# Stone-quarrying industry needs updating

by Angelo Xuereb

TRADITION, in the construction industry as elsewhere, cannot stop progress. Modernisation has overtaken the concrete industry in a big way these past 20 years, mainly because contractors have invested in this vital industry, where the stone-quarrying industry has not changed much in the past 40 years. Surely there must be a way of improving traditional methods.

An observer explained to me the other day that the major step forward in the quarrying sector came some 40 years ago, when cutting machines were introduced. Again, at the time, there was much discontent among the workers involved, and the same stone cutters who had been earning a hard living chipping away at the quarry face by hand strongly opposed the machines that would make life so much easier for them, because they thought the machines would take their livelihood away. Time has proved them wrong.

## Old-fashioned methods

But what new developments have taken place then? Nothing — despite the great boom years of the building industry in the sixties. On the contractors' side, though, things continued to move ahead, in keeping with international developments, albeit some 20 years behind the rest of the world.

Roofing stone slabs on iron girders were quickly replaced by concrete which was found to be more economical and advantageous. The small cement mixer operated by hand was soon replaced by those ready-mix monsters we know so well. This was just 16 years a joy and, even then there was some opposition from contractors who thought they would lose work.

Concurrently, the traditional *grabja* (winch) gave way to hydraulic cranes, making the lifting of stone slabs and concrete safer and less of a health hazard and more efficient in the porcess. Cranes made possible the introduction and the laying of prestressed roofing slabs and these have now become the order of the day on any building, practically replacing completely the use of ready mix in roofing works of large spans.

The latest development has been in the use of concrete columns and beams or steel structures as the mainframe for building, around which the stone/brick work is built. In certain cases these are now to be overtaken by prefabricated processes, which are definitely more efficient, more durable and, most importantly, more cost-effective.

The process of prefabrication of concrete elements has been around for at least four decades and has more than proved its worth.

While all this fast development has been going on in the rest of the industry in the last decade, the quarrying industry has continued in its same old rut — without any general investment in technology and modernisation.

I cannot understand why the quarry owners are thinking that their livelihood is at risk! The way I see it, the whole construction industry is to be strengthened and more work could be generated for everyone involved in this industry.

## Major projects

Prefabricated systems were introduced in Italy over 50 years ago. Prefabrication is mostly used on large projects of a commercial or industrial nature. In Malta, construction projects have always been relatively small and a huge investment in this sort of factory could not be justified.

Until now, the size and cost of major construction works did not merit consideration for such an investment. Now things are becoming more complex and the time factor is becoming more important.

Yet projects of this dimension are not the only reason why diversification is important. The cost of stone in itself has been rising fast and though it is still slightly below the cost of concrete bricks the gap is small and bricks would soon become a cheaper building element.

Furthermore because of poor production methods in the quarries, the stone being provided is not properly cut and contractors have to recut it correctly on site thereby increasing labour-hours and overall costs. Another problem is the unavailability of workers. The good wages offered are not enough to attract people to the hard life and health hazards of this industry. This labour shortage slows down development and increases costs.

With prefabrication, major projects are erected within weeks or days rather than months, and are much more cost-effective. But if the quarries modernise their systems, then there would be greater incentives for attracting workers to the stone industry since the hard labour element would be greatly reduced. More workers in the industry means more work potential, which in turn means even more work for the quarries.

## Poor-quality stone

Making life easier for stonemasons — like introducing the availability of properly cut stone (to the correct dimensions) and in smaller size on pallets rather than as is common practice today — would ensure a longer use of stone as against the use of its alternatives.

Yet quarry owners should be on their guard to eliminate some unscrupulous methods of selling. This includes trying to sell poor-quality stone, a practice which causes much consternation later when the building is completed and flaking sets in.

Because of this contractors are today making developers pay more for their project simply because they insist on using top-quality stone for the whole project (including foundations) "to play safe" rather than a mixture of poor quality stone in the foundation works which are then tarred and built on with the correct type of good stone.

If the quarry owners really want to sell the stone with *soll* they should allow a good price difference between these two different qualities of stone, each with its respective use. The good quality stone should be delivered to site on pallets with correct measurements at a higher price while the *soll* type of stone could be delivered on site using the present methods and systems at a much lower price.

Since this type of stone would only be used in foundations, the site would still be open and there is no need for the stone to be fairfaced. With such substantial differences, everyone would make use of this *soll* type of stone in foundations. This would mean a much better use of Malta's limited stone resources.

The modernisation of the stone quarrying industry is bound to occur once quarry owners realise the potential benefits.



# The art and science of building

by Lino Bianco

IN THE *Oxford English Dictionary* the word "structure" is defined as the "manner in which a building or organism or other complete whole is constructed; supporting framework or whole of the essential parts of something". Thus the structure of a building is the assemblage of parts which are required to maintain stability and, hence, form.

The concept of structure in ancient times includes both the supporting and the enclosing system employed. The structure of a hut provides both support and enclosure. This concept prevailed through the evolution of ancient building engineering.

"Architecture is merely an offshoot of the evolutionary pattern of settlements: it has embroidered the fundamental tradition of structure by establishing the convention that allows the 'support' and the 'enclosing envelope' to be considered as two separate entities". (1) The contemporary notion of architecture is rooted in this schism.

The year 1742 is a landmark in the history of buildings. It was the first time that a rigorous structural analysis into the failure of an existing structure was undertaken and recorded. Michaelangelo's dome of St. Peter was the basis of such an analysis.

The three mathematicians employed to advise on remedial measures to be taken, said existing knowledge based on observation was insufficient to deal with the problem. Instead, they tried to analyse the problem in terms of static equilibrium. (2)

A major difference between ancient and modern times exists. In the former, building materials and methods used were based on trial and error while in the latter they were grounded on scientific methods. The year 1742 marked the turning point. It led to the development of a much better understanding and analysis of structural behaviour.

## Structure in architecture

The purpose of a structure is to carry any forces exerted on a building and transmit such forces to the ground. There are a hundred and one ways to fulfil this purpose. In any structural system, forces — external or internal — are distributed and channelled along the designed paths such that, at any stage, equilibrium is present both within the individual element forming up the system itself and within the system as a whole. The structure may either form an integral part of the architecture or may be distinct from it.

Given any space, structure is concerned with the statics and mechanics of the elements defining the space. Such elements are vital for the existence of a building. It can exist without painting but not without structure.

In this mechanical aspect of structure, it is often argued that structure has a subordinate role to the space generated. Structure is here thought of as the hand maiden of architecture. The architect, as an artist, establishes the form and then suits a structure to fit the form.

A form created by an artist may neglect any consideration of science, but an architect cannot. Also, craftsmanship has long given way to scientific method. If handicapped by ignorance, it is best to give up his responsibilities as regards the structural adequacy of his building.

The role that structure plays in the creation of space is closely related to its function. Such space can only be spanned by a structure. The latter can also be used to create interiors and give scale and aesthetic quality to a space. "How imaginatively this redirecting of forces is done and how well the structure is able to enhance the functional, social and aesthetic meaning of the space it spans, is (a) measure of the quality of architectural structure". (3) Thus, the role of structure is integral to architecture. Structure is essential for architecture. Architecture cannot exist without structure.

The role of structure in architecture is a means not an end. This is not always true. Engineers such as Torroja and Nervi designed structures which qualify as architecture. "The clarity of the ideal which permeates their work gives their constructions a positive, objective character which is beyond fashion". (4)

Such engineers have not only exploited "the forms derived from mechanically efficient behaviour" (5) but used structure as their product and not simply a tool to generate architectural space. Their designs are not only an integral part of the architectural form but also a generator of the form.

A structure may lack integrity with the architecture through misuse of materials. A structure which makes indiscriminate use of materials reflects incongruity. The choice of materials is dictated by many factors which includes cost, availability, ease and suitability of construction and strength. If a material is exposed, colour and texture are critical in design.

"As a rule both the shape and the materials of any structure...

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# Structure and design

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represent an optimisation with regard to the loads which it has to carry and to the financial cost". (6) Diamonds would make a good aggregate in concrete. If they are used instead of ordinary stone then they would be a waste of limited natural materials. Also, such a decision would not be economically feasible. Furthermore, "at no time should the form and structure clash. They must always be compatible and harmonious with one another if, indeed, not one". (7)

## Creative design

Very often architects refer to structure as if it were subordinate to 'architectural design'. Also, engineers usually make use of the term 'design' as "a process whereby a balance is made between the imposed forces and the materials that resist these forces". (8) The differences of opinion are essentially based on emotional rather than intellectual convictions.

The following two extracts, the first by an architect and the other by a structural engineer, illustrate that 'architectural' and 'structural' design are not so much distinct.

"(Architectural) design is a complex and intricate process, yet deep within any given environmental situation there lies a natural or organic solution. There are many factors and components — such as historical continuity, regional and specific site conditions, physical and psychological needs of society, structural innovations and technological advantage, expressive form and creative space — that shape our environment. Only by careful and sensitive analysis and by diligently sifting all factors within the framework of our times does the creative synthesis evolve". (9)

"Engineering design makes use of (general) laws (established by scence) to solve particular problems. In this it is more closely related to art or craft; as in art its problems are undefined. There are many solutions, good, bad and indifferent. The art is, by a synthesis of ends and means, to arrive at a good solution. This is a creative activity involving imagination, intuition and deliberate choice, for the possible solutions often vary in ways that cannot be directly compared by quantitative methods". (10)

These extracts contain much in common. In either case the term 'design' is understood as the combined effect of 'knowledge acquired through the intellect' and 'knowledge acquired through the senses'. Intuition and desire are not enough.

"Truth and aesthetics are equal ingredients to the conception of form, which starts as an intuitive experience and progresses by successive aesthetic and analytical developments. One cannot succeed without the other, and design without aesthetics is mere uninspired copying ending in mediocrity if not disaster". (11)

The importance of an intellectual approach is best illustrated by Bronowski in his discussion about "architecture as moulding and architecture as the assembly of parts". (12) In the moulding action of the hand nothing is discovered about nature. However, in the analytic action of the hand "man splits a piece of wood, or a piece of stone, and lays bare the print that nature had put here ~~before~~ he split it". (13) The latter action represents an intellectual difference rather than just a technical one.

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