable increase in the participation of Cypriot women in the labour force. In 1992, women comprised 38.7 per cent of the total economically active population in Cyprus. Despite their increasing number Cypriot women are concentrated in female dominated and low paid occupations. The objective of this paper is to present a picture of Cypriot women in the labour market and to investigate the factors which are responsible for the lower status and earnings of women in comparison to that of men.

INTRODUCTION

The participation of women in the labour force has exhibited a steady increase internationally. The International Labour Organisation estimates showed that women's participation rates increased considerably after 1950, with the result that in 1980 women constituted more than one third of the total number of workers worldwide. Despite their increasing number working women still suffer a great deal of discrimination and their status and earnings are inferior to those of men.

During the last two decades there has been a growing concern about the inferior status and lower remuneration of women in the labour market. Considerable research, motivated by this concern, has been undertaken in the developed and most of the developing countries, especially during the decade of women 1975-85. Research indicated that in order to account for the inferior position of women in the labour market a variety of factors need to be considered, such as historical, social, economic, political and personal.

In Cyprus, a middle-income developing country, significant changes have taken place since 1960, when the island became an independent republic. Political, economic and social changes resulted in the redefinition of gender roles and the rise in the participation of women in the labour force.

HISTORICAL REVIEW

The main sources of statistical information regarding employment in Cyprus are the decennial Census reports and the Registrations of Establishments carried out by the Department of Statistics and Research. Both have their limitations and deficiencies.

According to the above sources women's participation rates increased from 18.0 per cent of the total employment in 1891 to 33.2 per cent in 1960.

The political crisis between the two communities in 1963-64 prevented a full census of the population after 1960 and Statistics after that date cover only the Greek population and the small minorities (Armenians, Maronites, etc.) in the Government controlled area. This renders any comparison before and after 1960 inaccurate.

Since 1960, employment opportunities were offered to women in a variety of sectors of the newly formed Republic. In addition, the socio-economic changes brought about by the consequences of the Turkish invasion, resulted in a considerable increase in the participation of women in the labour force. A significant increase occurred in the participation rates of married women as the economy rapidly expanded in the post-1974 war years. In addition, the ratification of most of the United Nations and the International Labour Office conventions contributed to the increase in the participation of Cypriot women in the labour force. In 1992 women constituted 38.7 per cent of the total economically active population.

Table 1 below, indicates that the participation rate of Greek Cypriot women can be favourably

compared to the corresponding rates of the southern and most of the northern European countries.

WOMEN'S TRENDS OF EMPLOYMENT

In Cyprus as in all Mediterranean countries traditional values were very strong and gender roles were distinctly defined. Women's domestic role influenced their patterns of employment and the earliest female occupations were mostly in industries which were home-based. According to the 1921 Census, the majority of female employment (88.64%) was concentrated in the following six principal occupations.

1. Weavers
2. Farmers and Cultivators
3. Ploughmen and Agricultural Labourers
4. Sewers and Dressmakers
5. Embroiderers
6. Domestic Servants

Agriculture has been the sector with the largest representation of women in employment. In 1960, women in agriculture constituted 63% of the total economically active women's population. According to the International Labour Office statistics (1985) between 1970 and 1980 the proportion of women working in agriculture declined all over the world.

In Cyprus the consequences of the Turkish invasion on the economy accelerated the decline in the sector of agriculture and created employment opportunities in other developing sectors of the economy, i.e. manufacturing and trade.

Table 1 Female labour force participation rates (1992) in European Community compared to Cyprus

COUNTRY	NUMBER OF WOMEN (Thousands)	WOMEN'S PARTICIPATION (%)
BELGIUM	1484	44.8
DENMARK	1222	71.3
GERMANY	12177	56.2
GREECE	1280	37.2
SPAIN	4098	31.7
FRANCE	9532	51.5
IRELAND	406	37.3
ITALY	7373	37.2
LUXEMBOURG	61	46.6
NETHERLANDS	2608	51.2
PORTUGAL	1987	57.4
UNITED KINGDOM	11400	61.8
CYPRUS	108	54.9

Source: Eurostat, Labour Force Survey, 1992, Statistical Abstract 1992 Dept of Statistics and Research, Nicosia.

Note: Women's Participation represents the ratio of the total employment of women to the working-age population of women (15-64).

Despite their increasing numbers in the labour force, women are concentrated in female dominated and low-paid occupations such as Clerical, Services and Sales, while their participation in Professional and Managerial occupations, is very low. Table 2, 3 and 4 set out information on the occupational distribution, the earnings and status of women in non-agricultural employment for the years 1976, 1981 and 1989.

Although the proportion of women in the professional group is quite high, the majority of women under this occupation belong to the Paramedical personnel, Teachers and Technical employees. Occupational segregation of the sexes is very well defined in Cyprus, even by the standards of Southern Europe, where sex segregation is much greater than in Western Europe, North America and the former socialist countries of Eastern Europe.

Table 2 Non - agricultural employment of women by occupation 1976, 1981 and 1989.

OCCUPATION	NUMBER OF WOMEN			PERCENTAGE OF WOMEN IN TOTAL EMPLOYMENT OF OCCUPATION		
	1976	1981	1989	1976	1981	1989
Professional, Technical and related workers	4620	6890	10371	36.1	38.2	40.9
Administrative & Managerial	160	260	485	6.5	7.6	10.2
Clerical Workers	7210	1150	19540	43.6	51.8	57.3
Sales Workers	4070	6240	10189	29.9	35.9	40.0
Service Workers	6240	8010	13825	37.3	41.8	45.3
Agricultural Workers *	10	130	75	5.0	16.5	10.0
Production Workers	12150	18050	21051	24.6	25.5	25.6
TOTAL	34460	50730	75536	30.8	33.6	37.2

Source: Registrations of Establishments, 1976, 1981 and 1989.
*Note: * Includes only the agricultural workers employed in non-agricultural sectors.*

EARNINGS AND STATUS OF CYPRIOT WOMEN

Women in Cyprus are generally paid much less than men in all occupational groups. As seen from Table 3, the rates of pay are different within the various professional groups.

In the estimate of the earning percentages shown in Table 3, over-time pay is included as well. The percentage ratio of female to male rates of pay, excluding over-time are 58 for 1981, 63 for 1985, 65 for 1989 and 66 for 1992. Thus the increase in female earnings is continuous.

Table 3 Monthly female earnings as a percentage of male earnings by occupation 1976, 1981, 1985 and 1989.

ISCO 1968	OCCUPATION	FEMALE TO MALE EARNINGS (%)			
		1976	1981	1985	1989
0/1	Professionals	53	62	77	72
2	Administrative and Managerial	70	68	71	73
3	Clerical	75	71	74	69
4	Sales	38	39	46	50
5	Services	59	58	53	54
6	Agriculture	52	51	57	55
7/8/9	Production	68	54	56	57
	TOTAL	55	57	67	63

Source : Annual Wages and Salaries Surveys 1976, 1981, 1985, and 1989.Department of Statistics and Research, Ministry of Finance, Nicosia,Cyprus.
Note : The data provide only an indicator and not absolute levels. ISCO : International Standard Classification of Occupations. As from 1990 a different ISCO was used. (ISCO 1988) This renders inaccurate any comparison of earnings by occupation before and after 1990.

The monthly female earnings as a percentage of male earnings are highest in the Professional and Administrative and lowest in the Sales, Services and Production occupations, where women are over-represented. It should be noted that Table 3 refers to paid employees only. Considering the self-employed who are mostly male (Table 4) and unpaid family workers, most of whom are female, women's earnings as a percentage of men's may be even lower than the figures indicated in Table 3. Moreover, there is a higher incidence of unemployment among female workers.

In the Private sector the ratio of female to male monthly earnings is much lower than in the Public sector. It should be noted that the earnings of employees in the Private sector are lower than in the Public sector in almost all occupational groups. In Cyprus, until 1992 the principle of equal pay for work of equal value was officially acknowledged in the Public sector and in some areas of the private sector including banking and the hotel industry. The ILO Convention No 100 on Equal Remuneration for Work of Equal Value was ratified in 1987 but its major principles were expected to be implemented in 1992 (three years after the passing of Law 158/89 on Equal Remuneration Between Men and Women for Work of Equal Value), so as to give time for the necessary amendments of the collective agreements and the preparation of the mechanisms for its implementation.

The examination of the figures and trends of Greek-Cypriot female workers proves that the status of Cypriot women in the labour force is inferior to that of men. This is detected in the lower participation of women in the labour force, their concentration in a small range of low-paid occupations and their poor representation in Administrative and Managerial posts.

FINDINGS OF RESEARCH STUDIES ON THE DETERMINANTS OF THE LOWER STATUS OF CYPRIOT WOMEN WORKERS IN THE LABOUR FORCE

Since 1975 several research studies, have been undertaken by the Department of Statistics and Research of the government of Cyprus investigating the participation, pattern of employment and position of Cypriot women in the labour market. In 1991, the Industrial Training Authority of Cyprus published a survey on the exploitation of economically inactive female population of Cyprus. In addition in 1994 the author completed a research study on Cypriot Women in Society and Civil Engineering. Data obtained from the above mentioned research studies indicated the following:

PARTICIPATION IN THE LABOUR FORCE

Caring for children, household work, low wages as well as the distance between employment and residence seem to be the major constraints on women's participation in the labour force. Market wage was the major incentive, while the number and age structure of children were the major potential constraints imposed on a woman to enter the labour market.

The perceived need for income usually is expected to be a function of family income and family size. In Cyprus the effect of increasing

Table 4 Economic status of working population

WORK STATUS	TOTAL NUMBER			WOMEN'S PERCENTAGE PARTICIPATION		
	1976	1981	1989	1976	1981	1989
Self Employed	23840	30570	31518	12.3	13.5	21.3
Unpaid Family Worker	3603	3573	3471	79.8	84.4	82.9
Paid Employee	89338	121504	168086	32.9	36.5	30.2

Source : Registration of Establishments 1976, 1981 and 1989, Department of Statistics and Research. Nicosia, Cyprus.

family income and family size seemed to thwart the wife's participation; many women claimed that the quality and quantity of child-care institutions prevented them from taking up paid employment while they had small children. Although, since 1976, the number of State pre-primary schools and Private Nurseries has increased considerably, it is obvious that caring of children is still a constraint on the employment of married women.

DISCRIMINATION AND SEGREGATION

Discrimination against women in the labour market can be classified in two broad groups.

a) Pre-entry labour market Discrimination.

b) Discrimination at work.

a) Pre-entry labour market Discrimination.

Gender socialisation and gender expectations influence the attitudes and career aspirations of boys and girls. Traditionally the man was considered as the main support of the house who had to carry the big burden of the marriage obligations, whilst the woman's role was to become a good housewife and mother. Therefore, men considered work as their first and ultimate priority contrary to women who considered their family obligations as their first priority.

Gender expectations are mainly responsible for the different streams of study and the different specialisations followed by boys and girls in education. Boys being taught to be tough and competitive follow mainly Commercial and Business Administration and Engineering Technology. On the contrary, there are very few girls in Engineering specialisations. The majority of them are in Humanities, Social Science and Medical and Paramedical, since they are conditioned to be tender and to care about others.

Education played a decisive role in the change of women's social status and position in society, since through education women acquire the means for their personal, cultural and professional improvement. In recent years a considerable improvement has been achieved with the unification of male and female studies and the revision of reading books so as to eliminate sexist ideology. Research studies in other countries show that although there are no written regulations implying gender differences in the system of education there is still a hidden curriculum for gender which permeates the entire system: i.e. the structuring of schools and teachers' gender expectations.

In the Ministry of Education in Cyprus, there has been some preliminary discussion but to-date there is no established policy towards the elimination of gender differences in the education system.

b) Discrimination at work.

Gender role expectations and employer's attitudes to the recruitment, promotion and training of women are contributory factors for women's segregation in lower paying occupations. In practice most women still do most of the domestic tasks and their attitude towards work is influenced by their gender expectations implied by the traditional society. Generally women seek employment with less responsibilities, in order to be able to fulfil their double role of: - reproducing children and looking after men -and going out to work.

Since women are thought to follow a pattern of intermittent participation in the labour market because of their family responsibilities they are placed at a disadvantage again in these occupations; they are appointed to posts of secondary importance. In addition, Trade Unions are considered to have played a role in barring women from certain occupations; Trade Unions regard women as a threat to job and income security.

The Survey on the Employment Status of Cypriot Women, conducted in 1981 revealed that employers were found to believe that women were in general not committed to the job market though investigation showed that the overall labour market experience of younger women exceeds that of comparable men. The employers claimed that the greatest disparity between the sexes was attributed to women's greater absenteeism, voluntary turnover, and lower supervisory skills.

It is important however to note that a high percentage of respondents (ranging between 52 and 69 per cent) claimed no difference between the two sexes for all the other performance indicators (i.e. efficiency and productivity, lateness, reliability, working with fellow employees of the same and opposite sex and taking orders from supervisors).

Table 5 Vertical structure of Civil Engineers employed by the Public Works Department (1992)

POST	NUMBER	MALE	FEMALE	HIRED	PROMOTED
Director	01	01	00	1963	1990
Executive Engineer A	02	02	00	1964	1990/91
Senior Executive Engineer	09	09	00	1953/69	1983/92
Executive Eng. Grade I	45	37	08	1972/86	1977/90
Executive Eng. Grade II	08	03	05	1990/91	
TOTAL	65	52	13	1953/91	1977/92

Source : Registration of Establishments 1976, 1981 and 1989, Department of Statistics and Research, Nicosia, Cyprus.

The survey on the position of women Civil Engineers in Cyprus, conducted by the author, indicated that family responsibilities, gender role expectations and employer's prejudism hinder the professional evolution of women; the social status, the professional achievements and position of women Civil Engineers was lower than men's while there were no women holding managerial posts in any of the major Public and Private establishments of the Construction industry.

The survey showed that about half of the female respondents were discriminated against in their work experience by their employers with respect to recruitment, work on site, promotions and salaries. It was noted that there were more differences in the duties and work behaviour of men and women Technicians than men and women Civil Engineers.

Earnings and Status of Cypriot Women

It is generally accepted that sex discrimination in pay and other conditions of employment is widely practised worldwide. In Cyprus until 1992 equal pay has been applied only to government, semi-government and banking organisations. Although in the Public sector there is equal remuneration for men and women, the average earnings of women appear to be lower than for men in all occupational groups.

The difference may be explained by the larger number of men employed, generally with longer work experience; this has resulted in more promotion posts and higher salaries for men.

The vertical structure of Civil Engineers employed by the Public Works Department may be used as an example (Table 5).

It was noted that in the Private sector, the difference between the rates of pay of female Civil Engineers and male Civil Engineering Technicians was marginal. The rates of pay of female Civil Engineering Technicians was much lower than the corresponding of males. This is an indication of the low status of women Civil Engineers in the Cyprus market. Until recently the Engineering profession was dominated by men, since women were considered by Cypriot society as unable to deal with scientific problems and mathematical applications. In addition work on site was not approved as a task appropriate to a woman's nature.

House and Stylianou used data collected by the Survey of Wages and Salaries, 1979 in order to find the factors of wage discrimination against women. Their conclusion was that age and education did not seem to be responsible for the earning differentials of the two sexes, since women earned less than men of the same age and educational level. Women's average earnings were not only lower than men's but they also rose at a slower rate with age than men's earnings.

The Survey on the Employment Status of Women in Cyprus revealed that employers' attitudes to the recruitment, promotion and training of women contributed to the sex pay differentials. According to the survey employers gave the following reasons for sex earning differences: lower productivity, trade union agreements and willingness of women to work for lower wages. The last point is verified by the findings of the Survey on Graduating Students Abroad 1986; females anticipated to be employed with a lower salary than males, coming to 77 per cent of the salary anticipated by males.

The Survey on the position of Cypriot women Civil Engineers revealed that a considerable number of employers indicated that men working in their establishments achieved higher basic salaries than women. They mainly attributed this difference to the following reasons:

a) Women are reluctant to take responsibilities.
b) Women are willing to work for lower salaries.
c) Women do not normally work above their contractual commitments.
d) Women are unable to cope with the demands of site work.

CONCLUSIONS

During the last 30 years there has been a considerable increase in the participation of Cypriot women in the labour force. In 1992, women comprised 38.7 per cent of the total economically active population.

Before 1960, agriculture was the sector with the largest representation of women in employment, where women normally worked as unpaid family workers.

The decline of agriculture and the socio-economic changes brought about after the independence of Cyprus enabled the participation of women in other sectors of the developing economy.

Cypriot women are concentrated in female dominated occupations such as clerical, sales and services. There is a well defined occupational segregation of the sexes which is amongst the most marked in Southern European countries.

Market wage was the main incentive for women to enter the labour force, while caring for children and household work were the main constraints. In addition household duties were responsible for the low occupational expectations of women.

In Cyprus, the earnings of women are lower to the earnings of men in all occupational groups. In 1992, the ratio of the monthly female earnings as a percentage of male's , excluding overtime, was 66 per cent.

Gender role expectations as well as employers' prejudices seem to influence female lower earnings and status compared to that of males.

The general conclusion must be that sex discrimination in pay and other conditions of employment is widely spread in Cyprus. Although there is a considerable improvement in the participation and position of women in the Cyprus labour market, there is a long way to go until women are as favourably treated as men.

REFERENCES

1. W.J. House (1985), *Cypriot Women in the Labour Market,* Geneva.

2. Industrial Authority of Cyprus (1991) *The Exploitation of Economically Inactive Female population of Cyprus,* Nicosia.

3. Ch. Antoniou (1994) *The Evolution of Cypriot Women in Society and their Increased Participation in Civil Engineering,* Mphil Thesis, University of Glamorgan, S.Wales, U.K.

4. L. M. Mousourou (1985) *Women in Occupation and Family,* Athens.

5. World Labour Report (1985) ed. International Labour Office, Geneva.

6. Survey on Graduating Students Abroad (1986), Dept of Statistics and Research, Nicosia.

Hazards from Radiofrequency Electromagnetic Radiation

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INTRODUCTION

The applications of radiofrequency electromagnetic energy are numerous and increasing. Naturally occurring levels of these fields in the environment are low but equipment utilising this form of energy is to be found in applications in commerce and industry, research, medicine and at home. The frequencies under consideration are extending from 100 kHz to 300 GHz at intensities which vary from very small to very high. In a variety of publications the range between 300 MHz and 300 GHz is often referred to as microwave (mW) radiation.

It is the higher intensities that are of concern, because they interact with biological systems and they are capable of producing adverse health effects.

QUANTITIES AND UNITS

Radiofrequency, or RF, fields are defined by the magnitudes of the constituent electric field strength (E) expressed in Volts per metre (V/m) and magnetic field strength (H) expressed in amperes per metre (A/m). E and H are vector fields i.e. they are described at each point by two quantities, magnitude and direction. For frequencies in the region of 10 MHz and above the basic limits of exposure will be expressed by the quantity specific absorption rate (SAR). This is simply defined as the power absorbed per unit mass and its SI units are Watts per kilogramme (W/kg). The SAR has no significance for frequencies below 10 MHz because biological effects resulting from human exposure are more fundamentally correlated to the current density induced in the body. For the frequency range between 0.1 and 10 MHz the relationships between electric and magnetic fields outside the body have not been well developed and hence the basic limits of exposure will be expressed in terms of the incident effective electric field strength (Eeff V/m) and effective magnetic field strength (Heff A/m).

For a plane wave the ratio of the electric field strength to the magnetic field strength is given by a constant known as the characteristic impedance (Z), where

$$Z = \frac{E}{H}$$

In free space,

$$Z = 120\pi \cong 377\Omega.$$

The Poynting vector, expressed in watts per square metre (W/m2), describes the energy transfer by representing the magnitude and the direction of the electromagnetic flux density,

$$S = E \times H$$

For a plane wave this is related to the electric and magnetic field strengths as follows:

$$S = \frac{E^2}{120\pi} = \frac{E^2}{377}$$

$$S = 120\pi H^2 = 337H^2$$

It is, also, reminded here that the frequency (f), the wavelength (λ) and the velocity (v) of electromagnetic waves are inter-related by:

$$v = f\lambda$$

Exposure conditions from an RF source such as an antenna can be divided into two regions: the near-field zone and the far-field zone. In many instances the former is subdivided further. In the immediate vicinity of the antenna is the reactive zone, where the energy is nearly fully stored and not radiated. This is followed by the radiation near-field.The distance from the antenna corresponding to the point to where the near-field changes to the far-field, is given by:

$$\frac{2a^2}{\lambda}$$

where a is the greatest dimension of the antenna.The distribution of the field in an area exposed to RF radiation is not always uniform and

is usually distorted when an object is placed in it. When electromagnetic waves encounter an object a portion of the incident energy is reflected, some is absorbed and another portion is transmitted through. The percentage of each depends on the frequency and polarisation of the field and the electrical properties and shape of the object. It is, therefore, usual to refer to two sitations when considering the effects of RF waves. The perturbed or body-present situation and the un-perturbed or body-absent situation. Since the interactions of RF fields with biological systems depend on the field characteristics the following factors should be considered when describing exposures to RF fields:

- near- or far- field exposure
- electric and magnetic field strengths for near-field exposure
- either electric or magnetic field strength for far-field exposure
- spatial variations of the field magnitude
- field polarization (direction of the electric field with respect to wave propagation direction)

EXPOSURE SOURCES AND DEVICES

RF energy is used extensively in many applications exposing workers and general public to potentially hazardous situations. When evaluating the importance and impact of RF sources the following factors must be taken into account:

- production of hazardous levels under normal and abnormal operating conditions
- the number of sources in use
- the number of persons who might be exposed and the duration of the exposure

The sources of RF radiation are classified in the following categories:

Ambient environment

The radiation present in the environment is mainly due to radio and television transmissions.

Estimates made in the USA show that urban population is exposed to a cumulative median exposure density of 50 ~W/m2. In some cases this may reach 10 mW/m2.

High power sources

This is an arbitrarily defined device which is capable of producing a main beam density of 1 W/m2 at a distance of 100m from the source.

Systems belonging to this category are:

- high transmitter power and high gain antenna broadcasting stations
- tracking and acquisition radars, including air traffic control radars
- satellite communications earth terminals

The average main-beam power densities generated by some of these systems could be as high as 1 kW/m2.

Low power sources

Common low-power RF sources and typical exposure levels include:

- police traffic control radar. 10 mW/m2 at distances <10m
- microwave relay systems used in television and telecommunications. Irradiation is much less than 10 mW/m2. It becomes negligible due to the fact that transmitters are mounted on tall towers and beams are highly collimated.
- cable TV distribution. The same as the above.
- microwave ovens. Energy is directed in a confined shielded space. Unwanted radiation may occur due to leakages. The quantities are considered very small due to rapid decrease in power densities with distance. For example: 50 mW/m2 at 5 cm becomes 15 mW/m2 at 30 cm and 0.1 mW/m2 at 1m.

Occupational exposure

a) Induction heating

Alternating magnetic fields induce electric currents, called eddy currents, to conductive materials in the vicinity of these fields. As a consequence of the circulating currents is the heating of the conductive material. This principle is utilised in various industrial applications such as:

forging, annealing, tempering, brazing and soldering. The operating frequencies are from 50 Hz to about 10 kHz.

For effective heating, the dimensions of the coils producing the magnetic fields are compact and hence the possibility for whole body exposure of operators is remote. Localised densities of the magnetic field to which parts of the operator, such as the hands, are exposed may be as high as 25 mT (20 kA/m). The levels of electric field densities are very small.

b) Dielectric heating

RF energy is used to heat up dielectric materials in many industrial processed such as the sealing of plastics, glue drying, curing particle boards and panels and heating paper and fabrics.

The operating frequencies are in one of the industrial, scientific and medical (ISM) frequencies, namely 13.56, 27.12 and 40.68 MHz from 50 Hz to about 10 kHz.

The power delivered by these units varies from a few kW to tens of kW, and the use of unshielded electrodes can produce relatively high fields around them. Surveys in many countries including USA, Canada and Sweden have shown that some operators are exposed to electric fields ranging from 200 V/m to 300 V/M and magnetic fields ranging between 0.5 A/m to 0.8 A/m. These surveys identify hazardous situations and various authorities recommend ways which will reduce the levels to acceptable levels.

Communications

The majority of workers in the fields of communication are exposed to low strength fields which seldomly exceed 1 $\mu W/cm^2$ in radio transmitter rooms, near the bases of transmitter towers and in adjacent buildings.

High level exposures occur, mainly, in the vicinity of antennas of high power transmitters. Workers climbing antenna towers may be exposed to local fields which can be as high as 1000 V/m for electric and 5 A/m for magnetic fields. Another potentially hazardous situation may arise when the interlocks of the transmitter cabinets are defeated and the doors are left open. The power densities in such situations may rise up to 2000 W/m^2.

Other sources of exposure to the general population and workers arise from the use of portable or mobile radio transmitters. Electric and magnetic field strength near the transmitting antenna could be quite high.

Medical

a) Diathermy

This was the earliest therapeutic application of electromagnetic fields. There are two types, short wave at about 27 MHz and microwave at 915 or 2450 MHz. The patient is exposed to high intensity localised fields which cause sustained increase in tissue temperature, exposure times are typically 15-30 minutes. Operators are exposed to fields in the range of 60 V/m and/or 0.16 A/m in the normal position. These levels could be exceeded considerably near the application electrodes.

b) Cancer therapy

This a relatively new method which basically causes local hyperthermia for tissue cancer therapy. Heating is induced by currents flowing in custom made coils at frequencies in the range of 13.56 MHz. As with diathermy, the patient is exposed to intense localised fields for short periods. There are no specific exposure measurements for operators.

c) Magnetic resonance imaging

RF fields in conjunction with static and slow varying magnetic fields are used in this imaging technique. Systems used at present operate at frequencies ranging from about 6 to 100 MHz. The magnetic field is contained within the patient enclosure and the exposure of the operators is negligible.

INSTRUMENTATION AND MEASUREMENT

The range of the RF fields examined is considerably extensive and there isn't a single instrument or technique which can measure the entire range. In general, instrumentation is made up of three distinct parts: sensor, leads and meter, each having the following function:

Sensor This is basically an antenna that usually incorporates the detector which detects the level of the particular field to be measured.

Leads They convey the signal from the sensor to the meter. When considering these it is usual to take into account their coupling the sensor and the meter. The major problem with the leads is that they can perturb the field or they themselves will act as antennae under certain conditions thus feeding incorrect values to the meter. Some of these problems are reduced by using either high resistance shielded wires or optical fibres.

Meter It consists of signal conditioning circuitry and means of display.

There are instruments which measure the electric or magnetic field parameters and fewer measuring directly in power.

The usual detectors are thermocouples, diodes and bolometric devices. For higher frequency, pulsating fields thermocouples appear to have more advantages in that their response is true rms and they are not affected by ambient conditions. A disadvantage is their weakness to handle larger impulse powers in which case they may burn out.

Accuracy and Calibration

Several methods are available for calibrating the measuring instruments, one of these should be used regularly to confirm the accuracy of the instrument. It is, however, always recommended to perform a functional check before and after a measurement is performed. Care should always be taken when measuring to eliminate common sources of error, the major being those of correct antenna orientation and field disturbance by the presence of the operator.

Survey of fields

A correctly measured potentially hazardous field should take into consideration as many unknown field characteristics as possible. A possible checklist which could be used is:

- rated power output of all sources
- nominal and spurious frequency and harmonics
- type, peak and rms modulation characteristics
- details of antenna characteristics
- polarisation of the field
- exact distance of measuring site to field source

DOSIMETRY

Exposure of living organisms to RF fields results in the induction of RF fields and currents inside the body. It is these internal fields and currents which are responsible for interactions with the biological systems. A quantity that is quoted for dosimetry is the specific absorption rate (SAR). It is defined as the rate of energy transfer to a unit mass of the body.

$$SAR = \frac{d}{dt}\left(\frac{\Delta W}{\Delta m}\right) = \frac{d}{dt}\left(\frac{\Delta W}{\rho \Delta V}\right)$$

where ΔW is the energy transferred to a mass Δm, ΔV is the volume containing the mass Δm and is the density of the mass.

For a sinusoidally varying field the SAR in a small volume of tissue in which the electric field, E, is constant, is given by:

$$SAR = \frac{\sigma E^2_{in}}{\rho}$$

where σ is the conductivity of the tissue and E^2_{in} is the rms magnitude of the electric field in the tissue. The initial rate of temperature rise is directly proportional to the SAR, provided that the heat losses are small and can be neglected.

$$\frac{dT}{dt} = \frac{SAR}{c}$$

where T is the temperature, t is the time and c is the specific heat capacity.

Two SAR's are frequently quoted, the average and the local. The average refers to the whole body average and is defined as the total energy transferred to the body in unit time divided by the total mass of the body. The local refers to a small volume or localised transfer.

The SAR in a biological system depends on several exposure parameters, these are: frequency, intensity, polarization, near- and far-field exposure, presence of reflecting surfaces, etc. Furthermore SAR depends on the parameters of the body such as: size, shape, electrical properties, etc.

There is a considerable amount of progress

that was made towards determining, either theoretically or experimentally, the SAR on humans and animals. The graphs shown in Figure 1 and Figure 2 are examples of this work.

It is interesting to note that for E polarisation, maximum absorption occurs at about 70-80 MHz. This frequency is usually referred to as resonant frequency.

The average SAR also depends on the size and shape of the body as shown clearly by Fig. 2, where SAR's absorbed by models of different species.

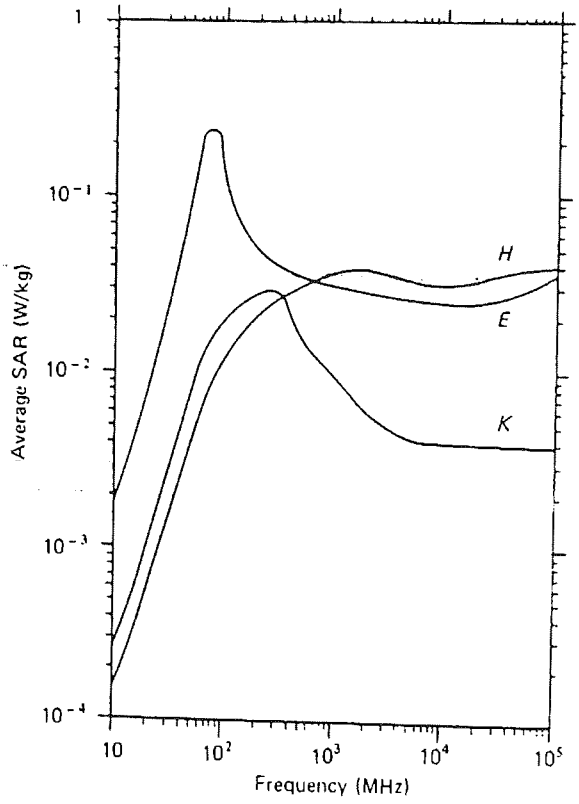

Figure 1 SAR in a spheroid model of an average man, 1.75 m, 70 kg, exposed to a plain wave of 10 W/m2. E electric field parallel to the main body axis, H magnetic field parallel to the main body axis and K wave propagation from head to toe.

INTERACTION MECHANISMS

Three interaction mechanisms exist, thermal, athermal and electric shock and burn.

Thermal mechanisms of interaction

When a living organism absorbs RF energy its

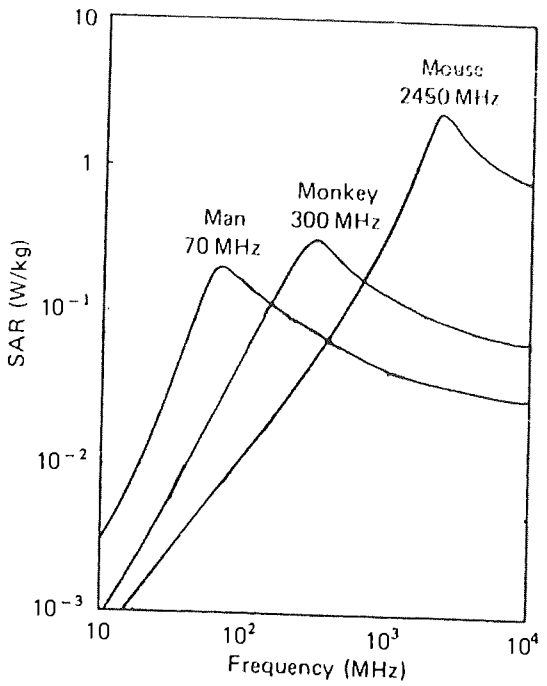

Figure 2 SAR in spheroid models of man, monkey and mouse exposed to a plane wave of 10 W/m2 in the E polarization.

temperature may rise. This is not always the case, because due to thermoregulatory re sponses RF energy may be deposited in the body without causing temperature increase. The initial rate of temperature rise depends and is proportional to the SAR, as indicated previously. The exact mechanisms of converting RF energy to thermal energy at molecular levels are not yet fully understood although there is a considerable amount of work in this field.

When RF deposition and conversion to thermal energy in a biological body exceeds its heat dissipation capabilities then an increase in temperature occurs,

One of the effects of this temperature increase is the killing of the living cells or cell mutagenesis which depends on the temperature and the time. These factors have been quantified and led to the concept of "thermal dose". The thermal dose may be described as the mathematical description of the time-temperature relationship as related to the biological endpoint and converted to an exposure time at some reference temperature. Theoretical and practical work has shown that the temperature of 43 ^{0}C is critical and may be taken as the reference temperature for expressing the heat dose.

Athermal mechanisms of interaction

RF fields and in particular those at lower frequencies, are capable of inducing currents in the human body. These currents may be of such magnitude so as to cause electrical stimulation of excitable membranes of nerves and muscles. The critical levels of field strengths are considerably high and are in the region of 100 kV/m for electric and 1.5 kA/m for magnetic fields. Various other effects associated with nerve stimulation have been observed and are mention at a later stage.

Electric shock and burn

When ungrounded or poorly grounded metallic objects are exposed to RF fields become electrically charged i.e. they accumulate an electric charge which depends on their surface area, insulation to ground and other factors. If a person, standing on the ground, touches one of these surfaces, it will provide a conductive path to ground. Depending on the amount of the current passing through the body the person may experience anything from a minor tingling sensation to a severe burn. Burns usually occur when the current exceeds 200 mA.

BIOLOGICAL EFFECTS

The biological effects of RF radiation will be dealt with by considering the present knowledge of effects humans and the experimental biological effects on animals.

Human studies

a) Cutaneous perception

Exposure of the human body to RF radiation may cause heating which is detectable by the temperature sensitive receptors of the skin. Various studies have shown that detectable thermal effects occur at certain frequencies (higher end) while at others (lower end) RF radiation is absorbed and may cause a temperature increase below the cutaneous thermal receptors. Cell damage may occur at a threshold temperature of about 42 ^{0}C, which is below the thermal pain threshold of 45 ^{0}C. Thus it can be concluded that that cutaneous perception is an unreliable indicator of potentially unsafe exposure levels. It can only be relied upon for fields whose wavelengths are comparable to the thickness of the skin.

b) Ocular effects

Although some studies have associated lens defects with microwave radiation exposure, the present view is that low-level, chronic exposure to microwave radiation does not induce cataracts in man.

c) Numerical modeling of thermoregulatory responses in man

Most studies on the effects of RF radiation on humans are based on models which have been designed to resemble as much as possible to the human body. None of these models is perfect and the results should be looked upon in this context.

d) Auditory effects (RF hearing)

When a person is exposed to pulsating radiation it is possible that the person would hear an audible sound described as buzz, click or knock, which appears to originate from within or behind the head. It is known that this effect is due to the thermoelastic expansion mechanism but it is not known what structure in the head transduces the microwave energy to acoustic energy.

e) Congenial anomalies and reproductive effects

At present the data on humans exposed to RF radiation are not adequate or sufficiently developed to be useful in defining risk or determining exposure limits.

Non-human studies

a) Thermoregulatory responses to RF radiation

The SAR required to increase the thermoregulatory effector or to raise the temperature of the animals decreases with increasing mass.

Thermoregulatory responses by mammals during RF radiation exposure are similar to those to high ambient temperature.

Due to heat stress from absorbed RF energy dose rates of 3.6 - 7 W/kg are lethal to rats, rabbits, dogs and resus monkeys exposed for 1 - 4 hours.

b) Reproductive Effects

RF radiation was found to be teratogenic at ex-

posure conditions that approach lethal levels for pregnant animals. Temporary sterility occurred in male rats at a SAR of 5.6 W/kg which caused considerable testicular temperature rise.

c) Effects on blood forming and immune systems

Effects on the blood forming and immune systems have been reported at SARs greater than 0.4 W/kg. These were not disassociated from the thermal effect.

d) Nervous system

Acute or chronic continuous or pulsed-wave irradiation of animals at SARs above 2 W/kg can produce morphological alterations in the central nervous system.

RF fields sinusoidally modulated at ELF frequencies, mainly 16 Hz, cause changes in the central nervous system in vitro and in live animals. The physiological significance of these effect have not been established.

e) Behaviour

Various effects were found in rats. Data on other species is not available.

f) Cataracts

Threshold RF power density for cataract induction, long term exposure, has not been defined. It is believed to be much higher than that required to cause other problems.

g) Endocrine and other Physiological Effects

Changes in gland operation, such as the thyroid, are consistent with those of heating.

h) Molecular, Subcellular and Cellular Effects

For most molecular or subcellular systems exposed in vitro, no consistent biological effects were reported.

i) Genetics and mutagenesis

Low or moderate intensity RF radiation was not found to cause mutation in biological systems unless the temperature increased considerably causing substantial thermal loading.

j) Life span and carcinogenesis

There is no conclusive evidence of the effect of long term exposure to RF radiation on the life span of experimental animals or on cancer.

PROTECTIVE MEASURES AND STANDARDS

The aim of protective measures is to eliminate or to reduce unnecessary exposure of humans to RF fields, and to keep all exposure below the relevant applicable limit of the general public or occupational exposed people.

Engineering at the design stages should take into account the safety aspect and incorporate within the equipment or devices appropriate means which reduce or prevent exposure to RF fields.

The manual accompanying the equipment should always state the safety rules applicable during operation.

Furthermore the operator should undergo appropriate training prior to handling the equipment.

As a rule stray fields and leakage should be kept below the limits applicable to general public.

The International Radiation Protection Association (IRPA) and the International Labour Office (ILO) have prepared the "Code of practice: Protection of workers against radiofrequency and microwave radiation in the working environment", ILO, Geneva, 1986.

Protective garments and eyewear have been developed to allow people to work in areas where the field strength is high, the properties of these are considered as unsatisfactory and their use is not recommended at present. The use of non-reflective materials for reducing reflections from objects and walls is effective.

Radiation surveys around RF sources should be regular.

To avoid RF burns or shock that may occur from charges induced on metallic objects in the vicinity of high RF fields, such objects should be grounded.

Care should be taken, when siting inflammatory or explosive materials, because sparking on metallic objects may ignite or detonate them.

Users of electronic prosthetic devices should be restricted from entering high field strength areas.

CONCLUSIONS

Electromagnetic fields in the radiofrequencies from 300 kHz to 300 GHz are quantified in terms of the electric field strength and magnetic field strength. It is usual, however, when evaluating the exposure hazards to express fields in terms of the power density W/m2.

Instrumentation for measuring RF fields is commercially available.

For complete field specification it is necessary to measure the values of both fields.

Contact with large, ungrounded metal objects in the presence of strong RF fields may be hazardous.

At any given frequency the field strength of the natural radiation is very small compared to the man-made radiation.

The urban population is exposed to power densities of the order of hundreds of mW/m2. Higher exposures may take place

In therapeutic application exposures may be high enough to cause an elevation of the tissue temperature.

The dosimetric quantity for exposure limits is the Specific Absorption Rate, SAR (W/kg).

At frequencies above 10 GHz the energy is deposited close to the body surface.

Maximum SAR of a grounded person, occurs at about 30 MHz, while for a standard person it occurs at 70 MHz.

Whole-body SARs of 1-4 W/kg at 70 MHz are expected to cause a core temperature rise of about 2°C in a healthy human in an hour.

High level RF is a source of thermal energy and may cause any of the problems associated with the heating of biological systems, such as: Burns, temporary and permanent changes in reproduction, cataracts and death.

EXPOSURE LIMITS

The objective of setting exposure limits is to protect human health from potentially harmful effects. Exposure limits are, as usual, distinguished between the general population and the special groups within it, such as those working in potentially hazardous environments, the so called occupational exposed population. The occupational exposed population is considered as the population consisting of adults exposed under controlled conditions and who are trained to be aware of the potential risks and to take the appropriate precautions. The duration of the exposure is not continuous but is limited to a normal day shift during a normal working lifetime. On the other hand the general public consists individuals of all ages and different heath status. The general public may be unaware of the presence of the fields and is exposed 24 hours per day and over the whole lifetime. The general public is not expected to take any precautions. It is obvious from the above considerations that the maximum levels for each group will be different.

IRPA proposed for this purpose the exposure limits shown in Tables 1 and 2.

Table 1 Occupational exposure limits to radiofrequency electromagnetic fields

Frequency Range f (MHz)	Electric Field E (V/m)	Magnetic Field H (A/m)	Power Density P_{eq} (W/m^2)	Power Density P_{eq} (mW/cm^2)
0.1-1	614	1.6/f	-	-
>1-10	614/f	1.6/f	-	-
>10-400	61	0.16	10	1
>400-2000	$3f^{1/2}$	$0.008f^{1/2}$	f/40	f/400
>2000-300000	137	0.36	50	5

Notes: Hazards of RF burns should be eliminated by limiting currents from contact with metal objects. This may be achieved by reducing the E values from 614 to 194 V/m in the range of 0.1 to 1 MHz and from 614/f to 194/ $f^{1/2}$ in the range from >1 to 10 MHz. Where f = frequency measured in MHz. (Source: IRPA)

Table 2 Exposure limits to radiofrequency electromagnetic fields for the general public

Frequency Range f (MHz)	Electric Field E (V/m)	Magnetic Field H (A/m)	Power Density P_{eq} (W/m^2)	Power Density P_{eq} (mW/cm^2)
0.1-1	87	$0.23/f^{1/2}$	-	-
>1-10	$87/f^{1/2}$	$0.23/f^{1/2}$	-	-
>10-400	27.5	0.073	2	0.2
>400-2000	$1.375^{1/2}$	$0.0037f^{1/2}$	f/200	f/2000
>2000-300000	61	0.16	10	1

Notes: f = frequency in MHz

SPECIFIC EXAMPLES

A court in California has recently (21 January 1993) freed from obligation a police radar manufacturer in allegations that the radar manufactured by the company caused cancer in an officer that used it.

Various tests were carried out by reputable organizations, including the American National Institute of Standards and Technology (NIST) formerly National Bureau of Standards, (NBS) have found consistently that the radiation level of electromagnetic energy is 18 times lower that the accepted exposure limits set by the Occupational Safety and Health Administration (OSHA). Other cases, however, are still outstanding.

The traffic radar was introduced as a speed enforcement tool, in some countries as long ago as the 1940's as a by product of the war radar developed during the World War II.

In the United States they operate in specified high frequency bands. These are within the X-band 10.525 GHz, K-band 24.150 GHz and Ka-band 33.7 GHz. These frequencies are in the bands used for mobile radio, TV, FM radio broadcasting and cellular telephones.

The output power from these units is normally in the range 10 to 100 mW with a typical output of 15 mW. Similar microwave transmitters operate automatic doors or employed as intruder alarm sensors. In 1981 the NBS performed a study in which the power levels measured within the police vehicle was 0.36 mW/cm2 while the average value was in the range of 0.01 mW/cm^2.

In 1991 a new study by the Institute of Police Technology and Management (IPTM) found that at two inches from the face of the antenna the maximum level was 0.55 mW/cm and the average value was 0.17 mW/cm^2.

Both worse case measurements are well below the acceptable minimum. Exposure of the public to this radiation was found to be below the measuring ability of typical survey monitors.

It is reminded here that the established exposure limits are in the range of 5 to 10 mW/cm2 as given by OSHA, the America Conference of Governmental Industrial Hygienists (ACGIH), ANSI and IEEE.

(Source: Conference of Radiation Control Program Directors Inc (CRCPD) Newsbrief, Feb 1993).

BIBLIOGRAPHY AND REFERENCES

1. *Non Ionizing Radiation Protection,* Suess M.J., Benwell-Morisson D.A., Eds. WHO Regional Publications European Series, No. 25, Copenhagen, (1989)
2. *Magnetic Fields Health and Safety Guide,* World Health Organisation (WHO) Publication. Health and Safety Guide No. 27, WHO, Geneva, (1989).
3. *Guidelines on limits of exposure to static magnetic fields,* (editorial/article), Radioprotection, Vol. 29 - No. 2 (1994), 253:265
4. *Guidelines on Protection Against Non-Ionising Radiation.* International Radiation Protection Association (IRPA). Duchene A.S., Lakey J.R.A., Repacholi M.H., Eds. IRPA. New York : Pergamon Press : 1991.

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The Effect of Auxiliary Energy and Collector Return Location on the Performance of Thermosyphon Solar Water Heating Systems

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ABSTRACT

This paper investigates the effect of the physical location of the auxiliary source of energy and the collector return height in thermosyphon solar water heaters. The investigation has been based on a domestic thermosyphon solar water heating system, which was simulated using the TRNSYS simulation programme. It is demonstrated that the arrangement with external auxiliary unit has a higher collector efficiency and results to a higher annual solar fraction than the in-tank auxiliary configuration. In the case of in-tank auxiliary, the system performance increases with the height of the auxiliary position from the bottom of the storage tank. The system performance is also sensitive to the height of the collector return from the bottom of the tank.

INTRODUCTION

Solar water heating is the most popular application of solar energy in the world. The simplest water heating system is based on the thermosyphon principle and is the type of system most developed. Thermosyphon solar water heaters are considered a very attractive application of solar energy and have gained popularity in many countries. In Cyprus, for example, it is estimated that there are more than 140,000 units in operation, which means one solar water heater for every five people on the island. According to a survey conducted by the Ministry of Commerce, Industry and Tourism, 91% of households in Cyprus are equipped with solar water heaters. Another example is Israel, where there are more than 600,000 units in operation, which are capable of supplying about 70% of a consumer's domestic hot water requirements (Kudish et al., 1985) and Greece with about 600,000 units installed and an annual production of 62,000 units (Lamaris, 1994).

Owing to the fact that solar energy is variable and intermittent, it is necessary to provide for an auxiliary source of energy to back up the system in case of insufficient solar energy and make it reliable and capable of meeting the hot water load. The question which usually arises in dealing with this part of the system is what size of auxiliary heater and where to install it. The size is easily determined once the collector and storage tank sizes are decided. With regard to the positioning of the auxiliary energy unit, there are two possible arrangements:

a. **In-tank,** (built-in the storage tank), where the auxiliary energy source is integrated in the storage tank, either in the form of electric immersion heater, or a hot water heating coil fed by a water boiler.

b. **External,** in the water leaving the storage tank, which requires a heater outside the storage tank (electric element or hot water heating coil).

According to Duffie and Beckman (1991), the external auxiliary heater has the advantage of using the maximum possible solar energy from the storage tank without driving up the collector temperature. In fact, this arrangement helps to avoid the heating of the whole quantity of water in the storage tank, and thus economize auxiliary energy. Michaelides et al. (1993) studied the effect of position of auxiliary in forced circulation solar hot water systems and demonstrated that the arrangement with external auxiliary unit results in a higher collector efficiency and definitely higher solar fraction than

the in-tank configuration. An experimental study conducted in Greece (Andronikos and Spyridonos, 1992) reported that the performance of a thermosyphon solar water heater is improved when the auxiliary heater is installed outside the storage tank. Morrison et al. (1984) found that the efficiency of a thermosyphon system with in-tank auxiliary heater is slightly higher than an equivalent pumped circulation system, due to better stratification in the storage tank in the thermosyphon system. External auxiliary, however, requires large power outputs and are therefore more expensive (Lorenz et al., 1993).

The purpose of this study is to investigate whether and how the thermal performance and solar fraction of a thermosyphon solar system is affected from the vertical position of the auxiliary heater in the storage tank in combination with the height of the collector return from the bottom of the tank.

THE SYSTEM AND THE SIMULATION MODEL

The schematic diagram of the system under investigation is shown in Fig. 1. It consists of two flat plate solar collectors having a total surface area of 3 m^2, tilted at 42 degrees from horizontal, an insulated vertical storage tank of capacity 180 litres equipped with a 3 kW electric heater and interconnecting piping. The collectors are connected in parallel through the supply headers, each employing ten evenly spaced parallel copper pipes embossed by semi-circular grooves formed in the flat plate absorber. This system is rated to meet the hot water requirements of a family of four under the weather conditions of Nicosia (Meteorological Service, 1985). It is assumed that the daily hot water consumption per person is 40 litres and the consumption pattern is similar to that of RAND (Mutch, 1974) and is illustrated in Fig. 2.

Due to the complexity of the problem the investigation has been conducted through computer simulations using the TRNSYS simulation programme (Klein et al., 1990). This approach can provide a mean of analyzing the dynamic performance of the system in response to selected meteorological data and load profiles. Morrison and Braun (1985) studied the performance of thermosyphon systems in Australia and reported a good agreement between experimental and TRNSYS simulation results.

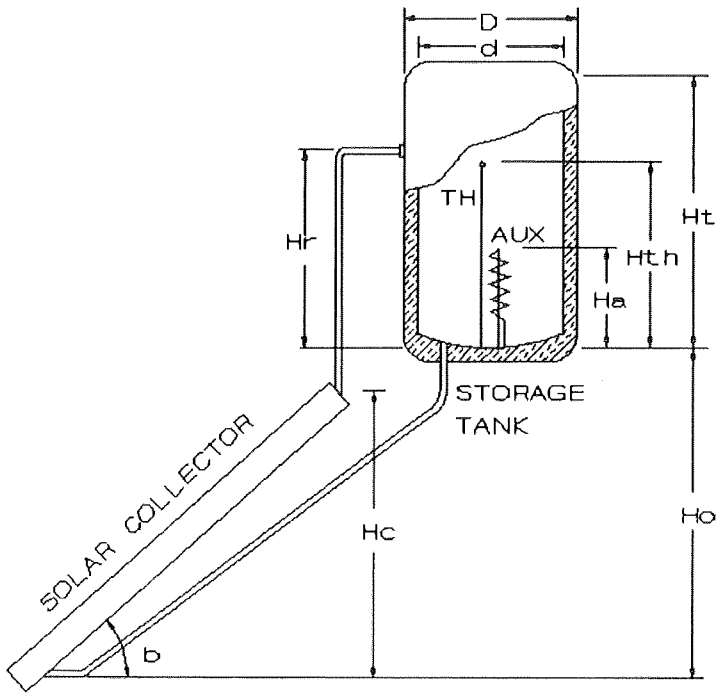

Fig. 1 Schematic diagram of a thermosyphon solar water heating system

The system parameters and other pertinent technical details of the system are given in Table 1. It is to be noted that the performance characteristics of the solar collector and the heat loss coefficient of the storage tank used

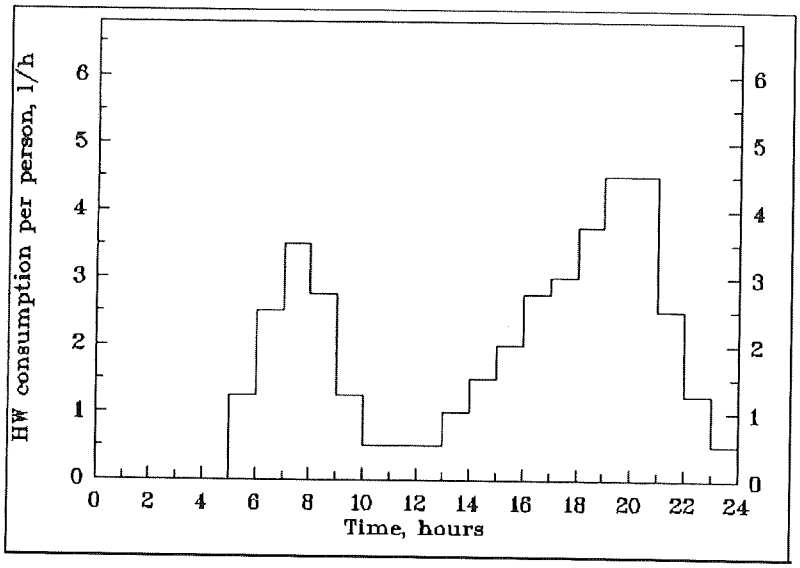

Fig. 2 Daily hot water consumption profile

for the simulations have been determined from experimental tests carried out in Nicosia while the heat loss coefficients for the interconnecting pipes were calculated theoretically.

Seven different scenarios have been studied, representing seven different positions of the auxiliary heater and collector return in the storage tank, as shown in Table 2.

ANALYSIS OF SIMULATION RESULTS

A number of simulations were run to investigate the performance of the system under the weather conditions of Cyprus and assuming the daily hot water consumption profile described by Fig. 2. The long term performance of the system is expressed in terms of its Solar Fraction, f, which is defined as the fraction of the hot water load provided by solar energy and calculated from the following relationship:

$$f = \frac{Q_{load} - Q_{aux}}{Q_{load}}$$

where Q_{load} is the hot water energy demand and Q_{aux} is the auxiliary energy supplied to the system. The long term collector efficiency, η, which is defined as the ratio of the energy collected by the collector during a certain period of time (month or year) over the solar radiation on the collector during the same period will also be investigated.

Table 1 Design parameters for the thermosyphon solar water heater

Parameter	Value
A_c	3 m^2
$F_R(\tau\alpha)_n$	0.77 *
F_RU_L	24.4 kJ h^{-1} m^{-2} K^{-1} *
G_{test}	54 kg h^{-1} m^{-2}
β	42 degrees from horizontal
N_R	20
d_R	12 mm
d_h	26 mm
L_h	1900 mm
d_i, d_o	20 mm, 20 mm
H_c	1000 mm
H_o	1150 mm
H_t	950 mm
L_i	1850 mm
$(UA)_{pi}$	0.74 kJ h^{-1} K^{-1}
V_s	180 litres
$(UA)_s$	4.2 kJ h^{-1} K^{-1} *
P_{aux}	3 kW
H_r, H_a, H_{th}, L_o, $(UA)_{po}$	Variable, see Table 2

* Obtained from experimental test

Table 2 Simulation results for different scenarios

Scenario	Dimensions				Performance	
	H_r (mm)	H_a (mm)	H_{th} (mm)	L_o (mm)	η	f
A	350	350	650	595	0.466	0.548
B	475	475	650	720	0.486	0.635
C	635	635	700	880	0.500	0.703
D	705	705	750	950	0.503	0.719
E	850	850	875	1095	0.510	0.730
F	900	900	925	1145	0.518	0.749
G	940	940	945	1185	0.540	0.795
All other dimensions constant, as listed in Table 1						

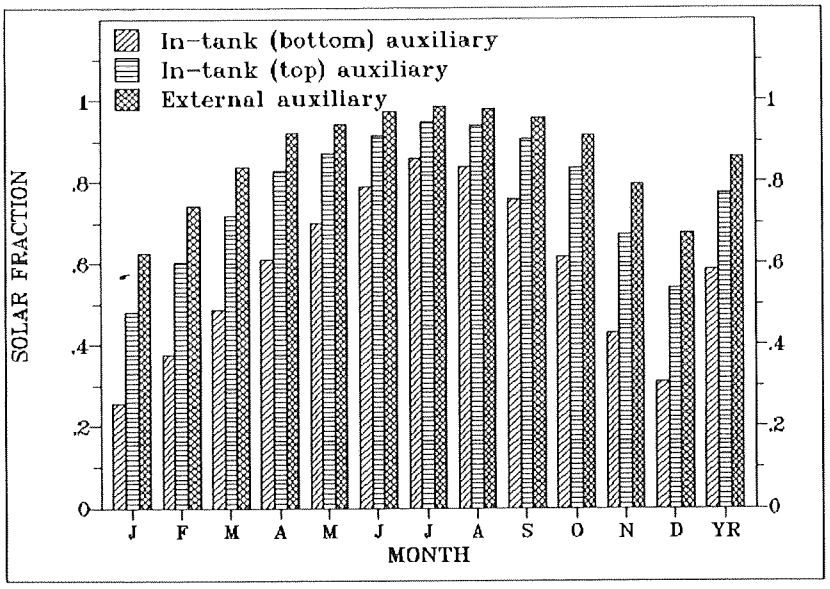

Fig. 3 Effect of auxiliary position on the system annual solar fraction

Simulation results, including the useful solar energy collected by the system, auxiliary energy needed to meet the load, heat losses from the storage tank and other useful information were also obtained. These results were used to determine the monthly and annual solar fraction of the system in order to demonstrate the effect that the position of the auxiliary heater has on the system performance.

Fig. 3 illustrates the variation of the monthly and yearly variation of the system solar fraction for three different heater configurations: external auxiliary heater, in-tank heater at the tank bottom and in-tank heater at the top of the storage tank. The collector return height for all three cases is kept at 705 mm from the bottom of the tank, which is the height for the typical thermosyphon system used in Cyprus. It is clearly shown that the annual solar fraction with external auxiliary is much higher than that predicted for the in-tank configurations and reaches the value of 86% yearly as compared to 77% in the in-tank top arrangement and only 59% in the case of in-tank bottom arrangement.

The higher solar fraction in the case of external

auxiliary is explained by the fact that the system uses the maximum possible solar energy from the storage tank without driving up the collector temperature.

The storage tank with external auxiliary heater is maintained at lower temperatures as compared to the in-tank configuration, where it is continuously kept at the design set temperature, thus resulting in higher heat losses. This is more distinct in the case of winter months where the difference in heat losses is much greater than the yearly average. This is because in winter the temperature difference between the storage tank and its surroundings is higher than that occurring in the summer.

A comparison between the two, "in-tank" configurations, indicates a clear superiority for the in-tank top arrangement. This is due to the fact that the auxiliary being at the top of the storage tank heats a smaller portion of the tank water at a high temperature, thus producing a temperature gradient and, therefore, a better stratification in the tank which results in a better performance. On the contrary, in the case of the bottom arrangement the heater heats a much greater portion of the tank and causes much more mixing, thus destroying stratification. The difference is more distinct during the winter months, where, in January for example, the solar fraction with the top auxiliary is higher than that with bottom auxiliary by 22 percentage units.

The above findings, however, assumed that the collector return height from the bottom of the storage tank is the same in both cases, i.e. 705 mm. In order to investigate the effect of varying both, the collector return height H_r and the auxiliary height H_a from the bottom of the tank, at the same time, a number of simulations were ran for the seven different scenarios described in Table 2. The simulation results were used to plot the graph of Fig. 4 which illustrates the variation of the annual solar fraction and the collector average efficiency with the height of the collector return and auxiliary from the storage tank bottom.

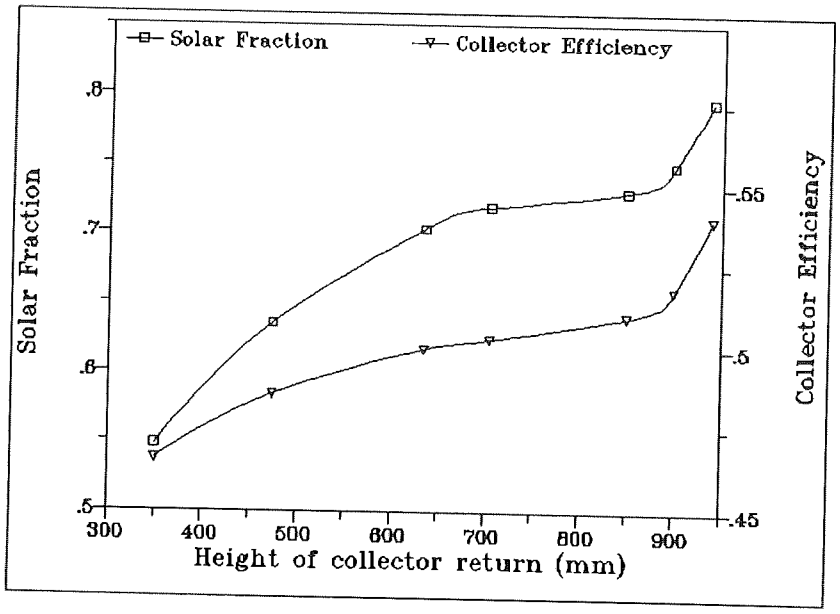

Fig. 4 Variation of annual solar fraction and collector average efficiency with the height of the collector return from bottom of storage tank.

It is clearly seen in Fig. 4 that the annual solar fraction and the collector average efficiency are sensitive to the variation of collector return and auxiliary height from the tank bottom. Scenario A which assumes a height of 350 mm from the tank bottom, that is 37% of the tank height, has the lowest efficiency and solar fraction while scenario G corresponding to a height of 940 mm, that is only 10 mm below the top the tank, has the best performance characteristics. The solar fraction increases rapidly as the height of the auxiliary and the collector return increase from 350 mm to 700 mm when it reaches a value of approximately 74% when it levels off as the height increases. Further increase in height results in a remarkable increase in the solar fraction and the collector efficiency.

The above findings may be explained by several reasons. Firstly, the low performance characteristics associated with the low height scenario is due to the fact that the heater heats the water at low level, including the incoming cold water, which then rises up destroying the stratification. Secondly, a very large portion of water in the tank is kept at high temperature causing a higher heat loss to the environment. At the same time, the temperature of water returning to the collector is relatively high causing the collector to operate at high temperature and thus lower efficiencies. Furthermore, as a result of smaller height, the thermosyphon circulation is slower, resulting to lower collector efficiency (Michaelides et al., 1992).

It is quite interesting to note that the system performance is maximised when the auxiliary heater and the collector return are fixed at the highest possible position. In this case, the collector outlet is discharged at the highest level of the tank, and the auxiliary is not required to heat up all the quantity of water in the tank but only a very small portion of that at the very top of the tank. This might be a problem, however, if for some instances the hot water demand is higher than that illustrated in Fig. 2. In such a case the auxiliary heater acts in fact as an instantaneous heater and its capacity may prove too small to meet the demand.

CONCLUSIONS

A thermosyphon solar water heating system, representative of systems commonly used in Cyprus, was investigated using the TRNSYS Simulation Program. The simulation results lead to the following observations:

1. With the collector return to the storage tank fixed at a height of 705 mm from the storage tank bottom, the yearly solar fraction of the system is as high as 86% when the auxiliary is external, 77% if the auxiliary is in the tank top level and only 59% if the auxiliary is in the bottom of the tank.
2. In the in-tank auxiliary configuration, the system solar fraction and the collector long term average efficiency are sensitive to the variation of the vertical height of the auxiliary heater and the collector return from the storage tank bottom. The solar fraction may vary from as low as 55% at a height of 305 mm from the bottom to as high as 80% at a height of 940 mm from the bottom of the tank.

NOMENCLATURE

A_c	Collector area
AUX	Auxiliary heater
d_h	Diameter of collector headers
d_i, d_o	Diameter of collector inlet & outlet pipes
d_R	Diameter of collector risers
D_s	Diameter of storage tank
f	Solar fraction (fraction of the load that is met by solar)
F_RU_L	Slope of the collector efficiency curve
$F_R(\tau\alpha)_n$	Intercept of the collector efficiency curve
G	Collector flow rate per unit area
G_{test}	Collector flow rate per unit area at test conditions
H_a	Height of auxiliary heating element above bottom of tank
H_c	Vertical distance between outlet and inlet of collectors
H_o	Vertical distance between outlet of tank and inlet to collector
H_r	Height of collector return above bottom of tank
H_{th}	Height of auxiliary thermostat above bottom of tank
L_h	Length of collector headers
L_i, L_o	Length of inlet and outlet piping
P_{aux}	Auxiliary energy input to tank
Q_{load}	Hot water energy demand
Q_{aux}	Auxiliary energy supplied to the system
TH	Thermostat
$(UA)_{pi}$	Conductance for heat loss from collector inlet pipe
$(UA)_{po}$	Conductance for heat loss from collector outlet pipe
$(UA)_s$	Conductance for heat loss from storage tank
V_s	Storage tank volume

β	Collector tilt angle
η	Collector efficiency

REFERENCES

1. Duffie, J.A. and Beckman, W.A, 1991. *Solar Engineering of Thermal Processes, 2nd Ed.,* John Wiley & Sons, Inc., New York.
2. Klein, S.A. *et al.,* 1990. *TRNSYS, a Transient Simulation Program (version 13.1).* Solar Energy Laboratory, University of Wisconsin.
3. Kudish A.I., Santamaura P. and Beaufort P., 1985. *Direct Measurement and Analysis of Thermosyphon Flow.* Solar Energy, 35, 167-173.
4. Lamaris, P. 1994. Personal communication.
5. Lorenz K., Broman L. and Bales C., 1993. *Criteria for cost efficient small scale hot water installations.* Proceedings ISES *Solar World Congress 1993,* 23-27 August 1993, Budapest, Hungary, Vol. 5, 123-128.
6. Meteorological Service, 1985. *Solar Radiation and Sunshine Duration in Cyprus. Meteorological Paper No 10.* Ministry of Agriculture and Natural Resources, Republic of Cyprus.
7. Michaelides I. M., Lee W. C., Wilson D. R. and Votsis, P.P., 1992. *Computer simulation of the performance of a thermosyphon solar water heater.* Applied Energy 41, 149-163.
8. Michaelides I. M., Lee W. C., Wilson D. R., 1993. *Computer simulation and optimisation of solar water heating systems.* Proceedings ISES Solar World Congress 1993, 23-27 August 1993, Budapest, Hungary, Vol. 5, 157-162.
9. Morrison G.L. and Tran H.N., 1984. *Simulation of the long term performance of thermosyphon solar water heaters.* Solar Energy, 33, 515-526.
10. Morrison G.L. and Braun J.E., 1985. *System modelling and operation characteristics of thermosyphon solar water heaters.* Solar Energy, 34, 389-405.
11. Mutch, J.J., 1974. RAND Report R1498: *Residential water heating, fuel consumption, economics and public policy.*
12. Andronikos, P. and Spyridonos, A., 1992. *The influence on the efficiency of a DHWS of an external electrical heater in comparison to the electrical heater included in the hot water tank.* Proceedings Fourth National Symposium on Renewable Energies, 6 8 October 1992, Thrace, Greece, Vol. A, 135-142.

Digitalizing, - Modelling and - Processing of Sculptured Surfaces

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ABSTRACT

Three dimensional volumeoriented object reconstruction is achieved in such a way that a 4D-Laser Mapper (4D-LM) synchronously samples Cartesian coordinates of target's surface and their reflected laser intensity (4D). The geometry and topology of the freeform surface is then described. The transformed data can be used by standard CAD-Interfaces (e.g. VDAFS, IGES, STEP) and linked to different systems for later CNC data generation processing. By employing the newly developed 4D-LM and the Advanced Surface Modelling Software package (ASMOS) the process from carrying out the measurement to obtaining valid CNC-data from different objects lasts only a few minutes. The reconstruction algorithm will be presented. Typical measurement and manufacturing results will be shown and discussed with respect to applications in CAD, CAM, CAP, CAQ and CNC.

INTRODUCTION

The ever improving quality standards of today's industrial development demands new and advanced measurement and manufacturing strategies that must be very flexible and have to contain fast process and quality loop controls. High precision and robust sensors are the key to opening the door to Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) systems. Once well defined hard- and software interfaces are available, the next level may be achieved to reach Computer Integrated Manufacturing (CIM) systems. The universal use of the quality control loop may now enable an acceleration and rationalization of the manufacturing loop reducing in manufacturing costs and allowing the delivery of new products on the market at much shorter intervals. Today the machine-tool and moulding industry use optic and acoustic methods for the production measuring technique.

The optical method comprises laser triangulation, holography, interferometry or photogrammetrical methods. Ultrasonic sounding measures the acoustical range. Due to the poor geometrical resolution [1], today's ultrasonic technology its not ideal for the moulding industry.

Tactile sensors are the most advanced and widely used measurement systems when digitizing freeform surfaces.

However, the distortion achieved by friction and drifting forces and the long measuring time needed for the digitization of large objects make this method also impractical for industrial measurement applications. Additional problems may arise if the actual tool geometry is different from the sensing stylus.

Therefore, a new non-contracting optical four dimensional measurement system will be introduced: the 4D-Laser-Mapper (4D-LM) [2]. Most tactile sensors available on the market have their own control, and have standard interfaces (e.g. DEMIS, VDAFS etc.) [3,4].

The 4D-LM ensures short measurement times and versatility which is required in the moulding industry. The data taken by the 4D-LM is processed by a new software module.

This module allows the process of carrying out the measurement to storing valid CAD/CAM-data within some minutes. The 4D-LM and this software module also effectively close the manufacturing loop by the generation of valid CAD/CAM data and lastly CNC data for manufacturing.

Practical examples will illustrate how digitalized data can be processed so that the geometry of the object's surface can be described.

The powerful tool of the digitalizing unit combined with the new software module, which is available now, will close the gap for later CNC manufacturing.

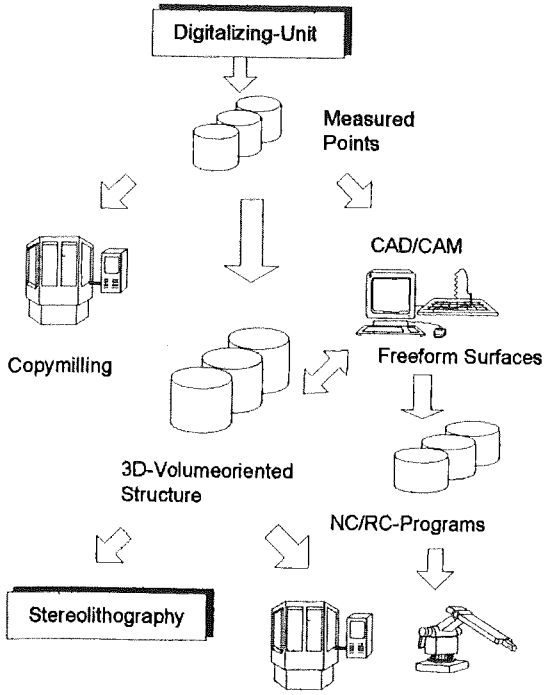


Figure 1 The different methods for the manufacturing of digitalized objects

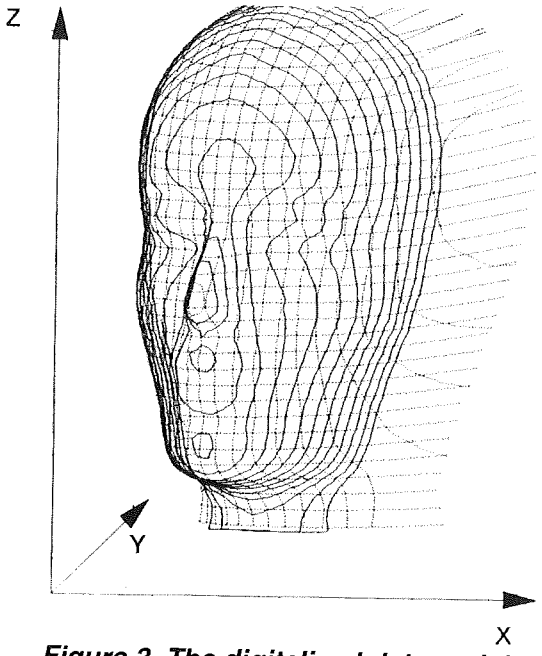


Figure 3 The digitalized data and the calculated loop contours

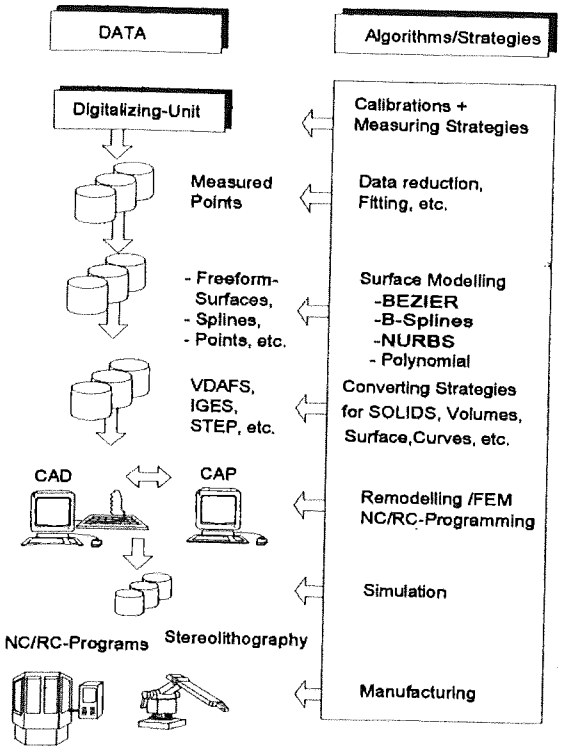


Figure 2 Product engineering information flow

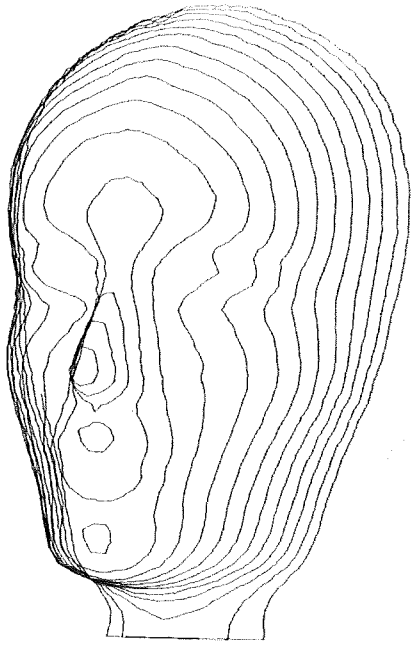


Figure 4 Loop contours

DATA GENERATION FOR CAD/CAM -SYSTEMS

The tooling and moulding industry currently models the moulding workpieces mathematically through CAD/CAM- and CAP-systems. Unfortunately the analytical description of such objects is not sufficient for practical applications. Here the space and time complexity must be increased to achieve the approximation and interpolation necessary.

Here, digitalizing a sculptured surface results in a very high amount of data (Mega Bytes). The computation performance of existing CAD/CAM-systems is insufficient for the processing of this data.

INTERNAL DATA MODELLING

The Cartesian coordinates that are a result of the digitizing of freeform objects by the 4D-LM are transformed into object coordinates by a postprocessor. The coordinates may now be processed as either NC-commands for copy-milling (duplicating milling) and stereolithography machines or in the data format for the sculptured surface modeller, Figure 1 and Figure 2.

POSTPROCESSING OF OBJECT COORDINATES FOR COPYMILLING AND STEREOLITHOGRAPHY MACHINES

The determination of loop contours is very time consuming and while analyzing NC-programs of copymilling machines we discovered, that the coordinates of the cutter center point represent a set of loop contours. Algorithms, which can be interactively selected by the user, filter the object's raw data that is still distorted by noise and therefore not useful for determination of smooth contours. The following step computes loop contours by defining virtual planes which are perpendicular to the actual cutter axis of the milling machine, see Figure 3 and Figure 4. The description of a surface by contours form the input interface for all further processing functions (e.g. positive, negative and pocket milling), for the NC-program generation according to DIN 66025, for the stereolithography and the tedraeder-structure (Finite Element Analysis, FEM) [5]. For the object shown in Figures 5, 6 and 7 the time needed for digitalizing, data reduction, filtering, fit

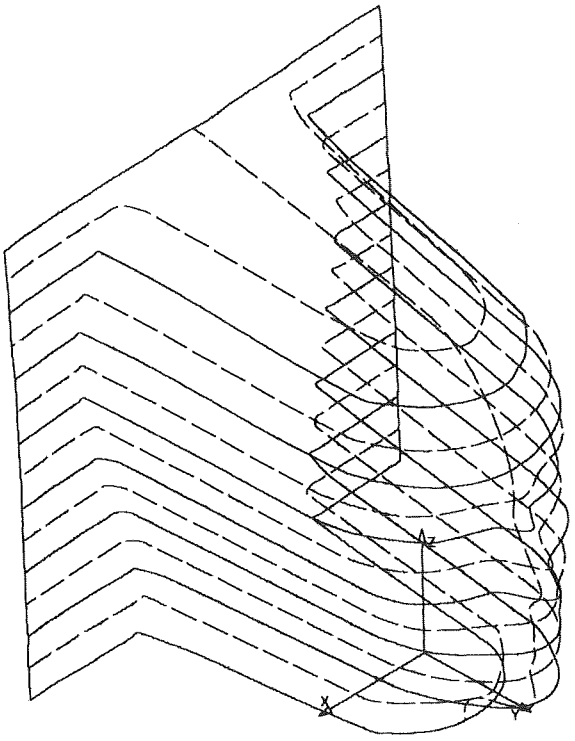


Figure 5 The generated freeform surface (B-Spline)

ting, contours processing and the stereolithography interface required about 3 to 4 MB and took about two minutes.

A data reduction is required to solve this problem. A data reduction of more than 80% can be achieved depending on the complexity of the workpiece by computing spline curves and spline surfaces and using the following algorithms [5,7]:

- bicubic Bezier,
- polynomial representation (Coons),
- B-Spline,
- Non Uniform Rational B-Splines, (NURBS) representation.

These computed internal representations of the digitalized object is obtained by the Advanced Surface Modelling Software Package (ASMOS) developed by the Institute for Control Technology for Machine Tools and Manufacturing Systems (ISW) at the University of Stuttgart, HTI and INRIA in Sophia-Antipolis, France during the EU-Project KIT-204. The output of ASMOS can be processed by all 2D / 3D-oriented CAD/CAM-systems. For the data transfer within CAD and CAP-systems the following interfaces are available [4,8,9]:

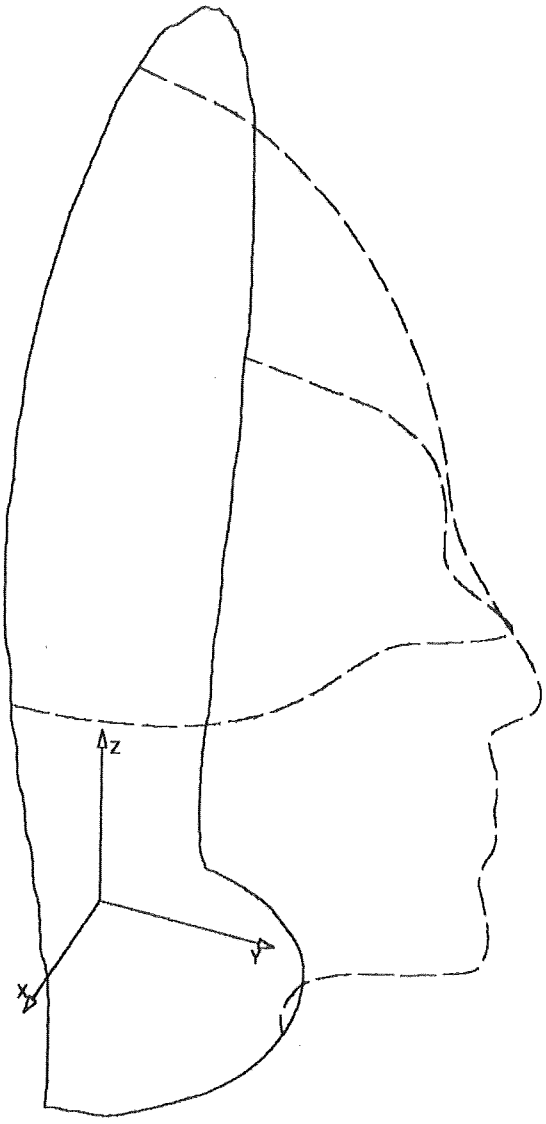


Figure 6 The generated freedom surface as a wire structure

- IGES 4.0 ,
- VDAFS 2.0 and - STEP.

VOLUMEORIENTED DIGITALIZING APPROACHES

When the digitalized object is measured not only from one side but from different overlapping views, it is then possible to reconstruct the entire object (Volume) by using specially developed algorithms. Figure 8 illustrates how the 4D-LM moves around an unknown object. The boundary of the object can be digitalized from different positions (Posi). In that case, the information about the object consists in a set of points (Pntsj) and a set of straight half lines (Laser rays Rij) issued from these points that

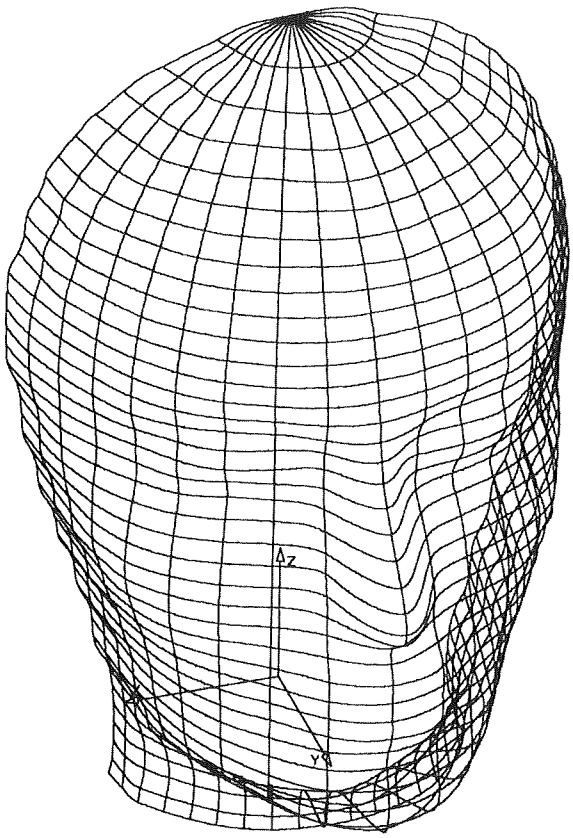


Figure 7 The generated freeform surface as a wire frame structure

cannot pass through the object.

Figures 9 and 10 show how the algorithm calculates the polygonal approximation of the object boundary, called contour in the sequel. The sequence of the laser positions, the sequence of the laser rays and their corresponding digitalized points are the input for the reconstruction algorithm. Due to the scalar product it is possible to solve normal and conflict cases such as in figure 9. The output of the algorithm is the approximated object contour.

This contour problem is in fact reducible to a sorting problem which can be solved by means of classical O(nlog(n)) sorting algorithm. Updating the solution, when a new measure (Posi+1) is available, can be done in O(log(n)) time.

REALISATION

Employing ASMOS the resulting data of a scanned workpiece can directly be used on one hand for 3D-CNC-simulation of the cutter

path of a five axes machine tool (Figure 13) and on the other hand for direct milling of the workpiece. Using the 4D-LM and applying pre-

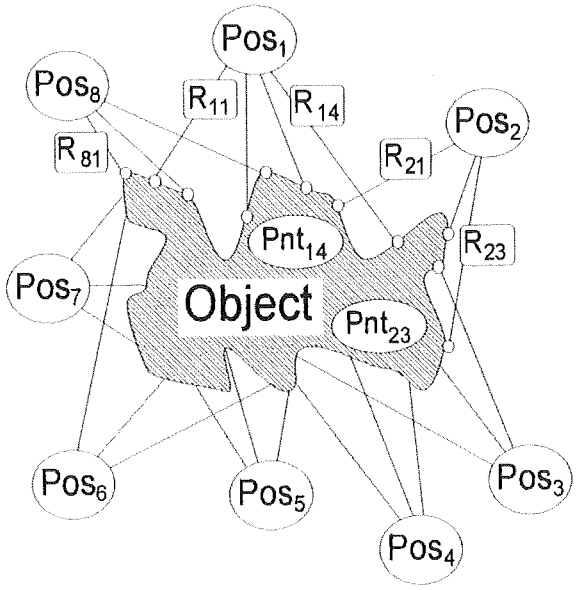


Figure 8 Volumeoriented digitalizing

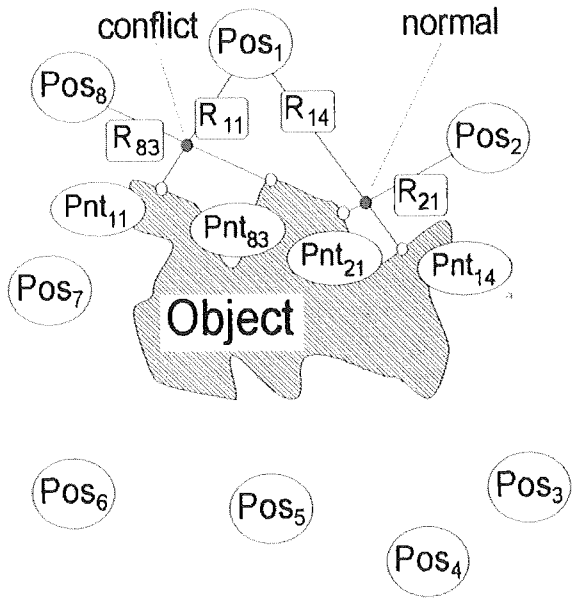
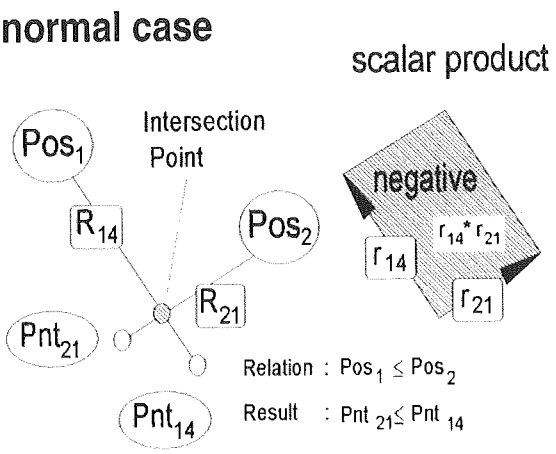


Figure 9 The normal and the conflict cases

sented freeform surface modelling algorithms it is possible in the application field of CIM and especially of CAQ and CAM to close the manufacturing loop very efficiently, see Figure 12.

A basic illustration of the system information flow using some algorithms can be found in Figure 2.

The total cycle from mapping the master piece to generating freeform surface "volume" orient



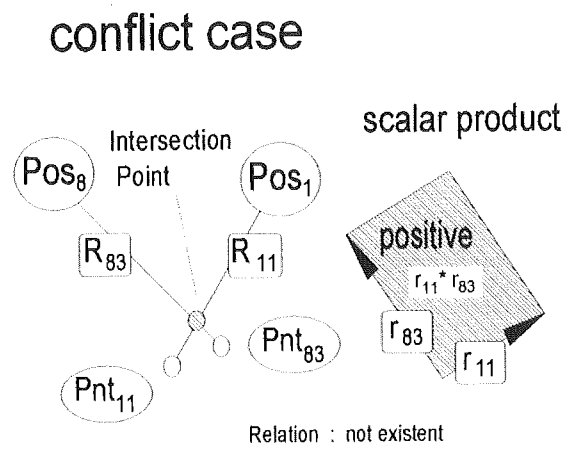


Figure 10 The sorting problem

ed CNC-data takes less than 2.5 minutes for the test object shown in Figure 3.

The entire software functionality is implemented in the programming language "C" and can be used on all UNIX /X11 Motif Workstations or PCs with the graphic interface PHIGS (Programmers Hierachical Interactive Graphic System). It is, at this time, an ideal prototype for the modell, design and milling industry.

CONCLUSIONS

The work described here is a concept for the creation of optimized, non interrupted information exchange in the production process for free formed objects with the overall aim of the volumeoriented reconstruction of digitized objects. Due to the volume oriented computer internal representation of the scanned data, it is possible to shorten drastically the cycle time

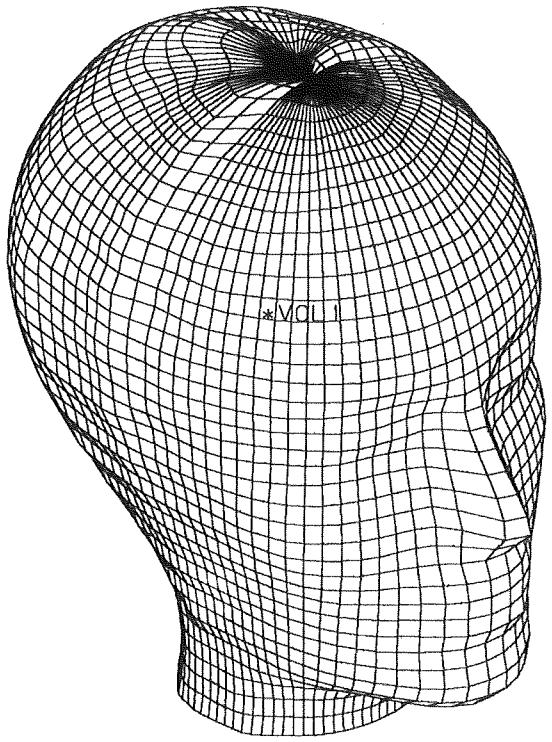


Figure 11 Volume oriented structure

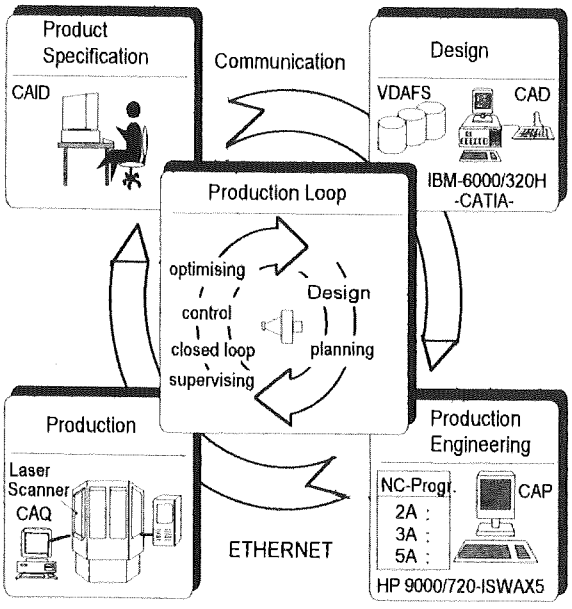


Figure 12 The production loop

for prototyping to mass production. This is the key requirement of today's manufacturing industry. The presented system implementation reduces production costs and improves the productivity and the quality.

Future steps in the EU project KIT will focus on volume oriented data processing. Then it will be able to carry out solid nominal-actual value comparison and recognition techniques. In addition the integration of the digitalizing system in a new developed open CNC Architecture System [12] will be done.

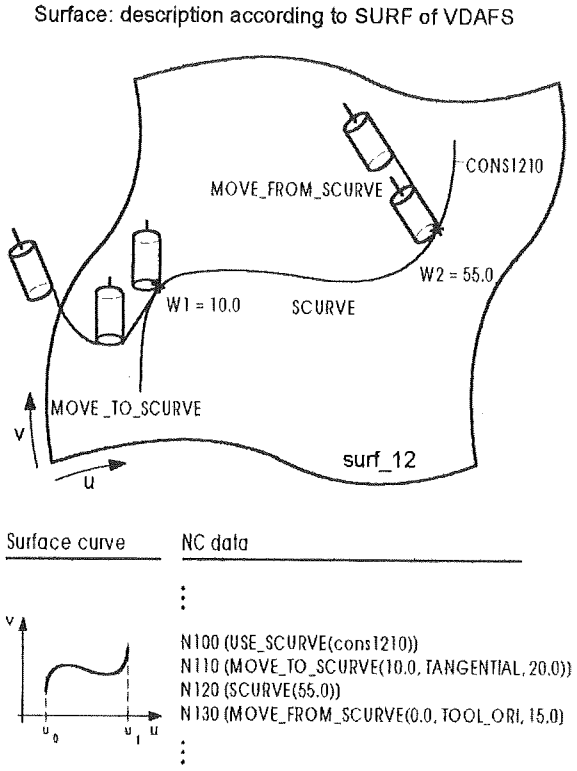


Figure 13 The implemented Geometry and CNC-Data Interface (10-11)

REFERENCES

1. Pritschow, G.; Hartl, Ph.; Ioannides, M.; Wehr, Al.: Vom Design Objekt in die Fertigung: Schneller mit 4D-Lasermessystemen. VDI-Z 134 , Nr. 9; Sept. 1992. S. 18-22.

2. Wehr, Al.: Entwicklung und Erprobung von opto-elektronischen Entfernungsmessystemen mit CW-Halbleiterlasern. Dissertation Uni. Stuttgart 1991.

3. N.N.: Dimensional Measuring Interface Specification (DEMIS), Version 2.1. CAM-I Computer Aided Manufacturing-International, Inc., Arlington, Texas (USA), 1989.

4. N.N.: VDAFS-Schnittstelle, Version 2.0: Verband der Deutschen Automobilindustrie e. V. Frankfurt a. M., 1986.

5. Hoschek/Lasser: Grundlagen der geometrischen Datenverarbeitung. 2. Aufl. B. G. Teubner Verlag Stuttgart, 1992.

6. Farin, G.: Curves and Surfaces for Computer Aided Geometric Design. Second Edition.

Academic Press, Inc. New York, 1990.

7. Bzier, P.: The mathematical Basis of the UNISURF CAD System, Butterworths, London 1986.

8. N.N.: Initial Graphics Exchange Specifications (IGES), Version 4.0, (IGES). National Institute of Standards and Technology, USA, 1988.

9. STEP, ISO CD 10303-42: Product Data Representation and Exchange - Part 42: Integrated Resources: Geometric and Topological Representation, National Institute of Standards and Technology, (USA) 21. Juni 1991.

10. Wei-Tai Lei: Fl°chenorientierte Steuerdatenaufbereitung f r das funfachsige Frasen. Dissertation. ISW 88, Uni. Stuttgart, 1992.

11. ESPRIT II - Project No. 5471: Five Axes Manufacturing Enviroment, (FAME) Deliverable D312 "Structure of Surface Oriented NC Data Preparation". Brussels, Nov. 1991.

12. Pritschow, G; Daniel, Ch.; Junghans, G.; Sperling, W.: Open System Controllers, a challenge for the future of the machine tool industry, Conference Proceedings of CIRP 1993.

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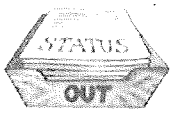

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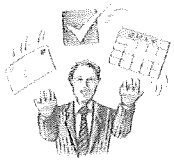
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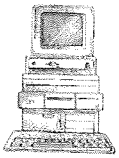
Rule-based Message management

Sequential Routing


Cross-Platform functionality (DOS, Windows, Mac, Unix)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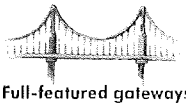
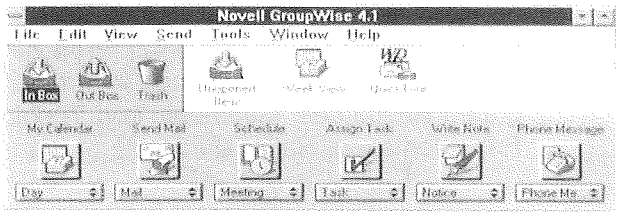
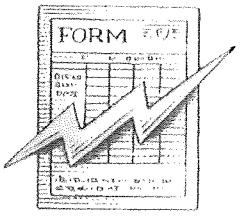

Full-featured gateways



Το GroupWise 4.1 είναι μέλος της οικογένειας προϊόντων GroupWare της Novell που έχει σαν μέλη το:



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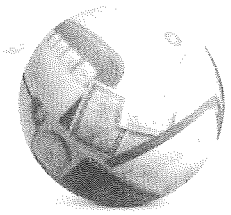

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HTI Calendar of Activities for Academic Year 1994-95

D. Charalambidou-Solomi, BA, MA (Lit), MA (Ed)
Lecturer, HTI

SEPTEMBER

● Two hundred and fifty-two (252) new students were enrolled on the regular programmes of HTI: 64 for Electrical Engineering, 64 for Civil Engineering, 60 for Mechanical Engineering, 31 for Marine Engineering and 33 for Computer Studies.

● Dr I. Michaelides, Senior Lecturer, and the lecturers Mr Th. Symeou and Mr E. Michael attended a course on «Renewable Energy Sources and their Applications in the Mediterranean Region» which was held in Malta between 29 August - 9 September within the framework of the E.U. Med-Campus Programme.

Dr Michaelides was one of the lecturers of the course.

● HTI Director, Mr D. Lazarides, had a meeting with all HTI staff on Friday, 9 September in the HTI Amphitheatre in order to brief staff on new developments and exchange ideas on current academic affairs.

● The HTI Director participated in the 6th Plenary Assembly of the Mediterranean Universities held in Neapolis, Italy between 15-19 September.

● Dr H. Stavrides, Head of Civil Engineering, participated in two international conferences: «Euro Networking» and «Mediterranean Cooperation in Education, Training and Research» which were held in Patra, Greece between 23-27 September.

● Mr C. Pavlou, Senior Lecturer, participated in the «2nd FISU Forum» which was held in Katania, Italy from 25 September - 2 October.

● The HTI Astronomy Club organised a lecture on Wednesday, 28 September in the HTI Amphitheatre on «Cosmic Collisions». The speaker was Mr A. Achillides, Senior Lecturer.

OCTOBER

● Mr P. Masouras, Lecturer, headed the Cyprus Deligation to the «2nd Balkan Olympiad in Informatics» which was held in Salonika, Greece between 1-7 October.

● HTI in collaboration with IEE - Cyprus Centre organised three lectures which were presented by Prof. Dr Ing. Ph. Hartl of Stuttgart University on «Satellite Navigation & Communication», on «Remote Sensing Satellites» and on «Laser Techniques for Distance Measurements».

All three lectures were delivered on 5 October in the Amphitheatre at CYTA Headquarters, Nicosia. The lectures were under the auspices of H.E. the Ambassador of the Federal Republic of Germany.

● HTI organised a Blood Donation Day on Monday, 10 October.

● Mrs D. Charalambidou-Solomi, Lecturer, attended a course on «European Union Integration» presented by Dr Kevin Featherstone, Department of European Studies, University of Bradford, UK, held in Nicosia between 10-13 October. The course was organised within the framework of the EU Med-Campus Programme.

● HTI in co-operation with the Cyprus Computer Society organised a course on «Fiber Optics» from 11-14 October.

● The Mechanical Engineering Department organised a course on «Computer Aided Design of Solar Systems» between 17 October - 23 November. The course was co-ordinated by Dr I. Michaelides, Senior Lecturer, and was sponsored by the Cyprus Industrial Training Authority.

● A second Blood Donation Day was held on Monday, 17 October.

● Mrs D. Charalambidou - Solomi, Lecturer, attended a course on «The General Framework of the Maastricht Treaty and EU Institutions» presented by Dr Jean Marc Peltier, working for the Foundation for European Studies in Maastricht. The course was organised between 17-

20 October in Nicosia within the framework of EU Med-Campus Programme.

● HTI celebrated the OXI Day on Thursday, 27 October with a gathering of students and staff in the main courtyard between 8.45 - 9.45 a.m. Speeches and poetry exalting the spirit of the OXI Day were read.

● Dr M. Ioannides, Lecturer, gave a lecture on «Stereolithography» on Thursday, 27 October in the HTI Amphitheatre.

● Dr Chr. Papaleontiou, Lecturer, visited the University of Glamorgan, Wales, between 28 October - 12 November within the framework of the staff exchange programme between HTI and the University of Glamorgan.

● HTI in collaboration with IEE-Cyprus Centre and the Industrial Training Authority organised a 25-hour course on «Designing and Installing LANS» between 24-27 October. The course was presented by an authorised instructor of the Euromanagement & Technology Bureau, London, and was attended by 20 participants.

● Mrs D. Charalambidou-Solomi, Lecturer, attended a course on «European Defence - Security before and after Maastricht» held in Nicosia between 24-27 October and presented by Dr Panayiotis Ifestos, Professor at Panteon University. The course was organised within the framework of the EU Med-Campus Programme.

● HTI in collaboration with IEE - Cyprus Centre and the Industrial Training Authority organised a 20-hour course on «Interconnecting Unix, 05/2 and Netware» between 31 October - 2 November. The course was presented by an authorised instructor of the Euromanagement & Technology Bureau, London, and was attended by 18 participants.

● The First Mid-Semester Examinations were held between 31 October - 4 November.

NOVEMBER

● The HTI Director, Mr D. Lazarides, participated in the international conference on «Maritime Safety and Environmental Protection» which was held in Constantinoupolis, Turkey, between 1-3 November.

● HTI in collaboration with the Cyprus Computer Society organised a course on «Software Project Management» between 1-4 November.

● The Electrical Engineering Department in collaboration with the Industrial Training Authority organised a course on «Power Electronics» between 2 November - 9 December. The course was presented by three HTI lecturers: Mr Ch. Theopemptou, Mr S. Hadjioannou and Mr E. Michael.

● On an invitation by the University of Stuttgart the Head of the Mechanical & Marine Engineering Department, Mr G. Iordanou, the Workshop Superintendent, Mr S. Savvides and Dr M. Ioannides, Lecturer, visited Germany between 3-12 November. During their stay they had the opportunity to visit various educational institutions and centres and examined ways of co-operation with HTI. They also participated in the seminar «Computer Integrated Manufacturing» which was held in Struttgart between 7-9 November.

● The Electrical Engineering Department in collaboration with the Industrial Training Authority organised a course on «Engineering Software» between 3 November - 5 December. The course was presented by three HTI lecturers: Mr Ch. Theopemptou, Mr S. Hadjioannou and Mr E. Michael.

● The Electrical Engineering Department of HTI in collaboration with IEE-Cyprus Centre and the Industrial Training Authority organised a course on «Troubleshooting Novell Netware» between 7-9 November. The course was aimed at personnel working in industry and was developed by the Euromanagement & Technology Bureau, London. It was presented by their authorised instructors.

● HTI in collaboration with the Cyprus Computer Society organised a course on «Cabling Systems» and was presented between 15-18 November by HTI staff.

● The HTI Hiking Club organised a walk on the mountain range of Madari on 19 November.

● HTI in collaboration with the Cyprus Computer Society organised a course on «Client / Server Computing» which was presented by HTI staff between 22-25 November.

● The HTI Workshops in collaboration with the Institute of Electronics & Electrical Technician Engineers of UK - Cyprus Group organised a 24 - hour course on «Alarm Systems for Fire & Theft» between 22 November - 8 December.

● The HTI UNESCO Day was celebrated on

Thursday, 24 November. Students and staff visited the Tekke of Um Haram in Larnaca. An officer from the Antiquities Department briefed them on the history of this Moslem monument. The visit ended with lunch by the beach.

DECEMBER

Dr Chr. Chrysostomou, Lecturer, participated in the seminar «Earthquakes and the Architect» and presented a paper on «Infill Walls». The seminar was held at the International Conference Centre in Nicosia between 2-3 December.

- HTI in collaboration with the Cyprus Computer Society organised a course on «Open Systems» which was presented by HTI staff between 6-9 December.

- Dr D. Serghides, Senior Lecturer, addressed the Annual General Assembly of the ISES-Cyprus in her capacity as President on 9 December at the Philoxenia Hotel in Nicosia.

- The Electrical Engineering Department of HTI in collaboration with the Cyprus Professional Engineers Association and the Industrial Training Authority organised a course on «Fast Packet Switching High Speed Networks» between 13-16 December. The course was developed by the Euromanagement & Technology Bureau, London and presented by their authorised instructors.

- The Computer Department of HTI in co-operation with the Cyprus Computer Society organised a course on «Internetworking/Bridges, Routers Gateways» between 13-16 December.

- Dr D. Serghides, Senior Lecturer, participated in the International Conference on «European-Mediterranean Initiatives Co-operation» on Friday 16 December in Nicosia. Dr. Serghides acted as a Moderator in the session «Renewable Sourses of Energy and Buildings».

- Dr D. Serghides, Senior Lecturer, participated in the seminar «Environmental Protection - Control of Pollution» held on Tuesday 20 December in Nicosia. The seminar was organised by the Cyprus Ministry of Labour & Social Insurance and the National Metsovio Polytechnic of Greece.

- The HTI Christmas party was held on Thursday 22 December. It was an opportunity for staff and students to mingle together over a drink and to exchange season's greetings.

- Lectures were suspended between 23 December and 6 January for the annual two-week Christmas Break.

JANUARY

- HTI in co-operation with IEE-Cyprus Centre and the Industrial Training Authority organised a course on «Supporting, Maintaining & Troubleshooting PCs» from 3-7 January. The course was developed by the Euromanagement & Technology Bureau, London and was presented by their authorised instructors.

- Mr G. Iordanou, Head of Mechanical & Marine Engineering Department, visited Brussels between 8-11 January to familiarise himself with procedures for participation in the European Union «4th Framework Programme: 1994-99» and the research programmes «EUREKA» and «COST».

- The Annual General Conference of the International Association for the Exchange of students for Technical Experience (IAESTE) was held in Athens, Greece, between 14-20 January. Sixty-three (63) countries participated with one hundred and eighty (180) representatives. HTI was represented by the HTI Director, Mr D. Lazarides, Chairman, and Mr Ch. Chrysafiades, National Secretary of IAESTE Cyprus. The Cyprus delegation received 31 places for the summer training of HTI students and offered 31 places to students from various IAESTE member countries to receive training in Cyprus.

- Mr E. Michael, Lecturer, completed his studies with the Cyprus International Institute of Management (CIIM) as a scholar of the Cyprus Government and received the postgraduate title of Master in Public Sector Management.

- The First Semester Examinations were held between 18-31 January.

FEBRUARY

- Classes and Industrial Training were resumed on 1 February.

- The Computer Department of HTI in association with the Cyprus Computer Society organised a training programme on «Identifying and Confirming User Requirements» between 6-9 February. The course was partly subsidised by the Industrial Training Authority.

- Dr L. Lazari, Lecturer, was awarded a scholarship by the Commonwealth Fund-

Management and Training Services Division to attend an Industrial Training Programme in Computer Aided Manufacturing & Computer Aided Design (CAD/CAM) in Singapore from 6 February - 3 March.

● HTI in co-operation with the Cyprus Computer Society organised a course on «Multivendor Networking: Linking PCs, Minis, Mainframes over Local & Wide Area Networks» between 14-17 February. The course was presented by HTI staff.

● The HTI Safety Committee organised a lecture on «Artificial Respiration» in the HTI Amphitheatre on Thursday, 16 February.

● Professor Dr Ing. G. Pritschow of Stuttgart University, Germany, visited HTI between 18-22 February to promote further co-operation between the two educational establishments. Professor Pritschow gave two lectures on Monday, 20 February in the Amphitheatre at the CYTA Headquarters in Nicosia. The one lecture was on «Software and Hardware in CNC of Tomorrow» and the other one was on «Linear Motors (Gearless) for Machine Tools and Robots».

The Lectures were under the auspices of H.E. the Ambassador of the Federal Republic of Germany.

● Mrs M. Theodorou, Lecturer, participated in the international symposium «Computer Week 1995» which was organised by the Association of Computing Machines in USA between 22 February - 8 March. Mrs Theodorou was the coordinator for the workshop «Database, Graphics, Data Structures and Programming in Teaching and Curriculums»

● HTI participated in the «2nd International Education Fair» with its own pavillion. The Fair was held between 22-26 February in the grounds of the International Fair in Nicosia.

● The Head of the Electrical Engineering Department, Mr C. Loizou, visited Brunnel University in UK from 27 February - 3 March under the staff exchange scheme between HTI and Brunnel University.

● Dr Chr. Chrysostomou and Dr Chr. Papaleontiou, Lecturers, visited earthquake - stricken locations in the districts of Paphos and Nicosia between 27 February - 3 March for the purpose of collecting scientific data concerning the earthquake which struck Cyprus on 23 February.

MARCH

● A number of HTI staff attended the conference on EU programmes «Med-Campus» and «Tempus» which was organised by the Cyprus University on 2 March.

● HTI Director, Mr D. Lazarides, visited Brussels with other Senior Civil Servants between 6-10 March to familiarise themselves with the functions and workings of the European Commission.

● HTI in collaboration with the Cyprus Association of Medical Physics and Biomedical Engineering organised a course on «Radiation Protection (Rad-PTOT '95)» between 13-17 March.

● The HTI Social Formal Dinner of the third year students was held on Thursday, 16 March at the Ledra Hotel.

● Dr D. Serghides in her capacity as president of the Cyprus branch of the International Solar Energy Society addressed the Annual General Meeting of the Cyprus Association of Mechanical Engineers held on Saturday, 18 March.

● The Electrical Department in collaboration with IEE-Cyprus Centre and the Industrial Training Authority organised a 25-hour course on «Fast Packet Switching and High Speed Networks» between 21-24 March. The course was presented by Michael Debenham, authorised instructor of the Euromanagement & Technology Bureau, UK.

● The Heads and some Senior Lecturers from HTI departments visited Glamorgan University in Wales and the Technical University of Budabest between 27 March - 3 April to discuss ways of closer co-operation i.e. staff - exchange schemes, participation in EU and research programmes.

● The Second Mid-Semester Examinations were held between 27 March - 3 April.

APRIL

● HTI in collaboration with IEE - Cyprus Centre organised a lecture on «Rapid Prototyping Techniques» delivered by Mr J.F. Bauer from the Bremen Institute of Industrial Technology at the CYTA Amphitheatre in Nicosia on 3 April. The session was chaired by Dr A. Stasis.

● Dr D. Serghides, Senior Lecturer, visited the City University between 3-7 April within the

framework of HTI - City University staff exchange scheme. During her stay in the UK Dr Serghides had the opportunity to meet with officers from the Building Research Establishment and to discuss the issue of energy efficiency in buildings.

- HTI in collaboration with the Cyprus Computer Society organised a course on «Software Quality Assurance» between 4-7 April.

- The HTI Hiking Club organised an excursion to Cavo Greco on Saturday, 8 April.

- Dr D. Serghides attended the ceremony of the award of her Doctorate at Guildhall, Portsmouth, UK, on the 8th of April.

- HTI in collaboration with the Cyprus Computer Society organised a course on «Relational Databases: Design, Tools and Techniques» between 11-14 April.

- Classes were suspended between 17-28 April for the Eastern Holidays.

MAY

- Mr Sp. Spyrou, Senior Lecturer, visited Germany between 4-6 May 1995 and participated in the meetings of Euro Exec Committee and IEE Europe Regional Board.

- Dr D. Serghides, Senior Lecturer, participated in the UK-ISES Conference on «Putting Passive Solar Energy into Practice» which was held on 5 May at the University College, London.

Dr Serghides, also, on the 6th of May participated as Cyprus - ISES representative in the Full Board meeting of the European - International Solar Energy Society in London at Russel Square.

- HTI in collaboration with IEE-Cyprus Centre and the Industrial Training Authority organised a 30 hour-course on «Supporting, Maintaining and Troubleshooting PCs» between 8-12 May. The course was developed by the Euromanagement & Technology Bureau, London and was presented by its authorised instructors.

- HTI organised a third Blood Donation Day on Monday, 8 May.

- Dr Chr. Chrysostomou, Lecturer, represented the Cyprus Technical Chamber in the seminar on «Methods of Evaluation of Civil Engineering Computer Programmes» which was organised by the Technical Chamber of Greece between 9-12 May.

- Dr P. Eleftheriou, Lecturer, participated in the second meeting of the Research Committee which was held in Israel between 10-14 May within the framework of the European Programme «Avicenne CT92-0017».

- The fourth Blood Donation Day of HTI was held on Thursday, 11 May.

- HTI in collaboration with IEE - Cyprus Centre and the Industrial Training Authority organised a 20 hour - course on «Law for Engineers» which was held between 15-17 May. The course was developed by the Euromanagement & Technology Bureau, London, and was presented by their authorised instructors.

- Dr A. Stathopoulos, Senior Lecturer, visited Salford University between 15-19 May. The purpose of his visit was to participate in the «Open to Europe Event» and to familiarise himself with the programmes of the Department of Applied Sciences & Computing of the University College, Salford.

- Dr D. Serghides participated as invited speaker in the EUROMED Tourism Project (MEDCAMPUS) «The effects of tourism in Cyprus - cultural physiognomy» at the University of Cyprus from 18-20 May. Dr Serghides presented a paper on «Our Architectural Heritage is at Risk». The event was organised by the University of Cyprus.

- The Head of the Mechanical & Marine Engineering Department, Mr G. Iordanou and Dr I. Michaelides, Senior Lecturer, participated in the international symposium «Training and Evaluation at the Energy Field» in Athens, Greece between 22-24 May.

JUNE

- HTI in co-operation with IEE-Cyprus Centre and IEE - London organised the International Conference on «Information Technology Applications» which was held at the International Conference Centre in Nicosia between 1-2 June. The Conference was under the auspices of the President of the Republic, Mr Glafcos Clerides. The Conference was addressed by the Minister of Trade & Industry, Mr Kyriacos Christofi.

- Mr A. Achillides, Senior Lecturer, visited USA in order to participate in the Seminar «Environment - Education and Development» between 3-30 June.

● HTI in collaboration with the Cyprus Computer Society organised a course on «BPR - Business Process Engineering» between 6-9 June.

● Dr Chr. Chrysostomou participated in the two-day conference which took place in Paphos, between 10-11 of June, and addressed the conference on «The effects of the Paphos Earthquake on buildings».

● Dr M. Ioannides, Lecturer, visited Paris between 18-23 June, on an invitation by the French Archaeological Academy of Athens, to participate in a Laser Workshop concerning the manufacturing of a replica of the Amathus Urn which is in the Louvre Museum. The Workshop was organised within the framework of the EU «KIT - Programme of International Scientific Co-operation in the Field of Information Technology».

● Dr D. Serghides, as president of the Cyprus branch of the International Solar Energy Society of Cyprus (ISES) addressed the «Sunday Solar Event '95» on the 18th of June. This was organised by ISES in co-operation with the Environment Department of the Ministry of Agricultural and Natural Resources and the Municipality of Engomi.

● Dr D. Serghides participated in the CBC radio the 19th of June.

● HTI in collaboration with the Industrial Training Authority and the Cyprus Professional Engineers Association organised a one-day course on «Creative Design of Industrial Products» on Thursday, 22 June.

● Mr P. Masouras, Lecturer, led the Cyprus Delegation which participated in the «International Olympiad in Informatics» which was held between 26 June - 2 July in Eidhoven, Holland.

● Mr C. Talbot, Product Development Unit Manager of Epping Forest College, UK, visited HTI on Thursday, 27 June and had a meeting with HTI Administrative Team to explore ways of co-operation between HTI and Epping Forest College.

● The End of the Year Exams were held for the First and Second Year Students between 7-20 June.

● The Graduation Ceremony was held on 30 June at the International Conference Centre in Nicosia. It was attended by the President of the Republic, Mr Glafcos Clerides, the Minister and Director-General of the Ministry of Labour and Social Insurance, diplomatic corps, other dignitaries and guests.

ΦΩΤΟΣΤΟΙΧΕΙΟΘΕΣΙΑ, ΔΙΑΧΩΡΙΣΜΟΙ ΧΡΩΜΑΤΩΝ
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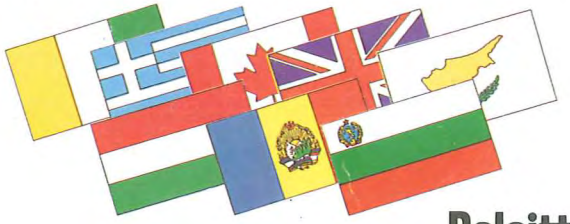

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ΔΙΚΟ ΣΑΣ ΣΠΙΤΙ

από το όνειρο... στην πραγματικότητα

Η ΕΤΑΙΡΕΙΑ ΠΟΥ ΠΡΟΣΦΕΡΕΙ ΣΤΑ ΜΕΛΗ ΤΗΣ ΟΥΣΙΑΣΤΙΚΗ ΕΞΥΠΗΡΕΤΗΣΗ

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