arkitettura w ambjent

special edition

20c

ARKITETTURA W AMBJENT

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comment

By this special edition of our magazine "A — Arkitettura w Ambjent", we intend to launch an all round improved publication on our former efforts. We have tried to feature articles of a high standard, maintaining a balance between general features which should interest the layman as well as technical material aimed at the professional. Besides, by sending this publication abroad to various Universities and leading Construction Companies, it will act as a source of information on all that is going on within the local Architecture and Civil Engineering spheres. We felt it was high time for Malta to be represented in such exclusive circles.

The success of our venture depends on reader's reaction to our "new look" magazine. We encourage readers comments and earnestly hope that our next issue will include your best suggestions.

Sincere thanks go to our sponsors, namely,

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and Mr. P. Camilleri and Mr. L. Mintoff for their kindness in spending their time helping us, and all those who contributed articles to this publication.

THE EDITORS

Manuscripts intended for publication should be submitted to the editors; the editors shall not be responsible for any damage or loss of articles or any other material submitted for publication.

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Cover Design: Plan of Malta's oldest city — Mdina, by Karl Borg.

PREFABRICATION

PROFS. KAROL KALDARAR:

Born 1930 in Komarno, Czechoslovakia, Profs Kaldarar studied at the University of Bratislava — M Sc (1955), at present Head of Department of Architecture and Civil Engineering, University of Malta; previous post, vice-president of TRUST Enterprises Prefabrikacia, member Europrefa, member of Commission of COMECON. Lectured in Germany and Cuba. Author of books, "The skeleton systems of industrial and social buildings" (1977) and "Agricultural Buildings" (1958); contributed articles to magazines of various countries.

PREFABRICATION

The prefabrication of building construction elements has a very old history. Such buildings were built many thousands of years B.C. At this time the people tried to manufacture a few elements in a small or larger quantity on the building site or somewhere else. These were the first steps of prefabrication, the first attempt to industrialize, (if we can call it so), the building construction work.

Prefabrication is the production of elements from any material, which will be installed later in the whole building. Generally people relate prefabrication to production of building elements from concrete, although a truss from steel or wood or a column from any material is also a prefabricated element.

New and modern construction works need mainly:—

Production of building materials, and also the actual construction of buildings.

Recent years have shown a necessity of providing a bigger amount of construction work than before, built also in a shorter time.

Such work necessitates new modern principles of organisation and construction and the solution is industrialisation.

Prefabrication solves these problems in a very efficient way. Most countries began to build large industrial factories or plants for the production of prefabricated elements, with the possibility of producing such elements also on the building site.

The advantages of prefabrication are:

the short time taken for building construction work,
the economical advantages of mass production,
the possibility to build a very large amount of buildings,
the possibility to employ the workers all year round, (without seasonal employment).

In the year 1960 the production of concrete and lightweight concrete elements in the most developed countries was as follows:—

COUNTRY	Prod. $10^6 m^3$/yr.	Prod. m^3/ hab.
USA	40,30	0.220
USSR	30,34	0.140
WEST GERMANY	3.35	0.062
EAST GERMANY	3.50	0.203
GREAT BRITAIN*	10.00	0.170
FRANCE*	2.4	0.052
CZECHOSLOVAKIA	2.11	0.153
POLAND	1.94	0.060
HUNGARY	0.75	0.044
BULGARIA	0.19	0.010

* *These figures are not confirmed.*

But the situation in the last 15 years changed completely. In 1977 Czechoslovakia produced about $13.5 m^3 \times 10^6$ of prefabricated elements, 6 times more than in 1960. 98% of the apartments are built from prefabricated elements, so are 60% of industrial and public buildings. Concrete elements are more and more used in all kinds of buildings where before steel was dominating especially in the field of industrial buildings and building of bridges, where a distance of a hundred metres, and more, without supports is very common.

The situation in the most developed countries in the field of production and erecting biuldings from prefabricated elements is the following.

USA: Generally the production of prefabricated elements is on a very high level. The production of prestressed railway sleepers and the level of automation of production tops all countries. Of a very high level both of quality and quantity is the production of prestressed concrete elements, wall and ceiling units. In the last years USA began to produce light weight and aerated concrete elements out of pulverised fuel ash. This also solves the problems of pollution and waste.

USSR: In the U.C.S.R. there exist many modern production plants manufacturing all kinds of prefabricated elements using local lightweight materials, ash and sand with aluminium powder to produce aerated concrete.

WEST GERMANY: In the area of production of wall panels West Germany excels in the quality and degree of finishing. West Germans are using prestressed elements, lightweight concrete elements, (mainly aerated concrete) as prefabricated elements on a very big scale. In 1976 they started to produce box units for use in buildings. The production machinery was mainly supplied from Finland. West Germany also imports prefabricated elements.

EAST GERMANY: The East Germans produce a big quantity of prefabricated elements of very good quality. They are well noted for the production of prestressed tubes. They are producing also a big quantity of lightweight concrete and aerated concrete. The importation of prefabricated elements is not large.

FRANCE: Prefabrication in France has a very high level of workmanship and a very good tradition. In many respects they are the leaders in prefabrication. They became very famous through Prof. FREYSINET, who built the first prestressed concrete bridge and who produced the first prestressed tubes which can withstand pressure of 16,20 and more atmospheres. In France there are two leading building construction firms, which are using mainly in their construction work prefabricated elements. These are Camus and Coignet. France mainly exports prefabricated prestressed tubes, as well as many other elements.

In the **UNITED KINGDOM** prefabricated elements are not very much in use however, some prefabricated products have been transported by ship even to Australia and New Zealand. This is not economically feasible, as to be economical, it is necessary to use local materials for the production of prefabricated elements and to make transport distances as short as possible.

SPAIN, BELGIUM and **NORWAY** didn't reach the level of developed countries in prefabrication. Belgium is importing prestressed tubes mainly from France and elements for industrial and social buildings from Holland.

SWEDEN: Sweden tops the list in the use of lightweight concrete elements, especially aerated concrete. The leading companies are ITONG and SIPOREX, which are not only exporting elements but also machinery.

They sold their licences to many European countries, and they also own factories overseas, for example in West Germany and in Austria. They produce large prefabricated elements on the building site and they have very good quality prestressed concrete elements produced in their factories.

In **HOLLAND** prefabricated elements are mainly products of ceramics. These are very cheap and complete with concrete elements, they are being exported to Belgium from where they import cement.

The **ITALIANS** produce concrete elements of very high quality especially their floor tiles which are the best in Europe. There are four leading firms producing machinery and selling them round the world. They are CHIESA from Milan, OCEM, CASANI and LONGINOTTI. The Italians have also a very good production of prestressed concrete elements, mainly for bridges, for big columns etc. Very famous is the firm COSSAMAGNA.

SWITZERLAND produces prefabricated elements on a small scale but their quality of prestressed elements is very high. In the last years they also started producton of unit box elements.

Nearly the same was the situation in **Austria,** but in 1961 the situation completely changed when the French firm CAMUS built the first factory for the production of elements for high rise buildings especially apartments. After that, many other factories were built and they are now also producing light weight concrete in big quantity. The firm ITONG has two big plants in Austria. The Austrians import some prefabricated elements from Czechoslovakia.

In **Bulgaria** and **Romania** the production of prefabricated elements started around the year 1958, on a big scale. Romania imports elements especially prestressed pipes from Czechoslovakia.

The **Polish** and the **Hungarians** have a lot of experience in the production of prefabricated elements. Poland bought the license for production of aerated concrete, from Sweden. The Poles import pipes from Czechoslovakia and produce a large amount of prefabricated elements.

Hungary tops the list in the production of prestressed elements especially railway sleepers but they are now being overtaken by the USA where the production is on a larger scale and on a higher level.

They are producing elements for large buildings and also exporting prefabricated **Hotels** and other buildings, but they are also importing some of the elements.

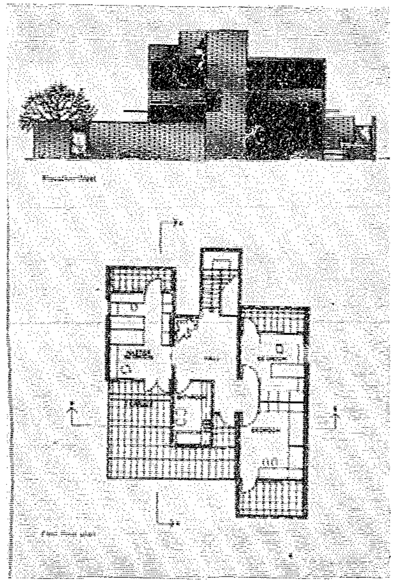
In these last years **China** started the production of prefabricated elements on a very large scale, especially the production of industrial buildings.

Brazil is famous for the production of prestressed elements for bridges and for other large industrial buildings.

Algeria produces prestressed columns for lighting and for electricity networks.

Finland has in the last year, a very good production of prefabricated elements. They were the first who started to produce prefabricated Unit Boxes. The boxes are produced by the LOHJA firm and exported to some other countries. The LOHJA firm is also exporting their machinery. From unit boxes they build many individual houses, apartment houses and others.

I tried to give a rough idea of the situation in a few countries and as you can see, the production of prefabricated elements is taking root in all countries. Many countries are preparing for the prefabrication of building elements under good conditions and they are combining the idea of prefabrication with the use of local materials with the special idea of using material, which was being wasted, (for example, ash — in Czechoslovakia they are producing from ash alone more than 2,000.000m^3 aerated concrete elements; for one flat only 40m^3 of these elements is necessary).



Unit Box Construction

In this respect it is necessary to use the advantages of mass prefabrication — the cost, the time of completion of works and the industrial production of elements, for export of building units complete with all fittings as is done in many countries (Sweden, France Hungary, etc:)

The highly finished products are the Unit Boxes used mainly for private houses, apartment blocks, hotels and other accommodation facilities. All the units for a big hotel or apartment block are transported to the site on low based trailers and trucks. The advantages of the box units are the possibility of good quality building and the creation of accommodation in a couple of days. As the units are highly finished, when arriving on site, the inconveniences of construction time are minimised.

(continued on page 17)

Technical aspects of the Malta fortifications.

DENNIS DELUCCA:

Architect, born 1952 in Gharghur, educated at St Aloysius College and University of Malta — B.A.Arch., B.Arch. (Hons.), A&CE. Occasional lecturer and research assistant at the University of Malta 1975-1976. Council member and Newsletter editor, Chamber of Architects and Civil Engineers, 1978. Several publicatons on Baroque Architecture in Malta.

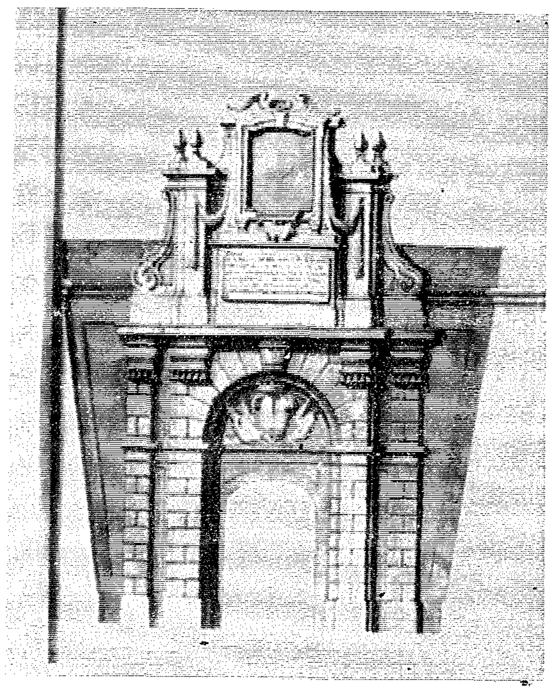
The settlement pattern of Malta as established following the arrival of the Knights of St. John in 1530 was characterised by three principle themes. In the first place there had been the foundation and subsequent development of a number of fortified towns around the Grand Harbour in the Eastern part of the Island. Secondly there had been the development of large unfortified inland village settlements like Qormi, Żabbar, Żejtun and B'Kara coupled with the parallel 'extinction' process of the Older Medieval hamlets. Thirdly there was the traditional and very persistant reluctance of the civil population to occupy the coastal zones of the Islands which because of their vulnerability to raids, became the object of a vast programme of coastal fortification started in the 17th century and subsequently elaborated in the 18th.

The whole philosophy behind the building of the Malta fortifications developed with the passage of time until it reached a peak point of complexity towards the close of the 17th. century and the begining of the 18th. One document(1) kept in the National Archives points out that the final form of the defence system evolved by the Order of Malta resulted from two conflicting schools of thought. The first school originated in the 16th century and favoured a strategy which was exclusively based on the defence of the Grand Harbour which as a result came to be viewed by contemporary military strategists as a 'Malta within Malta'. The second school which originated in the mid-17th century and which was an exclusively French tradition favoured a strategy which was based on a more fragmented form of defence relying on an elaborate network of forts, towers, batteries, redoubts and entrenchments carefully positioned along the vulnerable coastline. In theory this was not unlike the fragmented system of castles to which the Order had been so well accustomed in the Holy Land, but as was the case in that Eastern country, the limited garrison of Malta, which at most only numbered 25,000 defenders, severely handicapped the workability of such a fragmented system of coastal fortification and suggested instead the first alternative of having a more concentrated form of defence centered on the Grand Harbour. In view of this it is not at all surprising that most of the best military engineers who were brought over to Malta by the Order seem to have favoured a **strategy** based on the principle of achieving a balance of concentrated defence shared equally between Valletta and Floriana with 8,000 defenders on one side of the Grand Harbour and Fort St. Margherite supported by Vittoriosa and Senglea with another 8,000 defenders on the other side. In his "Discours General Sur Le Fortifications De Malte"(2) the engineer Tigné calls Fort St. Margherite 'the vital bullwork of the Port and its naval establishments' but realising that no fortress however strong could hold out indefinitely, the engineer's aim was to delay its capture by using the incomplete Cottonera lines designed by Valperga in the 1670's as a form of outworks, by converting the Salvatore Bastion of Birgu into a separate fort defending that town, and by fortifying Corradino Hill which dangerously overlooked the Western defences of Senglea. In other reports(3) Fort Ricasoli with its 2,000 defenders and Fort Manoel with its 500 strong garrison seem to have been viewed as separate entities with the dual purpose of guarding the entrances to the harbours and distracting enemy batteries mounted on Salvatore Hill and Ta' Xbiex. Finally, there were the two inland centres of Mdina and the Gozo Castello, both originally Mediaeval strongholds of the South Italian hilltop type. Curiously enough, the documentary evidence(4) indicates that the whole idea behind these Medieval centres, was for them to act as sources of distraction behind the enemy lines facing the Harbour fortificatons rather than as a refuge centre for the inhabitants. This may be defined as the negative side of the Order's defence strategy which is blatantly revealed in one document(5) where one finds that the buildings of the inhabitants to be built within Floriana were meant to serve the useful purpose of sheltering the Parade ground of Floriana from the fire of enemy batteries mounted on Corradino and Ta' Xbiex. Another function of the Gozo Castello and Mdina which was demonstrated in the Great Siege of 1565 was that of acting as signalling stations and sortie centres to harass the supply lines of a potential enemy by means of mounted cavalry. Apart from Mdina and Gozo Castello, the other vital points in the signalling network of the Defence system were the towers of St. Agatha, Lippija and Nadur which were meant to act as intermediaries between Gozo, Mdina and Valletta — the ultimate receiving end of the signalling process and the vital hub of the order's hold on Malta.

Why was the Order so preoccupied with creating a closed network of defence which by its form, size and finesse can be compared to the finest of continental Europe? In the first place, there seems to have been the constant threat of a Turkish invasion — a factor which is well illustrated in the written records of the Order and which underlines a predominantly defensive purpose which gave rise to a type of fortification directly derived from current military theories of attack and defence. But then there were other less significant but equally important political factors at work. One was that the Knights soon after coming to Malta realised that the building work on the fortifications was providing **Employment** for an ever-increasing population which was willing to work at cheap labour and which if unemployed might become restless and present an internal threat to the political stability of the Order.(6) Secondly, the Fortifications provided the Knights with a ready excuse to bring over to Malta several leading experts in the art of war and defence strategy who, on their return to Europe, increased the **prestige** of the Order on the chessboard of international politics. Thirdly, and this is most marked in the later 17th and 18th centuries, the Fortifications of Malta came to be viewed as an important outward manifestation of power admirably suited to the absolutist pretensions of the later Grandmasters — hence the sheer size of the Cottonera and Floriana lines and the elaborate architectural treatment of their main gateways, carefully designed in the full-blooded baroque style imported from the absolutist courts of Europe by such architects as Francois Mondion and Romano Carapecchia.

Some Definitions.

The sheer vastness of the Malta harbour fortifications renders a detailed analysis of each and every section rather prohibiting. But as they followed a more or less fixed formula of design, it will be sufficient to examine one part of the vast network in order to underunderstand the technical significance of the whole. **Fort Manoel,** designed in 1715 to secure



Baroque gateway by Romano Carapecchia.

the Marsamxett flank of the Floriana and Valletta defences provides a perfect specimen for such a study as it incorporates all the various design elements found in the other fortifications besides including a number of sophistications directly inspired by the best work of continental Europe. In view of its relatively late date, Fort Manoel represents the end result of a long history of fortification building in the Grand Harbour area starting with Fort St. Angelo, Fort St. Michael, Fort St. Elmo and the Valletta and Vittoriosa landward defences in the 16th. Century, the Floriana, Margherita and Cottonera lines as well as Fort Ricasoli in the 17th. century and finally Fort Manoel and Fort Tigne in the 18th. century. Moving outwards from the highest level of Fort Manoel, the main planimetric elements of the Fort are

1) **The Rampart:** (12.19m overall thickness) made up of four straight stretches of Courtine walls carefully set between the angled bastions. The Northern front was built on two storeys in the tradition of Vauban's Tours Bastionee which were works of two or more storeys dominating the fortification system. In the older fortifications of Malta such as the Valletta landfront designed by Laparelli the function of these towers was performed less efficiently by means of raised cavaliers set slightly back from the main rampart line. Likewise the 67 degrees angle of the Fort Manoel bastions can be compared to. say, Fort St. Elmo's 30 degrees bastions; as was the case on the continent, the bastion angles tended to become more obtuse with the passage of time.

2) A narrow stretch of **DITCH** (6.09m overall width) separating the rampart from a low-lying feature called the tenaille.

3) The **TENAILLE** (6.09m overall width) — a detached oblong work placed in the ditch with angled projecting ends meant to accommodate men with muskets to cover the back of the Ravelin in front. The tenaille was connected to the Ravelin by means of a covered pathway known as the CAPONNIERE which provided additional flanking fire for the ditch.

4) A wide stretch of **DITCH** (12.19m overall width) separating the tenaille from the outwork known as the Ravelin.

5) The **RAVELIN** (48.76m overall thickness of section) with an arris of 80 degrees; this was a detached traingular feature with two protected faces but with the back exposed so that in the event of its occupation by hostile forces, it could be immediately swept by fire from the rampart.

6) A narrow stretch of **DITCH** (9.14m overall width) bordering the faces of the Ravelin and separating it from the Chemin Couvert.

7) The **CHEMIN-COUVERT** (9.14m overall width) — a level walk on the outside of the moat protected by a high parapet and fitted with place d'armes and traverses. The Place d'armes were triangular squares placed at fixed intervals to enable troops to be assembled and organised to improve the defence. The travesses were packed banks of earth which blocked the Chemin Couvert at intervals so as to prevent it being swept by enemy fire.

8) The **GLACIS** (61m average span) which was the sloping ground starting from the top of the parapet of the Chemin-Couvert and ending in open treeless country.

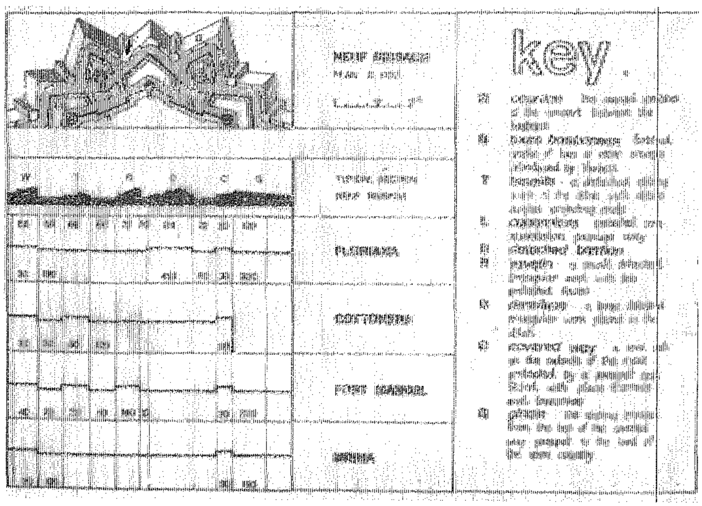
9) A complex series of 21 concealed underground **TUNNELS** projecting beneath and beyond the bastions to enable sudden sorties by the defenders and to facilitate the blowing up of outworks from underneath if these were captured by the enemy.

FORT MANOEL:

The main characteristic of Fort Manoel and indeed of all defences built in Malta after 1650 are the sophisticated design of the Rampart and the remarkable series of outworks which were devised to meet new methods of attack developed by the field armies of the 17th and 18th centuries. The **Rampart design,** usually followed what is known as Vauban's first system where the distance between any two bastion points was taken as 330m and the side of the bastion as 0.029 of this distance. The application of these figures at Fort Manoel is not surprising when one considers that the fort was designed by the engineer Francois De Mondion who was a student of the great French military engineer SEBASTIEN LE PRESTRE DE VAUBAN. The adoption of elaborate **outworks** to strengthen the main line of defence, became necessary following a new method of attack devised by the field armies of the time. This was the celebrated 'parallel approach' by which a potential attacker was supposed to begin his movements from several points spaced as far apart as his number of troops permitted in view of the stretch of fortification to be attacked.[8] The attacker then proceeded to get within gun-range of the outworks by means of zig-zag trenches which were connected by means of the First Parallel after the exact position of the gun-range had been established. This first parallel was a sunken trench laid out parallel to a line joining the outer points of the defence system. Here the batteries would be mounted in order to keep down the defenders' fire while new trenches could be pushed forward in the same zig-zag fashion.

Ordinary fire could only bury its shot in the earth parapets of the defence but it was possible to do much more damage by means of a new invention — ricochet fire. This involved siting the batteries in line with the faces of the defence, elevating the guns to a high angle and using a reduced charge of gunpowder. By this means shot could be made to plunge over the parapet onto the terreplein behind it disabling the men and dismounting the guns — hence the need of traverses in the design of bastions and outworks.

While the batteries of the first parallel were in action, communication trenches were pushed forward and a SECOND PARALLEL dug to contain further batteries. Further trenches, becoming increasingly oblique as they neared the main line of defence, would now reach the bottom of the glacis where the final THIRD PARALLEL would be dug from angle to angle. Then the approaches towards the first outwork or Chemin Couvert would commence and when this was reached a trench would be swiftly dug along it to hold the enemy guns which would start devavstating the second series of outworks. In view of this refined method of attack, it is not surprising that the fortifications of Malta reached a peak-point of sophisticated design with each and every element carefully planned as in a game of chess to anticipate each and every of the above moves adopted by any potential aggressor. Perhaps the finest example of an elaborate series of outworks devised to resist such forms of attack occurs at Floriana where a propecting HORNWORK was designed by the engineer Floriani to dominate the dangerous access through Braxia Valley on one side and the Grand Harbour on the other. The military engineers who designed the Harbour fortifications repeatedly stressed the important role of the outworks in their numerous reports, for, realizing that a fortress could hold out only until a breach had been made in its main line of defence, their main objective was to delay this crucial event as long as was possible by means of outworks positioned in and beyond the moat, always projecting outwards to an extent which seems to have been only limited by the size of the available budget. For the further the outworks stretched in front of the inner line, the further back the enemy would have to draw his First Parallel and the more breaches he would have to make before he could finally come to grips, after a long and tedious siege, with the core of the defence centred behind the parapet walls of the rampart. At the same time, the outworks had to be so planned so that they could be flanked and supported by the walls behind and beside them as any face not properly covered by supporting fire would

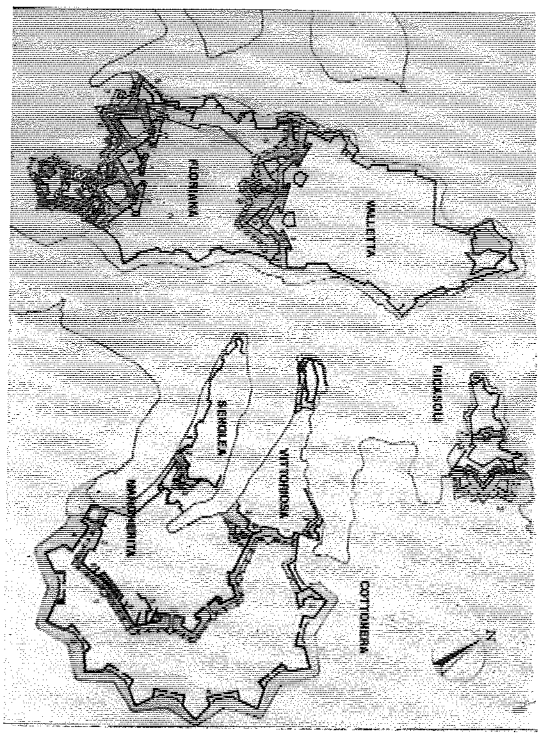


Typical 18th Century fortifications system on which Fort Manoel is based.

be chosen by a capable enemy engineer as a weak point of defence. But it was not enough to support the outworks from within; they had to be so designed so that if captured they could be at once swept by fire from above or blown up from below — this explains the lack of parapet walls behind the Chemin-Couverts, Ravelins and Demilunes of the Malta harbour fortifications, and the presence of an elaborate system of underground tunnels under the major fortifications. Considering the great amount of care taken in their design, it is indeed a pity that the vast fortification network created by the Knights was never tested in action after its completion. Had it been used to resist Napolean's landing in June 1798, the course of Maltese history could have been very different.

Coastal Defences:

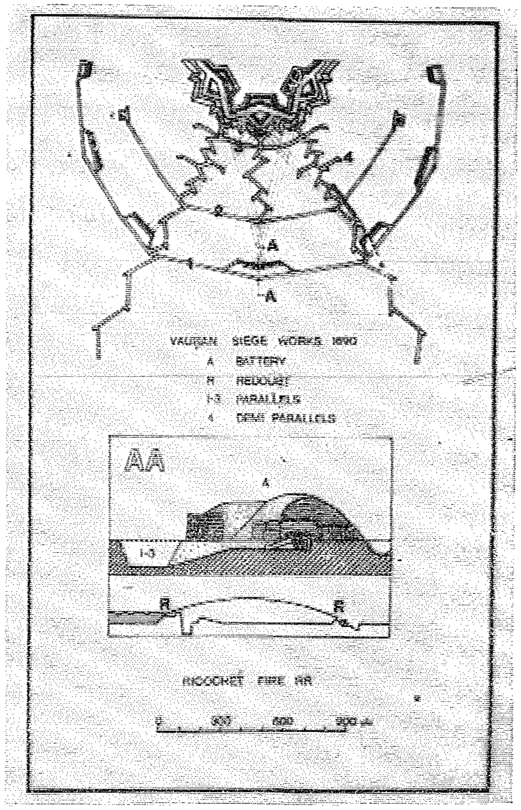
The idea of defending Malta's vulnerable **coastline** originated in the early 17th century, was developed in the mid 17th and finally elabroated in the 18th century. In fact in the early years of the 17th century, Grandmaster Wignacourt ordered the building of several coastal forts based on the prototype erected at St. Paul's Bay. Other forts built between 1610 and 1620 included St. Lucian (1610), St. Thomas (1614) and St. Mary on Comino (1618).[9] Towards the middle of the 17th century, Grandmasters Lascaris and De Redin decided to built a number of subsidiary structures which took the form of look-out towers, the prototype of which was designed by the Order's French Engineer Blondel des Croisettes, who also seems to have originated the whole idea of building these towers. An early example is the Mġarr Ix-Xini in Gozo (1685) while later examples are the Delimara Tower of the late 17th century and the Vincenti tower at Mqabba dating to 1726. On the 28th December 1714, the Council of the Order decided to strengthen the network of forts and towers by means of further defences consisting of batteries, redouts and entrenchments. The documents[10] show that by June 1715 several batteries had been constructed and a master plan for the fortification of the entire Maltese coastline drawn up. It appears that the driving force behind this battery building spree was the Grand Prior of France, the prince of Vendosme who was encouraged to do so by the King of France, the latter going as far as to examine the plans and send over to Malta a number of French Engineers specially trained in coastal defence strategy. The period of Grand-Master Vilhena saw a further improvement of the coastal defences by the building of several redoubts of the Ramla type (1722) in Gozo and defensive entrenchments. In 1722, the Prince of Vendosme devised a number of important projects for communication roads[11] linking the main Maritime defences and in 1723, a project for throwing large stones into the sea at Gozo's more accesible bays was started with the hope that if hostile ships should try to disembark troops, their bottoms would be torn off. Between 1724 and 1730 several entrenchments were also built along the great fault.[12] The apex of the coastal defence programme begun in 1714 was reached in the 1760's with the introduction of the fougasse and the construction of a number of low lying walls and rock-cut ditches linking the various batteries and redoubts defending the bays. But, because of mounting political unrest and financial difficulties, the master plan which was drawn up for the purpose was shelved and the coastal defences as they stood at the time of Napoleon's landing were but a shadow of what they were originally devised to be by the Order.



Harbour fortifications in the 18th century.

New Developments:

The introduction of batteries, redoubts and entrenchments into Malta in the 18th century was of considerable military importance for in contrast to the conventional harbour fortications, these were in 1715 viewed as Avant-Garde structures which were still in an experimental stage of development. Coastal **batteries** devised for Malta usually took the form of rectangular, half moon, star-shaped or circular structures with four to eight artillery units depending on the size of the available space and the importance or otherwse, of the place they were defending. While circular batteries were considered to defend narrow peninsulas, long stretches of beach were reckoned to be more effectively protected by means of rectangular batteries surrounded by a shallow ditch. **Redoubts** were less ambitious rectangular or angled structures which together with gun-powder magazines and entrenchments were meant to protect relatively straight stretches of beach; Contemporary documents show that they could either be open to the sky or roofed — reports by their architects indicate that in the latter case their casemate form of design involved careful consideration with regards to ventilation as in the heat of action their narrow enclosure tended to be filled with fumes and smoke with the consequence that the gunners inside could neither see nor breathe. Another defect of casemated redoubts was that their gun openings were easy marks for close range enemy fire. In the 1760's it became common to integrate redoubts with various forms of entrenchments which consisted in low lengths of stone walling with a parapet and gun openings, modelled in such a way as to imitate the trace of the harbour fortifications but on a miniature scale. Supported by redoubts and batteries, these entrenchments were reckoned to perform very effectively if properly linked by a road system for the easy movement of troops and armaments but, on the other hand, they demanded huge reserves of man-power and weaponry which were very far removed from the actual resources of 18th century Malta.



Typical 18th century Siege Works

The completed system of Harbour and Coastal fortification that was worked out in the course of three centuries by the architect-engineers of the Order, was viewed by contemporaries as a splendid manifestation of power underlining, despite the great demands on technical know-how and the prodigious sums of money involved, the absolute power of the Grandmasters enclosed within the defensive boundaries of Valletta. In so far as the civil population was concerned, the fortifications provided security, employment and an orderly form of town-planning which, in the case of the harbour cities, assumed a purely geometrc rectangular form echoing clearly and loudly the Renaissance ideal of a life-style that could be confined within Rational schemes of which the fortifications symbolised the boundaries-rigid, inflexible and eternally fixed. As such, these masterpieces of a lost art, constitute a tribute to the architects who designed them, the labourers who built them and to the magnificent Princes who financed them.

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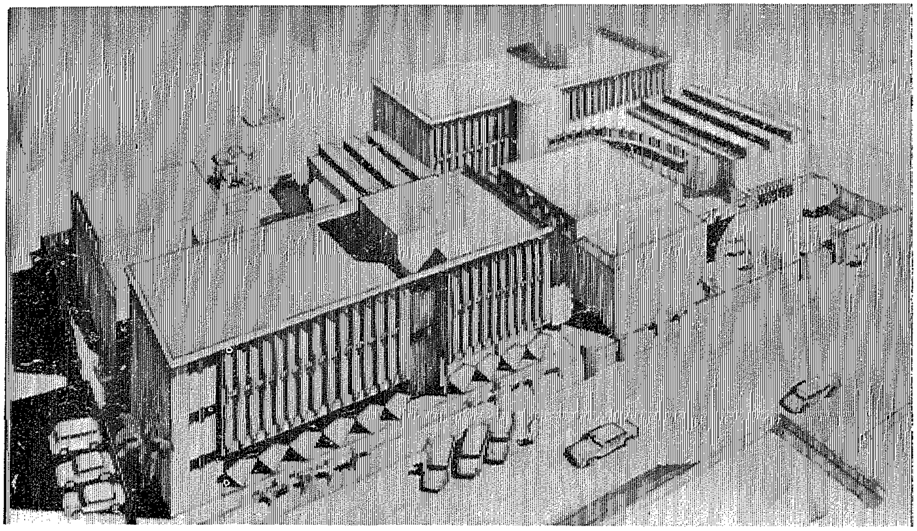
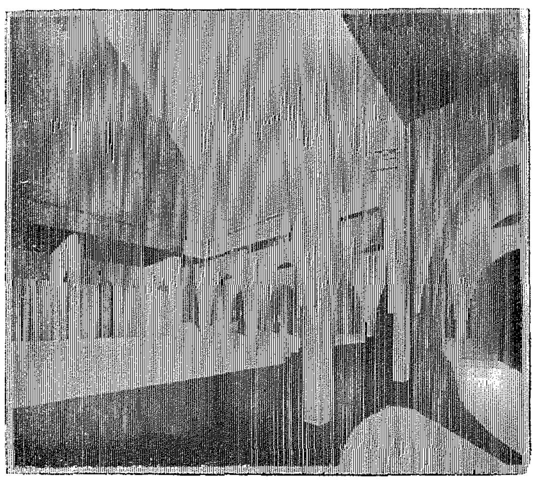


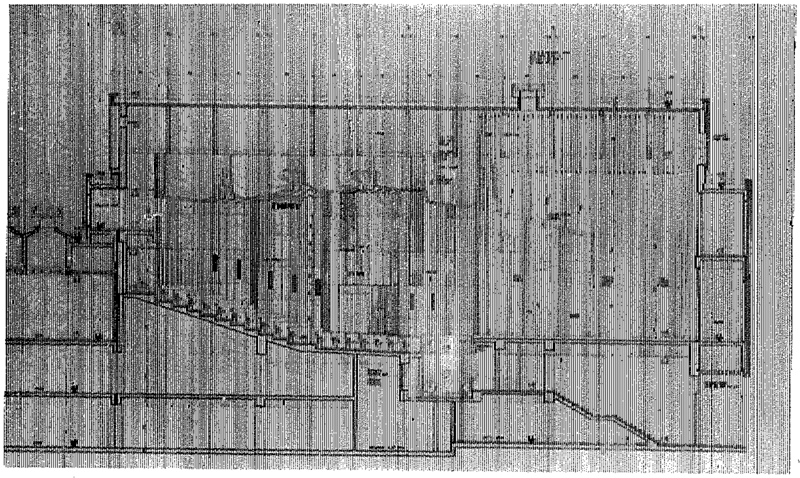
Malt Consult Internatonal, previously Malta Consult International, was founded in February, 1976, as a multi-disciplinary firm of Consultants. A mixed compliment of architects, engineers, quantity surveyors and cost consultants were recruited to start work on projects overseas. Three departments were set up, namely Architecture, Structural Engineering and Quantity Surveying. These operated in close liason with each other and by virtue of their set-up were required to become familiar with codes of practices, regulations and requirements at international level. The staff began to acquire the necessary experience as the various programmes demanding knowledge of building ~~operation~~ in different countries were being tackled.

The first project which was taken in hand was the detailed design for a large Mosque forming part of a big complex in the city of Taif in Saudi Arabia. The firm did all the production and executive drawings for this building which was designed by Sir Leslie Martin of Cambridge, England. Immediately after the completion of this project, work was started on another Sir Leslie Martin's design which concerned the construction of a big complex of soldiers' housing known as the Royal Guards project, Taif. Concurrently with this project the firm also carried out a design for a school complex in Riyadh. This was done from concept stage to production drawing stage, which meant that all the design work and drawings

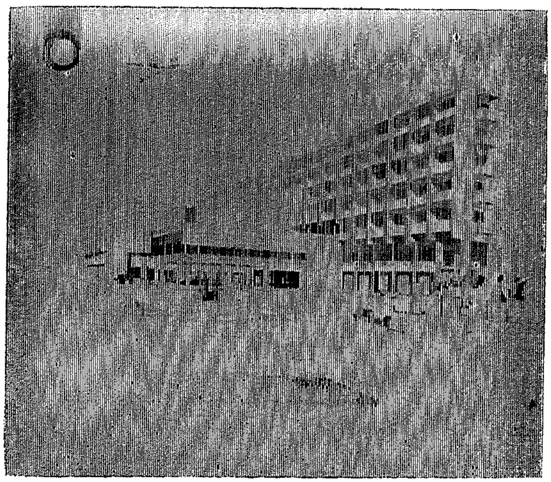


were carried out in the firm's offices. Another project which was carried out from concept stage to production drawing stage was a housing project with several amenities like recreation centre, fifty bed hospital, school etc for a 2000 strong security force for the city of Mecca. This work was the firm's first experience in the design of precast buildings and was carried out successfully in a relatively short period. These projects were intended for

to about 400 drawings AO size. The complex included two major halls with a large amount of other supporting accommodation. The project also included the design of seven storey high apartment buildings, a museum and restaurant. All this work had to be done within the short period of seven months, with a staff of about fifty. The work, therefore, involved a great deal of organisation and consultations and the firm is proud to have completed this



a country which has a rather harsh climate and the design involved careful consideration of the prevailing climatic conditions. This consideration based on proper research ensured solutions which were acceptable and workable. The largest job, however, handled so far in the firm's offices was a Conference complex for the city of Jeddah. The preliminary design was done by a firm of German architects Hentrich-Pltschningg and Partner. Our firm did production drawings, which together amounted



work to the complete satisfaction of the clients.

Apart from the large jobs the staff of Malt Consult in the past three years has also handled a number of small but specialized jobs at the design stage like an Ear Nose and Throat Clinic, a Polytechnic of Engineering Sciences, two hotels and other buildings. Several housing schemes were also designed in which the emphasis on design creativity was combined with structural solutions that incorporated in situ and precast construction.

All the projects prepared by the firm are presented in the form of clearly classified and accurately detailed drawings accompanied by the necessary annotations and specification documents drawn up by the Quantity Surveying Department.

Presently the firm is working on tentative projects for the new city of Jubail but it already has prospects of confirming these projects which it is hoped will be taken in hand shortly.

Malt Consult International is presently managed by Carm. Lino Spiteri B.Eng. & Arch., D.I.C. (Lond), C.Eng., F.R.S.H., F.I.P.H.E., A.M.I.W.P.C., M.P. and Godfrey Azzopardi B.Sc., B.Eng. & Arch., D.I.C. (Lond), C.Eng., F.I.C.E., F.I.Struct.E

Liquid Wastes Recycling

JOE DEGAETANO

Introduction

The recycling of waste water in one form or another has been practised the whole world over

Communities discharge their sewage with various degrees of treatment into receiving waters which dilute the effluent, normally a number of times, while in other instances, as in years of drought, with little dilution. Further downstream other communities withdraw this water and after treatment is distributed for domestic use and other uses. Thus one hears that the water of some of the largest rivers like the Mississippi is used twenty times or more by the time it reaches the mouth.

The need for recycling arises from various reasons and the method and degree of treatment depends on the use to be made, that is whether the reclaimed water is used for irrigation, industry recreational and directly or indirectly for domestic use.

Application of this knowledge to Malta will be discussed as well as the benefits accruing from such recycling.

Some ideas for the future will conclude this paper.

Need for Recycling.

The demand for water brought about by increase in domestic use, agriculture and industry and for recreational purposes has created a situation in water shortage areas which is overriding natural resources. The Middle East, North and South Africa and the Western States of America are examples from three continents where the need arose to reclaim waste water in order to:

i) **augment natural resources:** Reclaimed sewage in the form of purified effluent provides a regular source of supply not subject to climatic or meterological conditions. Moreover effluent can be purified to various degrees according to requirements.

ii) **provide a new source which is economiclly acceptable:** In arid or semi-arid regions because of scanty resources, the tendency is to turn to desalination of sea water because of unlimitied availability of supply. However, the cost of producing fresh water by desalination has always been very high and since the price of fossil fuel rose dramatically a few years ago it makes the cost of production even higher in a large majority of cases even in dual purpose schemes like water/power production. Reclamation on the other hand should become an economic proposition within the foreseeable future: The problem is not so much a public health one but the difficulty of removing industrial wastes by a cheap process.

iii) **Prevent or abate pollution:** Mention has been made of industrial wastes. Some of these are toxic and are not easily removed by conventional water works treatment if the source is a river. By the reclamation of liquid wastse these pollutants are removed.

Sewage outfalls unless properly designed and constructed are a serious source of pollution is, precisely the removal of industrial polgether to try to solve this problem before it is too late: Hence the Mediterranean Action Plan now being put into operation by UNEP, a United Nations Agency. The long term solutions is, precisely the removal of industrial pollutants and the proper design of outfalls to discharge only domestic sewage after some preliminary treatment and better still by the reclamation of liquid wastes.

Treatment and use of reclaimed liquid wastes:

The conventional method of full treatment of sewage consists of:

Primary treatment:

— Screening

— sand and grit removal, (this removes non-organic and heavy solids)

— primary sedimentation, (this removes settleable organic solids in the form of sludge which is then treated seperately by digestion).

Secondary treatment:

— biological treatment of the settled liquor in trickling filters or by an activated sludge process. (This achieves over 90%

bacterial kill by the agency of micro-organisms in the presence of oxygen).

Final Treatment:

— final sedimentation of the clarified effluent, (this settles surplus activated sludge produced by the biological process and not utilised as seed for the biological process itself).

Full treatment of sewage produces a purified and clear effluent with little suspended solids. More advanced treatment can follow depending on the use to be made e.g. irrigation, industry, domestic and other uses, some of which will be mentioned below.

(i) **Irrigation:** Normally it is safe to provide chlorination to an effluent from secondary treatment and utilize it for restricted cropping e.g. to grow fodder crops, vegetables which are not eaten raw and fruit provided no spray irrigation is practised. Appropriate legislation exists in countries using effluent for this purpose in order to safeguard public health.

If the original water contains mineral salts, the salinity which is not reduced by biological agencies in the purification process, is retained in the effluent and so salt tolerant crops and fruit must be grown. Knowledge of the soil itself is imperative in order to ensure that its structure is not impaired by irrigation with an effluent which may have high salinity especially sodium salts. Boron which is so essential for plant growth, may also be harmful to plants when it is present in the effluent in excess of about 1mg/litre.

(ii) **Industry:** Industry can reduce its water consumption by recycling process water within the industry itself and by the use of reclaimed waste water. Two thirds of the total demand for industrial water is required for cooling purposes such as power stations, oil refineries and the petrochemical and steel industries and so on. For power station cooling the major problem is control of pH, alkalinity and the nitrogen/phosphorous relationship: a further problem is biological fouling as a result of excessive growth of bacteria, fungi and algae which however can be controlled by chlorination. Other uses are in the pulp and paper industry where large quantities of purified effluent from secondary treatment may be utilized after only limited tertiary treatment by sand filtration and low level chlorination. Paper of high brightness requires further treatment to remove heavy metals and organics completely.

(iii) **Domestic:** If it were not for psychological, aesthetic and taste values, which are not a public health consideration, effluent from secondary treatment after further treatment by physico-chemical processes could be produced as potable water direct from advanced treatment plant. Such has been the progress in this field that Lake Tahoe in California is an artificial lake whose waters, used for recreational purposes consists of reclaimed sewage. In Pretoria, S. Africa, after a visit to an advanced sewage treatment plant, one is given to drink a glass of renovated water by Dr. Stander, the designer of the plant.

Psychological and other fears may be allayed if effluent from secondary treatment after advanced treatment(*) is recharged into an aquifer, provided of course the hydrological performance of the aquifer itself is known.

Recharge of renovated water in a sandy soil and gravel subsoil does not present the same hydrological difficulties as recharge in rock with its faults and fissures.

Provided there is sufficient detention times and also the minimum of loss of effluent as groundwater flow into the sea, recharging with renovated water may be carried out with success.

However, because of technical considerations and the constraints mentioned above, such artificial recharge should be carried out in no less than two stages. Let us say, first an advanced treatment plant of about 2300 cu.m/day. This would operate for a few years before a final 'go-ahead' decision is taken to implement a full scale scheme.

Application for Malta:

Water for domestic and touristic, industrial and agricultural use is largely ground water which is supplemented by four sea water distillers, (capacity, 4550 cu.m/distiller/day).

Present ground water production, public and private exceeds 23mill.cu.m per annum, (population 309,000) and has reached the safe yield of the aquifers.

(*) Advanced treatment may include all or most of the following processes:

Denitrification for nitrate removal; chemical precipitation by excess lime process to remove residual suspended solids, some heavy metals and toxic elements as well as bacteria and viruses sand filtration to further improve water quality; chlorination; activated carbon filtration to remove any residual colour, taste, odour and turbidity. All pathogens are completely inactivated by advanced treatment.

No additional water is available for agriculture which has less than 10% of land under irrigation. Agriculture must have the necessary water and investment in seawater desalination for agriculture is prohibitive and so the need has long been recommended to recycle waste water(*). Effluent from a secondary sewage treatment plant may successfully be utilized for irrigation after ensuring that the quality of the effluent will not impair the soil, soil products and any water bearing strata beneath. In this respect, irrigation area will be outside water catchment areas. Health requirements are also to be satisfied: hazards to farmers and to the public will be overcome by chlorination with sufficient contact time, by irrigation methods, and the exclusion of a number of crops chiefly those eaten raw from cropping patterns. All these restrictions will be embodied in appropriate legislation.

Industrial wastes do not as yet seriously affect biological treatment processes, but legislation will have to be enacted to control their quantity and composition prior to discharge into the sewer network to safeguard workers, sewer fabric, biological processes for agricultural and other uses and also discharge through sea outfalls.

Plans are going ahead to realise an integrated scheme whereby not only liquid but also solid wastes will be reclaimed for agriculture.

The benefit to agriculture from the integrated scheme are appreciable.

— Purified effluent alone would be available at the time of maximum crop requirements.

— as a source of water supply, the effluent with its fertilising constituents of nitrogen, phosphate and potash would provide crops with most of their nutrient need.

— land irrigated with purified effluent gives consistently higher yields than that receiving natural water plus organic fertilisers. Such results are attributed to the fact that with effluent irrigation plants receive nutrients at regular doses throughout the growing season and not just at the begining.

— from the employment angle, labour required on irrigated land is some three times that on dry land.

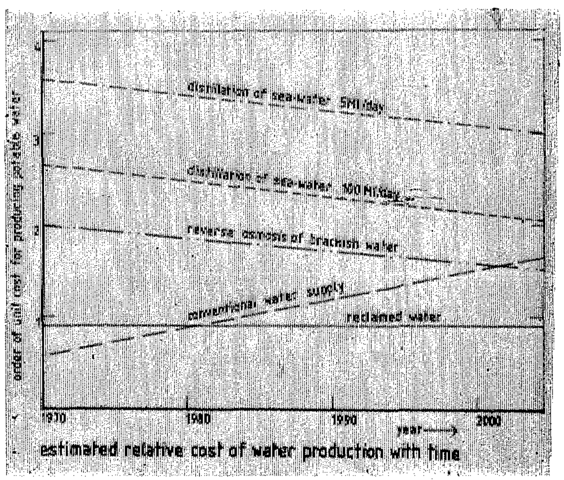
— income from land thus irrigated is also about three times as high as that from dry farming.

— some reduction in imported fertilizers will result.

Other benefits from the integrated scheme come from compost which is a nutrient source albeit to a rather limited degree, a soil conditioner and a plant rooting medium.

In reclaiming sewage for irrigation one finds that agriculture does not need water during the winter months which means that unless reclaimed water is stored or utilised in winter for some other purpose it would make the real cost of reclaimed irrigation water higher than what the farmer can reasonably be expected to pay. If industry is to use the surplus effluent in winter it must have the renovated water throughout the year: investigations are in progress to determine the maximum use of the effluent.

A long term solution would be to utilise renovated water during the winter months for recharging the lower table, (mean sea level) water bearing strata. This, although more costly than direct supply for domestic use would not allay any psychological fears but simulate what has been done for centuries on end by nature i.e. by rainfall infiltration into the aquifers. The renovated water, besides being given the advanced treatment methods mentioned earlier would have to be demineralised by say reverse osmosis in order that in recycling the



Trend in Relative Costs

(*)Following some remidial measures in the sewer network to be carried out in localities subject to sea water infiltration, the amount of sewage with an acceptable limit of salinity, (taking into consideration the favourable winter leaching effects of local soils), of about 1000 p.p.m Cl-, will be of the order of 16,000 cu.m./day. This will double the present area under irrigation.

salinity of the aquifer water is not impaired. This would also maximise the use of reclaimed effluent. Moreover the annual operation and maintenance costs of such a combined scheme, (cheap water for agriculture in summer and costly water for recharge in winter), would be much less than that for water produced from sea-water deslination.

Some ideas for the future:

Natural water resources are limited, therefore increased used of renovated waters in future will not only be practised in arid or semi arid regions.

This will be determined from economic aspects of the cost of transport of water from far away sources.

The biggest industry in the world is water because more water, tonnagewise, is carried by pipelines than any other industry, including steel.

Of course there is desalination but let us consider whether it is less costly and easier to remove 2 tons of suspended and dissolved matter from every 4500 cu.m (1 mill. galls) of sewage to obtain pure water than to remove from sea water 125 tons of highly soluble, (mostly sodium Chloride) matter to obtain the same 4500 cu.m of pure water: The accompanying figure shows the trend in relative costs.

Waste water fortunately lends itself to recycling and effluents should be stripped of their pollutants. So future domestic and industrial wastes will be separated and treated at source, the former directly for potable uses.

In fact the new policy of the Environment Protection Agency — USA aims at zero discharge of pollutants by industry and municipalities which means 100% recycling of waste water.

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(continued from page 7)

These unit boxes were used mainly in Finland and West Germany, but lately they were being planned for Portugal, for Middle East countries, for Saudi Arabia, with regards to housing standards, room layout, living habits and the traffic pattern of an islamic culture. With the unit box system all these functions can be easily satisfied. The climatic problems in these countries are the heat and the radiation of the sun. Thanks to the massive concrete construction of the box unit these difficulties are overcome and the temperature inside the house is very comfortable. Direct sunlight into the rooms is avoided by locating the houses in such a way that openings are facing south and north only, with part of the box forming a small cantilever to shelter the openings.

There are many possibilities for the use of basic Box Units by combining them with prefabricated wooden roofs and walls. The installation and construction time is very short; the erection on site takes only a few days. The owner can choose the degree of completion which leaves ample scope for saving for the do-it-yourself enthusiast.

In West Germany, the leading North German precast concrete manufacturer **Max Giese** started the manufacture of Box Units as an integral part of his extensive construction programme in the summer of 1977. The Box Units production line was installed in the existing factory biulding. The more important item of Box Unit machinery was supplied from Finland and designed and manufactured by LOHJA AB.

In Finland, in 1976, the Lohja Box Units were awarded in an architectural and economic competition. They built high class two storey apartments each having a balcony and a sheltered courtyard. The structural simplicity and the clean form of the units harmonize well with the environment. The result is a pleasant housing area on a human scale.

With the unit system, building construction companies are solving environmental problems by doing the construction work in factories and fitting the elements on the building site.

In the most developed countries more than 50% of all construction work is done inside factories and less than 50% on the building site. This has a big influence on the workers productivity, the time necessary to do the job and above all, the building costs are very competitive.

The opponents of prefabrication are mentioning some difficulties in using prefabricated elements, mainly Box Units seem to be the problem. We are planning a life of a house as 80 to 100 years, but the fashions are changing every 20 to 25 years. This really means a lot of modification problems, mainly changes of partition walls inside the building, etc. But this argument cannot overcome the advantages of the prefabrication method, which has industrialised building construction work on a broad and efficient basis.

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Vittoriosa

the growth of a city

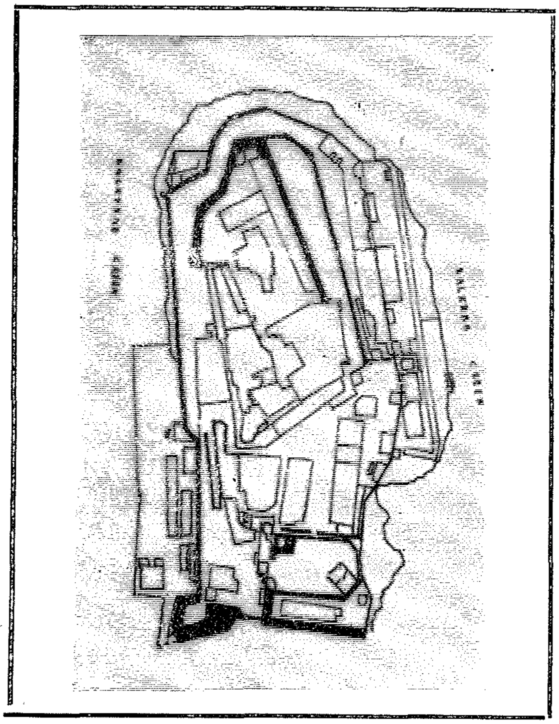
CHARLES BUHAGIAR

Vittoriosa is situated on the peninsula at the entrance of the Grand Harbour on a site once known as "Ta' Hammuna" between Cospicua and Kalkara. Due to its strategic position, the tip of the peninsula has always been fortified from time immemorial. And around such fortifications grew up the town of Vittoriosa.

Today, at the tip of the peninsula, stands Fort St. Angelo. However, in the times when man was more fascinated with mysticism than by military might, in the time of the Phoenicians (14th — 15th century B.C.), a temple had stood on the top of the promontory dedicated to Juno. As it was then the general custom never to leave temples isolated, it follows that there must have been some dwellings in the immediate vicinity to house the officiating priests, the people and foreign visitors who came to Malta to worship the temple. In this way Vittoriosa was born.

It is with the advent of the Romans that we first know what this town was called for according to Cicero,"... the town was called Melita as the Island itself".

However it was the Arabs who first built a small castle here, later to become known as the "Castello a Mare" or "a Rocca", to protect the Port of Galleys, now known as Dockyard Creek. The date of this building is very uncertain, the estimates ranging from 828 A.D. to 973 A.D. It is thought that in the time between the fall of the Roman Empire and the advent of the Arabs, the temple was destroyed and stones obtained from it were subsequently used in the build'ng of the fort. In the course of time, a suburb or fishing village grew up close to the Castle in the harbour and in later years was named il Borgo del Castello or il



Plan of Fort St. Angelo

Borgo. There are two different versions explaining the derivation of the name, "Birgu": Profs. A.P. Vella says that Birgu is derived from the Greek word, "Pyrgos" that means a small town near the sea, built behind a castle while Profs. J.J. Aquilina explains that Birgu is derived from low Latin "Burgus", used for Germanic burgs.

Count Roger expelled the saracens from these islands in 1090. The fort was taken over by a Norman garrison and the defences were strenghtened but nothing is known of the work carried out. Durig the Angevin domination (1266 — 1284) this castle consisted of interior and exterior works, the former behind the church of St. Mary and the latter in front of the church of St. Angelo. It was referred to as "Castrum Malte" or "Castrum Maris" to distinguish it from the other tower inside the town known as the "Castello della Citta" which was pulled down in 1445.

It is during this time that il Borgo started to expand so that up to the time of the arrival of the Knights it had a population of 4,000 inhabitants and a parish church which was 500 years old. The reasons for such an expansion are many; it was the only place in the South Eastern part of Malta which provided shelter for the inhabitants during frequent corsair raids while its position made it the centre of all maritime activity. The parish chuch at that time was known as "San Lorenzo a Mare" the reason being that Count Roger had routed the Arabs on the eve of the feast of St. Lawrence. Besides this church, at this time, there must have been another Church, which was later on, given to the care of the Dominican Friars — this church was known as the Annunciation Chapel. Unfortunately, since Vittoriosa has been a low class residential area it generally suffered neglect because its inhabitants had little or no interest in preserving its monuments. They always adjusted their daily lives at the expense of their building so that no authentic building dating to this period i.e. 1090 — 1530, remains.

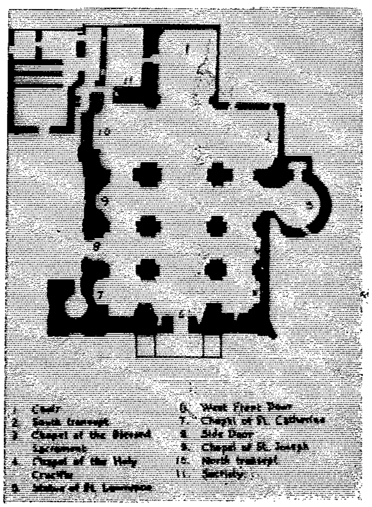
In the meantime the name of the fort 'Castello a Mare' was changed to Castel Sant' Angelo. Various theories were proposed to explain this: however the most fovoured one according to Lieutenant Commander Matthews is "it gained its name from that of Count Angelo de Melfi, governor of the island in 1352, since it was the custom at that time to dedicate churches, palaces, etc., to the patron or name of Saint of the owner or builder." Various Castellans reigned in St. Angelo sometimes even defying the Universita, at the time the government of Malta, which resided at Mdina. Hence with the arrival of the Order we find that the Castellan rule came to an end and the last Castellan "de Nava" was pensioned off with 100 ounces of gold annually.

To recapitulate, in about 1530, the peninsula, which later on was to be the site of the town of Vittoriosa, as we know it today, consisted of the fort of St. Angelo at its tip while the town itself was a conglomeration of close packed single or two-storied houses clustered along the water's edge and beneath the walls of the small fortress. All the houses had flat roofs, a feature which remains up to this day, almost unique to the island of Malta, in the whole of Europe. One still find traces of Arab influence in the layout of the city's old houses. The town was formed of narrow, twisting streets, similar to many towns of the Greek islands. To facilitate its defence, all streets ultimately led into the town square where the Castello della Citta was situated. Hence any marauders would, somehow or other finish beneath the walls of this tower. These streets were relieved from monotony by palaces which belonged to the wealthy merchants and such monumental buildings as the church of St. Lawrence, the chapel of the Annunciation and other chapels and the Castello della Citta itself. Although the population of the town numbered about 4,000, the town also catered for the surrounding hamlets, since the other two towns of Cospicua and Senglea which today, together with Borgo form the Cottonera, were, as yet, barely in their infancy.

On the 23rd March, 1530, Emperor Charles V of Spain signed away the ownership of the Maltese islands to the Knights of the Order of St. John of Jerusalem. At the time, the govern-ship of the Castle was in the hands of Castellan de Nava. The de Navas had built on the top of the rock, a palace as their dwelling and a chapel for private worship, named St. Anne, as it is today. On the 26th October, 1530, de L'Isle Adam, Grand Master of the Order, arrived in Malta and took up his residence in the palace of the de Navas in fort St. Angelo. It was during the reign of the Order ie. 1530 — 1798, that the town of Vittoriosa reached its zenith.

The Knights did not change, basically, the format of the town plan but what they did according to Bosio, "The city and the Castell di Malta were very poorly equipped with artillery and munitions and the dwellings unfit for occupation. L-Isle Adam despatched provisions, workmen and material to repair the buildings and strenghten the fortifications of Borgo... At the time there were several dwellings in the Borgo (by this Bosio probably meant big dwellings which belonged to the merchants and not the hovels of fishermen), but insufficient to contain such a multitude of newcomers and the majority had to settle down in tents. It was only possible, though with great difficulty, to find room for the hospital, auberges and the rest of the Convent that could not be housed at the Castle".

Since L'Isle Adam took up his residence in the castle, in the house of the Castellan, this was one of the first buildings to undergo reconstruction, and was turned into a Magistral Palace. We know very little of its original plan for this was changed during the British Occupation when it was called the "Captain's House". Thus the present entrance and drawing room, probably had formed the Council Chamber. The most magnificent feature of this palace is the beauty of its double windows adorned wth "Fat" or "Melitan" mouldings which are bulbous shaped mouldings usually in the form of a triple roll placed around doors and windows or used for canopies of cornices, uniquely in Malta. L'Isle Adam also laid out gardens in which he built a sort of summer house or grotto, known as the, "Nymphaeum". It was La Vallette who built a new Magistral Palace at the Borgo, while, with the removal of the convent to Valletta in March 1571, the old Magistral Palace was occupied by the governor of the Castle up to 1798. The Magistral Palace in the Borgo became known as the Governor's Palace, which however, was destroyed during the last war and its remains pulled down in 1950 to make way for a modern building.

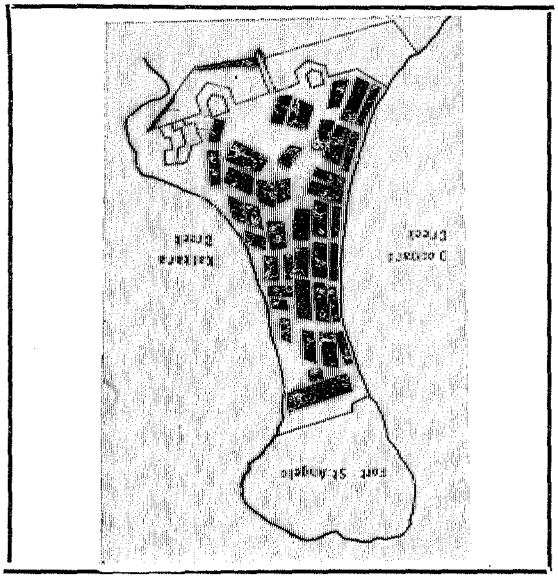


Plan of St. Lawrence Church

On the 8th November, 1530, the Church of San Lorenzo a Mare was taken over at the annual rate of twenty scudi and served as the Conventual church of the Order up to 1571. This church is one of the best preserved monuments in the Borgo and as such deserves a fuller description. The church as we know it today is that rebuilt from the design of Lorenzo Gafa in 1681. However it was first established as a parish in 1090; this church was demolished in 1508 to make way for a more spacious one, probably in Siculo-Norman style: It suffered great damage caused by a fire on Easter Monday, April 1, 1532. Without delay the rebuilding of the church was taken in hand. Important modifications included placing the roof slightly higher and building an adjoining sacristy and cemetry. The church was enlarged and endowned with a new cupola in 1581; this was followed by the renewing of its apse in 1586, the enlarging of the choir and rebuilding of the facade in 1620.

The church of St. Lawrence has the usual Latin Cross plan with three bays to the nave and a portion of a bay added at the west end to accomodate the galleries. On the south side there are two sacred chapels which lead into the south aisle. Buildings are placed along the whole length of this side, but on the north wall there is a side door opening into a small square with the oratory of the Holy Crucifix (1720) on one side and the eighteenth century church of St. Joseph closing the inland side and touching the north transept of the parish church. The whole site is restricted and steps climb up from the water's edge to the west front of St. Lawrence. The dome of St. Lawrence was damaged in 1942 and had to be pulled down — a great loss, for Gafa excelled in the design of domes. Besides the Chapter Hall and Sacristy were also razed to the ground in 1941. It took more than a decade to set all these damages to right again. The facade, because of the site, is raised on a high plinth and approached by a flight of steps. It is a powerful sturdy, facade with coupled Corinthian pilasters on the lower order and block like slabs of pilasters above. The centerpiece is linked to the wings with Vignola scrolls and the church has two squat towers — a monumental facade siuted to the parish church of the militant city of Birgu.

Having talked about the seats of power, both spiritual and temporal, one cannot but talk about the building in which justice was executed in these powers. The Order had its civil courts, from its arrival in 1530 till its transference to Valletta in 1571, in what is now known as the Inquisitor's Palace, then known as the "Castellania", situated in the principal road of the city. In 1574 the Order allocated this place to the Inquisition who later constructed the Palace around it — of the old Palace only the Siculo-Norman courtyard is left. The palace was enlarged to its present size in 1767. The exterior bears a Renessaince style of architecture; the facade has suffered considerable damage during World War II but fortunately the rather complicated interior remained intact. The building can be divided into two parts; the part which consisted of the rooms used by the inquisition for its functions ie. the prisons, cell and communal cells and the courtroom, and the other part of the building used privately by the inquisitor ie. his private quarters, the office, the chancery hall, the private chapel and what is known as Inquisitor Ruffo apartment.



Plan of Borgo

Of course such an influx of people all at one time created housing problems so that Grand Master L'Isle Adam set up a commission to deal specifically with such problems. Nicolo Falveri, an Italian architect who came to Malta along with the Knights assisted in these housing projects, while three years later, in 1533, he was joined by Matteo Cagliaturi and Evangelista Menga. All the buildings of the Knights were enclosed in a part of the town reserved for themselves termed, "Collocchio". Hence one finds the Auberge of the English Langue and the adjoining Chaplain's residence which were spared from the aerial bombing of World War II and are now privately owned; the Auberge of the French Langue in Strada Brittanica attribuited to Menga, while adjoining it there is the Auberge of the other two French Langues, Auvergne and Provence; the German Langue had its Auberge in the main square next to which was the Greek Parish Church, now demolished (1832) and the Italian Auberge in St. Lawrence street facing Senglea. All the Auberges which were not damaged during World War II are private property.

Other buildings constructed by the Knights were the Holy Infirmary, started in 1532 and finished at the end of year 1533, on a rectangular plot measuring a little more than two thirds of an acre and bounded by Strada St. Scholastica and Strada Miratore — it ceased to exist as such in 1574 while in 1652 the nuns of St. Scholastica moved in and changed it into their convent adding the adjoining chapel designed by Lorenzo Gafa in 1679, which remains intact up to this day. The Knights also constructed the Arms Depot or "Armeria" which then served as a British Naval Hospital in 1880 and lately as the Government Elementary School.

Due to all these buildings being erected at the same time the Borgo became known as "La Citta Nuova" and after the victory over the Turks in 1565 as "La Citta Vittoriosa". Other buildings dating to this period are the various palaces belonging to the distinguished Maltese families, the Palace of the Bishop, the Palace of the Universita, the old prison building which was destroyed in 1903 and replaced by a tennis court, various churches such as the old Annunciation Chapel, St. Anthony, Monserrat, St. Philip and the Carmelite churches, some of which were destroyed and never replaced.

To recapitulate, up till 1800 (the French occupation made no difference to the city of Vittoriosa) one would find a city based on a Medieval plan, embellished with the various palaces and churches and containing such features as the old residential quarters where the paupers lived (pulled down during the O'Farrell governorship) and the Jews Ghetto in Old Governor's Palace street. The city had reached its peak population of 5,000 inhabitants and was strongly fortified with fort St. Angelo at its tip and strong curtain walls with projecting bastions on the landward side ,thus forming an isolated citadel. Later on these defences were further strenghtened by the "Grunenbergh's Fortifications" and Vittoriosa was further sheltered by the construction of the Cottonera lines around the three cities.

Since the British converted fort St. Angelo into a naval base, most alterations during the British Occupation occured on the eastern waterfront. Hence we find the construction of the bakery building in the nineteenth century and an expansion of the Victualling Yard (which consists of a great number of warehouses) in 1819; excluding the public for a stretch of seafront from St. Angelo to the Carmelite Church by closing up the roadway and the narrow streets between the residences while the remaining part of the waterfront, except that part facing St. Lawerence Church, was taken up by the Admirality. Various buildings were also taken over by the British and their functions changed, but basically, the town plan remained unchanged.

With the advent of World War II, a lot of buildings were destroyed especially on the east side of the peninsula which adjoins the Dockyard. These were replaced by modern residential blocks whose regularity contrasts highly with the old western parts of the city. Amongst the buildings destroyed by the bombing and never replaced were the old Clock Tower in the city square and the Siculo-Norman Belfry adjoining the Dominican Church. The Church itself was also destroyed but rebuilt in 1952, the convent being finished in 1954 and the church in 1955 as designed by the Maltese architect, Edwin England Sant Fournier.

The buildings of Vittoriosa are a mirror of the history of the whole island. Unfortunately, it has been caught up in a vicious circle — since Vittoriosa is a low-income residential area people who "make it" move out and other low-income people move in. This trend had started during the Second World War, for at the time, people who could afford it left this danger area and went to live in outlying villages, such as Balzan, Lija and Rabat, never to return again. Consequently the population dropped to its present 4,300. Due to such a heavy exodus of the well-to-do, land values started to drop and pressure is building up on the authorities to demolish old biuldings and replace them by modern ones in an effort to check this slide in land values.

Vittoriosa has already lost many of its monuments through sheer ignorance and negligence, so one must sound a warning to consider any reconstruction carefully so as not to spoil this unique city in which are built more than 3,500 years of history.

Refernces.

Aquilina. J.J. .... Papers in Maltese Linguistics.

Bowermann. H.G. .... The History of Fort St. Angelo.

Camilleri. J. .... The Inquisitor's Palace.

Critien. A. .... The Borgo Holy Infirmary now St. Scholastica Convent.

Darmanin. S.F. .... The Phoenico-Graeco-Roman Temple and the Origin and Development of Fort St. Angelo.

Gabaretta. Can.Ant. .... The Church of the Grand Masters and the Inquisitors.

Quentin Hughes. .... The Building of Malta 1530 — 1795.
Fortress — Architecture and Military History in Malta.

Vella. A.P. .... Storja tal-Knisja tal-Lunzjata fil-Birgu.

Zahra. L. .... A Blend of Architecture at Vittoriosa
Fort St. Angelo — Sentinel of the Grand Harbour.
The Knights and their Buildings in Vittoriosa.

integrating architecture and engineering education

PROFS. JO TONNA

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Introduction.

Architectural practise and education in Malta developed against a very specific environmental framework. Nevertheless, they can provide some useful insights into the problem of relating the experiences of large, economically developed societies to the real needs of small island communities. The Maltese archipelago is a small, densely populated group of Mediterranean islands, which counts a superb building stone among its few resources. Building on a vigorous, even monumental scale has been going on in the islands since prehistory.

Origins of the Profession.

The origins of an architectural profession can be conveniently traced back to the mid-sixteenth century, when the military Order of the Knights of St. John first began to develop these islands as a first class military base. Before then, a vernacular construction system that cleverly exploited the possibilities of the local stone was already in existance. But the craft of building had developed in the classic pre-industrial pattern, with scarcely any differentiation between skills and roles within the trade, especially those related to design and supervisory skills.

The Knights came with articulate policies, an external flow of funds to finance them, and a well oiled bureaucratic machine to carry them out. Their arrival marked the beginning of a recurrent cycle of elaborate war preparations, followed by short destructive wars, and then by reconstruction and preparation for the next war. The building industry thrived on such preparations. Within fifty years the settlement pattern of the islands had been drastically altered, with the population centres gravitating towards the new, superbly-fortified cities around the harbours. As the scope of building expanded in scale and complexity, professional roles and institutions began to be developed.

The new administration had enough foresight to tap local know-how for their ambitious development programme. Local master masons were appointed to sit with the Order's own functionaries on the boards which were set up to oversee the building of the new cities and fortification works, as well as to regulate the industry. Top European military engineers and town planners came to Malta at frequent intervals to advise the Knights on fortifications and urban planning. The local men were thus exposed to the most advanced theories in architecture and military engineering; in turn they contributed the basic know-how to translate those principles into reality. The most gifted of them were sometimes sent abroad to acquire an academic formation of their own. One of them, Lorenzo Gafa, established his own school of architecture on his return. This was the first organised institution for professional training in this field that we know of in Malta.

In time the Knights developed a highly organised building department. At the top were two resident engineers, recruited abroad and invested as Knights on taking up their appointment. The middle echelon of the department comprised twelve chartered "Periti agrimensori" (literally, building and surveying experts) headed by a Maltese "Capomastro delle opere". The number of chartered "Periti" was regulated on a numerus clausus basis and there was great competition for these prestigious posts whenever a vacancy occured through the death or retirement of an incumbent. Applicants had, in the first place, to produce evidence of their practical experience and theoretical training; and then to subject themselves to a "viva voce" examination conducted by the "Capomastro delle opere" in the presence of other Officials of the Order. The subjects covvered were design and construction of buildings, land surveying, calculation of areas and volumes, valuation of buildings and lands and estimation of costs and time required for building. Experienced builders were often failed because they could not cope with the mathematical aspects of the examinations; or their appointment would be held in abeyance until they had taken a special course in mathematics at the University.

The concept of a "Perit" is important in the present context for it implies a range of activities extending beyond architecture proper into surveying, engineering and even law. Eighteenth century documents show that contemporary periti not only designed buildings and supervised their construction, but involved themselves in water-supply and road construction works, land surveying and valuations of buildings and landed property. This broad spectrum of professional activities developed naturally from the limited market for professional services and the low incidence of projects requiring really deep specialisation in one discipline or another.

19th and 20th Century Developments.

In 1800 the Maltese islands were taken over by the British. Like the Knights before them, the new rulers were quick to grasp the value of an existing building tradition that had developed organically around the islands' needs and resources. The professional and organisational structure developed by the Knights likewise survived practically undisturbed for the first fifty years of British rule.

In 1854 a comprehensive set of building bye-laws, obviously inspired by the British Public Health Act of 1848 was introduced. Its immediate purpose was to legislate minimum standards of lighting, ventilation, damp-proofing and sanitation of buildings; but it had several important side-effects. It was the first decisive measure to control building form through legislation. This code was subsequently amended and expanded by the 1934 act relating to "houses and drains", the 1935 Aesthetics Ordinance, intended "to ensure symmetry in buildings and preserving the amenities of the surroundings", and the 1962 planning law.

With each law the building process became progressively more enmeshed with bureaucratic procedures. The professional man began to assume the role of representing his clients in their relations with the authorities. This role is still an important one today and even more so when the literacy rate in the islands was very low. The system of professional training which had been developed under the Knights, built as it was around a long apprenticeship in the trade topped up with some very basic theoretical training, began to develop in other directions. The introduction of the building legislation was followed almost immediately by the inauguration of a course of professional studies at the Malta Lyceum, the subjects thought being Mathematics, Land Surveying, Valuation of Property and Elements of Architecture. In 1904 this course was upgraded to university level, with the first university graduates in Engineering and Architecture (BE&A) coming out in 1910. In 1915 Civil Engineering and Architecture became a faculty in their own right ie. there was one chair in Architecture and Civil Engineering — thus architecture joined medicine and law in the tight little group of professions for which a University education was a necessary qualification. In the pattern of professional education, the academic training now came first and practical experience later.

These developments were institutionalised by the enactment of the Architect's Ordinance of 1919. This laid down the completion of the university course as a necessary pre-condition for certification to practise as "Land Surveyor and Architect". In 1928 the Architect's Ordinance was amended to change the designation of "Land Surveyor and Architect" to that of "Architect and Civil Engineer". This change of nomenclature was symptomatic of the way the profession was developing, and marked the opening salvo of a debate which was to dominate the educational field for the next fifty years. Put in its simplest terms, the issue was how adequate standards in architecture and civil engineering could be achieved while still combining the two disciplines in one profession.

Many of those responsible for developing the education side maintained that it could not be done. This was subsequently proved true for both R.I.B.A. and I.C.E. turned down requests for recognition in 1937 — they asked for the combined course to be split before this request could even begin to be considered. Hence in 1947 the University began to award separate B.Arch. and B.Eng. degrees and the old BE&A course was phased out in 1956. In 1963 a completely new course in B.Sc. Civil Engineering was begun at the Polytechnic; in 1968 the five-year course in architecture, which had remained at the university was radically re-structed to conform to British models.

The Divorce between Education and Practise.

Ironically the first of these developments occured a year before independence, and the second four years after. In their high-minded quest for higher standards, the academic staff had lost sight of the fact that what was good for Britain need not necessarily be so for Malta. Education methods in Britain were the product of a specific socio-economic background and hence the reproduction of the British course structures, and their initial staffing by English expatriates, represented an external stimulus on the local educational system which had both its good and bad points.

On the positive side, there was a core of full time teachers in both disciplines; each course was backed by adequate facilities while design could be continuosly assessed; new fields of study were introduced while links with institutions overseas were developed, enabling students to study and work abroad.

On the debit side, the close relationship which had previously existed between education and practise was thrown completely out of gear; besides the transference of Civil Engineering to Polytechnic gave rise to speculation, such as, that the profession would lose its status — previously integrated disciplines were now polarised.

Meanwhile, the Architect's Ordinance had not yet been amended to take account of the innovations in the educational system. To enable students in both courses to qualify for the registration as "architect and civil engineer", Parliament introduced transitory provisions by which graduates could qualify for registration, after they had taken a complementary course in the opposite discipline. The BE&A degree, which had been abolished in 1956 was reinstated as a qualifying degree for all new courses. Besides as an additional qualification for the award of a warrant, a state examination conducted by a board outside the academic body was introduced.

Effects of Polarisation.

The passage of this amendment left the University with the formidable task of reactivating, at very short notice, an integrated course which had been buried for the best part of fifteen years without losing the very tangible advances that had been made in both components of the professional course during the time they were separated. This meant that the course had to cover a very wide range of disciplines which varied not only in the nature of their matter but also in teaching methods and philosophies. At the same time the other complementary courses had to be run.

The over-reaction to an external stimulus had destroyed an essentially integrative approach that had developed pragmatically in response to local environmental factors.

The separate Maltese courses had developed the faults which were later found in the English teaching methods ie. in architectural education, technical ability was generally broad and shallow while in engineering education technical ability was being pursued at the expense of a broader understanding of lifelike problems. Hence the transitional courses had to comprise a short engineering course for architects and a longer one in architecture for civil engineers. The performance of the graduate engineers when compared to first year students of the integrated course confirms earlier observations that engineering students tend to be more passive than their architectural counterparts in the initial stages of the design programmes, but become more articulate later when it comes to critical analysis of proposed solutions. They did better in examinations involving quantification but they were slower in developing design and graphic communication skills. They soon appeared to develop a threshold beyond which further development was negligible when compared to that registered by their architectural couterparts. One rather surprising observation that was made was that the structural solutions they proposed for their architectural projects were not, as one would expect, neater and more direct than those of the architects, but rather the opposite. This seems to confirm the doubts expressed elsewhere about the inadequacy of a purely mathematical approach to the teaching of structures, and the bias of traditional engineering education towards a tactical and secondary role, that of ensuring stability, when it should properly be concerned with strategy.

On the other hand, their opposite numbers in the complemantry course in engineering encountered no great difficulty in picking up analytical engineering skills. They also adjusted well to the purely engineering aspect of their work and their overall performance was quite creditable. This suggests that if architectural and engineering teaching methods are somehow to be brought together, it is the former which should precede the latter, and not vice-versa.

Many of the engineering students who managed to build up typically diversified "small" practises still confessed uneasiness, three years after completing their complementary course, about the open-endedness of architectural work as compared with the reassuring closed-endedness of the engineering work for which they were originally trained.

The Strategy of Re-Integration.

When it came to developing the new integrated course, it was decided that this should, as much as possible, remain project-based like the architectural course that it was partly supplanting; but the project content would be adjusted so that the academic skills taught in the engineering aspects of the course, using conventional engineering methods, would at some stage be fed into the programme of design projects. Instead of taking on the familiar sequence of progressively more complex building types, students were instead assigned a series of programmes with varying "mixes" of architectural and engineering content. Some programmes would be predominantly architectural in nature, or vice-versa; others would have a more balanced mix. As these programmes developed, engineering lecturers joined their architectural colleagues in supervising the design work and criticising and assessing the projects.

A large body of engineering knowledge still had to be transmitted through formal lectures, and this created problems such as finding of the right balance between the time students spent in the lecture rooms, in the studio, and working privately on their own. Examinations were also a problem since before students were continuously assessed according to the work carried out in the studios; the written examinations at the end of the year were of relatively minor importance. Engineering subjects had to be more rigorously examined and so the end-of-the-year examinations assumed greater importance. As a consequence of this project work during the third term suffered.

The failure rate among students was inittially high as an unpleasant consequence of the hurried introduction of the first integrated course. In general, those who did well in engineering also did so in the architecture side while only one did well in the architectural side but failed to get through the mathematically-based examinations.

This extended experiment in integrated teaching was begining to produce creditable results until it became a casualty of a political struggle for the control of the course between the University, of which the Architecture Department formed part, and the Polytechnic, which was responsible for the Civil Engineering. Polytechnic lecturers were forbidden to lecture outside its premises and hence could no longer involve themselves in the design projects. The schedule of formal lectures in engineering subjects became unnecessarily crowded at the expense of the time spent on project work and private study.

It is hoped that this administrative wedge which has short-circuited the process of meaningful integration would disappear with the implementation of the "student-worker" radical reforms in tertiary education, which amount to thin sandwich courses in which six months of study would alternate with six months of work in industry. The Chamber of Architects and Civil Engineers has strongly supported this scheme for it intertwines professional and academic training, as against the engineering system of academic training first and professional training later, while the professional training will develop both on actual construction sites as well as in the architect's and engineer's office.

Restructing the Integrated Course.

The drastic restructing of the present course to fit into the new student worker pattern seems a good opportunity to apply the feedback from the history of its development to the old problem of reconciling adequate standards of professional education with the unusually broad spectrum of disciplines that are required for local practise. Hence the end product shouldn't be the cumbersome concept of an "architect and civil engineer" but it should be reverted back to the traditionally Maltese concept of "perit".

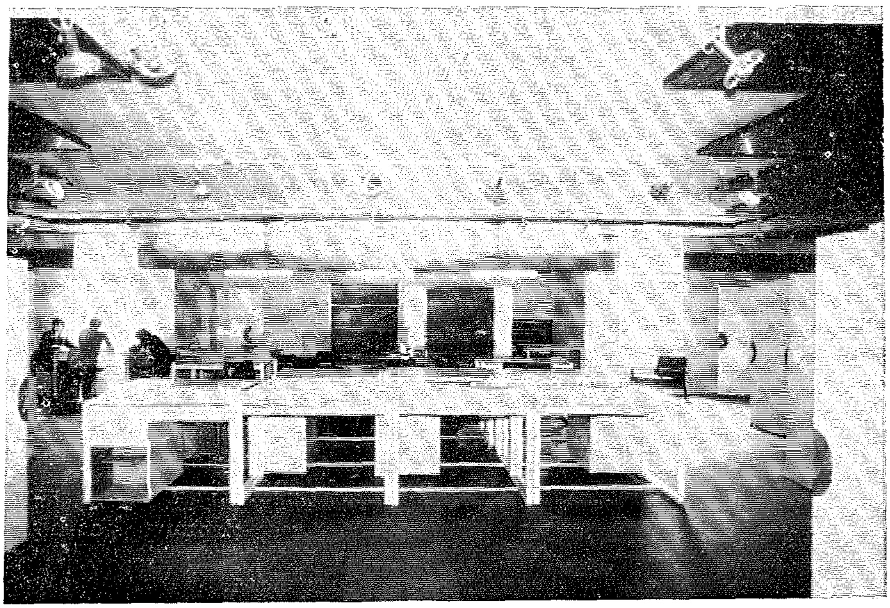
The "perit" could be viewed as belonging to an "environmental profession", meaning a combination of professions such as architecture, engineering and planning. Taking into account the limitations of local scale and resources, the Maltese "perit" is more involved in the actual construction of buildings than the British architect has traditionally been; at the same time he is more involved in actual building design than the conventional civil engineer. Design, while still important, is not as central as it is in the realm of activity of the conventional architect. The question now is, should design occupy the central position in the professional courses that it has done in the recent past?

To answer this question one must assess the formative value of a design education rather than the extent to which one would draw on designing skills in actual practise. The underlying goal of education is "learning to learn", and this applies more to the special case of a small, developing community, where the practitioner must prepare himself to assume a succession of varying professional roles, and to cope with the "one-off" tasks and projects the likes of which he has never handled before and is unlikely to come across later. Above all he must keep himself open to external stimuli without ever losing his sensitivity to the internal pulls of his immediate environment.

Besides, since a design education is a good a preparation as any for taking up the challenges of leadership in a dynamically developing society, then, even in the unlikely case that the recipient of such a design education would never actually design a building the time he spends in the design studio would never be wasted.

In the final analysis architectural and engineering education are both concerned with developing the ability to think with imagination and insight, to synthesise and to **design.** Far from being an obstacle in the way of integrating the two disciplines, a properly-structured programme of design projects could be the means of throwing a bridge between them.

The time spent on such design projects



Studio interior Architecture Department.

must naturally be worked out in relation to that given over to formal lecture courses. These will continue to be necessary to develop the analytical skills with which engineering education is chiefly concerned. If the initial stages of the course are heuristically structured, then the descriptive courses in engineering techniques could be concentrated to the fundamentals, so that the students would develop at an early stage, the ability to pick up knowledge of techniques independently, as they need them.

This suggests that it would be more sensible to progress from an initial predominantly project-based phase into one which is more heavily lecture-based. Initially the emphasis would be on problem-solving techniques that would develop the ability to look at whole problems. The student would then learn to deal in depth, and analytically, with specific parts of problems. In the third and final phase whole problems would again be taken on, but treated in much greater depth and detail than is feasible in the initial stage.

The problem of reconciling the breadth of the total integrated course with the depth to be achieved in each of its components could usefully be approached by identifying the levels of achievment that is required for each field. Once the desired level for the core courses which would be taken by all students has been identified, it would become possible to build in some options so that each student can build himself up to a higher level, in one or more chosen fields within a common course.

Conclusion.

When dealing with professional and educational institutions in a specific environment, patterns of previous development in these fields however rudimentary, must be studied closely, as it is likely to have emerged as a pragmatic response to that environment. Demarcation lines between related professions in developed countries could well be irrelevant and counterproductive to the needs of the developing countries. In the case under review there has long been a need for combining elements of the architectural and engineering professions into an integrated profession geared to the realities of the local practise. The educational base for such a profession should be so structured as to provide an organically integrated course of studies, and not a hybridised joint course that perpetuates the divisions between the two disciplines which originated in differing socio-economic backgrounds. Experience suggests that a valid strategy for achieving this would be to begin with a project-based approach largely geared to problem solving techniques, move to a predominantly lecture-based phase to develop the technical skills required to deal in depth with parts of problems, and finally synthesise the experience of these first two phases by special design studies in which whole problems are tackled in greater depth and detail than is possible in the initial phase.

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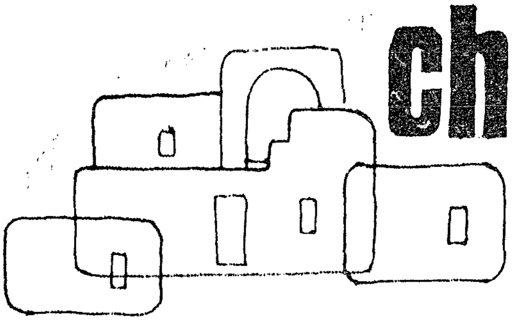


changed role of the maltese farmhouse

VINCENT GALEA

For anyone to talk of a "changed role", an idea of the past and present situations has to be put forward This is what I would attempt to do in the following article about Maltese farmhouses. Basically, the article would treat both the building's role and the functions it served. Both have changed during the past years, and, hopefully, this article would help to instill a clearer idea of this change.

As a start, the building form shall be considered. Thus, it would be necessary to discuss some typical example in order to make sure that most of the subject is understood. In this case, I would be quoting as an example, a farmhouse which is still in existance. It is found at Għajn Nastas, near St. Paul's Bay, in the Northern part of Malta. Of course, this is only one example and many others having their own particular characteristics can be found. Still, this example can be considered as a typical one for it embodies the basic characteristics found in many an old farmhouse.

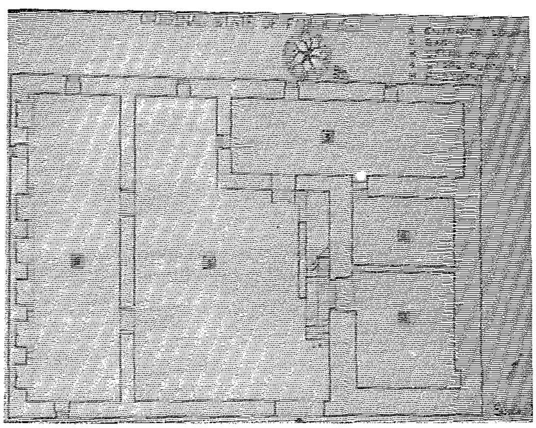
To be able to understand this subject, one must remember that in the past, the farmer's life was much harder than today, though by our modern standards, a farmer's life is still a very hard one. In order to eek out his meagre living the farmer had to work from dawn to dusk. For this reason his abode had to be so situated, such that only the least amount of time would be lost in commuting to and fro. During the hard times we are speaking about, the farmer, as most other people, had poor transport and the best way of making sure of being early at work was to have a habitable space in the middle of the fields themselves. For this reason farmhouses resulted in every part of the island where arable land was available. In order to improve his budget slightly, which often resulted in worsening his living conditions, the farmer used to keep animals. These had to be fed, which also meant providing space for keeping them. Thus, farmhouses, or as are they known locally "irziezet", had to provide space for the farmer's family and for his animals. The latter were more important for the farmer which, in turn, meant spending more time and space on these dumb creatures. In fact, more often than not, the farmer had to content himself with just a small room on the first floor, known as the "dar". And not even this room was totally exclusive to him as during the winter, when fodder was hard to come by, and could easily get wet, the room had to act as storage space, besides acting as the bedroom. In fact this "dar" often did not only cover the family's needs, but much more. To give a better idea of this situation one must say that this "dar" was only about 4m x 3m and often, it did not exceed eight courses (2.3m) in height. Such a size made manouvering in this space very difficult and even though warmth is desirable during the winter, it turned out to be quite stuffy.

Still, in this way the farm catered for all the farmer's needs, even though by our standards, in a very poor way. The other parts of the farmhouse were dedicated to his animals, perhaps with the exception of one small room on the ground floor, which served as sleeping quarters for the fairer sex — that is unless the situation arose in which the farmer had to use this space for his animals as well. In such occasions, the males, who usually slept in the "dar", had to find some other place where to sleep so that the females would move in. Seeing the importance animals had in the farmer's life, It Is no surprise that one very Important aspect of the farmhouse concerned the space reserved for these creatures.

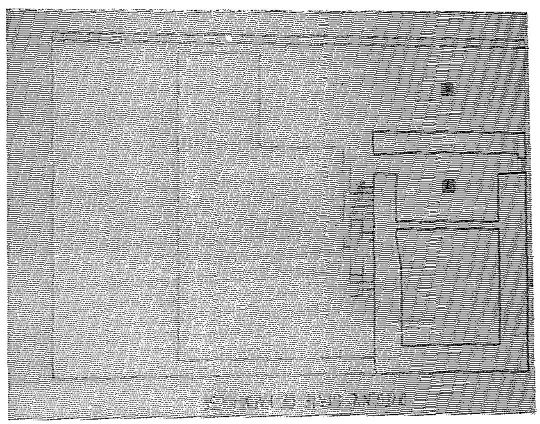
No animal could be considered extra on the farm — the more there were the better. In this regard, since animals do not all need the same treatment, different areas resulted for different animals. However, all the spaces in question had one thing in common. They had a shed and a yard which were locally called the "maqjel" and the "mandra" respectively. The different "imwieqel" were seprated for the different kinds of animals, especially for the beasts of burden, usually oxen and cows, the latter also being used to provide milk. These animals were usually used in the fields, but as a means of transport, horses, mules, etc., were used, donkeys being avoided! Then, there were different forms in which the "mwieqel" and "mnadar" where joined together. Often these were such that all the "mwieqel" looked upon a common "mandra". In this case the "mandra" catered for all the different animals during the different parts of the day. Another version was that of having a "maqjel" and a "mandra", separate and complete, for each kind of animal, thus being able to use all the spaces at one go. It looks as if the relation between "mwieqel" and "mnadar" depended on the number of animals that the farmer had. Definitley, a bigger number of animals needed a better provision of space and the result was that different "mnadar" had to be provided.

Something to be kept well in mind in this case is the fact that the farm was self-sufficient. The form of the farm was that which siuted its purposes best, and for this reason one could very well state that here is a perfect case of "Form follows function". The most important aspect that the farmer kept in mind was, how to earn a living. This was the function of the farmhouse; for this purpose the farmhouse was well geared.

This can be seen through the fact that very often the building was constructed in such a way that it provided the best living conditions for the animals, which, in turn, resulted in a better standard of living for the farmer. In such a situation arose the question of security. The farmer's possessions, more often than not, consisted of his animals and a few rudimentary tools. To lose his possessions would have meant a tragedy. Thus the farmer built his farmhouse in a way that minimized the possibilities of intrusions. When nature did not provide the necessary shelter, the farmer went to great lengths to ensure a secure abode. This could be seen from the way openings were provided in the building. These were as small as possible and looking onto the yard. Where outer windows had to be provided for ventilation, these were kept to a very small size and were barred by means of massive wooden blocks, often backed by a still stronger "stanga", thus giving a greater sense of security. Besides these precautions many means were devised to ensure "safe walls". These safe walls were provided in a variety of ways.



Ground Floor



First Floor

In one way a projecting course (in the farmhouse at Ghajn Nastas this method was apparently used, because the present dwellers recall the cutting of a "protruding course" some time back), inhibited people from climbing on to the roof; another way by which the farmers tried to provide safety — and to some extent this method is still in use locally — was by placing bits of broken bottles and glass on the top of the surrounding wall, thus avoiding any intrusion of undesired persons.

Besides these two ways of ensuring safety, others do exist, but it is not my aim to state them all. However the ones I mentioned, ought to help in establishing the sense of safety the farmer was searching for. The farm was all the farmer had, and hence he went to all extremes to safeguard it. All he wanted was security, and an assurance that this security was not breached.

Next, the farmhouse itself has to be discussed. The yard was the place of greatest importance for it was the focal point of the whole farm. This served as a "free space" where animals could be left to roam. A necessary element of this yard was a well, unless water was easily avialable from an external source.

One should also mention the fact that the roofs were flat. This served a triple function. The flat roofs were used as water catchment during the winter, as a space to dry fruit in summer and at the same time this space was also used as a sleeping area when the "dar" proved to be too hot a place to relax in.

In order to talk about the changes in the farmhouse's role, it is necessary to relate what was said above to what exists now. Many characterisitics have disappeared during the past years, and, especially since the sixties, the idea of having a self-sufficient farm which provided everything has decreased to near non-existance. In fact, during the last fifteen years, the idea of having a farmhouse in the old sense has disappeared. In no way should this be taken to imply that changes have only taken place recently. On the contrary, many changes had already taken place in the form of the farm. Yet, the idea of having a form according to its function was very much alive until recently. One other thing that has survived is the idea of having a razzett in the old sense for some types of farmers. A drastic change has occured recently, which, among other things, has classified farmers into two categories, namely those who till the land to grow vegetables and fruit and the others who keep animals and poultry to provide eggs, milk and meat. Some "combined" farmers are still in existance but most farmers nowadays can be classified as either one or the other. For this reason, changes in the structure which served these farmers were unavoidable.

One thing which has helped to separate the two kinds of farmers was the introduction of machinery. This made animals of burden redundant, since their place was taken by all sorts of vehicles. Such vehicles require "feeding" only when used while the beasts had to be fed all the year round, and used occasionally. Another aspect that helped bring about this change was the advent of Independence; Malta started changing its economy from one depending on "defence" money to one built on peaceful co-existance with its neighbouring countries, based primarily on industry and tourism. The latter calls for large amounts of fresh foodstuffs and unless exclusive farms for hens, cows, pigs, etc., were built, the necessary amounts could not be provided. Thus, for these purposes, dairy, poultry and swine farms were set up. These require continuous and sophisticated care and, for this reason, the farmer could not possibly cope with his animals and fields together. For such farms to be viable, they had to have a large number of animals, not just a few as before. For this reason farmers had to decide as to what farm they where going to set up.

Whichever type of farm the farmer decided to choose, there was one thing that had to be kept in mind. Now the form of his farm would not follow its function, or rather it would do this only in some respects. This meant that whether the farmer chose to rear animals or to till the ground the wholeness of the farm had to be lost.

The fruit/vegetable farmer no longer needed his animals to till his land, for the job was now being done by machinery. On the other hand, the dairy/poultry/swine farmer did not need the various sections of the old farm. As a result two kinds of farms resulted; in one case, space was required for the housing of particular animals, while in the other, the large amount of space previously needed for the animals was no longer required.

This change brought about a revolution in the farm's dimensions. In fact it brought to an end the old razzett for the fruit/vegtable farmer. Such changes in the farming techniques brought about a change in the farmers' buildings. And indeed, this change was a drastic one.

By this change, the farmer was turned

from a supplier into a conventional client. The farmhouse in the old sense is dead and done with. The vegetable/fruit farmer, now needs only a decent house in which to live plus some storage space for his machinery. But, the swine/poultry or dairy farmer still needs a razzett. However it is a different type of razzett — a more sophisticated one. He has to have a home yet he does not even dream of building it on the farm's site. Hence, as a result of this change, both farmers started building houses as distinguishable from farms. The idea of a "FARMHOUSE" disappeared. There exists a division betwen farm and house; the idea of having a farm which provided space for man and his animals together disappeared. Of course this system has its good points, such as, for example, the separation of humans from animals. Yet as far as architecture and the concept of "Form follows Function" are concerned this breakdown of the farming system has brought about one whole mess in farm architecture.

In fact, even though sanitary conditions have been improved there were many important, architectural aspects, such as the court-yard, which have disappeared. Most of the farmers' dwellings have become terraced houses. This is meant to show off the improved living standards of the farmer, reflecting the island's changing economy — on the other hand it means the death of another vernacular building type which had evolved through the ages. A terraced house looks like a terraced house whether it belongs to a farmer, policeman or architect. The house of the farmer, the farmhouse, has lost completely its particular identity.

Although one is satisfied with the farmer's financial improvement, the same cannot be said of his home. It might be a good idea to review the old concept of a "court-yard house" or "courthouse" which time has proved to be the most satisfactory type of house for a Mediterranean climate like ours. A return to the courtyard-house should ensure better "farm architecture". What we are after is improved architecture and thus one should examine all the good aspects of the farmhouse, rather then try to copy farm construction as found abroad, structures which are totally alien to our environment. Applying such good aspects to modern buildings would certainly help to alleviate the miserable state of affairs we now find ourselves in.

RED CHINA DOCK

RAYMOND FARRUGIA
EDWIN MINTOFF

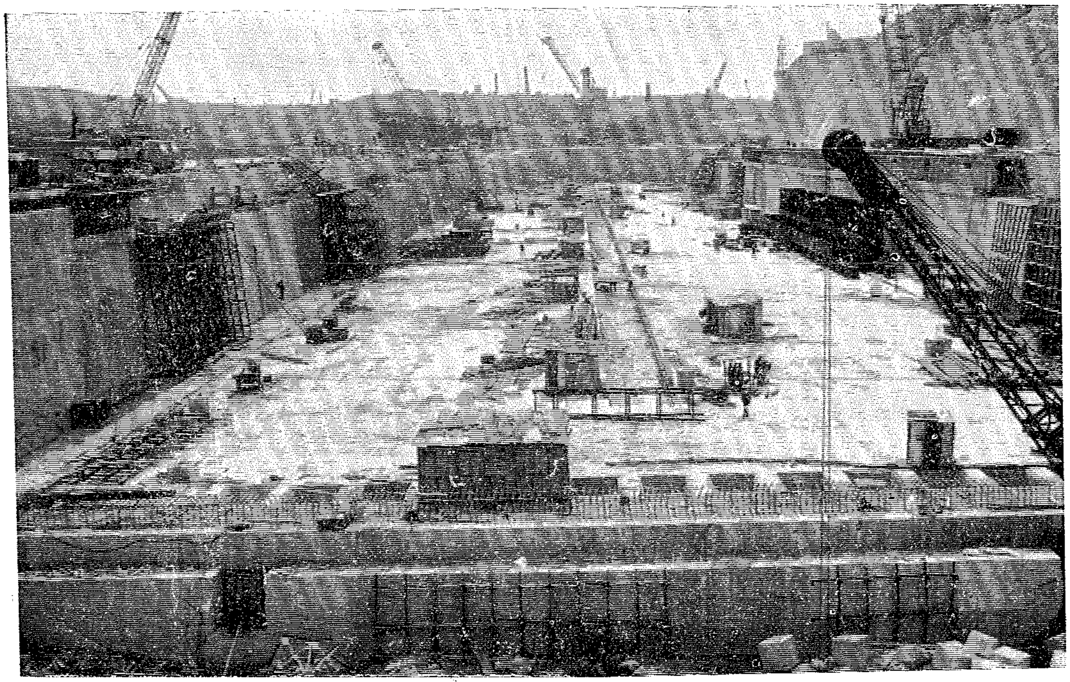
Introduction

Malta's revival of ship repair business, since the re-opening of the Suez Canal has prompted Authorities to improve and expand facilities at the Drydocks, the island's largest private employer. The highlight, without question, was the commisioning of what in about a year's time will be Malta's new drydock, suitable for 300,000 tons d.w. ships. The new dock, which will be able to handle any ship at present transitting the Mediterranean, has been financed by a loan as agreed between the governments of Malta and the People's Republic of China. The initial design stages were completed in China, whose technical specialists are presently supervising the construction programme which is right on schedule.

Preliminary Work

As is common knowledge, such gigantic projects require considerable preliminary work and considerations. The Red China Dock was no exception, and the great co-operation evident between the Maltese and Chinese technical experts helped in no small way to get things off the ground smoothly. The Chinese team of technical experts have shown great dexterity in helping to solve initial problems, and the communal meetings of all ranks, at which problems are brought up and eventually solved, have proved to be tremendously helpful.

The first stage of the project required the removal of considerable volumes of rock from the selected site of 'Ras Ħanżir' (literally the pig's head), limits of Corradino Heights. It is sufficient to say that existing wharf level is approximately seven storeys below ground level at Corradino Heights — this ought to give a fair idea of the sort of work carried out. Besides, a further substantial volume of rock had to be removed to accomodate the dock itself. This process proved to be by far more intriguing, since work was being carried out below mean sea level. However, before this part of the project could be executed, various precautive measures against water intrusion had to be carried out. A rather lengthy process was the erection of a series of cofferdams, a sound metallic barrier protecting the dock's opening to the sea. This array of gigantic metallic moulds were fixed firmly into the ground and sealed all round with great precision. Later they were infilled with cut material to further enhance the effect. There is no question that the dismantling of the cofferdams, once work on the dock is completed, will prove to be an-



General view of the Project

other lenghty process. As for rock cutting methods, explosives could not possibly be ruled out due to the vast volumes which had to be cut. However great care was taken to minimize discomfort to the inhabitants of the area and great care was taken to ensure all round safety. This was supplemented by a good number of hammers functioning on compressed air. Faults in rocks and variations in geological formations were not missing and these asked for specific solutions. Transportation and eventual disposition of the massive rock volumes was treated as a separate matter. Much of the initially cut rock was eventually used as filling material for other government projects such as road works and surfacing of sports grounds. However a substantial amount did find its resting place on the seabed, off the Grand Harbour. In such cases the rock matter was transported to hopper barges which were in turn pulled by tugboats to a distance out at sea, where eventually the material was deposited. Two tugboats were purposely commissioned and eventually manufactured at the Malta Drydocks, as part of the Chinese 'package deal'.

As already pointed out, cutting of rock below mean sea level gave rise to further problems, since the cofferdams could not possibly ensure a one hundred percent watertight solution. However as work progressed, further steps to solve this problem were taken*, and gradually these proved fruitful, making working conditions more reasonable.

Concreting Works

Eventually, as cutting works were almost completed, the natural follow-up was preparatory work for the major concreting works. The vastness and scale of the work undertaken is unquestionable. To give you, but a simple idea of this, the actual dock dimensions are, length 360m., depth 10.77m. and inside breadth 62m. Methods employed were basically conventional and innovations are only noticeable in the execution of minor, but relevant, details. 'Ready Mix' was largely used, and highly commendable was the great effort shown to maintain proper quality control throughout. For this reason, the Chinese technical team had set up a well equipped testing laboratory on site to

Variations in rock formations can create junctions that eventually result in soft spots for water intrusion. This was generally solved by grouting such openings under pressure.

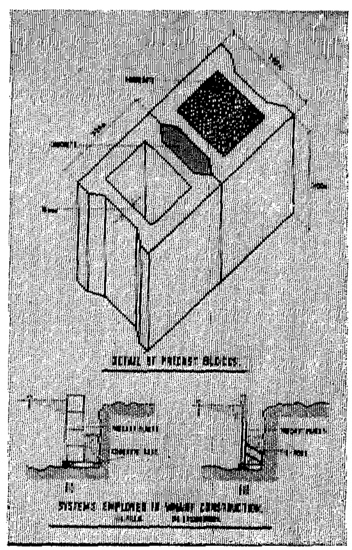
continually ensure desired quality control. Preparation of formwork elements (both timber and metal), was carried out at the project workshop atop the work site.

Setting up the formwork for the dock's side walls, implied the use of a standardization method, which would in due course facilitate work and also improve the production rate at the same time. A solution was found by assembling a framework on which the formwork could be set up in an appropriately accessible position. Indeed, the procedure at each stage was to establish the framework in a lying down position, whereby workers could easily set up the rather complex shuttering. Once this work was completed, by means of a lifting device, the framework was erected in place. The framework also guarantees that the shuttering remains in place during the pouring of the concrete. Further reinforcement was provided in the form of properly positioned metallic rods, firmly embedded into the rock face. Preceeding this, the rock face was manually treated to provide a proper surface for good concrete bonding. This proved to be one of the most laborious processes throughout the project's duration to date.

The ground/wall junction was treated as one whole, and as a consequence the formwork could be visualized as being of an L-shaped form. The same applies as far as concreting goes, which resulted in a series of reinforced L-shaped concrete blocks, which, when put one by the other, form the dock's side walls. As for the dock ground, this results to be the interlying space between the two opposing (lengthwise) dock walls, end wall and gate pit. In such a situation, concreting works were reduced to providing ground panels of approximately 12.5 x 13.5 metres square surface area, and one metre thick. Each of these panels was firmly anchored to the existing rock surface by firm compression piles. The latter consist of a number of mild steel rods, approx. 20cm. in diameter, welded to a circular sleeve. The length of piles was determined by the rock formation to be penetrated (lengths vary from 7 to 10 metres); in all cases holes for the piles were formed by means of a rotary drill. These compression piles help to maintain the stability of each concrete panel against any upthrust they may be subjected to. In this way the designers also ensured that the whole dock ground would be as homogeneous as possible. Due consideration was given to the properties of the concrete, the most important being water penetration and heat reaction. For a starter, low heat cement, namely Pozzolanic cement, was utilized to minimize heat reaction effects. The concrete mix used was 1:1:4, which classifies the mix as a high quality concrete. Besides admixtures were also introduced into the mix to further minimize the heat reaction effects. As for watertightness, a rubber bar between any two slabs was inserted; furthermore a timber panel impregnated with hot tar was also introduced mainly to take up the effect in the upper regions of the slab. Other parts of the project which entailed considerable concreting works include the 'bullnose', which may be considered as a man-made breakwater, the services gallery (see — 'Other Features'), gate pit and the outlets to the pumphouse presently under construction. All in all concreting works carried out are by far more complex than are outlined here. The engineer on site is highly satisfied by the progress of this part of the project and it is estimated that by March of 1979 all concreting works would be completed.

WHARF

An essential facility that had to be catered for was an appropriate length of wharf. In the construction process two different systems had to be employed; one was to cater for parts of the wharf to be constructed over fills whereas the other was concerned with construction in excavations.



Wharf: Sections

In the former case, a simple precast block system was adopted whereby a number of reinforced concrete blocks of three metres side were placed one on top of the other, thus forming in the process a column whose depth depended on the actual depth of the seabed. The voids created betwen adjacent blocks were later filled with concrete to ensure proper bonding. Though these blocks are actually hollow in section, they have considerable strength properties, especially after cavities are infilled with aggregate.

When these blocks are placed in their appropriate positions they form the outer boundary of the wharf. Meanwhile infill was dumped in between existing rock surface and blocks to form the wharf section where excavations existed.

Special consideration was given to the foundations of this structure as several difficulties were encountered owing to the fact that the major part of the work had to be carried out underwater. Besides this drawback, as in any other structure, the foundations have an important bearing on the strength and durability of the structure. For this reason the foundations were constructed with as much attention as is possible.

The setting up of the formwork for concreting was the first step in the construction of the base. A large funnel was used for the pouring of concrete underwater. In this way the concrete would descend and settle in a manner which would not cause underside spreading and also enables enough time to elapse, thus preventing the heat reaction due to the hydration of the mass concrete. It also enables better segregation of concrete to occur. All this work, as well as the correct placing of the precast blocks underwater required all the skills and experience of the divers working on this project.

To minimize as much as possible the difficulties encountered both during fill as well as during excavation a floating crane was built purposely at the Malta Drydocks to work in conjunction with the other equipment i.e. hopper barges, grippers, tug-boats, etc.

In places were excess rock existed beyond the proposed outer boundaries of the wharf, it was decided to employ a system of "precast panels". Again this method presented a number of difficultes as it was compulsory to make use of heavy lifting equipment, a number of divers, etc., but at the time it looked like the best method.

Besides, owing to the fact that the "Cottonera Area" and surrounding towns are somewhat close to the dock itself, blasting to demolish excess rock had to take place at long intervals, making use of a small amount of dynamite each time. Once the excess rock was cut it was placed into hopper barges and tugged out to sea, or used as infill for deserted quarries on the island according to the needs in the circumstances. The precast panels could then be placed in position to form the outer boundary of the wharf.

These reinforced panels are rectangular in shape, six to seven meters in length by two and a half to three meters wide. These precast panels had the advantage of "quality control" since their constructon on site facilitated their testing and checking. The rods were set firmly into the existing rock and were connected to hooks attached to the panels to ensure a firm position for these precast units, in the process preventing them from toppling over when fill was being poured in the space between the panels themselves and the rock surface.

DOCK GATE

The gigantic steel structure presently dominatng the Dock's bed is the subject of quite an account. The structure in question is the actual dock gate to be assembled in place in the very near future. The contract for the fabrication of this structure was awarded to the Malta Drydocks Corporation. The functioning principle behind the gate, known as a flap type gate, is quite simple. However the governing mechanism and the actual construction of the gate pit region are by far more complex, and for this reason alone it had to be given great significance. Indeed the actual construction of this region of the dock required great sensitivity and precision in execution. This is particularly evident in the construction of the pit's sill. Here the material used, reinforced granite blocks, was brought over purposely from China. This material has considerable compressive strength and at a value of 1000 kg/cm^2 accounts to approximatelly five times that of conventional concrete. The actual positioning of these blocks was carried out with great attention.

The actual structure is composed wholly of steel members and it is estimated that the tonnage of steel employed will approximate the 1,200 figure. The complete structure, internally and externally will undergo a grid blasting process to ensure a proper surface for epoxy paint treatment later. During the design, and especially during the fabrication stages, great care was given to ensure an easy passage for water and air into the tidal, operation, ballast and spare tanks. The above mentioned tanks are the main constituents of the gate itself.

The gate will rotate on two equally spaced hinges. This rotation is based on the simple principle that once the gate is empty, secured by a locking device at both ends in an erect position, water could be pumped in, increasing its weight and in the process creating an overturning moment. Eventually, by releasing the locking devce the gate will slowly turn on its side inside the gate pit. This is a mechanically controlled process; time taken depends on particular needs, and average duration is estimated at twenty minutes. A fender cushion attached to gate's face, ensures proper positioning and also avoids damage while the gate is in its lying down position.

Water-tightness was a great concern. An all round seal had to be employed and the selection fell on a 'piano type' rubber as this type had proved its worth in other similar situations. Once the structural work on the gate is completed, the dock will be flooded and gate floated into position. After the assembly of the gate into its erect position the dock seal test would follow in due course.

OTHER FEATURES

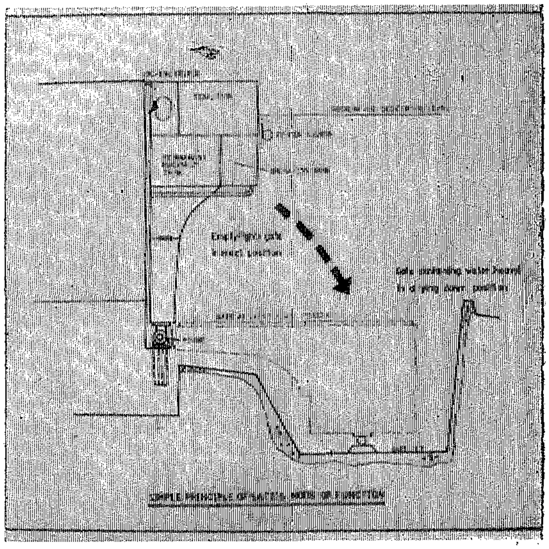
Although the above mentioned works constitute the bulk of the project other minor undertakings of noticeable importance are here mentioned for the record:

Services Gallery: An essential feature was the provision of a proper services gallery running all round the dock perimiter. This structure essentially consists of a gallery with a series of outlets through which provision of the required services, such as propane gas, compressed air, oxygen, electricity and water, may be supplied, thus being readily at hand when the need for them arises. A water proofing membrane runs all round the gallery to ensure minimal water intrusion.

Infrastructural Buildings: These are quite numerous and the principal ones include the Pumping House, a Wench House and a Boiler Room. Inevitably these accounted for a considerable amount of masonry work coupled with the assembly of a good number of mechanical plants that called for specialised work.

Workshops: One must bear in mind that it was out of the question to carry out on site all the work connected with the dock's construction. For this reason there exists a large workshop complex in the vicinity of the work site.

Trades catered for here include carpentry, welding, blackmiths and heavy plant machinery maintenance. Also provided for are storage areas, fuel supply and a unit to ensure a continuous provision of compressed air. The laboratory mentioned earlier in the feature, is also found here, and it is run by Chinese specialists.



Dock Gate

CONCLUSION

That the Red China Dock is the major Civil Engineering project undertaken locally for years is unquestionable. One of the major aims behind its execution is undoubtedly, to boost employment in this vital sector of our economy. In this respect the building of the Red China Dock has been a vast speculative venture which will provide the necessary facilities for modern ship-buildng and repairing, extending to the scale of supertankers.

ACKNOWLEDEMENTS: Our sincere thanks to Engineer C. Cassar and Works Foreman, Mr. Farrugia for their kind assistance in the completion of this feature.

EDITORIAL NOTE: As the contributors correctly point out the building of this dock is without question the major Civil Engineering project to be undertaken locally for years. Since such projects are hard to come by (more so, here in Malta), it might be a good idea to compile in book form the records of the work process that evolved. This could prove useful to civil engineering students and researchers in the future. On would in this way ensure that such useful information is not lost in some musty cupboard of some obscure governmental office.

The Case for Colour

GODWIN ZAMMIT

A basic and vital force, colour is lacking in the modern built environment. It is part of a total sensory experience of our environment and contributes immeasurable beauty to the visual world. As more and more people congregate into ever larger cities, the monochromatic buildings fail to satisfy the need, previously catered for by colour in the natural landscape.

As an integral part of our perceptual system it helps us to identify and define objects in space and acts as a signalling device which is evidence of certain conditons, conveying information about our surroundings.

Colours are commonly divided into two temperative groups. The warm reds appear to advance and have a stimulating effect. Red is enigmatic, being able to instill fear, excitement interest or energy — it all depends. The cold blues are receding with a generally depressing effect but may also be harmonious and relaxing. The symbolic meaning of colour varies greatly with cultural background, but there seems to be a universal preference tending towards blue especially in adults.

Psychologists suggests that the monochromaticity of the urban landscape is emotionally sterile and visually dangerous, resulting in what they refer to as sensory deprivation or perceptual isolation. The neocortex in the human brain is divided into left and right. Intellectual processes and logic (Sequential information) occur in the left region while vision, perception and artisic design (Simultaneous processes) are the domain of the right. However, the mid-brain region, termed the Limbic System and the subject of much recent neurophysiological research, has a direct link to the optic nerve and has a limited visual capability. It is believed that the emotional response to colour takes place through the Limbic System which is also responsible for symbolic associatons and the interest in the exotic.

In the name of sophistication, elegance and good taste, architects tend to neglect emotional responses in design, equating them with vulgarity and emphasise the intellect. Architectural colours are thus extremely cerebral and for limbic satisfaction one must go to the market place, and Piccadilly or Las Vegas at night.

Competence — the ability to interact effectively with the environment — and Cognition — the ability to understand it — are essential to psychological development says Robert White. Yet people generally misunderstand the built environment, and the designers are blind to this. Education may improve people's understanding of modern architecture but to design "as if people mattered" is urgently required. Colour is one ingredient which should help to humanise our cities.

In the past colour had a more prominent place in architecture. The bright colours in the Ancient Egyptian temples are well known but not so many realise that the Parthenon, that symbol of monochromatic perfection, was originally gaily coloured. Needless to say, if the Greeks used colour so did the Romans. The use of colour persisted through the Middle Ages until the Renaissance, when a split in art forms occurred. Architecture and sculpture became restricted to a predilation with form and space, leaving colour exclusively to the painters. In the cubist period monocromatic form even appeared in painting until the Fauvists reacted with bold splashes of pure colour.

During the modern movement there have been attempts at integrating the art forms. Piet Mondrian and Kasimir Malevich contributed greatly to the spatial use of colour and Gerrit Rietveld expressed a close relationship between artistic and architectural philosophies in the Schroder House.

Pop art and fashion in the sixties represented a rebellion against the colourless monotony of city life and in recent years the concept of the 'polychrome city', whose origin may be traced to the works of the French "coloriste" Jean-Phillippe Lenclos, is gaining strength.

Colour may be used to integrate with the surroundings or to make a definite statement, to remove glare, to affect mood, for visual stimulation and to remove monotony. (Research has shown that variety in itself is psychologically beneficial). It may be inherent in the material, applied as a surface coat or as coloured lighting. Large wall murals have been used to clean up decadent areas, but colour in design should be thought of early in the total design process. While the designer should learn all the facts available about colour, no scientific system may be expected to provide a sure way to good results, and experimentation is essential. In the end it remains up to the sensitivity of the designer to put colour to good usd in providing a happy environment.

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